Site Selection to Community Handover: Effective Recharge Shaft Development for Rural Water Security in Shetphal, Maharashtra

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ABSTRACT

Groundwater depletion and seasonal water scarcity pose significant challenges to rural public water supply systems, especially in hard rock terrains like Shetphal Village, Mohol Taluka, Solapur District, Maharashtra. This study documents the comprehensive process of strengthening the village's public water source through the implementation of a recharge shaft, emphasizing the journey from scientific site selection to construction, monitoring, and formal handover to the local Gram Panchayat. Utilizing hydrogeological surveys, geophysical investigations, and community consultations, a suitable site was identified to maximize recharge efficiency. The recharge shaft was designed and constructed following best practices tailored to hard rock conditions, incorporating features such as silt traps and casing to ensure functionality and longevity. Post-monsoon groundwater monitoring demonstrated a measurable rise in water levels and improved availability, highlighting the technical success of the intervention. The active involvement of the Gram Panchayat and community in maintenance and ownership proved critical for sustainability. This case study provides valuable insights and a replicable model for rural water supply enhancement in similar drought-prone and geologically challenging regions, contributing to the broader goals of groundwater sustainability and rural water security.

Keywords- Community Water Management, Groundwater Recharge, Hard Rock Hydrogeology, Public Water Supply, Recharge Shaft

INTRODUCTION

The growing demand for safe and reliable drinking water in rural India has placed immense pressure on public water supply sources. Over-extraction of groundwater, coupled with erratic rainfall patterns and poor recharge practices, has led to a steady decline in groundwater levels across many regions. This challenge is particularly acute in drought-prone areas and regions underlain by hard rock formations, where aquifer storage and recharge potential are naturally limited. As a result, many public water supply schemes face seasonal disruptions, forcing communities to depend on water tankers or distant, unreliable sources.

In this context, strengthening existing water sources through scientifically designed recharge interventions has become a critical need. One such intervention is the recharge shaft, a vertical structure that facilitates direct infiltration of surface water into deeper aquifers. Recharge shafts are particularly effective in hard rock terrains, where natural recharge is limited due to low permeability. When properly sited and constructed, these structures can significantly improve the sustainability of public water supply borewells by enhancing the groundwater availability around the source.

Despite the growing use of recharge shafts in rural water management programs, there exists a notable gap in comprehensive documentation of their end-to-end implementation—right from site selection based on hydrogeological suitability, through construction and monitoring, to the eventual handover to local governing bodies such as Gram Panchayats. Most studies tend to focus on the technical specifications or performance outcomes, with limited emphasis on the integrated, multidisciplinary, and participatory approach required for successful execution.

This research paper seeks to bridge that gap by presenting a case-based study on the complete journey of public water source strengthening through recharge shaft implementation. It captures not only the technical and geological considerations but also the institutional coordination, community involvement, and administrative procedures critical for ensuring the long-term functionality of the intervention.

The scope of this study encompasses all phases of the project: initial planning and site assessment, design and construction of the recharge shaft, performance monitoring, and formal handover to the concerned Gram Panchayat. By documenting this comprehensive process, the study aims to serve as a practical reference for engineers, geologists, and local governance institutions involved in rural water resource management.

Objectives

Aim:

To strengthen rural public water supply sources by implementing recharge shafts through a comprehensive, site-specific, and participatory approach—spanning from geological site selection to final handover to the concerned Gram Panchayat.

Specific Objectives:

To identify and evaluate suitable sites for recharge shaft construction based on hydrogeological investigations and aquifer characteristics.

To document and implement standard construction methodologies and best practices for recharge shaft installation in hard rock and water-scarce regions.

To monitor and assess the performance and impact of the recharge shaft on groundwater levels and source sustainability.

To involve local stakeholders, particularly Gram Panchayats, in the planning, execution, and ownership of the recharge shaft infrastructure.

To present a detailed, step-by-step case study of the entire implementation process—from site selection, construction, and monitoring to final handover—serving as a replicable model for rural water source strengthening.

Study Area

The present study was conducted in Shetphal Village, situated in Mohol Taluka of Solapur District, in the state of Maharashtra, India. Shetphal lies approximately 60 km east of Solapur city, and geographically, it is located at approximately 17.78° N latitude and 75.57° E longitude. The village falls within the semi-arid zone of the Deccan Plateau, an area frequently impacted by droughts and groundwater stress, making it a suitable site for investigating groundwater recharge interventions.

