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Water Resource Management in India: A Contextual Overview

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Abstract

Water resource management is a critical aspect of sustainable development, particularly in a country like India, where water scarcity and unequal distribution of water resources poses significant challenges to development. This is manifested in the recent water crisis that cities like Bengaluru are facing. This research paper explores in water resource management in Indeed through the lens of resource economics. It discusses the key issues, such as water scarcity, water pollution, inefficient allocation of limited water resources, and the role of resource economics in addressing these challenges through tools. Later, the paper proposes recommendations for more sustainable water management practices.

Keywords: Water resource management, agriculture sector, groundwater etc.

Introduction

With its different geography and crowded population that is growing fast, India, facing a tough time to control its water resources, deals with many macro issues. With the surge in urbanization, industrialization, and agricultural expansion, water becomes increasingly scarce necessitating the development of sustainable use methodologies. Nonetheless, water scarcity linked with economics in India would still not be fully understood without political factors including the magnitude of the problem in the different regions, the competing demands, and the way the political system organizes and governs and cooperates. Political economy approach here concerns itself with the power relationship between various interest groups, which ultimately influence water allocation choices, and further the problem of scarcity.

Problems with water resource management in India.

One of the most challenging problems with water resource management in India is the issue of water scarcity. The problem stems from the fact that despite having 17% of the world's population, India has access to only 4% of freshwater resources. However, not only the water resources are scarce, but also, are highly unequally distributed and used. For example, while on the one hand, more than 80% of water in India is used by agriculture, on the other hand, 52% (72 Mha) of Net Sown Area (141 Mha) is dependent on rainfall. This highlights that water usage in one of the largest uses of water i.e., agriculture is highly skewed along with low water use efficiency. Unequal distribution exacerbates the problem, leading to regional disparities in water availability.

The problem is even worse with respect to the groundwater problem in India. According to a report by World Bank, India is the largest consumer of groundwater in the world accounting for 25% of total ground water extraction. This highlights immense pressure on groundwater resources of the country. Further, according to the NITI Aayog's Composite Water Management Index (CWMI) report, by 2030, the country's water demand is projected to be twice the available supply, and 21 Indian Cities are expected to reach ground Zero. This is expected to cause 2 lakh deaths every year due to a lack of access to safe drinking water and a 6% loss of GDP by 2050.

Another issue with water resource management in the country is that of water quality. According to a report by the Central Pollution Control Board (CPCB), around 70% of India's surface water is contaminated, affecting not only human health but also agricultural productivity and ecosystem services.

Also, water quality in the country is a regional issue, with different states facing various contamination challenges. For example, in Uttar Pradesh, arsenic and fluoride contamination lead to health issues like skeletal and dental fluorosis.. Maharashtra deals with industrial pollution, heavy metals, and pesticides, posing risks of cancer and organ damage. Punjab deals with agricultural runoff containing pesticides and fertilizers, affecting groundwater quality. West Bengal faces arsenic contamination, while Rajasthan deals with high salinity, worsening water scarcity and health concerns. This poses substantial economic costs, ranging from increased healthcare expenditures to the loss of biodiversity. However, political factors such as regulatory capture and corporate influence often hinder effective pollution control measures,

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highlighting the need for political economy analysis to understand these dynamics.

Inefficient Allocation and Management: Reasons for the water crisis in the country and its implications.

Inefficient allocation and management practices exacerbate India's water crisis, particularly in agriculture, where over 80% of country's total water resources are consumed. Various issues in agriculture that poses water crisis ranges from cultivating water-intensive crops like rice and wheat, utilizing flood irrigation, and limited adoption of micro-irrigation. Additionally, subsidized canal water and counterproductive incentives given by policies such as MSP policies contribute to the crisis. According to a report released by the World Bank, inefficient irrigation practices result in around 60% of water wastage in India's

Agriculture Sector, Highlighting the Need for Improved Water Management Strategies

Moreover, despite 52% of the sown area being rainfed, there's insufficient focus on rainwater harvesting. In irrigated areas, poor canal maintenance, lack of participatory management of canal water, and low water tariffs further worsen the crisis. Moreover, groundwater depletion is fuelled by factors like widespread pump set use following the green revolution on a large scale, subsidized electricity, non-participatory aquifers management, deforestation, lack of focus in groundwater management, and loopholes in water laws like the Indian Easements Act. Encroachments on urban water bodies mainly for the construction of housing complexes exacerbate the issue.

