RELATIVE RELIEF ANALYSIS OF VARAHA NADI WATERSHED USING GEOGRAPHIC INFORMATION SYSTEM

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ABSTRACT Relative Relief is defined as the difference in heights between the highest and the lowest points in a unit area may it be a grid square, rectangle or a minute-grid square. It is also termed as the "amplitude of available relief or local relief ". The present study has been attempted to calculate the frequency and spatial distribution of relative relief in Varaha Nadi Watershed. The numerical analysis of area and relative relief distribution shows that the category of high relative relief occupies the largest area (184.24 km2) in the watershed. It covers 47.63% of the total area of the watershed. The extremely low and moderately low categories cover an area of 77.07 km2 (19.93%) and 50.10 km2 (12.95%) respectively. The remaining areas are occupied by low, moderately high and moderate relative relief categories. The moderately high relative relief category covers an area of 27.89 km^2 which occupies 7.21% area of the watershed. The low and moderate relative relief classes spread for an area of 28.92 km^2 and 18.58 km^2 respectively.

1. INTRODUCTION

Relative Relief is a very important morphometric variable which is used for overall assessment of the morphological characteristics of terrain and degree of dissection (Savindra Singh). The relative relief represents actual variation of altitude in a unit area with respect to its base level. While making the analysis of relief it is often important to relate the altitude of the highest and lowest points in any particular area, that is, to ascertain the amplitude of available relief (Glock).

Though Smith used grids (grids of 5 minutes each of latitude and longitude on a contour map of Ohio on the scale of 1:600000) to calculate the relative relief, his grids were of larger units. The present study has been attempted to calculate the frequency and spatial distribution of relative relief in grid squares of 1km x 1km each.

2. OBJECTIVES

The prime aim of the present study is to analyse the relative relief of Varaha Nadi Watershed with the following objectives: (1) To find out the relative relief of Varaha Nadi watershed. (2) To examine the relationship of relative relief with other terrain characteristics of the study area.

3. STUDY AREA

Varaha Nadi Watershed extends between 10°3'N to 10°15'N latitudes and 77°23'E to 77°40'E longitudes. It covers an area of 386.8 km^2 with a perimeter of 101.7 km (Fig.1). It extends from north to south over a distance of about 19.6 km and from west to east over a distance of about 32.4 km. In general, Varaha Nadi watershed is oriented from North West to South East direction. It is wider in the middle and upper part whereas it is narrower in the lower part. Varaha Nadi watershed lies in Kodaikkanal taluk of Dindigul district and Bodinayakkanur and Periyakulam taluks of Teni district. Varaha Nadi watershed is surrounded by Kodaikkanal taluk on the north, upper Palani Chola Reserved Forest on the southwest, Vaigai Reservoir on the west, Andippatti Reserved Forest on the southeast, Manjalar watershed on the east and Palani hills southern slope East Reserved Forest on the north-eastern part of the watershed.

4. METHODOLOGY

The analysis of relative relief of the study area has been carried out following Smith's method. This approach is the most convenient for computing relative relief and making quantitative generalizations. For this analysis, Survey of India toposheets numbered 58 F/7 and 58 F/8 on the scale of 1:50,000 have been used. The entire study area has been divided into grids of 1 km^2 using fishnet tool of ArcGIS software. In this process, a total of 485 grids measuring about 386.8 km^2 have

been analysed. After finding out the maximum and minimum values for each grid, the difference between maximum and minimum values have been calculated and plotted in each grid as centroid. With the help of ArcGIS, isolines have been generated using Inverse Distance Weighted (IDW) tool following the classification of Savindra Singh. Correlation and linear regression techniques have also been employed using SPSS to ascertain the relationship as well as association of relative relief with other terrain parameters.
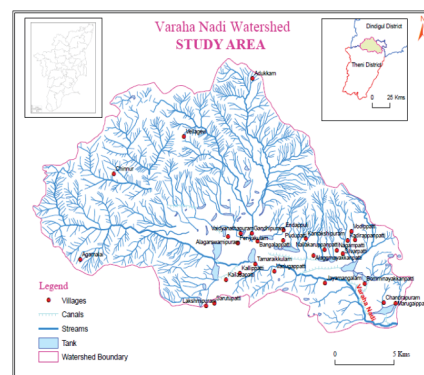

Figure 1: Location Map of the Study Area

5. RESULT AND DISCUSSION

The frequency distribution of relative relief is shown in Table 1. The maximum frequencies are registered in the high relative relief category. It accounts for 46.19% of total frequencies. The other maximum occurrence of frequencies is concentrated in the extremely low relative relief category which contributes 21.86% of total frequencies. If combined, both extremely low and high relative relief categories account for 68.05% of total frequencies. The low frequencies of 4.54%, 5.36%, 6.39% and 15.67% are found in the moderate, low, moderately high and moderately low relative relief categories respectively.

