

Role of Electrical Resistivity Method for Groundwater Exploration in Paithankheda area, of Gangapur Taluka, Aurangabad District, Maharashtra, India

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ABSTRACT

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In this study the data generated while conducting electrical resistivity surveys through Vertical Electrical Sounding (VES) at 22 sites in different location along with a available geological & hydro-geological information of Paithan Kheda village were analyzed. The objective are (i) to understand the nature and extent of aquifer (ii) to find out the location and thickness of unsaturated zones and (iii) to evaluate and extent of appropriate artificial recharge structures at suitable locations across the village.

Interpretation of the top sounding curves indicates presence of three to four subsurface geo-electric layers across the study area. The top soil layer has range of resistivity values from 2 to 30-ohm m & lithology comprise clay with kankar, lateritic sand. This is followed by the weathered and jointed Basalt layers with resistivity values 100 300-ohm m could be identified below the depth of 45m. At some places, doleritic dykes were also observed with resistivity values >300-ohms. The interpretation of VES data when correlated with the available litholog data indicates a prominent water bearing zone between 30 and 45 mbgl. The underlying hard and compact Basalt has very little possibility of occurrence of groundwater. The top unsaturated and unconfined granular zone up to a depth of 30mts could therefore be easily recharged artificially through rainwater harvesting measures thereby augmenting the groundwater resources of the existing aquifers. Site specific artificial recharge measures from

amongst counter bunding ,gully plugs ,check dams, percolation tank. Recharge shafts&subsurface dekes have been identified across the village for effective recharge of the aquifer especially in its north eastern &southern blockregions.Considering the deteeriorating grounwater situation,these initiatives would be significant in catering the needs of future generations.

Keywords : rainwater Harvesting. Artificial recharge (AR) Vertical Electrical Sounding (VES) well sitting Teremeter SAS300, litholog Morar shales Schlumberger Configuration.

I. INTRODUCTION

1.1 Electrical resistivity Method

Electrical resistivity methods are of foremost importance in groundwater explorasstion, in water quality evaluation and groundwater pollution studies because the resistivity of rock is very sensitive to its water content. Although several methods can be enumerated under the geophysical methods. The electrical resistivity method has been used in the present investigation. Some of the common sedimentary rocks being ,more porous possess higher water content ;hence they normally have a lower resistivity values.wet and clay soils normally have a lower resistivity than sandy soils Resistivity of each rock depends on certain characters such as porisity.degree of water saturation and concentration of dissolved salts(kearey and Brooks1988).

