Phoenix: International Multidisciplinary Research Journal
Vol 3, No. 2, April-June, 2025
ISSN:2583-6897

WATER RESOURCE MANAGEMENT AND PROJECTED DEMANDS IN KARNATAKA: AN ANALYSIS OF SECTORAL DEMANDS AND SURFACE WATER AVAILABILITY.

[1]Dr.Nagendra Swamy R B

https://doi.org/10.5281/zenodo.15795961

Abstract

Karnataka, a southern Indian state, faces severe water resource challenges due to its geographical and climatic conditions, particularly in drought-prone regions in the northern and eastern areas. This study investigates the projected sectoral water demands and available surface water resources across Karnataka, highlighting the challenges posed by growing demands from agriculture, industry, and urban households. Using data from the Karnataka Development Report (2007) and recent projections from the Water Resources Department (2022), this study analyzes historical and future water needs for sectors including agriculture, household, industry, and power, and assesses the surface water yield and allocations across major river basins like Krishna and Cauvery. The findings reveal a significant gap between water demand growth and surface water availability, especially in drought-prone regions with limited water allocations. This gap underscores the urgency of adopting sustainable water management practices, such as efficient irrigation, groundwater recharge, and inter-basin water transfers. Additionally, the study highlights the necessity for a unified policy framework and adaptive strategies to address climate variability and future water scarcity. The insights from this research aim to guide policy decisions and promote sustainable water use, ensuring equitable water distribution and resource security for Karnataka's diverse sectors in the coming decades.

Key words: *water resource management; sectoral water demand; demand supply gap; water allocation strategies.*

Introduction

Karnataka, a state in southern India, faces significant water scarcity challenges, particularly in its drought-prone regions, which include districts in the northern and eastern parts of the state. These areas are characterized by low and erratic rainfall, frequent droughts, and limited natural water resources. Karnataka's dependence on monsoon rains for agriculture and water supply exacerbates the vulnerability of these regions to climate variability. The state has experienced

[1] Assistant Professor, Department of Geography, Bhandari and Rathi College Guledagudda, Bagalkot, Karnataka, Email ID: rbnagendraswamy@gmail.com

multiple drought years in the past decades, severely impacting agricultural productivity, rural livelihoods, and overall water availability.

Karnataka's water resources are primarily derived from its river basins, including the Krishna, Cauvery, and west-flowing rivers. However, the distribution of these resources is uneven, with the western region receiving significantly more rainfall than the arid interior regions. The state's dependency on inter-state rivers like Krishna and Cauvery also complicates its water availability, as allocations are subject to tribunal decisions and interstate agreements. Rapid urbanization, industrial growth, and an increasing population are further straining these limited water resources, with competing demands across agricultural, industrial, and domestic sectors. Agriculture, which consumes over 80% of Karnataka's water resources, is particularly vulnerable to drought, leading to crop failures, reduced yields, and economic distress among farmers.

These conditions highlight an urgent need for effective water resource management strategies to mitigate the impacts of water scarcity. Sustainable management approaches, such as promoting efficient irrigation techniques, rainwater harvesting, wastewater recycling, and inter-basin water transfers, are essential to address the imbalance between demand and availability. Additionally, adaptive strategies that incorporate climate resilience, such as drought-resistant crops and improved groundwater management, are critical to securing Karnataka's water future in the face of recurrent droughts and climate change.

Objectives

1) To assess current and projected water demands across the different sectors of Karnataka state.

2) To analyze surface water yield from Karnataka's river basins for optimal allocation strategies.

Methodology

This study mainly relies on secondary data sources which is collected by Karnataka Development Report 2007 and this report provides historical data on sectoral water demand in Karnataka for the year 2000 and projections for 2025, covering sectors like agriculture, household, industry, power, and others. It includes water demand figures in million cubic meters (m^3) and thousand million cubic feet (TMC), along with annual growth rates for each sector. And also, the report from the Water Resources Department, Karnataka, published in Deccan Herald, offers recent data on water requirements across sectors (2021, 2030, and 2050), and details on surface water resources in major river basins, including Krishna, Cauvery, Godavari, and west-flowing rivers. It presents both the total yield and the usable yield as allocated by water tribunals.

