

Water Conservation and Management in Tribal Areas: A Study of Nashik District's Sustainable Practices and Challenges

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Abstract

Water scarcity has emerged as one of the most pressing environmental and socio-economic challenges in India, particularly in tribal regions where access to sustainable water resources is limited. Nashik district in Maharashtra, despite receiving significant monsoon rainfall, experiences acute water shortages in its tribal belts due to uneven rainfall distribution, basaltic terrain, and insufficient water storage infrastructure. This study examines water conservation practices in the tribal regions of Nashik from a geographical perspective, focusing on both traditional indigenous methods and modern government supported interventions. Using a mixed-method research approach involving field observations, household interviews, secondary data analysis, and spatial interpretation, the study evaluates the effectiveness of water conservation structures in enhancing groundwater recharge and improving water accessibility. The findings reveal that community-based traditional practices, when integrated with scientifically planned interventions, significantly enhance water availability and resilience against seasonal droughts. The study highlights the need for participatory planning, localized watershed management, and effective implementation of water policies to achieve sustainable water security in tribal areas.

Keywords: Water Conservation, Management, Sustainable, Challenges, Tribal Regions

1. Introduction

Water is a critical natural resource essential for human survival, agricultural productivity, and ecological balance. India faces increasing water scarcity due to population pressure, climate variability, over-extraction of groundwater, and inefficient water management. Tribal regions are particularly vulnerable, as communities depend heavily on natural water sources and live in geographically remote areas with limited infrastructure. Nashik district in northern Maharashtra exemplifies this paradox: it receives moderate to high rainfall but experiences significant water shortages, especially in tribal talukas. Recent reports indicate that over 6.3 lakh people across 1,973 villages in Nashik division face drinking water scarcity, with 1.32 lakh people in 763 villages of Nashik district dependent on tanker-supplied water during

dry months (Times of India, 2024). Talukas such as Surgana, Peth, Igatpuri, and Dindori are among the most affected. Physiographically, water scarcity in these areas is intensified by hilly terrain, shallow soils, and hard basaltic rock, which restrict groundwater storage and accelerate surface runoff. Despite these challenges, tribal communities have developed indigenous water conservation practices, such as farm ponds, earthen bunds, and community tanks, adapted to local environmental conditions. Modern government interventions, including check dams, percolation tanks, and MGNREGA-supported watershed programs, have complemented these traditional systems. This study seeks to analyze water conservation practices, assess their effectiveness, and recommend sustainable strategies to improve water security in Nashik's tribal regions.

2. Literature Review

In the tribal regions of Nashik, despite moderate to high rainfall, water scarcity occurs due to hilly terrain, shallow soils, and hard rock formations (Patil & Deshmukh, 2019; CGWB, 2023). Tribal communities have traditionally conserved water using methods such as farm ponds, earthen bunds, and community tanks (Sharma & Mehta, 2018). Modern government interventions, such as check dams, percolation tanks, and MGNREGA projects, complement these traditional methods and help raise groundwater levels (Government of Maharashtra, 2023). NGOs also play an important role by implementing micro-watershed projects and piped water supply in remote villages (Free Press Journal, 2024). Research indicates that integrating traditional knowledge with scientific planning, community participation, and climate-resilient measures is essential for sustainable water management (Ramesh et al., 2020).

