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AN APPROACH TO LAND RESOURCES MANAGEMENT: A CASE STUDY

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Abstract: *Physical constituents especially hydrogeomorphological features inevitably lead the nature of utilization and spatial distribution of the resources. It intricately and inextricably linked with the region's resources potential. This is well reflected in the various characteristics of hydrogeomorphologic features and existing land use and land cover. The essential features of hydrogeomorphological maps, i.e., lithology, geology, structure etc. are helpful in the resources identification, mapping, planning and management, however these maps so generated are most useful in ground water resources exploration. Geospatial technologies have boosted up data capturing as well as provided a powerful base for detailed mapping, database generation and analysis more effectively for the planning and management of natural resources. Geospatial information technologies nowadays provides more improved user friendly environment in the analysis of data. With the enhanced capability of spatial and spectral resolutions along with temporal and multi scale explanations of the sensors are promising in analyzing land use/land cover changes and related environmental studies and future management prospects.*
Keywords: *Land Resources, Hydrogeomorphology, Remote Sensing and GIS.*

1. Introduction: As an interdisciplinary science, hydrogeomorphology deals basically with the hydrologic processes with surface and ground water in spatial and temporal scale with landforms [1]. In general, hydrogeomorphology is the specific description of applied geomorphology that includes three interrelated themes (hydro+geo+morpho). Hydro means water including both surface and ground water; geo-means the earth (lithology) and morphology expresses the features in the form of land forms. Thus hydrogeomorphology deals the landforms caused by action of water which is the most important geomorphic agent in sculpting the landform [2].

The advanced remote sensing techniques are now playing a rapidly increasing role in the mapping and analysis of hydrgeomorphological features and natural resources development. Geographic Information System (GIS) and remote sensing technique have extended the capability of image analysis [3]. Land is the prime and basic natural resources that affect the development in all the respect. Its utilization is primarily concerned with the agricultural sector. Forest and water are the other most important natural and renewable resources. Therefore, development planning for these natural resources is the prerequisite rivet in the development of the area under study.

This paper aims to evaluate land resources based on GIS techniques and hydrogeomorphological aspects.

2. Objective: The objectives of the study can broadly be enlisted as: (i). To generate spatial database and suggest some measures for land resource management based on hydrogeomorphological study.

3. Study Area: Chakia Tahsil (24º 4' N to 25º 3' N and 83º 3' E to 83º 24' E) of Chandauli District (Uttar Pradesh) is taken for the case study. The *tahsil* is sharing its border with the Shahabad District (Bihar) in the East, Mirzapur District in the West and Chandauli *tahsil* in the North and finally Sonbhadra District in the South. Administratively, Chakia *tahsil* embraces the total area of 582.76 sqkm, with Chakia, Shahabganj and Naugarh as its three development blocks (Fig. 1and Fig. 2).

Physiography largely influences the land usage and settlement pattern. The two broad physical divisions with excellent combination of Vindyan Uplands in the south and alluvial plain in the north are truly juxtaposed here. The plain constitute nearly 23.48% of total area, whereas plateau covers nearly 76.52% of total area. The geologic conditions largely influence the hydrological characteristics of the area and hence they are considered as very significant aspects of hydrogeomorphological mapping. The alluvial plain lies mainly in Chakia and Shahabganj blocks constitute the part of *Gangetic* alluvial plain, shows the sediments of Quaternary age. The newer alluvial plain is mainly composed of sand, silt and clay, whereas older alluvial plain is composed of clay, silt and medium to coarse grained sand. The *Kaimur* upland exposed in the southern portion of the *tahsil* lies mainly in Naugarh block and some portion lying in the southern portion of Chakia and Shahabganj blocks. It comprises of a stratified unmetamorphosed group of rocks, presented by sandstone, shale, sandoquartizite and limestone [4].

This region is characterized by '*Monsoon*' with seasonal variations in the weather. The hot summer season starts in mid March and lasts till mid June until the onset of monsoonal rainfall. The average maximum temperature lies in between 30 to 40^{0}C. April, May records for hottest month. It receives its rainfall due to monsoonal winds, which starts from mid June and lasts till mid September. July and August receive the highest amount of rainfall. From November to February, the season is known for the winter season, with the pleasant cool weather (Table 1).

Table 1: Monthly Mean Maximum and Minimum Temperature, Mean Pressure, Relative Humidity and Rainfall at Chakia (2014).

