Hydrogeomorphology in Relation with other Natural Resources: A Case Study of Jilledubanda Eru Watershed, Anantapur District, Andhra Pradesh, India

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Abstract: ***Ground water is considered as the preferred source of water for meeting domestic, industrial and agricultural requirements, due to its longer residence time in the ground, low level of contamination, wide distribution, and availability within the reach of the consumer. About 90% of rural and nearly 30% of the urban population depend on ground water for drinking and accounts for nearly 60% of the total irrigation potential in the country. The dependency on ground water is expected to increase in future due to the increase in population. In this connection, Jilledubanda Eru watershed in Anantapur District is selected to study the distribution, potential, quality, and movement of ground water with respect to certain natural resources information derived through remote sensing and GIS techniques. The watershed is mostly covered in parts of seven mandals in Anantapur District. The total geographical area of the watershed is 496 sq. km. covered in the Survey of India toposheet Nos: 57 F/15, 57 F/16, 57 J/3, and 57 J/4 on 1:50,000 scale. The watershed lies between North longitudes 770 48' 25'' to 780 02' 45'' and East latitudes 140 05' 55'' to 140 26' 48''. The integrated remote sensing based information on natural resources include hydrogeomorphology, land use/land cover, rainfall and slope. The average annual rainfall of the watershed is 528mm. The study area is mostly occupied by grey/pink granite, hornblende biotite gneiss, granodiorite and lamprophyre. The granitic rocks are traversed by ENE-WSW trending dolerite dykes. The major direction of the lineaments is in NNE-SSW and NW-SE, based on the origin, the landforms are broadly divided into fluvial and denudational. Major land use/ land cover classes comprise built-up land, agricultural land, Forest land, waste land and other categories. About 45% of the watershed area is included under 1 and 2 slope categories. Ground water prospects and well density in the watershed is compared with thematic information on lithology, geomorphology, structure, and land use/ land cover and the relationship with each theme is discussed.***

Keywords: Anantapur District, hydrogeomorphology, lineament, slope, well inventory.

1. Introduction

Ground water is the mainstay of livelihood for millions below poverty level as a source of irrigation for food production, and drinking water. India is the largest consumers of ground water in the world. In hard rocks, aquifers are uneven in distribution and properties, highly unpredictable and flow equations are not fully understood yet, thereby not allowing full utilization of its potential. The fracture geometry and flow pattern in fractures are still en enigma. In hard rocks, dug wells and dug-cum-bore wells are the prevalent ground water [2] abstraction structures, and understanding their hydraulics is a vital aspect of ground water management. Reports on ground water pollution are appearing in growing numbers and a large population is affected by arsenic and fluoride pollution as also high salinity in ground water. Literature about genesis and release or mobility of arsenic and fluoride pollutants is still scanty. Estimation of ground water resource is basic to ground water planning. Ground water is an invisible resource and the laws governing its storage, movement and exploitation are distinct from those of surface water.

The principal factors controlling ground water occurrence and movement in hard rock terrain are climate, topographic setting, weathering, lithology and geologic structure [6]. While rainfall is the source of recharge, geomorphology plays a vital role in controlling distribution of precipitation, runoff, and infiltration contributing to recharge. Sustainability of ground water dictates that its extraction should be at a rate which does not exceed annual recharge and does not lead to ground water mining (Subhajyoti Das, 2008) The objective of the work is to study hydrogeomorphology or ground water prospects in relation to other natural resources like lithology, geologic structure, Land use land cover, soils, rainfall and slope to know their relationship with one another.

1.1 Study Area

Jilledubanda Eru rises in the south eastern part of Anantapur district, a highly drought affected [1] region. The Jilledubanda eru watershed is located in the Survey of India Toposheet Nos: 57 F/15, 57 F/16, 57 J/3, and 57 J/4 on 1:50,000 scale and lies between North longitudes 770 48' 25" to 780 02' 45" and East latitudes 140 05' 55" to 140 26' 48" (Fig.1). The watershed comprises total geographical area of 496 sq. km and covers parts of Bukkapatnam, Mudigubba, Dharmavaram, Puttaparthi, Nallamada Chennekothapalli, and Kothacheruvu mandals. Bukkapatnam mandal occupies more than half of the watershed area (52%) followed by Mudigubba (27%).

