Water Governance in India: The Role of Governance in Addressing Water Scarcity and the SDGs

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Abstract

Water governance in India is increasingly important as the country faces rising water scarcity and growing demand from population growth, urbanization, and climate change. This descriptive paper examines the role of water governance frameworks in managing water resources while contributing to the Sustainable Development Goals (SDGs), especially SDG 6 (clean water and sanitation). The paper presents a factual overview of the role of key water governance institutions, policies and programmes that aim to improve water access, quality, and sustainability across India. The study highlights major initiatives and concerns, including groundwater over-extraction, water contamination, and weak coordination among institutions. India experiences high to extreme water stress, particularly in water-scarce states like Punjab and Rajasthan. Governance responses include decentralized water management under the National Water Policy, community participation through Gram Panchayats, and programmes such as the Atal Bhujal Yojana, which promote groundwater conservation at the local level. The paper also reflects improvements in drinking water coverage and water quality monitoring, while acknowledging persistent urban challenges related to aging infrastructure and wastewater management. Overall, the conclusion shows that effective water governance supports not only SDG 6 but also related goals

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such as other SDGs. Strengthening institutional coordination and community engagement remains central to ensuring long-term water security in India.

Keywords: *Water Governance, Water Scarcity, Sustainable Development Goals, SDG 6.*

1. Introduction

Water governance in India is increasingly significant as the country faces rising water scarcity and rising demand from population growth, urbanization, and climate change. It has emerged as a crucial policy domain, as the nation experiences severe water scarcity challenges that threaten to hinder rapid socio-economic transformation. With approximately 18% of the world's population but only access to 4% of global freshwater resources, India faces a severe water availability challenge that threatens its developmental trajectory [1]. The Nation's water crisis is multidimensional, including issues of availability, accessibility, quality, and sustainability, all of which require comprehensive governance frameworks to address effectively. But the water scarcity in this context is dual-faceted, it demonstrates as *physical scarcity*, where the demand exceeds the natural supply, and *"economic scarcity*", where a lack of investment or human capacity prevents the adequate distribution of available resources [2]. However, India's water crisis challenges are not merely a matter of a physical are crises, but a crisis of governance's failures, where institutional failures exacerbate physical limitations.

With the persistence of these challenges, the solutions lie in the effectiveness of water governance. To define it, the range of political, social, economic, and administrative systems that determine who gets what, when, and how, governance encompasses the formal laws and informal norms that regulate resource management and service delivery [3]. Further the concept of water governance extends beyond traditional water management to encompass the political, social, economic, and administrative systems that influence water's use and management at different levels of society [4]. In the Indian context, water governance involves a complex interplay of constitutional provisions, legislative frameworks, institutional arrangements, and community-based systems that collectively determine how water resources are allocated, managed, and protected [5]. The 73rd and 74th Constitutional Amendments have further decentralized governance roles amongst local bodies. Also in India, this framework is famously

fragmented. But the responsibilities are often fragmented across multiple ministries and state-level agencies, leading to overlapping mandates and significant gaps in regulatory enforcement. This institutional complexity is particularly visible in the management of groundwater, which provides the primary source for irrigation but suffers from anarchy in extraction due to weak state-level monitoring [6, 7].

After introduction of the Sustainable Development Goals (SDGs), the United Nations in 2015 has provided a global framework for direct addressing the water challenges. SDG 6, which aims to "ensure availability and sustainable management of water and sanitation for all," directly addresses water governance concerns [8]. This goal includes several targets related to universal access to safe drinking water, adequate sanitation, water quality improvement, water-use efficiency, integrated water resources management, and protection of water-related ecosystems. For India, achieving SDG 6 is not merely an international commitment but a developmental imperative that interlinks with multiple other SDGs, including those related to poverty alleviation, health, food security, gender equality, and climate action etc.

