Identification of Groundwater Potential Survey Using QGIS of DBATU campus, Maharashtra, India

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Abstract : Groundwater is a resource of water that occurs below the surface of the earth. Groundwater is mostly found underground in between cracks and spaces in soil, rocks, and sand. Groundwater is a source of recharge for lakes and rivers. Groundwater is used as the main source of water supply in towns, cities, and rural areas surface water schemes are more expensive because of project construction costs. Raigad district faces extreme scarcity of water in the summer season due to improper management of rainwater. Therefore, it is leading to puncturing of the rivers, canals, and lakes by unnecessary construction of well or digging borewell, which eventually will dry out. The Comparative Study of Groundwater potential zones in Dr. BATU Campus it would be done because the campus faces water scarcity, as well as there are many upcoming constructions in the campus. The study demonstrates the potential of geographical information systems and statistical-based approaches to identify the hydrological processes and demarcate the groundwater prospect zones near a campus building. The area is situated in Heavy Rainfall, Humid tropical climate, and influenced by the Canal following in some parts of campus. Various thematic maps such as drainage, geomorphology, geology, slope, soil, lineament, and lineament density will be used. The area of the campus is 971.7 km^2 and the coordinates of the area are E18°10'15", N73°20'22". Potential groundwater zones will be detected by using QGIS, Google Earth, and using Earth Resistivity meter. The main objective of this study is to find out the potential groundwater zones and also the slope of groundwater in the campus so accordingly wells or bore well can be dug so at appropriate points. To evaluate Physic-chemical characteristics of groundwater, to study the spatial and temporal variation of groundwater quality, to develop a quality model using suitable prediction modelling.

Index Terms **– Geographical information systems (GIS)**

I. INTRODUCTION

The spatial variability of physical properties that significantly influence the fate of water and solute in soils needs a large number of measurements to be quantified. Surface electrical resistivity techniques could be used as a simple and practical method to determine this spatial variability. Electrical sounding and profiling measurements were taken on a small agricultural field (30 by 60 m) under two different soil conditions (dry and wet conditions). The soil profile is composed of three layers: a highly permeable sandy loam (alluvial terrace) overlying a gravelly sandy till that covers a friable sandy to silty shale. The soil physical properties (grain size distribution, porosity, hydraulic conductivity, bulk density, and organic matter content) of the uppermost layer were measured in the laboratory on undisturbed soil cores taken at three different depths on a 6 by 15 m grid in the field.

Geographic Information System (GIS) can be defined as a system for entering, storing, manipulating, analysing, and displaying geographic or spatial data. The development of Geographic Information Systems GIS is highly influenced by the evolution of information technology; the paradigm of GIS is shifting. Traditional GIS systems provide capabilities to handle geo-referenced data, including data input, storage, retrieval, management, manipulation, analysis, and output. However, with closed and centralized legacy architecture, current GIS systems cannot fully accommodate distributed, diverse network environments due to their lack of interoperability, modularity, and flexibility. With advances in computer networking technologies, a distributed geographic information services paradigm becomes a reachable goal.

Remote Sensing

Remote sensing is the process of detecting and monitoring the physical characteristics of an area by measuring its reflected and emitted radiation at a distance (typically from satellite or aircraft). Special cameras collect remotely sensed images, which help researchers "sense" things about the Earth. Some examples are:

- Cameras on satellites and airplanes take images of large areas on the Earth's surface, allowing us to see much more than we can see when standing on the ground.
- Sonar systems on ships can be used to create images of the ocean floor without needing to travel to the bottom of the ocean.

Cameras on satellites can be used to make images of temperature changes in the ocean

II. Objective

To check if the area is suitable for future construction of building in the campus or not. Also, to check if the water level and type of rock present at the decided points which will benefit the future construction. Also, to know the ground water level because the area faces a severe water scarcity in the summer season.

III. RESEARCH METHODOLOGY

3.1.1 Development of Thematic layers

The base map of DBATU campus was prepared according to the Survey of India (SOI) toposheets (1:50,000 scale). To assess groundwater potential zones, multi-parametric data set, namely, geomorphology, watershed, contour map, slope, vector, LU/LC, drainage density, were prepared using topographic maps, existing map, data collected from the field study, and satellite image using integrated techniques such as RS and GIS .The satellite data, Sentinel-2 imagery, were accessed from Earth to explore the site (http://www.usgs.gov/). The LU/LC, drainage map were prepared based on the Sentinel-2 (spatial resolution 10 meter) false colour composite (FCC) images in QGIS software using visual interpretation techniques with field check.

3.1.2 Geomorphology

Geomorphology is the study of landforms, their processes, form and sediments at the surface of the Earth (and sometimes on other planets). Study includes looking at landscapes to work out how the earth surface processes, such as air, water and ice, can mould the landscape

3.1.3 Land Use and Land Cover of the Study Area

Land Use/Land Cover (LU/LC) is a broad term that describes the categorization or classification of human activities and natural features on the landscape across time using established scientific and statistical methods of analysis of acceptable source materials

3.1.4 Drainage Density of the Study Area

The length of the stream to a unit area of the region is defined as the drainage density. It is a suitable tool for analysis of the landform in terms of groundwater potential.