Analysis Approach

1. **Sectoral Demand Growth Analysis**: Using the 2007 data, calculate the growth rates in water demand for each sector by comparing the 2000 and projected 2025 figures. Cross-reference with the 2022 data to identify patterns and assess if current trends align with earlier projections. This comparison provides insights into high-demand sectors and future needs, particularly for agriculture, industry, and household sectors.
2. **Surface Water Yield and Allocation Assessment**: Analyze the 2022 data to examine Karnataka's major river basins' yields and tribunal allocations. By comparing the total yield and usable allocation, assess each basin's capacity to meet regional demand. This step helps identify basins where demand might exceed supply and areas where water is underutilized due to allocation limits.
3. **Demand-Supply Gap Evaluation**: Combine findings from sectoral demand analysis and water yield data to assess potential gaps between demand and supply. Focus on drought-prone regions where surface water availability is limited, and demand is high, highlighting areas with critical shortages.

Review of Literature

This literature review examines recent studies that focus on sectoral water demand, surface water availability, and the challenges of managing these resources in Karnataka. These studies collectively highlight the need for targeted water resource management strategies and emphasize critical gaps in meeting projected sectoral demands, particularly in drought-prone areas.

Ahmed et al. (2024) investigate domestic water demand in the semiarid regions of North Karnataka, specifically in Ballari and Raichur districts, where surface water is limited, and groundwater is the primary source for domestic use. The study emphasizes the increasing supply-demand gap in these districts due to limited surface water availability and growing population needs. The authors propose an interlinking project between the Krishna and Pennar rivers to address this gap sustainably. This research highlights a significant challenge for Karnataka: the reliance on limited groundwater resources in the absence of sufficient surface water, which aligns with the research gap in understanding how projected sectoral demands can be met given the current water constraints. **Machnoor and Gurjar (2023)** provide a comprehensive analysis of water resource challenges in Karnataka, covering aspects like variability in rainfall, groundwater exploitation, and the availability of surface water resources. The study describes Karnataka's water stress conditions, with per capita water availability declining over recent decades due to population growth and environmental degradation. This study also highlights the growing demand across different districts and the critical need for efficient water management strategies. While it outlines Karnataka's current water management issues, the research emphasizes the need for region-specific demand projections to assess future needs accurately, thus reinforcing the research gap in sectoral demand projections and resource allocation. **Sawkar**

(2012) evaluates water supply sustainability in Bengaluru, focusing on surface, ground, and treated sewage water. This study provides insights into the heavy reliance on the Cauvery River for Bengaluru's water needs, which is already fully utilized under the Cauvery Tribunal Award, and predicts a substantial water deficit by 2036. Although the study is specific to Bengaluru, it highlights the broader challenge in Karnataka: a limited surface water supply against rising urban demands. This research underscores the need to identify and secure additional surface and alternative water sources, underscoring the gap in studies that forecast water demand across all major sectors and regions. **Venkatesha et al. (2015)** analyze groundwater resources in Bangalore, assessing both the quantity and quality of groundwater under the pressure of rapid urbanization and industrialization. The study reveals the extent of groundwater pollution and depletion due to increasing dependence on this resource. The findings highlight a critical issue for the broader state of Karnataka: the unsustainable use of groundwater in urban areas as a result of limited surface water allocations. This study strengthens the need for comprehensive resource planning, particularly in groundwater-reliant areas, to meet projected demands sustainably. **Jayaramu et al. (2015)** analyze water consumption patterns and forecast bulk water demand under a continuous water service demonstration in Hubli-Dharwad. This study highlights that the planned system capacity may not suffice to meet future bulk demand under full-scale continuous water service. Although focused on an urban area, this work demonstrates the necessity of accurate demand forecasting for sustainable water management and resource allocation, particularly in rapidly growing cities. This aligns with the gap in statewide demand projections that account for sectoral needs across Karnataka.

