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TRANSVERSE AND LONGITUDINAL PROFILE SPECTRUM OF SUKHNA CHOE WATERSHED: A GEOGRAPHIC ANALYSIS

Vikramjeet
Assistant Professor in Geography,
DNPG College, Hisar, Haryana

Abstract: This study has been undertaken to investigate transverse and longitudinal profile of Sukhna Choe Watershed in Chandigarh and Haryana. Primary and secondary source of data have been used for analysis. Topographical map, Cartosat-1, and field visits data have been collected and interpreted in ARC GIS and ERDAS software for calculating the various parameters as contours, hill shading, terrain profiles, longitudinal profile, aspect and slope analysis. However, it was discovered that the discontinuity of the longitudinal and transverse profiles tends to occur at the similar location, which may reflect the occurrence that influences the development on valley-side slopes.

Keywords: Profiles, Transverse, Longitudinal, Sukhna Choe, Watershed

1. INTRODUCTION

Watershed longitudinal and transverse attributes are essential for describing watershed topography (Lin and Oguchi, 2006)[1]. Watershed longitudinal profiles have frequently been linked to erosional power (Synder et al., 2003; Ferguson, 2003)[2,3]. The presence of both longitudinal and transverse watersheds in mountain belts has long been observed by the authors (Ramsey et al., 2008)[4]. A transverse orientation of rivers appears anomalous in many active uplifting mountain belts around the globe because they have simple drainage patterns transverse to their main structural trend (Hovis, 1996)[5]. The characteristics of transverse profiles in watersheds have been analyzed in a limited number of studies, with almost no studies examining both longitudinal and transverse profiles simultaneously. Watershed transverse profiles and their relationship with longitudinal and transverse characteristics remain to be investigated. Landscape characteristics such as "V-shaped valley", "U-shaped valley", and "box-shaped canyon" are derived from transverse profiles orthogonal to watersheds; therefore, a U-shaped valley most likely resulted from glacial erosion (Sugden and Jhon, 1976)[6]. Transverse profiles in watersheds are rare because of difficulties with data sampling. Watersheds can be examined for transverse profiles from various parts of the watershed, but there is only one representative longitudinal profile, namely that of the trunk stream. Topographic profiles are difficult to manually extract. However, recent developments in GIS have enabled efficient acquisition of topographic data through DEM analysis (Kumar S., 2018)[7]. There is no way to escape the limitation of anisotropies that prevents transverse profiles of watersheds from capturing landform variations, even though series of terrain profile lines, transverse or longitude, can reflect the variation characteristics of the terrain surface. Similarly, longitudinal profiles of gullies cannot reveal relief of positive terrain, such as yuan loess, ridges, and hills (Tang et al., 2009)[8]. A brand-new concept of catchment boundary profile spectrum has been introduced in this paper based on previous research. Shivalik hills provide a number of ephemeral streams. Sukhna Choe's drainage system is being studied in order to better understand runoff and geographic characteristics. The present research related to Sukhna Choe Watershed in Chandigarh-Panchkula region in Haryana. The main objective the present research work to analyse transverse and longitudinal profile spectrum of the study area. Spectrums of catchment boundary profile lines can be defined as landforms or catchment scales determined by catchment boundary profiles.

2. Study Area

This study area lies in the Siwalik Hills of the Himalayas (Johal and Tandon, 1983)[9]. This stream is located in Chandigarh, as well as in parts of Panchkula in Haryana. There is a seasonal stream flowing from the Siwalik Hills. Sukhna lake gets its water from this seasonal stream as well. Sukhna Choe covers an area of 22.43 square kilometers and lies between 30^{0}45’0” N to 30^{0}49’0” N Latitude and 76^{0}49’0” E to 76^{0}53’0’’E Longitude (Bansal and Grewal, 1987)[10]. There is forest between the hills and the lake that extends for a distance of about 20 km (Jindal and Ghezta, 1989)[11]. There are between 300 and 580 meters of elevation in this area (Bansal and Mishra, 1982)[12]. The climate is humid subtropical, characterized by summers that are very hot, and winters that are mild. It is primarily covered with trees, shrubs, climbers, and grasses. Furthermore, a variety of other species have been planted in addition to the natural vegetation. A wide variety of animals and plants live in the deep forest area, which grew in size over five decades. There are undulating hills and steep slopes in the study area. Sand, silt, and clay are the most common components of hills, and the surface of the hills lacks carbon. Fig. 2.1 shows the location map of the study area while Fig. 2.2 shows the satellite view of the study area.

