CHAPTER - 1

INTRODUCTION

Study of life layer of the continents brings together two major branches of the earth science: geomorphology and hydrology. Geomorphology is the study of landforms including their history and process of origin. Geomorphology is a science, which deals with the description of the morphology and the evolution of the landforms. Miller (1953, p.3) expresses his various, "Geomorphology, confining its attention to the form of the land and ignoring vegetational, animal and human phenomena can devise a satisfying classification of landforms based on their structure, mode of origin and stage of evolution.

According to Strahlers, 'The science of geomorphology treats the origin and systematic development of all types of land forms and is a major part of physical geography.'

In modern geomorphological studies three major aspects predominate. Firstly, mapping & measurement about the form of the land and about the spatial distribution of landforms. Secondary study of the earth and the process, which produce particular types of landforms. Thirdly, analysis of deposits that provide considerable information about the process and about the chronology of events occurred in the past.

Water is the most precious gift of nature to the mankind and has been recognised as one of the most vital natural resources. It is not so just because water sustain life but it is a renewable resource. It is also the most essential input for agriculture industry and power generation. The availability of water with proper quality and quantity at appropriate time and space are of great importance. The role of water resource development in the over all economic development of the country is well recognised. According to Reddy (1972) agriculture contributes thirty percent of India's Gross National Profit (GNP) and 60% of the employment potential, over two third of the country's population is agriculture dependent and irrigation contributes to 55% of agricultural out put. The water management is very essential to maintain quality, quantity and the availability of water due to increase in population, rapid urbanisation & 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 management of the precious resource has become the matter of utmost urgency. Ground water is one the national assests 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. Its distribution and occurrence varies. In space and time. Sinha (1983) pointed out that groundwater claims 50% of India's total irrigational requirements.

Remote Sensing is perhaps most aptly defined by B.F. Richason as the science technology and skill of "imaging from orbital and sub-orbital altitudes, in various (and simultaneously in several) parts of the visible and invisible (EMR) spectrum, and converting data into information by visual and digital processing". Remote Sensing, particularly from continually revisiting robotized satellites, provides a very effective supplemental source and technique of updated field observation and mapping of not only tangible phenomena but also of other elements that can be deduced from characteristics thereof. India is one of the major global players in several fields of space technology, including satellite Remote Sensing. Its current IRS 1-D and IRS P-6 satellites are currently providing fairly high-resolution multispectral data. With our own remote sensing satellites and Earth station in place, it becomes the most economic and fastest technique of extensively surveying/mapping inaccessible areas.

Geologists are by far the foremost civil users of aerial photographs and satellite data. Lithology, structure, topography, soil landform and landuse/landcover, urban expansion and its impact on the fringing areas, resource management and development planning are the vast and major areas of remote sensing application. The technique comes very handy for geo-hydrological studies as well. Lineaments, large and small, stand out often pretty easily from such data – more readily than even from direct field observation. Besides providing the general geo-hydrological background, these data particularly help pinpoint promising areas worthy of detailed field investigation. It thus precisely defines as well as minimizes the filed
work, results whereof can be interpolated over other areas to construct the
given thematic spatial pattern.

Besides the conventional visual interpretation approach, if the data
can be available in the digital form along with appropriate hardware
software and manpower infrastructure, rather sophisticated digital image
processing techniques can be deployed to more advanced use of this
technology. These techniques are more extensively used and more
elaborately developed in the application of vegetation and water body
studies. In Geological application, they have generally been confined to
very specific application for mineral exploration.

In India, paradoxically, aerial data are practically the preserve of the
few select Govt. of India departments, and are rarely available for academic
research. Even 1:25,000 scale toposheets are often not available yet. Any
topographic data in the digital form is simply out of bonds for academia.
An individual researcher is thus left to make do his things with whatever
data is readily available in his/her Department. The present study
depended mostly on the old LANDSAT imagery on 1:250,000 scale, and IRS
1-C/ 1-D LISS and PAN data available for a more recent date; besides
occasional help from or access to resources of Department of Applied
Geology of this University, and the RSAC of the MP Council of Sc. & Tech.
of DST. Digital Photogrammetric Workstations and sophisticated things
they can do are more impractical in small educational departments where
visual interpretational acumen and very simple tools comprise the principal
workhorse.

Advantages and Limitations of Remote Sensing:

Advantages:

1. Presents information on the basis of signals much beyond the
   sensitivity of human sight, employing NIR, MIR, TIR and MW spectral
   regions.

2. Presents a set of data in several bands of EMR, enabling us to
   interpret things in specifically suitable band data.

3. Far richer radiometric information and precise numerical values
   for discrete surface parcels (pixels), that can be analysed quantitatively in a
   number ways, and yield further sets of data.
4. Information of as many as three bands, including invisible band/s, can be combined as false colour composites, giving a richer and superior information.