Research Gap

These studies collectively highlight critical gaps in Karnataka's water resource management, including inadequate surface water allocations, high reliance on groundwater, and a lack of comprehensive sectoral demand projections. While some research has addressed water supply and demand forecasting for specific cities or regions, a detailed, statewide analysis that projects sectoral demands (e.g., agriculture, household, industrial) against surface water availability remains lacking. Addressing this gap is essential for developing sustainable policies that consider future growth across all sectors and ensure equitable water distribution across Karnataka.

Results and Discussions

Table 1: Projected Sector Water Demands in Karnataka for 2025

Sector	Water Demand 2000 (Million m^3)	TMC (2000)	Water Demand 2025 (Million m^3)	TMC (2025)	Growth Rate per Annum (%)
Agriculture	31,431	1,110	38,397	1,356	0.80

Household	1,647	58	2,594	92	1.84
Industrial	1,347	47	3,542	125	3.94
Power	1,497	53	1,846	65	0.84
Others	1,497	53	5,987	211	5.70
Total	**37,419**	**1,321**	**52,366**	**1,849**	**1.36**

Source: Karnataka Development Report 2007

This table presents the projected water demands for various sectors in Karnataka for 2025 compared to the baseline year 2000. Agriculture remains the dominant sector in water consumption, though with a relatively low growth rate (0.80% per annum). In contrast, sectors like industry (3.94% growth) and others (5.7%) show higher annual growth rates, indicating rising demand for water resources beyond agriculture. The total projected demand increases by approximately 40%, underscoring the importance of strategic water management to accommodate growing industrial and household needs.

Table 2: Water Resources Requirement in Various Sectors in Karnataka (2021, 2030, and 2050)

Uses	Demand 2021	Demand 2030	Demand 2050
Rural water supply including livestock	54.75	76.50	260.38
Urban water supply	59.56	70.33	185.06
Agriculture and Allied sectors	1491.16	1591.15	1591.15
Industry	96.80	130.03	204.74
Environmental flows	17	17	17
Total	**1,719.27**	**1,884.96**	**2,258.33**

Source**:** Water Resources Department, Deccan Herald, August 14, 2022

This table outlines the projected water requirements in Karnataka across various sectors for the years 2021, 2030, and 2050. While agricultural demands remain relatively stable, rural and urban water supply needs show significant growth, especially for rural water supply, which is projected to increase almost fivefold by 2050. Industrial demand also exhibits considerable growth. This trend reflects increasing pressure on water resources due to urbanization and industrialization, suggesting the need for sustainable planning and efficient resource allocation to meet future needs.

Table 3: Surface Water Resources and Allocations in Karnataka's Major River Basins

Basin	Yield (tmcft)	% of Total	Allocated by Tribunals / Usable Yield (tmcft)	% of Total Allocation

		Yield		
Krishna I and II	972.63	28.23	916	72.21
Cauvery	388	11.26	284.75	22.44
Godavari	52.37	1.52	22.37	1.77
West Flowing Rivers: Mahadayi, Palar, South Pennar, North Pennar	2,032	58.99	45.26	3.58
Total	**3,445**	**100**	**1,268.38**	**100**

Source**:** Water Resources Department, Deccan Herald, August 14, 2022

This table presents Karnataka's surface water resources, categorized by major river basins, and their respective allocations by water tribunals. The Krishna and Cauvery basins contribute a substantial portion of the state's water yield, with a combined 39.49% of the total yield and over 94% of the usable allocation. In contrast, west-flowing rivers, while having a high yield, receive minimal allocations for use (3.58%). This distribution highlights the challenge of optimizing water use across basins with differing yield and allocation levels, which is critical for addressing water scarcity, especially in drought-prone regions of Karnataka.

Conclusion

The analysis of Karnataka's projected water demands and surface water resources reveals an impending challenge in balancing water needs across sectors with limited and unevenly distributed water availability. Agricultural demand, while stable, continues to dominate overall water use, highlighting the need for sustainable practices in this sector. However, significant growth in household and industrial water demand, as indicated by high growth rates of 1.84% and 3.94% respectively, underscores the increasing strain that urbanization and industrialization place on Karnataka's water resources. Additionally, the analysis of surface water resources demonstrates that most of Karnataka's usable water is allocated to the Krishna and Cauvery basins, with other basins, particularly the west-flowing rivers, having substantial water yield but minimal usable allocations. This uneven distribution poses a considerable risk, especially in drought-prone regions, where water scarcity is already a critical issue. As total demand is projected to increase by approximately 40% by 2025, it is clear that strategic water management interventions are urgently needed to ensure sustainable access and allocation.

