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Research Paper

# Geohydrological Aspects of Madanapalle: a Droughtprone Town, Chittoor District, Andhra Pradesh, India

Engineering

**KEYWORDS :** V.E.S., Schlumberger electrode, Sub-surface layers, Allivanka, Surface water runoff

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## ABSTRACT

*The area of investigation located at Madanapalle, chittoor district, Andhra Pradesh. Vertical Electrical soundings (VES) were carried out in Alivanka micro basin at 7 locations using schlumberger configuration for the investigation of ground water resources in the drought prone area. The data were interpreted by partial curve matching and more sophisticated techniques based on inversion schemes. The curves are prominently at A, K&H type. Interpretations reveal the number of sub-surface layers, their thickness and their water bearing capacity within the study area. This will greatly help to understand the sub-surface geology and in identifying bore wells and digging of wells in negative areas will be avoided. It is absolutely necessary to construct check dams across the streams as many possible and where ever it is feasible. These check dams will not only minimize the surface water runoff and also act as recharge structures and will help to boost up ground water levels considerably. These water flow arresting measures can be tried out in Allivanka and Mugguralla vanka. Bunds if Elakakunta, Vaddigani cheruvu and Obulanaidu cheruvu may be strengthened along with carry out desiltation work.*

**INTRODUCTION:**

Madanapalle town is located at $13^0$ 39′ North latitude and $78^0$ 31′ East longitude at an altitude of 710-643 mtrs, above the sea level in the extreme western part of the Chittoor District , Andhra Pradesh. It is 13 kms away from Madanapalle road railway station on the Pakala – Dharmavaram meter gauge section and at a distance of 96 kms. from Chittoor Town which is the district head quarters. An ever increasing urban population in Madanapalle has thrown up a problem i.e., acute shortage of drinking water. There is no perennial river in and around of Madanapalle town. The main source of water supply is ground water only. Entire Madanapalle town is found to be a sheet rock with less vegetation cover and lies in between 700 and 743 meters above the sea level contour, quartz vein with fissures and fractures, contributing to ground water recharge from the rain falling on the surface of the ground into the ground water storage. Hence to assess the exact potential of ground water is found to be no easy task. The investigations are related to Geology, Hydrogeology, Geoelectrial, aquifer parameters and quality of water.

The climate of the area is hot and semi-arid for most part of the year especially in the month of may with a mean maximum temperature of 40.20C, a mean minimum of 24.40C and a mean of 30.20C. While December being the coldest month. The area receives an average rainfall of 650 mm. The rainfall is less during the early months of every year and it is generally more during June and December.

The area receiving an annual rainfall of 650mm, out of which 45 to 65 % of the total rainfall received during the north-east monsoon period. The ground water level has been declined in recent times. The rapid urban development in Madanapalle , Chittoor District demands excesses utilization of ground water, because of over exploitation of ground water, the warrants ground water assessments for sustainable methods provide indirect information about sub-surface formations by measuring the various physical parameters of the earth crust electrical resistivity survey by far is most suitable methods for ground water investigation.

Geophysical techniques are the highly useful one for the identification of ground water potential zones. Among various geophysical studies, we have selected vertical electrical sounding (VES) to carry out ground water potential zones identification in the present study area. The true resistivity values and thickness of layers are obtained by interpretation of the sounding curves. Using this method, depth and thickness of various sub-surface layers and their water yielding capabilities can be inferred. The main objective of the present study is to apply electrical resistivity method (VES) to identify the ground water condition and the nature of sub-surface layers within the study area.

Geology: The rock formations of the study area represent igneous and metamorphic rocks formed during Archaean – Proterozoic times. Weathered granite, Granite with intercalations of feldspar and quartz vein. Dolerite dyke. Hornblende biotite gneiss/ Migmatite. River alluvium of recent age is composed mostly of sand and subordinately of silty or clayey sand and is confined all along and on either side of the Alli Vanka, Mugguralla vanka and Bahuda.

Geomorphology: The land forms and the structural features associated resulted from the geotectonic activity indicate a definite control over the hydrological conditions of the area. In the evolution of landscape there is a systematic sequence of land forms which makes possible the recognition of stages of development and the difference in land forms are largely explainable in terms of differences in lithology structures and geomorphic process.