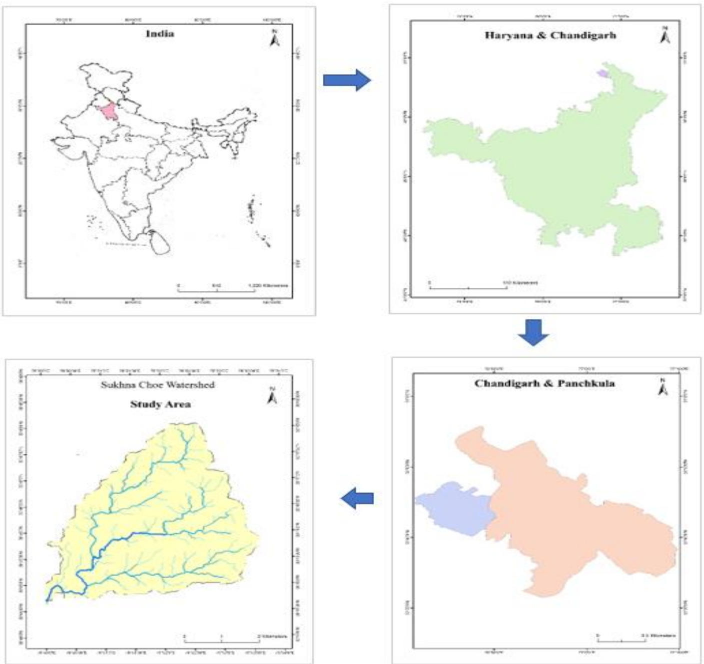


Fig. 2.1: Location Map of the study area

Fig. 2.2: Satellite view of the study area

3. Database and Methodology

The present study is based on primary and secondary data have been collected from filed visit and various data sources. SOI topographical sheet No. 53b-14 used for contour mapping, vegetation and other physical and cultural aspects. Google Earth images have been used to understand the relief of the study area. Cartosat-1 data (30 m resolution) have been used for DEM generation. Some field visits and observation have also been done to interpret and analyse the data and strengthens the study.

In an attempt to study the geomorphic and morphometric characteristics of Sukhna Choe. The delineation of Sukhna Choe watershed is done from Cartosat DEM by ERDAS software and surface operations were carried out by Arc GIS 10.3. Sukhna Choe demarcated on the basis of water divides. The study was carried out by using the various parameters like as slope, aspect, curvature, profiles and geomorphic features.

4. Results

Based on various data sources following results have been prepared:

4.1 Slop Analysis

As a result of a combination of many factors, slopes occur between hilltops and valley bottoms. They are influenced by geological structure, reliefs, climate, vegetation cover, drainage texture, frequency, and dissection indexes. Landforms of drainage basins are studied based on their morphometric attributes. A number of techniques for deriving and computing average slopes from topographic maps have been proposed over time**.** In the study, the area was classified into 8 categories with an interval of 5°. The slope was found to be 10°-15° in 26.38% area of the catchment. Therefore, Sukhna catchment is having a moderate slope and about 88%. of the total watershed area has slope angel less than 20 degree. Fig. 4.1.2 represents the slop map of the study area. Table 4.1 and Fig. 4.1.1 shows the slope analysis of the study in meters and percentage.

Table. 4.1: Slope analysis of the study area

Sr. No	Slope (Degrees)	Area	Area (%)
1.	Less than 5	364.64	16.1
2.	5-10	570.94	25.34
3.	10 -15	594.23	26.38
4.	15-20	439.41	19.49
5.	20-25	209.67	9.30
6.	25-30	63.67	2.82
7.	30-35	8.93	0.39
8.	35 and above	0.80	0.03

