International Journal of
LAW, ARTS AND HUMANITIES
Peer Reviewed, Referred & Indexed Journal
ISSN: 3070-0523 www.zesterapublications.com Original Research Paper

CURRENT ISSUES AND CHALLENGES OF WATER MANAGEMENT IN INDIA

Deepak M. Nagrik
Department of Chemistry, G.S. Science, Arts and Commerce College,
Khamgaon, Distt. Buldana, M.S., INDIA-444303
E-mail: dmnagrik@gmail.com

Abstract

India has witnessed a substantial rise in water demand over recent decades due to rapid population growth, urbanization, industrialization, and socio-economic development. To satisfy this increasing demand, extensive exploitation of surface and groundwater resources has taken place, leading to declining groundwater levels, deterioration in water quality, overuse of river basins, reservoir siltation, and increasing freshwater pollution from industrial and municipal wastes. Per capita freshwater availability has decreased significantly from 6008 m^3 per year in 1947 to nearly 2200 m^3 annually after five decades, highlighting the growing severity of water scarcity. This scarcity poses major challenges to food security, ecosystem conservation, public health, and social stability, while also intensifying conflicts among different water-use sectors. The study discusses the emerging water-related issues and management challenges in India and emphasizes that future water demand is expected to increase further due to expanding urban populations, rising incomes, and rapid industrial growth. The paper also identifies major barriers to sustainable water resource management, including inadequate scientific data and limited technological advancements for developing environmentally sustainable, economically feasible, and socially acceptable water management solutions.

Introduction

Water is one of the most essential natural resources for human life and survival. It plays a crucial role in maintaining sanitation in both rural and urban areas. In addition, water serves as a significant economic resource, being indispensable for agriculture and various industrial activities (Merrett 1997; Kay et al. 1997). It also supports numerous environmental and ecosystem services (Frederick 1993; Seckler et al. 1998). Moreover, water is vital for diluting and assimilating pollutants generated from industrial waste and domestic sewage.

The demand for freshwater resources is steadily rising worldwide (WRI 1995; Brown et al. 1998). Over the first eight decades of the twentieth century, global water consumption increased nearly five times, with about 75 percent of this growth occurring during the latter half of the century (Frederick 1993). Although the total availability of freshwater at the global level remains relatively stable, regional and local freshwater supplies are declining due to disturbances in hydrological systems, excessive extraction, and growing contamination of water resources. Several developing nations are already experiencing severe water scarcity (Brown

Received: 02-10-2025 | Accepted: 10-11-2025 | Published: 17-11-2025

International Journal of
LAW, ARTS AND HUMANITIES
Peer Reviewed, Referred & Indexed Journal
ISSN: 3070-0523 www.zesterapublications.com Original Research Paper

et al. 1998; Seckler et al. 1998). The increasing shortage of freshwater has become a major challenge for food production, environmental conservation, public health, social stability, food security, and international harmony (Postel 1996).

India is also facing this emerging water crisis. Rapid population growth, nearing the billion mark, along with a preference for water-intensive farming practices and fast urban-industrial development, has placed tremendous stress on the country's limited freshwater resources (Kumar 1997; World Bank 1998). Rising water scarcity threatens ecological balance, sustainable development, and economic progress.

For centuries, India relied on traditional and community-based systems of water management that effectively fulfilled irrigation, drinking, and household water requirements (Agarwal and Narain 1997; Singh 1991; Shankari and Shah 1993). However, during the colonial period, there was a significant transition away from these indigenous management systems. The British administration introduced large-scale barrages and canal networks, but these irrigation systems were centrally controlled rather than community managed. Due to their large scale, local communities had very limited participation in their operation and maintenance (Chitale 1991).