Some of the Geomorphological features of the basin are studied based on survey of India, topo sheet No.57 k/10 and the map prepared form satellite imagery and by conducting intensive field check. The land forms indentified in the study area, dolerite dyke, fault/fracture line valley (F.V.). Moderately weathered pediplain (PPM). Shallow weathered pediplain (PPS) pediment inselberg complex (PIC). There is acute drinking water problem prevailing in Madanapalle Town(Fig.1). The ground water level is 800 feet depth at present due to short fall of rain for last 4 years.

**Status of Bore wells**

| Status of Bore Wells | Power Bores | Hand Bores | Total |
|---|---|---|---|
| No. of bore wells | 237 | 154 | 391 |
| No. of dried up bore wells | 182 | 64 | 246 |
| No. of bore wells functioning at present | 55 | 90 | 145 |

**Population as per 2011 census** : 137262

**Water requirement for the present population** : 25.00 LGPD or 11.12 mld

**Present supply** : 9.90 LGPD or 4.41 mld

**Short fall** : 15.10LGPD or 6.71 mld

The Municipality is not in a position to supply water through pipe lines completely to the entire population. Water supply is being supplied through pipe line covering a population of about 15,000 only as against population of 1,37,262. The Municipality is transporting the water through tankers. The drinking water supply has been depending on transportation of water through tankers only.

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There is, therefore dire necessity to conduct Geohydrological survey and geophysical survey of Allivanka Micro Basin. That is only source under reserve forest, unexploited so far. Allivanka raises from MadiniKonda hill located adjacent to streams together join Bahuda river in Madanapalle town. This is located in the Survey of India topo sheet No.57 k/10 on a scale of 1:50,000 and lies in between North Latitudes $13^0 31' 30''$ and $13^0 33' 15''$ and the East longitude $78^0 30' 16''$ and $78^0 31' 23''$. In order to understand the ground water potential of this area, as also its quality for domestic and irrigation purposes, an electrical resistivity survey has been carried out and compared with the available lithology of the drill holes in the area to delineate the different water resources zones.

**Experimental**

Seven vertical electrical soundings (VES) were carried out in a 4 Sq. Km study area. A direct current resistivity meter with constant current facility was used for the soundings. Schlumberger method of Electrode separation of up to AB/2=100 mts is adopted. The vertical electrical sounding curves of the area is generally multi layered with a few containing three layer H-Type sections. Some of the typical curves obtained are shown in figure 2. The apparent resistivity curves were interpreted using the theoretical curves for three layered medium prepared by RIJKSWATERSTAT and the auxiliary point charts (Bhattacharya and Petra, 1968). The interpreted sections were correlated with lithological formations exposed in the area in the vicinity of the sounding stations. The unit obtained by the curve matching technique are as follows:

**Top Soil** : 9 to 48 ohm – meters

**Sandy Clay & weathered rock** : 14 to 28 ohm – meters

**Semi hard to hard formations** : 81 to 440 ohm – meters

The higher order resistivity of the top layer is due to dryness of the soils. The Geoelectrical sections of three soundings stations were correlated with the bore well sections as detailed in table 1.

**Table 1.**

| Lithology | 1.ALLI VANKA | | 5.MUGGURALLA VANKA | | 4.ELAKA KUNTA | |
|---|---|---|---|---|---|---|
| | Depth in mts. | Resistivity Ohm – meters | Depth in Mts. | Resistivity Ohm-meters | Depth in Mts. | Resistivity Ohm-meters |
| Top soil | 0-1.5 | 44 | 0-1.6 | 66 | 0-1.2 | 75 |
| Sandy and weathered rock | 1.5-25 | 18 | 1.6-27 | 24 | 1.2-19.4 | 28 |
| Semi hard to hard formation | 25-∞ | 390 | 27-∞ | 430 | 19.4-∞ | 440 |

