Volume - 7 | Issue - 7 | July - 2017 | ISSN - 2249-555X | IF : 4.894 | IC Value : 79.96

Original Research Paper

Geography

DIGITAL ELEVATION MODEL BASED ALTIMETRIC FREQUENCY ANALYSIS OF MANJALAR-MARUDANADI WATERSHED, VAIGAI BASIN, TAMIL NADU

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ABSTRACT Altimetric frequency analysis depicts frequency of heights at successive altitudes. It is one of the methods used to demonstrate the existence of erosional surfaces or levels or planes which could be correlated to the evolution of the landforms from one place to another. In this study, altimetric frequency analysis has been attempted to find out the erosion surfaces of Manjalar-Marudanadi Watershed. The analysis reveals that the maximum frequency of pixels is found below 300m and 301-400m elevation categories. The other highest frequencies are found between 401-500m, 1101-1200m and 1201-1300m classes. Therefore, it is likely that Manjalar-Marudanadi watershed has five erosion surfaces, viz., below 300m, 301-400m, 401-500m, 1101-1200m and 1201-1300m elevation classes.

KEYWORDS : Digital Elevation Model, Altimetric frequency histogram, GIS

INTRODUCTION

A method of analyzing relief is to compute the frequency of occurrence of heights above sea level and then to graph this frequency as a histogram. It is valuable when the geomorphologists are seeking to recognize and correlate erosion surfaces.

H. Bauling made considerable use of this method. In some cases he merely counted spot-heights all over the map, in others he covered the map of the area upon which he was working with a grid of small squares and noted the highest point in each square, either from an actual spot-height or from the contour pattern if no spot-height fell in a particular square. The frequency of occurrence of each height or group of heights (e.g. from 20 to 30 metres) was tabulated, and these frequencies were graphed on a vertical against the actual altitudes represented on a horizontal scale.

S.E. Hollingworth used the same principle with minor modifications. Instead of using all spot heights, he was concerned only with actual summit levels and he tabulated for each of the areas with which he was concerned with the number of summit level spot heights occurring within 10, 20, 40 and 50 foot intervals. Obviously the broader groupings smoothed out minor inequalities, but emphasized the major features.

A number of experiments by various workers have been made in order to determine the effectiveness of the several methods of computing the frequency of occurrence of the heights to be plotted. On the basis, firstly, of fully random sampling using only spot heights and secondly, of quasi-random sampling using a grid. In the case of the first if all the spot heights are used, the result may depend on the number of spot heights inserted on the map by the surveyors and cartographers.

2. OBJECTIVES

The aim of the study is to identify erosion surfaces in Manjalar-Marudanadi Watershed with the following objectives.

- To obtain data on frequency distribution of heights from reclassification of ASTER, SRTM and CartoSAT Digital Elevation Models.
- To construct Altimetric frequency histograms for the study area.

3. STUDY AREA

Manjalar-Marudanadi watershed lies between 10°6' to 10°19' North latitudes and 77°32' east to 77°50' east longitudes. It covers an area of 472.75 km² with a perimeter of 108.34 km (Fig.1). It extends from North to South over a distance of about 21.5 km and from West to East for a distance of about 34.1 km. Manjalar and Marudanadi rivers meet at Meenakshipuram and flow as a sixth order river till confluence with Vaigai river near Ayyampalayam. The general orientation of the watershed is from North West to South East. Manjalar-Marudanadi watershed is located in Attur, Dindigul, Kodaikkanal and Nilakkkottai Taluks of Dindigul district and Periyakulam taluk of Theni district. It is surrounded by Palani hills Southern Slope East Reserve Forest on the North, Upper Palani Chola Reserve Forest on the West, Vaigai Basin on the south and Kodavana River Watershed on the East. Ayyampalayam, Sevugampatti, Vattalgundu are important town Panchayats located in Dindigul district. Devadanappatti and Ganguvarpatti are two important towns located in the Theni district of the watershed.

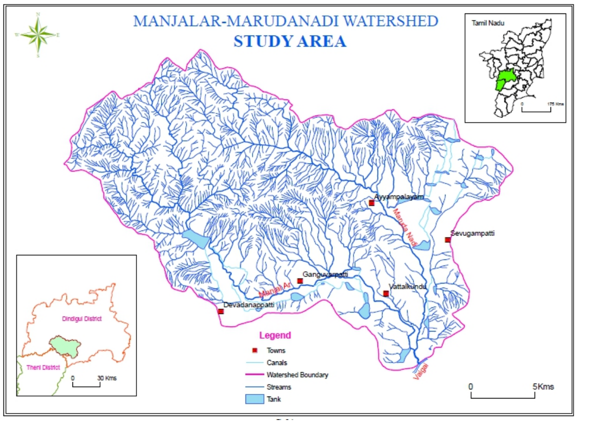

Figure 1: Location Map of the Study Area

4. METHODOLOGY

The present study has been carried out mainly based on secondary data generated through the Digital Elevations Models (DEMs) from ASTER (Advanced Space borne Thermal Emission and Reflection Radiometer – 30m), CartoSAT (30m) and SRTM (Shuttle Radar Topographic Mission – 90m). Data on frequency distribution of heights were derived from reclassification of DEMs with different categories of elevation. The pixel values for each category have been counted with the help of ArcGIS software and multiplied by pixel size twice. Histograms have been constructed for all the three data set by plotting relative pixel values on the horizontal axis and elevation class interval on the vertical axis.

