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EXAMINING THE GEO-ENVIRONMENTAL SETTINGS OF THE SELECTED WESTERN AND EASTERN HIMALAYAN RIVER BASINS

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ABSTRACT

Subansiri and Alaknanda basins have a similar geoenvironmental configuration with regards to their physiography, weather, snow and glaciers, soil, geology and tectonics, forest cover, and ecology. The natural and cultural diversity found in the Himalayas make it a very special place to visit. In the Himalayas, the northward push of the Indian tectonic plate under the Central Asian plate has resulted in a complex of sub-parallel structural units. In geography, relief is the term used to describe the quantitative assessment of topographic variation. In a small region, it is the difference between the highest and lowest points. Rich biodiversity is found in both the eastern Himalayan Subansiri basin and the western Himalayan Alaknanda basin, however there are notable ecological variations between the two.

KEYWORDS Himalayas, Geo-environment, forest, eastern and western

INTRODUCTION

River basin environmental management issues are ignored as secondary concerns. Despite the fact that these regions are often included in the country's vast stocks of natural resources, they usually only provide benefits to the mainland in the form of forest, water, wildlife, tourist, and leisure sectors. Manipur, and the forest and forest eco-systems of north-east India more broadly, are under extreme stress from a wide variety of biotic and abiotic sources. Population growth, land conversion for non-forest uses, shifting agriculture, illegal logging, lopping for fuel wood and fodder, trash disposal, forest fires, and other human activities are all major contributors. All of north India's major river systems, including the Ganga, Brahmaputra, and Indus, obtain their water from the snow and ice fields of the Himalayas. Other than the Arctic Regions, the Himalayas have the world's biggest store of snow and ice. As the Eastern Himalaya is mostly impacted by the ISM, precipitation occurs primarily in the summer. During the winter, the western Himalaya gets snowfall due to the dominance of westerly winds from the mid-latitudes. The snow-melt contribution is rather little, but the eastern Himalaya nevertheless delivers moisture surpluses via direct runoff of the substantial summer monsoon rains.

LITERATURE REVIEW

Sanjoy Saha et.al (2022) When there is no gauging station or reliable topographical conditions, hydrological data is unavailable, a drainage basin's geomorphic properties and hydrological behavior may be accurately portrayed via an examination of morphometric parameters. So, Exploring the hydro-geomorphic characteristics of the Rayeng basin in the Darjeeling Himalaya is the focus of this study. With the use of remote sensing and GIS, we were able to extract and evaluate the morphometric features of the study area. There seems to be a marked contrast in the runoff intensity and infiltration rate in the upper and lower portions of the Rayeng basin, as shown by the basin's varying drainage density, lineament density, stream frequency, texture ratio, and infiltration number. The topography of the Rayeng basin is

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not smooth, as shown by both the extracted ruggedness index and Melton's Ruggedness index, and that the main channel does not flow normally. The Topographic Positioning Index also reveals the basin's unique topographic variety (TPI). The Topographic Wetness Index (TWI) shows that there is a large geographic variation in this basin's water availability; the low-lying sections of the basin have a greater TWI than the steeply sloping high land. Hypsometric integral (HI) of the basin suggests its early developmental stage. Water with excellent potential for sustainable use is available to the people living in the basin's lower reaches. In the absence of hydrological data, this research will be useful for characterizing the hydro-geomorphic features of the drainage basin.

Netrananda Sahu et.al (2020) In order to meet India's growing need for electricity, the country's energy industry is investing heavily on hydroelectric projects in the Himalayas. Nevertheless, only three of the Himachal Himalayas' major storage dams have capacities of more than 1,000 megawatts (MW) each, and each of these dams has severe environmental impacts. Yet, hundreds of small runoff-river hydroelectric projects across the Himachal Mountains pose a serious threat to the river regimes and Himalayan biota. The Himachal Pradesh Directorate of Energy reports that there are 965 operational hydropower projects in the state with a total installed capacity of 27,436 MW as of the end of 2019. With an installed capacity of 10,596 MW, 216 of the 965 targeted units will be operational by the end of 2019. Just 58 projects, totaling 2351 MW, are now being constructed, while another 640, totaling 9260 MW, are in different phases of clearance and investigation; 30 projects, totaling 1304 MW, are to be assigned; and only four, totaling 50.50 MW, are contested or cancelled. Many HPPs are allowed despite environmental and geohazard concerns, which will have a negative impact on the Himalayan terrestrial biota. This study aimed to examine the impacts of hydropower and climate change on the Chenab, Ravi, Beas, Satluj, and Yamuna river basins in the Himalayas. We used statistical tests for detecting trends in basin-specific rainfall, temperature, and soil moisture from 1955 to 2019 using the Mann-Kendall test, the linear regression model, and Sen's slope test. To determine how vulnerable a basin is to natural disasters, a hazard zonation map was created, and a primary survey of 12 hydropower sites was conducted to get first-hand accounts of how residents there feel about the facilities.