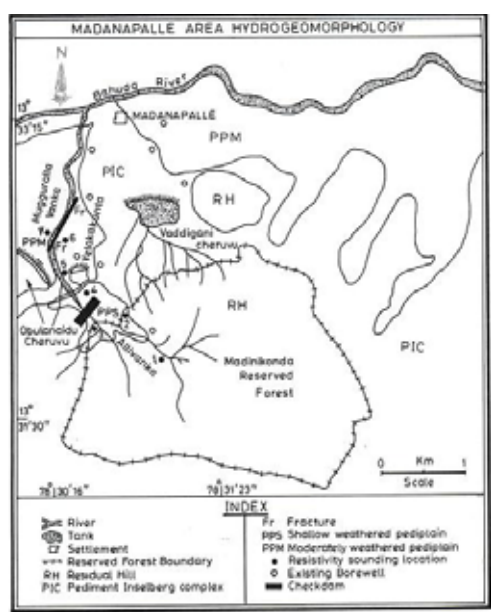
First layer ( Soil zone ) resistivity ranges from 9 to 75 ohm-meters and an average thickness of about 1.2 meters (table.1). This fluctuation in the resistivity values is due to local conditions, mainly the moisture content. The resistivity of the second layer is from 14-28 ohm-meters and its thickness ranges from 9.2 to 31 meters. This layer corresponds to the weathered layer. The high resistivities are noticed in areas of hard substratum. The electrical resistivity survey revealed the presence of a multi layered system characterized by alternating clay and sand zones along with their mixed proportions besides weathered products. For this zone the quality of the ground water in the study area in general is useful both for domestic and irrigation purposes.

**CONCLUSIONS:**

Based on this type of analysis, it can be easily told to even a common man about the ground water potential and storage. In any given particular zone. This will greatly help in precisely targeting the ground water, so that during the ground water exploration programme, digging of wells in negative areas will be avoided. The quality of the ground water in the study area in general, is useful both for domestic and irrigation purposes.

It is absolutely necessary to construct check dams across the streams as many possible and where ever it is feasible. These check dams will not only minimize the surface water runoff and also act as recharge structures and will help to boost up ground water levels considerably. These water flow arresting measures can be tried out in Allivanka and Mugguralla vanka. Bunds if Elakakunta, Vaddigani cheruvu and Obulanaidu cheruvu may be strengthened along with carry out desiltation work. Water evaporates very rapidly during summer season. Added to this, the water is lost due to surface tension. Thus even the less quantity of water available is less utilized, presently. But the storage of water can be increased along with percolation, if injection wells are drilled in the above tanks. Thus the water can be of use the only after the injection wells are constructed.

Hence it is essential to extent the sub surface dam and built it properly on right side of Bhudha River near head water works to improve the ground water storage. Number of gully control works and rock fill dams for the smaller streams and check dams for the main streams are essential to exclude the silt and to protect ground water loss through evaporation. Water harvesting structures are essential to improve recharge of ground water.




## REFERENCE

Murthuraj D., Srinivas Y.and Chandrasekar N., (2010), Delineation of ground water potential areas – a case study from Tirunalveli District, TamilNadu, India,International journal of applied environmental sciences, 5, pp 49-56. | | Patra, H.P., Nath, S.K., (1999),Schlumberger Geoelectric sounding in ground water:Principles, Interpretation and applications. Oxford & IBH Publishing company Pvt.Ltd., New delhi,p 153. | | Rijkswaterstaat, 1969. Standards graphs for resistivity prospecting. European Association of exploration Geophysicists, the Hague, The Netherlands. | | Selvam,s., T.Seshunarayan., G.Maniran., P.Sivasubramanian., D.Maniran.,(2010), Groundwater investigation using geo electrical survey: A case study from Kanukunta village, Andhra Pradesh, India Journal of outreach,4,pp 147-158. | | Todd, D.k., (1980),Groundwater hydrology. John Willey sons. Inc. New York, pp 535. | | Yadav, G.S. and Singh, C.L. 1985. New sets of direct and inverse schlumberger filters fore resistivity sounding interpolation. Bolletino di Geofisica teorica ed Applicata, Vol. 27,No. 108, P. 251-262. | | Zohdy,A.A.R. and Jackson,D.B. 1969. Application of deep electrical soundings for ground water exploration in Hawaii.Geophysics, Vol. 34, P.584-600. |