Thus, inefficient allocation and management practices exacerbate water scarcity and pollution issues in India. The tragedy of the commons phenomenon contributes to groundwater depletion, while inequitable distribution and inefficient pricing hinder effective resource allocation. However, in this, political economy also has a role to play in it. Political economy insights reveal how vested interests and power dynamics shape resource allocation decisions, leading to inequitable outcomes.

The consequences are dire, jeopardizing food security due to the non-availability of water for agriculture, exacerbating desertification, and enhanced risk to rain-fed areas due to extreme weather conditions due to climate change. It can also threaten urbanization, exemplified by Bangalore's water crisis. As the city was highly dependent on the water of the Cauvery River amidst declining groundwater levels and encroachment into lakes and ponds for the construction of housing complexes.

Economic ramifications include food inflation and bank NPAs, while energy production faces risks due to water scarcity's impact on hydropower and thermal plants.

Role of Economics in Water Resource Management

Resource economics plays a crucial role and can play a crucial role in guiding water resource management policies and practices. Some of the techniques of resource economics that can be used to ensure efficient water resource management are discussed below.

Deploying Effective Pricing Strategies: there is a need to introduce pricing mechanisms using techniques like contingent valuation, hedonic pricing, and travel cost analysis for water that accurately represent its economic significance, encompassing scarcity and environmental impact. This may entail metering water consumption and levying charges according to usage. Proper pricing serves as an incentive for conservation and fosters efficient utilization, simultaneously yielding funds for infrastructure development. Presently, according to a report by the World Bank, merely 0.5% of India's freshwater resources are subject to pricing, indicating a substantial oversight in acknowledging water's economic worth. By adopting efficient pricing methods, this discrepancy can be rectified, fostering a culture of conservation. In this, economic valuation techniques, such as willingness to pay surveys, provide insights into the intrinsic value of water resources. According to the Asian Development Bank, implementing efficient water pricing mechanisms could generate additional revenue of up to $1.9 billion annually, incentivizing conservation and sustainable use.

Using Market-Oriented Strategies: Policymakers can also explore market-driven tools like water markets and tradable permits to enhance the effective distribution of water assets. Permitting the buying, selling, or trading of water rights empowers users to adapt to dynamic circumstances and allocate water to its optimal uses. This approach aids in mitigating challenges associated with inefficient allocation and excessive groundwater extraction. For example, research conducted by the International Water Management Institute (IWMI) indicates that introducing water markets in specific Indian regions has the potential to elevate agricultural income by 8-10% through enhanced water allocation efficiency.

Investing in Water Infrastructure: Direct investments towards the development and upkeep of water infrastructure, encompassing storage capacities, irrigation networks, and facilities for wastewater treatment. Such investments not only improve the dependability of water supply but also elevate its quality and optimize distribution efficiency, fostering both economic growth and ecological balance. As per data from the Central Water Commission, India's existing irrigation capacity hovers around 140 million hectares, yet only approximately 46% of this capacity is effectively utilized. This highlights the imperative for additional investments in irrigation infrastructure to enhance water supply consistency and agricultural output. In this, Geographic Information Systems (GIS) or GIS technology can be used to analyse spatial data related to resource distribution, land use patterns, and environmental conditions.

Encouraging Adoption of Water-Saving Methods: Advocate for the uptake of technologies and practices that promote water conservation across agriculture, industry, and households. These include systems like drip irrigation, rainwater collection, and appliances designed for efficiency in water usage. Investment in research and development to innovate new technologies can further bolster endeavours to conserve water and mitigate wastage. For instance, as per insights from the Indian Agricultural Statistics Research Institute, the implementation of drip irrigation systems has the potential to slash water consumption in agriculture by up to 50% when compared to conventional flood irrigation methods. Encouraging widespread adoption of such technologies holds substantial promise for advancing water conservation initiatives.

Improving Governance and Oversight: Strengthen regulatory structures and governance mechanisms to ensure adherence to water management policies and regulations. This entails implementing robust enforcement measures, transparent surveillance systems, and involving stakeholders in decision-making processes. By emphasizing accountability and good governance, it facilitates sustainable management of water resources. A report from the Ministry of Jal Shakti

reveals that only a mere 10% of India's water bodies meet the standards for 'good' water quality, underscoring the necessity for stricter regulations and enforcement to combat water pollution. Strengthening governance and oversight can enhance water quality and ensure sustainable water resource management.

