INTERNATIONAL JOURNAL OF LATEST TECHNOLOGY IN ENGINEERING, MANAGEMENT & APPLIED SCIENCE (IJLTEMAS)

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue VII, July 2025

Water Resource Management in India

Dr. S.V. Lingeswara Rao

Department of Geology, Sri Venkateswara University TIRUPATI – 517 502, Andhra Pradesh, India

DOI: https://doi.org/10.51583/IJLTEMAS.2025.1407000083

Abstract: Water is dire essential for the sustenance of life. Of late, owing to population explosion, industrial expansion and agriculture development have utilising water resources excessively. The merciless exploitation of both surface and ground water there is looming water scarcity. Thus it is the need of the hour to manage water resources by using prudently and managing optimally. Conservation of water, minimizing wastage and ensuring its more equitable distribution through integrated water resources development and management is the main aim of National Water Mission. Community engagement and participation can contribute to sustainable water management through rainwater harvesting. The present paper appraises the quantity, driving factors of water woes, major issues of water resources, water resources management and strategies. It also provides an analytical overview of the emerging water resources management issue in India and to comprehend the gravity of the current water situation

Key Words: Water, Availability, Consumption, Water Woes and Water Resources Management

I. Introduction

As an important economic resource, water is essential for all forms of livelihood activities, agriculture, animal husbandry and most of the industrial production processes. Depleting water resources is one of the major concerns of urban India and it is likely to create a severe crisis in future as our urban population is expected to increase from 377 million in 2011 to 600 million by 2031 (**Amarasinghe, 2004).** Currently, India is home to about 18% of the world's population and accounts for about 2.4% of the world's geographical area. India consumes 4% of the total water resources.

Agriculture sector withdraws about 80% of all withdrawal. India has low water use efficiency compared to the developed countries. The overall irrigation project efficiency in developed countries is 50–60% as compared to only 38% in India. The industrial plants in our countries consume about 2 to 3.5 times more water per unit of production compared to similar plants operating in other countries. In the domestic water sector the loss of water on account of leakages in mains, communication and service pipes and valves is approximately 30 to 40% of the total flow in the distribution system.

The present utilization of water can be estimated as about 750 BCM whereas for the year 2050 it is estimated to be 1180 BCM. Conservation of water, minimizing wastage and ensuring its more equitable distribution both across and within States through integrated water resources development and management is the main aim of National Water Mission

India has only 4% of the World's freshwater, but 18% of the world's population. The main source of freshwater is the monsoon, with annual rainfall of approximately 4000 BCM, equivalent to 1170 mm of rainfall. Most of the Indian states depend upon monsoon for its water requirements. At the same time, some northern states have excess water, while some states such as Maharashtra, Tamil Nadu, and Rajasthan are short of water. In 1951, India's per capita water availability was 5177 cubic meters, but in 2011 it was reduced to 1545 cubic meters and is expected to decrease further to 1300 cubic meters by 2030 **(CGB, 2024).**

II. Major Driving Factors Of Water Woes

Stemming groundwater depletion

Excessive use of groundwater for irrigation in agriculture also puts pressure on resources. Groundwater is one of the most important sources for irrigation as well as for rural and urban domestic water supply. However, overexploitation of this valuable resource has led to its depletion. The World Bank is helping the supporting the government's national groundwater program, the Atal Bhujal Yojana, to help improve groundwater management. Implemented in 8,220 gram panchayats across seven Indian states, this is the world's largest community-led groundwater management program. Since groundwater conservation lies in the hands of hundreds of millions of individuals and communities, the program is helping villagers understand their water availability and usage patterns so they can budget their water use accordingly. In the agrarian state of Punjab, where rampant tube well irrigation is causing the water table to fall drastically, the Bank helped the state government pilot an innovative scheme to conserve groundwater. The "Paani Bachao, Paisa Kamao" (Save Water, Earn Money) scheme incentivizes farmers to reduce groundwater usage. Around 300 enrolled farmers were given cash incentives to save electricity used for irrigation, resulting in water savings of between 6 and 25 percent without any adverse effect on the yield**(GOI, 2021).**

Consumption through agriculture

India is one of the world's leading agricultural producers, so it is also one of the countries with the highest water consumption of land and crops. The water source of is contaminated with biological pollutants. The amount of solid waste is also increasing in the waters of India.

