The International Journal Of Engineering And Science (IJES)
|| Volume || 4 || Issue || 2 || Pages || PP.33-39|| 2015 ||
ISSN (e): 2319 – 1813 ISSN (p): 2319 – 1805

The Subansiri River Basin Of Eastern Himalaya And The Alaknanda River Basin Of Western Himalaya: A Comparative Geomorphic Study Using GIS And Remote Sensing

[1,] Sangita Devi , [2,] Dulal C. Goswami
[1, 2,] *Department of Environmental Science Gauhati University, Guwahati-781014, Assam, India*

----------**ABSTRACT**----------
Geomorphology is the study of landforms or topographic features of the earth's surface and their associated processes of formation and decay. The development of a drainage system over space and time is influenced by several factors such as geology, structural components, geomorphology, soil and vegetation of an area through which it flows. In this study, geomorphologic features of the Subansiri and the Alaknanda river basins representing the eastern and the western Himalayas respectively, have been examined using Remote Sensing data under the GIS platform to make a comparison of these two representative river basins from the two extreme segments of the Himalayan arc. The study shows some contrasting features of geomorphology in respect of the two Himalayan river basins under review.
***Keywords*:** *Geomorphology, GIS, Himalaya, Relief, Slope*

Date of Submission: 10-January 2015, Date of Accepted : 20-February 2015

I. INTRODUCTION

Study of morphometrical parameters provides significant information about the geology, hydrology, and soil and vegetation cover of a river basin. It helps in assessment of ground water potential, environmental monitoring and basin management. Various hydrological phenomena can be correlated with the physiographic characteristics of a drainage basin, such as size, slope, shape of the drainage basin density, size and length of the contributories; etc (Rastogi and Sharma 1976; Magesh et al. 2012a). Identification of drainage network within basins or sub-basins can be achieved using traditional methods such as field observations and topographic maps or alternatively with advanced methods using remote sensing and GIS (Macka 2001; Sreedevi et al. 2009). In the field of basin morphometric analysis pioneer works have been carried out by Horton (1945) and Strahler (1964). Subsequently, many researchers from different parts of the globe have done similar works based on the methods suggested by them. In India morphometric studies of various drainage basins have been carried out by many researchers viz. Rastogi and Sharma(1976), Nautiyal(1994), Nag and Chakraborty (2003), Rudraiah et al.(2008), Magesh et al. (2012a) etc. In this study few geomorphological parameters viz. slope, relief and aspect characteristics are studied using remote sensing and GIS technology to compare the eastern and western Himalayan landscape taking two representative river basins viz. the Subansiri and the Alaknanda respectively.

II. STUDY AREA

The study area comprises of the Subansiri river basin of eastern Himalaya and the Alaknanda basin of western Himalaya (Fig. 1). The entire Subansiri basin covers an area of 38051.56 sq.km, the extension of which in India is 26.57°N to 28.40° N and 92.42°E to 94.47°E and the Alaknanda basin is bounded between 30° 0' N- 31° 3' N and 78°37'E - 80°2' E with a basin area 10936.35 sq.km.