Shevita Pandita et.al (2019) The north face of mountains in the northern hemisphere is wet and gloomy, which attracts a wide variety of plant and animal life. The species variety on the mountain's northern slopes may be affected by a number of environmental factors, all of which should be investigated. There are three distinct inclinations in the north: due north, due east, and due west. The present study of the Bhadarwah valley's Pir-Panjal and Dauladhar mountains included in-depth analyses of the correlation between vegetation and four factors. This research analyzed the impact of these factors on the flora on three distinct sub-slopes. Three locations on the northern sub-slopes of the lower strata in the western Himalayas were sampled, all of which were at the interface between forest and grassland ecosystems. The findings demonstrated that the lower Himalayan layer is home to a plethora of herbaceous plant species (Bhadarwah valley). There is little overlap across the locations, and as much as 65.8 percent of the species are unique to each location. Canonical correspondence analysis is used to infer the effect of environmental factors on species composition along distinct North Mountain face sub-slopes (CCA). North-east facing slopes get more sunlight, which warms the air and soil. In the north face of a mountain, soil pH, moisture, electrical conductivity, and mountain steepness have little effect on species composition. So, it follows that additional environmental conditions may impact the species composition, and that this is an area that need more investigation to fully understand.

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Sumit Das et.al (2018) Water resource evaluation, management, and conservation are all greatly aided by modern remote sensing and geographic information system (GIS) methods. This study uses remote sensing and GIS techniques to categorize the various groundwater potentials present in the Pravara basin. Many elements, such as lithology, geomorphology, slope, soil, lineament density, drainage density, land use, and rainfall, contribute to a region's groundwater potential, and both the influencing factor (IF) and frequency ratio (FR) techniques analyze these aspects. These thematic layers are created in ArcGIS by combining data from a variety of satellite imagery and traditional data sources. In a GIS setting, we use IF and FR techniques to convert all these layers to a high-resolution raster format and combine them. Groundwater prospect maps may be made using overlay analysis. The study area is divided into very high, high, moderate, low, and very low groundwater potential zones according to the map of groundwater prospect zones that was produced as a result of the study. After checking the accuracy of the resultant maps, we find that the frequency ratio approach is more accurate than the influencing variables (AUC = 73% vs. 69%). Groundwater zonation is made easier and faster by this research, and the findings may be put to use immediately in the planning and sustainable management of the Pravara basin.

Khem Raj Bhattarai (2017) It is now understood that differences in geographical and temporal scales contribute to differences in species richness. Ecology and biogeography study patterns and scales extensively. The scope of analysis and confounding variables affect the species richness connection. The overarching goal of this study is to better understand how patterns of species richness emerge from the interplay of various scales and explanatory factors. Understanding species richness variation along gradients requires addressing the issue of scale for both theoretical and practical reasons. Succession, community formation, and the spread and persistence of species are only some of the processes that benefit greatly from our knowledge of pattern, its sources, and its implications. The hierarchical theory of species diversity classifies levels of analysis primarily as "local,""landscape," and "regional." Stand diversity, measured in terms of local species richness or -diversity, is the measure most often used. Turnover between two elevational bands, two plots, or two locations is the a-diversity or species change. Both - and -diversity contribute to the overall richness of whole mountain ranges or research systems, which is known as regional or -diversity. Both small- and large-scale mechanisms have an impact on the diversity of species in a given area (e.g., evolutionary). To explain variance at various spatial scales, many explanatory factors should be considered. Variation at the local level has been detected using characteristics like as disturbance, grazing, and tree cover. Species richness variation at the landscape scale is often detected using topographical parameters, whereas variation at the regional scale is typically detected using climate, water-energy dynamics, and historical processes. Yet, due to the lack of a distinct border between the various scales, it is difficult to make a clean distinction between them. Researching the whole elevational range, from the tropics to the high mountains or the long latitudes, is an example of a comprehensive research. The subtropical and warm-temperate zones are covered by an examination of a nearby mountain at the intermediate scale. Patterns of species richness need a diverse set of theories that take into account historical, ecological, and climatic aspects. That climate, biological interactions, and historical events all have a role in shaping species richness variation throughout space and time is indicative of this.

