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RESEARCH ARTICLE

Vertical Electrical Soundings (VES) Geophysical Exploration analysis of Part of South-East Agroclimatic Zone of Karnataka, Kolar District, Karnataka, India Using Geographical Information System (GIS) Techniques.

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Abstract

Vertical Electrical soundings and profiling have proved to be valuable tools in prospecting for geothermal energy in many countries. Three principal variations of direct current methods have found use in geothermal energy exploration, though there have been controversies in the literature over the relative merits of these techniques. The selected area Total thickness of the area (h1) ranges between 1 mtr to 82 mtr, average value is 3 mtr, (h2) ranges between 1 mtr to 201 mtr, average value is 15 mtr, (h3) ranges between 0 mtr to 207 mtr, average value is 51 mtr, (H) ranges between 0 mtr to 210 mtr, average value is 72 mtr, Apparent Resistivity of the area at 25 mtr ranges between 0 to 382 mtr and average value of the area is 115 mtr, at 100 mtr ranges between 65 to 961 mtr and average value of the area is 299 mtr, at 200 mtr ranges between 0 to 1510 mtr and average value of the area is 512 mtr.

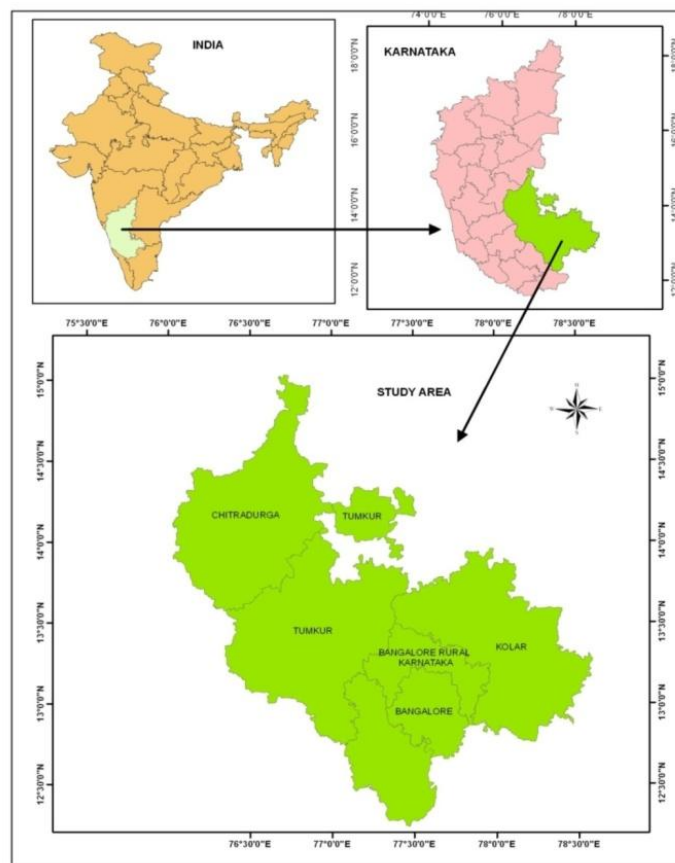
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Introduction:-

The resistivity method is aimed at measuring the potential differences on the surface due to the current flow within the ground. Since the mechanisms that control the fluid flow and electric current and conduction are generally governed by the same physical parameters and lithological attributes, the hydraulic and electrical conductivities are dependent on each other (George et al., 2015). Groundwater is the major source that meets the drinking and domestic needs of any area of the world. Thus, its exploration and accessibility assumes a great significance to the scientists and society. In the crystalline hard rock groundwater generally occurs in the weathered basement, or regolith, and the fractured rock (Verma et al., 1980). In many parts of the world groundwater is a primary source of fresh water. Some regions are becoming overly dependent on it, water tables to declining because of consuming groundwater causing unremittingly (Gleick, 1993). Groundwater rights have not changed accordingly by population growth and economic development, the laws governing, even in developed nations. (Livingston, & Garrido, 2004). Groundwater is the subject of growing social concern around the globe. The ownership and control of underground aquifers, the intensive use of groundwater resources, potential changes in both groundwater quality and quantity and the related impacts on natural systems command the attention of scholars and policy makers in many countries. India, with 70–80% of its food production based on groundwater resources, is perhaps the sharpest world example of the challenges involved in managing this resource (Deb Roy and Shah, 2002).

