Effect of electrical resistivity method for ground water prospecting in hard rock region

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ABSTRACT :

The study was conducted for assessment of electrical resistivity method for ground water prospecting at farmers field in Parbhani Tahsil. The area falls under hard rock region. In this method the vertical electrical soundings with Schlumberger array were carried out at forty different locations in the area The data gathered from this method at each soundings were interpreted by curve break method for finding the depth of soil formations. The interpreted data each soundings were compared with the actual observations recorded during the drilling process at 15 such observation locations. The method was found effective in hard rock areas as the average per cent deviation between observed and estimated depth of water bearing strata from resistivity soundings was found to be 13.45. The reliability of this method is found 75% for selecting the site for irrigation water and 85% for determining the depth of water bearing formation.

Key words : Electrical restivity method, Ground water prospecting.

INTRODUCTION

Water is important for animal and plant growth. We need water for different purposes such as drinking, washing, agricultural, industrial etc. Due to modern agricultural practice and industrial growth, water requirement is increasing day by day. In order to meet the steep increase in demand for water all the available sources of water should be mobilized and new sources need to be tapped out. Therefore special attention should be paid towards groundwater utilization, as it has been somewhat overlooked even though it is quantitatively more when compared to surface resource.

Recently the ground water has been recognized as most important and significant source of water for irrigation, domestic, and industrial uses. The ground water accounts for more than 50 per cent of fresh water resources. In the state of Maharashtra, per cent area irrigated by groundwater is more than 50 % of the total irrigated area. It shown that the total ground water resources is huge but problem lies in its exploration, development, and management. This involves the necessity of estimation and assessment of groundwater Potential by micro studies in basaltic area of Maharashtra.

In view of the above, the resistivity studies were initiated for generating information on groundwater exploration technique in the area.

MATERIALS AND METHODS

Surface electrical resistivity method was used with Schlumberger array for geophysical investigations in this

study, owing to the fact that it gives quite accurate results and it has some technical advantages over other methods.

The data obtained with electrical resistivity sounding were interpreted by the curve break method. During the present study, the vertical electrical sounding were carried over at different locations on the farmers fields. All these locations fall under hard rock region of Rahuri tahsil of district Ahmendnager .

The curve break method is best suited to Schlumberger array, which is also reported by Dhotre, et al (1996). Incurve breaks technique, the graph off apparent resistivity versus depth of investigation were plotted. The depth of investigation is taken as half of the distance between the current electrodes. A different segment is to be obtained for each potential electrode spacing. All these curve segments were joined to form a resistivity curve.

The apparent resistivity, ohm-m, is taken on X-axis and the depth of soil formation m, on Y- axis. The curve showed the number of layers and the soil formation in each layer. In these curves, there is a break after each layer. Whenever this observed break is maximum between two layers, it is considered most suitable formation for identifying the ground water. The data obtained by resistivity meter using Schlumberger array is shown in Table 1. The farmers drilled the bores at these spots sited by this method. During drilling process, the samples of drill cuttings were collected from every 10 m depth of drilling or at the depth when the soil formation changed. The drill cuttings were identified to know the

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type of soil formations. This job of identification was carried out in consultation with geologist from the state agency on groundwater research i.e. Groundwater Survey Development Agency (GSDA). From these observations the well-logs for each well were prepared.

RESULTS AND DISCUSSION

The reconnaissance survey on open dug wells in the area and the resistivity survey were carried out at different locations and the collected data were analyzed and are presented below.

For studying the reliability of electrical resistivity method, the vertical electrical soundings were carried out in the study area and these soundings results are tabulated in Table 2. This table shows the percentage deviation between the depth of water bearing strata actually observed during drilling and the depth of water bearing strata interpreted by the curve break method.

From Table 2, it is seen that the maximum positive per cent deviation is 43 at sounding No. 9 and maximum negative per cent deviation is 25 at sounding No. 7. The numerical average per cent deviation was found to be 13.45.

It is further revealed that at sounding 1 and 4 the deviation is zero for fist water being strata. Out of 15 bores, 4 bores found dry and 11 bores showed water bearing formation. Thus it can be concluded that the said instrument and the methodology is 75% reliable in hard rock region for sitting the spot of well. While comparing the data of water bearing formation, the said instrument and methodology was found 85% reliable.

Table 1: Data sheet for resistivity soundings

Obs. No.	MN/2 (m)	AB/2 (m)	Resistance, R Ohm	App. Resistivity Ohm-m
1	1	3	2.25	3.14
2		6	0.29	15.94
3		12	0.12	26.95
4		18	0.09	45.66
5	3	12	0.18	12.72
6		18	0.06	9.89
7		24	0.03	8.90
8		30	0.02	9.33
9	6	30	0.03	6.78
10		36	0.06	19.72
11		42	0.05	22.61
12		48	0.04	23.75
13		60	0.03	27.99
14	12	60	0.02	9.04
15		66	0.07	41.35
16		78	0.05	42.76
17		84	0.03	31.68
18		96	0.02	23.75
19	24	96	0.02	14.13
20		108	0.07	50.79
21		120	0.05	45.23
22		132	0.03	33.08
23		144	0.02	26.38

Note: MN- Potential probe, m; AB-Electrical problem

Table 2 : Depth of water bearing formations interpreted from curve break method and actually found during drilling process.

S.No.	Depth of water bearing formation calculated from Curve Break Method, m	Depth of water bearing formation actually observed, m	% deviation
VES:1	30	29	+ 3.44
VES:2	63	60	+ 5
VES:3	6	8	- 25
VES:4	15	14.2	+ 5.63
VES:5	6 and15	7 and 16	- 14.28, +6.25
VES:6	6	5.8	+ 3.44
VES:7	15	12	+ 25
VES:8	6	5.7	+ 5.26
VES:9	4.5 and 10.5	7.9 and 12	- 43, - 12.5
VES:10	4.5 and7.5	6.8 and 7.9	-33.82, -5.06
VES :11	21 and27	25 and27	-16
VES:12	6 and15	7 and 15	-14.28
VES:13	6.5 and 10.5	7 and 12	- 7.14, 12.5
VES:14	6 and10.5	9 and 16	- 33.33, -34
VES:15	6	10	- 40.0
			Average: 13.45

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