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Identification of Groundwater Potential for Tankerfed Village Merdi Taluka –Murbad Using GIS

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ABSTRACT: Groundwater is the primary source of domestic and irrigation water in the tanker-dependent village of Merdi, located in Taluka Murbad, Maharashtra, and situated within the structurally complex basaltic terrain of the MalshejGhat–Bhimashankar ranges. The present study integrates Remote Sensing (RS), Geographic Information System (GIS), Multi-Criteria Decision Analysis (MCDA), and detailed hydrogeological field investigations to delineate groundwater potential zones and identify reliable abstraction sites for sustainable water supply under the Jal Jeevan Mission (JJM). The study area is underlain by Deccan Trap basalts of the Sahyadri Group, comprising pāhoehoe and megacrystic lava flows that host groundwater predominantly within weathered, fractured, and jointed horizons. Multiple thematic layers—including geology, geomorphology, lineaments, drainage density, slope, LULC, and rainfall—were generated and weighted using the Analytical Hierarchy Process (AHP). The weighted overlay analysis produced a comprehensive Groundwater Potential Map, highlighting high-potential zones in the western and northeastern parts of the village, strongly influenced by structural discontinuities such as NW–SE dykes and NNW–SSE/NE–SW lineaments. Field validation confirmed the presence of a major fault-controlled aquifer system, and exploratory well excavation at the selected site yielded substantial discharge (≈42,000 L/hr), with winter water availability estimated at 452,160 m^3/day and even reduced summer availability exceeding JJM demand by a significant margin. Results demonstrate that integrated RS–GIS–MCDA analysis, supported by hydrogeological evidence, provides a robust framework for groundwater resource assessment in basaltic terrains. The study concludes that Merdi village possesses adequate groundwater potential to transition from a tanker-fed to a tanker-free status, provided systematic monitoring and sustainable extraction strategies are adopted.

KEY WORDS: Multi-Criteria Decision Analysis (MCDA), Groundwater Recharge, Slope and Drainage Density, Jal Jeevan Mission (JJM), Village Merdi, Murbad Taluka, Basaltic Terrain / Deccan Trap Basalt

I. INTRODUCTION

Groundwater is a critical resource in semi-arid regions of India, particularly for tanker-fed villages like Merdi in Taluka Murbad, Maharashtra. The area is characterized by hilly terrain at the foothills of the Bhimasankar range, underlain by basaltic formations of the Sahyadri Group. Sustainable groundwater development is essential for meeting domestic water supply under the Jal Jeevan Mission (JJM). This study employs a GIS-based multi-criteria approach to delineate groundwater potential zones and prioritize sites for exploratory wells[1-3].

Study Area:

Village Merdi is located approximately 80 km north-northeast (NNE) of the Thane administrative headquarters and lies at the foothills of the Bhimasankar hill range. The study area is bounded by the MalshejGhat and Bhimasankar ranges and, Statigraphically, forms part of the Sahyadri Group. Physiographically the terrain is highly rugged and mountainous, controlled by the north–south trending Sahyadri mountain system, which displays a steep scarp on its western flank. The region is dominantly underlain by Deccan basalt sequences of latest Cretaceous–Paleocene affinity, predominantly expressed as pāhoehoe lava flows; extensive Megacryst-bearing flow units are also present. The village Merdi is of Three wadis Bandeshet,Alyachiwadi,Lodhyachiwadi.

Geomorphologically the area represents a moderately dissected plateau. Dykes with a predominant NW–SE orientation are exposed locally, and two principal lineaments (NNW–SSE and NE–SW) are mapped across the area. The presence and orientations of these structural elements indicate significant tectonic activity during the region's palaeotectonic evolution.

