ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 4, Issue 2, March 2015

Drainage network analysis of Rajghat dam reservoir, district Sagar, M.P., India using Remote sensing techniques

Chourasia Abhilasha[1], Rawat R.K.[2] and Thomas H.[3]
[1]Research Scholar [2,3]Associate Professor
Department of Applied Geology, Dr.Harisingh Gour Central University, Sagar– 470003 (M.P.), INDIA

Abstract: ***The present study is aimed at assessing the geo-environmental and geo-hydro geological aspects of Rajghat dam situated in Sagar District of Madhya Pradesh, India; the various thematic maps have been prepared on 1:50,000 such as drainage analysis and slope analysis helped in evaluating of drainage analysis of the study area which has been shown in this paper. Drainage and slope map of the study area has been prepared using the IRS-P6 LISS-IV Mx (5.8 m) on 1:50,000. The study shows that the integration of all attributes provided drainage network analysis of Rajghat dam reservoir. The techniques of Geo-informatics have been proved to be efficient in identification of hydrological aspects for watershed management. IRS LISS IV multi- temporal data was used for geo-environmental studies. Besides the important environmental parameters, critically sensitive socio-economic conditions of the said watershed were taken into considerations for all round sustainable development. This study has been carried out to find groundwater prospect zone with suitable sites for artificial recharge of groundwater reservoir in the study area. Initially a list of water-scarce and water-excess area was prepared. In the study area, even though the rainfall is comparatively high during mansoon, occurrence of rainfall is mostly limited to about three months in a year thus scarcity of water is often felt during pre-mansoon season. The artificial recharge structures help to conserve rainfall. The study recommends that the issue of drinking water supply in surrounding areas must be part of an integrated water resources management paradigm. To achieve the objectives, catchment area and direct surroundings protection has been recommended.***

Keywords: **Geo-environmental, geo-hydro geological, drainage analysis, slope analysis, remote sensing, Rajghat dam reservoir.**

INTRODUCTION

The Rajghat dam is rock and earth fill type of dam. This dam is 1680.0 m long with 400.0 m masonry spillway, and which get water from Bewas River, Parkul River, and Jamunia River junction at Hinota village. Bewas River is 53.03 kms, Parkul River is 33.93 kms, and Jamunia River is 18.05 kms long at the dam site. The catchment area of Bewas river at the dam site is 472 sq. kms is located between 23° 23' 36" N to 23° 46' 22" N latitude and 78° 30' 32" E to 78° 46' 42" E longitude. The total water capacity of dam is 96.0 million cubic meter with 80.0 live storage, and 16.0 dead storage. Bed level of river is 495.0, minimum sill level is 509.0 m, maximum water level is 518.0 m, and maximum bed level is 520.0 m at dam site. The Bewas River originates from the northeast part of Raisen district located at about 720 meter near the Pipalia Katan. The study area falls in Survey of India (1:50,000) top sheets No. 55I/9, 55I/10, 55I/11, 55I/13 and 55I/14 (Fig.1). The normal annual rainfall of the study area is 1234.8 mm about 90% of the annual rainfall takes place during the southwest monsoon period i.e. June to September only 5.5% of annual rainfall takes place during winter and about 4.5% of rainfall occurs during the summer months. January is the coldest months with the temperature falling as low as 8.6^0 C and max. up to 24.5^0 C, and in the month of May, the temperature goes up to 46.7^0 C.

For integrated geo-environmental management/planning remote sensing has providing useful in conjunction with ground truths data on soils, land use, vegetation, surface & groundwater, geology, landforms, topography, settlements, etc. This paper attempts an overview of the application of remote sensing to geo-environmental and geo-hydrological studies of Rajghat dam, Sagar (M. P.).

ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 4, Issue 2, March 2015

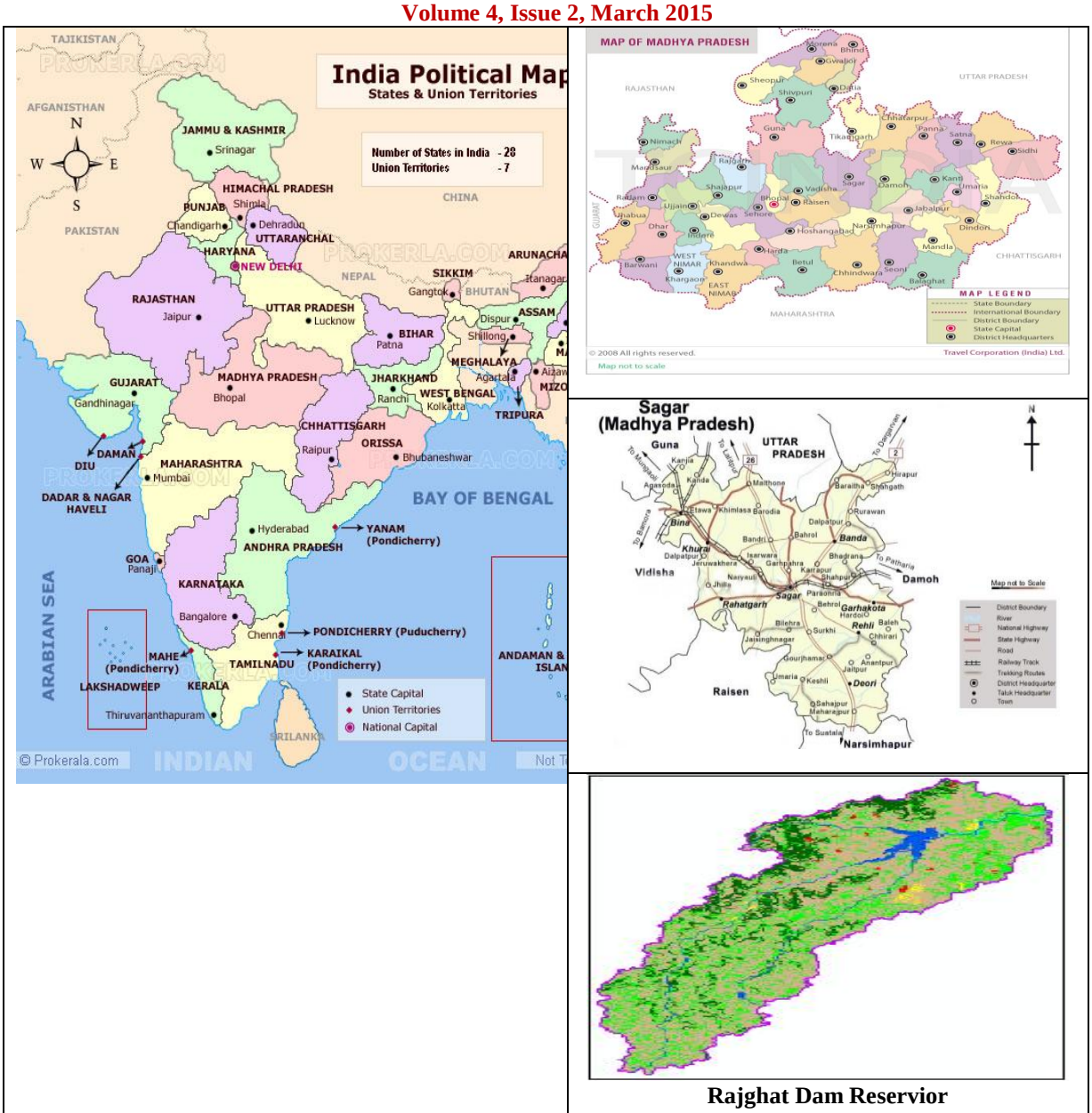

Fig. 1. Index Map of Rajghat Dam, Sagar (M. P.)