Location of the Study area:-

The study area is forest within the Dry Agro Climatic Region of Karnataka and spreads over in 3294sqkm. It lies between 12°30'0" and 15°0'0" latitude and between 75°30'0" and 78°30'0" longitude and it encompasses seven districts viz., Bangalore Urban, Bangalore Rural, RamanagaraTumkur, Kolar,Chikkaballapura, Chitradurga. Total district area is 35214 sqkm and the forest area which is focus of the study is only 9%.



Map 1.1:- Location Map of the study area

Material and Methods:-

The most widely used geophysical method for groundwater exploration is electrical resistivity method as it is efficient in detecting water-bearing layers, besides being simple and inexpensive to carry out field investigations (Zohdy, 1974). The method involves measurement of applied current (I) through two electrodes and potential (V) across two other electrodes. Apparent resistivity is derived from these measurements for various electrode separations. There are different electrode arrangements such as Schlumberger, Wenner, Dipole–Dipole, Two-Electrode Array, etc. Geophysical Investigation The geophysical investigation involved the electrical resistivity method. The Vertical Electrical Sounding (VES) technique adopting a Schlumberger array was used. The half current electrode spacing ($AB/2$) was varied from 1 m to a maximum of 100 m. The choice of the VES stations was constrained by the geology, structure (lineament) map, terrain, accessibility and representativeness of the spread of the stations. Every VES station was appropriately geo-referenced. Secondary information on existing VES data and borehole records (logs, yield etc.) were assessed re-processed and incorporated. One Hundred and twenty five (125) Vertical Electrical Sounding (VES) data.

Lineament analysis followed by resistivity survey is cost effective while studying geomorphologic data. In order to assess the groundwater conditions in the area, electrical resistivity surveys were carried out with Schlumberger electrode configuration to pinpoint the most favorable locations in the area. Integrating hydrogeomorphological data with geophysical investigations, Teeuw (1999), Shahid and Nath (2002)

South-East dry agroclimatic zones of karantaka using Arc GIS 10.2 Version generated different types of thematic maps like top soil map, weathered map, highly weathered map, Apparent resistivity 25mtr, 50mtr, 75mtr, 100mtr and 200mtr. Through these spatial maps we can easily understood about of the surrounding forest area. The typical-hydrogeological section of a hard rock terrain consists of a soil zone followed by a weathered zone are overlying bedrock.

A total 38 VES conducted in Sidlaghatta, Chikkaballapur&Gudibande taluks taluk, Chikkaballapur district for deep drilling. The area is underlain by the granites, schists and peninsular gneissic complex of Precambrian to Achaean age. The interpreted results at the recommended sites indicated 4 layered geo electric sections in which the last layer is massive formation.

Results:-

In the South-East zone of Dry agroclimatic region of Karnataka selected one representative area Total 75 numbers Vertical Electrical Soundings (VES) around the forest region and South Eastern part of the Study area Kolar, Malur and Srinivasapura taluks selected for the understand about the resistivity of the subsurface through this method we can easily identify and analyse the resistivity of the sub surface of the forest area and surrounding forest area. How subsurface fractures are present in the forest area through fracture zones only water moving into the groundwater level (Alley, et al., 2002; Sophocleous, 2002). Electric methods are well suited for the recognition of favourable hydrogeological areas; this method has helped to highlight the resistivity of the surveyed materials in each area. It is very suitable to formations of Douala basin as results of the good resistivity contrast between clay and sand materials.

