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A Study on The Ratio of Relative and Absolute Altitude of Kudiraiyar Watershed Using GIS

KEYWORDS: Dissection Index, Relative relief, GIS, Fishnet, IDW

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ABSTRACT *Drainage dissection is a significant morphometric tool and is an indicator for estimating the nature and magnitude of dissection in relation to vertical exaggeration of the terrain. It is expressed as the ratio between the relative altitude and absolute height. It is dimensionless because it is expressed always in terms of ratio or percentage. An attempt has been made in this study to analyse the degree of roughness of the surface of the Kudiraiyar watershed. The numerical analysis of areal distribution of dissection index shows that the category of very low dissection index occupies a smaller area (18.31km2) of the watershed. It covers 15.50% of the total dissection area of the watershed. The high and moderate dissection index areas constitute 28.49 km2 (24.12%) and 27.86 (23.58%) km2 respectively. The low dissection index covers 20.39% of the total watershed which occupy 24.09 km2 of the study area. The very high dissection index occupies an area of 19.38 km2 (16.41%).*

1. INTRODUCTION

The word dissection index defines the roughness of the surface created by numerous valleys or ravines. It is an important parameter of drainage basin and useful in the study of the terrain and drainage basin dynamics. Dissection is directly related to the stage of cycle of erosion. Very high values of dissection closely correspond to youthful stage whereas low values are related to penultimate stage (Von Engelin). According to Dove Nir, the concept of relative relief is not entirely a satisfactory criterion to analyse the nature of relief. Equal relative altitudes are not always of equal importance, since their absolute altitude may differ. The picture gained from relative altitude is static, for it fails to take into account the vertical distance from the erosion base.

In general, the values of dissection index are basically a ratio which range between 0 (%) and 1 (100%). But it cannot be absolute zero because no part of the earth is devoid of dissection except the surface which is permanently covered and protected with thick ice sheet and also it cannot be more than unity except in the case of vertical cliff. Thus, dissection index determines and discriminates the stages of cycle erosion and recites the history of terrain development. Generally, three groups of dissection index viz., (i) 0.0 – 0.1 or 1% to 10%, (ii) 0.2 – 0.3 or 2% to 30% and (iii) above 0.3 or 30% are closely related to penultimate or monadnock stage, equilibrium or mature stage and inequilibrium or youthful stage of cycle of erosion and terrain development (Govind Prasad).

2. OBJECTIVES

The aim of the present study is to analyse the dissection index of Kudiraiyar Watershed with the following objectives: (1)To find out dissection index of Kudiraiyar watershed, (2) To observe the relationship of dissection index with other terrain characteristics of Kudiraiyar watershed.

3. STUDY AREA

Kudiraiyar River is the fifth order stream according to Horton's method of stream ordering. It is one of the important watersheds of Amaravadhi sub-basin. It is located between 10^0 13′ 25.689″ N and 10^0 28′ 58.739″ N latitudes and it extends from 77^0 19′ 37.701″ E longitudes to 77^0 24′ 3.507″ E longitudes. It covers an area of 118.13 km^2 (fig.1). It is bounded by Porandalar watershed on the east, Amaravathi sub-basin on the west and the north and Kumbur Ar watershed on the south. Attur is the important village located in the northern part of the watershed where as Nagavalasu village is located in the eastern part of the watershed. Kukkal is the village situated in the rugged terrain of the south central part of the watershed.

4. METHODOLOGY

The analysis of dissection index of the study area has been carried out following Dove Nir's formula. Dissection Index = $\frac{Relative\ Relief}{Absolute\ Relief}$

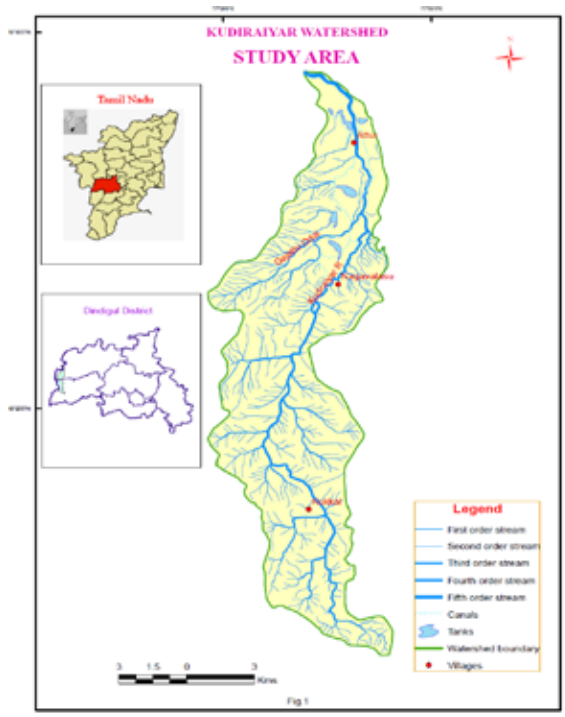

Figure 1: Location Map of the Study Area

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This method is the most convenient one for computing dissection index and making quantitative generalizations. Calculation of dissection index has been based on the analysis of contours represented on Survey of India's topographical sheet numbered 58 F/7 and 58 F/8 on the scale of 1:50,000. For analysis, the square grids of 1 km^2 X 1 km^2 are drawn over the study area using fishnet tool of ArcGIS 9.3 to plot the dissection index values in respective grids. In this process, a total number of 132 grids measuring about 118.13 km^2 have been analysed. The various categories of dissection zones have been generated using Inverse Distance Weighted (IDW) method. Correlation and linear regression techniques have also been attempted using SPSS to ascertain the relationship as well as association of dissection with other terrain parameters.