India's water governance has evolved significantly over the past several decades, from supply-side approaches to demand management strategies, and from centralized control to participatory frameworks [7]. However, the effectiveness of these governance systems continues to be challenged by groundwater over-extraction, surface water pollution, institutional fragmentation, inadequate infrastructure, and the growing impacts of climate variability. Understanding how water governance mechanisms address these challenges while contributing to the SDGs is essential for policy refinement and implementation improvement**.**

2. Literature Review

In the Indian context, water security is increasingly recognized not as a crisis of physical scarcity, but as a governance crisis defined by fragmented institutions and regulatory gaps [9]. This is particularly evident in states like Uttar Pradesh and Punjab, where the intersection of rapid urbanization and heavy agricultural reliance has led to an "alarming decline" in groundwater tables due to unregulated extraction [10, 11]. While groundwater remains the lifeblood of rural irrigation and urban supply, the lack of state-level monitoring and the presence of overlapping mandates between local bodies and parastatal

agencies create significant inefficiencies in service delivery [12, 13]. A recent research underscores that states with robust administrative frameworks are more successful in achieving outcomes aligned with the Sustainable Development Goals (SDGs), yet many Indian states continue to struggle with inequitable access and poor wastewater management. The several scholars address on this issue has evolved significantly over the last two decades [14]. Shah (2009) famously characterized India's "groundwater economy," arguing that community-based management may be more effective than top-down state regulation. This is complemented by legal analysis, which highlights how existing laws fail to protect equitable access, and exploration of how local power dynamics dictate resource allocation [9]. While international frameworks like Integrated Water Resources Management (IWRM) advocate for decentralized, basin-level planning are essential for the Ganga basin but India's implementation remains uneven [2]. Despite the success of infrastructure-heavy initiatives like the Jal Jeevan Mission in expanding access, a critical gap remains: the literature often treats irrigation, drinking water, and pollution control as isolated silos [15]. There is a pressing need for a synthesized analysis that connects these sectoral efforts to the broader "integrated governance architecture" required for SDG 6 [16, 17]. This chapter addresses these gaps by providing a descriptive analysis of India's comprehensive water governance framework, examining how institutions, policies, and programmes collectively address water scarcity challenges while contributing to SDGs.

3. Methodology

This paper employs a descriptive research design to evaluate India's water governance overview and to provide a factual, evidence-based overview of institutional arrangements, policy frameworks, and major programmes related to water resources in India, with particular emphasis on their alignment with in alignment with water scarcity challenges and advancing the SDGs. By synthesizing secondary data from the Ministry of Jal Shakti, NITI Aayog, and UN agencies, the paper synthesizes information across multiple sources to present an integrated picture of water governance. This approach permits for comprehensive documentation of existing governance mechanisms, identification of implementation challenges, and assessment of progress towards India's water scarcity challenges and SDG targets without imposing normative frameworks or conducting original empirical research.

4. Water Scarcity In India

India's water scarcity constitutes a critical developmental challenge with wide-ranging social, economic, and environmental implications. According to the NITI Aayog Composite Water Management Index, 21 major cities including Delhi, Bengaluru, Chennai, and Hyderabad were projected to exhaust their groundwater resources by 2020, affecting nearly 100 million people. Approximately 600 million Indians face high to extreme water stress, and around 200,000 deaths annually are linked to inadequate access to safe water. The World Resources Institute's Aqueduct Water Risk Atlas identifies large parts of India, particularly Rajasthan, Punjab, Haryana, and Gujarat, as experiencing extremely high baseline water stress. The groundwater depletion in northwestern India is among the fastest globally, with satellite data indicating losses of about 4 cm per year. Agricultural activities drive this over-extraction, accounting for nearly 89% of total water withdrawals. Surface water resources are also under severe strain. Monitoring data from over 4,500 locations reveal that nearly half fail to meet prescribed water quality standards due to industrial effluents, untreated sewage, agricultural runoff, and other anthropogenic activities. Despite major restoration initiatives, the Ganga River continues to receive approximately 3,000 million liters of sewage daily, with treatment capacity covering only about half. Also, the climate change intensifies these challenges by increasing monsoon variability, droughts, floods, and glacial retreat in the Himalayas, disrupting traditional hydrological patterns. Spatial and temporal imbalances further complicate water availability, as nearly 75% of India's annual rainfall occurs during the monsoon months, alongside stark regional disparities between river basins. Urban water scarcity presents distinct challenges, including infrastructure deficits, inequitable distribution, rising demand, and high non-revenue water losses, as demonstrated by crises such as Chennai's severe water shortage in 2019.

5. Water Governance Institutional Framework

India's water governance is defined by a complex, tiered framework rooted in the 7th Schedule of the Constitution, which primarily classifies water as a State subject, while reserving inter-state river management for Union oversight [18]. This constitutional duality necessitates a high degree of coordination across federal, state, and local institutions.