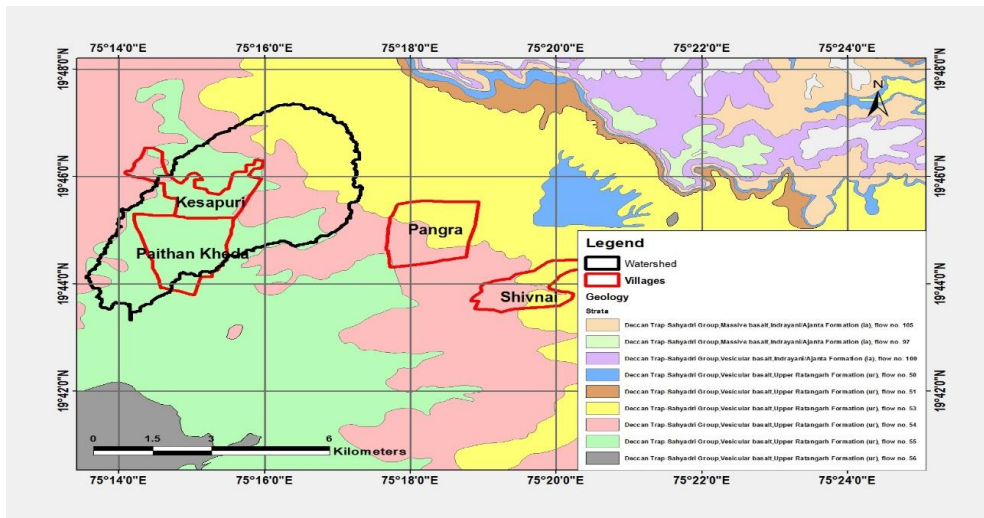


1.2 Geophysical investigations

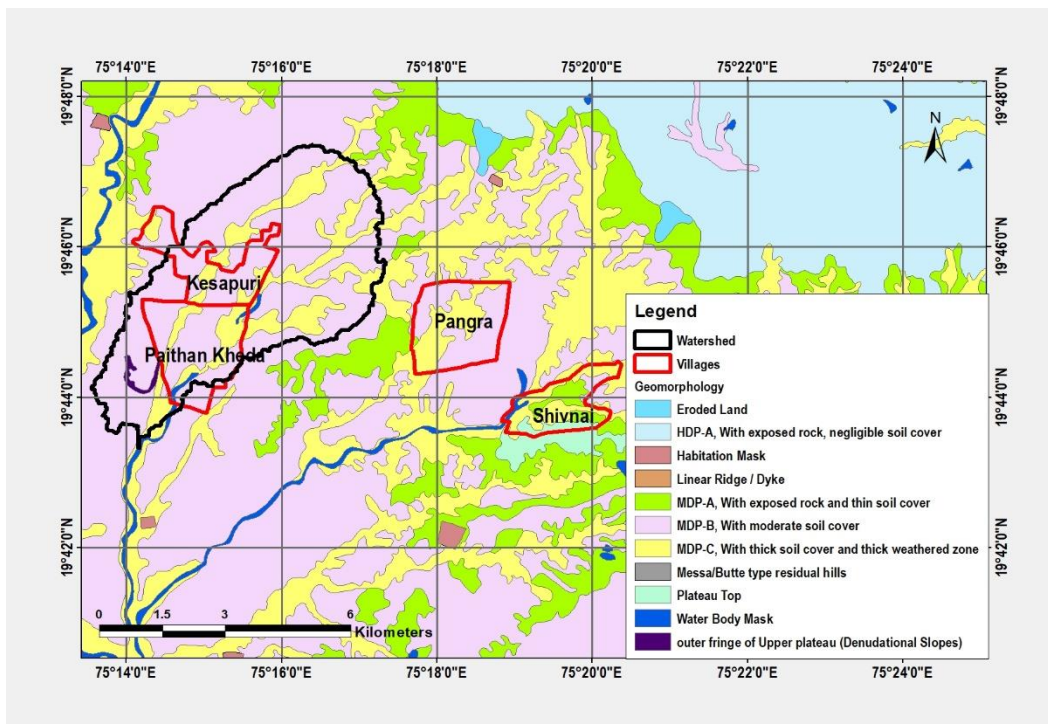
Geophysical investigations were carried out by electrical resistivity methods, using the instrument named ABEM Terrameter –SAS 300. The methods for investigation are vertical electrical sounding (VES) BY Schlumberger configuration. By way of conducting such soundings at different litho layers beneath the ground were probed to understand the thickness and apparent resistivity of each litho- layers and its capacity to bear water.

Appropriate no of soundings is done at the project location for getting litho logical characteristics variation with depth.

GEOLOGY:



GEOMORPHOLOGY OF THE AREA



1.3 Analysis of VES data

The obtained readings in the field are plotted in the bi-logarithmic graph sheet and geoelectric field curve were interpreted and correlated with standard two layers master curves (Orellana and Mooney) by partial curve matching techniques to ascertain the water bearing strata beneath the earth. The same was also cross-checked with computer software IPI2WIN.

MATERIALS AND METHODS

Theoretical Basis

The apparent resistivity (ρ_a) function of current passed into the ground, measured by potential electrodes as potential difference (Voltage) is given as

$$\rho_a = \pi \frac{(AB/2)^2 - (MN/2)^2}{MN} \times R \quad (1)$$

Where R is the resistance, AB and MN are current and potential electrodes respectively. A multilayer resistivity

1.4 Suggestion and recommendation

Finally, the recommendation and suggestion are made on based on the hydrological investigation of the area and subsequent geophysical data interpretation which clearly indicates the layer resistivity p1, p2,p3,& p4 and its thickness.

1.5 Geophysical Survey (VES) Conducted for the study

For the study, Vertical electrical soundings (VES) surveys had been carried out at 19 locations for structure I and 4 locations for structure II using Schlumberger electrical resistivity techniques to ascertain the nature of bedrock below the soil cover, and to delineate the layer thickness of different formations and resistivity contrast of different layers. The obtained data from the field were analyzed and interpreted to ascertain the water bearing strata beneath the earth. The analyzed data parameters from the different selected locations are given Table-2.

