PROJECT BAWARI: REGENERATIVE HYDROLOGY THROUGH STEPWELL REVIVAL FOR WATER EQUITY IN ARID LANDSCAPES

RECLAIMING TRADITIONAL STEPWELLS WITH CLIMATE-SMART ENGINEERING
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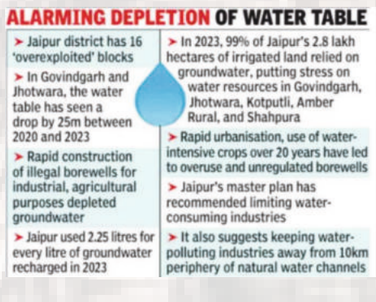
INTRODUCTION

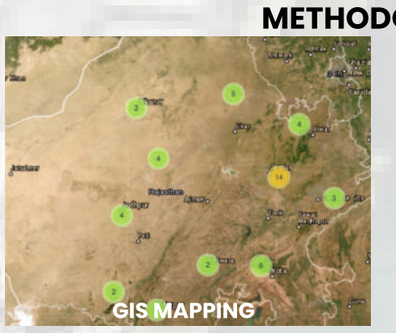
India's arid and semi-arid regions are grappling with an escalating freshwater crisis, fueled by climate change, erratic monsoons, and urbanization. In Rajasthan, traditional stepwells (locally called bāwaris) once vital for harvesting rainwater and recharging aquifers have been abandoned due to modern infrastructure and neglect. Project Bawari merges ancient regenerative hydrology with low-cost modern technology to revive abandoned stepwells, transforming them into decentralized, climate-resilient aquifer recharge units. By combining GIS mapping, hydrogeological surveying, and real-time IoT sensing, we reimagine these heritage assets as future-ready water infrastructure.

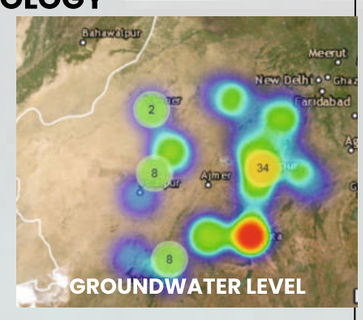


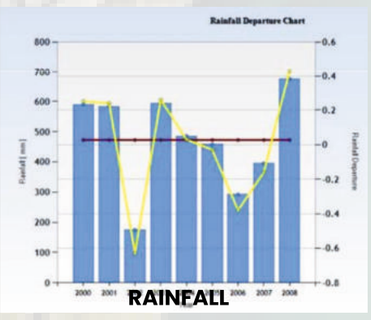
OBJECTIVE

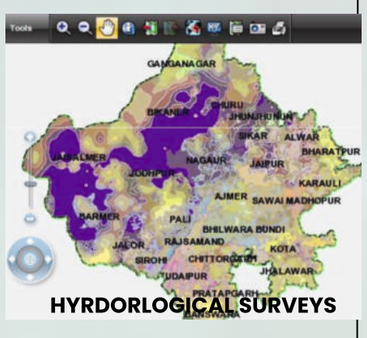
- To create a replicable, tech-enabled model for stepwell revival that strengthens water security and climate resilience in arid regions by:
- Transforming stepwells into decentralized aquifer recharge units that function as natural, climate-resilient water buffers
- Installing real-time IoT-based sensors to monitor water levels, quality, and contamination risks, with automated alert systems
- Empowering local youth as "Jal Rakshaks" (Stepwell Guardians) through digital training and integrating climate literacy into school programs

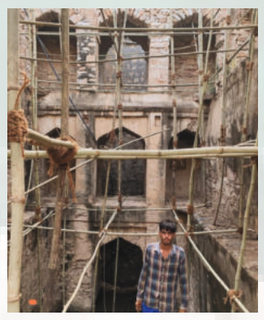
METHODOLOGY



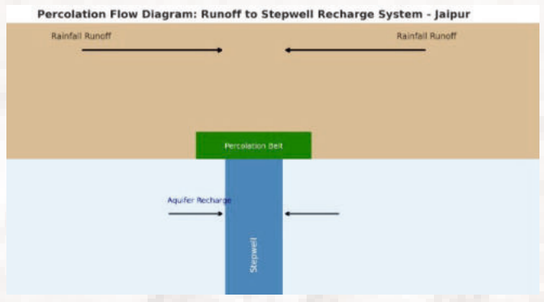






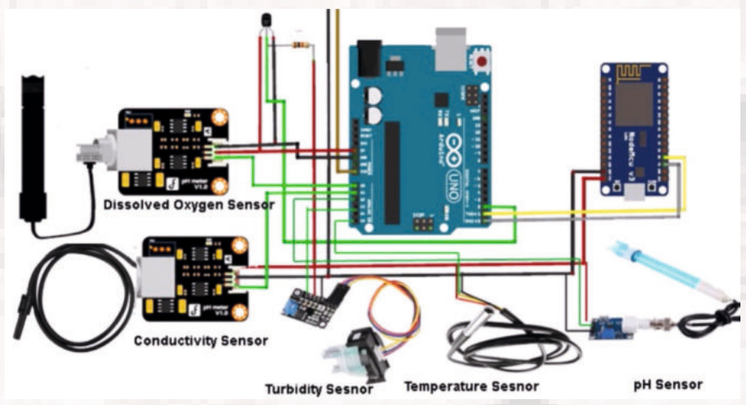


RESTORATION WORK



- Initiated water walks with historians & hydrogeologists to study traditional stepwell design, groundwater recharge methods to identify viable stepwells
- Mapped 50+ stepwells digitally using GIS technology to locate viable stepwells based on aquifer depth, rainfall catchment, and recharge potential.
- Partnered with Gram Bharti Samiti and Nath Sanskriti Seva Sansthan for structural rehabilitation: Masonry repair, desilting, and sediment filtration retrofits using eco-materials and vernacular design.
- Drainage Linkages: Surface runoff redirection through bioengineered percolation belts to optimize infiltration.
- Trained local youth as Stepwell Guardians to ensure post-restoration maintenance and water quality tracking.