II. DATA ACQUIRED

1. The remote sensing data has been acquired from IRS-P6 LISS-IV Mx data (5.8 m), Dated: April 16, 2010, LANDSAT-7 ETM + Data (30m), Dated: 21 July, 2012, ASTER - DEM (30 m), Dated: 21 July, 2012.
2. The survey of India toposheet no. 55I on 1:250,000 scales and no. - 55I/9, 55I/10, 55I/11, 55I/13 and 55I/14 on 1: 50,000 scale for detailed analysis.
3. Drainage and Slope Map:-
    a. Drainage network has been generated in GIS environment using ASTER- DEM data and Arc Hydro water resources on ArcGIS 9.2.
    b. Slope map has been created using Spatial Analyst on ArcGIS 9.2 and DEM data with 30 m spatial resolution.
4. Geological studies:

ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 4, Issue 2, March 2015

a. The Geological Map has been collected from P.H.E. Dept., Sagar (M.P.), and Sagar District Geological Map has been collected from Geological Survey of India, Bhopal and updated through satellite remote sensing data i.e., IRS-P6 LISS-IV Mx, and LANDSAT-7 ETM, data with updated through satellite remote sensing data and ground survey.

III. RESULTS AND DISCUSSIONS

Geological studies

The geological (lithological) map has been prepared using IRS-P6 LISS-IV Mx data and field investigations. The important litho-units existing in the area are Upper Vindhyan Sandstone, Deccan Traps Basalt, and Alluvium. In the Vindhyan sandstones, primary porosity varies from negligible to high depending on the degree of compaction. The storage and movement of ground water in these formations is controlled mainly by the secondary porosity and permeability resulted due to weathering of joints and fractures. Overall groundwater condition is good along the lineaments and at their intersections. Deccan traps are the most important formations in the study area due to their large aerial extent. The weathered jointed, fractured and vesicular units of basalts form moderately potential aquifers. The zeolitic basalt or weathered zone form good aquifer. A common weathering product of the Deccan trap basalt is a friable light greenish or yellowish green earth material. The alluvial deposits are confined mostly to the area along the river courses and in the northeastern parts of the study area. It is composed of fine to medium sand, silt, clay and grit, which are high potential aquifers [7], [8].

Drainage network analysis

Drainage network analysis is important for geo-environmental and geo-hydrological studies. Drainage density of a region depends on the climatic factors, landforms, slopes and stage of geomorphic cycle, lithology and its permeability etc. Hence, drainage density is an important index in geo-hydrological studies, and can be evaluated from toposheet have emphasized that permeability has a fundamental influence on drainage density [13]. In bedrock areas, drainage textures, patterns and other features, based on the lithological character of underlying rocks and their structural disposition. The drainage patterns are dendritic pattern, rectangular pattern, and radial pattern [8]. A drainage map of the study area has been prepared using the IRS-P6 LISS-IV Mx (5.8 m) on 1:50,000 (Fig.2).

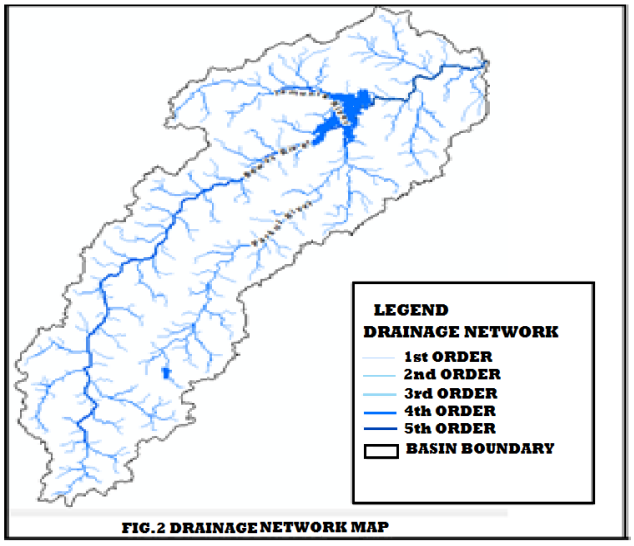

FIG.2 DRAINAGE NETWORK MAP

Drainage density the stream length per unit area in region of drainage basin are another element of drainage analysis, which provides a better quantitative expression to the dissection and analysis of land form, although a function of climate, lithology and structures and relief history of the region etc. can ultimately be used as an indirect indicator to explain, those variables as well as the morphogenesis of landform [4],[5],[16][17]. The drainage density of the catchment area is in the order of 3 to 6 km / km^2 (Fig.3).

ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 4, Issue 2, March 2015

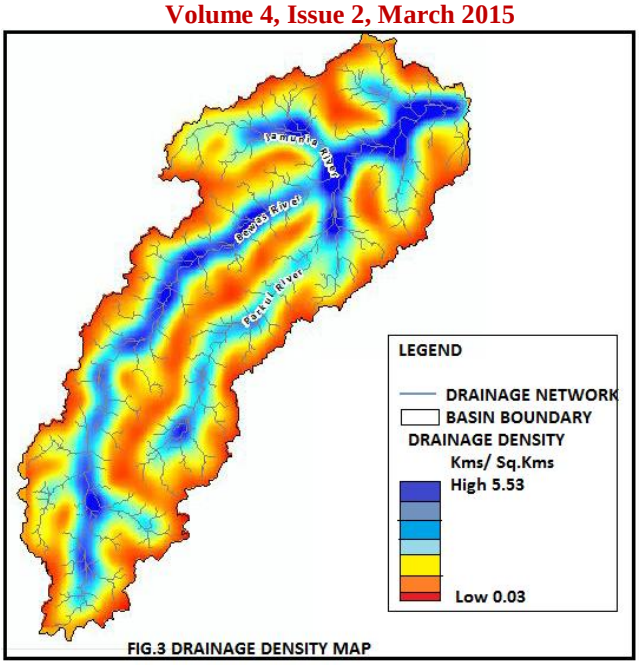

FIG.3 DRAINAGE DENSITY MAP

Slope Analysis

Slope is the most important feature of the earth's surface form. The slope stability analyses in geotechnical engineering have followed closely the developments in soil and rock mechanics. Maximum slope line is well marked in the direction of a channel reaching downwards on the ground surface. In any region valley slopes, occupy most of the area of erosional relief in greater extent in comparison to flood plains, river terraces and other local depositional landforms. Water is the most important factor in most of the slope stability analysis. Pour water in soil can strongly influence the physical interaction among soil grains. Changes in pore pressures can directly impact the effective stresses, which in turn, affect both the shear strength and consolidation behavior of soil. Therefore, analysis of pore fluid seepage plays an important role in the solution of many geotechnical problems, especially those concerning the stability analysis of slopes and retaining structures. By the literature survey, there are many contributions to slope-geomorphology and various methods of representing the slope, (contributions made by [1],[2],[3],[6],[9],[10],[13],[14],[15],[18] are very important Fig.4).

