SHORT NOTE

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# AN INTEGRATED STUDY ON GROUND WATER RESOURCE OF PEDDA GEDDA WATERSHED

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Remote sensing has became an indispensable tool for the management of natural resources of which ground water is a part. Hydrogeo-morphological studies coupled with hydrogeological and structure/lineaments have proved to be very effective tool to discern ground water potential zones in the watershed (Prudhvi Raju and Vaidyanadhan, 1984; Das *et al.*, 1992; Sharma and Jugran, 1992; Sarkar *et al.*, 2001; Rao *et al.*, 2001, Bahuguna *et al.*, 2003).

The study area is a minor watershed and posing severe shortage of water for domestic and irrigation activities for the last four years due to scanty rainfall. The ground water table has gone to deeper depths and most of the dug wells got dry. An attempt has been made in this study to locate potential ground water zones and exploit ground water to cater the needs of the people in the area.

Physiographically, the area may be divided into two units namely, hilly terrain and plains. The hilly terrain is located in southern and north-western part and plains are located in the central area of the watershed. The study area is covered in 65 O/5 and 65 O/1 of Survey of India toposheets on 1: 50,000 scale bounded by 17° 4' and 17° 55' northern latitude and 83° 10' and 83° 25' eastern longitude. The drainage area of the watershed covers 184.9 km$^2$. The river terminates into the Bay of Bengal near the village Dibbadipalem (Lat 17° 50' 38" and Long 83° 24' 43"). It comes under the Visakhapatnam district of Andhra Pradesh. In this study, IRS-IB-LISS-II and IRS-ID-LISS-III data for the years 1992 and 1999 have been used respectively. The ground truth survey was carried out in January, 2003.

The drainage pattern such as dendritic, parallel, rectangular, radial, sub-dendritic and barbed were observed in the basin. Dendritic type of drainage is characteristically developed over plains. The plains are further demarcated as pediplain shallow and pediplain moderate in geomorphological studies. These areas were identified as ground water potential zones in the study area.

The area is located in the north Eastern Ghats Mobile Belt (EGMB). It is composed of high grade metamorphic rocks and igneous intrusive bodies. The order of abundance of rocks is khondalite,

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charnockite and quartzite. The geological formations occurring in the area can be grouped into two types, hard and soft rocks. Rocks like khondalite, charnockite and quartzite are grouped into hard rocks. The unconsolidated and semi-consolidated formations like alluvia and sediments are grouped under soft rocks, and these are limited in occurrence in the area. Hard rock formations generally have no primary porosity and hence, the occurrence of ground water in these formations is usually limited to the secondary porosity developed through weathering and fracturing (Karanth, 1987). The prospects for ground water development in these hard rocks are limited. Ground water in these formations occurs under phreatic and semi-confined conditions. The structural trend of these rocks is N-NE to S-SW and it coincides with the general trend of the Eastern Ghats. But, local variations are identified at some places (Sriramadas, 1964; Chetty *et al.*, 2002). A huge domal structure occurs in the area with a trend of NE – SW and is encircled by Denudational hills.