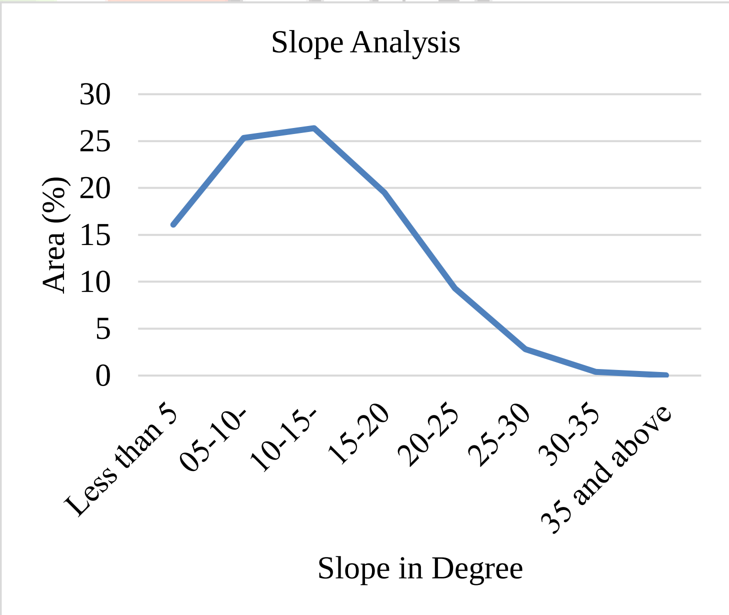


Fig. 4.1.1: Slop analysis

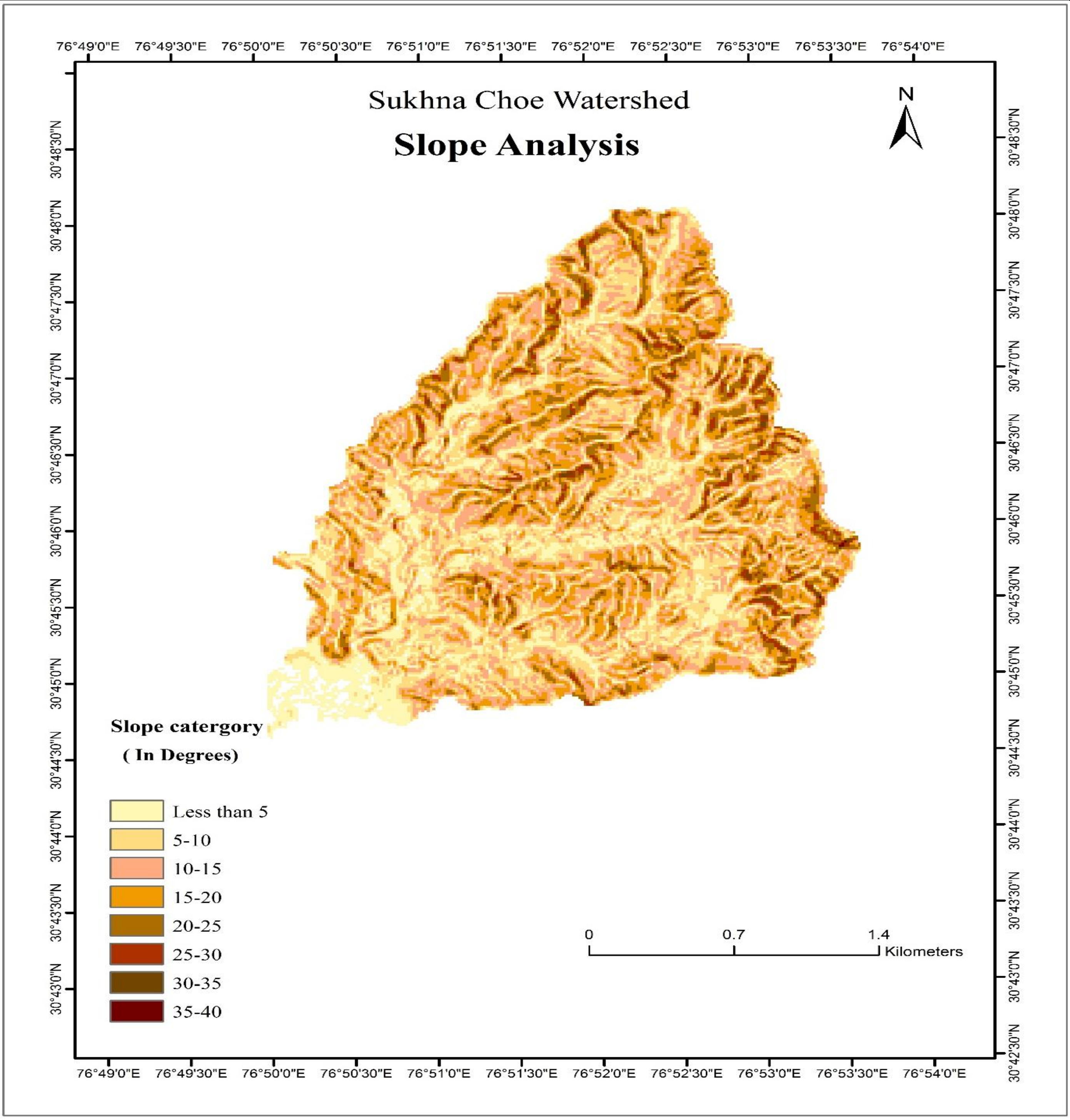


Fig. 4.1.2: Slope map of the study area

4.2 Curvature

Among the primary parameters is the curvature of the terrestrial surface. A geomorphological measure of slope or orientation on the XY plane that indicates how quickly they change over length per unit length. The curvature value of a surface can tell us whether a part is concave or convex. Various curvatures are derived from a variety of criteria, but in the more important morphometric analysis, they are profile curvatures, plan curvatures, tangential curvatures, longitudinal curvatures, cross-sectional curvatures, maximum curvatures, minimum curvatures, and general curvatures. Convex/concave and horizontal surfaces can be identified with them. Water erosion organized areolarly and linearly on the flanks (gully erosion) is possible in the areas of divergent and convergent flows. Fig. 4.2.1 shows the curvature map of the study area.