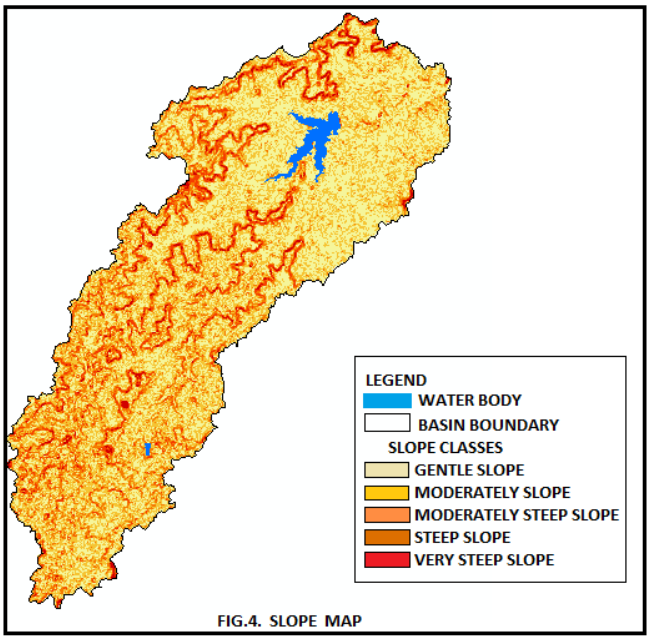

FIG.4. SLOPE MAP

ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 4, Issue 2, March 2015

IV. CONCLUSION

Remote sensing techniques with an emphasis on geology, geomorphology, physiographic, hydro-geomorphology, structure, geo-hydrology, land use/land cover has helped in identification of the potential zones for geo-environmental planning and predicting limitations to their implementation with reasonable accuracy. The valley fills and buried pediments are good groundwater potential zones. From the drainage analysis, it is clear that the Bewas catchment is suitable for surface reservoir and check dams. So this study is future enhance about the quality of groundwater and their water sample analysis. Thus, it has been clear that the dam is better for particular purposes.

REFERENCES

[1] Calef, W.C. (1950), "Form and Process", Cambridge University Press, London, pp.473.

[2] Calef, W.C. and Newcomb, R. (1953), "An Average Slope map of Illinois", Annals Assoc, An. Geog., v.43, pp.305-316.

[3] Eyles, A.C. (1965), "Notes on the Ecology of Nysius huttoni White (Heteroptera: Lygaeidae)", New Zealand Journal of Science, v.8, pp.494-502.

[4] Horton, R.E. (1932), "Drainage Basin characteristics", Trans. Am. Geog. Union, v.13, pp.350-61.

[5] Horton, R.E. (1945), "Erosional Development of Streams and their Drainage Basins", Bull. Geol. Soc. Am., v.56, pp.275-370.

[6] Miller, O.M. and summer son, C.H. (1960), "Slope Zone Maps", Geographical Review, v.50, pp.194-202.

[7] Pareta, K. (2005), "Rainfall-Runoff Modeling, Soil Erosion Modeling, Water Balance Calculation, and Morphometric Analysis of Molali Watershed, Sagar, Madhya Pradesh using GIS and Remote Sensing Techniques", 25th International Cartographic Congress, INCA, 2005.

[8] Pareta, K. (2011), "Geo-Environmental and Geo-Hydrological Study of Rajghat Dam, Sagar (M.P.) using Remote Sensing Techniques", International Journal of Scientific & Engineering Research (IJSER, 2011), vol.2, Issue 8.

[9] Pity, A. (1969), "A Scheme for Hill slope Analysis: Initial considerations and calculations", University Hull Occes, Pub. Geog. No.9, pp.76.

[10] Raisz, E. and Henry, J. (1937), "An average slope map of southern New England", Geographical Rev., v.27, pp.412-467.

[11] Rawat, R.K. and Chourasia, A. (2013), "Geoenvironmental evaluation of Rajghat dam, dist. Sagar (M.P.) using geo-informatics techniques", XXXIII INCA International Congress on Integrated Decentralized Planning: Geospatial Thinking, ICT and Good Governance, v.33, pp.370-372.

[12] Ray, R.G. and Fischer, W.A. (1957), "Geology from the Air, Science", v.126(3277), pp.725-735.

[13] Richards, K.S., Arnett, R.R. and Ellis, J. (1985), "Geomorphology and Soils", George Allen and Unwin, London, pp.441.

[14] Smith, G.H. (1935), "The relative Relief of Ohio", Geographical Rev., v.25, pp. 248-272.

[15] Smith, G.H. (1939), "The Morphometry of Ohio: The Average Slope of the Land (abst.)", Annals Assoc. Am. Geogr., v.29, pp.94.

[16] Strahler, A.N. (1952), "Dynamic Basis of Geomorphology", Bull. Geol. Soc. Am., v.63, pp.923-938.

[17] Strahler, A.N. (1956), "Quantitative Slope Analysis", Bull. Geol. Soc. Am., v.67, pp.571-596.

[18] Wentworth, C.K. (1930), "A Simplified Method of Determining the Average Slope of Land Surfaces", Am. J. Sci., v.21, pp.94-184.