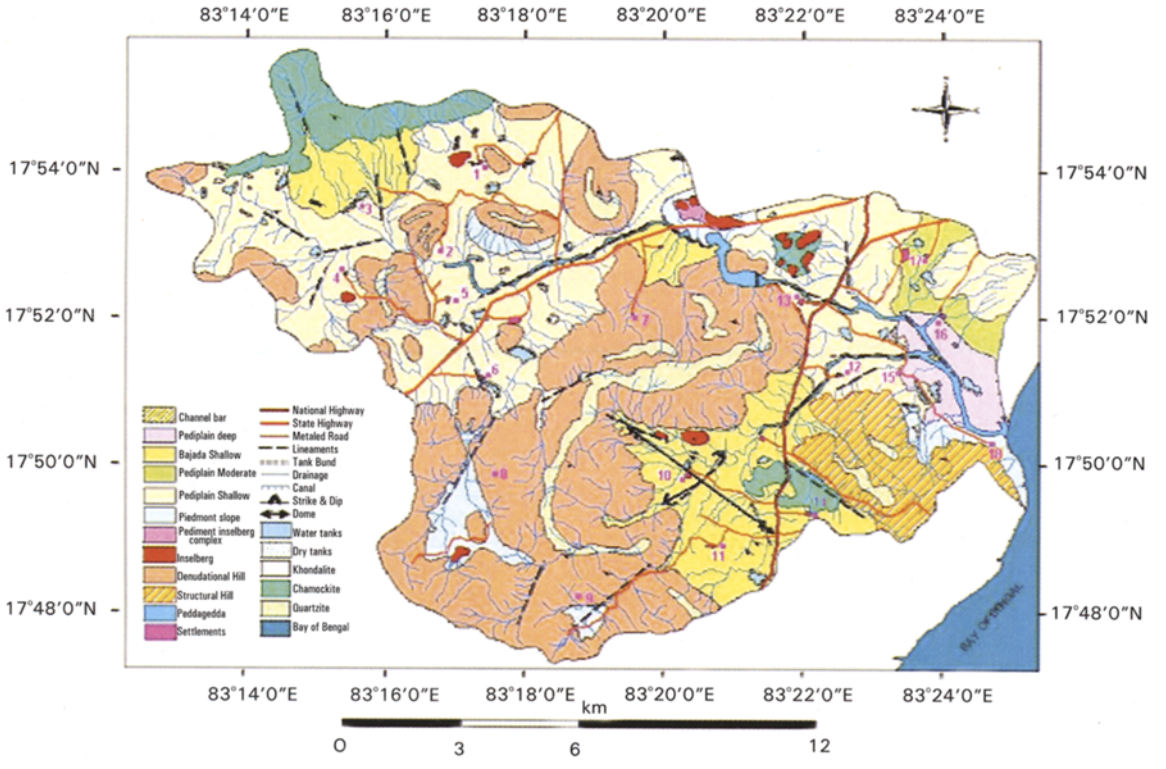
The normal rainfall of the area is 1202 mm, but in the year 2002 the rainfall was only 598 mm. This type of scanty rainfall persisted in the last four years. With this affect, the water levels in the wells have decreased. Considerable decrease in water table from 4.1m bgl to 5.6 m bgl was observed in Madhurawada, which is the major panchayat in the area. In the nearby village, Vemulavalasa also the water table decreased from 5.5 m bgl to 12.9 m bgl. This may be ascribed to erratic rainfall and excess draft in the area in the last four years.

Linear features on the False Color Composite (FCC) on 1:50,000 scale, were identified and traced. In a hard rock terrain, the fracture zones are the most important features as they form the secondary aquifers (Venkatachalam *et al.*, 1991). A limited number of field checks, have been carried out to observe its validity in the field. High lineament density is observed over the hilly terrain, and moderate to low lineament density over the plains. This shows that the hills are structurally controlled. The lineaments are proved to be good ground water potential zones in the watershed. Lineament interception with existing wells observed in the villages Kolavanipalem, Erravanipalem, Gummidivanipalem, Marikavalasa, Nidigattu and Ramayogi Agraharam yield a large quantity of ground water.

The study area is divisible into 9 landforms: channel bar, bajada, pediplain shallow, pediplain moderate, pediplain deep, piedmont slope, pediment inselberg complex, structural hills and denudational hills. These landforms act as ground water storage reservoirs and some of them can act as recharge and run-off zones (Jai Sankar *et al.*, 2001). Different landforms have been delineated by standard visual interpretation techniques on IRS-IB-LISS-II data (Fig.1).

Channel bar deposition formed at the termination point of Marikavalasa gedda into the Pedda Gedda River. It is located in the major river course and covers limited area. The bajada with moderate lineaments density in the watershed is delineated. The area is characterized by khondalite rock and has limited thickness of weathered zone with moderate drainage density. The depth of water table varies from 2 m bgl to 6 m bgl in this zone. It is an excellent ground water potential zone. The villages covered in this zone are Pappulavanipalem, Boravanipalem, Marikavalasa, Devumetta and Kommadi.

The area near the river mouth comes under Pediplain deep. This zone contains 20 - 25 meters thick weathered material and the water table fluctuation observed is from 1.2 m bgl to 4 m bgl. Geologically, the area is covered by khondalites with quartzite intrusives at some places. This reveals that the area is structurally controlled with moderate density of drainage. This is the resultant of combined affect of *in-situ* weathering and fluviatile activity of the watershed. This is the major ground water potential zone in the area. Villages covered in




**LIST OF VILLAGES**

| | | |
|---|---|---|
| 1. Lakshmidevi Peta | 7. Narayaneswara Temple | 13. Boyipalem |
| 2. Ayyavarikanamam | 8. Appikondapalem | 14. Bottavanipalem |
| 3. Kolavaripalem | 9. Chemudupalem | 15. Kapula Uppada |
| 4. Gorinta | 10. Kommadi | 16. Nidigattu |
| 5. Gollalakanamam | 11. Bakkannapalem | 17. Kottavalasa |
| 6. Mamidilova | 12. Paradesipalem | 18. Nagarapalem |

**Fig. 1.** Integrated map of Peddagedda Watershed

this area are Kapula Uppada, Pataparadesipalem and Nidigattu. Large dia dug wells are being used for irrigation purposes in this area.