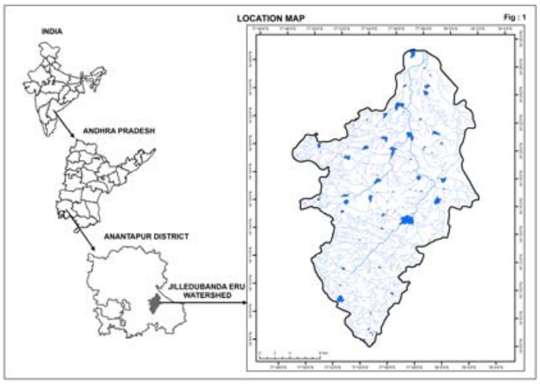


Figure 1: Location Map

2. Methodology

High resolution Indian Remote Sensing satellite, IRS-P6 LISS-IV data of 29th April 2009 with a spatial resolution of 5.8m covering Jilledubanda eru watershed is analyzed. Onscreen interpretation is carried out delineating different geomorphological units / landforms, lithological formations and geological structures and hydrogeomorphological map is prepared by integrating the above said parameters (NRSA, 2008) [4] [5]. Further, well inventory data collected during fieldwork is made use in finalizing hydrogeomorphological / ground water prospects map of the study area on 1:10,000 scale (Fig-2). Land use/land cover map is prepared using high resolution satellite data based on the guidelines adopted by NRSA (2006). Ground truth information is integrated and final Land use/land cover map is prepared on 1:10,000 scale (Fig.3). Slope map is prepared using Survey of India toposheet on 1: 50,000 scale (Fig.4). Information on depth of the well and yield are collected from 132 wells during field work. A detailed description of hydrogeomorphic units, land use/ land cover classes and various slope categories are given in the project report (APSRAC, 1997).

2.1 Geology and Hydrogeomorphology:

The study area is characteristically occupied by hard rock terrain consisting of Archaean Peninsular Gneissic Complex of hornblende biotite gneiss, granodiorite and Closepet granite (GSI, 2002) [3]. These granitic rocks are traversed by dolerite dykes. In the northern part of the watershed an isolated patch of lamprophyre is present. In the present study hydrogeomorphological mapping is carried out using IRS P6 LISS-IV satellite data. The landforms in the study area are broadly divided into two categories namely fluvial and denudational landforms (Fig.2). As the depth of weathering and nature of soil cover plays a major role in the ground water prospecting, the pediplain is further sub-divided into pediplains with shallow and moderate weathering and thus twenty five geomorphic units are delineated. They are valley, valley fill under fluvial category. In case of denudational landforms, shallow weathered pediplain on Lamprophyre, moderately and shallow weathered pediplains, pediment, pediment inselberg complex, inselberg, residual hill and denudational hill on Closepet granite, moderately and shallow weathered pediplains, pediment, pediment inselberg complex, inselberg, and residual hill on granite and granodiorite, moderately and shallow weathered pediplains, pediment, pediment inselberg complex, inselberg, residual hill, denudational hill and structural hill on hornblende-biotite gneiss. Dyke ridges are intruded into all the four lithological formations. Various aspects of ground water occurrence, distribution, quality, status of development of Anantapur District were elaborately discussed (APSRAC, 1997). The average well density in mandals included in the watershed ranges from 4-7 per sq.km and Bukkapatnam mandal which occupies more than half of the watershed is declared as over exploited (CGWB, 2007).

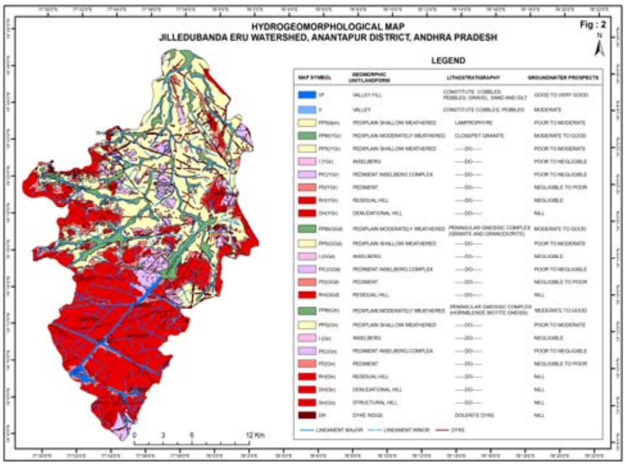


Figure 2: Hydrogeomorphology Map, Jilledubanda Eru

2.2 Land use /Land cover

This map is broadly classified into five categories which include built-up land, agricultural land, forest land, waste land and others (Fig.3). Agricultural category consists of Kharif un-irrigated, double crop, plantation, and current fallow. Forest land category includes dense forest deciduous, dense forest open and scrub forest while the waste lands are land with dense scrub, land with open scrub, barren rocky/stony waste and under others category mining area is present. Tanks, rivers and streams are grouped under water bodies.

