CHAPTER-1

INTRODUCTION
Water plays an important role in the evolution of life on our earth. This is one of the few basic ingredients essential for sustaining life anywhere in the universe. Water has a variety of use. There is no facet of life, for which water is not required. It is abundant in nature and renewable. Water has no substitute but its use can be optimised with the help of latest technology. Nature has been generous to us in many ways but more so in her gift of life giving water perched on high snow-peaked mountains flowing through fairly well spread-out networks of perennial rivers and their tributaries and augmented by a unique annual phenomenon of winged water supply known as the monsoon.

Harnessing of water resources and its optimum and most effective utilisation enables the fertile land to produce more food for the people and generation of electricity for turning the wheels of industries and irrigation schemes.

In India, agriculture is the largest sector of economic activity. Nearly 76% of India’s working population is engaged in agriculture and almost 50% of the gross National product is accounted for the agriculture sector. According to Reddy (1992), agriculture contributes thirty percent of India’s gross National profit and sixty percent of the employment potential. In India, irrigation has played an important role in promoting agriculture production in the last 35 years. The proper utilization of the water resources whether, it is groundwater or surface water is attained by
conjunctive use of both surface as well as subsurface reservoirs that is the maximum use of surface water. By this system of use of water resources we derive more advantages by less difficulty for a long service. The problem of exploring the groundwater of the Sonar river basin for the irrigation and drinking purposes is, therefore, of vital importance to the country which is already in deficit in the matter of food grains.

The long range planning on the groundwater utilization has to be done on the basis of the evaluation of the available potential in an area on a drainage basin concept. To determine the groundwater potentials, one has to study the reservoir rocks and the interaction and response of ground water bodies to climatological, topographical, geological, meteorological and hydrologic cycles including artificial recharges from surface water storages, such as reservoirs, tanks, ponds, soils and water conservation practices, etc.

Groundwater resource is a product not only of surface phenomenon but also of complex factors which are not so easily determinable from the surface. This is one of the reasons, why much headway has not been made in parametric hydrology in relation to groundwater. The objective of groundwater resource evaluation is to make the effective and optimum use of groundwater resource by rational development to meet all predictable short and long term need in conjunction with surface water resources.
The water management is very essential to maintain quality, quantity, and the availability of water due to increase in population, rapid urbanisation and industrial growth. Though, its availability is limited, yet demand for water is ever increasing. It has direct impact on human being and socio-economic development. Hence, the need of proper planning and management of the water resources has become a matter of utmost urgency. Groundwater is one of the national assets which will help to ensure the adequate municipal water supply, to provide growing industrial needs and to ensure constant irrigational use even in adverse climatic conditions. Sinha (1983) pointed out that groundwater claims 50% of India's total irrigational requirements.

1.1 The Sonar river basin

The Sonor river rises (Photograph 1.1) from the small hill of the south-west of Sagar district (Lat.N.23°22', long E 78°37'). It flows in north-easterly direction in Sagar and Damoh districts, passing through the localities like Rehli, Garhakota, Sitnagar, Aslana, Narsinghgarh and Hatta. It's valley in Damoh called the 'Haveli' is a fertile black soil plain, forming the principal wheat growing tract of the district. It joins the Ken river about 13 kilometers beyond the north-western boundary. Out of its total length about 186.7 kms., it flows 102.4 kms. through the Damoh district. The river does not attain any great width and flows in a deep Channel, (Photograph 1.2).
1.1: A panoramic view of Sonar river near Hatta town.
Its bed is more or less stony. Its greatest width is about 320 meters. The principal tributaries of the Sonar is the Kopra river on the right bank and the Bewas (Photograph 1.3) and Gadheri (Photograph 1.4) on the left bank. The Kopra river (Photograph 1.5) rises from the centre of Rehli tehsil of Sagar and flows for about 81 km. parallel to the Sonar. It joins the major river ken about 1.5 km below Sitangar.

