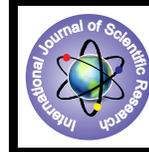


# Mapping for Artificial Recharge Sites in Jainoor and Sirpur(U) Mandals of Adilabad District, Telangana State, India. By Electrical Resistivity Method



## Physics

KEYWORDS :

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### ABSTRACT

*With the increased demand on water resources, the availability of ground water became scanty in arid and semi arid regions. The agricultural activities are purely based on the availability of surface and ground water resources.*

*To augment the demand for ground water, the application of artificial recharge method offers great scope at the time of shortage of water. The selection of recharge method depends on the geology of area, geomorphology, soil conditions and weathering profile and thickness. The lithology in the area is Basaltic rocks of Deccan Plateau and Peninsular gneisses and granites. Successive basaltic lava flows resulted in layered crystalline rocks with intervening beds of clay, ash beds etc. The inter-trappean beds form good aquifers in addition to the top weathered and fractured zones of secondary fractures.*

*A comprehensive geophysical attempt is made to delineate various lithological conditions by applying electrical resistivity method by vertical electrical sounding (VES) in the study area. There are about 120 electrical resistivity soundings conducted, and most of the VES curves were interpreted as A, H, and HA type. Through the electrical resistivity data obtained were interpreted and a lithological map and iso-resistivity maps are prepared. The iso-resistivity and electrical profile maps became a model in locating artificial recharge zones. The second and third order streams are also acting as good aquifer recharge areas. The electrical resistivity method is proved to be more suitable in locating possible sites for artificial recharge.*

### Introduction:

Today, Groundwater resources are alarming and have become serious concern. Water is becoming precious like any other noble metals. The demand for water resources is increased to many folds, due to rapid urbanization and industrialization. It is the responsibility of every citizen to monitor the ground water resources and to cater the needs for the generations to come. The artificial recharge is gaining its importance as one of the strategies of water management. Artificial recharge refers to transfer of surface water to the aquifer to accelerate through percolation of stored or flowing surface water (Karanth, 1994).

Geophysical methods particularly electrical resistivity is one of the useful tools in identifying the subsurface structural characteristics including the weathered profile. The application of electrical resistivity in hard rock terrain like granites and basalts is more informative and result oriented. Identifying the weathered thickness becomes easier by using Vertical Electrical Sounding (VES).

Artificial recharge aims at augmentation of natural replenishment of ground water storage by some method of construction like spreading of water or artificially charging natural condition. It is useful for reducing overdraft, conserving surface run-off and increasing availability of groundwater supplies in arid and semi-arid regions (Taheri Tizro, 2008).

Artificially recharging ground water is to be considered as is governed by several factors like, presence of suitable source of supplying water and lithological composition, thickness and permeability characteristics of geological formations etc., (Healy and Cook, 2002).

### Location:

The area under investigation forms part of topo sheet No 56 I/15 covering two mandals namely Jainoor and Sirpur(U) of Adilabad district, Telangana state, India. These two mandals occupies between latitudes 19°15'00" to 19°29'00" and

longitudes 78°50'00" to 79°00'00" covering an area of about 280sq-kms.(Fig. 1). The study area is 70kms away from the district Head quarter Adilabad, and is around 300km from the state capital of Hyderabad. The area is well approachable by all means.

The major geomorphic regions identified in the study area are Deccan Traps plateau region, hills and pediplains. The topography is undulating and the western part of the area is covered with residual and structural hills and reserve forest. The eastern part of the area is mostly plain with gentle sloping to furdsther east.

### Climate and Rainfall:

The climate of the study area is characterized by hot summer and is generally dry during SW monsoon period. The mean daily maximum and minimum temperatures are around 29°C and 15°C. Normally the summer season is quite hot due to presence of coal mines in the adjacent areas. The year may be divided into four seasons namely cold season (Dec-Feb), summer season (March-May) south-western monsoon (June-Sept) and followed by post monsoon (Oct to Dec) and May is the hottest month with 46-48°C.