Month	Mean Temperature (^{0}C)		Pressure (hpa)	Relative Humidity (%)	Rainfall (mm)
	Max	Min			
January	22.0	7.6	1018.5	74.3	00.4
February	24.9	12.6	1016.7	73.7	62.4
March	32.7	17.3	1012.3	53.2	12.0
April	38.1	21.8	1006.9	54.3	10.4
May	41.4	26.6	1000.9	43.3	00.0
June	36.4	27.3	998.85	67.3	172.8
July	34.8	26.8	997.7	80.2	219.5
August	33.5	25.9	1001.5	84.4	292.4
September	34.3	25.7	1004.9	80.7	91.0
October	30.5	22.0	1010.1	87.4	68.5
November	28.5	13.3	1015.7	79.5	159.5
December	25.0	10.1	1011.5	78.5	159.5

Source: *Meteorological Department, BHU*

The population of the *tahsil* is mainly rural in nature. According to 2011-12 censuses, Chakia, Shahabganj and Naugarh blocks have a total population of 148734, 123655 and 67736 persons, which share 9.05%, 7.53% and 4.12% of total Chandauli district respectively. Of total *tahsil*, male population shares 52.09% of total population, whereas female population constitutes nearly 47.91% of population.

4. Database and Methodology: The relevant data for the present analysis is collected from multiple data sources like Survey of India (topographical maps), National Remote Sensing Centre, Hyderabad (satellite imagery) and various other Government offices located at district headquarters. IRS P6, LISS III (2014; Path 102, Row 54) satellite data is used to prepare hydrogeomorphological map and land use and land cover map (Table 2). Hydrogeomorphological features were delineated by using visual image interpretation technique and kept into two major categories, namely, features of alluvial plain and features of Vindhyan upland. Supervised classification using maximum likelihood classifier is done for the LU/LC analysis for the categories namely, urban, rural, dense forest, open forest, scrub forest, water bodies, sandy/rocky waste, fallow land and cropland (Fig. 3).

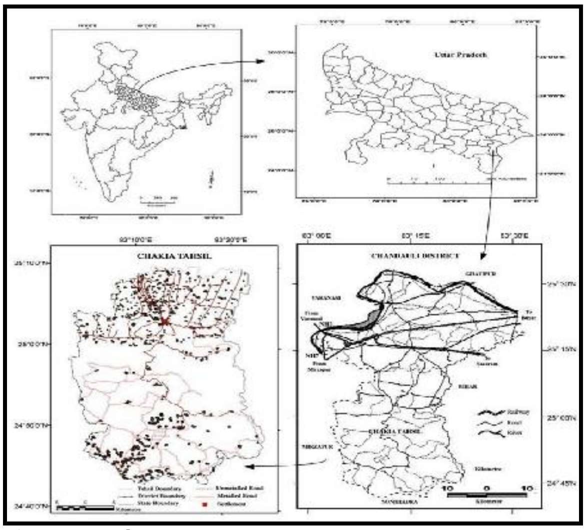

Figure 1: Study Area

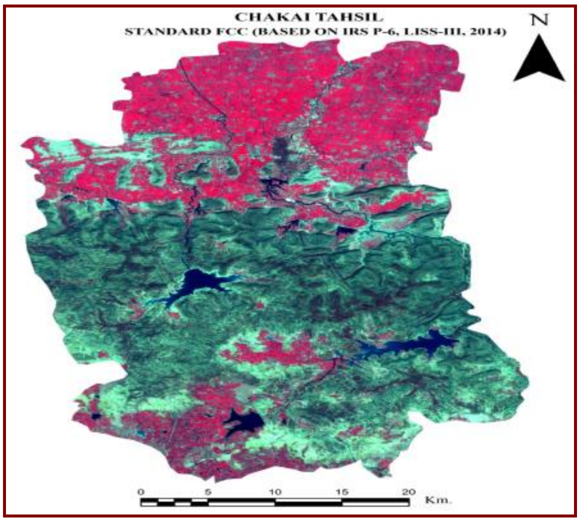

Fig. 2: Satellite Image (IRS P6, LISS-III, 2014)

Various maps were generated with the use of GIS software. Then image analysis were carried out. The whole research work has been carried out in different steps such as pre-field study, field check, post-field and then finally writing work.