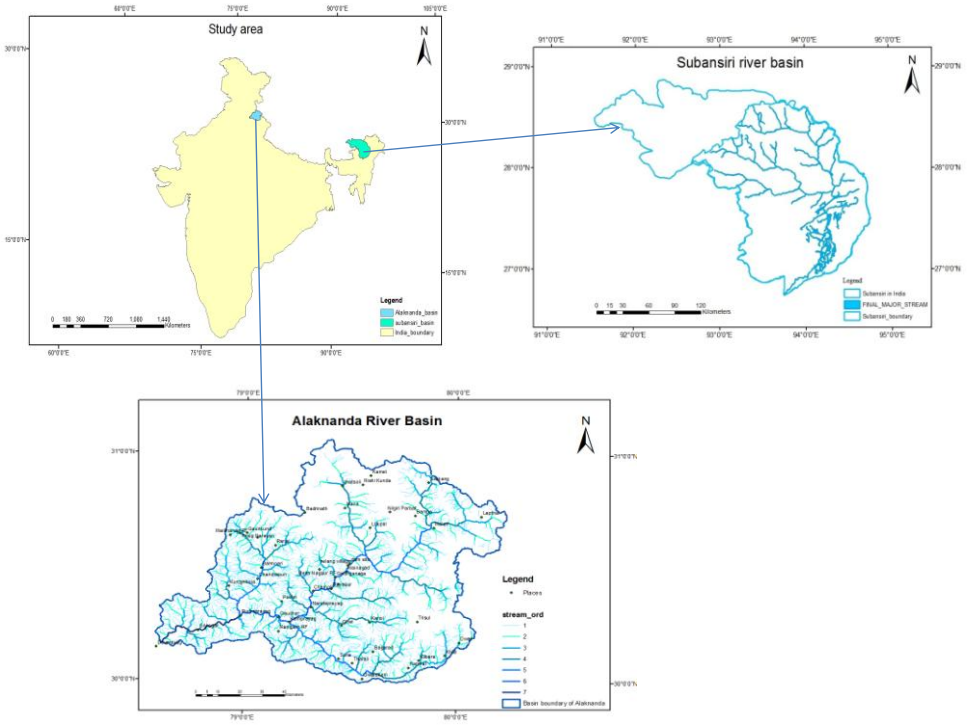

Figure 1: The study area

III. DATABASE AND METHODOLOGY

The data used for the study of the selected basins are Survey of India 1:50,000 scale toposheets No. 83 I/2 to I/16, 83 E/1 to E/16, 83 H/1 to H/16, India and Pakistan 1:250,000 toposheets No. NH 44-5, 6 and ASTER GDEM of 30m resolution. These toposheets are geometrically rectified, georeferenced and digitized to delineate the watershed boundaries. These are projected to the regional projection (WGS 1984 UTM Zone 46 N and 44N for the Subansiri and the Alaknanda basins respectively). Stream orders are assigned following Strahler (1964) stream ordering technique. Digital Elevation Model is prepared for each watershed under GIS platform using standard procedures to derive relief, aspect and slope maps for both the watersheds using ERDAS 9.1and ArcGIS 9.3. software.

IV. RESULTS AND DISCUSSIONS

Relief of Subansiri and Alaknanda basins: Relief refers specifically to the quantitative measurement of vertical elevation change in a landscape. It is the difference between maximum and minimum elevations within a given area, usually of limited extent**.** The relief of the Subansiri basin of eastern Himalaya varies between 29 m to 7,174 m; on the other hand it varies between 454 m to7799 m in the Alaknanda basin of western Himalaya (Fig. 3&4). In case of Subansiri basin, the relief ranging from 29-1000 m covers the highest area of the basin i.e. 27.85% and the range 7000-8000 m shows the lowest area coverage of 0.0003%. On the other hand, in case of Alaknanda basin, the relief ranging from 1000-2000 m covers the highest area of the basin i.e. 21.19% while between 7000-8000 m it covers the lowest area of 0.059% (Table1& Fig. 5). It is observed from the statistics that most of the basin areas of the Subansiri river and of the Alaknanda river lie in the relief range of 1000-5000 m accounting for 63.83% and 77.17% of the total basin area respectively. The Percentages of area covering different slope categories are graphically represented in Fig. 5.