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue VII, July 2025

Lack of traditional conservations methods

The decline in traditional water reclamation areas, and the discharge of sewage and sewage into traditional waters, exacerbates the country's water scarcity situation.

Increasing Population

The demand for water is further increasing due to the increase in demand due to population growth, industrialization and rapid urbanization. There is a significant mismatch exists between available water and the spatial distribution of the population.

Depleting Water Sources

The southern state of Kerala receives one of the highest levels of rainfall in the country, however, its undulating terrain drains most of the rainwater into the sea. Rapid growth of built-up areas across the state has led to depleting water sources. Since the early 2000s, the World Bank has been supporting the state government in ensuring that rural families receive a dependable supply of piped water in their homes, at a price that even low-income households can afford. Jalanidhi I (2000-2008) and Jalanidhi II (2012-2017) have helped bring water into village homes by putting local communities in charge of managing their own water supply schemes for the first time in their lives

In Punjab, where groundwater levels are reaching critical levels, the **Punjab Municipal Services Improvement Project (2020)** is helping two large cities shift to surface water sources, like from local canals. The improvements in the water supply are expected to benefit more than 3 million people by 2026 and an estimated 5 million projected population by 2055. In 2019 the southern metropolis of Chennai reeled under a severe water crisis and water was brought in by train from some 200 kilometres away to save the city. Today, Chennai has become the first Indian city to recycle its wastewater at scale to meet the non-drinking water needs of its industries. One completed, two Tertiary Treatment Reverse Osmosis (TTRO) plants will be able to recycle about 20 percent of Chennai's sewage, enabling the city to reduce its consumption of fresh water.

Water Pollution

It is estimated that about 38,000 million liters per day (mld) of wastewater are generated in the urban centres having population more than 50,000 in India (housing more than 70% of urban population). The municipal wastewater treatment capacity developed so far in India is about 11,000 mld accounting for 29% of wastewater generation in these two classes of urban centers. In view of population increase, demand of freshwater for all the uses will be unmanageable. It is estimated that the projected wastewater from urban centres may cross 1,00,000 mld by 2050 and the rural India will also generate not less than 50,000 mld in view of water supply designs for community supplies in rural areas**(Status of Water Quality in India, 2025, CPCB).**

III. Major Issues Of Water Resources

Freshwater shortage

India's water demand depends primarily on the monsoon. Environmental changes and population growth are of concern, coupled with the general lack of long-term availability of water resources. Water is a renewable resource and all of Earth's water is naturally recycled through the water cycle or hydrologic cycle. The hydrological cycle is the continuing process of evaporation of water from the various surfaces, followed by condensation to form clouds, these clouds accumulate and precipitate to form rainfall which runs across surfaces in the form of surface water bodies and the water further percolates into the ground to form ground water which is collected in aquifers. The hydrological cycle directly affects the avail ability of freshwater resources and anthropogenic activities such as excessive withdrawals and pollution disrupt this natural process and result in water-related risks **(*SIWI, 2020*)**

Unsafe and poor quality

Despite improved drinking water, many other water sources are contaminated with both biological and chemical pollutants, with more than 21% of national illnesses associated with water. Also, only 33% of the country has access to traditional hygiene. This makes clean drinking water unavailable and jeopardizes the health of Indians.

Groundwater Stress

Many rural communities in India around urban sprawl also have no choice but to drill wells to access groundwater sources. There is no easy answer for India, which needs to develop water sources for food and human consumption, but India's overall water availability is very tense.

Demographic Needs

Children in 100 million households across the country are short of water and every one in two children is malnourished. Environmental justice needs to be restored in India so that families can raise their children with dignity. Providing water to the community is one way to ensure that opportunity.

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue VII, July 2025

Corruption and Lack of Planning

India's water crisis is often blamed on lack of government planning, increased privatization of businesses, industrial and human waste, and government corruption

Water Resource Management

Water Resources Management (WRM) is the process of planning, developing, and managing water resources, in terms of both water quantity and quality, across all water uses. It requires the support and guidance of institutions, infrastructure, incentives, and information systems. Water resource management also entails managing water-related risks, including floods, drought, and contamination ***(World Bank, 2017).*** Water Resources Management (WRM) is the process of planning, developing, and managing water resources, in terms of both water quantity and quality, across all water uses. It includes the institutions, infrastructure, incentives, and information systems that support and guide water management. The World Bank is engaged in different aspects of water resource management and the supply of drinking water and sanitation services across the country. Over the last decade, the World Bank has supported the government's efforts to bring clean drinking water to rural communities. A range of projects with a total financing of $1.2 billion have benefitted over 20 million people.