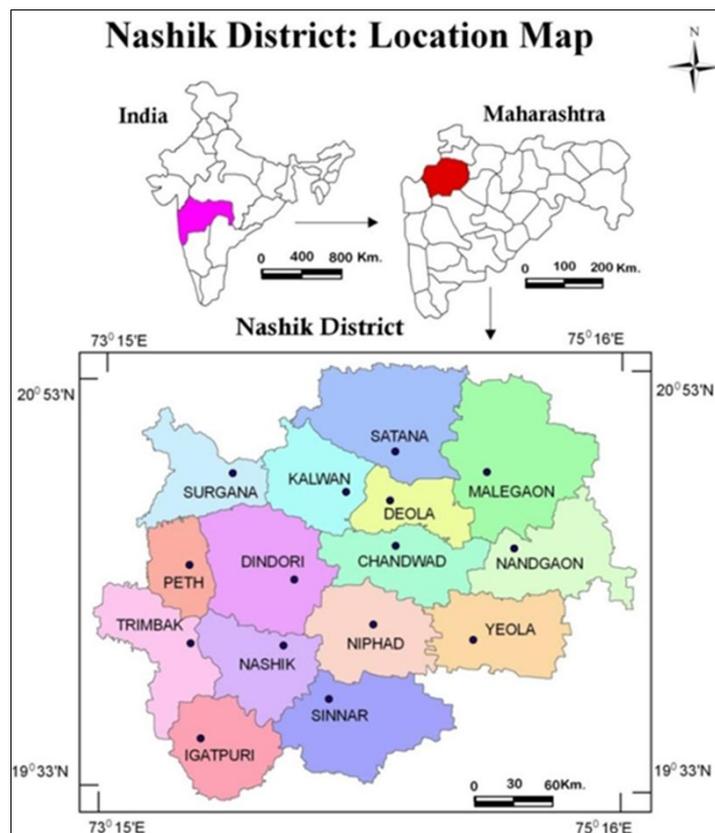
3. Objectives

1. To study water conservation in Nashik District.
2. To analyze water conservation practices adopted by tribal communities.
3. To study the management of flowing water and its storage.
4. To assess groundwater trends and water resource management strategies.

4. Study Area

The study focuses on the tribal regions of Nashik district, northern Maharashtra, covering approximately 15,582 sq. km ($19^{\circ}33'N$ – $20^{\circ}53'N$, $73^{\circ}16'E$ – $75^{\circ}16'E$). Nashik is bounded by Dhule, Jalgaon, Aurangabad, Ahmednagar, Thane, and Palghar districts and lies near the Western Ghats (Sahyadri range). Tribal populations are mainly concentrated in talukas such as Surgana, Peth, Igatpuri, Dindori, Kalwan, and Trimbakeshwar, with communities including Kokna, Bhil, Warli, Thakur, and Mahadeo Koli. These areas are largely hilly, forested, and remote, with limited access to infrastructure, making them highly dependent on natural water sources.

Physiographically, the region has undulating to steep terrain, with elevations ranging from 300 to 1,300 m above sea level, underlain by basaltic rock formations. This restricts groundwater storage and leads to rapid surface runoff during monsoon rains. Climatically, Nashik experiences a tropical monsoon climate, with rainfall varying from 500 mm in the eastern plateau regions to over 3,000 mm in the western hilly areas. Water sources such as streams, wells, and springs are largely seasonal, drying up during summer. The Godavari River and its tributaries drain the district, but many streams are unreliable for year-round supply. The physical and socio-economic conditions of these tribal areas make them highly relevant for studying water conservation practices, which is the focus of this research.



Map No: 1

5. Methodology

This research uses a mixed-method approach that integrates both qualitative and quantitative techniques. Primary data were collected through field observations, informal household interviews, and discussions with village elders and women, focusing on water availability, seasonal fluctuations, and conservation practices. Secondary data were obtained from government publications, census reports, district water

conservation plans, and recent academic and media sources. Spatial and geographical analysis involved evaluating topography, rainfall patterns, soil types, and land-use patterns to understand their influence on water availability. Integration of primary insights with secondary data allowed a comprehensive assessment of water conservation practices and their effectiveness.

6. Data Analysis

Tribal regions of Nashik experience acute seasonal water scarcity despite moderate monsoon rainfall. The hilly terrain and shallow soils contribute to rapid runoff and poor groundwater recharge, making traditional water sources insufficient for year-round use. Tribal communities have historically employed indigenous conservation practices, including earthen bunds, farm ponds, contour trenches, and community-managed tanks. These structures effectively store

rainwater and provide domestic water during dry periods. Modern interventions include check dams, Kolhapur-type weirs, percolation tanks, and rooftop rainwater harvesting systems, implemented under MGNREGA and state water programs. In talukas such as Igatpuri, Dindori, and Peth, these measures have resulted in groundwater level rises of 1.5–3.5 feet, demonstrating measurable success when combined with community maintenance (Groundwater Survey of Maharashtra, 2023).

Table 1: Water Scarcity in Tribal Villages of Nashik District

Indicator	Value
Villagers facing drinking water scarcity in Nashik district	1.32 lakh people in 763 villages
Villagers facing scarcity in Nashik division	6.3 lakh people in 1,973 villages
Water tankers deployed	399 tankers during peak summer
Villages relying on tankers	1,303 villages
Increase in dependent population	7.2 lakh people
Villages supplied by tankers (Oct 2023)	359 villages

Source: Times of India (2024)

These figures highlight the severity and scale of water scarcity in Nashik’s tribal regions. Despite rainfall, tribal villages rely heavily on tanker water due to inadequate local

storage. The data underscore the need for effective conservation structures and participatory water management strategies.

