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ORIGINAL ARTICLE

A study on groundwater hydrochemistry in Khatra Block, Bankura district, West Bengal

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Abstract

A study was conducted to detect the hydrochemistry of groundwater in Khatra Block,Bankura district, West Bengal. For this, nineteen water samples from borewells during postmonsoon and premonsoon sessions each were collected. Analyses of these water samples were done to evaluate their hydrochemistry and usability for domestic and agricultural uses. Measurement of some parameters which include pH, TDS, and EC has been done in situ sample location points itself. For determining other parameters like cations (Ca^{2+}, Mg^{2+}, Fe^{2+}, Na^{+}, K^{+}) and anions (Cl^{-}, HCO_3^{-}, SO_4^{2-}, F^{-}), samples were brought to the laboratory. For determining irrigation suitability of collected groundwater samples, parameters such as sodium adsorption ratio (SAR), soluble sodium percentage (SSP), residual sodium carbonate (RSC), magnesium adsorption ratio (MAR), Kelly's ratio (KR), permeability index (PI) and corrosivity ratio (CR)were calculated. The waters are found to belong to low salinity and sodium types when marked in the US Salinity Laboratory (1954) diagram and suggest good for agricultural uses. The hydrochemistry of the investigated area is normally good but varies from very hard to hard. In few localities of the investigated area, total hardness is identified as high, which suggest not to use the water for drinking purpose. In such places, the groundwater may be contaminated by interaction between rock and water along with agricultural drain out. The Piper plot shows marked domination of Ca^{2+}–Na^{+}–SO_4^{2-}, mixed Ca^{2+}–Mg^{2+}–Na^{+}–HCO_3^{-} types. To determine the suitability of these groundwater samples for domestic purposes, Water Quality Index (WQI), Gibb's ratio for both cations and anions, and Chloro-Alkaline Indices (CAI) have been calculated along with plotting in Chadha's and Schoeller diagrams. It also indicates the preponderance of alkaline earth over alkalis and weak acids over strong acids. For utilizing the groundwater in domestic purposes, index of water quality was also determined. Water Quality Index values varied from 74.74 to 209.4 in postmonsoon, and 70 to 205 in premonsoon period which suggest the water good enough to use for domestic purposes.

Keywords Hydrochemistry · Irrigation suitability · Piper's diagram · WQI · Gibb's diagram · Chadha's diagram · Khatra block · Bankura district

Introduction

Groundwater forms a principal source of water supply in the world (Todd 1980). It forms our most abundant fresh water resource. The contribution of groundwater is only 0.6% of the whole resources of water on earth. In the developing countries, like India, groundwater constitutes ~ 80% of the domestic water supply in rural areas and only 50% in urban areas. Groundwater constitutes a major safe source of water for drinking in Indian subcontinent (Acworth 1987; Ahn and Chon 1999), but currently its quality is deteriorating due to combined effects of over extraction, chemical pollution, etc. Hard rocks consisting of gneisses of granitic composition of Archean/Precambrian ages constitute the major aquifers of the world. These aquifers occur mostly within the fissured/fractured or weathered formations of the hard rocks (Al-Futaisi et al. 2007). The study on quality assessment of groundwater exposes usefulness of this water to be used for domestic or agricultural purposes. Only 77% of populations in urban areas and only 31% of populations in rural areas obtained access to usable water supply in Indian

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ORIGINAL ARTICLE

Decipherment of potential zones for groundwater occurrence: a study in Khatra Block, Bankura District, West Bengal, using geospatial techniques

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Abstract
Groundwater is considered as one of the most valuable natural resources as it supports human civilization. Freshwater is considered as an important natural resource which occurs partially on the surface and dominantly beneath the surface. The resource is declining drastically owing to the rapid increase in population and its management in an improper way. The occurrence of groundwater in hard rock terrain still behaves as enigmatic. Various terrain parameters control the movement and storage of groundwater. Accordingly geoscientists are using various techniques to explore the potential zone amongst which multi-criteria evaluation (MCE) technique seems to be more precise. Application of remote sensing and geographic information system (GIS) has come out as very effective tools in deciphering groundwater potential zone by modeling terrain features specially in hard rock arid regions. The present study is aimed to find out groundwater potential zones in Khatra Block of Bankura District, West Bengal, India characterized by hard granitic terrain and semi-arid climatic condition. In the present study various thematic maps viz., geomorphology, geology, lineament density, drainage density and slope have been prepared. For these, IRS Resources at LISS-4 with 5.8 m spatial resolution digital data, CARTOSAT-1 digital elevation model, CartoDEM with 2.5 m spatial resolution, along with other data sets such as Survey of India toposheets (73J/13, 73I/16, 73I/12), GSI Map have been used. Digitized vector maps relating to chosen parameters, were converted to raster data using 30 m × 30 m grid cell size. Different theme weight and class rank have been assigned to these raster maps. Each theme weight has been multiplied by its respective class rank and all the raster thematic layers have been summed up in a linear combination equation in Arc GIS Raster Calculator module. Similarly, the weighted layers have been statistically modeled to get the areal extent of groundwater prospects. This integrated approach, helped in classifying the groundwater availability in the study area into five categories, viz. very good, good, moderate, poor and very poor. Finally, it can be stated that the modeling assessment method proposed in this study forms an effective tool for delineating groundwater potential zones for proper development and management of groundwater resources in hard rock terrains.

Keywords Hydrogeomorphology · Lineament density · Automatic lineament extraction · Raster calculator · Arc GIS · Groundwater potential

Introduction

Water scarcity is a major problem in arid and semi-arid regions across the globe due to rainfall deficiency, which puts tremendous pressure on groundwater. This has caused a decline in the available resource during the past few decades. India also is approaching to a freshwater crisis. Groundwater constitutes the largest only freshwater resource in different parts of the world, and this becomes the main obstruction in providing sustainable water demands during continuous dry seasons (Assaf and Saadeh 2008). Moreover, the use of groundwater has increased and this has led to a water stress situation owing to unscientific exploitation of this natural resource. This has led to developing a technique which is cost and time effective for proper evaluation of this natural resource and its management. A groundwater development programme needs a huge volume of data from different sources. Integrated remote sensing and GIS study is the only

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