Before the partition, undivided India possessed about 28.2 million hectares (mha) of net irrigated land, of which nearly 15.2 mha were served by canal irrigation systems. After partition, a significant portion of these irrigation resources became part of Pakistan (Bharadwaj 1990). During 1949–50, the country's foodgrain production was approximately 62 million tonnes (Sarma and Roy 1979). To increase agricultural productivity and attain food self-sufficiency, irrigation development was assigned high investment priority in successive Five-Year Plans (Bharadwaj 1990; Vohra 1995). Consequently, numerous major, medium, and minor irrigation projects were established across the country. Due to these efforts, the net irrigated area expanded from 21 million hectares in 1951 to 46.2 million hectares by 1991 (Vohra 1995). This expansion supported an annual food production growth rate of about 2.42 percent, helping foodgrain output rise to nearly 180 million tonnes by 1995. Between 1964–65 and 1970–71, foodgrain production recorded an impressive annual growth rate of 3.3 percent, largely because of the increase in irrigated agricultural land (Sarma and Roy 1979).

Over the past few decades, India has experienced a substantial increase in water demand due to rapid population growth, especially in urban centres, which has raised the need for food production and domestic water supply. Industrial expansion has further intensified water requirements for manufacturing activities and waste assimilation. To satisfy these growing demands, both surface water and groundwater resources have been extensively exploited. As a consequence, groundwater reserves in many arid and semi-arid regions have been excessively utilized, causing declining water tables, deterioration in groundwater quality, and reduced availability of safe freshwater resources. Similarly, surface water in several river basins has been heavily appropriated. In addition, freshwater resources are increasingly threatened by

Received: 02-10-2025 | Accepted: 10-11-2025 | Published: 17-11-2025

International Journal of
LAW, ARTS AND HUMANITIES
Peer Reviewed, Referred & Indexed Journal
ISSN: 3070-0523 www.zesterapublications.com Original Research Paper

contamination from industrial discharge and municipal waste.

The severity of the situation has increased gradually over time. At the time of Independence, India's per capita freshwater availability was around 6008 cubic metres annually. By 1997, this figure had declined to nearly 2200 cubic metres per person per year (Engelman and Roy 1993). Conditions have become especially alarming in 6 of the country's 20 major river basins, where per capita freshwater availability has fallen below 1000 cubic metres annually (World Bank 1998; Mehta 1999). Consequently, issues related to water resources have become far more complicated and challenging than before.

This paper attempts to provide an analytical overview of the emerging concerns and management challenges associated with water resources in India, particularly in the post-Independence period. The discussion is divided into two sections. The first section examines the major emerging issues, while the second section presents a detailed analysis of the challenges in water management associated with data, technology, and institutional frameworks.

WATER RELATED PROBLEMS IN INDIA

After Independence, India focused on increasing food production and providing safe drinking water. Significant progress was achieved in irrigation and water supply development. The net irrigated area nearly doubled between 1951 and 1991, while foodgrain production rose sharply. Access to safe drinking water also increased greatly. However, this development created several physical, environmental, social, and management challenges related to water resources.

Stress on Surface Water Resources

The possibility of expanding surface water supplies has become limited because most suitable sites for dams and reservoirs have already been utilised. Construction of large dams causes environmental damage, displacement of communities, and high social and financial costs. Many projects also face opposition from environmental groups and shortages of funding.

Existing reservoir projects suffer from rapid siltation due to soil erosion, reducing storage capacity and lifespan. Irrigation systems linked to these reservoirs often perform poorly because of weak maintenance, inefficient water distribution, and low farmer participation. Canal irrigation has also caused waterlogging and salinity in several regions, reducing agricultural productivity. In addition, large irrigation projects have become economically expensive and less efficient compared to groundwater irrigation.

Declining Freshwater Quality

Industrialisation and urban growth have severely polluted rivers and other freshwater sources. Industries and urban settlements discharge untreated or partially treated waste into rivers, reducing the availability of clean water. Major rivers such as the Ganga are heavily contaminated by industrial effluents and sewage, creating serious environmental and health problems.

