GENERAL CHARACTERISTICS OF RELIEF AND ITS ANALYSIS USING REMOTE SENSING AND GIS: A CASE STUDY

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Abstract

The terrain features and characteristics largely influence the nature of utilization and distribution resources. Today, it has become very important to have elementary knowledge about every land pixel. In this regards, remote sensing techniques and Geographic Information System (GIS) are more popularly used in studies about the earth's surface features. The advantage of these techniques is also lies in the easy facilitation of data because these techniques provide an easy approach to different data types like multi-spectral, multi-temporal, multi-scale and multi-sensors that helps in successful analysis and prediction of terrain related aspect. Mapping of land features provides a solid platform for evaluation and utilization of resources on a sustained basis as well as other resource's related mapping like soil resource mapping, ground water potential zones, geomorphological mapping and etc.

Key words: Topography, Remote Sensing, GIS, Physiography, Aspect, Relief, Slope, Relative Relief, Dissection Index

Introduction

Remote sensing and Geographic Information System (GIS) together provides a powerful base for detailed mapping, database generation and analysis more effectively in the planning and management of natural resources like land, forest and water etc.. For this purpose terrain variation has an important role in decision making. For the development and prosperity of any region depends on its characteristics of land surfaces. Land in itself is one of the important natural resource. Recent changes in geospatial information technologies, especially remote sensing and geographic information science have put forward a new dimension and interactive approaches in mapping and analysis of natural resources including land resources. During the last three decades, the availability of remotely sensed data with improved spatial and spectral resolutions along with temporal and multi scale explanations have generated more momentum to establish a proper relationship amongst various associated surface elements including soil, land use/land cover.[1] The remote sensing data helps in fairly accurate hydrogeomorphological analysis and identification and delineation of land features. Remote sensing techniques provide an opportunity in resource evaluation as some resources are not directly visible and they are explored through indirect methods based on terrain features like geological and geomorphic features and their hydrologic character.[2]

The present paper aims to describe the characteristic features of the terrain, slope and physiography of the study area, *i.e.*, Chakia Tahsil, Chandauli District of Uttar Pradesh.

Geographical Personality

Chakia Tahsil (24º4' N to 25º3' N latitude and 83 º 3 'E to 83 º 24' E) of Chandauli district enjoys juxtaposed combination of alluvial plain in the north covering Shahabganj and Chakia block and Vindhyan plateau region in the south, which covers almost entire Nauragh block of the Tahsil.

Geologically, alluvial plain shows the sediments of Quaternary age. Newer alluvial plain, mainly composed of sand, silt and clay, whereas older alluvial plain, mainly composed of clay, silt and medium to coarse grained sand.[3] Auden (1933) gave a view of fourfold division of the Vindhyan system like Semri, Kaimur, Rewa and Bhander.[4] This formation, namely Kaimur upland exposed in the southern portion of the Tahsil mainly in Naugarh

block, comprises of a stratified unmetamorphosed group of rocks, presented by sandstone, shale, sandoquartizite and limestone.

Karmanasa, Chandraprabha and Garai are the prominent rivers, which are draining this region. The population of Chakia Tahsil is mainly rural in nature.