The rain fall in this region is wavy and the SW monsoon is very active. The rainfall increases from S-W towards N-W monsoon periods. Monthly rainfall distribution of five year average is given in Fig. 2. The annual average rainfall of the two Mandals is around 960mm, and is nearer to the district average of 1050mm. The highest rainfall received during the year 2013 in North West monsoon period is 825mm. The average rainfall in the North east monsoon period is about 900mm.

### Drainage:

The mighty River Godavari, which enters into Telangana state at Basar village (a spiritual temple place of Goddess Saaraswathi). The river Godavari drains the study area with its tributaries such as river Bander, and other small

rivulets.

The drainage in the area is parallel to sub-parallel and is the natural phenomenon of Basaltic terrain. In the SW side of the Sirpur(U) & Jainoor mandals is showing sub-dendritic type of drainage. The Bander River in the area is flowing from West to East and joining with the mighty river Godavari (Fig. 3.). It is peculiar to note that no surface water bodies are found in the study area. This may be due to plain or gentle sloping topography and lead to surface runoff of rain water instead of percolating in to sub surface, and sometimes spreading like blanket of water on surface during rainy period.

The lineaments are showing the East West direction, and majority are found with NE-SW trend in the basaltic terrain, and a few are in the NW-SE direction in granitic terrain. The fracture intensity in this area is more profound for the infiltration of rain water.

There are two major types of soil profiles observed in the study area. The insitu black cotton soil derived from basalt rocks with a thickness of 2.5 to 3.0 meters. The red and brown sandy and loamy soils derived from granites to thickness of 1.5 to 2.0 meters. The soil covers in the up land areas is less and up to 1.0 to 1.5 meters only. In general the in the area are more fertile moisture retainers.

**Geology of the area:**

The area under investigation is covered with Deccan traps and peninsular gneisses and granites. Basaltic flows of molten lava poured out of fissures which spread over the north and north-east parts of the study area. These flows gave rise to flat topped mountains known as Deccan traps. In between the lava flows during the period of interval, intertrappens were deposited. During the long period of volcanic activity there were no significant geological changes occurred except for alteration of Deccan traps into laterites and the depositions of alluvium and gravel (CGWB 2013).

In the south-western part of the area is covered with oldest rock types of peninsular gneissic complex (Archeans) including granites, gneisses and intruded by basic dykes and quartz veins (Fig.4). The granites and gneisses in the area are mainly gray and pink consolidated type. At some locations these basalts shows well developed vesicles with secondary minerals like quartz and calcite.

These Basalts are both massive and vesicular type. The successive lava flows resulted in layered crystalline rocks with intervening beds of clays. The contact zones between successive flows and intertrappens beds form good aquifers in addition to the weathered and fractured zones.

plains are developed in the Proterozoic and Gondwana sedimentary domains. Groundwater occurs in the pores formed due to secondary structures which have been developed due to weathering and tectonic activities over the period in granites and gneisses.

Groundwater occurs under unconfined conditions in the shallow weathered mantle and semi-confined to confined conditions in the fractured and fissured zones. The occurrence and movement of groundwater in the study area mainly controlled by climatic conditions and intensity of rainfall, topography, geological formations, weathering, joints, fractures, fissures, bedding plays an important role. The depth of weathering in the area ranges between 5-12 meters below ground level and the depth of fracturing extends down to 30-50 meters depth and occasionally up to 100meters (CGWB 2013).

Groundwater is generally trapped from shallow weathered zones through dug wells (depth ranges from 4-12 meters) and from deep fractures through bore wells (depth ranges from 40-60 meters). In general it is observed that the numbers of bore wells are very meager and the main agricultural practices are from dug wells only.

**Electrical studies:**

Among geophysical methods the electrical resistivity is chosen to apply in the study area, because of its rapid economical and result oriented. This electrical resistivity reveals better information related to shallow sub surface structural features under heterogeneous conditions (Keller and Frisckchdt, 1966; Griffith and King; 1965; Zohdy et al., 1974). Extensive use of electrical resistivity method for groundwater exploration is extensively used because of direct relation between electrical conductivity and groundwater, simple field operation and improved interpretation techniques (Sabar.S.M et al, 2009).