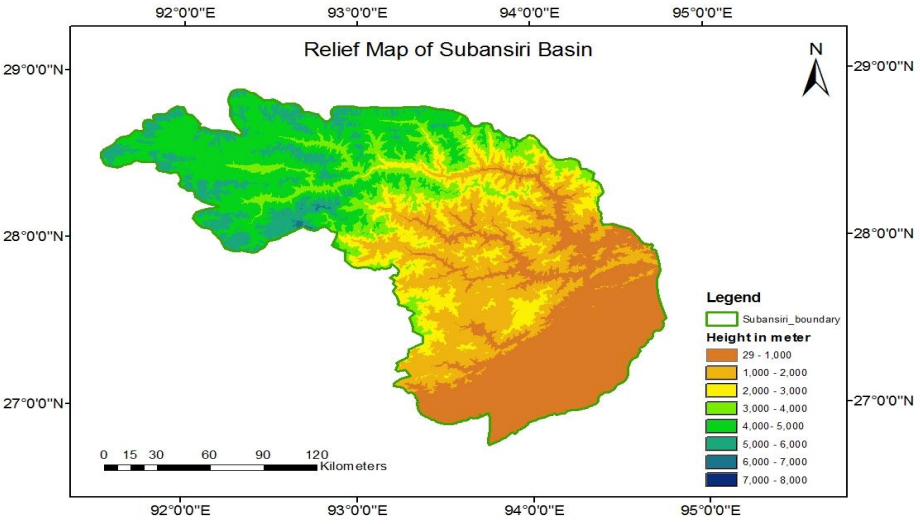

Figure 2: Relief Map of the Subansiri River Basin

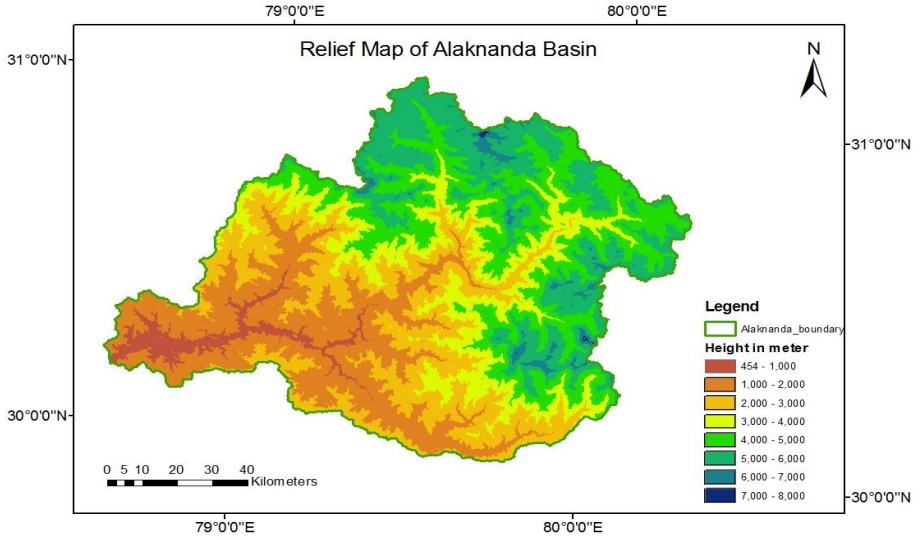

Figure 3: Relief Map of the Alaknanda River Basin

Table1 Relief condition of Subansiri and Alaknanda basins

Heigtht in meters Subansiri Basin (m)	Percentage of area (%)	Height in meters Alaknanda Basin (m)	Percentage of area (%)
29-1000	27.85	454-1000	3.45
1000-2000	21.90	1000-2000	21.19
2000-3000	11.30	2000-3000	20.93
3000-4000	9.44	3000-4000	14.68
4000-5000	21.17	4000-5000	20.37
5000-6000	8.19	5000-6000	17.51
6000-7000	0.13	6000-7000	1.79
7000-8000	0.0003	7000-8000	0.059

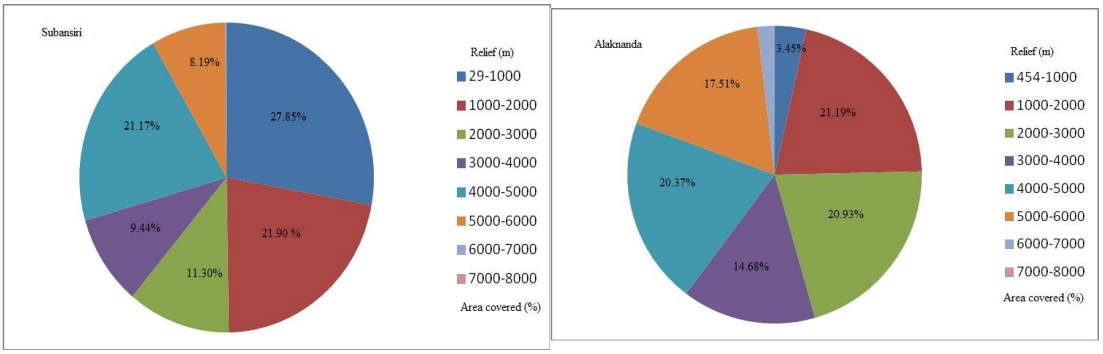

Figure 4: Graphical representation of relief characteristics of the Subansiri and the Alaknanda river basins

Slope (or gradient): The measures of slope as hydrologic parameters are also very important. The slope of a terrain refers to the amount of inclination of physical feature, topographic landform to the horizontal surface. Hill slopes become steeper with increasing relief. The slope maps (Fig. 7&8) for both the Subansiri and Alaknanda basins in turn are derived from the ASTER GDEM using the aspect and slope tool in ArcGIS 9.3 Spatial analyst module. The slopes are classified under nine different classes for both the basins ranging between 0-90 degrees. It is revealed from the Table 2 that the slope ranges between 0-89 degree for the Subansiri basin and 0-82 degree for the Alaknanda basin. In case of the Subansiri basin, gentle to steep slopes (0-23 degree) cover 48.87% of the basin area, while it is 31.75% for the Alaknanda basin. On the other hand, extremely steep slope (23-35 degree) covers 30.92% in the Subansiri basin, while it is 31.38% for the Alaknanda basin. The distribution of different categories of slopes in the Subansiri and the Alaknanda river basins are shown in the slope maps given in fig.6 and Fig. 7 respectively.