Table 2: Details of Data, Their Description and Sources

S.No.	Data	Description	Sources
2	Satellite Data	IRS-P6, LISS-III (Resource at 2, LISS-III) (Oct 2013 and Feb 2014)	NRSC, Hyderabad
4	Weather Data	Temperature, Rainfall, Humidity, Pressure	Meteorological Department, BHU
5	Hydrological Data	Canals, Reservoirs,	Irrigation Department and Jal Nigam, Chandauli, UP Ground Water Board, Lucknow
6	Forest	Types, Area, etc.	*Kashi Van Prabhag*, Ramnagar

5. Results and Discussions

5.1. Hydrogeomorphology: Identified and delineated hydrogeomorphological features with total area (%), image description, lithology, ground water prospects and associated LU/LC is mentioned in the Table 3 (Fig. 4).

Table 3: General Characteristic of Hydrogeomorphic Features and Ground Water Prospect (Based on IRS P6, LISS-III, 2014)

S.N.	Hydrogeomorphic Unit	Total Area (%)	Image Description	Ground Water Prospect	Associated Land Use/Land Cover
1	***Alluvial Plain***	21.27	Light to dark red tone with coarse to smooth texture,	Excellent	Intensive cultivation, Settlement, Plantation and forest cover in patches
2	***Intermountanne Valley***	9.29	Medium red tone with patches of dark red tone, Coarse texture, Identified as depression between escarpment and residual hills	Good to Moderate	Intensive cultivation, settlement
3	***Pediment***	5.17	Light to moderate greenish tone, Characterized by scrub	Poor to very poor	Scrub and Open forest, Plantation, Fallow land
4	***Buried Pediment***	15.29	Weathered material, good cultivation	Good to Moderate	`Moderate to good cultivation, plantation, Settlement
5	***Valley fill***	1.29	Medium to smooth texture	Good to excellent	Good to very good cultivation
6	***Dissected Plateau***	31.87	Marked various lineaments, covered with dense and open forest, associated with various landform features like gorge, valleys, hills	Good to moderate	Dense and open forest cover
7	***Structural hills***	4.77	Dense and open forest, structurally controlled unit.	Very Poor	Open and scrub forest cover
8	***Denudational hill***	8.68	Dense forest, dark red/ brownish tone with moderate to smooth texture.	Very poor	Dense forest cover
9	***Residual hills***	2.37	Covered with scrub forest, bright tone with coarse to smooth texture	Very Poor	Scrub and bushes

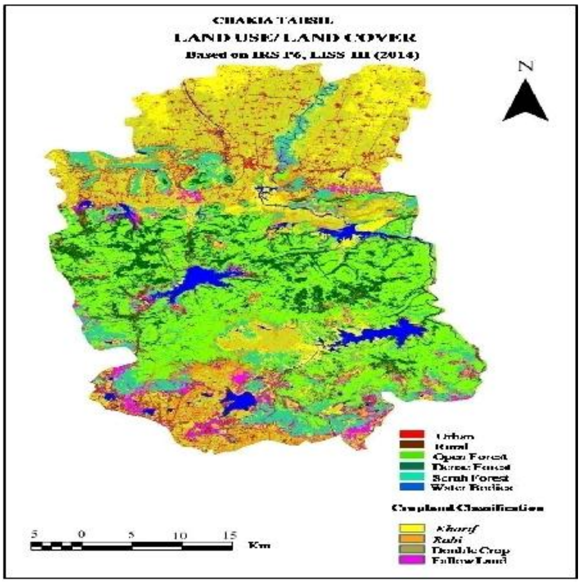

Figure 3: Chakia Tahsil: Hydrogeomorphology

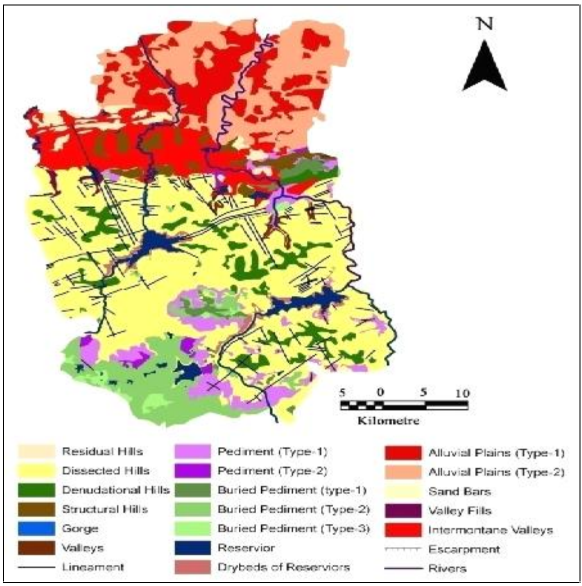

Figure 4: Chakia Tahsil: LU/LC (2014)
Source: Image analysis and GIS based Computation

Remote sensing and geographical information system (GIS) has become one of the leading tool in the field of ground water research, which helps in assessing, monitoring, and conserving ground water resources [5]. The alluvial plain region constitutes nearly 21.27% of the total area. The plateau region covers nearly 78.73% of total area cover. Hydrogeomorphology largely influences the nature, spatial distribution and utilization of natural resources. Flood plain features along the river course are the most important hydrogeomorphic features. It is composed of sand, silt, clay and gravel. They always offer a good scope for settlement and the socio-economic establishment. The middle portion of the study area is occupied by the intermontanne valleys.