Geophysical studies were carried out in the study areas as Vertical Electrical Resistivity Sounding (VES) to decipher the basement, using Shlumberger array to a maximum depth of 120 meters, where the basement rock is encountered. Interpretation of geo-electrical data indicates the presence of near surface potential layers and weathered zones (Hani Al-Almost, 2012).

Electrical resistivity conducted using IGIS resistivity instrument (DDR-3), Schlumberger configuration of electrodes was used for the field surveys. The maximum current electrode separation extended up to 150m. The increase of electrode separation lead to rapidly reduced the potential difference to be measured at potential electrodes (Kirsch and Ernston, 2006). Therefore the potential electrode distance was increased gradually to get a better signal. The selections of sounding locations were governed by the field conditions. The apparent resistivity values obtained were interpreted using traditional curve matching procedure and drawing auxiliary point diagram (Orellana and Moony, 1966).

There are around 120 VES's were carried out to cover the entire study area and the results were tabulated and shown in Table no: I. The VES curves obtained were also interpreted using IPI2WIN software for different layers. Resistivity pseudo sections prepared considering the linear positions of VES points, generally the VES curves were showing multilayer of H, A and HA type.

**Hydro geological conditions of the area:**

The Deccan Traps form plateaus and sloppy hills with escarpments. Structural/denudation hills and valleys and

**Results and Recommendations:**

Selection of artificial recharge zones the main task was to

STRATIGRAPHIC POSITION OF THE AREA



identify factors facilitating recharge (Saraf and Choudary, 1998). The existing artificial recharge system in the area has been studied with respect to its topography, hydrogeology, lithology and responses in the water levels of wells (Saranan, 2012).

The geo-electrical data after interpretation prepared the iso-resistivity maps for individual layers like h1, h2 and h3 for their thickness. The iso-resistivity maps are restricted to three layers and are shown in (Fig. 5 a-d). The total thickness (H) is attained by summing all the three layers (h1+h2+h3), and is considered as the zone of weathering (Fig. 5d), the total weathered thickness is more in the eastern side of the study area.

Resistivity profiles drawn along AA', BB', CC' and DD' in different directions (fig.6a-d). These profiles considered to study the horizontal variations in resistivity and its respective weathered and saturation zone. Profiles AA' and CC' are drawn in the NE-SW direction, BB' and CC' are drawn NW-SE direction. Profile AA' ( fig.6-a) is passing through Gouri village to a length of 8km in NE-SW direction, low resistivity zones are found at Pochamloddi and sivanur vil- lage with a weathered and fractured zones 30-35 meters. This phenomenon is also reflected in the iso- resistivity map.

The similar low resistivity zones are observed at Marlawai, Burnur, Sirpur and Danora villages are found to be more suitable sites to construct recharge structures. In these sites the weathered zone thickness varying from 7.5meters to 10meters. Electrical resistivity data acquired for both vertical and lateral variations, made possible to estimate the aquifer thickness and its lateral distribution of groundwater.

Pochamloddi, Sivanur, Marlawai, Danora, Burnur and Sirpur villages are found in low resistivity zones with less than 50 ohm-m and a corresponding thickness of 10-30meters, indicates the weathered formation and is more favorable for groundwater accumulation. This type of unconfined formation is found to be more suitable for the development of artificial recharge structures. Electrical resistivity in the deeper levels of 50 and 80 meters are noticed with secondary structures like fractures and fissures and may form good aquifer.

The resistivity variations both vertical and lateral it is possible to estimate the depth of weathered formations and its lateral distribution of groundwater. The low resistivity with less than 50 ohm-m indicates the weathered profile and is favorable for the accumulation of groundwater. A huge artificial recharge structure is possible at Marlavai village which is located in between two hillocks and is the interaction place of profiles BB', CC', DD'.

Fig. 1. Map showing of the study area.