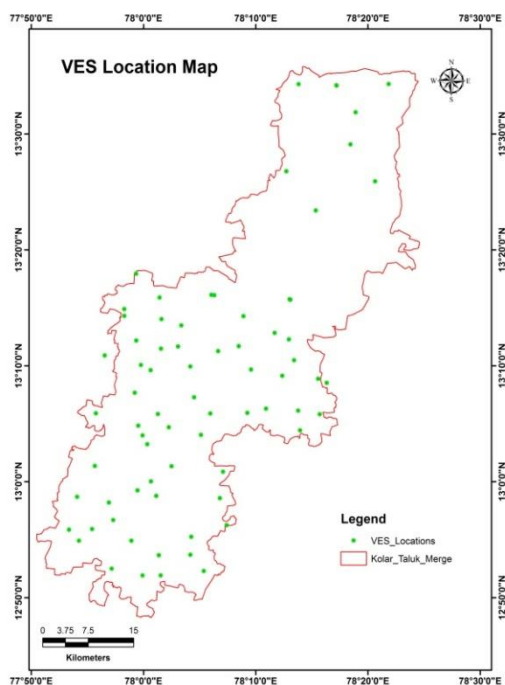
The apparent resistivity is calculated for a wide range of values of the separation between the electrodes using the values of the potential between the measuring electrode and a proposed function that characterizes the behavior of the electrodes used which substantially improves the measurements for small depths (Faleiro, et al., 2016). In the part of Kolar, Malur and Srinivasapura Total 75 Vertical Electrical Sounding were conducted and Longitudinal Conductance shows 0.43 to 0.80 mhos in Northern part of the study area (Srinivasapura) taluk depending upon the lithology longitudinal conduction changes. Low values observed in southern part of mulabagilu area and Northern part of Srinivasapura taluks ranges between 0.07 to 1.80 mhos.

Apparent resistivity at 25 mtr Lakkur tank, Dimbala, maderahalli and Doddasala shows low value and high value chikkakuntur, ghattahalli site 3, chowdenahalli and channakallu. Apparent Resistivity at 100 mtr Dimbala, lakkur and aralimara and chenjamaale and high in Bettadahalli, Chowdenahalli, thoralakki and chikkakuntur. Apparent resistivity at 200 mtr Kgmalsandra, Lakkur tank, Dimabli and Rastetambihalli shows low value and high value chikkunte, chowdenahalli, Bettadahalli and thoralakki.

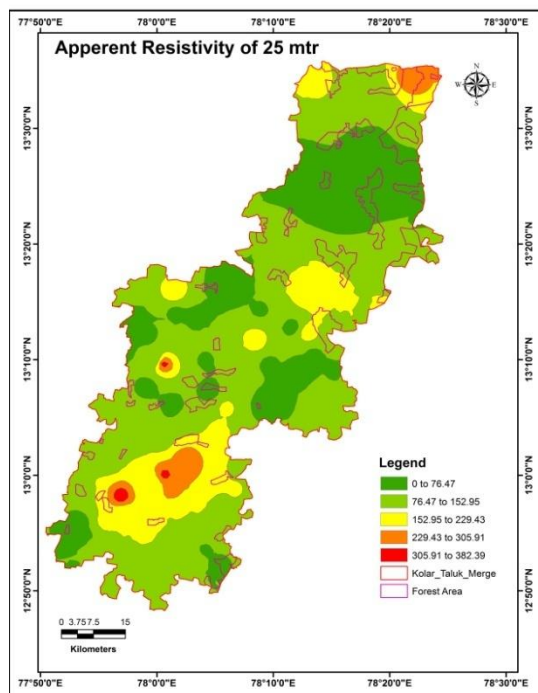
Table 1.1:- VES Interpreted results of Micro Level Aquifer Mapping Pilot project area in parts of Kolar district, Karnataka.