5. Satellite data is continually available on a regular basis, enabling regular monitoring and change detection.

6. Each scene of Sat. data covers large areas, giving panoramic views of regional structures/patterns.

7. Enables selective focusing-defocusing of feature or feature categories (through processing), as is inherently resorted in mapping and map use.

Limitations:

1. Requires high-tech environment for its best utilization, as well a technically trained manpower.

2. Rather poor spatial resolutions; and full use of only tone, leaving other elements of images unutilized.

3. Poor geometric fidelity; heights are still only experimental.

4. A radical difference between raster data format of satellite RS data, and the vector format of cartographic data, resulting in the resilient incongruity between the map and image.

5. Orthographic geometry of maps and perspective geometry of maps also not fully reconciled – orthorectification cannot handle the shadow effects of relief and man-made structures.

6. Orthophotomaps are more a concept that a practical thing, as overlaying vectors on images presents contrast problems and also conceals image information.

1.1 Dhasan River Basin:

Dhasan river is a moderate size southern sub-tributaries of the river Yamuna in which it pours through the river Betwa. Originating at the northern skirts of Raisen district (M.P.). The river flow essentially northward (or stightly to the NNE) for over these hundred kms to joint the Betwa river near Jigni town of U.P. It traverses over Sagar, Tikamgarh, Nowgown districts of Madhya Pradesh and Lalitpur, Jhansi, and Hamirpur districts of Uttar Pradesh. Madhya Pradesh shared almost ¾ of its expanse of over thousand square kms, which extents from 23°30'N to 25°46'N latitude and 78°20'E to 79°51'E longitude (Fig. 1.1).
Dhasan River Basin, India
Index Map
The total length of the Dhasan is 314 km. Though there is no main tributaries of the Dhasan river, there are some small tributaries pouring into the river, notable amongst there are Bila, Taeper, Narkrer on the right bank, and Narosa, Ur, Supiar, Sukhani, Lakheri on the left bank. Dhasan river basin is surrounded on almost all sides by other river basin, i.e Sonar-Ken basin in the east, Bina-Betwa basin in the west, Narmada river basin in the south, and Yamuna river is situated in the north direction of the Dhasan river.

1.2 Location and Extent of the Study Area:

This area selected for the study has not been studied in detail either from hydrogeology and geomorphology. The Dhasan river originates from the Northeast part (Jashrat hill, 714 meters, Photo. 1.1) of Raisen district near the Bhaisa Village (23°33'N latitude and 78°31'E Longitude). The total catchments area of the Dhasan river basin (Photo 1.3, 1.4) is 11330 square kms (Fig. 1.2). The Dhasan river flows towards to North-East and meets the river Betwa near Jigni town (Hamirpur district) in Uttar Pradesh; Betwa river is an important right bank tributary of the Yamuna river. It is crossed by the national highway No. 26, Jhansi to Lakhandon road, and Sagar to Bhopal road, Nowgong to Mauranipur road, as well as by the Katni-Bina and Jhansi-Manikpur Railway lines of the Central Railways.

The Dhasan river basin is covered under following topographical maps of the Survey of India:

**List of Topographical Sheets:**

(I) 1:250,000 scale maps -
54/K, 54/L, 54/O, 54/P, and 55/L;

(II) 1:50,000 scale maps -
54K/ 14, 15, 16;
54L/ 12, 13, 14, 15, 16;
54O/ 2, 3, 4, 5, 6, 7, 8, 9, 12;
54P/ 1, 2, 3, 4, 5, 6, 7, 8, 9, 10;
55I/ 5, 6, 7, 8, 9, 10, 11, and 13.
Photo. 1.1 A View of Jasrathi Hills & Origin Point of Dhasan River Near Jasrathi Village

Photo. 1.2 A View of Jagthar Hills (Conical Hill of Basalt) Near Jagthar Village
Photo 1.3 A Panoramic View of Dhasan River Near Girar Village

Photo 1.4 A View of Dhasan River in Dry Season Near Lakhanjir Village
1.3 Selection & Significance of the Study Area:

Hydrologically, the entire study area is hard rock formation. The scarcity of water for drinking as well irrigation purposes is the main problem of the Dhasan river basin. The most fascinating aspect that led the author to undertake the study of geomorphology of the Dhasan 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. The analysis of all the geomorphic characteristics of the Dhasan river basin is most important to recognize the geomorphic regions.

The above cited consideration prompted the author to take up this problem "Geomorphological And Hydrogeological Study of Dhasan River Basin, India, Using Remote Sensing Techniques," for the research work, so that significant contribution could be made towards the groundwater assessment, and management of the Dhasan river and its basin for a fruitful use. The groundwater resources present in the area can solve the water scarcity problem.