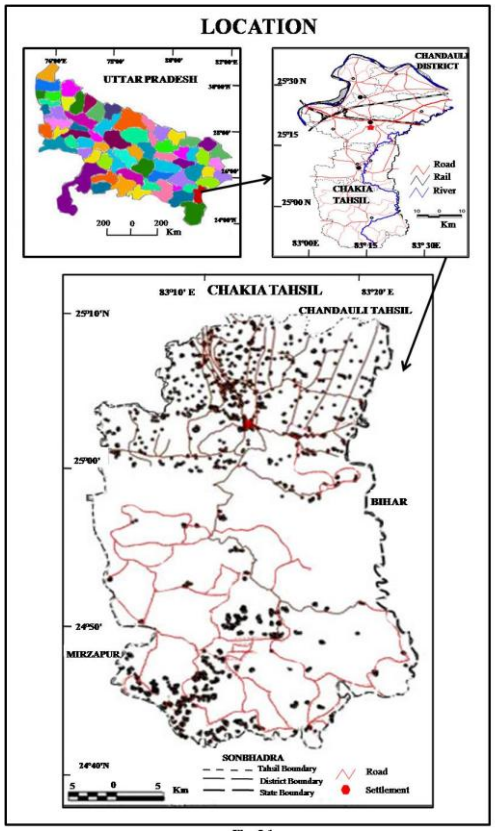

Fig. 1: Chakia Tahsil: Location

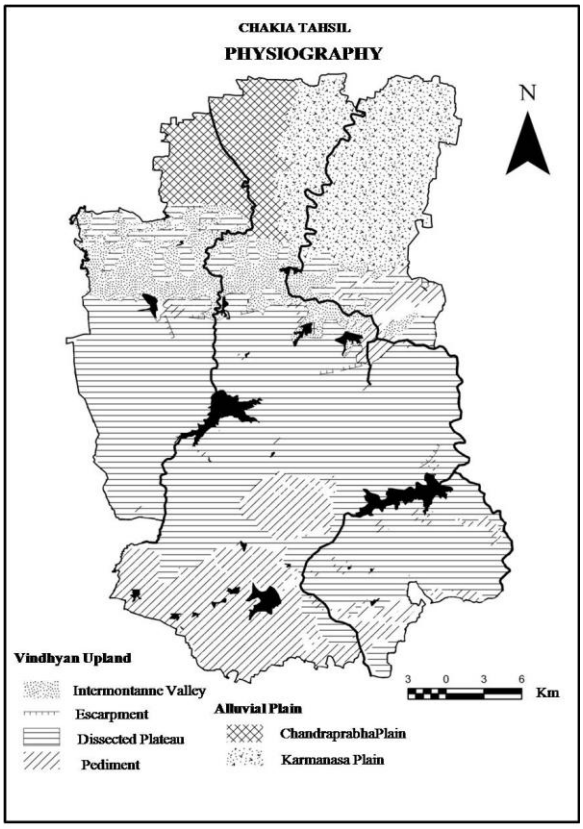

Fig. 2: Chakia Tahsil: Physiography

Physiography

The northern alluvial plain generally consists of flat topography. The dead level topography generally creates water logging problems in several places. The Southern plateau region of the *tahsil* is highly dissected and sculpted by the rivers like Karmanasa and Chandraprabha. From Table 2.1, it can be seen that plain feature has 23.48% share in which Karmanasa plain has 15.04% of area coverage and nearly 8.44% area coverage by Chandraprabha plain. The plateau region covers nearly 76.52% of the total area in which 9.79%, 57.78% and 8.95% is shared by intermontanne valley, dissected plateau and pediment zones respectively.

Table 1: **Physiographic Units and Area (%)**

1) Alluvial Plain		**2) Vindhyan Plateau**	
Features	Area (%)	Features	Area (%)
Karmanasa Plain	15.04	Intermontanne Valley	9.79
Chandraprabha Plain	8.44	Dissected Plateau	57.78
		Pediment	8.95
Total Area	**23.48**	**Total Area**	**76.52**

Source: Satellite image interpretation done by the Researcher

Aspect

Aspect denotes the direction in which the maximum slope faces. It designates the range between 0° and 360° (N). Direction is counted clockwise. North (0-22.5) covers nearly 14.98%. North-East (22.5-67.5) with 13.62%, East (67.5-112.5) with 12.53%, South-East (112.5-157.5) with 11.16%, South (157.5-202.5) with 11.19%, South-West (202.5-247.5) with 11.18%, West (247.5-292.5) with 12.26%, North-West (292.5-337.5) with 13.08% of the total area of the Tahsil is lying under these aspects (Fig. 3and Table 2)

Table 2: **Aspect and Area (%)**

Aspect	Aspect (°)	Area (%)
North	0-22.5	14.98
North-East	22.5-67.5	13.62
East	67.5-112.5	12.53
South-East	112.5-157.5	11.16
South	157.5-202.5	11.19
South-West	202.5-247.5	11.18
West	247.5-292.5	12.26

Source: Satellite Image Interpretation and GIS based computation done by the Researcher.