Table 1: Frequency Distribution of Relative Relief

Relative Relief (m)	Frequency	Frequency (%)	Categories
<15	106	21.86	Extremely Low
15-30	76	15.67	Moderately Low
30-60	26	5.36	Low
60-120	22	4.54	Moderate
120-240	31	6.39	Moderately High

>240	224	46.19	High
Total	**485**	**100**	

The numerical analysis of area and relative relief distribution (Table 2) shows that the category of high relative relief occupies the largest area (184.24 km^2) in the watershed. It covers 47.63% of the total area of the watershed. The extremely low and moderately low categories cover an area of 77.07 km^2 (19.93%) and 50.10 km^2 (12.95%) respectively. The remaining areas are occupied by low, moderately high and moderate relative relief categories. The moderately high relative relief category covers an area of 27.89 km^2 which occupies 7.21% area of the watershed. The low and moderate relative relief classes spread for an area of 28.92 km^2 and 18.58 km^2 respectively.

Table 2: Areal Distribution of Relative Relief

Relative Relief (m)	Area (km^2)	Area (%)	Categories
<15	77.07	19.93	Extremely Low
15-30	50.10	12.95	Moderately Low
30-60	28.92	7.48	Low
60-120	18.58	4.80	Moderate
120-240	27.89	7.21	Moderately High
>240	184.24	47.63	High
Total	**386.8**	**100**	

The spatial distribution of relative relief shows that extremely low, moderately low and low categories are found in the central, south and south-eastern part of the watershed occupying a small area. The moderate relative relief category is found along the borders of low and moderately high relative relief zones. This category is also found in the north-western part of the watershed. The moderately high relative relief is concentrated in the north-west, central and north-eastern part in juxtaposition with the high and moderate relative relief categories. The high relative relief category of above 240m is found extensively in the central, north-west, south-west, north and north-eastern part of the watershed. The relative relief map (fig.2) shows the spatial variation of relative relief in six categories. They are described as below.

5.1 Extremely Low
The extremely low relative relief category occupies 77.07Km^2 (19.93%) of the total area of the watershed. The spatial distribution of relative relief shows that extremely low category is found in the central, south and south-eastern part of the watershed covering the second largest area after high relative relief category.
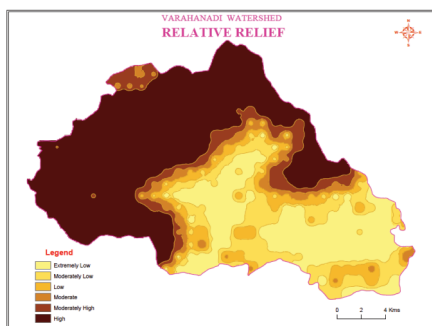

Figure 2: Spatial Distribution of Relative Relief

5.2 Moderately Low
The moderately low relative relief category occupies an area of 50.10 km^2 (12.95%). The spatial distribution of relative relief shows that moderately low category is found to be the third largest category which occupies the central, south and south-eastern part of the watershed.

5.3 Low
The low relative relief category occupies 28.92 Km^2 (7.48%) of the

study area. This category is found in the central, south and south-eastern part of watershed bordering moderately low relative relief group.

5.4 Moderate
The moderate relative relief group is distributed over an area of 18.58 km^2 (4.80%). This group of relative relief is concentrated in the south, central and north-eastern part of the watershed flanked by low and moderately high relative relief categories. This category is also found in the north-western part of the study area.

5.5 Moderately High
The moderately high relative relief category covers an area of 27.89 Km^2 which amounts to 7.21% of the total area of the watershed. The moderately high relative relief category is concentrated in the north-west, central and north-eastern part of the watershed. This category is found in juxtaposition with moderate and high relative relief categories.

5.6 High
The category of high relative relief occupies the largest area (184.24 Km^2) in the watershed. It contributes 47.63% to the total area of the watershed. The high relative relief category of above 240m is found extensively in the central, north-west, north and north-eastern part of the watershed.

6. CONCLUSION
The spatial distribution of relative relief shows that extremely low, moderately low and low categories are found in the central, south and south-eastern part of the watershed occupying a small area. The moderate relative relief category is found along the borders of low and moderately high relative relief zones. This category is also found in the north-western part of the watershed. The moderately high relative relief is concentrated in the north-west, central and north-eastern part in juxtaposition with the high and moderate relative relief categories. The high relative relief category of above 240m is found extensively in the central, north-west, south-west, north and north-eastern part of the watershed.

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