Lithologically it is associated with sand, silt and boulders and offers a good permeability for ground water recharge and cultivation prospects. A broad, flat and gently sloping pediments, offer limited scope for ground water potential. Few patches in the north- eastern part and southern part are marked by this hydrogeomorphic unit. These are generally covered with open scrub forest.

Buried pediment zones are generally marked with flat and smooth surface consisting of low to moderately weathered materials. Ground water potential may vary from moderate to good. This has shown good to excellent cultivated zone. Valley fills on the imagery are identified as linear depressions present in between the hill ranges and occupy lowest reaches in topography, commonly filled with pebbles, cobbles, gravel, sand, silt and other detrital materials. The groundwater potential ranges from moderate to good [6].

The southern portion is nothing but an extension of Vindhyan upland. This plateau region registers a wide range of hills, valleys, beautiful gorges and waterfalls. The northern part of the plateau is characterized by steep escarpment and pediment zones. Structural hills in the area under study are marked in forms of isolated hillocks with an average elevation of 200-250 m. These hills are covered by forest and open scrub. Denudational hills in the dissected plateau region are found with dense forest cover along with lineaments at some places. The average elevation is extending beyond 300 m. Residual hills are the end products of the process of pediplanation. Structural hills, denudational hills and residual hills indicate poor to very poor ground water prospect.

5.2 Drainage: Along with Karmanasa and Chandraprabha, a small portion of Garai River is also coming into this region. Latif Shah, Munsakhand, Bhainsora, Chamer, Shamsherpur, Chandraprabha, Naugarh, Muzaffarpur dam are the other important sources of water in this region. Nakoiya, Baburi, Chandauli, Lehra Disty and their tributary canals also play their role in the productivity and prosperity of this region.

5.3 Land Use/Land Cover: From the fig., the region shows well cultivated entire northern plain including hydrogeomorphic features like alluvial plain, valley fills, intermontanne valley and buried pediment, pediment in patches in the southern part of the region. The residual hills and pediment shows scrub forest cover and open forest, whereas denudational hills reflecting dense forest cover. Based on GIS computation, it was found that built up area constitute nearly 6.6%. Neary 57% of land comes under cultivated land. Forest cover constitutes nearly 26%. Wasteland category including stony waste and open scrub covers nearly 7.7% of the total area. Rest water bodies categories constitute 2.7% of the area total.

6. Suggestions for Land Resource Management: From the point of view of hydrogeomorphology, alluvial plain, intermontanne valleys, buried pediments and valley fills are the good to excellent zone for the ground water prospect. Pediment, dissected plateau, structural hills, denudational hills and residual hills, which varies from various lithounits, offers very poor to moderate prospects for ground water resources and land resources utilization [7]. There are many scholars whose works are worth considerable in the natural resources management through remote sensing and GIS techniques etc [8,9].

The alluvial plain in this region suffered from water logging problems for many years but now these drawbacks were converted to a greater extent to more fertile area by use of proper irrigational facilities and technologies. Cultivation area increased due to more utilization of fallow land and open forest of the pediment areas. Some open forest areas due to human intervention are added into scrub forest areas. The dense forest shows slight increase in the cover.

The region may be more productive if the land under single crop cultivation is converted into multiple cropping land. Also land under permanent fallow land may be used for fodder and fuel plantation. Agro-forestry should be encouraged in the villages located in and around intermontanne valleys, buried pediment zones and valley fills areas.

7. Conclusion: Hydrogeomorphological study of the area provides a broad spectrum to comprehend various dimensions regarding the natural resources, their distribution, occurrences, management etc. Land, water indisputably most important natural resources and direct the distribution, type, the nature of other different resources. Hydrogeomorphological study can give a promisable help in understanding and alleviating the problems associated with the watershed. Exploration of ground water occurrences, understanding the recharge and discharge zones and related issues, forest, land resource management issues etc have a greater implication with the hydrogeomorphological study.

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