Relief Analysis

The relief analysis has been done using DEM data of CARTOSAT-1 (2014) of 2.5m of spatial resolution variations at convenient spacing along E-W and N-S reference lines (Fig. 4 & 5).

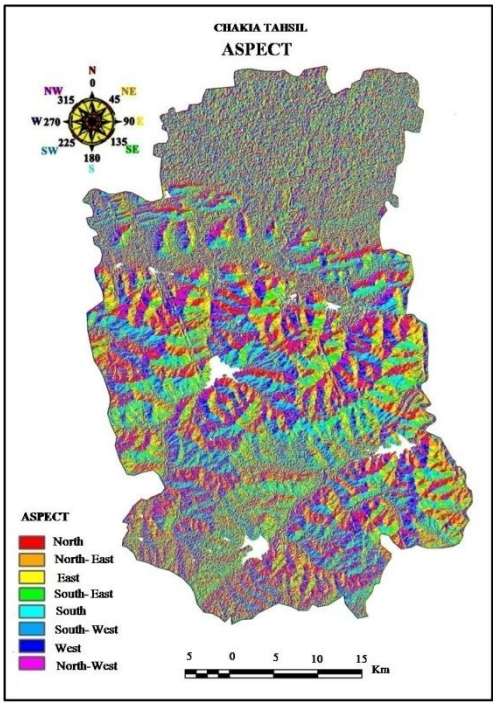

Fig. 3: Aspect

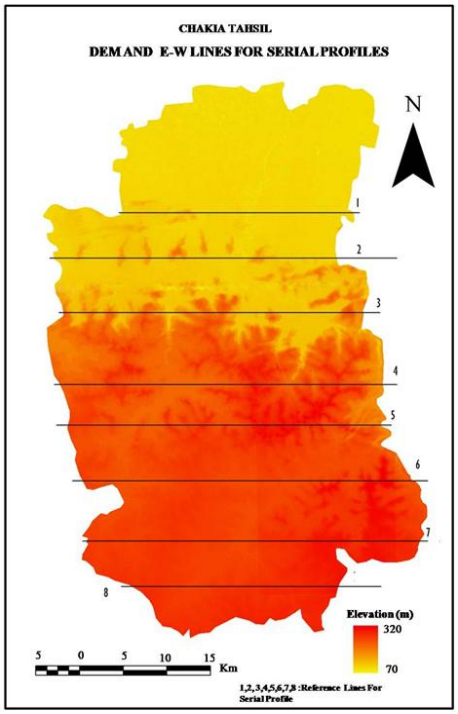

Fig.4 : East-West Reference Lines

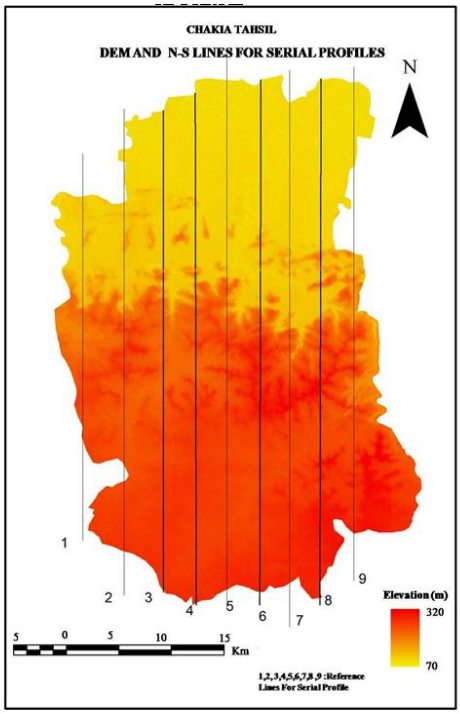

Fig.5:East-West Reference Lines

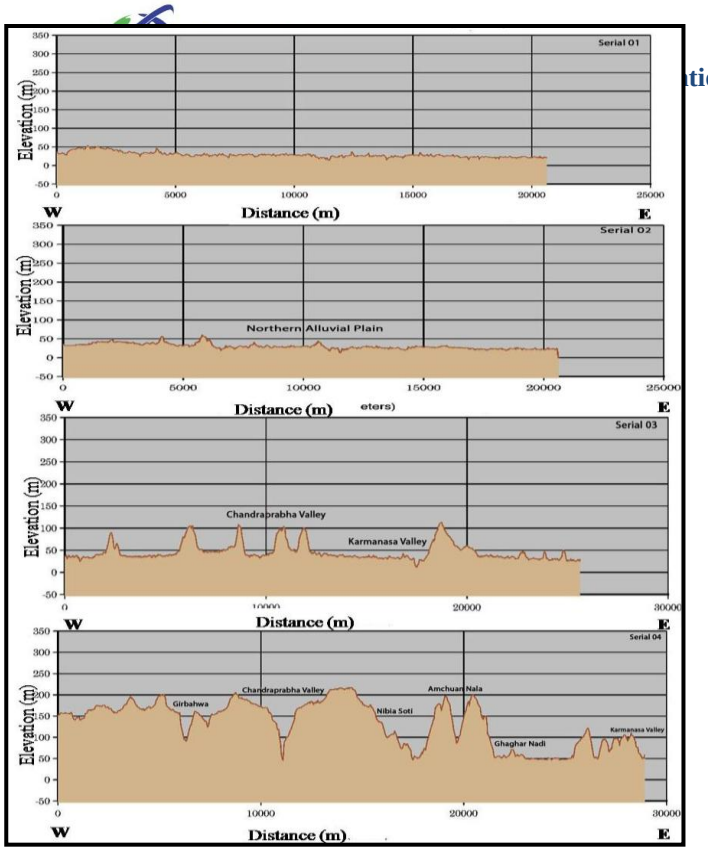

Fig. 4.1 Serial Profile Along E-W Lines No. 1,2,3 & 4

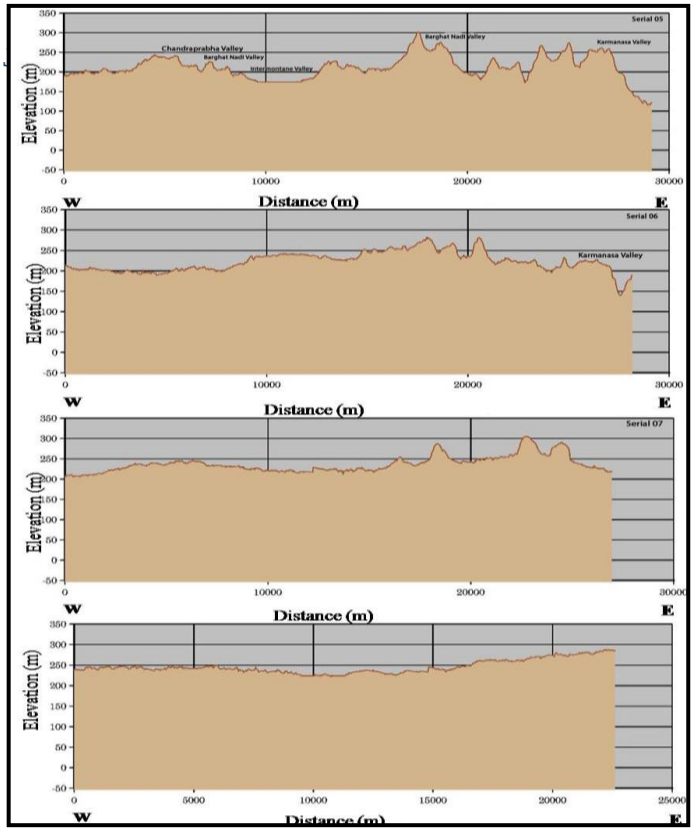

Fig. 4.2: Serial Profile Along E-W Lines No. 5, 6, 7 & 8

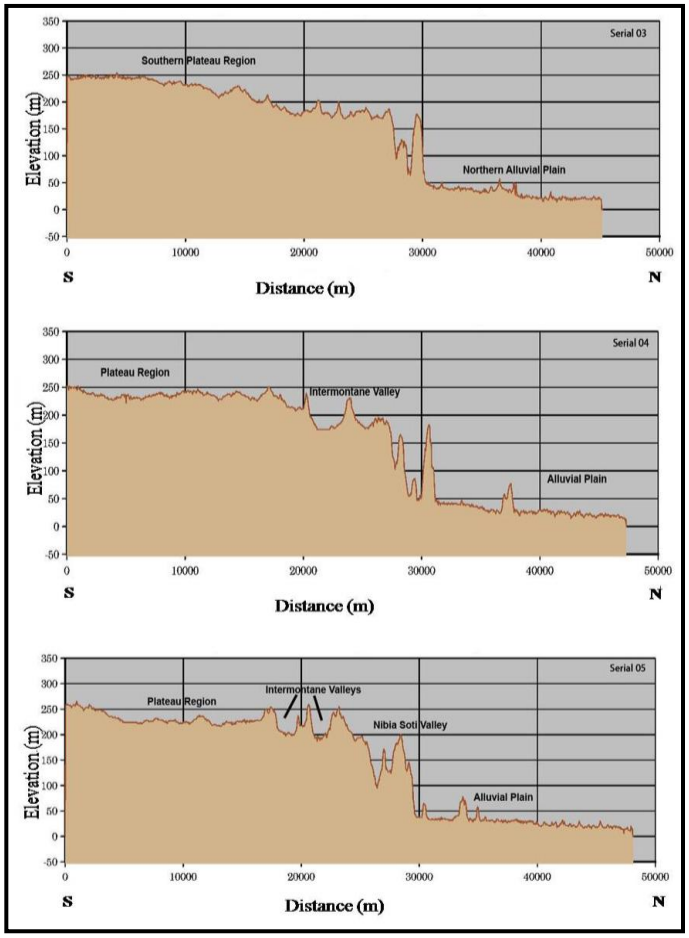

Fig. 5.1: Serial Profile along N-S Lines No. 3, 4 & 5

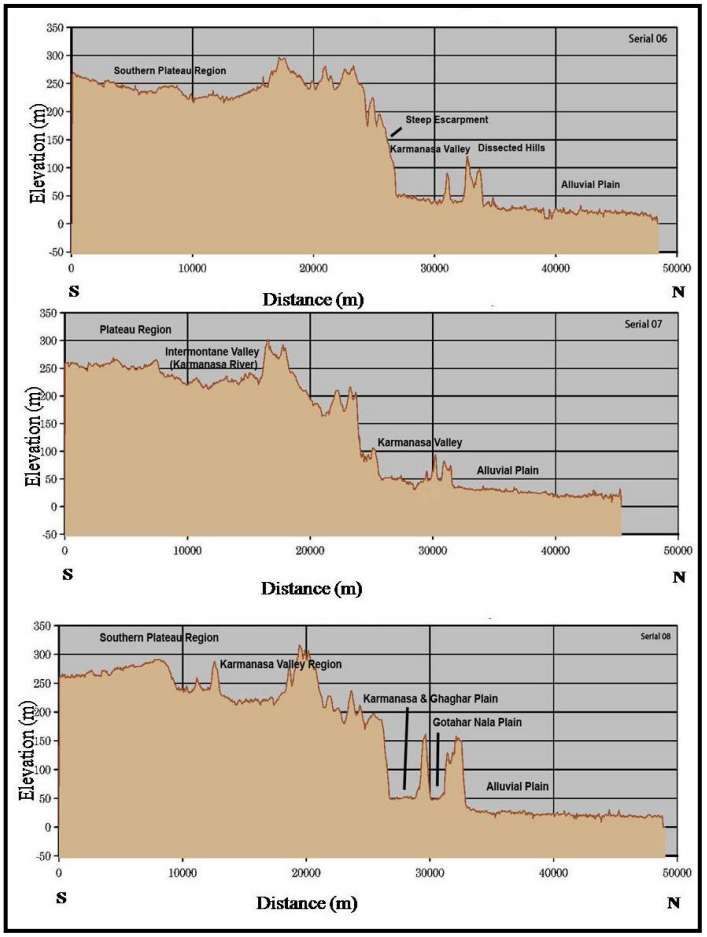

Fig. 5.2: Serial Profile Along N-S Lines No. 6, 7 & 8

From the Figures 4.1 and 4.2, profile is seen almost leveled and elevation is not exceeding even beyond 100 m. Residual hills can be seen along the profiles 2 and 3.. Elevation of the hills are ranging from 120 m to even beyond 200 m. Thus the northern plain