3.1.5 Slope of the Study Area

The slope is an important criterion that helps to delineate the groundwater potential zone. It directly affects infiltration and surface runoff. Low/nearly level slope has high infiltration and low runoff, resulting in good groundwater recharge, while moderate to steep slope enhances surface runoff. A slope map was prepared from the SRTM elevation data with the help of ArcGIS software the slope map is categorized into three classes, nearly sloping (0–1%), very gently sloping (1–3%), and gently sloping (3–5%)

3.1.6 Vector of the Study Area

The Vector Map (VMAP), also called Vector Smart Map, is a vector-based collection of geographic information system (GIS) data about Earth at various levels of detail. Level zero (low-resolution) coverage is global and entirely in the public domain. Level 1 (global coverage at medium resolution) is only partly in the public domain.

3.2 Instruments:

1. Earth Electric Resistivity Meter - A resistivity meter is an electronic device used to measure the flow of electric current through the ground from electrodes inserted at regular intervals by using Schlumberger Method.

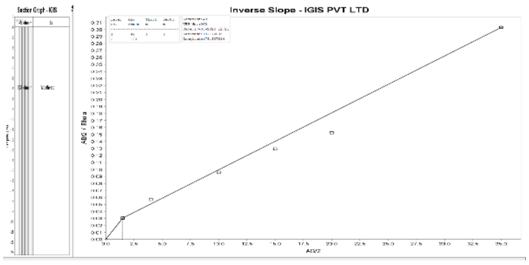
2. Software – IGIS VES is use for making graphs.

IV. RESULTS AND DISCUSSION

Point No. 1

Location:- Latitude – E18^{0}17’08” and Longitude – N73^{0}33’78’’

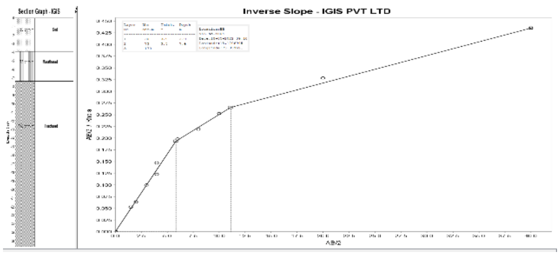
Soil found upto the depth of 0 to 1m, weathered rock found upto the depth of 1 to 23m. Weathered rock have low resistivity, so there will be presence of ground water within the level of weathered rock .



Point no. 2

Location:- Latitude – E18^{0}17’06’’, Longitude – N73^{0}33’36”

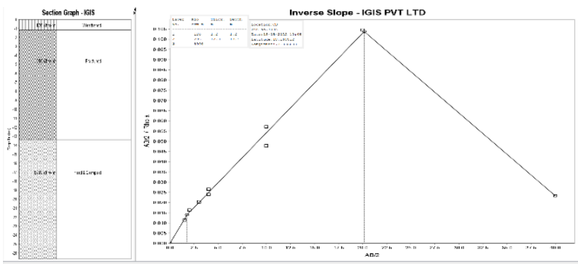
Soil found upto the depth of 0 to 4 m and weathered rock found upto the depth of 4 to 7 m, fractured rock found upto the depth of 7 to 26 m. Weathered rock and fractured rock have low resistivity so there will be presence of ground water within the level of weathered rock and fractured rock .



Point no. 3

Location:- Latitude E18^{0}16’88’’ and at Longitude – N73^{0}33’66’’

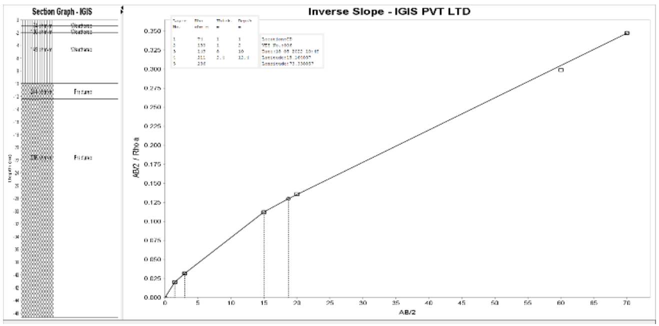
Weathered rock found upto the depth of 0 to 1 m, fractured rock found upto the depth of 1 to 13 m, Hard and compact rock found upto the depth of 13 to 26 m. Hard rock have the high resistivity,so there will be no presence of ground water.



Point No. 4

Location:- Latitude – E18⁰16'40'' and at Longitude – N73⁰33'88''

Weathered rock found upto the depth of 0 to 10 m, Fractured rock found upto the depth of 10 to 46 m. Weathered rock and fractured rock have low resistivity so there will be presence of ground water within the level of weathered rock and fractured rock.