Table No:1 Statigraphic Succession of the area

Sr.No	Age	Statigraphic Unit		Lithology
		Group	Formation	
1	Quaternary	-	-	Alluvium
2	Upper Cretaceous ToPalaeocene	Sahyadri Group (Deccan Trap)	Upper Ratangarh Formation	6 Mainly compound Pohoehoe Flow
			Lower Ratangarh Formation	7 Mostly compound Pahoehoe Flows
			Salher Formation	Megacryst Flow

Hydrogeological conditions:
The Study area Village Merdi is entirely dependent on groundwater for both domestic supply and irrigation. The Parondi River flows in a NE–SW direction about 500 m from the gaothan (village core). Local first- and second-order nalas drain toward the east. The overall surface drainage pattern is Dendritic, indicating relatively homogeneous lithology and permeability contrasts controlled mainly by fractures and weathering[4-5].
Aquifer types and occurrence:
Groundwater occurs dominantly in weathered, fractured and jointed zones of the Deccan basalt (shallow aquifer system). These near-surface weathered and fractured horizons constitute the primary water-bearing units exploited by dug wells and shallow borewells [6].
Static water levels (seasonal):
Winter (post-monsoon): static water levels in dug wells are typically 4–5 m bgl (below ground level).
Summer (pre-monsoon): water levels decline to 6–10 m bgl, with some wells going dry at the upper end of this range.
Well depths and yields

- Dug wells: depths range 6–10 m. Typical reported yields are 30,000–45,000 L/day (equivalent to 30–45 m^3/day).
- Borewells: depths range 50–60 m. Reported yields are 450–950 L/day (equivalent to 0.45–0.95 m^3/day).

Water supply status
The village has relied on tanker-supplied water for the past decade, indicating that existing local groundwater resources and/or distribution infrastructure are insufficient to reliably meet demand throughout the year [8-10].

Table No:2 Showing Hydrological conditions of Shallow and Deeper Aquifer of the area

Parameter	Dug wells	Borewells
Depth range (m bgl)	6–10	50–60
Static water level (winter, m bgl)	4–5	—
Static water level (summer, m bgl)	6–10 (may dry)	—
Typical yield	30–45 m^3/day	0.45–0.95 m^3/day
Primary use	Drinking & irrigation	Drinking & backup irrigation

Table No:2 Showing Hydrological conditions of Shallow and Deeper Aquifer of the area

II. RELATED WORK

Several studies have demonstrated the effectiveness of integrating Remote Sensing (RS), Geographic Information Systems (GIS), and Multi-Criteria Decision Analysis (MCDA) for groundwater exploration in hard-rock terrains. Early work in basaltic provinces emphasized that structural features—particularly lineaments, faults, and dykes—play a dominant role in groundwater occurrence due to the limited primary porosity of basalt.
Studies by Krishnamurthy et al. and others highlighted the usefulness of satellite-derived lineament mapping and geomorphological interpretation for delineating fracture-controlled aquifers. Research in the Deccan Trap region, including the findings of [11-12], confirmed that lineament density, orientation, and intersection zones correlate strongly with high-yielding wells. Likewise, DEM-based analyses of slope and drainage density [13-14] have proven essential for identifying recharge-prone areas, particularly in rugged basaltic landscapes where infiltration is strongly influenced

by terrain characteristics. The use of AHP within MCDA has been widely adopted for weighting thematic layers such as lithology, LULC, geomorphology, rainfall, slope, and drainage patterns. Numerous case studies from semi-arid regions of western and central India demonstrate that AHP-based weighted overlays produce reliable groundwater potential maps, especially when validated through well inventory and field hydrogeological data. Overall, existing literature supports the integrated RS–GIS–MCDA approach used in the present study. Previous findings align with the results for Village Merdi, where groundwater availability is primarily dependent on structural discontinuities, weathered basalt horizons, and terrain-controlled recharge processes.