GEOENVIRONMENTAL SETTING OF THE STUDY AREA

The terrain, geology, seismicity, tectonics, water, and soil quality, as well as the temperature and meteorology, make up a region's geo-environment. The Himalayas are special because of their rich biological and cultural history and their unusual geo-environmental context.

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The Himalayas are the result of a northward push of the Indian tectonic plate under the Central Asian plate, creating a complex of sub-parallel structural elements. The Himalayas are a striking geographical feature since they are thought to be the youngest mountain range on the globe (Rao and Sexena, 1994). The Himalaya are a vast arc that spans roughly 2,400 kilometers and 6,12,021 square kilometers; they were produced by the continental convergence and collision of India and Eurasia. Historically, the vast Himalayan mountain range has been understood to span the latitudes 26°20′–35°40′ N and the longitudes 74°50′–95°40′ E. Specifically, the Himalaya ranges from the Yarlung tsangpo- Brahmaputra valley in the east to the Indus Trench below Nanga Parbat (8,125 m) in the west. All of the Indian Himalaya, from west to center to east, plus the borders of Nepal, Bhutan, a sliver of Pakistan, and chunks of China are covered here. (Bruno and Messerli, 1989). It extends from the Pamir's Knot in Afghanistan to the Arakan-Yoma Mountain Range in Myanmar, taking in some of those countries' respective territory in between. The Himalayas cushion the Indian subcontinent from the devastating effects of arctic winds that originate in Tibet. Most of the main rivers that run through the northern regions of the nation have their sources in the Himalaya, hence the mountain range has played a crucial role in the economy.

METHODS

GENERAL METHODOLOGY

The research relies on both geographical and traditional types of databases. Data from a variety of satellite remote sensing sensors are compiled in the geographic database. Spatial data on the required watershed characteristics are being derived from maps, fieldwork, and Digital Terrain models, over which various thematic layers have been superimposed. Critical components of the approach used in this research include the categorization of watershed information gathered by satellite imagery and combined with other traditional data types in a GIS.

Gathering first-hand information about a region requires a detailed base map. In order to provide for this need, a base map is created using ArcGIS 9.3 and ERDAS 9.1 in conjunction with toposheets from the Survey of India (SOI). DEM maps are created after the ASTER GDEM layers have been properly mosaiced in ERDAS 9.1 to provide an understanding of the basins' relief, slope, and aspect. For both basins, GIS is used to derive geological and soil maps from GSI and NBSS source maps. Furthermore, using the 1:50,000 scale SOI toposheets, we digitized streams on screen to create drainage network maps of the four minor catchments in order to analyze their morphometric properties. Only those time periods for which data is freely accessible were considered for this database. We examine the long-term consequences of natural and human activities on the study region by analyzing data and information from scholarly papers, published and unpublished studies, etc, paying special attention to the ways in which climatic variation, landuse changes, developmental activities, etc. have affected the region.

DATABASES AND SOURCES

The database is made up of both direct data gathered in the field and secondary data gleaned from a wide range of sources, including government agencies, universities, and other published materials.