1.4 Previous Work:

There are only a few major works done in this field. V.K.Dixit has done some geohydrological study of Sagar district; this work has with conventional method in the 1971. V. Subrananiam (1974) has studied in geomorphology in Sagar district, and J. B. Dhagat (1990) has done some hydro-geological study of Bila command area. Some of the paper presented at the seminar on geomorphological studies in India (1967) and seminar on Madhya Pradesh Groundwater development (1976), at the department of Applied Geology. Sagar University, Sagar (M.P.) related to geomorphology and ground water condition around Sagar (M.P.).

W.D. West and V.D. Choubey (1964) have made a comparative geomorphological study of Sagar and Katangi area. F.Dixey (1970) has done geomorphological study of Madhya Pradesh and Rajarajan (GSI) has also done a very good work on the Geology of Sagar district in 1978. Some research papers have also been published by K.N. Das (1971), B.R. Singh (1972), S.K.Babu (1972), M.V.Durge (1973), S.N.Pandey (1973) in this field. However, barring only the last one to some extent, all these old works were done with conventional methods.

1.5 Period of Study:

The first reconnaissance study was carried out in the beginning of the year 2001 to study the problems in Dhasan river. The detailed morphometric analysis have been done one and half years commencing from January 2002 to June 2003, & the detailed Hydrogeological studies were carried out mainly in two phases viz. Pre-monsoon during May, 2002 and post-monsoon during November, 2002. The total duration of field, laboratory and writing work have been three years and three month commencing from August 2001 to November 2004.

1.6 Population Distribution in Dhasan River Basin:

The four districts, viz., Sagar, Tikamgarh, Chhatarpur, and Jhansi have a total area of 251136.60 sq. kms with a total population of 6415213 persons according to the census of 2001 (Appendix - 2). In the Dhasan basin, Sagar district (23.10%), Tikamgarh district (28.23%), chhatarpur district (20.76%) and Jhansi district (18.37%) are included. The total area (11330 sq. kms) of the basin supports a population of 3117928 persons (Table - 1.1). According to the census of 2001, the average density of population in the basin is about 266 persons per sq. kms (Table - 1.2), which is high than Madhya Pradesh average of 196 persons per sq. kms & lower than Uttar Pradesh 689 persons per sq. kms. The density of Population in the basin is uneven (Fig. 1.3). This may be correlated with the nature of soil, relief, slopes, water availability & variation in rainfall.

The percentage of urban population indicates that only 24\% of the total population of the Dhasan basin lives in urban centres (Appendix-3). There are seven centres, population above 25000 & ten small urban centres (population less than 25000 to 5000) in the basin. All the urban
Dhasan River Basin, India
Population Distribution

Population in
- 25,000 - 15,000
- 15,000 - 10,000
- 10,000 - 5,000
- 2000
- 1000 Persons