III. METHODOLOGY

The present study employed an integrated approach combining Remote Sensing (RS), Geographical Information System (GIS), Multi-Criteria Decision Analysis (MCDA), and hydrogeological field investigation to assess the groundwater potential zones in Village Merdi, a tanker-fed region located within the MalshejGhat–Bhimasankar hill ranges.
Advanced geospatial techniques were utilized to prepare and analyze several thematic layers, including geology, geomorphology, rainfall, lineaments, land use/land cover (LULC), drainage density, slope, and hydrogeological parameters. These layers were subsequently integrated using MCDA to derive a comprehensive Groundwater Potential Map (GWPM).
Remote sensing and GIS are widely accepted as efficient and cost-effective tools for identifying groundwater-bearing zones, particularly in rugged and inaccessible terrains where conventional hydrogeological methods are difficult to apply. In the present study, satellite imagery and digital elevation models (DEMs) were interpreted to extract drainage networks, lineaments, geomorphic units, and LULC classes. Hydrogeological surveys were conducted to collect dug-well, borewell, and PWS yield data, which were used to validate the spatial analysis.
Multi-Criteria Decision Analysis (MCDA) was adopted to integrate the various thematic layers. MCDA simplifies complex decision-making processes by dividing them into components, assigningweights to each thematic layer based on their relative influence on groundwater occurrence, and combining them using weighted overlay techniques. This integrated RS–GIS–MCDA methodology is particularly effective in high-relief terrains such as Merdi, where groundwater occurrence is controlled by fractures, lineaments, weathering patterns, and variable rainfall distribution.
The combined interpretation of lineament maps, groundwater priority maps, and fracture traces enabled the identification of structurally significant groundwater-bearing zones. A major fault trending NNW–SSE was delineated, indicating structural controls on subsurface groundwater movement and storage.
This integrated methodology provides a more reliable and spatially consistent evaluation of groundwater prospects than the use of any single technique, making it highly suitable for regions like MalshejGhat where geological complexity and rugged topography significantly influence groundwater availability.

Table No.3 Showing Details of Database used

Sr. No.	Data Used	Parameters Extracted	Source	Application
1	Survey of India Toposheet (SOI) 47 E/8	Contours, drainage network	Survey of India	Boundary preparation, drainage extraction
2	High-resolution optical satellite imagery	Land Use / Land Cover (LULC)	Bhuvan	Land use mapping
3	Lineament data	Lineament buffer, fracture trends	GWPM prepared by GSDA	Lineament mapping and buffering
4	Rainfall data (Maharain)	Annual and seasonal rainfall	Meteorological records	Rainfall layer preparation
5	Topography / Elevation data	Drainage density, slope	GWPM prepared by GSDA	Drainage density & slope analysis
6	Geomorphology and Geology maps	Geomorphological units, geological formations	GWPM prepared by GSDA	Geology & geomorphology layers
7	Hydrogeological data	Yield data of borewells and PWS wells	Aquifer testing by hydrogeologist	Yield analysis and field validation

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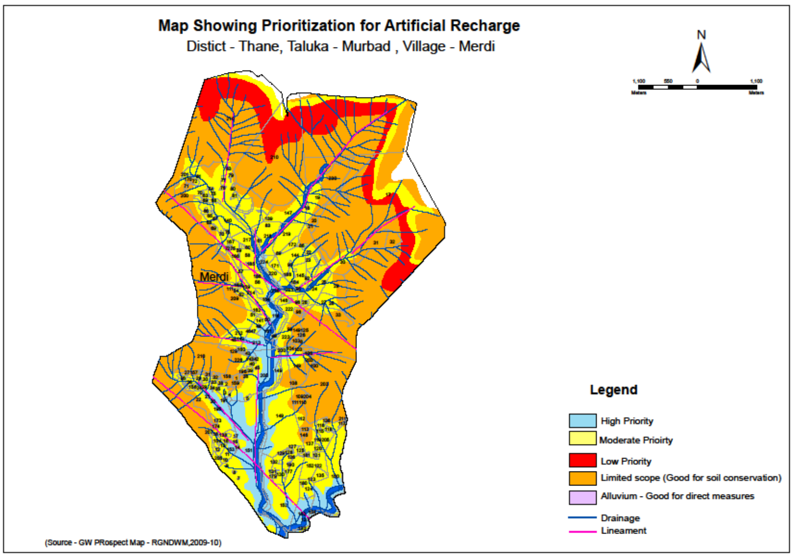

Map No:1 Groundwater Prospecting Map

Lineaments are one of the most critical structural elements influencing groundwater occurrence, particularly in hard-rock terrains such as those dominated by megacryst- and compound pāhoehoe-type basaltic flows. In such geological settings, primary porosity—the pore space originally present in the rock—is extremely low due to the dense, fine-grained nature of basalt. As a result, secondary porosity, created through tectonic processes such as faulting, jointing, and fracturing, becomes the dominant control on groundwater storage and movement. Lineaments, being surface expressions of these subsurface structural discontinuities, serve as vital indicators of groundwater-bearing zones.

