

Hydrogeological and Environmental
Investigation
of Bharar River Basin District-Chhatarpur (M.P.)

PROJECT-SUMMARY
AND PUBLICATIONS

Submitted by :

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SUMMARY

The Project report comprises of Nine chapters. The entire study has been elaborated through figures, field photographs, including measured and calculated data in a tabular form. The salient features of the study area are summarized below.

1.0 INTRODUCTION :-

The Bharar river is a tributary of the Dhasan river, which is major tributary of the Yamuna river. An area of about 131 sq. km., which lies between E longitudes $79^{\circ} 20' 15''$ to $79^{\circ} 33' 30''$ and N latitudes $25^{\circ} 01' 30''$ to $25^{\circ} 07' 00''$ and falls in survey of India toposheet No. 54 O/8 and 54 O/12 (1:50,000), has been investigated. The study area lies around Nowgoan town of Madhya Pradesh.

1.1 The investigated area is approachable from Nowgoan town by roads. It is criss-crossed by a number of metalled and tar roads permitting easy access to any part of the study area.

1.2 The project work was started from first week of July 2015 and completed in July 2017.

2.0 PHYSIOGRAPHY, DRAINAGE & VEGETATION :

The physiography of the study area shows rugged and undulating terrain with few scattered and elongated hills and parallel distinct quartz reefs trending NNE-SSW. The area is gently sloping towards north-east. It attains a maximum height of 318 metres above Mean Sea Level and minimum height of 270 metres above Mean Sea Level.

2.1 The Bharar river originates from the eastern hillocks of granite about 3 Kms, south-east of the village Pannapura and after flowing about 26 Kms. It confluence with the Dhasan river about 3 Kms North-west of the village Garouli.

2.2 The morphometric analysis of the study area shows that Bharar is a fourth order stream according to Strahler (1957). The drainage pattern of the Bharar river basin is mostly dendritic.

2.3 As a consequence, most of the study area is nearly barren of forest and vegetation, in spite of the fact that most area come under protected forests. The most abundant flora of these forests are Sagon (*Tectona grandis*), Gunja

(Lannea), Kher (Acacia catechu), Saj (Termatia tomentus), Mahua (Madhuca indica), Amla (Phylan thusemblica), Bel (Aeglemarmelos), Babul (Acacia Arabica), Ber (Zizyphus Jujuba), etc.

3.0 HYDROMETEOROLOGY

3.1 Climate of the Bharar river basin is of warm semi-arid type. The winter season is normally cold, while the summer season is hot and dry. The rainy season is quite pleasant with greenery. Generally December and January months are the coldest months, May and June are the hottest months, Where as july and August are the wettest months of the year. The monthly average maximum temperature of the Bharar river basin varies from 45.50 C (May) to 24.09 C (January), Where as the minimum temperature ranges from 7.01 C (January) to 28.60 C (June). The maximum humidity varies from 31.0 (April) to 81.0% (August), Where as, the minimum humidity ranges from 17.0 (April) to 75.0% (August).

3.2 The average annual rainfall of Nowgaon raingauge station is 969.00 mm. which is calculated for 30 years (1987-2016). Mean monthly rainfall varies from 2.90 (April) to 338.96 (August) mm.

3.3 The residual mass curve of Nowgaon raingauge station indicates that the cumulative departure points (1987-2016) are well above the base line indicates a good period for the ground water increment due to rainfall :

4.0 GEOLOGY

A detailed geological map has been prepared on the basis of field traverse to described existing geology of the study area. It shows that the rock formation of the study area belong to Bundelkhand pink porphyritic granite , medium grained pink granite and fine grained pink granite. Three type of granitic rocks have been Categorized on the basis of texture and colour variation.

5.0 GROUND WATER EXPLORATION

5.1 The ground water exploration has been done by using the geological method, geophysical (electrical resistivity) method and remote sensing technique. Electrical resistivity sounding indicates that the depth of weathered zone of graninte (aquifer) in

the Bharar river basin varies from 6.60-9.55 metres in general and its resistivity ranges from 75.44-92.70 ohm/m. based on six vertical electrical sounding in the area.

5.2 The remote sensing technology has been found applicable to different aspects. In the present study, the author has used this technique in hydrogeomorphological mapping and lineament mapping. In hydrogeomorphological mapping different geomorphic set up of the area has considerable influence on the ground water occurrence. The relationship of the lineaments with lithology and structure help in delineating the recharge and discharge areas. The fractures density of different hydrogeomorphic units, and lineaments, indicate that Deeply Burried Pediplain (BPP-D) and Infilled valley (IFV) are excellent hydrogeomorphic units from the view of occurrence of ground water. Inter section of lineaments is one another excellent hydrogeomorphic unit. These units have good ground water potential in the study area.