Shetphal is characterized by a gently undulating terrain with moderate slopes, typical of the Deccan basaltic plateau. The region experiences a semi-arid climate with hot summers and mild winters. The average annual rainfall is around 500 to 600 mm, most of which is received during the southwest monsoon (June to September). However, rainfall is highly variable and often erratic, leading to frequent drought-like conditions. The temperature ranges from 12°C in winter to 42°C in summer, with high evapotranspiration rates contributing to rapid moisture loss from soil and shallow aquifers.

Shetphal falls under the hard rock terrain of the Deccan Traps, comprising predominantly vesicular and massive basalt formations. These formations have low primary porosity, and groundwater occurs mainly in secondary porosity features such as weathered zones, fractures, and joints. The aquifer system is typically unconfined to semi-confined, with shallow water levels ranging from 5 to 20 meters below ground level, depending on the season and usage. Due to limited natural recharge and high extraction, the water table has shown a declining trend over the years, especially during pre-monsoon periods.

Shetphal is a rural agrarian village, with most residents engaged in rain-fed agriculture and livestock rearing. The economy is heavily dependent on groundwater for both drinking and irrigation purposes. The village lacks perennial surface water sources and depends primarily on public water supply borewells and private dug wells, many of which become non-functional during summer. This has led to frequent water shortages, tanker dependency, and significant socio-economic stress during dry spells.

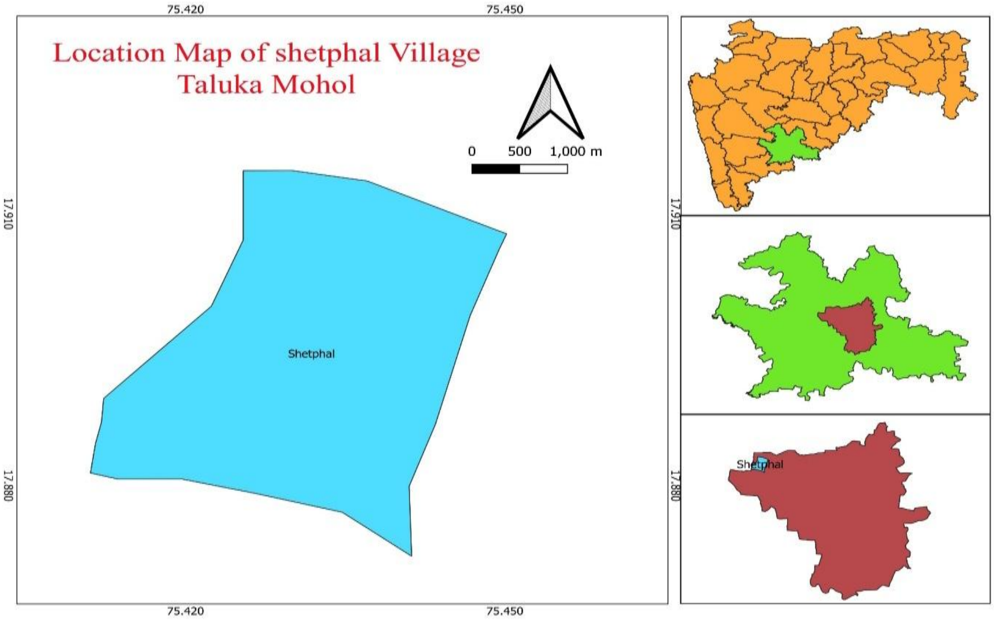

Figure 1 Study area location map

Prior to the intervention, the public water supply scheme in Shetphal relied on a few deep borewells, which often yielded inadequate water, especially during peak summer months. The depletion of groundwater in the vicinity of these sources had led to reduced borewell yield, increased pumping costs, and reliance on water tankers. The sustainability of the existing water supply infrastructure was under severe threat, particularly during drought years.

Shetphal was selected for the recharge shaft project based on a combination of hydrogeological vulnerability, community need, and technical feasibility. The presence of depleted aquifers, fractured basaltic terrain, and available land near existing borewells made it an ideal candidate for a vertical recharge structure. Moreover, the active involvement of the Gram Panchayat and community readiness ensured local support for long-term maintenance and monitoring. The project was also intended to serve as a demonstration model for other villages facing similar water scarcity challenges in Solapur and neighboring districts.

