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ORIGINAL ARTICLE



HYDROGEOMORPHOLOGICAL STUDIES IN JAIPANDA WATERSHED, WEST BENGAL STATE, INDIA USING REMOTE SENSING AND GIS TECHNIQUES

SUBODH CHANDRA PAL AND GOPAL CHANDRA DEBNATH

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Abstract:

To evaluate the hydrogeomorphological conditions of Jaipanda watershed, Bankura district, West Bengal geological, hydrogeological and geomorphological studies were carried out, through visual interpretation of satellite data (LANDSAT, ETM+) with adequate ground truth. The study shows that the Jaipanda river basin is occupied by granites and gneisses of Archaean age. The recent alluvium deposits are present along the steam courses. The study area is traversed by various directional features or lineaments and most of them are NE-SW, ENE-WSW and EW directions. Groundwater potential of geomorphological unites viz. Denudational hill, Residual hill, Pediment, Pediplain and Valley fill is discussed.

KEYWORDS:

Hydrogeomorphology, Remote Sensing and G.I.S.

INTRODUCTION

The population growth has been creating more or more stress on agricultural sector for increasing the food grain production, which consequently increased deforestation and demand for more water. The available surface water resources are inadequate to meet all the water requirement for various purposes. So the demand for underground water has increased over the years. Generally, groundwater is less prone to pollution in comparison to surface water. Hence, groundwater serves as an important source of water for various purposes in rural and urban areas. Groundwater occurs in pore spaces of rocks and in fractures, joints and faults. In any hard rock terrain groundwater exploration studies are carried out to find out the fractured, jointed and weathered zones by utilizing various methods. In recent years extensive use of satellite remote sensing has made it easier to define the spatial distribution of different groundwater-prospect classes on the basis of geomorphology and other associated (Sinha et al., 1990). In many earlier studies (Bedi and Bhan, 1978; Karanth and Seshu Babu, 1978; Lattman and Parizek, 1964; Moore, 1978; Raju et al., 1985; Satyanarayana, 1991; Palanivel et al., 1996) remote sensing techniques have been applied for groundwater prospecting.

The term 'Hydrogeomorphology' designates the study of landforms as caused by the action of water (Scheidegger, 1973). By this definition, almost all of geomorphology is 'Hydro' - geomorphology, because water is one of the most important agent in forming and shaping of land forms. From the groundwater point of view, integration of geological, structural and hydrogeological data with hydrogeomorphological data minimize the area for further detailed survey by sophisticated methods eg., electrical resistivity surveys, in finding out the groundwater potential zones with fruitful results. In the

Title : HYDROGEOMORPHOLOGICAL STUDIES IN JAIPANDA WATERSHED, WEST BENGAL STATE, INDIA USING REMOTE SENSING AND GIS TECHNIQUES Source:Golden Research Thoughts [2231-5063] SUBODH CHANDRA PAL AND GOPAL CHANDRA DEBNATH yr:2013 vol:2 iss:11 HYDROGEOMORPHOLOGICAL STUDIES IN JAIPANDA WATERSHED, WEST BENGAL.....



present study, an attempt has been made to evaluate the groundwater potential of various hydrogeomorphological units in the Jaipanda river basin, Bankura district, West Bengal, India.

Watershed size varies from fractions of hectares to thousands of km 2. According to watershed atlas prepared by AIS & LUS (1990), the mean area of watershed is less than 500 km 2 (\pm 50 %) where the codification number for this watershed is 2A2C5.

SITE PRESENTATION

This study area looks like a semielliptical shape and occupies the Khatra, Onda, Taldangra and Bishnupur, blocks. All the part of this study area is situated in the centre of the Bankura district of West Bengal state, India. This study area is bounded by latitudes 22053'28", to 23010'23" and from longitudes 86051'16" to 87012'47". This study (Figure-1) area covers an area of 403.507 km2. It is one of the major tributary or important tributary of Silabati River. The climate is extreme with maximum temperature up to 420C and minimum temperature down to 60C. The annual rainfall of the study area varies between 1055 and 1070.3 mm. The maximum amount of rainfall received during the monsoon season from June to September about 80.73%. The relative humidity in the month of April is 61 (2008) and in the month of September is 99 (2008). The maximum altitude is 166 mt., demarcated in the north-western part and the minimum elevation is about 49 mt. observed in the south eastern part of the watershed



Figure 1. Location map of the study area.

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DATA USED

Survey of India (SOI) topographical sheets (73 I/12, 73 I/16, 73 J/13, 73 M/4 and 73 N/1) on 1:50,000 scales have been used as a base map for the preparation of quantitative morphometric study. Contours available on SOI topographical maps have been used for the preparation of Digital Elevation Model (DEM). SRTM data, Geological map (1:253,440 scale) published by Geological Survey of India was also used. Except these, one satellite data (Table-1) is also used for this work which is in the following.

