Nature Environment and Pollution Technology
An International Quarterly Scientific Journal

Vol. 8	No. 2	pp. 347-350	2009

Original Research Paper

Demarcation of Groundwater Prospective Zones in a Degraded Region of Western Ghats: A GIS Based Approach

Rajesh Reghunath, S. Biju Sekhar*, R. Nithin* and R. B. Binoj Kumar
Department of Geology, University of Kerala, Kariavattom Campus, Trivandrum-695 581, Kerala
*Centre for Environment and Development, Trivandrum, Kerala

Key Words:
Groundwater potential zones
Groundwater prospective index
Degraded regions
Western Ghats
Attappady

ABSTRACT

Attappady region in the Palghat district of Kerala is one of the severely degraded areas in the Kerala Western Ghats. Apart from the severe ecological, socio-economic, political and cultural problems, the region faces an acute water scarcity too. By identifying the severe ecological degradation and the consequent sociological problems, a watershed based massive ecorestoration project has been initiated in Attappady by the State government. The present study carried out in this area deals with the identification of groundwater potential zones. The groundwater potential zones of Attappady area generated from this study identifies five zones- very high, high, moderate, low and very low. The groundwater potential map generated in this study by making use of GIS tools will be useful in narrowing down the target areas for ground resistivity surveys in order to pinpoint the prospective well site. The results of this study can be used in the ongoing ecorestoration project at Attappady.

INTRODUCTION

Water is one of the most important resources, whether it is for irrigation, power generation, or for purposes of drinking, manufacturing, etc. The spatio-temporal variations in rainfall and regional/ local differences in geology and geomorphology coupled with indiscriminate tapping of groundwater are the main reasons leading to scarcity of groundwater in many parts of the country. Present study focuses on the groundwater potential of Attappady block of Palghat district of Kerala state. This particular area was selected for the study because it is one of the most severely degraded regions in the Kerala Western Ghats due to over-exploitation of resources and as a result experiences an acute water scarcity. By identifying the severe ecological degradation and the consequent sociological problems, Government of Kerala has initiated a watershed based massive ecorestoration project at Attappady by channelling international funds and it is on going at present.

STUDY AREA

Attappady block is predominantly a tribal block and lies at the eastern half of the Mannarghat taluk of Palghat district of Kerala state (Fig. 1). The major rock types identified in the study area can be grouped into Wayanad schist complex (equivalent to Sargur supracrustals of Karnataka) and Peninsular gneissic complex. The study area is characterized with major lineaments and they are confined to the zone adjacent to the Bhavani river which follows a shear zone (Nair et al. 1981). The land use of Attappady can be grouped into natural vegetation (forest) and agricultural crops. The terrain is highly undulating and slope varies from gentle to very steep. The study area receives highly variable rainfall ranging from 700 to 4000 mm or more. The rainfall drastically reduces towards the eastern side resulting in a rain shadow effect in the eastern half of the study area. It is also to be noted that the

major rivers flowing through Attappady have been dammed either immediate outside or at the periphery of Attappady and the stream flow has been diverted to other drainage systems/neighbouring State. This fact along with the overexploitation of natural resources resulted in severe ecological degradation in the study area.

MATERIALS AND METHODS

In the present study, factors like geomorphology, structures, drainage, geology, slope and rainfall were taken into consideration for evaluating the groundwater potential of the study area. Geomorphology and structural (lineament) maps were generated from the remote sensing products (IRS 1C LISS III) and the drainage density and ground slope maps were prepared from the toposheets by digitizing the drainage lines and contours (Rajesh Reghunath 2003). Proper ranks and weightages were assigned to each component (geomorphology, lineament density, drainage density, geology, slope and rainfall), based on their proximity favouring the occurrence of groundwater. An index is formulated for all thematic maps based on the ranks and weightage. The final groundwater potential map prepared is based on the overall index (Groundwater Prospective Index - GWPI) obtained by the integration of all thematic layers selected for the study.

RESULTS AND DISCUSSION

Factors Controlling the Groundwater Potential

Geology: The various rock types in the area consist of hornblende gneiss, biotite gneiss, biotite schist and charnockites and intrusions of quartz pegmatite veins, dolerite/ gabbro and other basic dykes (Nair & Maji 1995). Texture of the rocks is more important as it defines the water holding and transmitting capacity of these rocks vis-a-vis the aquifer characteristics. In Attappady block, majority of the area is underlined by hornblende gneiss, which is intruded by dykes.