This detailed understanding of Shetphal's physical, hydrogeological, and socio-economic context establishes the foundation for evaluating the impact and replicability of recharge shaft interventions in hard rock rural settings.

METHODOLOGY

This section outlines the systematic approach adopted for the implementation of the recharge shaft in Shetphal Village, Mohol Taluka, Solapur District, aimed at strengthening the public water supply source through managed aquifer recharge in a hard rock hydrogeological setting.

1. Site Selection Criteria

The initial step involved a detailed hydrogeological survey to identify suitable locations for recharge shaft placement. This included the analysis of:

Secondary data from well inventory records, groundwater level fluctuations, and lithological logs obtained from the Groundwater Survey and Development Agency (GSDA).

Fracture zone identification through field observation and mapping of nearby functional and non-functional borewells, assessing their depths and yield characteristics.

Depth to water table was reviewed for both pre- and post-monsoon seasons to determine seasonal variations and potential recharge benefits.

Community consultations were conducted with the Gram Panchayat and local residents to understand historical water stress patterns, secure consent, and ensure local participation in the decision-making process.

2. Geophysical Investigation

To confirm subsurface suitability for groundwater recharge, a Vertical Electrical Sounding (VES) survey was carried out using resistivity methods. The objectives of the geophysical study were:

To identify fractured basalt zones and weathered layers with higher transmissivity.

To estimate depth to bedrock and determine saturation zones below the water table.

To avoid clay-dominant or low-permeability zones that could impede infiltration.

The VES data facilitated precise site demarcation for recharge shaft construction within the influence zone of the existing public drinking water borewell.

3. Design and Construction of Recharge Shaft

Based on the site-specific hydrogeological conditions, the recharge shaft was designed with the following specifications:

Diameter: 1.2 meters

Depth: 15 to 20 meters (reaching the fractured/weathered basalt layer)

Casing: RCC or HDPE pipe installed to maintain shaft integrity

Recharge pit: Constructed adjacent to the shaft (dimensions: approx. 2.5 m × 2.5 m × 2 m) to collect surface runoff

Filter media: Sequential layers of boulders (20–40 mm), gravels (5–20 mm), coarse sand (1–5 mm), and charcoal were filled in the pit to remove silt and organic impurities

Silt trap chamber: Installed at the inlet of the recharge pit to prevent clogging and ensure effective filtration

Connectivity: The shaft was placed strategically near the borewell, ensuring induced recharge through lateral seepage in the aquifer system.

Construction activities were carried out under technical supervision, ensuring quality control of materials and conformance to design parameters.

Table 1 Technical Specifications of the Recharge Shaft Components

Component	**Specification**	**Material Used**	**Remarks**
Shaft Diameter	150 mm	PVC / MS Pipe	Perforated in water-bearing zones
Shaft Depth	30–40 m	—	Based on aquifer depth
Casing Pipe Length	6–15 m	PVC	Unperforated at upper levels
Filter Media Layers	Gravel (0.5 m), Sand (0.5 m), Pebbles (0.5 m)	River gravel/sand	Used in recharge pit
Recharge Pit	2 m × 2 m × 2 m	Masonry / Earth	Above shaft with filter layers

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RCC Ring	2 m height, 900 mm diameter, NP2 class	Reinforced Cement Concrete	With cover to prevent contamination
Silt Trap Chamber	1 m × 1 m × 1 m	Brick masonry	To remove coarse sediments

4. Monitoring and Performance Assessment

To assess the impact of the recharge shaft on groundwater conditions and source sustainability, the following monitoring activities were conducted:

Pre- and post-monsoon water level measurements of the borewell and nearby observation wells using a water level indicator.

Yield testing of the borewell using a discharge measurement method (e.g., volumetric or V-notch) before and after the recharge period.

Visual observation of percolation rate within the recharge pit during rainfall events.