6.0 OCCURRENCE AND MOVEMENT OF GROUND WATER:

The ground water occurs under unconfined conditions, The water table maps reveal that the movement of ground water is towards the main river courses. The water table contour pattern shows that the Bharar river has influent and effluent pockets. The pre-monsoon depth to water table varies from 0.71 to 11.07 metres. The post-monsoon depth to water table varies from 1.75 to 14.05 metres. The fluctuation of water table varies from 0.30 to 7.10 mts. The relation of water table and topography reveals that water table is a subdued replica of topography.

7.0 AQUIFER PARAMETERS & GROUND WATER POTENTIAL :

The pumping tests carried out on Six large diameter (open) wells in the Bharar river basin reveal that the value of transmissivity determined by papadopulos and cooper method varies from 42.25 to 62.10 m^2/day and the average value is 50.53 m^2/day . The specific capacity value of these wells determined by slitcher's method varies from 0.171 to 0.760 imp/m of drawdown. These values are an approximate because the control points are very meager. Isotransmissivity map reveals that there is a variation in the value of 'T' in the study area. It indicates that there is no homogeneity in the water-bearing formation of the study area. It is also indicated from the pump test analysis data that the Bharar river basin has low to moderate ground water potential. The fractured

zone transmit the water to the well but the weathered zone is the chief source of stored water. The 'T' values indicate that the well yields are adequate for domestic and up to some extent for irrigation purpose.

7.1 The annual ground water increment in the Bharar river basin is 0.001969 million hectare mts., Which is calculated by ground water level fluctuation method. The annual ground water utilization by the different sources is 0.001456million hectare mts. Hence the balance of the available ground water for future exploitation is 0.000513 million hectare mts. every year.

8.0 HYDROCHEMISTRY OF WATERS :

The result of chemical analysis of surface as well as ground water has been presented in piper's trilinear diagram, water quality diagram to determined suitability of waters for domestic as well as irrigation purposes. These diagrams reveals that the chemical quality of surface water as well as ground water is mostly suitable for both domestic and irrigation purposes. At present there is slight effect of deradation on the quality of surface water due to sewage ,domestic wastes and distilary wastes.

9.0 GROUND WATER DEVELOPMENT & MANAGEMENT :

An attempt have been made to demarcate the favourable zone for ground water development on the basis of remote sensing studies.

9.1 Various method have been suggested for ground water recharge because maximum rainwater goes as run-off through rivers, Nalas. The main method is soil check and boulder check can be constructed across all small streams in the watershed and agricultural fields. To detain rain water for a longer period of time throughout the monsoon season. Another method is construction of samall check/stop dam on small tributaries. This way the water pool is available in the Nalas or small tributaries during and after rainy season for various uses.

9.2 The available ground water should be utilized conjunctively by constructing the dug wells (4.6mts. diameter), dug-cum-borewells (20-40mts.) and deep bore wells (40-60mts.) in the study area. Percolation tanks and ponds should be constructed to augment the ground water resources particularly in the villages which are situated down ward slope of granite domes.

LIST OF PROJECT WORK PUBLICATION

A- Project work presented in international/National seminar/Conference:

1. **“Drinking water quality of Bharar River Basin, District Chhatarpur central-India.”** National seminar on next generation and challenges of Education. Health and Environment held, at Deptt. of Chemistry, Govt. Maharaja P.G.College, Chhatarpur, March.04-05, 2016.
2. **“Morpho- Mathematical Analysis of Bharar, River Basin, District Chhatarpur, Central-India.”** International Conference on Water Environment, Energy and Society (ICWEES-2016). Held, at AISECT University Bhopal, March 15-18, 2016.
3. **“Suitability of surface and sub-surface water for irrigation purpose in Bharar river basin, District Chhatarpur, central-India.”** National seminar on Advances in Geosciences held, at Deptt. of Applied Geology, Dr.H.S.Gour V.V. Sagar, August,5-6,2016.
4. **“Targeting ground water potential zones through Remote sensing to Technique in Bharar water-shed, District Chhatarpur-central India.”** National conference & field workshop on pre-Cambrian of India held, at Deptt. Of Geology, Bundelkhand, V.V.Jhansi, November,22-24,2016.