Pediplain moderate contains 10 – 20 meters soil cover and allows ground water to store in weathered zone. The fluctuation of water table in this zone is from 2 m bgl to 5.3 m bgl. These areas are suitable for the construction of dug and bore wells. The villages covered in this zone are Kottavalasa and Garipeta.

The pediplain shallow areas have close proximity to the hilly terrain. The soil cover observed less than 10 meters thickness and sloppy. The depth to water table varies from 2.8 to 6.2 m

bgl in the zone. A number of dug and bore wells sunk in this area are yielding moderate quantity of ground water. The villages in this zone are Bhimannadorapalem, Erravanipalem, Gollalakanamam, Gummidivanipalem, Dukkavanipalem and Dhampavanipalem

Piedmont slope, Denudational hills, structural hills and pediment inselberg complex are poor ground water prospect zones. These can act as run-off zones in the study area.

The ground water potential of the study area

**Table 1:** Ground water prospects of Pedda Gedda watershed

| Type of drainage | Geomorphic unit | Lithology | Structure | Description | Ground water prospects |
|---|---|---|---|---|---|
| Major river course | Channel bar (CB) | Sand, silt, clay and gravel | Criss crossed by major fractures and lineaments | It is formed by fluvial deposition of alluvium along the river course | Excellent |
| Parallel | Bajada shallow (BJS) | Thin layer of soil, gravel | Major/ minor lineaments are present | It is formed by series of stream deposition along the foot hill. | Excellent |
| Major river course | Pediplain deep (PPD) | Deeply weathered khondalite | Major /minor lineaments are present | Gently sloping plain with >20m thickness of weathered zone | Very good |
| Dendritic | Pediplain moderate (PPM) | Moderately weathered khondalite | Major/minor lineaments are present | Moderately sloping plain with 10 -20m thickness of weath ered zone | Good |
| Dendritic | Pediplain shallow (PPS) | Shallow weathered khondalite | Major/minor lineaments/ fractures present | Moderately sloping plain with <10m thickness of weathered zone | Moderate |
| Sparse drainage | Piedmont slope (PS) | Khondalite overlain by thin layer of soil | Minor fractures/ lineaments | Gently sloping plains at the foot hills zones having <5m weathered zone | Poor |
| Radial | Pediment Inselberg complex(PIC) | Eastern Ghats Charnockite | Minor fractures/ lineaments | Ridges with moderate slope | Poor |
| Radial | Stractural hill (SH) | Eastern Ghats Khondalite, charnockite | Associated with folding and criss-crossed by lineaments/fractures | Hills having low relief and steep slopes with definite structural trends | Poor |
| Parallel and Radial | Denudational hill (DH) | Eastern Ghats Khondalite, charnockite and quartzite | Associated with folding and criss-crossed by lineaments/fractures | Hills having high relief and steep slopes with definite structural trends | Poor |

has been assessed on the basis of physiography, drainage, rock types and geomorphological studies using remote sensing techniques. These maps have been prepared on 1:50000 scale and an integrated map is generated following an overlay technique (Fig. 1).

Basing on lineament density, hydrogeological, geomorphological and drainage conditions, the landforms such as bajada shallow, channel bar, pediplain deep, pediplain moderate and pediplain shallow are identified as potential zones. Most of these zones are located over the plains, whereas, bajada shallow occur in the vicinity of hilly terrain. The watershed is covered by khondalite rock, which is highly weathered and formed deep weathered zones at some places. Deep weathered zones such as pediplain moderate and pediplain deep have delineated as ground water potential zones in the area. The total depth of the dug wells ranges from 5.5 m bgl to 12.9 m bgl. The fluctuation of water table observed is from 1.2 m bgl to 6.2 m bgl. The river is a non-perennial one and therefore, it is not a source of water for the development. In this juncture, the ground water potential zones are delineated as excellent, very good and good (Obi Reddy *et al.,* 2000) can be used for ground water exploitation to cater the needs of the people in this area (Table. 1). Dug, dug-cum-bore and bore wells are suggested to exploit ground water from the above potential zones.

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