5. RESULT AND DISCUSSION

The analysis of the frequency distribution of dissection index (Table 1) reveals that very low category of dissection index occupies 28.79% of the total frequencies. The low dissection index group constitutes 21.97% whereas the moderate and high dissection areas occupy 16.67% and 14.39% of the total frequencies respectively. The very high dissection index is found to cover 18.18%.

Table 1: Frequency Distribution of Dissection Index

Class interval	Frequency	Frequency (%)	Categories
<0.08	38	28.79	Very Low
0.08-0.16	29	21.97	Low
0.16-0.24	22	16.67	Moderate
0.24-0.32	19	14.39	High
>0.32	24	18.18	Very High
Total	132	100	

The numerical analysis of areal distribution of dissection index (Table 2) shows that the category of very low dissection index occupies a smaller area (18.31km^2) of the watershed. It covers 15.50% of the total dissection area of the watershed. The high and moderate dissection index areas constitute 28.49 km^2 and 27.86 km^2. They together occupy 24.12% and 23.58% of the total study area respectively. The low dissection index covers 20.39% of the total watershed which occupy the areas of 24.09 km^2. The very high dissection index occupies an area of 19.38 km^2 (16.41%).

The spatial distribution of dissection index varies from north to south and east to west (Fig 2). It is ranging from 0 to 0.66 indicating the impact of slope, absolute relief and relative relief on dissection. In general, the spatial distribution is described as below.

5.1. Very Low Category

The category of very low dissection index covers a smaller area (18.31km^2) in the watershed. It occupies 15.50% of the total area of the watershed. The spatial distribution of dissection index reveals that this group of dissection index is mostly concentrated in the extreme northern and southern part of the watershed.

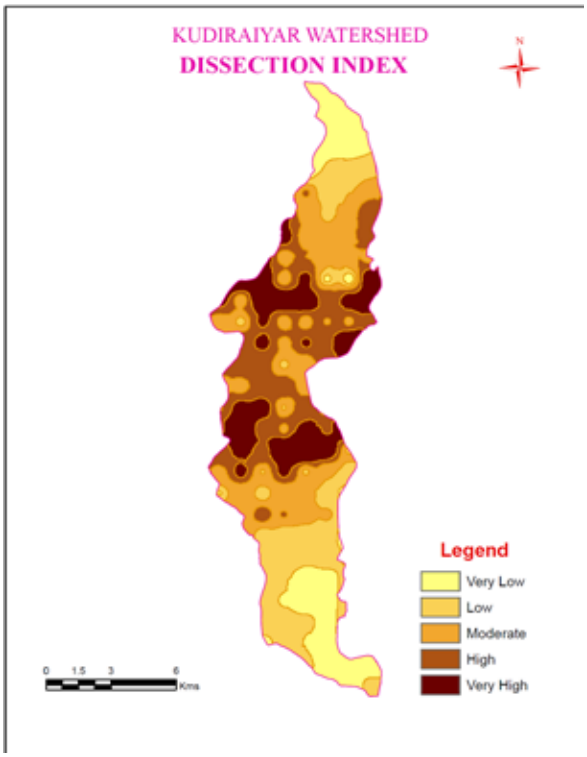

Figure 2: Spatial Distribution of Dissection Index

5.2. Low Category

The low dissection index occupies an area of 24.09km^2 which accounts for 20.39% of the total area of the watershed. The low dissection index lies in the northern as well as the southern part of the watershed bordering the very low dissection index.

Table 2: Dissection Index – Area Distribution

Class interval	Area (km^2)	Area (%)	Categories
<0.08	18.31	15.50	Very Low
0.08-0.16	24.09	20.39	Low
0.16-0.24	27.86	23.58	Moderate
0.24-0.32	28.49	24.12	High
>0.32	19.38	16.41	Very High
Total	118.13	100	

5.3. Moderate Category

The area of moderate dissection constitutes 23.58% (27.86 km^2) of the total study area. This category of dissection index is found in the north as well as in the south bordering in the low dissection index categories.

5.4. High Category

The high dissection index area covers 28.49 Km^2 (24.12%) of the total area of the watershed. It is largely concentrated in the central part of the watershed. It is also found in the eastern part of the watershed bordered by the moderate the dissection index.