Table2 Slope categories of the Subansiri and the Alaknanda basins

Serial number	Slope (in degree)	Percentage of area covering different slopes of the Subansiri basin	Slope (in degree)	Percentage of area covering different slopes of the Alaknanda basin
1	0-8	15.96	0-10	6.90
2	8-16	15.96	10-17	10.93
3	16-22	16.94	17-23	13.91
4	22-29	16.36	23-29	15.61
5	29-35	14.56	29-34	15.77
6	35-42	10.74	34-40	14.42
7	42-50	6.48	40-46	11.54
8	50-65	2.45	46-54	7.57
9	65-89	0.54	54-82	3.33

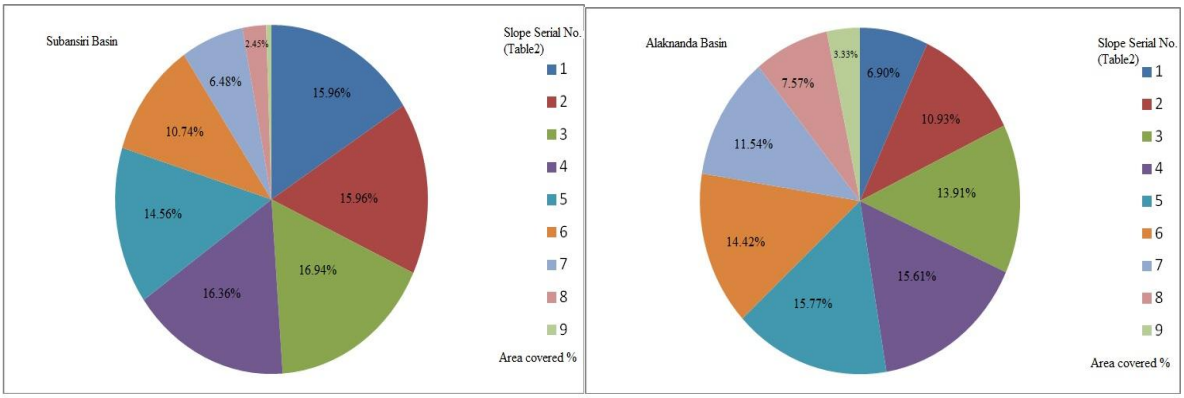

Figure 5: Graphical representation of different slope categories in the Subansiri and the Alaknanda river basins.

