

Sustainable Water Management and Environmental Geography of Chhatrapati Sambhajnagar District

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Abstract:

Chhatrapati Sambhajnagar District (formerly Aurangabad District) in Maharashtra lies primarily within the Godavari Basin, with some northern parts draining into the Tapi Basin. The district's physiography—comprising plateau terrain, hilly uplands, and river basins—along with its semi-arid climate and variable monsoonal rainfall, shapes its water resources, land use patterns, and ecological constraints. In recent years, the district has experienced acute water stress: numerous small irrigation and tank projects have dried up, groundwater levels have declined sharply, and hundreds of villages now depend on tanker-based water supply. This paper, using secondary data, district-level reports, media sources, and geographical and climatic information, examines the interplay between environmental geography and water resource sustainability in the district. The analysis argues that long-term sustainability requires a hybrid strategy that integrates traditional water-harvesting systems, watershed management, groundwater recharge interventions, ecological restoration, and community-led governance.

Keywords: *Chhatrapati Sambhajnagar, environmental geography, water sustainability, groundwater recharge, community water management, Marathwada.*

Introduction:

Water forms the core of human settlements, agriculture, industry, and ecosystems. In a geographically diverse and densely populated country like India, water availability is inherently uneven. Chhatrapati Sambhajnagar District in Maharashtra illustrates this complexity. The district spans both the Godavari Basin and the periphery of the Tapi Basin. Its landscape includes Deccan Trap plateaus, hilly terrain, and river plains. Rainfall is moderate but highly variable (average approximately 734 mm), and summer temperatures frequently exceed 45°C.

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In the context of increasing climate variability, declining groundwater reserves, and rising demand from agriculture, industry, and urban settlements, sustaining water resources in such physiographically sensitive regions has become a challenge. Reports from 2024–2025 indicate that 56 of the district's 98 minor irrigation and tank systems have completely dried up, forcing dozens of villages to rely on tanker water. This study investigates how environmental geography influences water availability, resource stress, and sustainability in Chhatrapati Sambhajnagar, and proposes community-driven, ecologically informed strategies for sustainable water management.

Methodology:

This research adopts a mixed-method approach. Geospatial analysis was performed by integrating a Digital Elevation Model (DEM) of Chhatrapati Sambhajnagar District with land use and cropping pattern maps, enabling spatial correlation of topographic characteristics with agricultural activities. Field surveys and farmer interviews were conducted in selected villages representing diverse landforms—such as the plains near Paithan and the hilly areas near Kannad—to collect qualitative insights on farming practices, cropping choices, and water-use behaviour.

Study Area:

Sambhajnagar district, located in the central part of the state, is an elevated land that has been incised by the Godavari River and its tributaries in the southern part. Except for a little part in the north and north-west, it belongs to the Tapi drainage. The entire district is in the Godavari basin. The Sambhajnagar district measures between 19⁰53' north to 20⁰40' north latitude and 74⁰39' east to 76⁰40' east longitudes. It is bounded by the Jalna district to the east, Nashik district to the west, Ahmednagar district to the southwest, and Jalgaon district to the north. It also has small boundaries with the Buldhana district in the north-east and the Beed district in the south.