5.5. Very High Category

The very high dissection index occupies an area of 19.38 km^2 which constitutes 16.41% of the total area of the study area. This classification of dissection index is found in the north central as well as in the south central part of the wa-

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tershed as isolated patches.

The relationship of dissection index with absolute relief, relative relief and slope has been established with correlation and regression analysis (Table 3). The dissection index and slope evince a moderate positive correlation (0.596) at 0.01 significant levels. It is inferred from the result that the dissection index increases as the slope increases. But these variables do not have a perfect correlation as the correlation co-efficient is not 1. It is further substantiated from the best fit line of regression shown in fig.4 that the dissection index and slope have only 35.1% of association.

Table: 3 Regression Analysis of Dissection Index with other variables

Variables	R	R^2	Adjusted R^2	Sig.
Slope	0.596	0.356	0.351	0.000
Relative relief	0.805	0.648	0.645	0.000
Absolute relief	0.013	0.000	-0.008	0.881

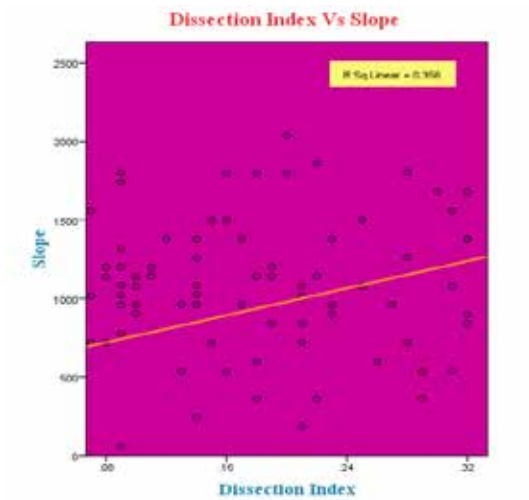

Figure 3: Dissection Index Vs Slope

The relationship between relative relief and dissection index shows a strong positive correlation with 64.5% of association. It is learnt from the result that the degree of dissection increases with the increase of relative relief.

The dissection index and absolute relief have correlation coefficient of 0.013 which indicates that there is no correlation and association between dissection index and absolute relief. It can also be clearly understood from the best fit line of linear regression shown in fig.4.

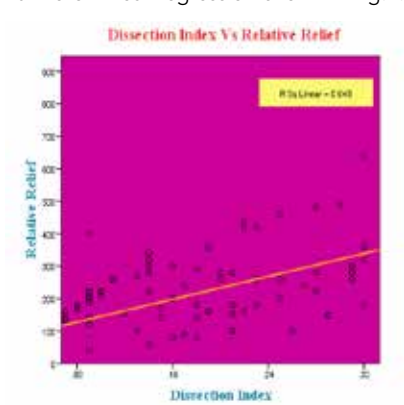

Figure 4: Dissection Index Vs Relative Relief

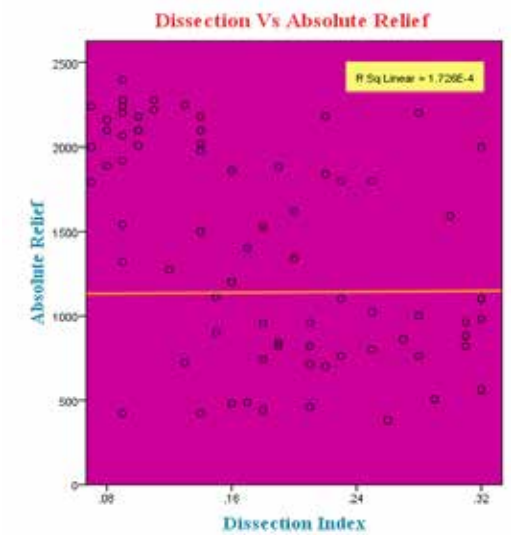

Figure 5: Dissection Index Vs Absolute Relief

6. CONCLUSION

The following conclusions may be deduced from the quantitative analysis of dissection index of Kudiraiyar Watershed.

*The spatial distribution of dissection index reveals that the very low category is found in the extreme northern and southern part of the watershed. Low dissection index is concentrated in the northern as well as the southern part of the watershed bordering the very low dissection index. This category of dissection index can also be visualized as small pockets in the northern central and south central part of the watershed. The moderate category of dissection index is found in the north as well as in the south bordering the low dissection index group. This category can also be seen in the central part of the watershed as a small patch. The high dissection index is concentrated mostly in the central part of the watershed. It is also found in the north eastern part of the watershed bordered by the moderate dissection index areas. The very high dissection index lies in the north central as well as in the south central part of the watershed as isolated patches.

*Absolute relief has no relation and association with dissection index.

*The relationship between relative relief and dissection index shows a strong positive correlation with 64.5% of association. It indicates that the degree of dissection increases with the increase of relative relief and vice versa.

*The dissection index and slope evince a moderate positive correlation (0.596) at 0.01 significant levels although not a perfect one. The very steep slope and steep slope correspond to high dissection index while level and gentle slope lead to low dissection index.

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