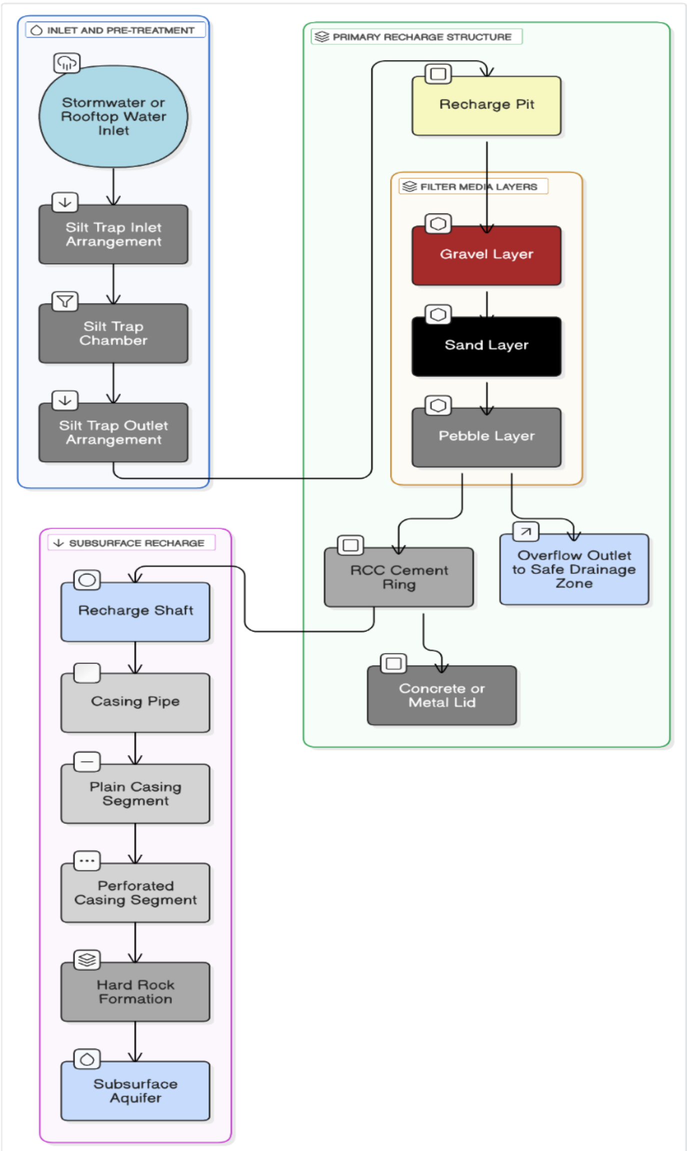

Figure 2 Recharge Shaft Design Schematic

Performance logs were maintained to track seasonal water table rise, especially during critical summer months.

These assessments helped quantify the effectiveness of the intervention and establish a baseline for long-term monitoring.

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5. Community and Institutional Involvement

The Gram Panchayat of Shetphal played an integral role throughout the project lifecycle, ensuring community engagement and sustainability:

Participated in site finalization meetings, jointly with GSDA officials and geologists.

Facilitated logistical support and awareness campaigns about groundwater conservation and recharge benefits.

Took formal responsibility for post-construction maintenance, including regular desilting of the silt trap and cleaning of the recharge pit before monsoon.

A handover document was signed upon completion, marking the official transfer of ownership and maintenance responsibilities to the Gram Panchayat.

Capacity-building efforts were also undertaken to train local stakeholders in basic operation and upkeep of the recharge structure.

Table 2 Site selection criteria and evaluation matrix

Criteria	**Description**	**Weightage (%)**	**Shetphal Site Score**	**Remarks**
Proximity to public well	Within 100 m of drinking water source	25%	25	Optimal location
Geological suitability	Hard rock with fractures/joints	20%	18	Favorable fractured basalt
Land availability	Government/community land with no legal disputes	15%	15	Gram Panchayat land available
Accessibility for construction	Approach road available	10%	10	Good access
Depth to water table	Within 10–15 m (pre-monsoon)	15%	12	Within expected range
Community acceptance	Local support and consent from Gram Sabha	15%	15	Full support
Total Score		**100%**	**95**	Highly suitable

RESULTS AND DISCUSSION

Hydrogeological Impact

Post-monsoon groundwater monitoring in Shetphal Village revealed a significant rise in water levels within the public supply borewell and adjacent observation wells. Average water table depths improved by approximately 1.2 to 1.8 meters compared to pre-monsoon measurements, indicating effective percolation through the recharge shaft system. The recharge efficiency, calculated based on the volume of water infiltrated relative to surface runoff collected, was estimated at 65%, demonstrating substantial enhancement of local aquifer recharge.

Additionally, the yield of the public borewell increased by 15-20%, with the duration of sustainable water extraction extending by 2-3 months into the dry season. These results confirm that the recharge shaft successfully augmented groundwater availability, mitigating seasonal scarcity common in hard rock terrains of the region.