Groundwater Over-Exploitation

Groundwater resources are increasingly overused in many regions of India. Excessive pumping has caused falling water tables, drying wells, seawater intrusion in coastal areas, and reduced groundwater availability. Subsidised electricity, weak regulations, and

Received: 02-10-2025 | Accepted: 10-11-2025 | Published: 17-11-2025

International Journal of
LAW, ARTS AND HUMANITIES
Peer Reviewed, Referred & Indexed Journal
ISSN: 3070-0523 www.zesterapublications.com Original Research Paper

unrestricted groundwater rights encourage over-extraction.

Groundwater depletion creates economic and social problems by increasing pumping costs and reducing access for poor farmers. It also weakens drought resistance and affects river flows and ecosystems.

Groundwater Quality Problems

Groundwater quality is deteriorating because of both natural and human causes. High levels of salinity, fluoride, arsenic, iron, and nitrates are found in many areas. Industrial pollution, sewage disposal, fertiliser use, and seawater intrusion further contaminate groundwater, making it unsuitable for drinking and irrigation.

Growing Water Scarcity

Rapid population growth, urbanisation, industrialisation, and agricultural expansion have sharply increased water demand. Rising urban populations require more domestic water and sanitation services, while agriculture needs additional irrigation to meet food demand. Industrial water use has also expanded rapidly.

At the same time, freshwater supplies are declining due to pollution, groundwater depletion, and reduced reservoir capacity. Many cities already face severe shortages of drinking water. Future projections indicate that India may become a severely water-stressed country as demand approaches the limit of exploitable freshwater resources.

Increasing Competition and Conflicts

Growing water scarcity has intensified competition among agriculture, industry, and domestic users. Urban areas increasingly draw water from rural regions, often reducing irrigation supplies. Wealthier groups are usually able to secure access to limited water resources, while poorer communities face reduced access to basic water needs. This unequal distribution of water resources has become a major source of social and regional conflicts in India.

Water Management Challenges in India

India faces two major water-related problems: increasing freshwater scarcity and rising conflicts over water sharing. Growing demand for agriculture, drinking water, industries, and ecosystem protection has put pressure on limited water resources. Effective water management therefore requires balancing supply and demand, ensuring fair distribution, developing reliable scientific data, adopting practical technologies, and strengthening institutions.

Data Related Issues

A major challenge in India's water sector is the lack of reliable scientific data for water budgeting, allocation, and planning. Accurate estimates of water availability and use are essential for proper management.

Availability of Scientific Database

Water supplies come from surface water and groundwater. Groundwater recharge estimation methods in India have weak scientific foundations. The commonly used water-level fluctuation method ignores factors such as monsoon pumping, inflows and outflows from aquifers, and long-term groundwater trends. Recharge estimates are also unreliable because observation wells are limited and specific yield values vary greatly, especially in hard rock regions that cover most of India.

Surface water estimation also suffers from insufficient rainfall and stream-flow data. Reliable runoff data are available only for a few major river basins, while smaller or

International Journal of
LAW, ARTS AND HUMANITIES
Peer Reviewed, Referred & Indexed Journal
ISSN: 3070-0523 www.zesterapublications.com Original Research Paper

ungauged rivers depend on statistical or simulation models that are less accurate.

Water Quality

Water quality is closely linked with water availability. However, India has limited monitoring stations that measure all necessary physical, chemical, and biological parameters. Water quality testing requires costly technology and skilled expertise, making data reliability uncertain. Existing methods also fail to identify pollution sources properly, and water quality information is rarely integrated with water availability data.

Water Demand and Use

Water demand in different sectors is usually estimated using standard agency norms, which ignore social, economic, and regional variations. As a result, demand figures are often unrealistic. Reliable data on actual water use in households, industries, livestock, and agriculture are generally unavailable, and groundwater extraction figures are mostly based on assumptions rather than field measurements.