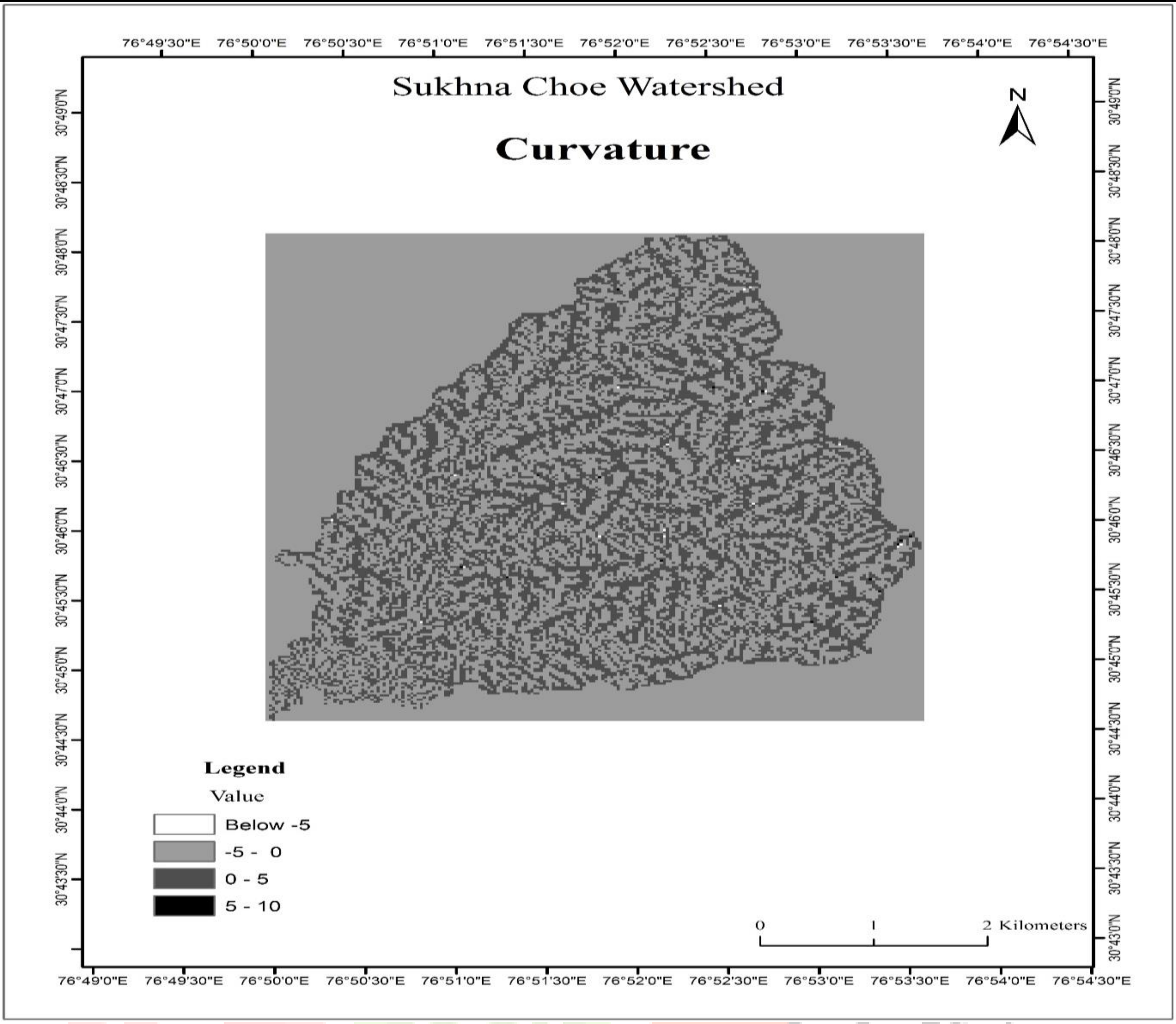


Fig. 4.2.2: Curvature map of the study area

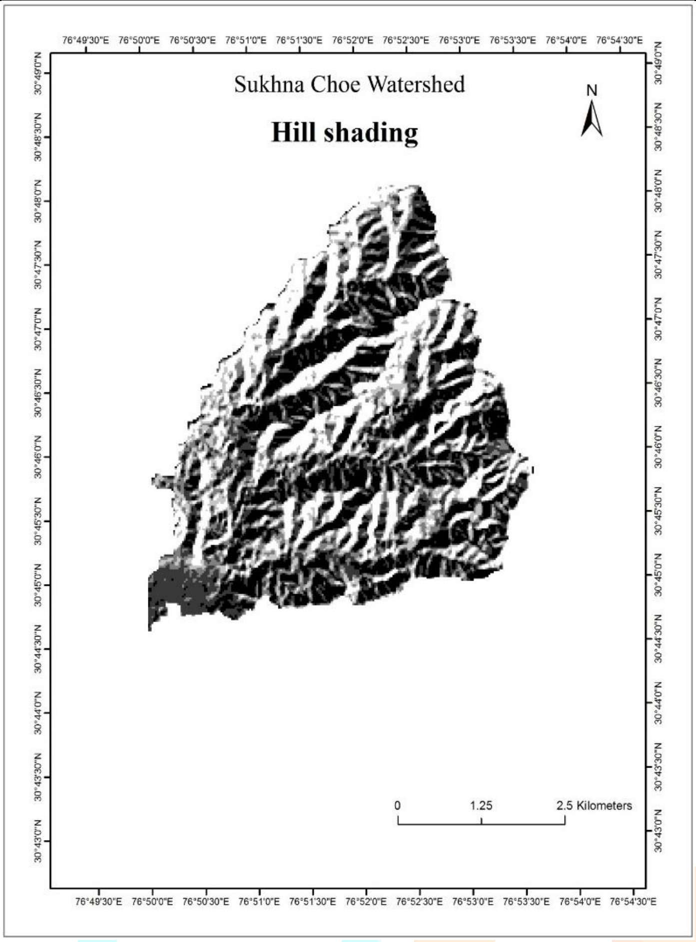
In the present study, it has been observed that the maximum area is having ranges between -5 to 0 value which means that the slope curvature indicates that the surface is upwardly convex.

4.3 Hill Shading

Shading on hills denotes the form of the land by varying tone from light to dark. An eye can readily discern the relief pattern of hillshade. On a map, it conveys a vivid and effective representation of ground relief. Figure 4.3.1 displays the slopes in the south-east direction of Sukhna Choe. It is evident from the map that the slopes vary from grayscale to dark black in the south-east direction. In the dark shaded areas, there is a steeper slope. Table 4.3 shows the light source direction, slope angle, direction, and vertical exaggerations that were used in the current study.