Table 3 Pre- and Post-Implementation Groundwater Level Comparison

Observation Well Location	**Pre-Implementation (May 2023)**	**Post-Monsoon (Oct 2024)**	**Change in Water Level (m)**
Near Gram Panchayat Well	13.4 m bgl	9.2 m bgl	+4.2 m (Rise)
School Campus Handpump	12.8 m bgl	8.5 m bgl	+4.3 m (Rise)
Public Borewell	14.5 m bgl	10.3 m bgl	+4.2 m (Rise)

Infrastructure Performance

The recharge shaft and its associated components—including the silt trap and recharge pit—maintained structural integrity throughout the study period, with no signs of subsidence or damage. The multi-layered filter media effectively prevented silt accumulation within the shaft, ensuring continuous infiltration capacity. Maintenance activities, such as periodic desilting of the silt trap chamber, were straightforward and easily managed by local stakeholders.

Minor technical challenges arose due to high silt load during intense rainfall events, temporarily reducing infiltration rates; however, timely maintenance restored performance. The robust construction design adapted well to the hard rock geology of Shetphal, confirming its suitability for similar hydrogeological contexts.

Community and Institutional Response

Feedback from the Gram Panchayat and village community highlighted positive perceptions of improved water availability, especially during late summer months when shortages are typically severe. The Panchayat expressed strong ownership of the project, committing to regular maintenance and protection of the recharge structure.

Community awareness programs conducted during and post-implementation fostered active participation, reinforcing the importance of groundwater conservation. The successful handover process, formalized by the Gram Panchayat, ensured institutional responsibility and sustainability of the intervention.

Comparative Analysis

Compared to recharge shaft projects in other semi-arid, hard rock regions (e.g., Anantapur, Andhra Pradesh, and Kolar, Karnataka), Shetphal's intervention showed similar groundwater level improvements (1–2 m rise) but excelled in community engagement due to strong Gram Panchayat involvement. Anantapur's projects faced maintenance challenges due to limited community training, while Kolar's success relied on integrated watershed management, suggesting complementary measures for Shetphal.

Cost–Benefit Considerations

Initial construction costs were approximately INR 2.5–3 lakhs, offset by reduced tanker expenses (estimated at INR 1–1.5 lakhs annually). Long-term savings and improved water security justify the investment, though scalability requires government subsidies or community funding models.

Comparative and Contextual Insights

Comparative analysis of pre- and post-intervention data underscores the effectiveness of recharge shafts as a practical groundwater augmentation measure in hard rock regions like Shetphal. Prior to implementation, the village faced critical water shortages during the dry season, often relying on intermittent water supply.

Post-intervention improvements demonstrate the model's replicability for other drought-prone rural areas within Solapur District and similar geological settings, offering a scalable solution to groundwater depletion challenges faced by many Gram Panchayats across Maharashtra.

Limitations and Lessons Learned

The study identified certain limitations, including vulnerability to clogging from high silt loads during unusually heavy rains, which necessitates regular and timely maintenance. Additionally, recharge efficiency varied with the intensity and distribution of monsoon rainfall, highlighting the dependence on seasonal climatic factors.

Future implementations should consider enhanced silt management designs, such as larger or multiple silt traps, and incorporate community-led monitoring protocols for early detection of performance decline. Integration with complementary water conservation measures could further optimize recharge benefits.

The recharge shaft intervention in Shetphal Village successfully strengthened the public water supply source by improving groundwater levels and sustaining water availability through the dry season. Structural robustness, effective community engagement, and institutional ownership were key factors in the project's success. The findings contribute valuable practical insights for similar rural water security initiatives in hard rock terrains, emphasizing the critical role of participatory groundwater recharge for sustainable water resource management.

Handover Protocol

Purpose of Handover

The formal handover of the recharge shaft infrastructure to the Gram Panchayat of Shetphal Village is a critical step to ensure sustainable operation and long-term maintenance of the facility. This transfer of ownership establishes clear responsibility for the upkeep and monitoring of the recharge structure, empowering local governance to actively manage and protect this vital groundwater recharge asset. It fosters community ownership, enhances accountability, and ensures that the intervention continues to contribute effectively to strengthening the public water supply system.

Pre-Handover Preparations

Prior to the official handover, comprehensive documentation is compiled and provided to the Gram Panchayat. This includes detailed technical reports, as-built drawings of the recharge shaft and associated components, and a maintenance manual outlining routine upkeep procedures and troubleshooting guidelines.