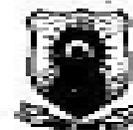
B- Project work published as Research paper:

1. **“Geological setting of Bharar River Basin, District Chhatarpur (M.P.)”:** Research Journal of Bundelkhand (Interdisciplinary) ISSN 2395-7816 Vol.III, September 2015.pp.85-86.
2. **“Morpho-mathematical Analysis of Bharar River Basin, District Chhatarpur Central-India.”** Series Title-Water science and Technology library, Book title-Hydrologic modeling, Book sub title-select proceeding of ICWEES-2016, Vol.81 ISBN-978-981-10-5800-4,Chapter-29, Editors-Vijay, P.Singh, Shalini Yadav, Ram Narayan Yadav, Springer publication Singapore. (Coming in September,2017).

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The quality and content of the paper were appreciated by the expert panel

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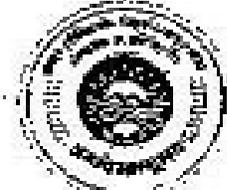
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Phawal river basin, district Chhatrapur, Central India"
at Department of Applied Geology, Doctor Harsingh Gour Vishwavidyalaya SAGAR (MP).


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**Suitability of Surface and Sub Surface Water for Irrigation Purpose in
Bharar River Basin District Chhatarpur - Central INDIA**

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Abstract

During the course of hydro-chemical studies in Bharar River Basin district Chhatarpur (M.P.) 08 surface and 26 subsurface (Ground water) water samples have been collected and chemically analyzed. The analysis reveals that the water is slightly alkaline (Ph.7.1-7.8) moderately hard to hard (TH 120-210 ppm.) and the TDS values ranges from 275-405 ppm. The other parameters like SAR (0.08-0.20), percent sodium (4.6-19.8), R.S.C(-1.5 to -5.8) and PS (1.0-6.96) are also below the desirable limit and suggests suitability for irrigation purpose. The plotting of SAR diagram against Na% (after Wilcox), the plot of permeability index (Donee'n classification) and the U.S. salinity diagram suggests that the water is suitable for irrigation without any hazard to crops.

Keywords : *Irrigation quality, Bharar river, water pollution.*



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Targeting ground water potential zones through Remote Sensing technique in Bharar watershed, District Ghhatapur - Central India

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In the present paper an attempt has been made to delineate favourable zones for Ground water exploration using IRS- LISS-III data. Bharar watershed is bounded by Longitudes 79°20'15" to 79°33'30" E and Latitudes 25°01'30" to 25°07'00" N. The study area fall in the survey of India toposheet No. 54 Q/8 and 54 Q/12. Different thematic maps such as hydrogeomorphological map, lineament map and ground water favourable zone have been prepared through visual interpretation of IRS- LISS II data. Hydrogeomorphological map reveals that deeply buried pedplane (BPPD), infilled valley (IFV) and lineament are excellent hydrogeomorphic unit from the view of ground water occurrence. They have ground water potential in the study area. Lineament map indicate that totally 15 lineament are identified and marked. In the study area there are two predominant sets of lineaments. One set of lineament trending NE-SW and other striking NW-SE direction. Ground water potential zone delineated by integration of hydrogeomorphological map and lineament map. These potential zones reveals that among the various hydrogeomorphic units some are grouped as good potential zones and some into moderately potential zones and rest as poor zones.

GEOLOGICAL SETTING OF BHARAR RIVER BASIN DISTRICT CHHATARPUR (M.P.)

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ABSTRACT

In the present paper an attempt has been made to describe the geological setting of the study area. The study area is covered with Bundelkhand granite which is of Archaean age. Author has recognized three types of granites on the basis of their colour and textures.

KEY WORDS

Geological setting, Bharar Basin, Archaean age.

INTRODUCTION

The Bharar river basin is bounded by latitude 25°00'00" to 25°10'00" N and longitude 79°20'00" to 79°35'00" E and covers an area of more than 150 Sq.Km. (Fig. 1). The basin experiences arid to semi-arid climatic conditions and annual rainfall is about 1067mm. The major portion of the basin is hilly, rugged and rocky terrain. The basin is a part of Bundelkhand granite massif.

MATERIAL & METHODS

The study area has been mapped on 1:50,000 scale of survey of Indian base maps No. 54 C/8 and 54 C/14 of 1975-76. A detailed geological map (Fig. 2) has been prepared on the basis of field traverses to describe the geology of the study area. It shows that the rock formations of the area are Fine-grained pink granite, Medium-grained pink granite and Pink porphyritic granite. These granitic rocks are traversed by quartz reefs and basic dikes.