Table 4.3: Factors used for Hill-Shading

Azimuth	Direction	Z-factor	Slope	V.E
315	North west	5	45°	1:5



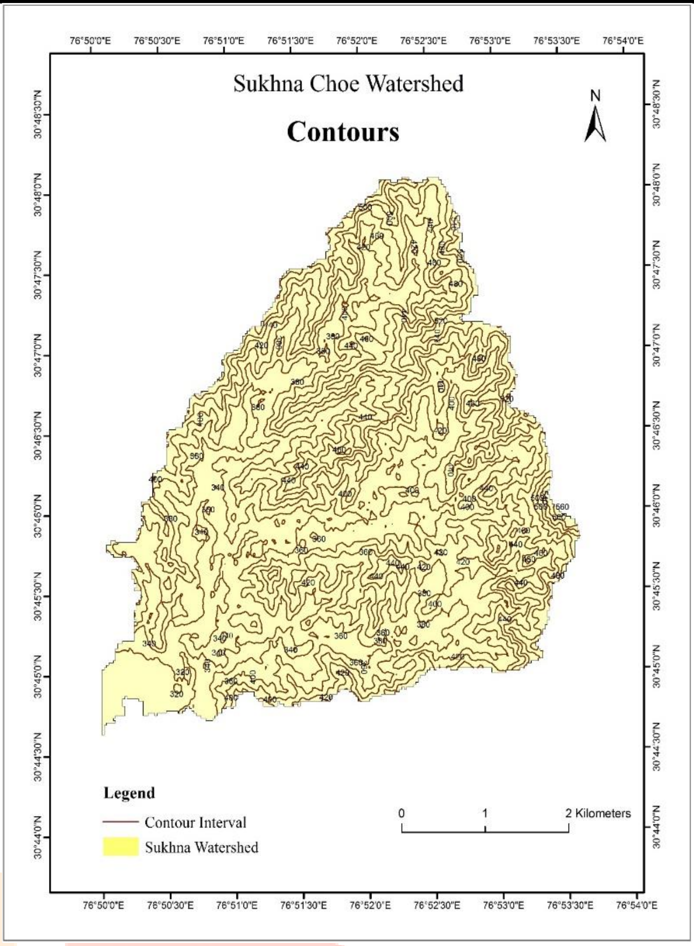


Fig.4.3.1: Hill Shading map of the study area

Fig. 4.4.1: Contours mapping

4.4 Contours Mapping

Based on topographical data, contours have been demarcated. According to the contour values in the Sukhna Choe Watershed, the elevation range of the area and the contour closeness also reveal different ridges in the area. The contour values range between 300 and 560 m from mean sea level, which indicates that the area is hilly due to its elevation range. The closely spaced contours along the borders indicates steep gradient while the valley floors are relatively gentle sloping areas. Fig. 4.4.1 shows the contours in the study area.