- Subansiri basin's Gayung and Sipu, as well as the Alaknanda basin's Bhardari Gad and Kyar Gad, make up the four sub basins used for the sample, morphometric parameters are computed and relevant interpretations are provided using 1:50,000 scale

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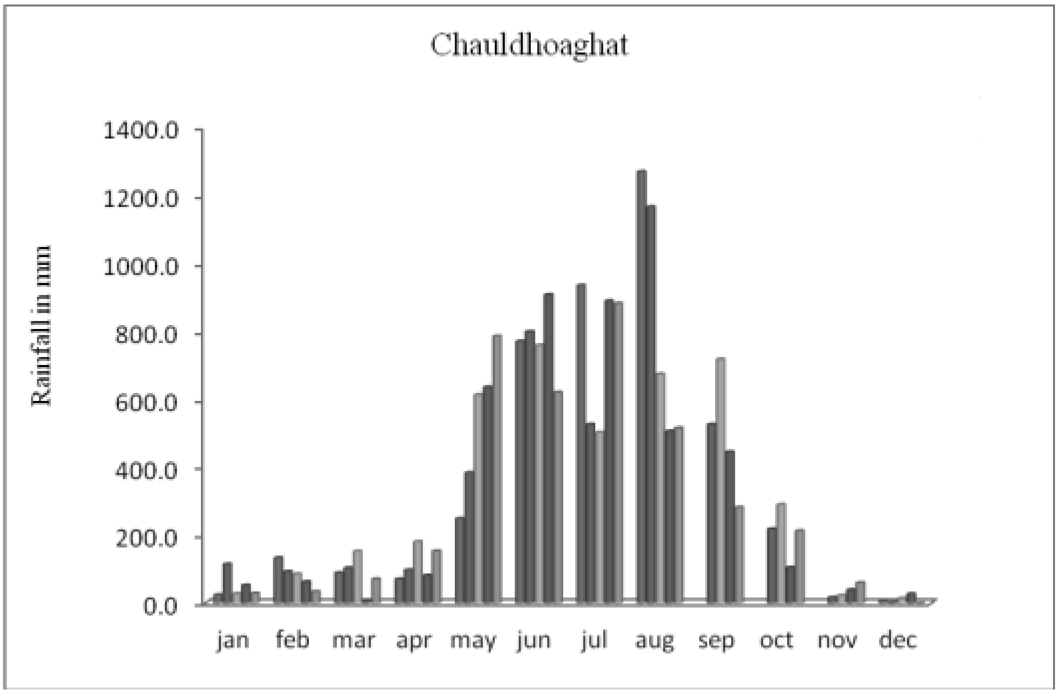
topographical survey maps of India. Nevertheless, due to insufficient toposheets of suitable scales, the drainage network of the whole Subansiri basin could not be digitized; only the principal streams are rendered using the toposheets and satellite imageries that are now accessible.

- ASTER GDEM with a resolution of 30 meters is used to create digital elevation models (DEMs) for both basins.
- Government of India's Brahmaputra Board; Assam's Water Resource Department; and other public and unpublished government records and reports are mined for information on the Subansiri and Alaknanda rivers' discharge.

DATA ANALYSIS

Most of the precipitation comes from the Chauldhoaghat and Dam site gauging stations in the Subansiri basin in the eastern Himalayas, temperature, and discharge data for the hydrometeorological comparison, while the Rudraprayag and Joshimath gauging stations provide the same data for the Alaknanda basin of the western Himalayas.

Rainfall in the Subansiri basin is studied using long-term records from the Chauldhoaghat and North-Lakhimpur stations. The available rainfall and temperature data for Rudraprayag and Joshimath in the years 2018-20 are, however, evaluated for the Alaknanda basin. North-Lakhimpur station rainfall records for the years 2018-2020 were also accessible.