These linear geomorphic or structural features are readily identifiable on satellite imagery because of their distinctive linearity, continuity, and contrast with surrounding terrain. Their appearance is often highlighted by variations in tone (colour differences), texture, shadow, relief, vegetation patterns, and even soil-moisture responses. Drainage anomalies—such as abrupt changes in stream direction, deflected channels, or elongated valleys—also help in mapping lineaments and understanding their structural origin. In basaltic terrains like Merdi, where geological units such as pāhoehoe flows are laterally extensive but vertically discontinuous, lineaments help reveal buried fracture systems that are otherwise difficult to detect in the field.

Tectonic features such as faults, fracture zones, joints, dyke contacts, and bedding-plane separations frequently correlate with these lineaments. Integrating lineament mapping with geological and Geomorphologically information significantly improves the accuracy of groundwater exploration. Several studies, including Pandian et al. (2013), demonstrate the effectiveness of this approach in identifying structurally controlled aquifers in hard-rock regions. Lineament intersections are especially important, as zones where two or more lineaments cross often display enhanced secondary porosity, increased weathering, and improved permeability—conditions highly favorable for groundwater accumulation.

To quantify the influence of lineaments on groundwater occurrence, four multi-buffer zones were generated at distances of 50 m, 100 m, 150 m, and 200 m from each mapped lineament. These buffer zones represent decreasing degrees of structural influence with distance. Areas within 50–100 m buffers are typically the most promising, as they lie closest to fracture traces where permeability enhancement is greatest. Beyond 150–200 m, the influence gradually diminishes, though localized groundwater pockets may still occur if minor fractures or weathered zones intersect the larger structural features.

In the study area, several lineaments form crisscross or intersecting patterns, indicating complex structural deformation associated with regional tectonic forces. These intersections act as high-potential groundwater zones, particularly where they coincide with weathered basalt horizons or concealed fracture networks. The presence of a major NNW–SSE-trending fault further enhances the Hydrogeological significance of these structural features, as faults often provide deep conduits for groundwater movement.

Overall, the distribution, orientation, intersection, and density of lineaments play a decisive role in evaluating groundwater prospects in the basaltic terrain of Village Merdi. When integrated with other thematic layers such as geomorphology, drainage density, slope, and lithology, lineament analysis becomes a powerful tool for delineating groundwater potential zones with a high degree of spatial reliability.

Slope is one of the fundamental terrain parameters influencing the spatial distribution, movement, and storage of groundwater. It plays a direct role in controlling infiltration, runoff intensity, soil moisture retention, and the overall

hydrodynamic behavior of a watershed. In hard-rock terrains such as the basaltic region of Village Merdi, where groundwater occurrence is predominantly governed by secondary porosity, slope becomes an especially critical factor because it dictates whether precipitation will percolate into the subsurface or move rapidly as surface flow.
Areas characterized by low or nearly level slopes provide ideal conditions for infiltration. In such zones, the velocity of surface runoff is greatly reduced, allowing rainwater to remain in contact with the ground surface for longer periods. This increases the chances of percolation into weathered and fractured basalt layers, thereby enhancing groundwater recharge. Conversely, regions with moderate to gently sloping terrain facilitate moderate runoff, reducing the time available for infiltration. In steeper slopes, gravitational force accelerates runoff, limits soil–water interaction, and minimizes groundwater recharge, leading to poorer groundwater prospects.
To evaluate the slope characteristics of the study area, a detailed slope map was generated using Shuttle Radar Topography Mission (SRTM) elevation data. The processing was carried out in ArcGIS, which allowed for precise extraction of surface gradients across the terrain. Similar methodologies have been widely adopted in groundwater studies (Szabó et al., 2015; Rawat et al., 2018), demonstrating the reliability of SRTM-derived topographic products for Hydrogeological assessments. The slope raster was computed based on the rate of maximum change in elevation between each cell and its surrounding neighbors, expressed as a percentage.
The resulting slope map categorizes the study area into three distinct terrain classes:

- Nearly level to very low slope (0–1%)
  These are the most favourable regions for groundwater recharge. The minimal gradient supports high infiltration rates, encourages soil moisture accumulation, and allows surface water to pond temporarily, enabling deeper percolation into fractured basalt. Such zones often correspond to valley floors, weathered pediment surfaces, and gently undulating plains.
- Very gently sloping (1–3%)
  These areas show transitional characteristics where infiltration is moderate but still reasonably favorable for groundwater movement. They often serve as recharge-supporting zones that distribute runoff from uplands toward low-lying areas. Due to their moderate ability to retain water, they play an important role in sustaining shallow aquifers.
- Gently Sloping (3-5%)
  These regions exhibit relatively higher runoff and reduced infiltration capacity. They are typically associated with elevated basaltic surfaces, dissected plateaus, and upland ridges. Although these areas are less suitable for direct groundwater recharge, they contribute significantly to surface drainage, feeding lower-slope zones where infiltration may increase. The delineation of these slope categories is important in the broader context of groundwater potential mapping. When integrated with other thematic layers—such as geology, geomorphology, lineaments, drainage density, and LULC—the slope map helps identify the precise locations where Hydrogeological conditions are most favorable. In the rugged basaltic terrain of Village Merdi, the interplay between slope and structural features further influences the distribution of secondary porosity, making slope analysis indispensable for accurate groundwater assessment.

Rainfall is the most fundamental and influential hydro meteorological parameter controlling groundwater recharge. In hard-rock terrains such as the basaltic landscape of Village Merdi, where groundwater storage is almost entirely dependent on secondary porosity features like fractures, joints, and weathered zones, rainfall acts as the primary driver that replenishes these aquifers. Because surface water bodies are limited and infiltration opportunities are constrained by terrain and Lithology, the spatial and temporal distribution of rainfall becomes a key determinant of the groundwater potential of the region.
The study area receives the bulk of its annual precipitation from the southwest monsoon, which typically becomes active in early June and continues until September. This seasonal concentration of rainfall leads to intense, short-duration storm events capable of generating both high runoff and significant infiltration, depending on slope, soil texture, vegetation cover, and structural controls such as lineaments. The rainfall pattern is highly variable from year to year, making continuous monitoring essential for understanding long-term groundwater behavior.
Rainfall: Rainfall data for the year 2024, collected from a dedicated rain gauge station in the region, show that the monsoon was above normal, with markedly higher rainfall intensities compared to the previous five-year average. Such anomalies can have substantial implications: on one hand, they enhance the recharge potential if the terrain conditions allow infiltration; on the other, extreme rainfall may produce rapid runoff on steep slopes, reducing the time available for percolation. Detailed examination of the rainfall regime revealed that the maximum monthly rainfall, approximately 1157 mm, occurred in July, coinciding with the peak monsoon activity. The high precipitation during this period significantly contributes to both surface water flow and subsurface recharge, particularly in zones where fractures and weathered basalts are prevalent.

To evaluate the influence of rainfall on groundwater availability, the rainfall data were classified into four categories representing different recharge potentials. These classes help identify areas where rainfall intensity and distribution are sufficiently favorable to support infiltration. Typically, high-rainfall zones—when combined with low slope, permeable soil, and dense lineament networks—correlate strongly with high groundwater potential. Conversely, areas with moderate rainfall but steep terrain or limited structural permeability tend to exhibit poor recharge characteristics despite adequate precipitation.