At the Union level, the Ministry of Jal Shakti, established in 2019,

centralizes water management by merging previously disparate departments [19]. It oversees critical technical bodies such as the Central Water Commission and the Central Ground Water Board. While the National Water Resources Council, chaired by the Prime Minister, exists to harmonize national policy, its impact is often hampered by the political friction inherent in reconciling diverse state interests [20].

The recent shifts emphasize a basin-wide approach, most notably through the National Mission for Clean Ganga, which integrates ecological flow, pollution control, and community participation [21]. Despite these national initiatives, the brunt of implementation lies with State-level departments and increasingly autonomous State Water Resources Regulatory Authorities. These bodies often struggle with limited technical capacity and political interference [22].

Decentralization, empowered by the 73rd and 74th Constitutional Amendments, mandates that Panchayati Raj Institutions and Urban Local Bodies manage local water supply and sanitation [23]. This is supplemented by community-driven entities like Water User Associations and Village Water and Sanitation Committees, which foster participatory irrigation and local maintenance [24].

Finally, environmental integrity is managed by the Central and State Pollution Control Boards, which regulate effluent standards. However, the system faces persistent hurdles: fragmented authority, incomplete devolution of funds to local bodies, and weak enforcement of quality standards. Achieving holistic water security in India remains contingent on bridging the gap between high-level policy and grassroots execution.

6. Major Programs and Initiatives

The Jal Jeevan Mission (Rural), launched in 2019, represents India's most ambitious drinking water program with a target of providing tap water connections to all 192 million rural households by 2024 [25]. As of December 2021, approximately 87 million households had received tap connections, representing significant progress from the baseline of 32 million households in August 2019 [26]. The mission emphasizes functionality, adequacy, and sustainability of water supply, with provisions for water quality testing, greywater management, and retrofitting of rainwater harvesting structures.

The mission adopts an implementation framework that places strong emphasis on community participation through Village Water and

Sanitation Committees, in which women are mandated to constitute at least 50 per cent of the membership [26]. These committees play a central role in preparing village action plans, designing water supply schemes, overseeing their implementation, and managing operation and maintenance activities. The programme also promotes institutional convergence by linking water conservation works with MGNREGA, sanitation initiatives with the Swachh Bharat Mission, and the creation of water-related assets under the Mahatma Gandhi National Rural Employment Guarantee Act.

The Atal Bhujal Yojana specifically targets groundwater depletion in priority regions across Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, and Uttar Pradesh. Implemented in 8,350-gram panchayats spread over 78 districts identified on the basis of critical groundwater stress, the scheme emphasizes community engagement in groundwater governance. Its approach includes the preparation of groundwater security plans, promotion of demand-side measures to improve water-use efficiency, and supply-side interventions aimed at aquifer recharge. A key feature of this is its performance-based incentive system, under which gram panchayats demonstrating measurable improvements in groundwater management are eligible for additional financial support.

The National Mission for Clean Ganga coordinates a multi-sectoral effort to restore the Ganga River and its tributaries [21]. The mission focuses on pollution control through the expansion of sewage treatment infrastructure, regulation of industrial effluents, maintenance of ecological flows, riverfront development, biodiversity protection, and active public participation. Considerable investments have been made to enhance sewage treatment capacity, with projects approved to treat nearly 4,200 million liters per day of wastewater in towns within the Ganga basin. Despite this progress, persistent challenges remain in ensuring uninterrupted plant operations and in managing non-point and diffuse sources of pollution.

The Pradhan Mantri Krishi Sinchayee Yojana consolidates various irrigation initiatives under a single national framework, guided by the objective of "Har Khet Ko Pani" or ensuring water access for every field [27] . The scheme encompasses the Accelerated Irrigation Benefits Programme aimed at completing ongoing major and medium irrigation projects, the Har Khet Ko Pani component for expanding irrigation coverage through new water sources and watershed development, and the Per Drop

More Crop initiative, which promotes water-efficient micro-irrigation technologies. As an outcome of these efforts, the area under drip and sprinkler irrigation expanded substantially, rising from about 6 million hectares in 2014 to over 10 million hectares by 2020 [28, 29].