REGIONAL GEOLOGY

The regional geology of the area comprises of Bundelkhand Granite Complex, Bijawar, Gwalior group and Vindhyan Super group of rocks. PASCOE (1950) and CHHATARGEE *et al.* (1971) described the following regional stratigraphic sequence of the area around Bharar River Basin.

DECCAN TRAPS-CRETACEOUS-EOCENE
VINHYAN SUPER GROUP (1500-500 M.Y.)
BIJAWAR AND GWALIOR GROUPS
(2400-2100 M.Y.)
-----UNCONFORMITY-----
BUNDELKHAND GRAPHITE COMPLEX
(2600 M.Y.)
MAHRONI FORMATION (ARCHEANS)

GEOLOGY OF THE STUDY AREA

A detailed geological map in fig. 2 has been prepared on the basis of field traverse to describe the geology of the study area. It shows that the rock formation of the area belong to porphyritic granite and massive granites. The author has recognized 3 types of granite rocks on the basis of texture and colour variation of the rock as described by Jhingan (1958), Saxena (1961), Basu (1986) and Jain & Chaurasia (1999).

The following is the stratigraphic succession present in the area according to Basu (1986), Jain & Chaurasia (1999).

Bundelkhand	Basic dykes
Igneous	Quartz reef
Complex	Fine grained pink granite
	Medium grained pink granite
	Pink porphyritic granite

BUNDELKHAND GRANITES

Approximately 98% part of the study area is covered by the bundelkhand granites the bundelkhand granite owing the exfoliation dome like masses (Chatterji, 1971) which constitute towers and mounds giving rise to rugged and undulating topography. The Bundelkhand granite is also exposed in the form of small hillocks giving rise undulating and elevated ground (Pascoe, 1950). It varies greatly in texture, mineralogical composition and color from one exposure to another. On the basis of texture and color the author has recognized 3 types of granites which are described below:-

1. PINK PORPHYRITIC GRANITE- It is exposed around Dauria village. The rocks are commonly pinkish red on the fresh surface and become deeper red on weathering. It weathers easily and form hillocks with gentle slope. The feldspar phenocryst are tabular.

2. MEDIUM GRAINED PINK GRANITE- It is exposed in the South-eastern part of the study area, minor exposures are also exposed around Khami village. It has a sharp to marginally diffused contact

with surrounding fine grained pink granite. It is massive rock with equigranular hypidiomorphic texture. Mineralogically it consists of feldspar (or orthoclase) quartz and little biotite/ mafic mineral. These rocks also show typical spheroidal weathering which is formed due to temperature variation.

3. **FINE-GRAINED PINK GRANITE**-It is most common rock type present in the study area. It has covered about 85% of the study area. It is exposed in almost part of the study area except South-eastern part. It is pinkish white to pink rock with moderate proportion of dispersed ferro-magnesium constituents. It is characteristically non porphyritic massive granite.

INTRUSIVE ROCKS

QUARTZ REEF-The most spectacular land marks in the study area are the North-East-South-West trending ridges of quartz. Geological mapping done by the author reveal that in the study area about 150 sq.kms. There are 3 major and 5 minor quartz reefs. With average width 0.25-0.7 km and length of 1.2-2.5 km, the bodies trend between North-East-South-West. The majority of quartz reef occurs in the North-South part of the study area. Quartz is chief mineral constituents of the reef. The reef shows a dominant grayish white color. Over most stretches quartz seems to be medium to fine grained and some of the grains appear megacrystal. However, the grain boundaries are fused at the place where the rock is igneous. The reef exhibits sharp contact with enclosing granite.

STRUCTURAL ASPECTS

The study area is not much subjected to the tectonic activities; joints are predominant structural features of the study area. Joints in the Bundelkhand granites are much dominant in South-eastern and Western-south area then Northern and central area. Medium grained pink granite are most jointed then the fine-grained pink granite. In the pink (medium grained) granites 3 sets of joints are commonly developed to steeply dipping NE-SW and NW-SE trending and third horizontal.

CONCLUSION

It is concluded that three types of Bundelkhand granites have been found in the study area. These are classified according to their colour and textures. Open and tight joints are present in the Bundelkhand granite. Pink granite is of high economic value as dimension stone. On the basis of the regional and local geological setting of the study area, it is expected that

Bundelkhand granite massif has some gold deposits for which a detailed exploration studies should be performed particularly in the western boundary area of Bundelkhand granite massif.

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