V. CONCLUSION

Geographic Information System (GIS):

Map making is an event that we perform every day. GIS allows users to create, collect, analyse and visualize data in an integrated database for use in a wide array of disciplines. Community based planners can utilize GIS along with contemporary data and local knowledge for capacity-building and long-term sustainability. Land use land cover maps are prepared by using of GIS and obtained from IRS-ID-LISS III, which georeferenced with SOI of 1:50,000 scale. Information on land use and land cover is required for the assessment of groundwater availability and management. The research area contains a verity of land uses and land covering including agricultural land, built up area region, forests, wastelands, trees and water bodies. As shown, there are various classes of drainage density ranging from very low to very high. In our study area it shows that zone of lower drainage density will have good groundwater prospectus. The slope is an important criterion in determining the potential zone for groundwater. It has an impact on infiltration as well as surface runoff. The Vector Map is a compilation of GIS data about Earth with varying levels of detail that is vector-based.

Electric resistivity meter (SSR-MP-ATS):

Based on all the case study presented, it shows that the application of SSR-MP-ATS had successfully helped engineers in mapping several civil engineering interests and problem, especially during preliminary stage in groundwater exploration. The groundwater can be easily detected with supported by borehole data and geochemistry information as this technique is efficient in term of cost, time and data coverage. Besides, the types of arrays chosen during data acquisition is important in obtaining precise result based on the main objective of the study. The theory and application of resistivity method should be explored in depth by engineers to obtain a reliable information. To improve understanding of this application, guidance and help from geophysicists are required as this field was their expert. We take 14 different readings with the SSR-MP-ATS machine and get the following results: point 1 depth of soil is 1.0 m and weather rock are 1-23 m. By plotting the inverse slope, we get a graph that shows high groundwater is present at that point. Similarly at point 2 depth of soil is 4m. Weather rock is 1-7 m and fracture rock are 7-26 m. By plotting inverse slope, we get the graph which shows high groundwater presents at this point. At point 3 depth of weather rock is 1m, fracture rock is 1-13 m and hard and compact rock is 13-26 m. Moderate groundwater presents and this site is suitable for civil construction purposes. Similarly, for points 1-14 we get the values for those particular points and by plotting an inverse slope graph we get, points 1, 2,4,6,8,10,11,13 at these points we get high level of groundwater available and these sites are highly suitable for construction of wells and bore-wells. For points 7,9,12 by plotting an inverse slope graph we get high depth difference between fractured and hard and compact rock. At these points we get the moderate level of groundwater availability. So, these sites are suitable for bore- wells construction. For points 3,5,14 plotting by the inverse slope graphs we get highly present of hard and compact rocks, so in that case groundwater availability is very poor. These sites are suitable for construction purposes.

Conclusive Table:

Points	Location	Water Presence
1	Latitude – E 180°17'08" Longitude – N 730°33'78"	High
2	Latitude – E 180°17'06", Longitude – N 730°33'36"	High
3	Latitude E 180°16'88" Longitude – N 730°33'66"	Low
4	Latitude – E 180°16'40" Longitude – N 730°33'88"	High
5	Latitude – E 180°17'10", Longitude – N 730 33'99"	Low
6	Latitude – E18017'07", Longitude – N730°34'29"	High
7	Latitude – E 180°16'84" Longitude – N 730°34'30"	Moderate
8	Latitude – E 180°16'84" Longitude – N 730°33'74"	High
9	Latitude – E 180°16'75" Longitude – N 730°33'86"	Moderate
10	Latitude – E 180°16'60" Longitude – N 730°33'61"	High
11	Latitude – E 180°17'05" Longitude – N 730°33'66"	High
12	Latitude – E 180°17'18" Longitude – N 730°33'82"	Moderate
13	Latitude – E 180°17'30" Longitude – N 730°33'75"	Low
14	Latitude – E 180°17'44" Longitude – N 730°33'54"	High

Table - Water Availability

Comparative Conclusion:-

From the foregoing, it may be mentioned that both resistivity imaging results revealed the highly complex hydrogeological setting of the study area. These studies also identified potential aquifer zones in such a geologically complex setting. Resistivity models generated by inverse modelling of measured apparent resistivity data signify potential groundwater aquifers at lateral distances over different profiles, we get the soil at 0-50Ωm of depth, wherein fractured and weathered rocks are predominant at depths beneath 151-250Ωm and 51-150Ωm simultaneously. Which is good for potential zone exploration of water. Layer of hard and compact layer with intercalation of sand indicates at 251-1000Ωm. The vertical electric resistivity data helps to indicate different types of aquifers present in the study area. By this we identify the potential aquifer zone. The longitudinal condense map suggests the area falls under the category of very good and excellent protective capacity rating which is a high transmissivity in some part of the area which forms the potential aquifers. The lithology of the bore well also supports the resistivity model. Also, result indicates that the low resistivity obtained at depths of and below is conducive for groundwater extraction. This zone coincides with the low resistivity precinct observed at distance over profile. Thus, this spot can be considered to drill a bore well. The combine result of lithology and obtain data from the electric resistivity meter signify the various effective result to find out most suitable site for groundwater exploration. This study is beneficial to the farming community for exploration and management of ground water. In the following 14 reading which were decided by doing GIS survey of the study area. Also, by referring all the maps slope, drainage density, land use and land cover. Then after the points were decided electric resistivity meter was used to find out the ground water level as well as rock so to cross check the data of GIS.

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