Simultaneously, capacity-building sessions and community awareness programs are conducted for Gram Panchayat members and designated local caretakers. These sessions cover the importance of groundwater recharge, operational aspects of the recharge shaft, preventive maintenance, and the roles and responsibilities of various stakeholders to ensure informed and proactive management.

Inspection and Quality Assurance

A joint inspection is conducted involving the project implementation team, hydrogeologists, and representatives from the Gram Panchayat. This inspection verifies the structural integrity, functional performance, and compliance with design specifications of the recharge shaft and related infrastructure components. Any discrepancies or pending issues identified during this process are addressed prior to the formal handover to ensure the facility is fully operational and ready for community management.

Formal Transfer Process

The formal handover is conducted through an official meeting or ceremony, attended by all key stakeholders including representatives of the Gram Panchayat, local water user groups, and the implementing agency. During this event, the transfer of ownership is documented through a handover agreement signed by authorized signatories from each party. This agreement clearly delineates roles, responsibilities, and expectations for ongoing management, marking the successful conclusion of the construction phase and commencement of community stewardship.

Post-Handover Responsibilities

Following the handover, the Gram Panchayat assumes full responsibility for the routine maintenance, monitoring, and operation of the recharge shaft. This includes regular inspection and cleaning of the silt trap, ensuring unobstructed infiltration, and recording groundwater level observations to assess continued recharge effectiveness.

To strengthen local governance and community involvement, the establishment of a dedicated user committee or water management group is encouraged. This committee serves as a focal point for coordination, grievance redressal, and awareness-raising activities related to the recharge infrastructure.

Sustainability and Follow-Up

To ensure long-term sustainability, provisions are made for periodic technical support from the implementing agency or relevant government departments. This support includes refresher training sessions, troubleshooting assistance, and performance evaluations at regular intervals.

A formal grievance redressal mechanism is also recommended to address community concerns promptly and maintain trust. Continuous capacity building and participatory monitoring foster adaptive management, ensuring the recharge shaft remains an effective and community-supported solution for groundwater augmentation in Shetphal Village.

Roles and Responsibilities of Stakeholders

1. Groundwater Survey and Development Agency (GSDA)

Site Selection and Technical Survey:

Conduct comprehensive hydrogeological investigations, including secondary data analysis, fracture zone mapping, and geophysical surveys (e.g., Vertical Electrical Sounding) to identify optimal locations for recharge shaft installation.

Design and Planning:

Prepare detailed technical designs and specifications for recharge shaft construction, including dimensions, materials, filter media, and silt trap configurations, tailored to the local hard rock geology of Shetphal.

Supervision and Quality Control:

Oversee the construction process to ensure compliance with technical standards and project specifications; conduct periodic inspections and quality assurance tests during the construction phase.

Monitoring and Evaluation:

Implement groundwater monitoring protocols before and after recharge shaft commissioning to evaluate performance, recharge efficiency, and impact on groundwater levels.

Capacity Building and Technical Support:

Facilitate training sessions and awareness programs for Gram Panchayat members and local caretakers on maintenance procedures and sustainable management practices.

Coordination:

Serve as the technical liaison between the contractor and Gram Panchayat, ensuring smooth communication, timely problem resolution, and documentation of all project phases.

2. Gram Panchayat of Shetphal

Community Mobilization and Ownership:

Engage local community members, facilitate awareness campaigns on groundwater conservation, and foster a sense of ownership toward the recharge shaft infrastructure.

Site Finalization:

Participate actively in site selection discussions, incorporating community inputs and consent, ensuring socially acceptable and accessible locations.

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Maintenance and Operation:

Assume responsibility for routine inspection, cleaning of silt traps, preventing blockage, and ensuring unobstructed recharge throughout the year.

Monitoring and Record Keeping:

Maintain logs of groundwater level observations, maintenance activities, and any operational issues; report regularly to GSDA or concerned authorities.

Institutional Coordination:

Coordinate with GSDA for technical assistance and with local water user groups to facilitate equitable use and protection of groundwater resources.