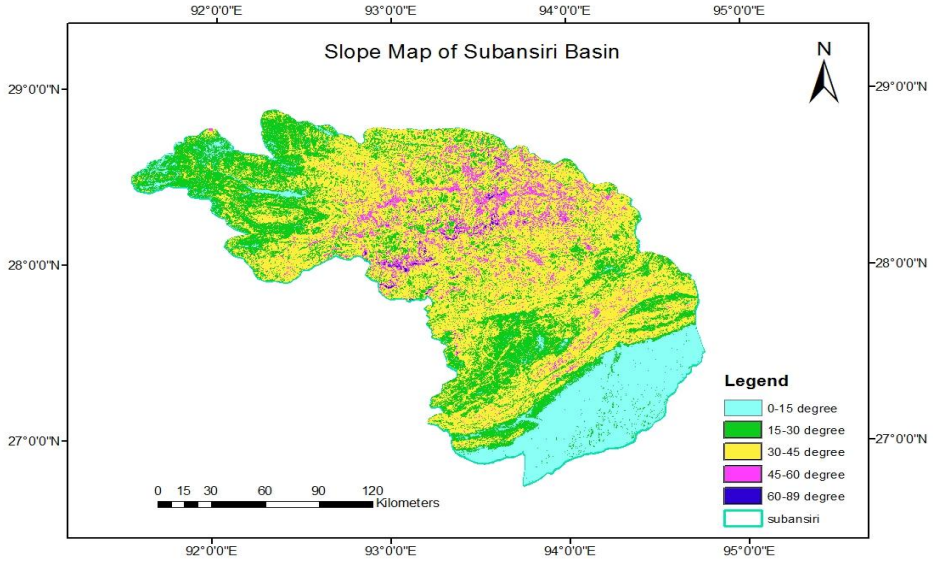

Figure 6: Slope Map of the Subansiri River Basin

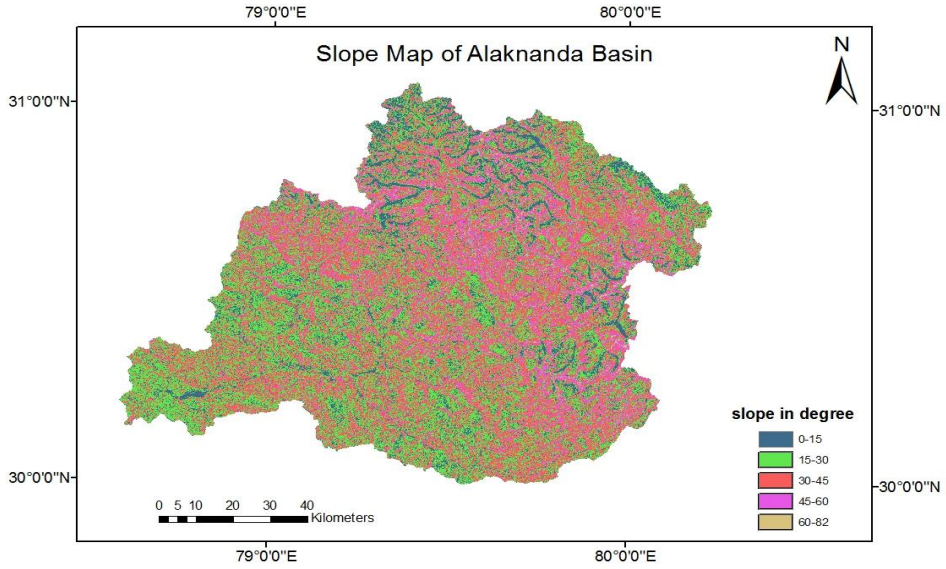

Figure7: Slope Map of the Alaknanda River Basin

Aspect: The aspect of a terrain is the direction to which it faces. Aspect influences vegetation type, precipitation patterns, snow melt and wind exposure. Aspect can also have a strong influence on temperature. This is because aspect affects the angle of the sun rays when they come in contact with the ground, and therefore affects the concentration of the sun's rays hitting the earth. The aspect of a slope can make very significant influence on the local climate. For example, because the sun's rays are in the west at the hottest time of day in the afternoon, in most cases a west-facing slope will be warmer than a sheltered east-facing slope (unless large-scale rainfall influences dictate otherwise). This can have major effects on altitudinal and polar limits of tree growth and also on the distribution of vegetation that requires large quantities of moisture. In this study the Subansiri basin is west facing while the Alaknanda is east facing showing the opposite characteristics (Fig. 8 and Fig. 9).