Improvements in Water resource management

Water availability does not depend solely on ecological conditions. The river was tamed, managed and managed here to serve the economy, people and states. However, management and exploitation (i.e., management patterns of these rivers) have created social and economic inequalities, and sometimes even dramatic ecological consequences.

Corporate social/Environmental responsibility

Due to heightened tensions at various levels, government agencies are new to water management to better integrate stakeholders and users in different countries, regions and regions of the agricultural, industrial and drinking water sectors.

Integrated water management

The new approach needs to focus on integrated water management, which is closely related to river basins. Water flows according to the nature of river's regime and earth's topography and does not respect administrative boundaries, so water must be managed in an integrated, science-based manner.

Rain Water Harvesting (RWH)

Rain water harvesting is the collection and storage of rainwater that runs off from roof tops, parks, roads, open grounds, etc. This water runoff can be either stored or recharged into the ground water *(***Centre for Science and Environment, N.D***)*. A rain water harvesting system will comprise a catchment, a conveyance system, first flush mechanism, filters to remove pollutants and a storage tank or recharge structure. These systems can be installed in individual houses, colonies, institutions, hospitals, industries and more. Most water is moved or dried instead of being used, so a rainwater harvesting program needs to be devised and implemented. The collected water can be used immediately for agriculture and consumed immediately by humans with improved filtration methods to reduce aquatic pathogens.

Eliminate the root causes

Rather than relying on quick fixes based on flawed logic, city and state agencies need to focus on addressing the root of the problem. Depletion of reservoirs in general, especially leads to deterioration of water table. Government regulations are needed to limit the amount of groundwater that households can extract. This water should be weighed and priced.

Tracking floods and droughts

India is prone to droughts as well as floods even as climate change is increasing unpredictability in weather patterns and leading to more extreme weather events. Reservoirs can help mitigate these extreme events by storing water and releasing it when needed. However, reservoir operators often do not have the technological tools to help them take crucial decisions that can avoid floods. Two World Bank-supported **hydrology projects** have introduced new systems and technology that give reservoir managers an accurate picture of the water situation unfolding in their region. These systems have laid the foundation for a comprehensive knowledge base that can improve the overall management of water resources in the country. These systems can also help alleviate the harshest impact of droughts. Water resources monitoring system is now getting expanded to cover the entire country, including the Indus, Ganga, and Brahmaputra-Barak river basins.

Other government measures

- River basin planning
- Interlinking of Rivers
- Watershed management program
  - PM Krishi Sinchai Yojana

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue VII, July 2025

- Neeranchal Watershed Management

Managing India's most iconic river

The Ganga is India's most important and iconic river and is worshipped by millions as a living goddess. However, the Ganga today is facing formidable pressures of rapid urbanization along its banks as over 100 towns and cities pour their domestic sewage into the river. The World Bank has been supporting the Government of India's efforts to rejuvenate the Ganga River since 2011. Two World Bank projects, worth $1 billion, are helping set up the institutions needed to manage the river and build the infrastructure to keep it clean. Sewage from cities is the biggest source of organic pollution in the Ganga. By building and maintaining sewage treatment plants and a network of drains, sewage water from houses in several of these cities now gets treated before reaching the river.

Making irrigation more predictable

Rainfed agriculture in India is a risky enterprise, owing to uncertainties in rainfall, coupled with periodic dry spells and heavy cyclones and floods during the monsoon season. Agriculture is hardly possible during the non-monsoon season without irrigation facilities. Over the last 50 years, India has invested substantially in infrastructure necessary to usher irrigated agriculture to vast areas all over the country. Minor irrigation schemes are benefiting small and marginal farmers in particular. A **World Bank project** in the remote rain-fed western region of West Bengal has helped farmers from disadvantaged tribal communities build small irrigation facilities. Farmers now harvest two crops each year and are no longer leaving their villages in search of work elsewhere.