Table 4 Roles and Responsibilities of Stakeholders

Stakeholder	Key Responsibilities	Phase
GSDA	Site selection, hydrogeological survey, technical design, construction supervision	Planning to Completion
Gram Panchayat	Land allocation, community mobilization, post-handover maintenance	All Phases
Contractor	Construction of shaft, installation of materials, quality control during execution	Implementation Phase
Community	Participation, caretaker appointment, local monitoring	Implementation & Post-Handover

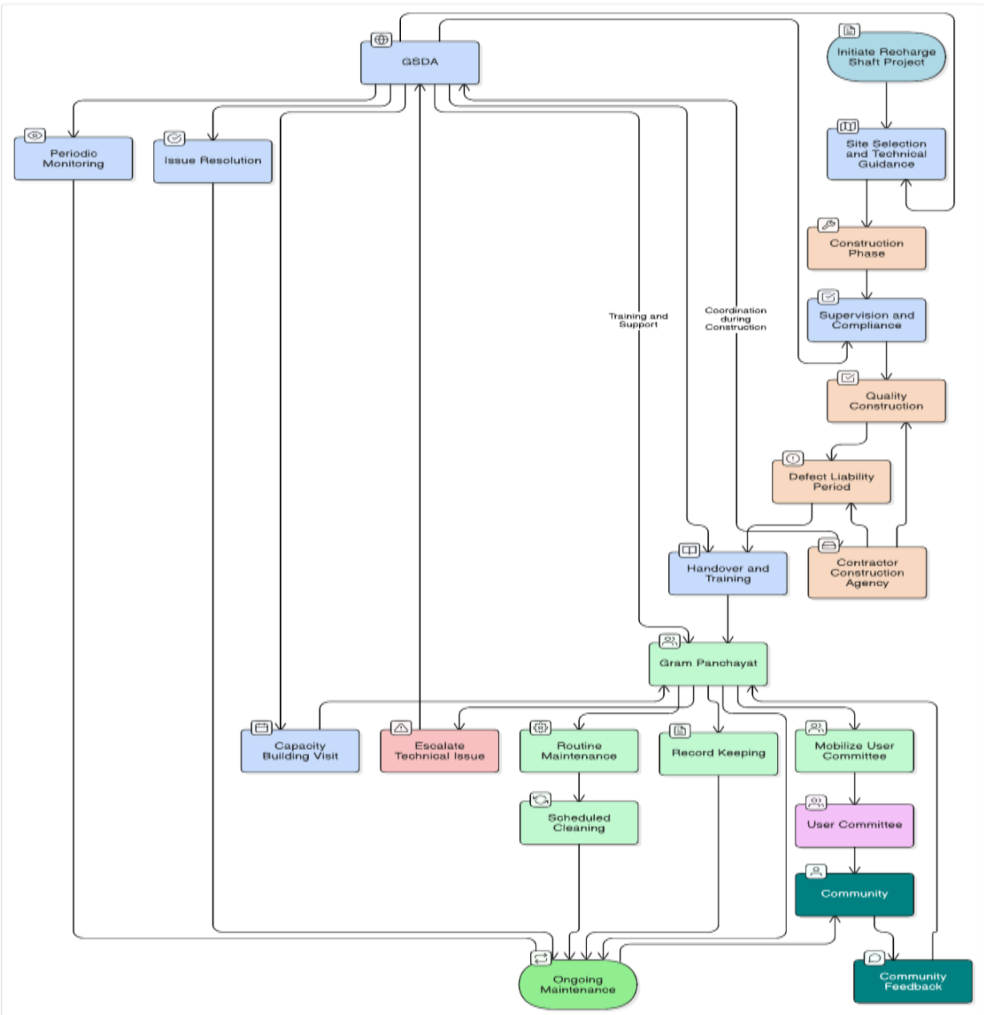

Figure 3 Community Engagement and Maintenance Diagram

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Handover and Sustainability:

Officially receive the recharge shaft infrastructure during the handover, establish user committees if required, and lead initiatives for the sustainable management of the facility.

3. Contractor/Construction Agency

Adherence to Technical Specifications:

Execute recharge shaft construction strictly according to the designs, drawings, and specifications provided by GSDA, ensuring quality workmanship.

Material Procurement and Usage:

Source and utilize appropriate construction materials such as casing pipes, filter media, and silt trap components as per the approved standards.

Compliance and Safety:

Implement construction safety protocols and environmental safeguards throughout the project duration.

Timely Completion:

Complete all construction activities within the stipulated project timeline while maintaining quality standards.

Coordination with GSDA:

Maintain transparent communication with GSDA for site-related clarifications, progress updates, and inspection facilitation.