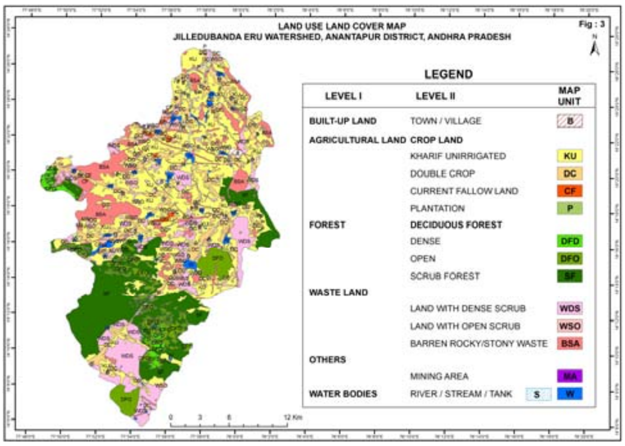


Figure 3: Land Use / Land Cover Map, Jilledubanda Eru

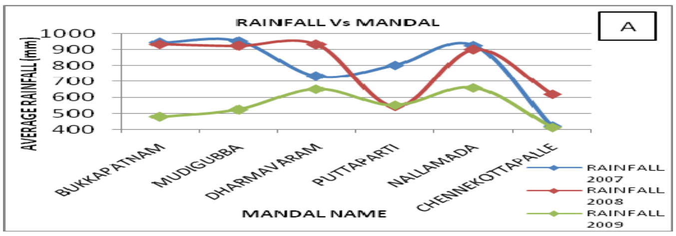
2.3 Slope

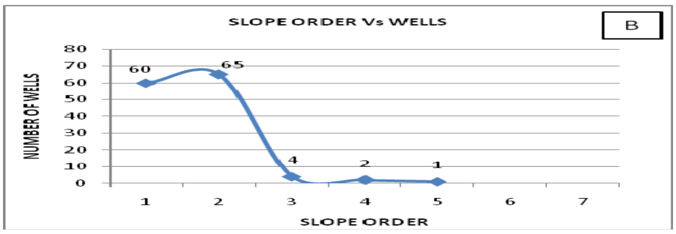
Slope map includes seven categories which comprises of nearly level (0-1%), very gently sloping (1-3%), gentle, sloping (3-5%) , moderately sloping (5-10%), moderately steep sloping (10-15%), steep sloping (15-35%), and very steep sloping areas (<35%).

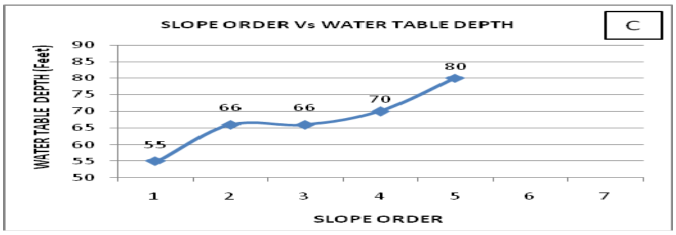
3. Results and Discussion

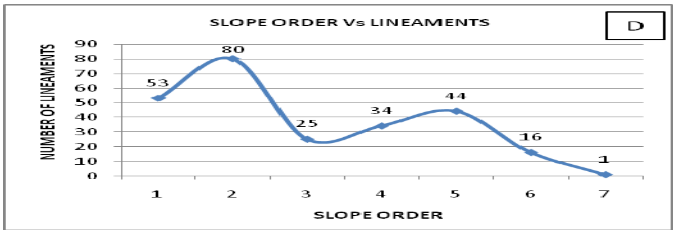
The thematic maps on natural resources such as lithology, geomorphology, lineaments, land use/land cover, slope and well inventory data is compared (Fig.4 A to P) with one another and the following observations are made. During 2007 and 2008 the average annual rainfall in Bukkapatnam and Mudigubba mandals is more than 900 mm. When compared to these two years the average annual rainfall is lower in all the mandals of the watershed during 2009 (Fig.4A).

