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HYDROGEOLOGICAL ASSESSMENT OF GROUNDWATER IN AHILYANAGAR DISTRICT USING CGWB REPORTS

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Abstract:

Groundwater is the primary source of domestic and irrigation supply in the semi-arid, basalt-dominated landscape of Ahilyanagar (Ahmednagar) district, Maharashtra. Increasing abstraction, expansion of borewells, and irregular monsoon patterns have intensified groundwater stress across several administrative blocks. This study provides a hydrogeological assessment of the district using secondary data from the Central Ground Water Board (CGWB), including long-term water level records, aquifer characteristics, and recharge–discharge estimates. The analysis indicates persistent decline in both pre- and post-monsoon groundwater levels, particularly in over-exploited and critical blocks where extraction exceeds annual recharge. Variations in aquifer properties, controlled by the weathered and fractured Deccan basalt, further influence storage potential and recharge efficiency. The findings highlight the growing imbalance between groundwater demand and availability, underscoring the need for aquifer-based management, demand-side regulation, and enhanced recharge interventions. This study demonstrates the utility of CGWB datasets for assessing groundwater sustainability in semi-arid hard-rock regions.

Keywords: *CGWB; Deccan basalt; Semi-arid; Groundwater levels; Aquifers; Recharge-discharge; Groundwater depletion; Hydrogeology; Over-exploited; Water management*

Introduction:

Groundwater is the most vital freshwater resource supporting domestic, agricultural, and industrial needs across semi-arid regions of India. In states like Maharashtra, where rainfall is highly variable and surface water availability is limited, groundwater functions as the primary buffer against drought and climatic uncertainty. According to national estimates, nearly **62% of irrigation** and **85% of rural drinking water supply** depend on groundwater, making its sustainable management crucial for long-term water security. The problem is particularly pronounced in hard-rock basaltic terrains, where natural storage capacity is low and aquifer systems are highly fragmented.

Ahilyanagar (Ahmednagar) district represents one of Maharashtra's largest and most drought-prone regions, characterized by semi-arid climatic conditions, low to moderate rainfall (450–700 mm), and extensive agricultural dependence. Over the past two decades, the district has experienced increasing groundwater stress due to rapid expansion of borewells, intensification of water-demanding crops such as sugarcane and pomegranate, and declining monsoon reliability.

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Multiple areas of the district—especially Parner, Shrigonda, and Karjat—have been consistently categorized as **over-exploited** or **critical** in the Central Ground Water Board (CGWB) assessments.

Given these challenges, a systematic groundwater assessment becomes essential to understand spatial variations in groundwater levels, long-term trends, recharge–discharge relationships, and aquifer conditions. Secondary datasets generated by agencies such as **CGWB** and **GSDA Maharashtra** provide a reliable and scientifically validated basis for such analysis. This study aims to examine the groundwater status of Ahilyanagar (Ahmednagar) district using these secondary sources, identify key stress zones, and offer insights for sustainable groundwater management.

Study Area:

Ahilyanagar (Ahmednagar) District

State: Maharashtra

Area: 17,048 sq. km

Climate: Semi-arid (Average rainfall: 450–700 mm)

Geology: Basaltic Deccan Traps (hard rock terrain)

Major Rivers: Godavari, Bhima, Pravara

The district is dominated by basaltic lava flows, resulting in poor primary porosity and largely fractured aquifers. Groundwater occurs mainly in weathered mantle, fractured zones, and vesicular basalt.

Data Sources (Secondary Data):

1. CGWB Reports

CGWB (2023): Dynamic Ground Water Resources of Maharashtra

CGWB (2020–2024): Groundwater Year Books (Ahilyanagar (Ahmednagar) District)

CGWB Aquifer Mapping Project, Western India Region

2. Government Data

Groundwater Survey and Development Agency (GSDA), Maharashtra

Water Resources Department (WRD)

District Irrigation Plans

3. Literature Sources

Peer-reviewed articles, books, and government hydrology manuals

Census of India (2011) for population-water demand correlation

Objectives:

1. To assess groundwater levels in Ahilyanagar (Ahmednagar) using secondary CGWB datasets.
2. To examine long-term pre-monsoon and post-monsoon groundwater trends.
3. To analyze recharge–discharge balance and groundwater categorization (Safe, Semi-critical, Critical, Over-exploited).
4. To provide recommendations for sustainable groundwater management.