The National Hydrology Project seeks to modernize India's water resources information system to enable more informed decision-making (Central Water Commission, 2020). The project involves the establishment of extensive surface water and groundwater monitoring networks, development of advanced hydrological and forecasting models, creation of a national water resources data center, and capacity building within water management institutions. Together, these initiatives strengthen the availability and reliability of data required for evidence-based water governance.

The Namami Gange Programme provides an integrated framework for the rejuvenation of the Ganga River through a combination of infrastructure development and ecological restoration measures [30]. In addition to investments in sewage treatment, it includes riverfront development, afforestation, biodiversity conservation, public awareness initiatives, and collaboration with religious groups and civil society organizations. By 2020, the programme had sanctioned projects exceeding INR 30,000 crore. Notable innovations under Namami Gange include the use of public–private partnerships (PPP model) for sewage treatment projects, deployment of technology for real-time water quality monitoring, and a renewed focus on maintaining ecological flows in the river.

7. Sub-Sectoral Perspectives and Challenges

Groundwater is the backbone of India's water security, supplying nearly 65 per cent of irrigation and 85 per cent of rural domestic needs. However, excessive extraction has led to critical depletion, with around 17 percent of assessment units classified as over-exploited, particularly in agriculturally intensive states such as Punjab and Haryana [31]. This crisis is rooted in Green Revolution policies, including subsidized electricity and the promotion of water-intensive crops, which continue to distort water use patterns [32]. Weak regulatory enforcement and the proliferation of illegal wells further complicate governance, prompting a shift towards community-led and technological solutions such as the Atal Bhujal Yojana, water budgeting, crop diversification, aquifer mapping, and micro-irrigation [33, 34].

Water quality presents an equally severe challenge. Hundreds of rivers stretch remains polluted due to inadequate sewage treatment capacity, while groundwater contamination from arsenic, fluoride, and nitrates affects millions across multiple states (Rajiv Gandhi National Drinking Water Mission, 2013). Although regulatory frameworks exist, enforcement gaps persist. Initiatives like the Jal Jeevan Mission and Namami Gange reflect efforts to decentralize monitoring and integrate ecological restoration with community participation [35].

Urban water stress is intensifying due to rapid urbanization, high non-revenue water losses, and deep distributional inequities [36]. Policy responses such as AMRUT, Jal Jeevan Mission (Urban), rainwater harvesting mandates, and Water-Sensitive Urban Design offer pathways forward, though their success depends on strengthening municipal capacity and financial sustainability.

8. Role in Contribution to The Sustainable Development Goals

Water governance in India plays a central role in advancing Sustainable Development Goal 6 (clean water and sanitation) and simultaneously supports progress across several other SDGs through strong interpectoral linkages. While measurable improvements have been recorded, progress remains uneven across regions and indicators. Access to safely managed drinking water increased from 50.3 per cent of the population in 2015 to 61.8 percent in 2020, reflecting expansion of improved water sources and strengthened quality monitoring systems [37]. However, persistent rural–urban disparities remain evident, with urban coverage at 82.3 percent compared to only 50.0 percent in rural areas.

Sanitation outcomes have improved substantially under the Swachh Bharat Mission. The share of the population using safely managed sanitation services raised from 28.6 per cent in 2015 to 48.5 per cent in 2020. Through the construction of over 100 million toilets and large-scale behavior change campaigns, the mission achieved universal rural sanitation coverage and eliminated open defecation in many regions. Nevertheless, challenges persist in ensuring sustained toilet usage, effective faecal sludge management, and adequate wastewater treatment.

Despite policy emphasis on conservation, improvements in water-use efficiency have been modest. Agricultural water productivity remains low by global standards due to continued reliance on water-intensive crops

and inefficient irrigation practices (SDG 6 Synthesis Report, 2018). While certain industrial sectors have improved water efficiency through audits and regulatory compliance, substantial scope remains for increased water recycling and process innovation.

India's progress on integrated water resources management, assessed under SDG indicator 6.5.1, stands at 49 out of 100, indicating a medium–low level of implementation. Key constraints include weak river basin planning, limited stakeholder engagement, inadequate financing, and insufficient coordination across institutional levels.