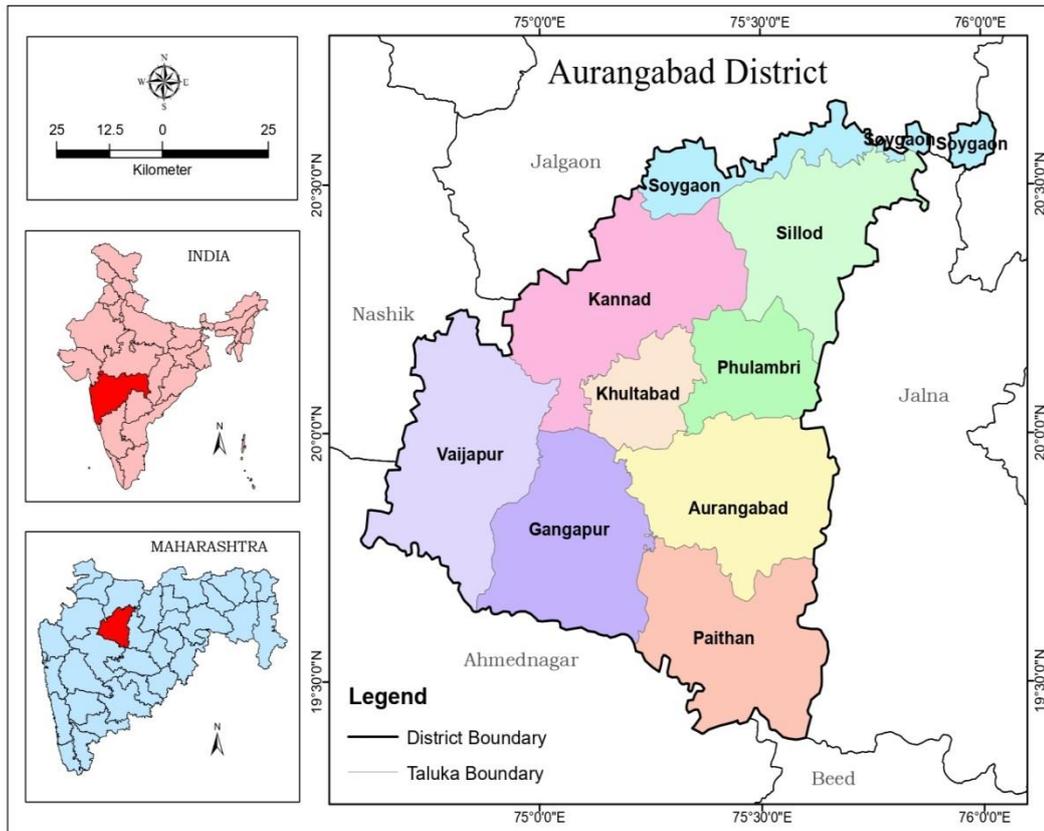
Sambhajnagar district covers an area of 10,100 km², out of which 37.55% is urban and 62.45% is rural, and it accounts for 3.28 percent. As per the recommendations of the Sukhtnor committee of the district, Aurangabad, Gangapur, Kannad, Paithan, Khultabad, and Vaijapur are included in the drought zone. The study area consists of nine tahsils, viz. Aurangabad, KhultabadKannad, Soygaon, Sillod, Paithan, Gangapur, Vaijapur, and Phulambri.

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Map No. 1 - Location Map of Sambhajnagar District



Geology:

The geology of Chhatrapati Sambhajnagar District is overwhelmingly dominated by the Deccan Trap Basalt formation, which exerts a decisive influence on groundwater availability and long-term water sustainability. Basaltic rocks possess very low primary porosity and permeability, preventing uniform storage and movement of water through the subsurface. As a result, groundwater does not occur in extensive, continuous aquifers but is instead restricted to secondary porosity features such as joints, fractures, and vesicular or amygdaloidal zones created during the cooling of lava flows. These structurally controlled and highly localized aquifer pockets make groundwater exploration unpredictable and often unreliable. Consequently, farmers and communities increasingly resort to drilling deeper borewells in search of productive fractures, a practice that accelerates groundwater depletion and leads to rapid decline in the water table across the district. This combination of geological constraints and human dependence underscores the importance of region-specific recharge measures and sustainable groundwater management strategies.

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Hydrology:

The hydrology of Chhatrapati Sambhajnagar District is shaped primarily by the Godavari River and its major tributaries, including the Shivna, Purna, and Kham rivers, which together form the district's principal drainage network. The Jayakwadi Dam at Paithan, constructed on the Godavari, serves as the region's largest reservoir and functions as a critical source of irrigation, industrial supply, and drinking water. However, the reservoir's storage levels are highly sensitive to variations in upstream rainfall, making it vulnerable to monsoonal fluctuations and regional climatic variability. Periods of deficient rainfall in the upper catchments directly reduce inflow into the dam, impacting water distribution across rural, urban, and agricultural sectors. This dependence on monsoon-fed river systems underscores the district's hydrological fragility and highlights the need for integrated watershed management and decentralized water storage strategies.

The Role of Geology and Terrain in Water Storage & Recharge:

The geology and terrain of Chhatrapati Sambhajnagar District play a decisive role in determining its natural water storage and recharge potential. Dominated by Deccan Trap basalt flows, the region is underlain by hard, often impermeable strata that significantly restrict percolation and limit the formation of widespread aquifers. While these basaltic plateaus can support agriculture when supplemented by canal or tank irrigation, their inherently low natural recharge capacity makes groundwater depletion almost unavoidable in the absence of artificial recharge structures such as percolation tanks, contour trenches, and recharge wells. The district's gently sloping but undulating terrain further accelerates surface runoff during monsoon rains, allowing large quantities of water to escape without infiltrating into the subsurface. This challenge is compounded by limited forest cover, which contributes to soil erosion, reduces infiltration, and weakens the district's ecological resilience. Although the hilly uplands around Antur, Abbasgad, and similar areas possess the potential to function as effective watershed recharge zones, widespread deforestation and soil degradation have severely diminished their capacity to retain and transmit water. Consequently, the intrinsic geological and geomorphological characteristics of the district impose strict constraints on natural water availability, underscoring the necessity for location-specific, scientifically informed, and ecologically grounded water management interventions.