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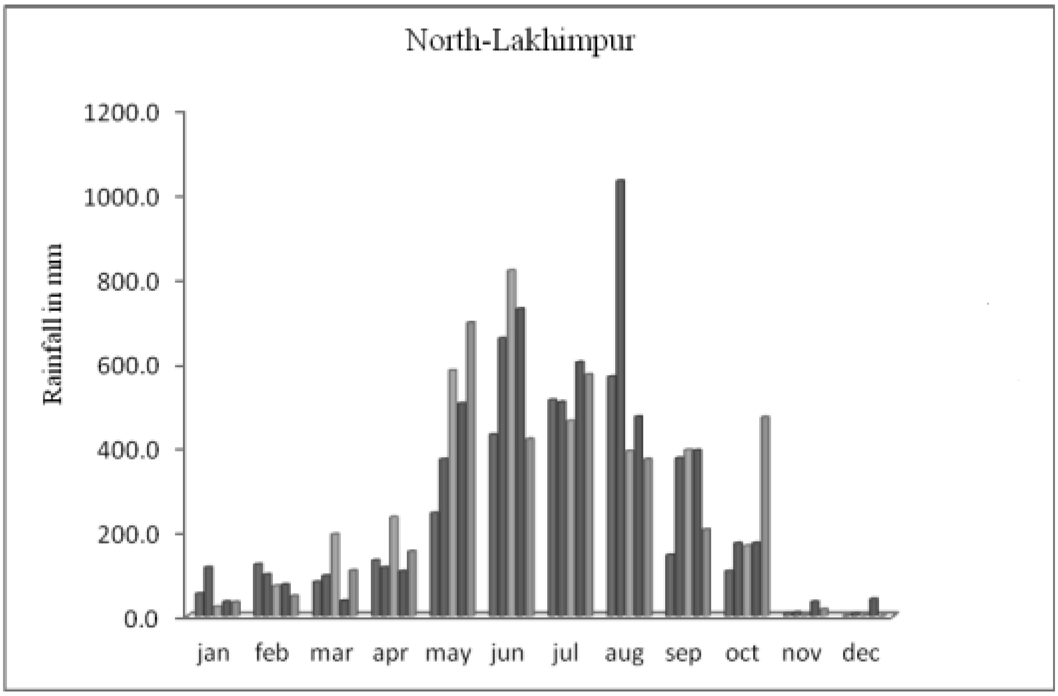

Figure 1: Monthly total rainfall (mm) at (a) Chauldhoaghat and (b) North Lakhimpur from 2017 to2021

Toposheets 83 I/2 through I/16, 83 E/1 through E/16, 83 H/1 through H/16, and 53N/1 through N/15 from the Survey of India's 1:50,000 scale series The investigation of the selected basins made use of toposheets No. NH 44-5, 6 at a scale of 1:250,000 and ASTER GDEM at a resolution of 30 m. In order to define the watershed limits, these toposheets are geometrically corrected, georeferenced, and digitized. To the regional projection, they are projected.

Stream orders are allocated using the method described by Strahler (1964). Both the ERDAS 9.1 and ArcGIS 9.3 programs are used to create digital elevation models (DEMs) of the watersheds, with the goal of deriving relief, aspect, and slope maps.

Relief of the Subansiri and the Alaknanda Basins

The term "relief" is used to describe the quantitative evaluation of the topographic variation in a landscape. It's the difference between the highest and lowest points in a localized region. The Subansiri basin in the eastern Himalaya has a relief of 29 m to 7,174 m, whereas the Alaknanda basin in the western Himalaya has a relief of 454 m to 7799 m. (Figure 2 & 3). Relief between 29 and 1000 meters (m) accounts for 27.85 percent of the basin's total area, whereas elevations between 7 000 and 8 000 meters (m) account for only 0.003 percent. Nevertheless, in the Alaknanda basin, the area covered by relief between 1000 and 2000 meters is the greatest (at 21.19 percent), while the area covered by relief between 7000 and 8000 meters is the smallest (at 0.059 percent) (Table 1). According to the data, 63.83 percent and 77.17 percent of both the Subansiri and Alaknanda river basins are located within the 1000-5000 m relief range. Figure 4 provides a visual representation of the percentages of land that fall under various kinds of relief.