Slope: The area is highly undulating and slope varies from 0° to >35°. Steep slopes are located on the northern boundary (southern face of Nilgiris) and also in the southern sector covering Siruvani hills. The valley portions in the central part representing the flood plains of Bhavani and Siruvani rivers have gentle to moderate slope (0 to 10°) and the remaining portion is covered by moderate to steep slopes.

Rainfall: As mentioned earlier, the study area receives highly variable rainfall. In the eastern side, the rainfall ranges from 700-

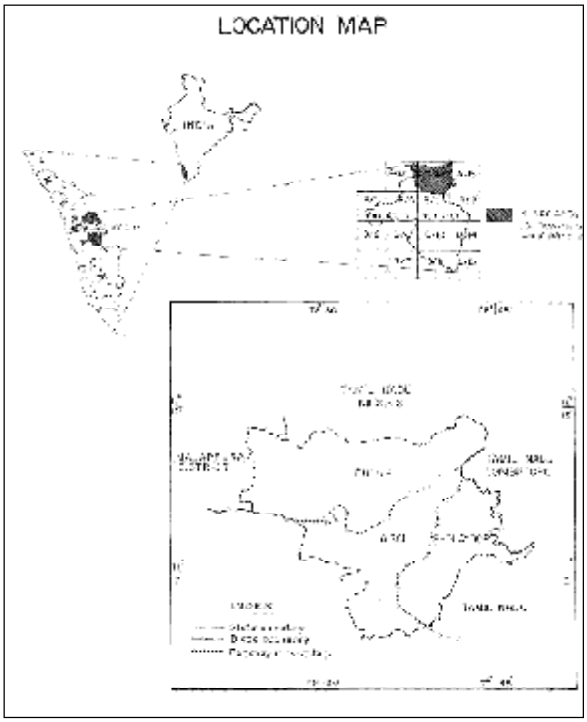

Fig. 1: Map of the location.

1500 mm, while in the western side, it ranges from 2000- 4500 mm (CWRDM 1998).

Geomorphology: Geomorphologically, the Attappady block can be divided into 6 major units such as denudational hills, valley fills, pediments, intermontane valleys, lateritic uplands and rivers, among which the denudational hills dominate the topography. The denudational hills and buried pediments can be further divided into further sub units such as denudational hill-high, medium and low, buried pediments-shallow, medium and deep, etc.

Drainage density: The drainage density exhibit low values near the boundaries of the study area. The valley portions show higher values indicating higher run-off. The observed drainage density of the study area ranges from less than 1 to more than 5 km/km^2.

Lineament density: The major lineaments of the study area can be identified along the shear zone adjacent to the Bhavani river. Based on the lineament studies, Attappady block can be broadly divided into four zones of lineament density such as < 0.5, 0.5-1, 1-1.5 and > 1.5 km/km^2.

GIS analysis: The selected parameters, viz., geomorphology, lineaments, drainage, geology, slope and rainfall were integrated in the GIS platform by overlay analysis. The resultant map was divided into five zones of groundwater potential namely, very high, high, moderate, low and very low. Fig. 2 shows the groundwater potential map of the Attappady area.

Very high potential zones are limited to a small area in Attappady block. These high potential zones are limited to the valley fills and intermontane valleys. This zone is characterized with very high lineament density. The high potential zones identified fall in the southwestern (near to the Kanjirapuzha reservoir) and central parts (northern and southern portions of Agali) of the study area.