4.5 Aspects

In physical geography, aspect is the compass direction that a slope faces. For example, a slope on the eastern edge of the mountains described as having an easterly aspect. An aspect map shows to which side a slope is directed. An aspect value of 0 means that the slope is facing the North shown in the figure. 4.5.1. Figure 4.5.2, 4.5.3 and table 4.5 the aspect map of the study area.

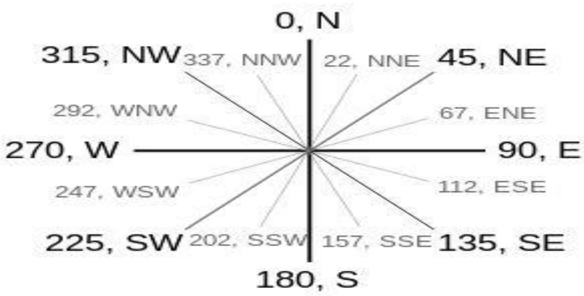


Fig. 4.5.1: Direction

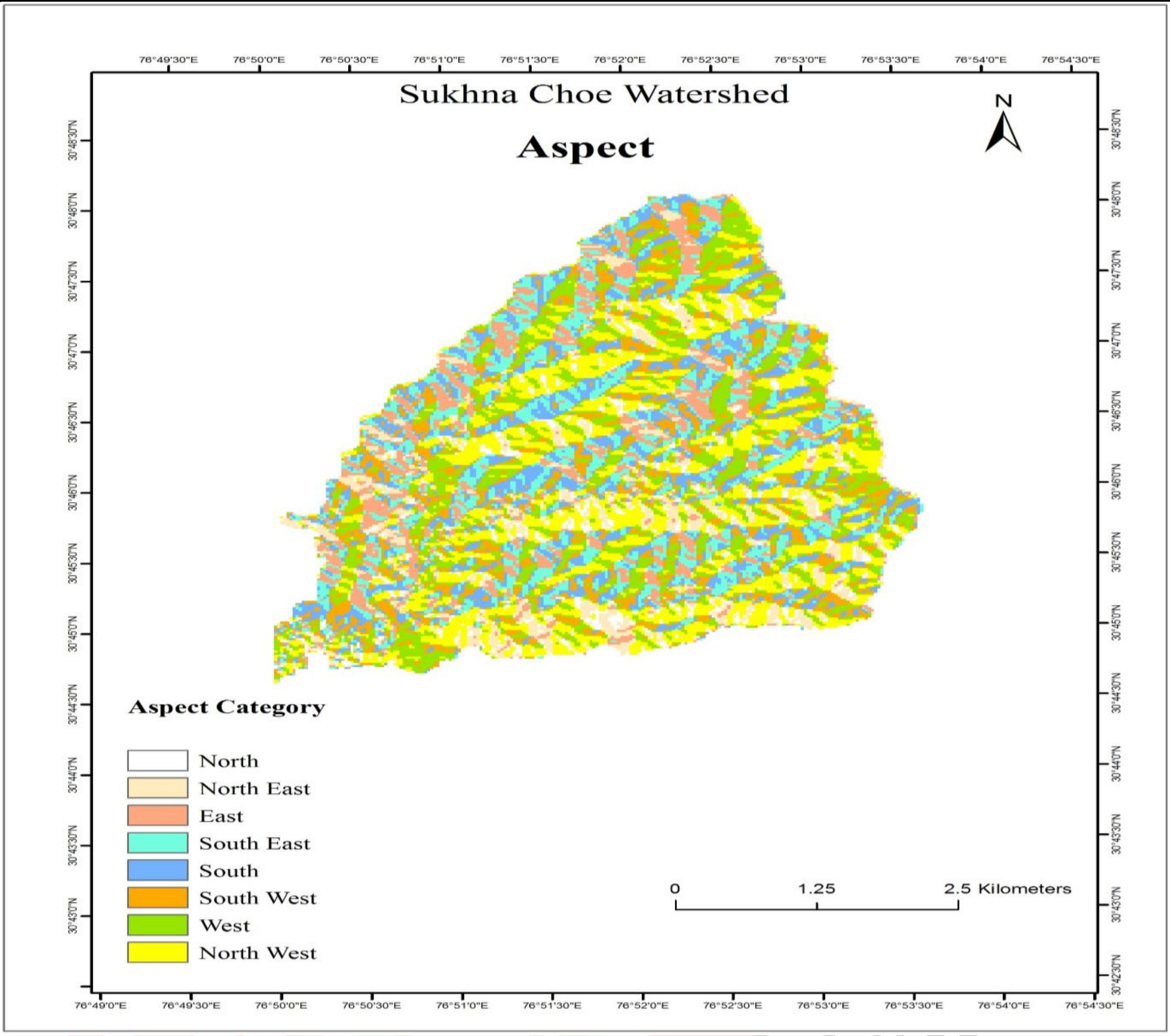


Fig. 4.5.2: Aspect map of the study area

Table 4.5: Aspect Analysis

Sr. No	Aspect	Degree	Area	Area (%)
1	North	0°	214.21	9.46
2	North-East	45	169.83	7.50
3	East	90	247.39	10.92
4	South-East	135	306.05	13.51
5	South	180	303.26	13.39
6	South-West	225	311.09	13.74
7	West	270	386.46	17.07
8	North-West	315	325.67	14.38