The classification of rainfall into four potential-based categories serves multiple purposes:

- ✓ It allows integration with thematic layers such as slope, LULC, geomorphology, and drainage density during multi-criteria analysis.
- ✓ It identifies zones where increased rainfall translates directly into enhanced recharge, especially in structurally controlled terrains.
- ✓ It helps distinguish between zones with high rainfall but low recharge, commonly found in rugged, elevated areas with rapid runoff.
- ✓ It provides a spatial framework for designing water conservation measures, such as check dams, recharge shafts, percolation tanks, and contour trenching.

Overall, the rainfall analysis plays a crucial role in groundwater potential mapping. By understanding not only how much rainfall occurs but also how it interacts with terrain, geology, and structure, the study provides a comprehensive assessment of the recharge regime in Village Merdi. When combined with slope, lineaments, geomorphology, and land use layers, rainfall becomes a powerful parameter in identifying zones of high groundwater potential across this complex basaltic landscape.

Geological / lithological observations

- ✓ Red bole at the lithological contact indicates a change in volcanic flow units. The lithologic variation suggests the area is tectonically disturbed.
- ✓ Along the Parondi river, the exposed bedrock is highly weathered basalt, coarse-grained. The river bank and surrounding area are locally overlain by massive basalt.
- ✓ An abrupt change in lithology near the river suggests the presence of a fault. Groundwater Priority Map and DRM (GSI) mapping support the presence of a fault trending NW–SE (as interpreted from the maps).

2. Structural interpretation

- ✓ Presence of red bole + abrupt lithological contacts + contrasting weathering (highly weathered vs massive basalt) is consistent with structural discontinuity (faulting) and/or intrusive contacts (dykes).
- ✓ The well is located downstream of a dyke trending NE–SW (field note). The tectonic disturbance and juxtaposition of weathered versus fresh basalt suggest localized enhanced permeability near the fault/dyke zones.

3. Hydrogeological observations (well)

- ✓ Water-struck (saturated) zone: from 3.00 m bgl to 11.00 m bgl (i.e., first water strike at 3.00 m; water present to the bottom of the well at 11.00 m).
- ✓ The well is located in a tectonically disturbed sector (on or adjacent to a structural lineament). Highly weathered basalt in the well indicates good local secondary porosity and storage near the well interval.
- ✓ Static water level is expected to decline in summer because the area is semi-arid and the local geology limits recharge.

4. Dewatering & yield — pump details and calculated volumes

Installed pumping machinery

- ✓ Diesel engine: 5 HP → field-measured discharge 400 L/min.
- ✓ Electric motor: 3 HP → field-measured discharge 300 L/min.

Combined pumping rates and conversions (carefully shown)

- ✓ 5 HP pump = 400 L/min = 400 × 60 = 24,000 L/hour.
- ✓ 3 HP pump = 300 L/min = 300 × 60 = 18,000 L/hour.
- ✓ Combined (both pumps) = 400 + 300 = 700 L/min = 700 × 60 = 42,000 L/hour.

Pumping duration and volumes

- ✓ Pumping duration reported: 7–8 hours per pumping event.
- ✓ Combined pumps, 7 hours: 42,000 L/h × 7 h = 294,000 L = 294 m^3.
- ✓ Combined pumps, 8 hours: 42,000 L/h × 8 h = 336,000 L = 336 m^3.
- ✓ If only the 5 HP pump is run for 8 hours: 24,000 L/h × 8 h = 192,000 L = 192 m^3.
- ✓ If only the 3 HP pump is run for 8 hours: 18,000 L/h × 8 h = 144,000 L = 144 m^3.

Recuperation / recovery

- ✓ Reported rate of recuperation / recovery: ~12 hours (overnight) (field note).
- ✓ Water availability In Winter:

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- ✓ Static Water level in Winter:3.00 mtrsbgl
- ✓ Total Water Column:8 mtrsbgl
- ✓ Water Availability in Winter= 452,160 m³/day

Water availability In Summer:

- ✓ Static water Level In Summer:4.50mtrs bgl
- ✓ Total Water Column:6.50mtrs bgl
- ✓ Water Availability InSumme=326560 m³/day
- ✓