constitutes the dead level plain with scattered dissected hills. One of the important geomorphic features is witnessed in the serial number 16. Hills and valleys are the two very important marked features in the middle portion of the area. On an average the elevation is near about 200 m . Valleys of Girbahwa, Chandrprabha, Nibia Soti, Amchuan Nala, Ghaghar Nadi and again Karmanasa Valleys are identified in the Serial no. 4. Rest serials started showing characteristic features of plateau with elevation above 300 m and more.

Total 8 serials profiles are drawn for the north-south profile, but only serial nos. 3, 4, 5, 6, 7 and 8 are taken for the analysis since rest of the serials are missing somewhere on the reference lines. Alluvial plain and plateau are marked by Serial Nos. 3 and 4. Nibia Soti valley is identified by Serial No. 5. Here the elevation is ranging even more than 250 m (Fig. 5.1). Steep escarpment is marked on Serial 6. On Serial No. 7 elevation is ranging 300 m and more with marked features of intermontanne valleys and Karmanasa valley. Serial No. 8 shows Karmanasa, Ghaghar plain and Gotahar Nala plain. On this serial elevation is marked more than 300 m (Fig. 5.2).

Slope

The degree of slope controls the amount of run off, velocity of river, erosion, transportation and deposition and plays an important role in the development of drainage network. As the structure, lithology, climate, soil, vegetation. altitude, relief and tectonic disturbances influence the slope development. It may be indicative of various variables which affect the hydromorphogeological development of the area and may be used as a tool by different field planners.[5] The slope of the study area reflects more than 69.93% under level to gentle slope (15° and below) covering northern and southern portion with some variations. Nearly 19.98% of area is categorized under gentle to moderate slope (15°-30°). Moderate slope (30°-45°) consists nearly 5.01% of the area. Nearly 4.98% and 0.10% of the area is under moderate to steep (45°-60°) and very steep (60° and above) category respectively (Table: 3 and Fig.6).

Table 3: **Slope and Area (%)**

Slope (Degrees)	Area (%)	Nature
15 and Below	69.93	Level to Gentle
15-30	19.98	Gentle to Moderate
30-45	5.01	Moderate
45-60	4.98	Moderate to Steep
60 and Above	0.10	Very Steep

Source: Image Interpretation and GIS based Computation done by the Researcher

Relative Relief

Relative relief is the measure of the elevation differences between the highest and the lowest point in unit area. From the Fig. 7 and Table 4, it is evident that low value of relative relief with 30 m and below is obtained for nearly 75.45% of area constituting entire northern and southern portion with little variations. The zone of escarpment shows appreciable variations in relief. Nearly 11.43% of area is categorized under 30-90m of relative relief. 90-150 m of relative relief consists of nearly 5.78% of the area which is running in the middle zone of the area. With 4.34% of the area reflects 150-210 m of value of relative relief. The high value of relative relief with 210m and above occurs in nearly 3.00%, almost in the middle zone of the area.