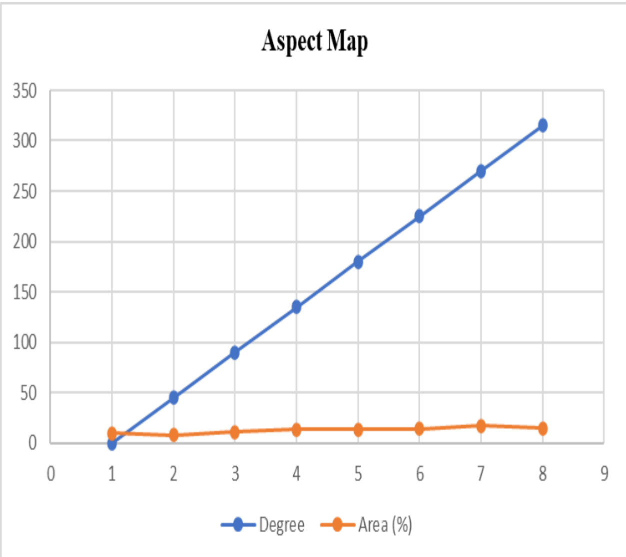
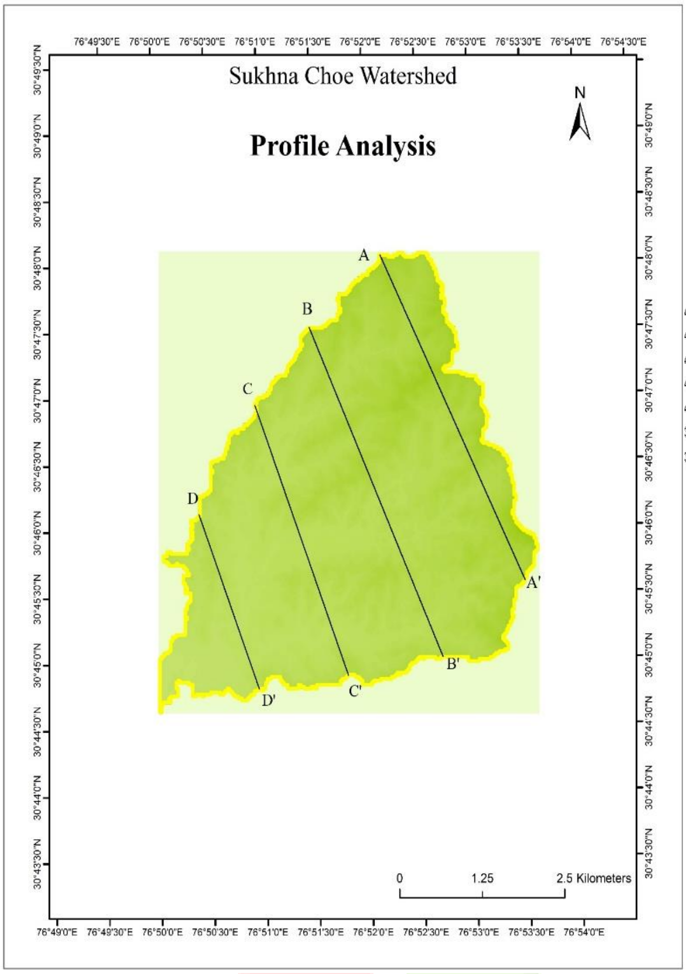


Fig. 4.5.3: Aspect Analysis

Based upon the above table 4.5, figure 4.5.2 and figure 4.5.3, it has been found that the hills are having maximum aspect in west direction covering an area of 17.07% and lowest aspect in north-east direction covering an area of 7.50%.

4.6 Terrain Profiles

A profile, also known as a topographic cut, is a representation of the relief of the terrain obtained by cutting transversely the lines of a topographic map. On a map, it depicts the rise and fall of the ground along a selected line. A profile can aid in gaining a clear understanding of the nature of relief along a line. Profiles can be created using 3-D modeling, which provides a better understanding of the topography (Figure 4.6.1 and Figure 4.6.2). Terrain profile is also known as cross profile. This is drawn to know the relief across a river. It is best suited to understand the characteristics of a river valley from its source to mouth.