Table No:4 Static water condition of the area in Summer & Winter

Season	Static Water Level (m bgl)	Total Water Column (m)	Water Availability (m³/day)	% Drop from Winter
Winter	3.00	8.00	452,160	–
Summer	4.50	6.50	326,560	27.7%

Calculation of % Drop:

- ✓ %Drop=452,160452,160−326,560×100≈27.7%

Water Availability and Demand Assessment

As per the Jal Jeevan Mission (JJM) norms, the water demand of the study area is 81,510 m³/day. Available water during winter has been estimated at 452,160 m³/day, exceeding the demand by approximately 370,650 m³/day (≈555% of demand). However, given the semi-arid climate and local geological conditions, the static water level is expected to decline during summer, which may reduce the effective water availability. Therefore, planning for water supply should consider seasonal variations, focusing on minimum expected availability rather than peak winter values. Regular monitoring of groundwater levels, seasonal recharge assessment, and conjunctive use strategies are recommended to ensure sustainable water supply throughout the year.

Water Demand and Availability

As per Jal Jeevan Mission (JJM) norms, the water demand of the area is estimated at 81,510 m³/day, while the available water in winter is approximately 452,160 m³/day. However, due to the semi-arid climate and the geological conditions of the region, the static water level is expected to fluctuate during summer. The estimated water availability in summer, considering different drawdown scenarios, is summarized below:

Table No:5 Showing Availability of water Availability from JJM Source

Season	Available Water (m³/day)	Assumed Drawdown (%)	Estimated Water Availability (m³/day)
Winter	452,160	0%	452,160
Summer	452,160	20%	361,728
Summer	452,160	30%	316,512
Summer	452,160	40%	271,296

These estimates highlight the potential reduction in water availability during the dry season, emphasizing the need for careful groundwater monitoring and sustainable management practices.

IV EXPERIMENTAL RESULT AND DISCUSSION

In this study, we departed from conventional single factor assessments and adopted an integrated approach—combining Remote Sensing (RS), Geographic Information Systems (GIS), and targeted Hydrogeological surveys—to delineate probable groundwater zones. Multiple thematic layers were produced to represent the primary controls on groundwater occurrence; each layer was evaluated and weighted according to its relative influence on groundwater storage and recharge. GIS analysis incorporated geomorphology, geology, land use/land cover (LULC), soil type, lineament buffers, slope, rainfall, and drainage density. Classes within each thematic layer were rated on a 1–5 scale (1 = very low, 5 = very high) in ascending order of positive influence on groundwater potential. The weighted overlay of these layers provided a continuous groundwater potential index for the study area, enabling objective prioritization of recharge and abstraction sites.

The thematic layers, representative classes, assigned weights, and qualitative contributions to groundwater potential are summarized in Table 1.

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Table No:6 Showing Relation between Thematic Layers Qualitative Contribution to Groundwater

Thematic Factor	Representative Classes	Assigned Weight (1–5)	Qualitative Contribution to Groundwater Potential
Geomorphology	Plateau; Valley; Floodplain	2–5	Medium to Very High
Geology	Basalt; Alluvium	3–5	High to Very High
LULC	Agriculture; Forest; Urban	1–4	Low to High
Soil	Clay; Loam; Sandy	1–5	Low to Very High
Lineament Buffer	0–500 m; 500–1000 m	1–5	Low to Very High
Slope	0–5°; 5–15°; >15°	5–1	Very High to Low
Rainfall	<800 mm; 800–1200 mm; >1200 mm	2–5	Medium to Very High
Drainage Density	Low; Medium; High	1–5	Low to Very High

According to the 2011 census, the base population of the study area is 988. Using Jal Jeevan Mission (JJM) projections, the design population for supply planning has been estimated at 1,482. Applying current JJM norms for per-capita consumption yields an aggregate water demand of 81,510 m^3/day for the service population. Table 2 summarizes the demand–supply balance and the recommended abstraction site.