Table 4: **Relative Relief and Area (%)**

Relative Height (m)	Area (%)	Relative Height (m)	Area (%)
30 and Below	75.45	30 and Below	75.45
30-90	11.43	30-90	11.43
90-150	5.78	90-150	5.78
150-210	4.34	150-210	4.34

Source: Image Interpretation and GIS based Computation done by the researcher

Dissection Index

Table 5 shows value of dissection index, area (%) and the nature of dissection. The middle portion is exhibiting a comparatively higher degree of dissection with coverage of 0.37% of area. Almost southern and northern portion of Chakia is devoid of high degree of dissection. The region reflects value 0.2 and below with 79.23% of area cover. Moderate dissection is observed in 11.48% of area with value 0.2-0.4. Moderate to high dissection with value 0.4-0.6 covers nearly 8.92% of area Dissection can depend on many factors, but the most visible factor is the action of water which is sculpting the regional landforms, especially in the steep valleys and falls. Dissection index of the region is high (Fig. 8).

Table 5: **Dissection Index and Area (%)**

Dissection Index	Area (%)	Nature	Dissection Index
0.2 and Below	79.23	Low	0.2 and Below
0.2-0.4	11.48	Moderate	0.2-0.4
0.4-0.6	8.92	Moderate to High	0.4-0.6
0.6 and Above	0.37	Very High	0.6 and Above