Satellite	Sensor	Path/Row	Bands	Date of acquisition	Spatial Resolution
LANDSAT	ETM+	139/044	1,2,3,4	Nov. 18 th 2006	30*30mts.
Objectives Table 1: Details of the satellite data used in this study					

Dbjectives Table 1: Details of the satellite data used in this study

METHODOLOGY

The study was carried out in the Jaipanda watershed by using LANDSAT ETM+ satellite imagery with having Path & Row 139-044 of 18th November, 2006 on 30mts. spatial resolution. Drainage map of the basin was prepared from the Toposheets of Survey of India on 1:50,000 scale. This map was superimposed on the satellite imagery of the same area. The imagery was visually interpreted by using standard interpretation keys such as colour, tone, texture, pattern of drainage, shape and topography etc. to prepare geomorphological map. All the conventional information such as geological, hydrogeological and the geomorphological information also collected during field checks were used in the finalization of the hydrogeomorphological map.

RESULTS AND DISCUSSION

Geology of the Area

In order to understand the groundwater conditions of the study area, a general lithological map has been prepared with the help of LANDSAT ETM+ satellite imagery, geological map (GSI) and ground truth. This may provide some information about the movement and storage of ground water. This study area is the extended part of the Chotonagpur plateau region therefore the area is mainly covered with Pink granite or biotite granite gneiss, sand, silt and clay.



Figure 2: Map showing the Geological Structure

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HYDROGEOMORPHOLOGICAL STUDIES

The study area was broadly divided into several hydrogeomorphic units (Figure-3), which are based on the visual interpretation of satellite imagery, topographical map and field check. The delineation of the hydrogeomorphic unit aimed at demarcating areas of ground water potential zones for development. These hydrogeomorphic units were identified and verified during field checks and then a hydrogeomorphological map was prepared. The geological, structural and hydrogeological data was integrated with the satellite information for the finalization of hydrogeomorphological map.

ALLUVIAL PLAIN

This hydrogeomorphic unit occurs all along the course of the river Jaipanda. Ground water development prospects are very good in this zone. The old flood plains constitute different terrace plains. These are underlain by sand, silt admixed with clay and form very potential aquifers in the area. The present day flood plain deposits consist of sand, silt with fine grained gravels and form a promising aquifer. This land form occurs along a narrow patch on both the sides of the river Jaipanda.

WASHED PLAIN

This geomorphic unit is a major hydrogeologic unit in the study area. Here infiltration is moderately good. The thickness of weathered zone varies from 10-20 metres and favors a good amount of water to circulate within this zone before reaching the deeper fractured zones. Ground water potential is very good and this hydrogeomorphic unit is suitable for dug wells, dug-cure-bore wells and bore wells. Field studies reveal that the bore wells drilled at hydrogeomorphologically favorable sites in this unit are good water yielders.

VALLEY FILLS (V)

Valley fills are linear depressions present in between the hill ranges, filled with pebbles, cobbles, gravel, sand and silt. Valley fills are promising zones of ground water occurrence and comprise sand, silt, clay with calcareous concretions and gravels. Field studies (Das et al., 1996) suggest a structural control of the drainage as envisaged from the coincidence of joint roses and the flow directions of the major and minor rivers (Fig. 3).

BURIED PEDIMENT SHALLOW (P)

This area is cauterized by nearly flat to gently sloping topography, shallow to moderately deep, loamy soils followed by regolith zone where the very shallow to shallow coarse textured soil with occasional weathered outcrops of country rocks. Wastelands with or without scrub. Shallow to moderately deep, loamy skeletal soil. Single crop area low productive potential which shows the poor groundwater potential condition.

BURIED PEDIMENT DEEP

This area is cauterized by gently sloping zone of colluvial and alluvial sediments at the foot of the hill. Moderately deep to deep, fine textured loamy soil. As far as the agricultural characteristics concerned this study area from single crop cultivation with low productive potential which sows the moderate groundwater potential condition.

Finally the basin area has been classified into five zones on the basis of their groundwater potential such as very good - good, good - moderate, moderate - poor, poor - very poor and negligible after integrating well inventory and yield particulars with the geological, hydrogeological and geomorphological data (Fig. 3).

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Figure 3: Map showing the Hydrogeomorphological Units.

CONCLUSIONS

Jaipanda river is a 5th order stream with dendritic to sub-dendritic drainage pattern. Geologically, the area is occupied by granites and gneisses. Hydrogeomorphologically, the Jaipanda river basin is divided into areas occupied by Alluvial Plain/Flood Plain, Washed Plain, Valley Fills, Buried Pediment Shallow and Buried Pediment Deep. By studying the hydrogeomorphological conditions of the basin, it is possible to decipher the groundwater potentiality. It is moderate to good, in most part of the basin while the fractured zones, alluvial plain and valley fills are very good potential zones and the rest of the study area having moderate ground water potentiality.

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