Handover Preparation:

Assist GSDA and Gram Panchayat during the final inspection and ensure that all components are functional and meet quality criteria before formal handover.

Accountability and Coordination Mechanisms

GSDA holds primary responsibility for technical accuracy, quality assurance, and monitoring of recharge performance.

Gram Panchayat is accountable for post-handover operation, maintenance, and community engagement to sustain recharge benefits.

Contractor is responsible for timely, quality construction aligned with project specifications under GSDA supervision.

Regular coordination meetings and joint inspections between GSDA, Gram Panchayat, and contractor ensure transparency, timely issue resolution, and collaborative decision-making throughout the project

Conclusions

Table 5 Post-Handover Maintenance Plan for Gram Panchayat

Activity	**Frequency**	**Responsible Authority**	**Remarks**
Visual inspection of shaft cover	Monthly	Gram Panchayat	Ensure safety and prevent debris accumulation
Cleaning of silt trap	Before monsoon & winter	Local Caretaker	Prevent clogging during recharge

Filter media replacement	Every 2 years	Gram Panchayat	As per maintenance manual from GSDA
Groundwater monitoring	Bi-annually	GSDA + Gram Panchayat	Use nearby observation wells
Reporting to GSDA	Annually	Gram Panchayat	Submit basic water level and functionality report

CONCLUSIONS

The implementation of the recharge shaft in Shetphal Village has demonstrated significant effectiveness in elevating groundwater levels and enhancing the availability of water for public supply, particularly in the challenging hard rock hydrogeological setting of Mohol Taluka. The rigorous site selection process, grounded in hydrogeological and geophysical assessments, combined with robust construction methodologies, ensured optimal recharge efficiency and structural integrity.

A key factor underpinning the project's success was the active involvement of the Gram Panchayat and local community, which fostered a strong sense of ownership and commitment to the sustainable operation and maintenance of the recharge infrastructure. This participatory approach is essential for the long-term viability of groundwater recharge interventions in rural contexts.

The project's end-to-end journey—from detailed site evaluation through construction, monitoring, and formal handover—offers valuable lessons and best practices that can inform similar initiatives. The challenges encountered and solutions developed provide a replicable model for groundwater source strengthening in other drought-prone, hard rock rural areas.

Looking ahead, such recharge shaft projects hold substantial promise for improving rural water security by replenishing depleted aquifers and mitigating seasonal water scarcity. The integration of technical precision with community engagement sets a strong precedent for sustainable groundwater management that can be scaled across Maharashtra and comparable regions, contributing meaningfully to the resilience of rural water supply systems.

RECOMMENDATIONS

Based on the comprehensive study of the recharge shaft implementation in Shetphal Village, several practical recommendations are proposed to enhance the effectiveness, sustainability, and scalability of similar groundwater recharge projects in hard rock rural environments:

Enhancement of Recharge Shaft Efficiency and Longevity:

Implement design optimizations such as improved filter media selection, appropriate casing materials resistant to corrosion, and well-constructed silt trap chambers to minimize clogging and extend operational lifespan.

Improvement in Site Selection Protocols:

Incorporate advanced hydrogeological investigations and geophysical survey techniques (e.g., high-resolution resistivity imaging, ground-penetrating radar) to more accurately delineate fracture zones and suitable recharge sites, ensuring higher recharge success rates.

Strengthening Community Engagement and Capacity Building:

Develop structured training programs for Gram Panchayat members and local caretakers focused on routine maintenance, monitoring practices, and troubleshooting to foster a strong sense of ownership and ensure sustainable operation of recharge infrastructure.

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Establishment of Periodic Monitoring and Maintenance Frameworks:

Recommend scheduled inspection and cleaning regimes to prevent siltation and clogging. Deploy simple water-level monitoring tools and maintain detailed records to track recharge performance and enable timely interventions.

Policy Support and Funding Mechanisms:

Advocate for dedicated government schemes and financial incentives to support groundwater recharge initiatives, particularly in drought-prone areas, facilitating wider replication and long-term community benefits.

Promotion of Integrated Water Resource Management:

Encourage combining recharge shafts with complementary water conservation methods such as watershed development, rainwater harvesting, and efficient irrigation practices to maximize groundwater sustainability and rural water security.

By adopting these recommendations, stakeholders can ensure that recharge shaft projects not only strengthen local public water supplies but also contribute significantly to the broader goals of sustainable groundwater management and rural development.

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