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Water is one of the most stable chemical compounds, mother earth has ever produced and its history may date back to 3,500 to 4,000 million years, when the pristine global gases on surface comprising an ensemble of $H_2$, $O_2$, $CH_4$, $NH_3$, $CO$, $CO_2$ and $N_2$ must have made permutations and combinations to reach this stable chemical constituent, now covering 71% of the earth's surface. In fact, this best natural solvent has enabled civilisations to thrive in its proximity, along the ancient river valleys. It is said that water is synonymous with life and in fact, the human body is constituted of 63% of water alone. World statistics exhibits that 65% of the fresh water is used basically for agriculture. In India, in particular, it accounts 83% for irrigation, while the rest 17% is utilised for domestic and other purposes.

In India, the ground water resources have gained ever increasing importance for irrigation purposes since independence. However, a significant jump in groundwater utilisation has been observed in the last two decades due to the rapid growth of industrialisation and a critical role in stabilization of agriculture.
The increasing demand for water has entailed an increased tapping of surface as well as subsurface water resources. However, the groundwater seems to be a low cost and quick option as compared to the huge investments and long gestation period involved in surface water projects. Proper harvesting of rainwater is necessary to meet various demands of water. Conservation and augmentation of water and its proper management help to meet the challenge of recurring droughts in arid and semi-arid areas, and mitigate the damage due to floods. Consideration of priorities of water resources is the key to the economic growth and prosperity of a region.

The Kulhan nala basin being a close suburb of Raipur, the industrial capital not only of Chhattisgarh region but whole of southeastern M.P. and adjoining areas of Bihar and Orissa, has gained considerable industrial importance.

During the past 2-3 decades, several cement plants, iron and steel industries etc. have come up in the study area and many more are in the pipeline. The population rise, consciousness for increased agricultural production and heavy industrial concerns require greater amount of water, due to which the ground water demand has increased manifold. This necessitated an in-depth approach for its exploration, planned development and management.
Keeping in view the above aspects "Ground water potential and water management studies of Kulhan nala basin" have been taken up under the present research programme.

1.1 LOCATION AND AREAL EXTENSION:

Raipur district is the first and the foremost regime of Chhattisgarh region in Madhya Pradesh, which is known from the past for its 'Agriculture and Irrigation' on synchronised and systematised pattern, as the garner of popularity for its productivity in paddy crops in whole of Chhattisgarh belt.

The district is located in the southeastern part of Madhya Pradesh and occupies roughly the central part of the Chhattisgarh Basin. The Kulhan nala basin, lying to the eastern part of Raipur town, is spread over an area of 992.09 Sq.Km. (fig. 1.1 and 1.2). The area is confined within north latitudes 21°02' and 21°34' and east longitudes 81°38' and 81°54', falling in the survey of India toposheet Nos. 64G/10, 11, 12, 14, 15 and 16 on 1:50,000 scale.

The study area is included in parts of the four blocks of Raipur district, namely (1) Abhanpur - 28 Km. south of Raipur along the National Highway No. 43. It is also connected by Raipur-Abhanpur train via Eastern Railway. (2) Arang - it is about 30 Kms. south of Raipur along Raipur-Tiruaianagar- train.
Fig. 1.1 LOCATION MAP OF STUDY AREA
Eastern Railway and is also well connected by the National Highway No.6. (3) Dharsiwa - lies 18km. north of Raipur and accessible by the State Highway No. 5, and (4) Tilda - located 38Km. northeast of Raipur along South Eastern Railway main line. The study area is bounded by the Mahanadi Main Canal to the southeast and the Jamunia nadi basin to the northeast, whereas the entire western margin of the basin is delimited by the Mandhar Branch Canal.

1.2 ACCESSIBILITY:

All the block headquarters of the district are well connected by a network of all-weather motorable roads. The district headquarter of Raipur lies on the Bombay-Howrah main line of the South Eastern Railway and is well connected with the contiguous districts like Bilaspur and Durg and also with neighbouring states of Orissa, and Maharashtra. Apart from railway lines, National and State Highways also provide effective communication and conveyance of convenience for trade, travel and commerce in the district.

The important villages of the study area are Uparwara, Ganaud, Riwa, Kharora, Raikhera, Chandkhuri, Kurra etc. which are well connected by roads to Abhanpur, Balodebazar, Arang and Bilaspur. Many of these embankments of the Mahanadi canal system (Mandhar branch...
and Bhatapara Branch) which traverse the area from south to north have also motorable roads. Thus, the study area is approachable through good communication facilities.

1.3 PHYSIOGRAPHY, DRAINAGE AND VEGETATION:

The entire area forms a flat, gently undulating country having an elevation range between 255m and 320m above mean sea level. The general slope of the area is towards the northwest. Almost flat and featureless topography of the area is perhaps due to its simple structure in which strata occur almost horizontally. The soil and alluvial mantle overlying the limestones exhibits characteristic topographic features, being represented by broken grounds resulting from the formation of numerous shrinkage holes of varying dimensions. These shrinkage holes, formed as a result of sinking of water along the solution cavities in limestones, are noticed along the banks of Kulhan nala and in the quarries giving rise to badland topography.