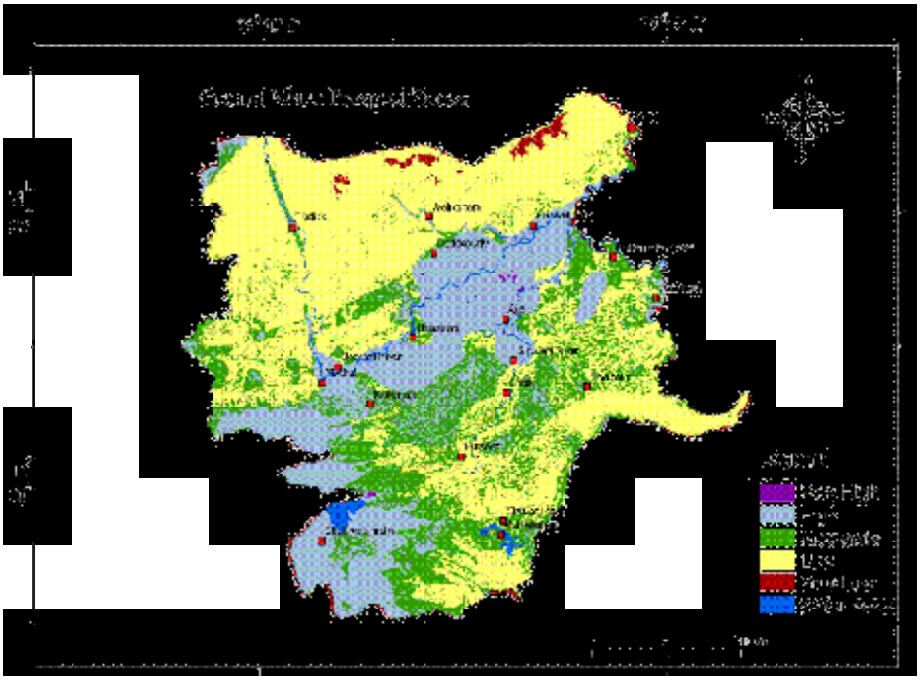

Fig. 2: Ground water prospect map of Attapady block.

High potential zones are mainly concentrated in areas having moderate to high lineament density. In the Attappady block, where ever the denudation landforms are associated with good lineament density, such zones qualify as high potential zones. These high potential zones are lithologically composed of gneissic rocks with intrusions of dykes. Slope in this region is comparatively less.

Moderate potential zones mainly comprise part of denudational hills. This zone is characterized by moderate drainage density. Lithologically, these zones comprise schistose and gneissic rocks with a good number of intrusive bodies. Buried pediments (shallow as well as medium) and lateritic uplands also fall in the moderate potential zones. In some areas of denudational (high) hills, especially in the northwestern part of the study area, groundwater potential is moderate due to the presence of lineaments.

Low potential zones are mainly concentrated in some parts of denudational (high) hills. This is due to the fact that slope and drainage density in this region is relatively high. Lithologically, majority of this zone consists of hard, massive and highly resistant charnockitic and granitic rocks devoid of any major intrusions or structures, which makes the region not potentially suitable for groundwater occurrence.

Very low potential zones are mainly distributed in highly elevated areas of the Attapppady block. These areas are characterized with steep slopes and high drainage density which create higher run-off and, hence, the groundwater potential is very low.

CONCLUSION

Demarcation of prospective zones of groundwater resources in Attappady region has helped to demarcate five zones in the area namely very high, high, moderate, low, and very low potential zones. The present study shows that the valley fills; intermontane valleys and some parts of the denudational hills, where lineament density is high are the possible areas where groundwater targeting can be initiated. The data generated from this study can be used in the ongoing ecorestoration project at Attappady.

ACKNOWLEDGEMENT

The first author thanks Department of Science and Technology (DST), Government of India for providing financial support in the form of a research project under the Fast Track Young Scientist scheme. Authors thank Head, Department of Geology, University of Kerala; Director, Centre for Earth Science Studies and Director, Centre for Environment and Development for the facilities provided for this study.

REFERENCES

CWRDM 1998. Ecorestoration plans for the Attappady wasteland, Comprehensive Environmental Conservation project-Executive Summary, Centre for Water Resources Development and Management, Calicut, 1-26.

Nair, P.K.R., Prasanna Kumar, V. and Thomas Mathai 1981. Structure of the western termination of the Bhavani lineament. J. Geol. Soc. India, 22: 285-291.

Nair, R.V.G. and Maji, A.K. 1995. Targeting gold prospects by panning and soil sampling from Attappady valley, Kerala. Indian Mineralogist, 49: 131-142.

Rajesh Reghunath 2003. Detection of suitable sites for artificial groundwater recharging and site specific methods in Attappady Block, Kerala, First year technical report submitted to DST, New Delhi.