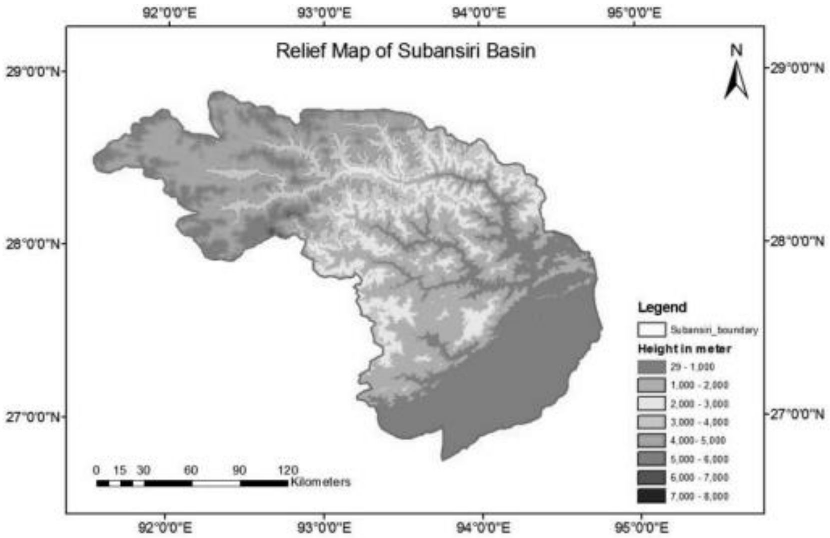

Figure 2: Relief Map of the Subansiri river basin

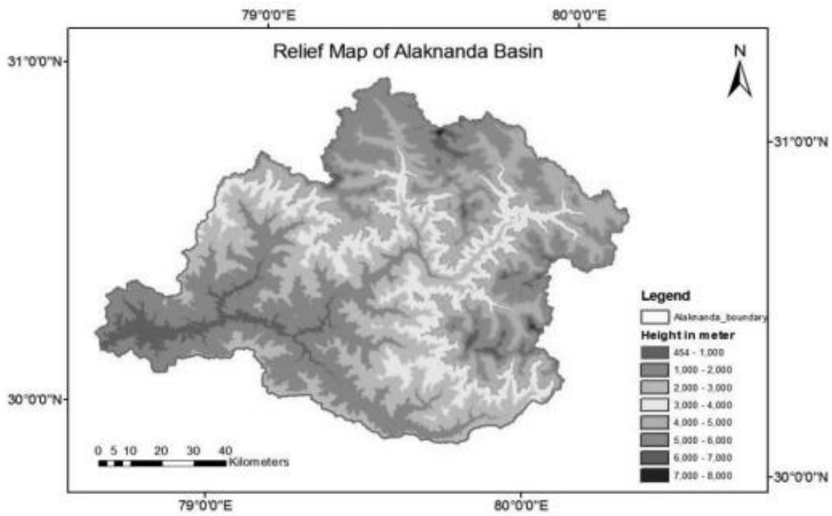

Figure 3: Relief Map of the Alaknanda River basin

Table 1: Relief characteristics of the Subansiri and the 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

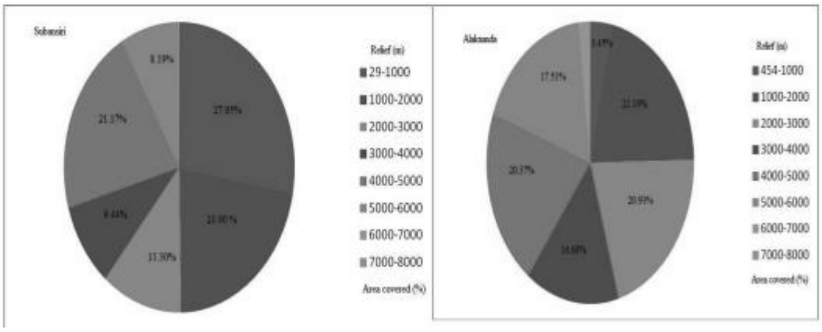

Figure 4: Graphical presentation of relief characteristics of the Subansiri and Alaknanda River basins

CONCLUSION

The western Himalayas have a very different geological and climatic context from the eastern Himalayas in terms of things like altitude range, slope steepness, rock type, soil profile, and tectonic activity. The Main Central Thrust (MCT) parallels the Himalayas and is a steep, north-dipping push. While there are significant biological variations between the eastern and western Himalayan Subansiri and Alaknanda basins, both are home to a wide variety of plant and animal life. Lower in the Subansiri basin is where you'll find the highest concentration of marshes and beels, much more so than in the Alaknanda basin. The opposing properties of the basins' physiography, relief, slope, and aspect are shown through morphometric research (case study 1).

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