Table No:7 Showing Availability of Groundwater Form recommended Source

	Value
Projected population (JJM)	1,482
Water demand (JJM norms)	81,510 m^3/day
Available groundwater (estimated, winter)	452,160 m^3/day
Recommended abstraction site	Dug well — southwest of identified fault line

A direct comparison of design demand with estimated groundwater resources indicates that, under winter (high-availability) conditions, in-situ groundwater is substantially greater than the JJM demand. However, seasonal variability in semi-arid settings necessitates conservative planning. To account for probable seasonal drawdown, a pragmatic adjustment was applied: a 30% reduction in available groundwater to approximate summer low-yield conditions. Table 3 shows the seasonal availability after adjustment.

Table No:8 Showing Availability of Groundwater Form recommended Source in Winter & Summer

Season	Source Availability (m^3/day)	Assumed Drawdown (%)	Adjusted Availability (m^3/day)
Winter	452,160	—	452,160
Summer	452,160	30	316,512

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Figure 1a: Showing Site Selection Survey

Figure1b: Showing Geological Section And Static Water Level of Excavated Well.

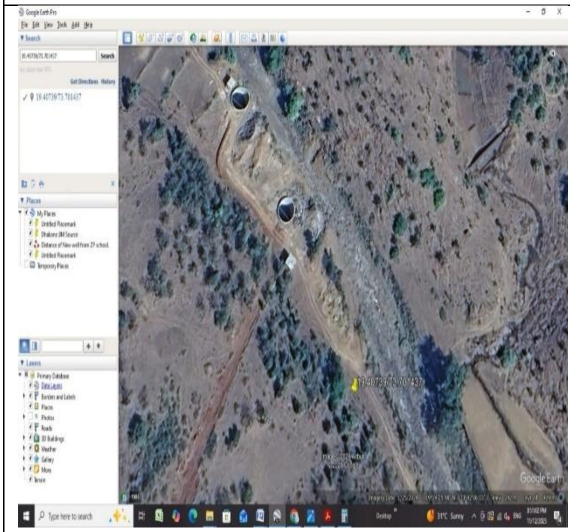
Figure 1c: Showing PWS Source of JJM on Google Earth

Figure 1d: Showing Successful running of water Supply scheme From JJM Source

Even after applying a 30% seasonal drawdown, the adjusted availability (316,512 m³/day) remains in excess of the calculated JJM demand (81,510 m³/day), indicating that the identified abstraction location—selected on the basis of favorable geomorphologic and structural controls (proximal to the fault-controlled zone)—is likely to satisfy year-round needs if managed sustainably. It is recommended that the final site be supported by an adaptive monitoring program (periodic static–water-level measurements, specific-capacity tests, and seasonal pumping trials) to refine yield estimates and inform demand management. Additionally, implementing conjunctive measures (rainwater harvesting and managed aquifer recharge in high-potential zones) will increase the resilience of the supply under extended dry conditions.
This integrated approach, combining thematic analysis with population-based water demand, provides a data-driven framework for effective groundwater resource planning under JJM.

V. CONCLUSION AND FUTURE WORK

In the present study, the successful application of techniques such as RS, GIS, MCDM, and Hydrological Survey helped evaluate and identify probable groundwater potential zones. Different steps chosen for the study include the development of the thematic layer followed by the appointment of weight for each influencing factor with the help of the AHP method and, last, overlay analysis for the demarcation of groundwater potential zone. The result reveals that the study's potential zones are high in the west and north-eastern portion of the Study area while low to medium groundwater potential is located in the central and South Eastern Portion of the area though there are cluster of Lineament but a Dyke is controlling the groundwater movement of that portion hence this dyke is acting as a Barrier dyke.. Derived groundwater potential results from the integrated operation of various factors such as slope, rainfall, lineament, drainage density, and soil patterns, including the geomorphic and geological control. The result revealed that the LULC and geology play a major role in the groundwater condition of the area. Overall, the integrated application of RS and GIS method supported by the Hydrogeology analysis increases the values of the result, therefore, it is possible to design a Successful Pipe water Supply Scheme Under Jal Jeevan Mission which is a flagship program me of Indian Government. , and with help of integrated application of RS and GIS method supported by the Hydrogeology analysis it is possible to change the status of the study area as Tankerfed Village To Tanker free Village.

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