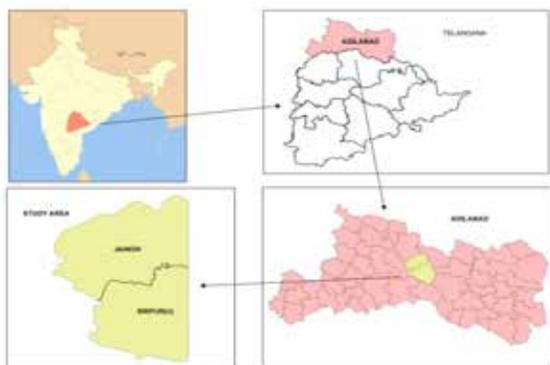


Fig. 2. Szowing the average rainfall

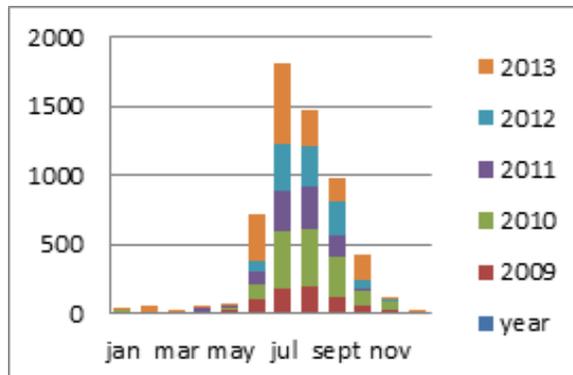


Fig. 3. Map showing drainage and lineaments

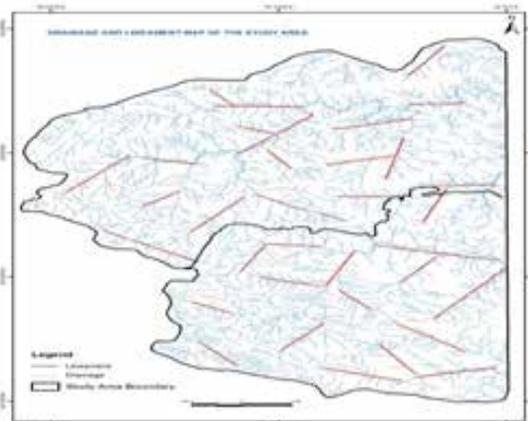
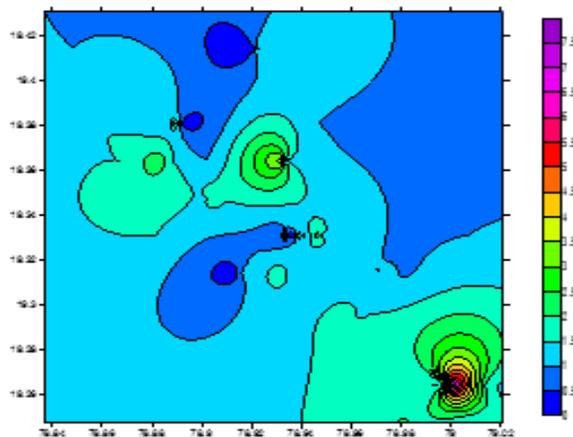
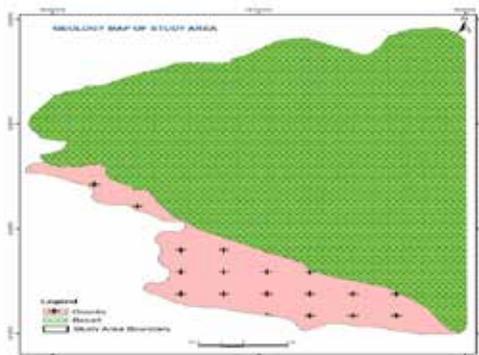
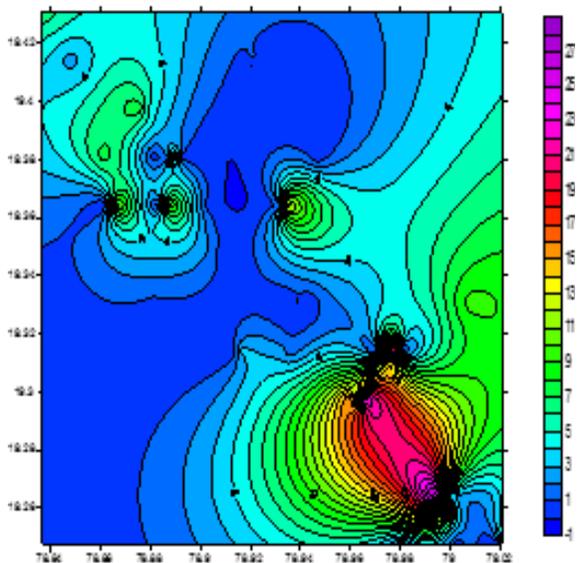