Integrating Economic Considerations into Policy Formulation: Embed economic analysis, including cost-benefit evaluations and impact assessments, into the development and appraisal of water resource management policies. Cost-benefit analysis helps evaluate the economic viability of water projects and interventions. This approach enables policymakers to identify the most economical interventions and prioritize investments based on their potential economic, social, and environmental returns. Furthermore, it facilitates evidence-driven decision-making and enhances efficiency in resource allocation. Research by the Asian Development Bank indicates that an annual investment of $6.7 billion in water supply and sanitation services in India could yield economic dividends of up to $32 billion per year, showcasing the economic advantages of prioritizing water infrastructure investments.

Facilitating Public-Private Collaboration: Foster partnerships between the public and private sectors to harness expertise and resources for water infrastructure development and administration. Public-private partnerships
(PPPs) can mobilize private capital, stimulate innovation, and enhance service delivery efficiency. Nevertheless, it's imperative to ensure that PPP arrangements are transparent, equitable, and aligned with public interest objectives. For instance, the Government of India's Smart Cities Mission aims to encourage PPPs to enhance water supply and sanitation infrastructure in urban locales. By leveraging private sector capabilities and resources through PPPs, the implementation of water management projects can be accelerated, thereby improving service delivery efficiency.

Investing in Research and Capacity Strengthening: Dedicate funding towards research, education, and capacity-building initiatives aimed at advancing knowledge and competencies in water resource management and resource economics. This encompasses supporting academic institutions, training programs, and knowledge exchange platforms to equip stakeholders with the requisite tools and insights to effectively address water challenges. According to UNESCO, investments in water research and development offer substantial returns, with each $1 invested estimated to yield economic benefits ranging from $3 to $34, depending on regional factors and research activities. Investing in research and capacity strengthening can bolster expertise and capabilities in water resource management, leading to more effective solutions for addressing water challenges.

Steps taken by India for Effective Water Resource Management and Way Forward.

In this direction, India has implemented various policies and strategies to effectively manage its water resources. The National Water Policy sets objectives for sustainable water management, while initiatives like the Integrated Watershed Management Programme and Jal Shakti Abhiyan aim to tackle water-related challenges at the grassroots level. Decentralized governance structures are crucial for ensuring community participation and ownership in water management efforts. The Ministry of Jal Shakti reports that over 7.5 million hectares of land have been treated under the Integrated Watershed Management Programme, resulting in improved soil moisture retention and groundwater recharge.

Numerous case studies highlight successful water management initiatives across India. In Rajasthan, rainwater harvesting projects have replenished groundwater resources and enhanced water security in arid regions. Similarly, watershed development programs in Maharashtra have showcased the potential for community-led approaches to water conservation and management. The World Bank notes that rainwater harvesting in Rajasthan has led to an average annual groundwater recharge of around 15 billion cubic meters, benefiting over 1.5 million people.

Several specific case studies demonstrate effective water management strategies. For example, the Mukhya Mantri Jal Swavlambhan Abhiyan in Rajasthan adopts a participatory water management approach, involving Gram Sabhas in budgeting for water resources and utilizing advanced technologies like drones for water body identification. In Andhra Pradesh, the Neeru-Chettu Programme focuses on repairing, renovating, and maintaining irrigation assets to ensure water supply in drought-prone areas.

In Maharashtra, the Jalyukt Shivar Abhiyan aims to make the state drought-free by employing geo-tagging of water bodies and utilizing a mobile application for web-based monitoring. The "Pani Bachao, Paise Kamao" initiative incentivizes farmers to conserve water by providing them with a fixed electricity quota and offering direct benefit transfers for every unit of electricity saved. In Uttar Pradesh, initiatives like those in Akhni village in Bundelkhand have successfully transformed drought-prone areas into productive agricultural regions through the construction of farm ponds, water body restoration, and intensive tree plantation.

Conclusion

The challenges of water scarcity in India, exacerbated by climate change according to the IPCC, require urgent attention. Sustainable water management practices are crucial, necessitating a balance between economic objectives like efficiency and sustainability, and political realities such as competing interests and power dynamics. Solutions must prioritize sustainable practices, including improved water harvesting and storage facilities while considering cost-benefit analysis to ensure economic feasibility. Policymakers should focus on reducing groundwater extraction through measures like promoting micro-irrigation and crop diversification, which would help internalize the externalities associated with over-extraction. Additionally, rejuvenating groundwater through infrastructure projects like check dams and percolation ponds is essential, making water resources excludable and thus easier to manage. Modifications to the legal framework, including amendments to the Indian Easement Act and adoption of model bills on groundwater conservation, are necessary to ensure effective management. Policymakers must prioritize investments in research and infrastructure to guarantee water security for future generations.

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