The Kulhan nala is the principal drainage of the area. It has two main tributaries namely Deorani-Jethani nala and patthra nala. Dhumma nala is a small tributary draining into the Deorani-Jethani nala. The Kulhan nala originates in the southern upland and after flowing initially towards northeast and changes its direction towards NW and finally joins the Charun river (a tributary of the Seonath river).
The Mahanadi Main Canal and the Handhar Branch Canal are the major sources of water for irrigation. The canals, however, operate from July to September only. Besides these canals, the area is studded with a large number of tanks and lakes. Most of the tanks dry up in summer, while a few of the bigger ones viz. Pindraon, Pikridih, Kurud and Kirna, contain water throughout the year. The area bears scanty vegetation. The southern and the northern parts of the basin are occupied by protected and reserved forests. The former stretching in the E-W whereas the latter in N-S directions, comprising of open mixed vegetation. Besides babul, the only tree commonly seen throughout the area, mango, mahua, neem, tamrind, ber, pipal, banyan, semal, jamun and eucalyptus are generally grown near the villages as a part of social forestry programme.

1.4 PREVIOUS WORK:

The area under investigation comprises of rocks belonging to the Chhattisgarh Supergroup, which occupies an important stratigraphic position in the Indian Stratigraphy. The stratigraphic studies of Chhattisgarh Basin have been carried out since as early as 1866.

Medlicott (1866-67) during his traverses, in the Chhattisgarh basin observed the following three types of rocks: (1) strong bedded quartzite - sandstone; (2) massive, fine, homogeneous clays and finely
laminated siliceous limestone, and (3) flaky, earthy siliceous limestone, and considered them to be equivalents of Lower Vindhyan age.

Blanford (1872) recognised massive sandstone at the base followed by limestone and shale, over which an alternate sequence of thinly bedded sandstone and limestone rests. He compared them with the Pengangas of the Wardha-Pranhita valley of Lower Vindhyan affinity.

Ball (1877) and King (1885), on the basis of regional traverses of the Chhattisgarh basin, considered the present rocks as equivalents of the Vindhyans.

Bose (1898-99) described the rock sequence of Chhattisgarh Basin as "Chhattisgarh Plain Series (Lower Vindhyan)" constituted by Chandarpur sandstone at the bottom and Raipur shales and limestone at the top.

Bhattacharjee (1936-37, 1937-38) mapped the western part of the Durg district (Degree sheet- 64C) and correlated the rocks with the Cuddapahs.

Dutt (1964) based on traverse mapping in the southern part of the Chhattisgarh Basin, proposed the first comprehensive stratigraphic succession of the "Chhattisgarh Series" and assigned an Upper Kurnool age for these strata.
Systematic mapping in parts of Raipur district has been carried out by Sen and Satyanarayanan (1963-64) and Sen (1964-65). They have reported, the occurrence of stromatolites in Nandini limestone, for the first time from this basin.

Schnitzer (1969, 71) made a valuable contribution to the stratigraphy of the northern part of Chhattisgarh basin. He established the cyclic nature of sedimentation and identified each cycle by a local geographic name.

Adyalkar and Phadtare (1972), have carried out systematic geohydrological investigation of karstic limestone in parts of Raipur district and indicated high secondary permeability and rich groundwater potential.

Murti (1972, 1978 a & b) has studied various aspects in the central and south central parts of Chhattisgarh Basin, including occurrence of barytes in Gunderdehi shale, sedimentary structures, stromatolites and paleocurrent studies of the Chandarpur Group.

Kreuzer et al (1977) carried out geochronological study of the Chandarpur glauconite and gave a K-Ar age of 700-750 my.

Verma et al (1977) based on paleomagnetic studies on the Gunderdehi shale, placed it in between the age of Rewa and Cuddapah sandstone.
Murti et al (1984) reported the presence of radioactive elements in the sediments of Chhattisgarh basin.

Murti (1987) carried out detailed stratigraphic and sedimentological studies in the central part of the basin and divided the basin into a lower Chandarpur Group and an upper Raipur Group of the Chhattisgarh Supergroup.

Recently Das et al (1992) based on their work carried out in the southern part of the Hirri sub basin, have further modified the stratigraphy and discussed the "Lithostratigraphy and sedimentation of Chhattisgarh Basin.” The entire succession of Chhattisgarh Basin is divided into three groups. The lowermost Singhora Group developed in Baradwar sub basin, followed by the Chandarpur Group, lying unconformably over the Singhora Group, comprising mostly of arenite lithounit and grading conformably into Raipur Group at the top consisting of argilite-carbonate suite.

1.5 METHODOLOGY:

A reconnaissance survey in the entire Kulhan nala basin, has been carried out. Based on the previous work and the data obtained from the survey, the following methodology has been adopted for hydrogeological studies of the area.
1. Preparation of geological map on 1:50,000 scale by traverse mapping and study of physiographic features in relation to geology of the area.

2. Petrographic studies (megascopic and microscopic) were done on systematically collected rock samples of the area.

3. Morphometric analysis of the Kulhan nala basin and preparation of slope category map on 1:50,000 scale.

4. Hydrometeorological data were collected and interpreted.

5. Well inventory data have been collected for pre and post-monsoon periods. The water level maps, fluctuation map, depth to water level maps have been prepared and interpreted.

6. Geomorphological map has been prepared using remote sensing data and its interpretation has been attempted.

7. Electrical resistivity survey have been carried out at different places covering the entire study area, the data have been analysed and interpreted.
8. Pumping tests have been conducted in large diameter dugwells of the study area and hydrogeological properties have been determined.

9. Groundwater samples were collected and analysed for $p^H$, temperature, total dissolved solids, conductivity, major cations and anions and a few trace elements. From the angle of domestic and irrigation purposes, the analytical data have been presented in the form of graphs and interpreted for the quality of water.

10. Finally, groundwater potential of the region has been determined and water management studies with reference to the artificial recharging of the groundwater reserves have been carried out, keeping in view of future development.

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