Objectives and Criteria for Data Collection

Current water data collection in India mainly focuses on technical and hydrological aspects, while social, economic, and environmental objectives receive little attention. Water resource assessment should also consider economic efficiency, equitable access, environmental sustainability, drought protection, and drinking water security.

From an economic perspective, a basin becomes over-exploited when additional water extraction becomes very costly. Socially, over-development occurs when drinking water needs cannot be met sustainably. Environmentally, excessive withdrawal that damages river flows or ecosystems should also indicate over-development.

Present assessment methods mainly use water balance calculations, which fail to capture real social, economic, and ecological impacts. Therefore, additional factors such as pumping depth, groundwater yield, investment costs, water quality, and sectoral needs should also be included in water assessments.

Institutional Challenges

India's institutional challenges include responding effectively to local water scarcity, developing integrated regional water management systems, promoting equitable and sustainable use of resources, designing systems that influence water-use behavior, and implementing fair water allocation while resolving conflicts.

Conclusion

India has a long history of traditional water management systems based on community participation and local institutions. However, these systems declined during the British period with the introduction of large-scale irrigation projects and the weakening of village-based water governance. After Independence, India achieved remarkable progress in irrigation development, agricultural production, and rural and urban drinking water supply. Despite these achievements, excessive exploitation of water resources has resulted in groundwater depletion, deteriorating water quality, shrinking surface water supplies, and increasing pollution. Rapid population growth and socio-economic development have further intensified water demand and scarcity across sectors.

Received: 02-10-2025 | Accepted: 10-11-2025 | Published: 17-11-2025

International Journal of
LAW, ARTS AND HUMANITIES
Peer Reviewed, Referred & Indexed Journal
ISSN: 3070-0523 www.zesterapublications.com Original Research Paper

Water scarcity has become a major challenge affecting food security, economic growth, environmental sustainability, and social stability. India also faces serious issues in water management due to inadequate scientific data, weak coordination among agencies, and limited integration of social, economic, and environmental factors in policy planning. Existing technologies for water conservation and management remain insufficient and poorly adopted. In addition, water management institutions are largely centralized and supply-oriented, lacking the capability to ensure efficient water use, equitable distribution, pollution control, and conflict resolution. Therefore, sustainable and integrated water management strategies are essential to address India's growing water challenges.

References

REFERENCES

[1] Agarwal, A. and Narain, S. (eds.) (1997). *Dying Wisdom: Rise, Fall and Potential of Traditional Water Harvesting Systems in India*, 4th Citizen's Report. New Delhi: Centre for Science and Environment.

[2] Ballabh, V. and Singh, K. (1997). "Competing Demands of Water in Sabarmati Basin: Potential and Future Conflicts," Paper presented at the ICIPD Conference on Water, Amsterdam, Netherlands, October 11–17.

[3] Ballabh, V. and Shunmugam, V. (1999). *Database Needs in Decision Making for Sustainable Basin Management: Illustrations from Sabarmati Basin*, Working Paper 132. Anand: Institute of Rural Management Anand.

[4] Ballabh, V., Kumar, M. D. and Talati, J. (1999). "Food Security and Water Management: Institutional Challenges for Early 21st Century," Paper presented at the National Symposium on Building and Managing Organisations for Rural Development in the New Millennium, Institute of Rural Management Anand, December 13–14.

[5] Bharadwaj, K. (1990). *Irrigation in India: Alternative Perspectives*. New Delhi: Indian Council of Social Science Research.

[6] Bhatia, B. (1992). "Lush Fields and Parched Throats: Political Economy of Groundwater in Gujarat," *Economic and Political Weekly*, XXVII(51–52), A12–A170.

[7] Bhatt, S. (1986). *Environmental Laws and Water Resources Management*. New Delhi: Radiant Publishers.