Water governance also contributes significantly to other SDGs. SDG 2 (zero hunger) is closely linked through irrigation and agricultural water management, which have supported national food self-sufficiency, although unsustainable water use threatens long-term resilience. SDG 3 (good health) benefits from improved water and sanitation access, which helps reduce waterborne diseases, though the disease burden remains high among children (IHME, 2019). SDG 5 (gender equality) is supported through household tap connections and women's participation in Village Water and Sanitation Committees under the Jal Jeevan Mission (UNICEF, 2016). Finally, water governance contributes to SDG 13 (climate action) and SDG 15 (life on land) through conservation, recharge, and ecosystem-based approaches, though stronger integration of climate adaptation remains essential [38].

9. Coordination Challenges and Governance Gaps

Despite the presence of an extensive institutional framework, water governance in India continues to be undermined by persistent coordination failures and structural weaknesses. The constitutional designation of water as a state subject has long complicated the management of inter-state rivers and basin-level planning, frequently resulting in protracted and adversarial legal disputes rather than cooperative solutions [5]. At the state level, responsibilities for irrigation, groundwater, and water supply are often divided among multiple departments, leading to fragmented decision-making, overlapping mandates, and limited coordination across agencies [38].

At the local level, the promise of decentralized water governance remains only partially realized. Although constitutional provisions empower local bodies to manage water resources, they commonly lack adequate financial resources, clearly defined functions, and the technical capacity or "functionaries" required for effective implementation. As a result,

community participation mechanisms often fall short of their intended objectives. In many cases, decision-making processes are dominated by local elites, reducing participation to a symbolic exercise and marginalizing vulnerable and less powerful groups [36].

The effectiveness of water governance is further constrained by limited access to reliable and comprehensive data. Significant gaps persist in groundwater assessment and water quality monitoring, which restrict the scope for evidence-based planning and adaptive management, despite recent initiatives such as the National Hydrology Project aimed at modernizing hydrological information systems. Compounding these challenges is a substantial financing gap. Achieving long-term water security is estimated to require investments of around INR 51 trillion, yet political resistance to tariff reforms and cost recovery mechanisms continues to impede the mobilization of adequate financial resources

10. Suggestions

To optimize water governance role in India, we must work from top-down mandates and also requires a strategic integration of institutional reforms, Resource Management, Community efforts and modernized data systems etc. to ensure a more responsive and sustainable management.

a) Institutional Reform: like Passing the River Basin Management Bill and empowering local authorities with financial and technical autonomy.
b) Resource Management: to shifting from supply-side to demand-side management through crop diversification, subsidy reform, and professionalized urban utilities.
c) Community & Resilience: to work on scaling community-led groundwater initiatives and integrating climate vulnerability into infrastructure design.
d) Data Transparency: Modernizing hydrology projects into open-access water accounting systems to ensure accountability.

11. Conclusion

India's water governance has evolved significantly over the past several decades, from supply-side approaches to demand management strategies, centralized to participatory framework. However, the effectiveness of these governance systems continues to be challenged by groundwater over-extraction, surface water pollution, institutional

fragmentation, inadequate infrastructure, and the growing impacts of climate variability. To understanding the water governance mechanisms how it address these challenges while contributing to the SDGs is essential for policy refinement and implementation improvement**.** This chapter reveals these gaps by providing a descriptive analysis of India's comprehensive water governance framework, examining how institutions, policies, and programmes contributing to SDG 6 and indirectly by spillover to related other SDG goals like. The national strategy rejoins through various initiatives like the Jal Jeevan Mission for rural tap access, Atal Bhujal Yojana for groundwater restoration, and Namami Gange for river rejuvenation. These efforts have generated significant progress directly toward SDG 6, particularly in sanitation and rural connectivity. However, the system has loophole like water-use efficiency is low, and India's Integrated Water Resources Management score of 49/100 reflects a medium-low implementation level. For achievement of long-term sustainability in water security, India must work on bridging the gap between policy formulations and initiation with grassroots execution. This requires addressing a massive financing deficit through tariff reforms, modernizing data systems under the National Hydrology Project, and moving beyond symbolic community participation. Triumph depends on strengthening the technical and financial capacity of local bodies and shifting towards crop diversification to mitigate the impact of agricultural subsidies. Also, it requires harmonized state interactions for basin-wide approach that integrates climate resilience. Ultimately, India's ability to strengthen food security, public health, and climate resilience depends on transitioning from fragmented management to an integrated, evidence-based approach that cohesively help to achieve national interests with sustainability.

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