Geologically, the Sonar river Basin forms the north-central part of the Indian table land. It falls in the south-eastern part of the Vindhyan basin and nearly two-third of the basin is composed of Vindhyan. However, the western part of the Sonar river basin comes in the north-eastern margin of the Deccan trap. The middle part is mainly covered by the recent deposits. The whole region is ideal from geological point of view as it exhibits all important formations varying in age from Late precambrian to the recent. The stratigraphy of the rock formations found in the study area is as follows:

Recent - Alluvium and Soil
Upper Cretaceous to Eocene - Deccan Traps
Upper Cretaceous - Lameta Beds
Late pre-cambrian - Vindhyan Super Group

Geomorphologically the area has ridges, plateaus, conical hills, valleys, etc.

Politically, the Sonar river basin is covered by three tahsils of Sagar district and two tahsils of Damoh
1.2: A view of Sonar river near Garhakota showing its small width and the deep channel.

1.3: A view of Bewas river near village Parsoria showing a pool of water in summer season.
1.4: A view of Gadheri river near Garhakota showing its dryness in summer season.

1.5: A view of Kopro river near village Bansa-Tarkheda showing its dryness in summer season.
District. A small area of Chhatarpur and Panna districts also falls in the basin. Although, the boundaries of the basin do not coincide with that of the political boundaries. The basin is bounded on the north and north-west by the district boundaries of Chhatarpur; in east by Panna, in the south and south-east by Jabalpur and in the west by Sagar.

1.2 Location and Extent of the Study area

The catchment area of the Sonar river basin is 5,632.27 square kilometres and it falls in Sagar and Damoh Districts of Madhya Pradesh. It falls in the survey of India Toposheet Nos. 54L, 54P, 55I and 55H and lies between longitude 78°30'E to 79°52'E and latitude 23°20'N to 24°30'N (Fig.1.1). The total length of the river is 186.7 kms. The Sonar river is one of the most important river of Sagar and Damoh Districts. It flows towards north-east and meet the river Ken Near Uda town. Ken river is the tributary of the Yamuna river.

1.3 Accessibility

The surveyed area is accessible by roads. It is criss-crossed by metalled and tar roads, permitting easy access to any part of the whole basin in the dry season - Sagar and Damoh, the district headquarters, are situated on the Bina-Katni railway line of the central railway. The area is served by a few metalled roads and highways connecting big cities like, Sagar and Jabalpur (Fig.1.2). Most of the villages lying in the area are well connected by metalled as well as tar roads. Approach to the villages
situated adjacent to the Sonar, Bewas and Kopra river is difficult and during the rainy season a few of them are unapproachable.

1.4 Selection and Significance of the area

Hydrogeologically, the entire study area comprises hard rock formation. The scarcity of water for drinking as well as irrigation purposes is the main problem of the Sonar Catchment area. The deterioration of the water quality is also reported at places from the area. The location of the Sonar river basin, itself is of great significance. The south-eastern part of the basin is folded, faulted, uplifted and domal topography has developed, which also attracted the author to trace the geomorphic history of the region and to correlate the development of present landforms with underlying structure. The study of the basin also helps in correlating the structural significance of the Narmada-Son, line in the tectonic history of the Peninsular India.

The evolution of the Bhande and north-western escarpments also has great significance in the study of the geomorphology of the basin. The most fascinating aspect that led the author to undertake the study of geomorphology of the Sonar river Basin was the regional geomorphic history. The study of erosion surfaces and other associated landforms is very important in terms of the periodic upliftments of the area. The evolution of drainage has also been of great importance in the study of the geomorphic history of the region. In south-western part ample examples of superimposed
drainage have been detected. The study of topographic variations in the Vindhyan country and the Deccan Trap country presents a vast field for the study of slope analysis and hillside slopes. There is variation in the hillside slope elements. The analysis of all the geomorphic characteristics of the Sonar-river basin, is most important to recognize the geomorphic regions.