Climatic Variability and Dependence on Monsoon:

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Climatic variability exerts a profound influence on water availability in Chhatrapati Sambhajnagar District, which lies within a semi-arid zone characterized by high inter-annual fluctuations in monsoon rainfall. The district's heavy dependence on the southwest monsoon means that any reduction in seasonal rainfall—such as the deficit experienced during 2023–24 results in immediate and far-reaching impacts, including the drying of irrigation tanks, sharp declines in groundwater levels, crop failures, and widespread reliance on tanker-based water supply. The 2024 documentation of more than 50 minor irrigation and tank projects becoming completely dry highlights the region's acute hydrological vulnerability. Compounding these challenges are extremely high summer temperatures, often exceeding 45°C, which substantially increase evaporation losses from reservoirs and storage structures while simultaneously intensifying domestic, agricultural, and industrial water demand. This interplay of climatic variability and monsoon dependence underscores the need for resilient, climate-adaptive water management strategies in the district.

Land Use, Deforestation, and Soil Constraints:

Land Use, Deforestation, and Soil Constraints

With only about 9 percent of the district under forest cover, the natural processes of vegetative absorption and groundwater infiltration remain limited. Extensive agricultural expansion, rapid urbanisation, and growing industrial activities—carried out without adequate green buffers—intensify surface runoff and reduce groundwater recharge potential. Soil erosion across the plateau and hilly regions, compounded by ongoing deforestation, results in the loss of topsoil, declining soil fertility, and a reduced capacity of the land to retain moisture.

Human Pressure: Agriculture, Industry, Urban Demand:

Agriculture in the Marathwada region is heavily dependent on irrigation, and the failure of tank-based systems has accelerated the over-extraction of groundwater. Borewells and open wells are being drilled to increasing depths, many of which now reach their structural and hydrological limits, indicating long-term unsustainable withdrawal. Recent media reports further indicate that several villages and hamlets have begun relying on tanker-supplied water to meet basic needs. Industrial growth particularly the establishment of water-intensive units such as breweries has placed additional pressure on limited water resources. Local authorities have cautioned that water allocations for industrial use may need to be reduced if domestic demand continues to rise. Urban water supply infrastructure, including pipelines and treatment

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plants, has not kept pace with demand. As a result, several city zones experience irregular and intermittent water supply, especially during peak-demand periods.

Towards Sustainability: Strategies and Recommendations:

Long-term water sustainability in Chhatrapati Sambhajnagar requires an integrated, geography-based strategy that addresses both natural constraints and human-driven pressures. Strengthening traditional water-harvesting systems is essential: silted tanks, check-dams, and percolation structures must be rehabilitated, and additional recharge measures—such as percolation pits, recharge wells, contour bunding, and watershed treatments—should be prioritised, particularly in basaltic plateaus and upland regions like the Antur and Abbasgad hills. Parallel to this, expanding forest cover and implementing soil-conservation measures will enhance infiltration, reduce erosion, and improve overall watershed health. Effective water governance must regulate groundwater extraction through licensing, monitoring, and metering while encouraging shifts toward drought-resilient crops and efficient irrigation technologies such as drip and sprinkler systems. Strengthening the district’s water-supply infrastructure, including pipelines, treatment facilities, rainwater-harvesting initiatives, and wastewater reuse, will reduce pressure on freshwater sources. Central to the success of these interventions is strong community participation: village committees, Gram Panchayats, and local groups should lead watershed planning and maintenance, supported by awareness campaigns under initiatives like “JalSamruddhaGaonAbhiyan” to achieve long-term, tanker-free water security.

Conclusion:

Chhatrapati Sambhajnagar district’s environmental geography — basaltic geology, plateau terrain, semi-arid climate, limited forest cover — shapes both its vulnerabilities and potentials in water resource sustainability. Recent years have exposed these vulnerabilities vividly: dried-up irrigation projects, dwindling groundwater, rising tanker dependence, and urban water supply failures. However, the same geography — if managed intelligently — offers pathways to resilience. Traditional water-harvesting practices, when revived, along with modern recharge techniques, watershed management, community governance, and integrated land-use planning, can transform scarcity into sustainable water security.

Sustainability here does not mean returning to “old ways” only — but adapting local traditional knowledge with modern science and governance. Given the projected climate

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variability, growing demands, and limited resources, such an integrated, geographically-informed, community-centric water strategy is not optional — it is imperative.

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