Source: Image Interpretation and GIS based Computation done by the Researcher

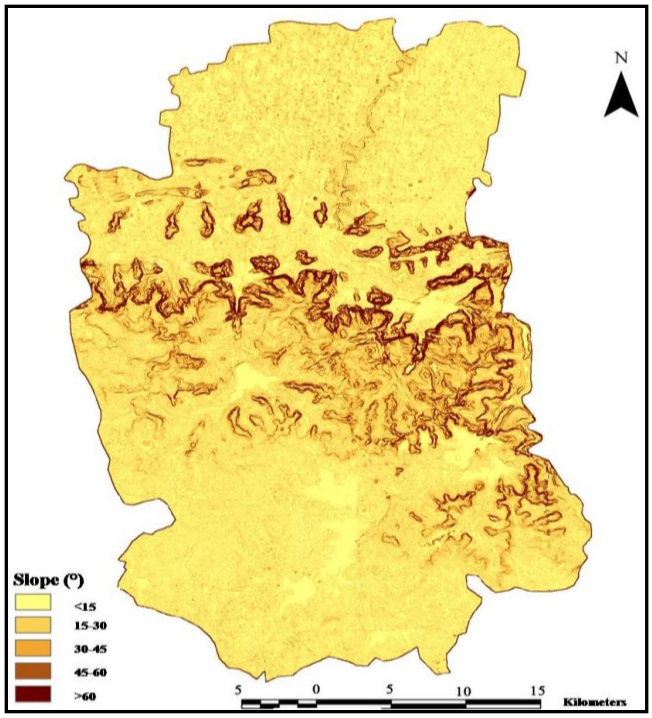

Figure 6: Chakia Tahsil:Slope

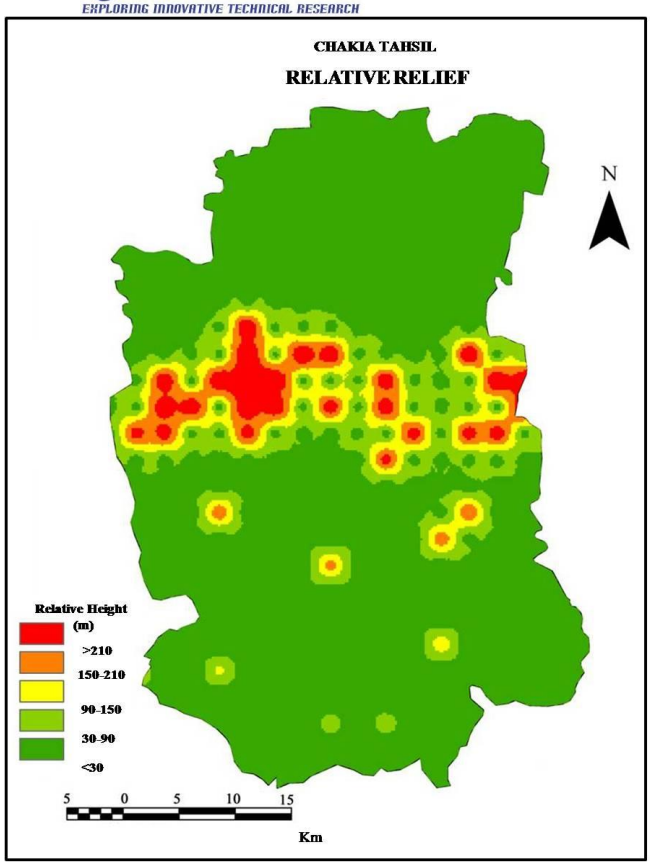

Fig.: 7: Relative Relief

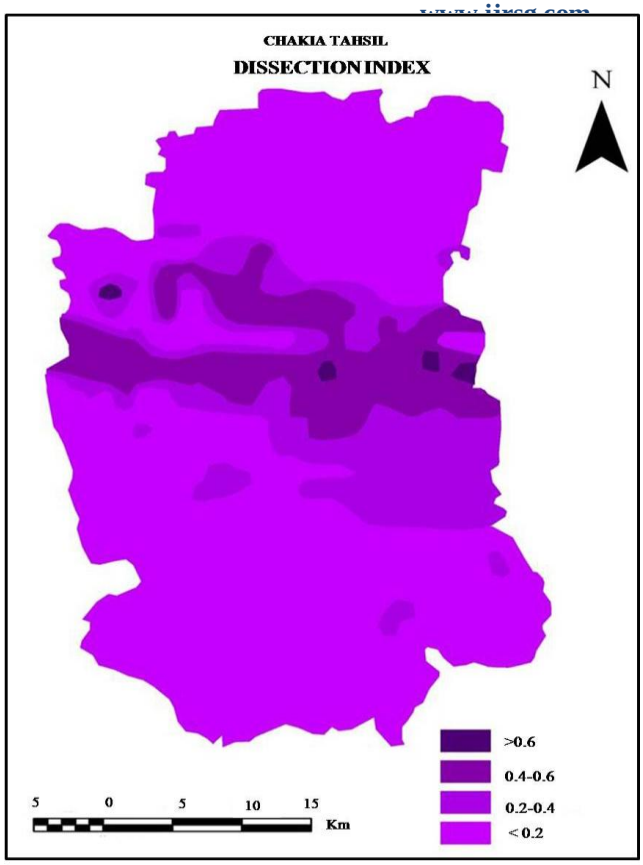

Fig. 8: Dissection Index

Conclusion

Chakia Tahsil endowed with two major contrasting features, which is reflected during relief analysis. Northern plain is almost leveled with some little variations. Small isolated hillocks are found in the plain. The southern region is characterized by rugged and hilly terrain. This plateau region registers a wide range of hills, valleys, lineaments, gorges and waterfalls. Karmanasa and Chandraprabha in this region are responsible for the creation of hydrogeomorphic features and terrain variations. The slope, relative relief and dissection reveal that the middle zone is consisting of the zone of the steep escarpment. The average relative relief of this plateau in the northern part where Girbhawa, Chandraprabha, Nibia Soti, Ghaghar Nadi is making their valleys on the same cross sectional line are varying from 50 m to even beyond 200 m. The southern part of this plateau is exhibiting on an average height of 320 m.

References

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