5. RESULT AND DISCUSSION

In this study, data on frequency distribution of heights were derived from reclassification of DEMs obtained from ASTER, CartoSAT and SRTM with different categories of elevation. The DEMs have been reclassified with 19 altitudinal groups with 100m interval starting from < 300m class. The frequency of pixel values is tabulated and shown Table 1.

Table: 1 Frequency of Pixel Values

Elevation (m)	ASTER DEM	Relative values	CartoSAT DEM	Relative values	SRTM DEM	Relative values
<300	18219675	0.39	263996831	0.56	17629788	0.37
301-400	76713112	0.16	21341547	0.05	81391534	0.17
401-500	23048837	0.05	12624929	0.03	23830348	0.05
501-600	18187265	0.04	10804765	0.02	18037049	0.04
601-700	12917206	0.03	9360159	0.02	13238122	0.03

701-800	10163274	0.02	12582667	0.03	10177184	0.02
801-900	10750115	0.02	16534200	0.03	10557640	0.02
901-1000	14405403	0.03	21968760	0.05	14327608	0.03
1001-1100	18286990	0.04	21152327	0.04	18469384	0.04
1101-1200	21383245	0.05	22743890	0.05	20985579	0.04
1201-1300	27462608	0.06	20104412	0.04	27064220	0.06
1301-1400	18868077	0.04	10756739	0.02	19282176	0.04
1401-1500	10962989	0.02	8135510	0.02	10938095	0.02
1501-1600	7646188	0.02	6711076	0.01	7946332	0.02
1601-1700	6139772	0.01	6168388	0.01	6234282	0.01
1701-1800	6319085	0.01	4965831	0.01	6372629	0.01
1801-1900	4702396	0.01	2237986	0.00	4963215	0.01
1901-2000	2158461	0.00	476412	0.00	2144385	0.00
>2000	419994	0.00	9605	0.00	397749	0.00
Pixels	472731776		12624929		23830348	

It is evident from the table that almost 55% (ASTER), 61% (CartoSAT) and 54% (SRTM) of the pixel values are found below 300m and 301-400m elevation groups. Histograms (figures 2 to 4) have been constructed for all the three data set by plotting relative pixel values on the horizontal axis and elevation class interval on the vertical axis. It can be inferred from the histograms that the maximum frequency of pixels are found below 300m and 301-400m elevation categories. The other highest frequencies are found between 401-500m, 1101-1200m and 1201-1300m classes.

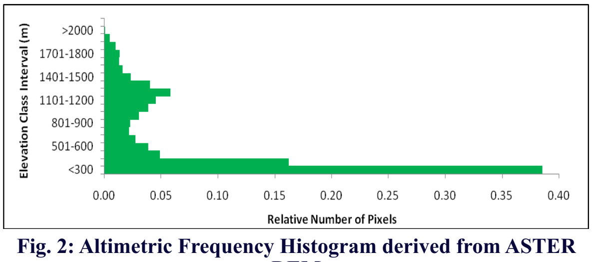

Fig. 2: Altimetric Frequency Histogram derived from ASTER DEM

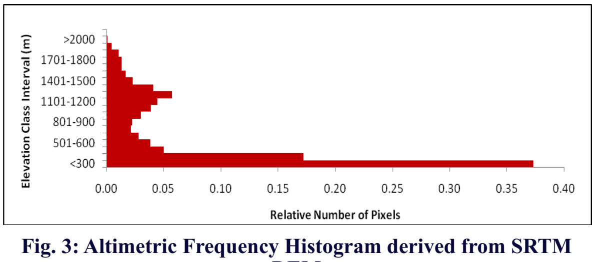

Fig. 3: Altimetric Frequency Histogram derived from SRTM DEM

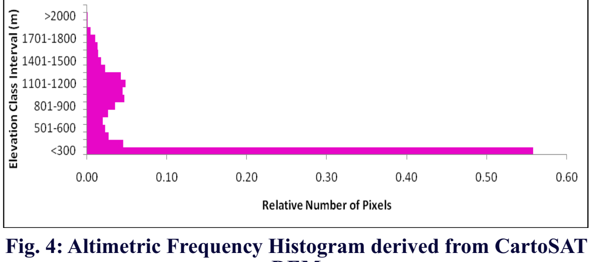

Fig. 4: Altimetric Frequency Histogram derived from CartoSAT DEM

6. CONCLUSION

The following five prominent erosion surfaces have been identified in Manjalar- Marudanadi watershed using Altimetric frequency analysis. They are;

- Below 300m
- 301-400m
- 401-500m
- 1101-1200m
- 1201-1300m.

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