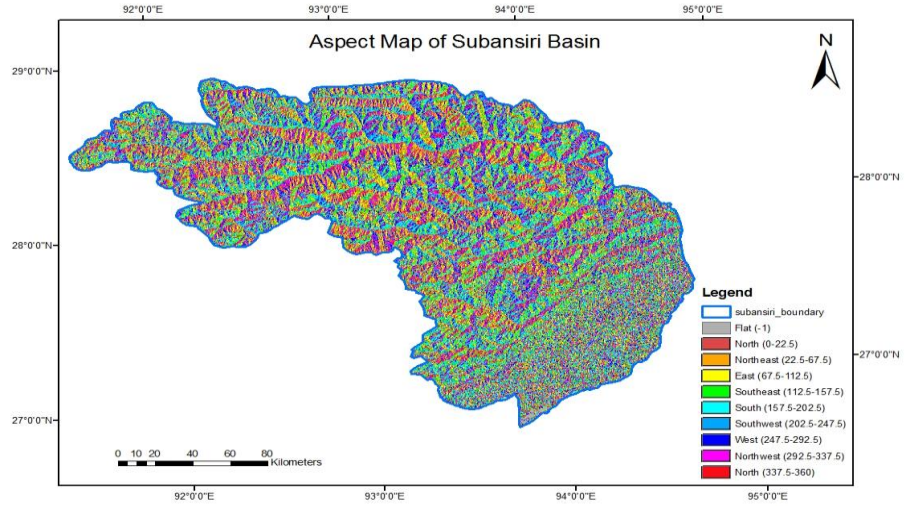

Fig. 8: Aspect Map of the Subansiri River Basin

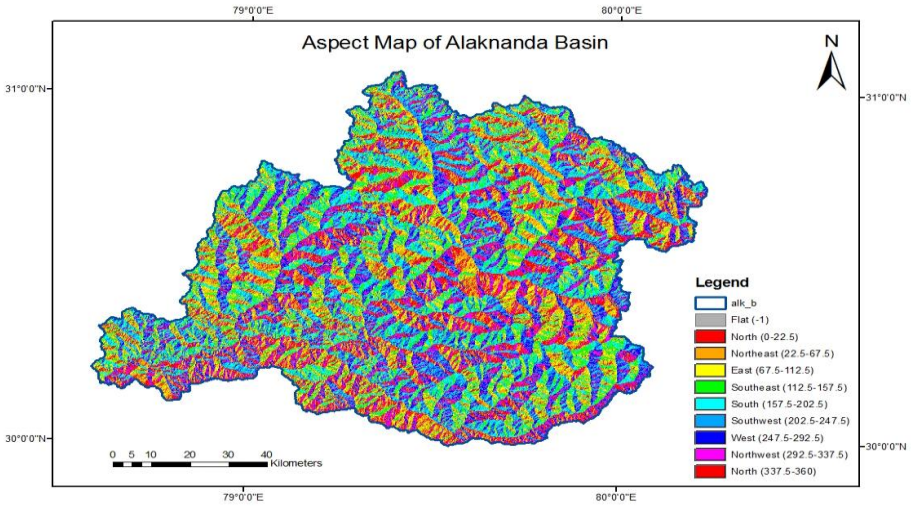

Fig. 9: Aspect Map of the Alaknanda River Basin

V. CONCLUSION

It is observed from the study that both the two basins viz. the Subansiri and the Alaknanda have contrasting features in regard to their relief, slope and aspects conditions. These differences reflect the contrasting geographical, hydrometeorological and denudational characteristics of the study areas representing opposite extremities of the Himalayan arc. The results of the study may prove useful in understanding the regional physiography and structure of the great Himalayan arc and the dominant geographic processes operating on them.

REFERENCES:

[1] R.A. Rastogi, T.C. Sharma, Quantitative analysis of drainage basin characteristics, *Journal of Soil Water Conservation India, 26,* 1976, 18–25.

[2] Magesh, N.S., Chandrasekar, N. And Kaliraj, S., A, GIS based automated extraction tool for the analysis of basin morphometry, *Bonfring International Journal of Industrial Engineering and Management Science***,** *2*(1), 2012 a, 32-35.

[3] Sreedevi, P.D., Owais S., Khan H.H. and Ahmed S., Morphometric Analysis of a Watershed of South India Using SRTM Data and GIS, *Journal of Geological Society of India, 73,* 2009, 543-552.

[4] L.B. Leopold, M.G.Wolman., J.P. Miller, Fluvial processes in geomorphology (WH Freeman and Company, San Francisco and London, 1964).

[5] Nag, S. K., and Chakraborty, S., Influence of rock types and structures in the development of drainage network in hard rock area, *Journal of Indian Society of Remote Sensing*, *31*(1), 2003, 25-35.

[6] M. Rudraiah, S. Govindaiah, V.S. Srinivas, Morphometry using remote sensing and GIS techniques in the sub-basins of Kagna river basin, Gulburga district, Karnataka, India, *Journal of Indian Society of Remote Sensing*, *36*, 2008, 358.

[7] Khanduri, Kamlesh , GIS & Remote Sensing Technology in Geomorphic analysis of Mandakini River Basin, Garhwal Himalaya, Rudraprayag District, Uttarakhand, India, *International journal of Advanced Scientificand Technical Research*, *2*(1), 2011, 138-144.

[8] M.D. Nautiyal, Morphometric analysis of a drainage basin, district Dehradun, Uttar Pradesh, Journal of Indian Society of Remote Sensing, 22(4), 1994, 251–261.

[9] Rao. K Nageswara, Swarna Latha.P., Arun Kumar.P, M. Hari Krishna, Morphometric Analysis of Gostani River Basin in Andhra Pradesh State, India Using Spatial Information Technology, *International Journal of Geomatics and GeoSciences, 1*(2), 2010, 181-185.