Most of the surface waters are endangered to their biological existence. At few places water has already reached the condition under which higher organisms can no longer survive. This development is due to increase in industrial wastes, domestic sewage, and agricultural run-off which are accumulated in very limited lakes and river systems. Man himself is threatened the nature in two main ways: In the first, surface waters are providing more and more of drinking water supply, since the natural ground water resources are rapidly diminishing and, further, exploration is becoming increasingly expensive and difficult. Secondly, Most of the contaminants are released into river, particularly the agricultural run-off and domestic sewage in water, which enhance the rate of pollution. Some of the pollutants (trace elements and heavy metals) become further enriched in the aquatic food chain and may then present a serious damage to man resulting in environmental health hazards. Further, the bulk of the material transported to world oceans is in the form of sediments ($13.5 \times 10^9 t/yr^{-1}$) and the Asian rivers supply 30% of the sediment to world ocean (Milliman and Meade, 1983). In
Sonar drainage basin, more than 65% of the total area is covered by intensive human activity, several rural towns situated on its banks and along the river, further, add to the environmental misery of the river water.

The above cited consideration prompted the author to take up this problem "Hydrogeological and Environmental Studies of Sonar river basin M.P. India" for the research work, so that significant contribution could be made towards the environmental impact assessment, conservation and management of the 'Sonar river' and its basin for a fruitful use. The ground water resources present in the area can solve the water scarcity problem. The study of sources of deterioration of groundwater can help in the improvement of the quality of groundwater.

The area of study is a virgin one and no work has been done on this river basin, neither. Hydrogeological nor environmental. These aspects gave an added attraction to take up this problem. Further, the Diamond Cement Factory is located along the bank of Sonar river at Narsinghgarh provides an additional attraction and new dimension to the environmental problem.

1.5 Previous work

The area selected for the study has not been studied in detail either from hydrogeological or environmental interest. Although, there exists a wealth of literature dealing with Vindhyans, Lametas, and Deccan Traps. Some of them is directly concerned with the present region.
Captain Franklin (1828) was the earliest pioneer on record who had examined some portions of Damoh district, then a part of Sagar district, between Hatta and Pathariya. The earlier pioneer workers who had studied the geology of the area are Coulthard (1833), Carter (1853), Oldham (1856), Medlicott (1860), Dubey (1992), etc. Soni (1982) has studied the hydrogeology of some part of the Bewas river.

Rajarajan (1978) has done a very good work in this area. He has been carried out the regional geological set up of Sagar and some part of Damoh district. Hardikar (1990), has done some geoenvironmental study of Sonar river.

1.6 Methods of Investigation

Detailed reconnaissance survey in the entire Sonar river basin has been carried out to understand the environmental and hydrogeological conditions. Based on the previous work and the data obtained from the reconnaissance survey, the following methodology has been adopted for hydrogeological and environmental studies of the area.

1. A study of the physiographic/geomorphologic features of Sonar river basin.

2. Morphometric analysis has been done for the entire Sonar river basin on 1:250,000 maps and different maps have been prepared and interpreted.

3. Hydrometeorological data have been collected from the government organisations. The various graphs have been prepared and interpreted.
4. Geological map has been prepared by taking a number of traverses in the entire area.

5. Rock and soil samples have been collected for their analysis.

6. Studied the Hydrogeology of the area with the help of well inventory data collected for pre and post monsoon periods from the existing dug wells of the study area. The water table maps, fluctuation map, depth to water level maps, Ground surface map, cross section, etc., have been prepared and interpreted. Hydrogeomorphological and lineament maps have been also prepared and interpreted using remote sensing techniques.

7. Pumping tests have been conducted on large diameter (dugwells) wells existing in the study area and the hydrological properties have been determined.

8. Electrical resistivity survey has been done at some places in the study area. The data have been analysed and interpreted.

9. Studied groundwater resource evaluation; Assessment of annual groundwater increment, annual groundwater draft, availability of groundwater for future development.

10. Water samples have been collected from dug wells and analysed from the angle of domestic and irrigation uses. The analytical data have been presented in the form of different graphs and interpreted for the chemical quality of water for the above said purposes.
11. Planning and Management of groundwater resources of the area has been done. Ground water potential zones have been demarcated for groundwater exploration. Their qualitative, quantitative & workability characteristics have been defined.

12. Impact of irrigation and industries on environment have been studied.