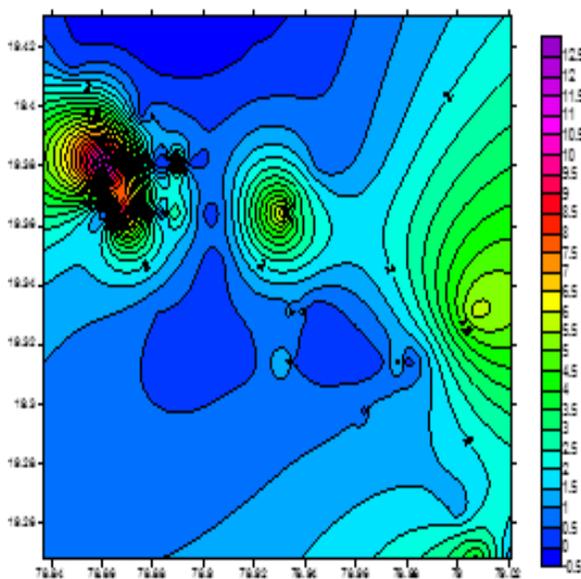
Fig. 4. Geological map of the area.



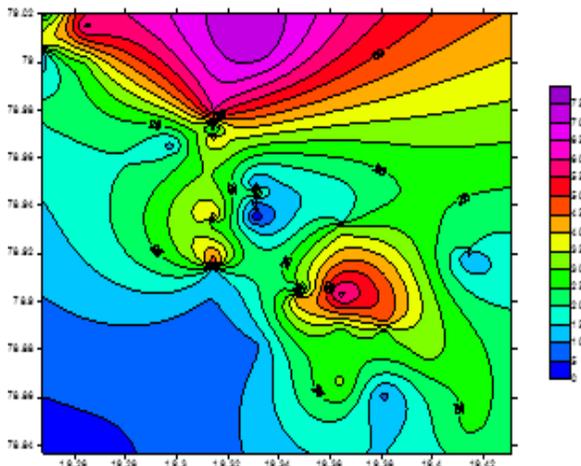
Iso-resistivity of h1



Iso-resistivity of h2



Iso-resistivity of h3



Iso-resistivity of h4

Fig. 5. Iso-resistivity Contour diagrams for VES layers

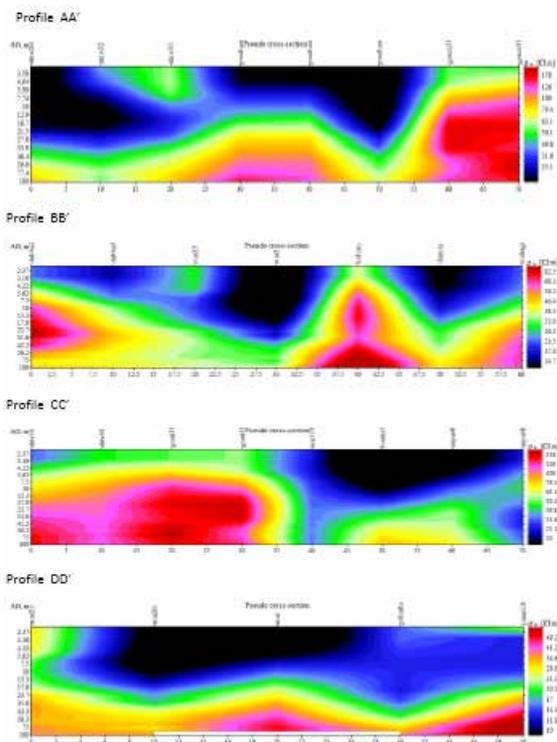


Fig. 6. Pseudo sections drawn for depth of weathering

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