Table 2: Taluka-wise Water Data (Long-Term Average Trend Based)

Talukas	Average Rainfall Status	Average Groundwater Trend	Stored Water % (Estimated Average)	Flowing Water % (Estimated Average)	Tanker Dependency (Average Status)
Surgana	Moderate to High (Hilly, Western Ghats influence)	Moderate Improvement	42–45%	55–58%	Some villages dependent
Peth	High	Improved	45–48%	52–55%	Low dependency
Igatpuri	High (Western Ghats region)	Good Recharge	48–52%	48–52%	Very minimal
Dindori	Moderate	Gradual Improvement	44–47%	53–56%	Moderate
Kalwan	Moderate	Limited Improvement	40–44%	56–60%	Partial dependency
Trimbakeshwar	High	Significant Improvement	48–52%	48–52%	Very minimal

Source: Times of India (2024)

The above table presents an analytical overview of water resource conditions in the tribal talukas of Nashik district based on long-term geographical and hydrological patterns. Talukas located in the Western Ghats region such as Igatpuri, Trimbakeshwar, and Peth experience comparatively high rainfall due to orographic influence, which contributes to better groundwater recharge and lower tanker dependency. In contrast, Surgana and Kalwan, though hilly, show moderate to high rainfall but relatively higher proportions of flowing water because of steep slopes and runoff losses.

The stored water percentage is influenced by watershed development works such as check dams, percolation tanks, and farm ponds, which are more effective in areas with improved recharge conditions. Talukas with better groundwater trends, such as Igatpuri and Trimbakeshwar, show nearly balanced stored and flowing water proportions. Dindori demonstrates gradual improvement due to ongoing water conservation efforts, but still maintains moderate tanker reliance in some pockets. Kalwan reflects limited groundwater improvement, likely due to geological structure and moderate rainfall, resulting in partial tanker dependency during dry seasons. Overall, the table indicates that rainfall distribution, topography, and water conservation infrastructure collectively determine groundwater trends, storage capacity, and dependency on external water supply systems in Nashik’s tribal regions.

Findings

- Geographical Influence:** Rugged terrain, shallow soils, and basaltic formations limit groundwater storage, making the tribal areas prone to water scarcity despite moderate rainfall.
- Effectiveness of Traditional Practices:** Indigenous water conservation methods such as earthen bunds, farm ponds, and community tanks remain highly effective when maintained by the community.
- Impact of Government Programs:** Modern interventions improve water accessibility and groundwater recharge, but their effectiveness depends on timely implementation and integration with local practices.
- Role of NGOs:** Grassroots initiatives fill critical gaps in remote areas, especially where formal infrastructure is limited.

Challenges

- Irregular Rainfall Patterns:** Uneven and unpredictable monsoon rainfall reduces effective water harvesting and groundwater recharge.
- High Surface Runoff:** In hilly and sloping regions, rainwater flows rapidly as runoff instead of percolating into the soil.
- Limited Storage Infrastructure:** Insufficient check dams, percolation tanks, and farm ponds restrict the capacity to store rainwater locally.

4. **Groundwater Over-Extraction:** Excessive withdrawal of groundwater for agriculture and domestic use lowers the water table.
5. **Poor Maintenance of Structures:** Lack of regular desilting and repair reduces the efficiency of existing conservation structures.
6. **Low Community Participation:** Limited awareness and involvement of local communities weaken long-term sustainability.

Suggestions

1. Promote micro-watershed development tailored to local topography and hydrological conditions.
2. Ensure community participation in planning, construction, and maintenance of conservation structures.
3. Strengthen government program implementation and monitoring, especially in remote tribal settlements.
4. Conduct capacity-building programs for tribal youth and women to foster local water stewardship.
5. Integrate GIS-based planning and climate-resilient strategies to optimize conservation measures.

Conclusion

Water scarcity in Nashik's tribal regions reflects a strong correlation between rainfall patterns, groundwater recharge, and water storage capacity across different tahsils. Western Ghats tahsils such as Igatpuri, Trimbakeshwar, and Peth receive comparatively high rainfall due to orographic influence, which contributes to better groundwater recharge and relatively balanced stored and flowing water proportions. In contrast, tahsils like Kalwan and parts of Surgana, despite receiving moderate rainfall, experience higher runoff because of steep slopes and limited storage structures, resulting in lower groundwater retention and partial tanker dependency. Dindori represents an intermediate condition, where moderate rainfall combined with ongoing conservation efforts has led to gradual groundwater improvement. Thus, a direct relationship can be observed: higher rainfall combined with effective watershed structures enhances stored water percentage and reduces tanker reliance, whereas inadequate storage infrastructure increases surface flow and seasonal scarcity.

The comparative analysis of tahsils also highlights that rainfall alone does not determine water security; rather, the efficiency of conservation infrastructure and groundwater recharge mechanisms plays a decisive role. Tahsils with improved watershed management show measurable groundwater rises and lower external water dependency, while those with limited intervention continue to face storage deficits. Therefore, strengthening inter-tahsil watershed planning, enhancing storage capacity in moderate-rainfall zones, and integrating traditional practices with scientific water management strategies are essential to achieve balanced and sustainable water conservation across Nashik's tribal regions.

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