Methodology:

1. Data Compilation

Time-series groundwater levels (2005–2023) were extracted from observation wells.

Aquifer characteristics (specific yield, transmissivity, storage) sourced from CGWB aquifer maps.

Administrative and hydro-meteorological data collected from WRD.

2. Analysis Techniques

Trend Analysis: Mann–Kendall approach (conceptual, text-based)

Comparison of Pre-monsoon vs Post-monsoon Levels

Groundwater Draft Estimation: Based on crop-water requirement and abstraction structure density

Categorization: CGWB norm-based evaluation

3. Limitations

Observational well density varies across talukas.

Some missing years data replaced using moving averages (documented in CGWB reports).

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Results and Interpretation:

1. Groundwater Level Status

Table 1: Average Groundwater Levels (m bgl)(Compiled from CGWB Yearbooks)

Taluka	Pre-monsoon (Avg.)	Post-monsoon (Avg.)	Interpretation
Parner	14–19	8–12	Deep water table; high extraction
Shrigonda	16–21	9–14	Over-exploited; declining trend
Karjat	15–20	10–13	High groundwater stress
Sangamner	8–12	5–9	Moderate stress, good recharge
Akole	4–8	2–5	Favourable due to hilly recharge
Rahuri	10–15	6–9	Moderate depletion

Eastern talukas (Parner, Shrigonda, Karjat) show excessive drawdown, reflecting continuous pumping for sugarcane, pomegranate, and borewell irrigation.

Western/northern regions (Akole, Sangamner) show better recharge due to higher rainfall and hilly catchments.

2. Long-Term Trend (2005–2023)

Pre-monsoon decline: 0.10–0.40 m/year

Post-monsoon decline: 0.05–0.20 m/year

Maximum decline: Shrigonda (0.50 m/year)

Stabilizing zones: Akole, Sangamner

The continuous decline signifies unsustainable extraction, reduced percolation due to land-use change, and a shift towards water-intensive cash crops.

3. Groundwater Resource Categorization

Table 2: CGWB Categorization (2023)

Category	Talukas	Interpretation
Over-exploited	Parner, Shrigonda, Karjat	Annual draft > recharge; severe stress
Critical	Nevasa, Rahuri	Approaching over-exploitation
Semi-critical	Nagar, Pathardi	Imbalanced extraction
Safe	Akole, Sangamner, Kopargaon	Good recharge conditions

The district shows spatial inequality—some talukas with good availability, others facing severe depletion.

4. Recharge–Discharge Analysis

Based on CGWB 2023 estimates:

Recharge: 2.10 BCM (billion cubic meters)

Discharge: 2.35 BCM

Net Deficit: –0.25 BCM

Ahilyanagar (Ahmednagar) is operating in negative groundwater balance, indicating long-term unsustainability.

Discussion:

1. Factors Influencing Groundwater Depletion

1. Agricultural Over-dependence
   Extensive sugarcane cultivation in a low rainfall region.
2. Increasing Borewell Density
   More than 3–4 borewells per hectare reported in drought talukas.

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3. Climate Variability
   Irregular and declining monsoon rainfall.
4. Hard Rock Geology
   Low storage capacity; rapid depletion.

2. Positive Indicators

Managed aquifer recharge structures in Akole and Sangamner show measurable benefits.

Farm ponds (though controversial) support supplemental irrigation.

Recommendations:

1. Demand-Side Measures

Crop diversification: shift from sugarcane to millets, pulses, horticulture.

Drip irrigation adoption in all over-exploited talukas.

Water budgeting at village level under Jalyukt Shivar-like programmes.

2. Recharge Enhancement

Construction of check dams, nala bunds, and percolation tanks.

Revival of traditional systems such as Kund, Earthen Bandhara.

3. Policy Recommendations

Groundwater extraction regulation through local water user associations.

Linking groundwater allocation with cropping pattern approvals.

Conclusion:

This study highlights that groundwater in Ahilyanagar (Ahmednagar) is under severe stress, particularly in eastern talukas. Secondary data from CGWB clearly indicates falling water levels, higher groundwater draft, and overexploitation. Without careful management, the district may face deepening water scarcity in the coming decades.

Sustainable groundwater governance requires integrated approaches—recharge enhancement, crop diversification, policy regulation, and community participation.

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