Suggestions

Promote Water-Efficient Agricultural Practices: Since agriculture remains the largest consumer of water, adopting water-saving practices like drip irrigation, crop rotation, and drought-resistant crop varieties can significantly reduce water use. Education and incentives for farmers to implement these practices would help mitigate the pressure on water resources.

Enhance Urban and Industrial Water Management: Given the high growth rates in household and industrial water demands, it is essential to improve water-use efficiency in these sectors. Implementing strict regulations on industrial water recycling, promoting rainwater harvesting in urban areas, and encouraging water-efficient appliances can contribute to reducing overall demand.

Optimize Inter-Basin Water Transfers: The disparity in water yield and allocations among Karnataka's river basins suggests a need for better distribution strategies. Carefully planned inter-basin water transfers from surplus basins (e.g., west-flowing rivers) to deficit regions could alleviate water scarcity in drought-prone areas, provided environmental impacts are minimized.

Strengthen Groundwater Recharge Efforts: Since surface water allocations are limited, enhancing groundwater recharge in dry regions through methods like check dams, percolation tanks, and reforestation is essential. This would improve water availability during dry spells and reduce dependency on surface water alone.

Develop a Comprehensive Policy Framework for Water Allocation: Karnataka would benefit from a unified water policy that prioritizes equitable water distribution across sectors and regions, especially during droughts. This framework should be adaptable to changing climate conditions, ensuring resilience against future water scarcity.

Invest in Research and Technology: Continued research on advanced water management technologies and practices, such as smart irrigation systems and predictive models for demand-supply management, can support more efficient water use. Monitoring systems to track sectoral water consumption can also help identify and address inefficiencies proactively.

These suggestions aim to create a balanced approach to Karnataka's water resource management by promoting conservation, improving allocation, and preparing for future demand growth, thereby ensuring water security for all sectors and regions of the state.

References

1. Satishkumar, W. K. U. (2021). Investigation on variability of potential runoff on planning of conservation measures under semi-arid tracts of north-eastern Karnataka. *International Journal of Current Microbiology and Applied Sciences*, 10(2). doi:10.20546/IJCMAS.2021.1002.034.
2. Shrivastava, A. (2017). Water supply in the state of Karnataka, India. In *Water governance and management*. doi:10.1057/978-1-137-58828-9_15.
3. Karthick, B., & Ramachandra, T. V. (2007). Spatial variation of physico-chemical and hydrological parameters with land-use in Venkatapura catchment, Karnataka.

4. Pushpa, C. O. (2014). An investigation into land use dynamics in Karnataka - An ecological perspective.
5. Ahmed, A., Chatterjee, J., Nannewar, R. G., & Srikanth, R. (2024). Fulfilling domestic water demand in semiarid regions of North Karnataka: Challenges and way forward. *International Journal of Rural Management*, doi:10.1177/09730052241236075.
6. Machnoor, A. V., & Gurjar, D. S. (2023). Problems and prospects of water resources in Karnataka. *International Journal of Agriculture and Food Science*, doi:10.33545/2664844x.2023.v5.i1a.108.
7. Sawkar, R. H. (2012). Evaluation of surface, ground, and sewage water for sustainable supply of potable water to Bengaluru. *Journal of The Geological Society of India*, doi:10.1007/S12594-012-0220-Y.
8. Venkatesha, G., Samarth, U., Ramaraju, H. K., & Sharma, A. K. (2015). Groundwater geophysical studies in the developed and sub-urban BBMP area, Bangalore, Karnataka, South India. *International Journal of Environmental and Ecological Engineering*.
9. Jayaramu, K. P., Burt, Z., & Kumar, B. M. (2015). A study of the consumption pattern in a continuous water service demonstration zone and bulk water demand forecasting for Hubli-Dharwad, India. *Journal of Water Sanitation and Hygiene for Development*, doi:10.2166/WASHDEV.2015.096.