Sl.NO	Locations	Layer Resistivities in Ohm.m				Total Thickness/depth in m				Apparent Resistivity in Ohm.m		
		Rho1	Rho2	Rho3	Rho4	h1	h2	h3	H	AB/2 at 25m	AB/2 at 100m	AB/2 at 200m
55	Uppukunte	570	103	147	1423	1	7.7	25	0	153	330	551
56	KG Mailsandra	85	15	329	9999	1.4	6.6	14	22	85	372	0
57	Ammanallur	41	12	480	9999	0.6	2.4	207	210	111	265	331
58	Cholaghatta	22	770	9999	0	5.4	201	0	206.4	247	349	457
59	Raghupathi agra	125	17	450	9999	0.8	7.3	91	99.1	61	131	314
60	Kurugal	90	7	455	9999	0.7	4.2	14	18.9	51	166	356
61	Doddavallabhi	7	18	357	9999	0.9	13	52	65.2	36	114	205
62	Raste Tambihalli	82	10	196	9999	82	9.6	171	177.7	57	105	161
63	Uddappanahalli tank	55	12	336	9999	1	9	113	123	39	99	192
64	Bhairanahalli	139	45	169	9999	1	9	8	18	117	314	835
65	Sitappanahalli	191	86	476	9999	1.3	14	57	73	170	318	798
66	Kothahudve	21	46	410	9999	1.5	2	27	30.5	295	563	914
67	Kothapalli	61	36	320	9999	2	4	47	53	210	451	925
68	Mudivaripalli	39	50	250	9999	1.5	15	59	75.5	88	191	476
69	Koorgepalli	39	87	259	9999	1.5	15	40	56.5	111	337	692
70	Koorgepalli	13	40	265	9999	2	9	13	24	65	295	550
71	Tupalli	100	24	245	9999	0.7	9.5	12	22.2	60	266	549
72	Pandivaripalli	252	21	258	9999	0.5	15	30	45.5	43	114	200
73	Dimbala	23	13	286	9999	1.5	19	30	50.5	19	65	159
74	Koppali	79	3	350	9999	0.9	1.5	25	27.4	68	231	513
75	Koppali2	80	15	250	9999	1.5	12	24	37.5	65	234	510

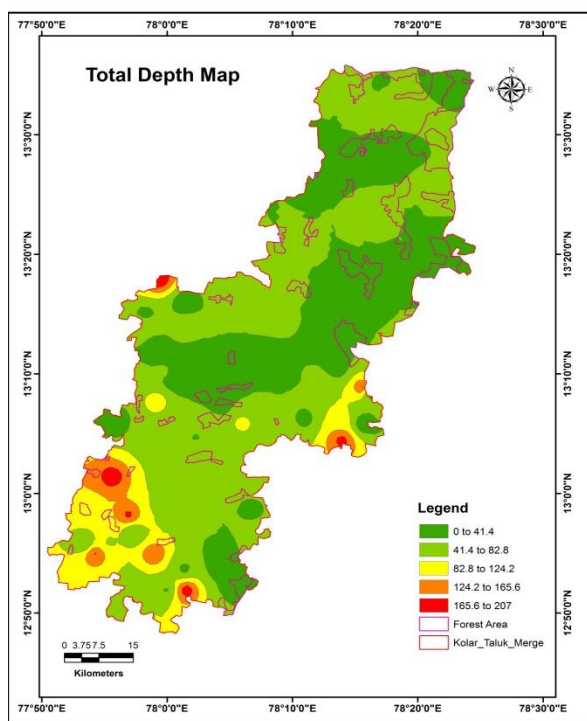
Source: CGWB Bangalore



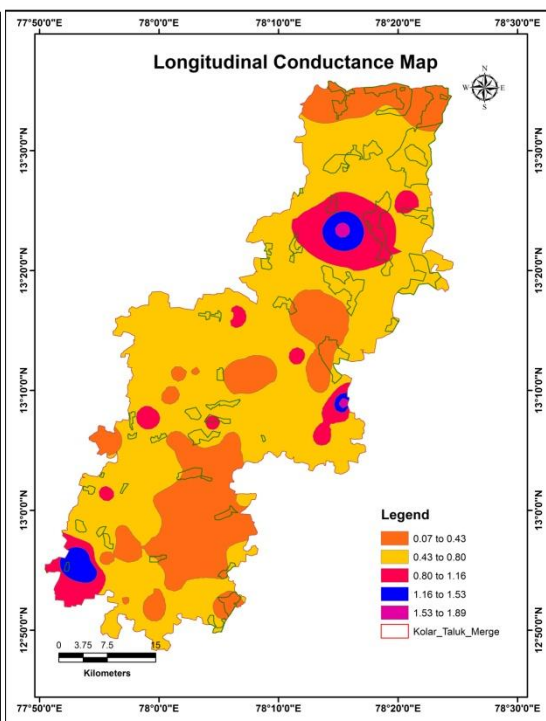
Map 1.2: VES Locations Map



Map 1.3: Apparent Resistivity of 25 mtr



Map 1.4: Total Depth Map



Map 1.5: Longitudinal Conductance Map

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