Table 2: Analyzed Data parameter

Apparent				Thickness (m)			
p1	p2	p3	p4	h1	h2	h3	h4
1. Mr. Bhau Rotge land at Paithankheda (Near Kesapuri village)Paithan Kheda Block (Nearly 22Km from Aurangabad –Shegoan Road)							
13.1	40	1.33	452	1.01	2.18	2.91	-
2.Janabai Krmakar Land at Paithenkheda (Nearly 22Km from Aurangabad –Shegoan Road)							
22.54	2.623	16.24	28.59	1.08	2.79	6.04	-
3. Ashokh Ghundre land at Paithankheda (Along the Nala)							

Electrical parameters hydrological sigificance

Sr.No.	Resistivity (Ohm-m)	Thickness (M)	Inferred Litho logy	Hydrological Significance
1	20-30	2-40	predominantly clay/clay with kankar Black cotton soil	Generally, lies in unsaturated zone aquifer at good upper leve,&poor at depth
2	30-100	5-50	Highly weathered Basalt	First Principal aquifer of the area
3	100-300	0-48	Highly weathered & fractured Basalt	Second Principal aquifer of the area
4	>300	Bottom Layer	Hard and Compact Basalt	Very poor aquifer, acts as brrier for grounwater movement

- where,
- f_1-f_5 Apparent Resistivity of each litho layer in ohm-m
- $h_1- h_4$ Thickness of each layer in m
- From the survey data analysis, majorly K and KHK types
- of curves were found in the area indicating the presence of
- multilayered inhomogeneous formation (Refer Table). Top

- In addition to new bore wells, defunct bore wells and
- dry wells in the surrounding area could be used for rainwater
- Collection.
- Rooftop and paved rainwater harvesting should be
- Compulsorily (legislation) done for large department /
- Institutional buildings of the Village.e Grampanchayat Building ZP school Buildings& Buildings like Samaj Mandirs etc.
- The rainwater collected should be put to desiltation and
- Filtration prior to transporting down the earth through existing
- Or newly constructed later harvesting structures like dug wells,
- Bore wells, shafts, trenches etc.
- A detailed water management plan for the entire Village is
- Required to be prepared for utilizing the maximum quantity of
- The available surface (rainwater) resource which is currently
- Going to waste. From the carried studies the broad description
- Of the groundwater development and management plan
- Envisaged for Paithankheda is as under:

RESULTS AND DISCUSSION

The analyses of sounding curves obtained from Geophysical survey data over the areas have brought out three To four subsurface geo-electric patterns. The top layer (depth Range- 2 to 20 m) consists predominantly of clay / clay with kankar/ Black cotton Soil followed in respective order by Highly weathered & jointed Basalt (depth range- 20-55 m) and Hard & Major parts of the investigated area are potential zones for ground water exploration and exploitation purposes and for long term sustainability these areas have sufficient scope for artificial recharge predominantly through the construction various appropriate water harvesting structures.

CONCLUSION AND RECOMMENDATIONS

As discussed above, it is concluded that field geo-electrical Survey is very rapid and reliable method to explore an area For finding out the prospect of groundwater occurrence. It helps to delineate the area precious for groundwater Development and management. Based on the above field Survey and subsurface aquifer conditions, most of the areas need artificial recharge of the aquifers by adopting appropriate measures.

Following suggestions or recommendations have been proposed for groundwater development in the city. A well-planned recharge scheme for the entire city should developed for the construction of various artificial recharge structures such as injection wells, recharge shafts, storage ponds and tanks etc. at suitable locations.

GROUNDWATER DEVELOPMENT AND MANAGEMENT PLAN

The number of water harvesting structures should be distributed dividing balance resources equally for dug wells and tube wells and taking consideration of 100 % development of net groundwater availability in the block.

Therefore, it is suggested that a scientific study at every five years' period is a must to check the impact of groundwater development on groundwater regime and accordingly number of structures should be modified. By considering these points, there are many ways to adopt this practice but the structures which are feasible in the study area & almost across Paithankheda are: contour bundings', gully plugs, check dam, percolation tank, recharge shafts & subsurface dykes. Broadly, the area for artificial recharge have to be divided into two categories i.e. overexploited and safe to semi-critical area where long term trends of groundwater level is declining. It is observed that gully plugs and contour bunds maybe Constructed on the upper reaches of streams. Percolation Tanks can be considered in areas which provide sufficient Spread. In locations where streams are of 5-6 m wide and have sufficient depth, a series of small check dams in the stream course may fulfill the objective of conservation of groundwater. During rainy season, it should be mandated that the farmers use bunds in the area for storing the water in their fields. In areas where clay beds that prevent percolation of water to the unsaturated zone in the weathered Basalt and Highly Fractured Jointed Basalt, recharge shaft may prove good structures for artificial recharge of groundwater in the alluvial flat terrain areas, due to very poor drainage density the feasibility of percolation tanks is almost remote. In these areas where the pre-tertiary aquifer has gone dried and the clay beds do not allow percolating the water in deeper level, recharge shaft is only means to be adopted to augment the groundwater.