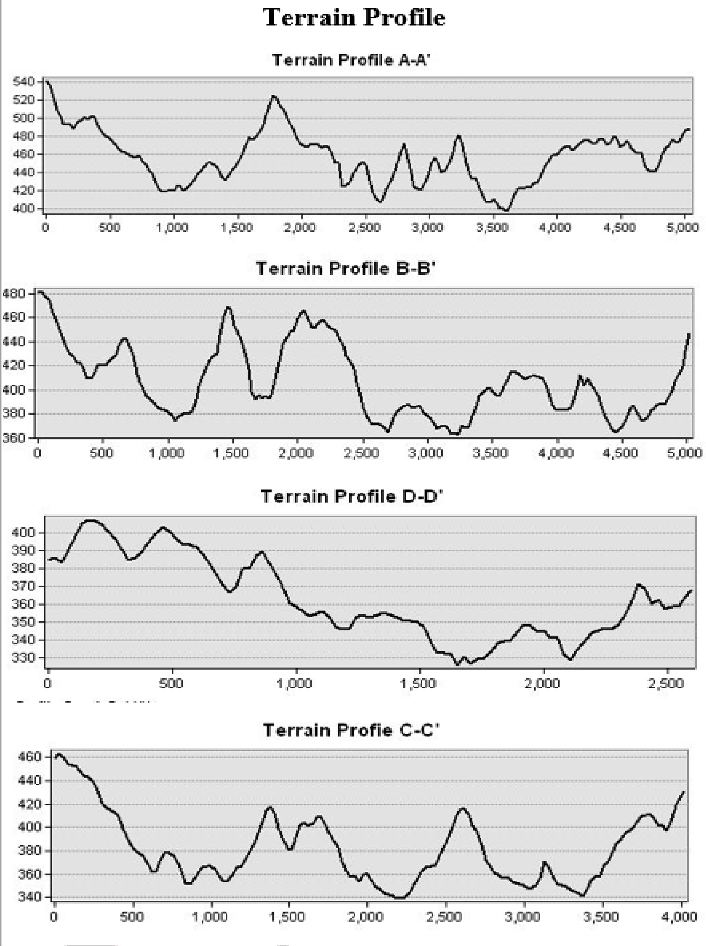


Fig. 4.6.1: Profile analysis mapping Figure 4.6.2: Terrain Profile of the sukhna watershed

Through Terrain Profiles, it can be seen that the Choe is deep and narrow in the upper course and even in the middle course it continues to erode and deposit, whereas in lower course it is wide.

4.7. Longitudinal Profile

A longitudinal profile is drawn along the length of a river, railway line, road, canal etc. Long profile or valley thawed gives a vivid picture of breaks in longitudinal profile or longitudinal course of the river and numerous pronounced breaks may indicate nick points or heads of rejuvenation, and these breaks help in examining the polycyclic nature of landform development. Figure 4.7.1 shows the longitudinal profile of the study area.

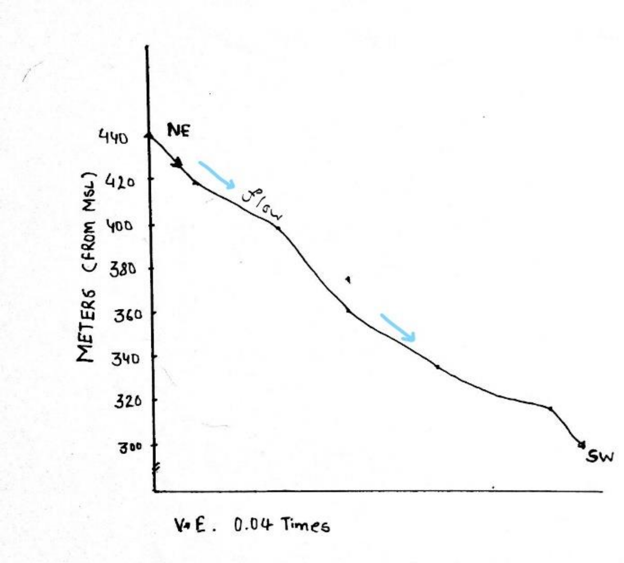


Fig. 4.7.1: Longitudinal profile of area

The Figure 2.15 shows that the main channel of the Choe has a rugged and bouncy slope at the headwaters and later after 3.5 km it has a gentle slope till mouth.

Conclusion

Thus, in this research paper, different Relief characteristics of the study area are having variations and they can be seen co-relating with each other such as High Relief means high degree of slope and it also modify the channel streaming. Profile analysis also reveals that the slope of the Choe in the upper region is high and the chose are deep and narrow whereas in the lower course it meanders and has a gentle slope. The Sukhna Choe flows from north east to south west. The combined analysis of the indices can reflect the different terrain types in Sukhna Choe.

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