SYSTEM DESIGN & FEATURES



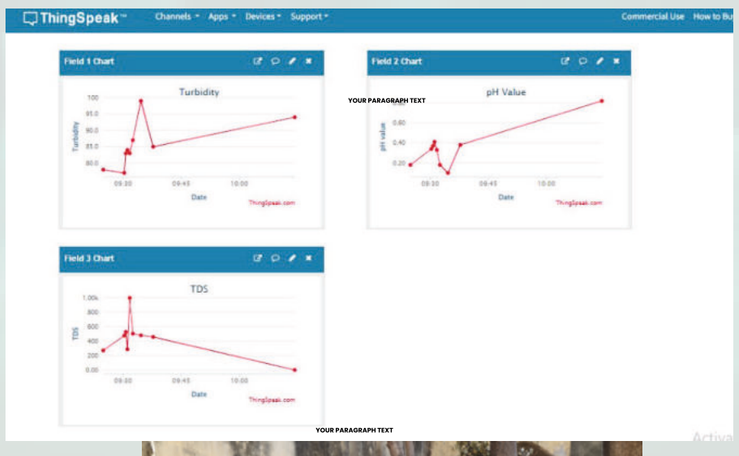
Tech Integration: Real-Time IoT Diagnostics
Arduino-based IoT system installed in stepwells

- Multi-parameter sensors monitor
- TDS (Total Dissolved Solids)
- pH
- Turbidity
- Conductivity
- Automated Alerts: Dashboard values help to known when parameters breach thresholds

DATA-DRIVEN GOVERNANCE & IMPACT REPORTING

Digital Water Logbook: Every step well tracks and stores water data (levels, quality, recharge ates) over time, creating a timeline that helps compare performance across locations.

Live Dashboard Access: NGOs, government agencies, and CSR partners can view this real-time data through an online dashboard — helping them visualize impact clearly



FUTURE SCOPE

Sensor & System Upgrade: Develop solar-powered, modular IoT kits with LoRa transmission and extended sensing for nitrates, fluoride, and microbial pollutants.

Smart Filtration Enhancement:: Incorporate an intelligent nanomaterial-based filtration device (e.g., Smart Rust technology) for automatic detection and removal of impurities, ensuring recharge water is potable-quality.
Moore Identification Model: Use AI and satellite data to pinpoint clusters of viable stepwells with optimal runoff catchment and recharge capacity

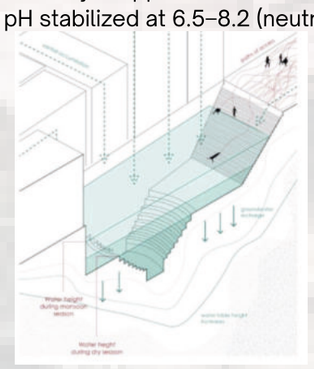
Community Dashboard App: Launch a bilingual app for real-time monitoring, alerts, and data access by local water stewards and students.

IMPACT ASSESSMENT

- Restored Stepwells (2022–2025)
- Bhanpur Kala Ki Bāwari (2022–2023)
- Sarjoli Chul Ki Bāwari (2023–2024)

Hydrological Achievements

- 21,000 liters/day recharge through natural seepage
- Groundwater table rise of 15–18 feet post-monsoon
- Water quality improvements:
- TDS reduced from ~850 ppm ➔ ~510 ppm
- Turbidity dropped from 10 NTU ➔ 4 NTU
- pH stabilized at 6.5–8.2 (neutral)



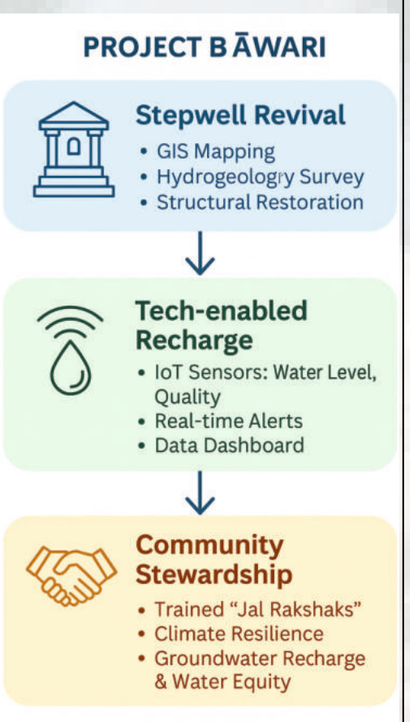
Climate Resilience Outcomes

- Built climate buffer by decentralizing storage and enabling aquifer recharge even during dry spells
- Trained 25 local youth as Jal Rakshaks to handle digital sensors, monitor water quality, and report anomalies

Social Impact

- Revived stepwells as community hubs through local water festivals and cultural gatherings
- Strengthened community ownership of water assets and traditions
- Trained 25 youth and women as Jal Rakshaks, embedding climate stewardship in local governance
- Educated 200+ students in climate resilience through workshops linked to stepwell conservation

COMMUNITY COLLABORATORS & RESTORATION PARTNER



Advancing the United Nations Sustainable Development Goals (SDGs)

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