Settlements larger than 25,000
Population shown as scaled spheres

Scale of Spheres

4 Lakh  2 Lakh  1 Lakh  50,000

Kilometres
Table - 1.1

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Tahsil and Urban centers</th>
<th>Population in the basin</th>
<th>Urban centers</th>
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<tbody>
<tr>
<td>1.</td>
<td>Geratganj</td>
<td>15026</td>
<td>-</td>
</tr>
<tr>
<td>2.</td>
<td>Sagar</td>
<td>384501</td>
<td>309164</td>
</tr>
<tr>
<td></td>
<td>Karrapur</td>
<td></td>
<td>9285</td>
</tr>
<tr>
<td>3.</td>
<td>Rahatgarh</td>
<td>52270</td>
<td>-</td>
</tr>
<tr>
<td>4.</td>
<td>Banda</td>
<td>228346</td>
<td>26178</td>
</tr>
<tr>
<td></td>
<td>Shahgarh</td>
<td></td>
<td>14585</td>
</tr>
<tr>
<td>5.</td>
<td>Khurai</td>
<td>52270</td>
<td>-</td>
</tr>
<tr>
<td>6.</td>
<td>Bijawar</td>
<td>100442</td>
<td>-</td>
</tr>
<tr>
<td>7.</td>
<td>Bada Malhara</td>
<td>145809</td>
<td>15042</td>
</tr>
<tr>
<td>8.</td>
<td>Chhatarpur</td>
<td>117211</td>
<td>-</td>
</tr>
<tr>
<td>9.</td>
<td>Nowgown</td>
<td>101069</td>
<td>33029</td>
</tr>
<tr>
<td></td>
<td>Harpalpur</td>
<td></td>
<td>15410</td>
</tr>
<tr>
<td>10.</td>
<td>Mandawra</td>
<td>30151</td>
<td>-</td>
</tr>
<tr>
<td>11.</td>
<td>Mahroni</td>
<td>39849</td>
<td>-</td>
</tr>
<tr>
<td>12.</td>
<td>Baldevgarh</td>
<td>173192</td>
<td>7585</td>
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<td></td>
<td>Badagaon</td>
<td></td>
<td>7724</td>
</tr>
<tr>
<td>13.</td>
<td>Palera</td>
<td>161819</td>
<td>14646</td>
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<td></td>
<td>Khargapur</td>
<td></td>
<td>12412</td>
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<tr>
<td>14.</td>
<td>Tikamgarh</td>
<td>147910</td>
<td>68572</td>
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<tr>
<td>15.</td>
<td>Jatara</td>
<td>117217</td>
<td>15593</td>
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<td>16.</td>
<td>Prithvipur</td>
<td>49500</td>
<td>-</td>
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<td></td>
<td>Lodhurakhas</td>
<td></td>
<td>29542</td>
</tr>
<tr>
<td>17.</td>
<td>Niwari</td>
<td>8500</td>
<td>-</td>
</tr>
<tr>
<td>18.</td>
<td>Mauranipur</td>
<td>226464</td>
<td>116663</td>
</tr>
<tr>
<td>19.</td>
<td>Banmar</td>
<td>35995</td>
<td>-</td>
</tr>
<tr>
<td>20.</td>
<td>Gursari</td>
<td>103130</td>
<td>62500</td>
</tr>
<tr>
<td>21.</td>
<td>Bangra</td>
<td>35196</td>
<td>-</td>
</tr>
<tr>
<td>22.</td>
<td>Rath &amp; other</td>
<td>29805</td>
<td>-</td>
</tr>
<tr>
<td><strong>Basin Total</strong></td>
<td><strong>2352939</strong></td>
<td><strong>764989</strong></td>
<td></td>
</tr>
</tbody>
</table>
density centres of the basin are directly related with rural areas. The population density is high surrounding the urban centres & forest and hilly area are present in the low.

### Table - 1.2

**District wise Population, Density and Growth**

<table>
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<tr>
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<th></th>
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</thead>
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<td>1.</td>
<td>Sagar</td>
<td>6374.60</td>
<td>1647736</td>
<td>2021783</td>
<td>22.70</td>
<td>317.16</td>
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<td>2.</td>
<td>Tikamgarh</td>
<td>5048.00</td>
<td>940829</td>
<td>1203160</td>
<td>27.88</td>
<td>238.34</td>
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<td>3.</td>
<td>Chhatarpur</td>
<td>8690.00</td>
<td>1158076</td>
<td>1474633</td>
<td>27.33</td>
<td>169.69</td>
</tr>
<tr>
<td>4.</td>
<td>Jhansi</td>
<td>5024.00</td>
<td>1429698</td>
<td>1715637</td>
<td>20.00</td>
<td>341.48</td>
</tr>
<tr>
<td>5.</td>
<td>Dhasan Basin</td>
<td>11330.50</td>
<td></td>
<td>3117928</td>
<td></td>
<td>266.68</td>
</tr>
</tbody>
</table>

### 1.7 Methodology:

The author has carried out systematic investigation involving interdisciplinary approach to suggest a suitable programme for water resources and geomorphological study in Dhasan river basin. A detailed reconnaissance survey in the entire Dhasan basin area has been carried out. Based on the previous work & data obtained from the survey, the following methodology has been adopted for the present study.

- Preparation of geological map using remote sensing techniques & its interpretation.
- Preparation of geomorphological map and study of landforms features of the Dhasan river basin area using remote sensing techniques.
- Morphometric analysis has been done for the entire Dhasan river basin on 1:250,000 maps & different maps have been prepared and interpreted.
- Hydrometeorological data have been collected form the government organisations. Analysis of hydrometeorological data with the preparation and interpretation of necessary graphs & maps.
- Hydrogeomorphological & Lineament maps have been prepared and interpreted using remote sensing techniques.
- Investigation of Hydrogeology of the area with the help of well-inventory data collected for Pre- and Post-monsoon period form the sample-dug wells of the study area. The water table maps, depth to water level maps, fluctuation maps, ground surface map, water-table cross section, and water level change maps were prepared for 1993 and 2002 Years and interpreted.
- Pumping tests have been conducted on dug wells existing in the study area and the hydrological properties have been determined.
- Assessment of annual groundwater increment, annual groundwater draft, groundwater development, & groundwater management plan.
- Assessment of groundwater available for future development, assessment of groundwater need for drinking, domestic & irrigation.
REFERENCES:


Reddy, M.S. (1992), "Development, augmentation & storage, in Proceeding: Third National Water Conversion, Ministry of India", Govt. of India, New Delhi, pp. 1-10

Il Ed., Kendall/Hunt, USA., p. x.