National Water Policy 2012

The Ministry of Water Resources, now the Jal Shakthi Ministry of the Government of India, formulated the National Water Policy (NWP) 2012 to govern the planning and development of water resources for efficient use building on learnings from previous policies NWP 1987 and NWP 2002. The objective of the NWP 2012 is to take cognizance of the existing situation and propose a framework for the creation of a system of laws and institutions for better water management **(MoWR, GOI, 2012).**

The NWP 2012 outlines certain basic principles for governing water resources which includes having an integrated perspective at local, state and national levels for planning and management of water resources, giving consideration to minimum ecological needs, safe water and sanitation as a pre-emptive need and the need to factor in the impact of climate change on water resources to state a few. The NWP 2012 emphasises the need for planning and management of water resources to incorporate strategies for adaptation to climate change. It also prioritizes enhancing water availability as a whole through regular assessments of trends in water availability and accounting the water allocations for different uses. Another important aspect the NWP 2012 focuses on is the conservation of river corridors, water bodies and infrastructure in a scientifically planned manner while engaging with the various stakeholders.

Management of groundwater resources

Groundwater resources across urban India have been intensively exploited for domestic, private, industrial purposes and sometime have been used to augment the municipal supply. Excessive overdraft and groundwater contamination has caused a serious groundwater crisis and since it is a common pool resource it is necessary to recognise that it cannot be treated as private property. Using this understanding the Government of India formulated the Model Bill for the Conservation, Protection, Regulation and Management of Groundwater, 2016. This legislation in line with the Model bill has currently been enacted in 11 states and union territories and 18 other states are in the process of enacting the same. The Model Bill identifies groundwater protection zones and requires the preparation of groundwater security plans based on dynamic resource assessments. It also proposes that urban areas should appoint Ward Groundwater Committees and Municipal Water Management Committees.

Water Resource Management Strategies

Owing to galloping population, agricultural and industrial development, water scarcity is looming large and it is the need of the hour to utilise water prudently and implement strategies instantaneously. The strategies can be adopted focusing on key priorities and engaging all stakeholders to ensure sustainability and viability of the interventions. Some of these strategies include the following.

1. Establishing a WRM team within the Water utility department.
2. Augmentation of water resources
3. Management of groundwater resources
4. Rainwater harvesting
5. Urban water demand optimization
6. Wastewater treatment and reuse.

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue VII, July 2025

IV. Conclusion

As an important economic resource, water is essential for all forms of livelihood activities, agriculture, animal husbandry and most of the industrial production processes. The most important crops of India — rice, wheat and sugarcane, are the most water consuming crops. Rice which is a major export crop consumes about 3,500 liters of water for a kilogram of grain produced. Further with constant population increase and depletion in water resources water management will increasingly become more difficult in future. The picture of the same is visible in precipitating crisis of water in southern states. Water management needs to be the central focus of efforts in the agriculture sector and the environment improvement. Additionally, a focused effort has been made to ascertain the level of community participation in achieving the success of Roof Top Rainwater Harvesting (RWH).

References

1. Amarasinghe, U. A.; Sharma, B. R.; Aloysius, N.; Scott, C.;Smakhtin, V. and de Fraiture, C. (2004). Spatial variation in water supply and demand across river basins of India. Research Report 83, Colombo, Sri Lanka: International Water Management Institute. https://www.iwmi.cgiar.org/Publications/IWMI_Research_Reports/ PDF/ pub083.
2. Central Ground Water Board (2024), Report, CGB, 2024.
3. Government of India (2021), Department of Agriculture Report, GOI, 2021.
4. Punjab Municipal Services Improvement Project (2020), Water Quality of Punjab, Government of Punjab, Government of India
5. Central Pollution Control Board (2025), Status of Water Quality in India, 2025, CPCB.
6. SIWI (2020), Principles and Practices of Integrated Water Resources Management - Workplace-based Professional Training. Retrieved from Stockholm International Water Institute : https://www.siwi.org/uploads/2020/06/IWRM_Manual1_final.pdf
7. World Bank (2017), Water Resources Management – Strategy, Retrieved from World Bank: https://www.worldbank.org/en/topic/waterresourcesmanagement#2
8. MoWR, GOI (2012), National Water Policy (2012), Retrieved from National Water Mission, http://nwm.gov.in/sites/default/files.