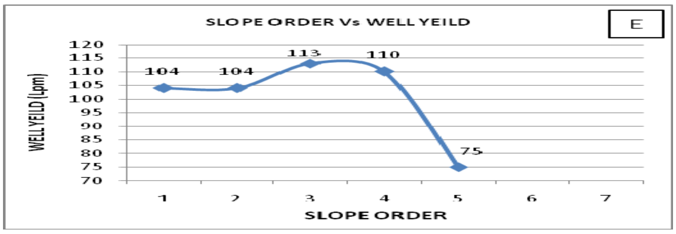
Figure 4 (A,B,C,D,E,F,G,H,I,J,K,L,M): Interrelationship of Natural Resources in Jilledubanda Eru Watershed, Anantapur District, A.P.

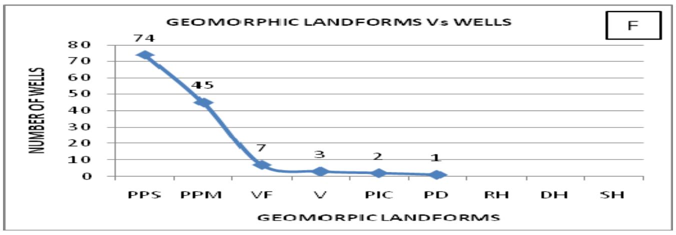


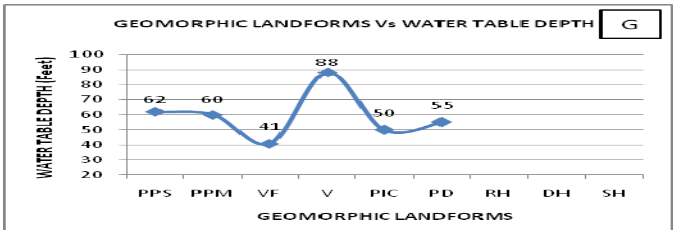


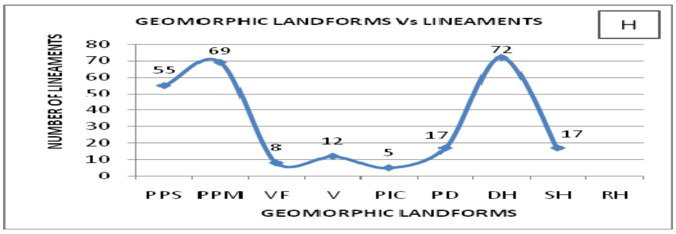


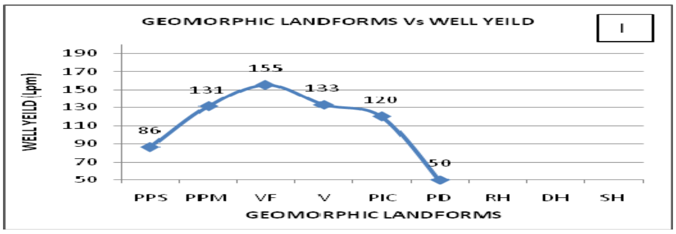


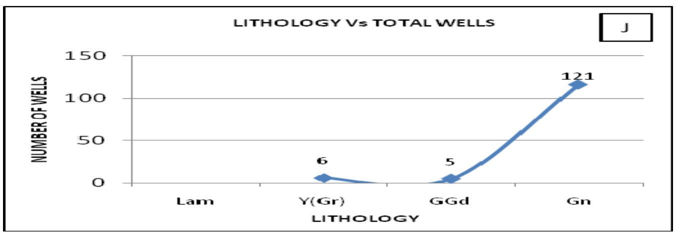


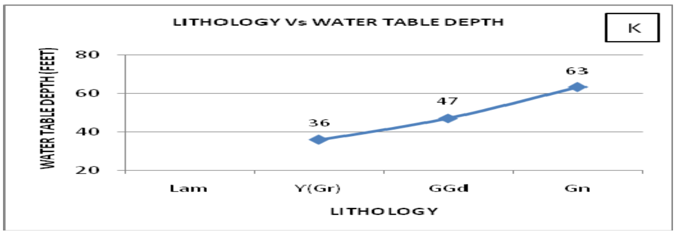


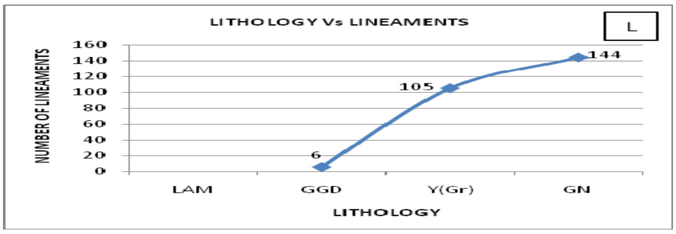


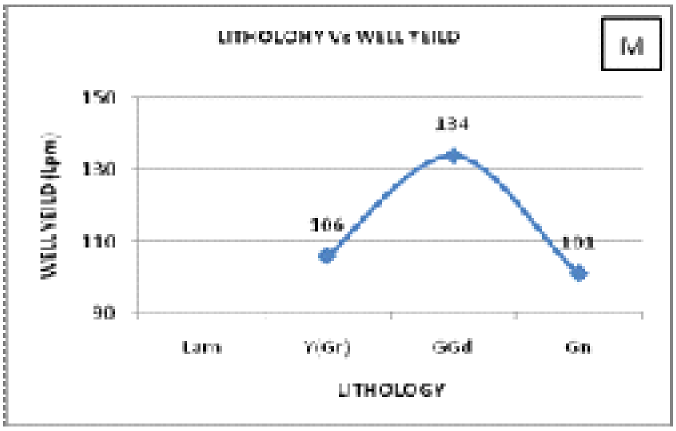


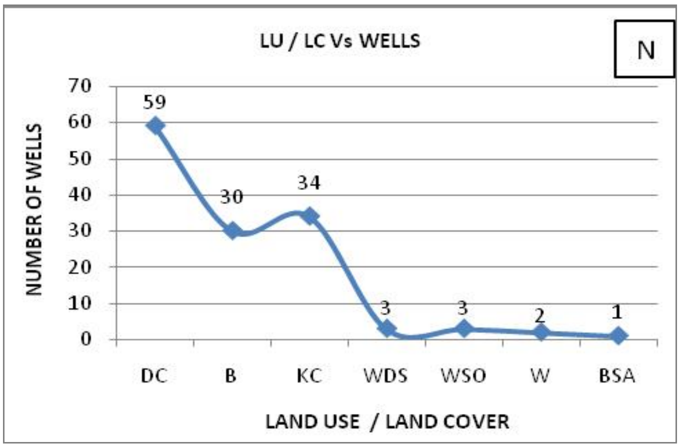


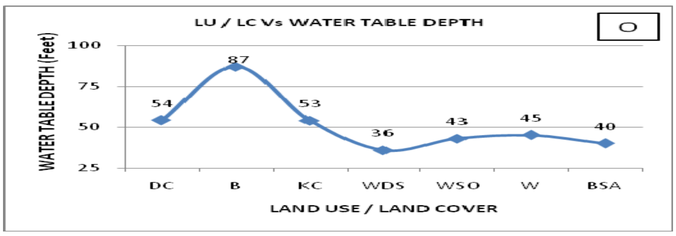


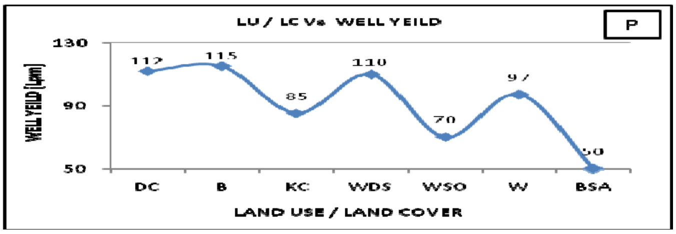












4. Conclusions

As number of lineaments is highest, number of wells is also highest in slope order 2 because of its larger areal extent (27%). The depth to water table is also highest in this category because of low rainfall in this region. In general, the ground water prospects range from good to moderate in moderately weathered pediplain areas. This is a well-established fact and is evident from the number of wells, depth to water level, number of lineaments and well yield in moderately weathered pediplain areas. Number of wells is highest in Hornblende-biotite gneiss because of its larger areal extent and gneissic nature. Average well yields are highest in built-up land followed by double cropped areas because majority of built-up land is surrounded by double cropped areas facilitating good ground water recharge.

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Authors Profile

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