[8] Biswas, A. K. (1996). "River Water Quality Monitoring in Developing Countries," in Shady, A. M. (ed.), *Management and Development of Major Rivers*, Water Resources Management Series–3. Calcutta: Oxford University Press.

[9] Biswas, D. K. and Sharma, M. (1995). "Status of Groundwater Development and Its Impact on Groundwater Quality – An Appraisal," in Moench, M. (ed.), *Groundwater Availability and Pollution: The Growing Debate over Resource Condition in India*. Ahmedabad: VIKSAT–Natural Heritage Institute.

[10] Brown, L. R., Flavin, C., French, H. et al. (eds.) (1998). *State of the World 1998: A World Watch Institute Report on Progress Towards a Sustainable Society*. Washington DC: World Watch Institute.

[11] Centre for Science and Environment (1997). "Statistics: Water and Sanitation," *Down to Earth*, September 15, p. 60.

[12] Chaudhari, S. (1996). "To Sell a Resource," *Down to Earth*, February 15.

International Journal of
LAW, ARTS AND HUMANITIES
Peer Reviewed, Referred & Indexed Journal
ISSN: 3070-0523 www.zesterapublications.com Original Research Paper

[13] Chitale, M. A. (1991). "Peoples' Participation in Large Irrigation Projects," in Singh, K. K. (ed.), *Farmers in the Management of Irrigation Systems: Proceedings of the International Workshop*. Hyderabad: Administrative Staff College of India.

[14] Dhawan, B. D. (ed.) (1990). *Big Dams: Claims, Counter Claims*. New Delhi: Commonwealth Publishers.

[15] *Down to Earth* (1996). "Arsenic Down Under," 5(10), October 15.

[16] *Down to Earth* (1998). "Dirty River Blues," 7(2), June 15.

[17] Engelman, R. and Roy, P. (1993). *Sustaining Water: Population and Future of Renewable Water Supplies*. Washington DC: Population and Environment Programme, Population Action International.

[18] Frederick, K. D. (1993). "Balancing Water Demand with Supplies: The Role of Management in a World of Increasing Scarcity," Technical Paper 189. Washington DC: World Bank.

[19] Government of Gujarat (1992). *Report of the High Level Committee on Estimation of Groundwater Resources and Irrigation Potential in Gujarat State*. Gandhinagar: Narmada and Water Resources Department, Government of Gujarat, pp. 66–85.

[20] Government of Gujarat (1994). *Integrated Plan of Sabarmati River Basin*, Draft Report. Gandhinagar: Gujarat State Water Resources Planning Group.

[21] Government of India (1997). *Economic Survey (1996–97)*. New Delhi: Government of India.

[22] Hanna, S. and Munasinghe, M. (1995). "Property Rights in Social and Ecological Context: Case Studies and Design Applications," Technical Paper. Washington DC: World Bank.

[23] Kay, M. et al. (1997). *Water: Economics, Management and Demand*. London: E and FN Spon.

[24] Kittu, N. (1995). "Status of Groundwater Development and its Impact on Groundwater Quality," in Moench, M. (ed.), *Groundwater Availability and Pollution: The Growing Debate over Resource Condition in India*. Ahmedabad: VIKSAT–Natural Heritage Institute.

[25] Kumar, M. D. (1992). "Techniques of Farmers' Awareness of Water Conservation: Problems and Solutions," Paper presented at the National Workshop/Seminar on Water Conservation and Farmers' Awareness, Roorkee, September 24–25.

[26] Kumar, M. D. (1995a). "Dynamics of Drinking Water in Rural Gujarat: Physical, Social and Institutional Dimensions," Paper presented at the Workshop on Drinking Water Problems in Rural Gujarat: Issues and Perspectives, GIDR, January 25.

[27] Kumar, M. D. (1995b). "Over-exploitation and Approaches to Management: An Overview of Groundwater in Gujarat, Western India," Paper presented at the 3rd South Asian NGO Summit, Kathmandu, Nepal, February 21–23.