iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 **Issue:** VII **Month of publication:** July 2019

DOI: http://doi.org/10.22214/ijraset.2019.7136

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
Volume 7 Issue VII, July 2019- Available at www.ijraset.com

Hypsometric Analysis of the Malaprabha Sub Basin of Krishna River, Karnataka, India

Sumalata Elabanavi[1], Suresh Lamani[2]
[1]*M.Sc.Geoinformatics, School of Environmental Science and Public Health and Sanitation Management Karnataka State Rural development and Panchayat Raj University, Gadag*
[2]*Course Coordinator, M.Sc. Geoinformatics, School of Environmental Science and Public Health and Sanitation Management, Karnataka State Rural development and Panchayat Raj University, Gadag*

Abstract: This research is intended to assess the estimation of erosion status of the watershed helps in selecting suitable conservation measures to check erosion and water conservative management practices in the watersheds. Hypsometric analysis with the help of Geographic Information System (GIS) to understanding the geological improvement of basin and for delineation of erosion proneness of watershed. The hypsometric curve and hypsometric integrals are the main indication factors of watershed condition. Hypsometric analysis is the relationship of horizontal cross sectional drainage basin area to elevation. The graph of hypsometric curve indicates the geological stage of watershed and erosion susceptibility of basin. The present study has been carried out by using Cartosat-1 Digital Elevation Model (Carto-DEM) remotely sensed data and GIS in the Malaprabha sub basin of Krishna River. The hypsometric analysis of Malaprabha sub basin is carried out and value of hypsometric integral (Hi) is found 0.5 which indicates the watershed is at Mature stage.
Keywords: Remote Sensing and GIS, Carto-DEM, Hypsometric Curve, Hypsometric Integral.

I. INTRODUCTION

The hypsometric curve is a description of the cumulative relationship between elevation and the area within elevation intervals. The curve is plotted with the elevation plotted as the ordinate and the area within the watershed above the elevation plotted as the abscissa. The hypsometric curve also be represent in uniform with the cumulative fractions plotted rather than the actual values. As shown in figure. The standardized form is useful for comparing the area elevation characteristics of watersheds. Such comparison might be useful if a regional hypsometric curve were being developed from the analysis of hypsometric curves of watersheds in the region; after standardizing the hypsometric curves for watershed, an average curve could be constructed for the region the regional hypsometric curve could be used to represent the area elevation characteristics of the watershed.

A number of indices have been developed to convert the hypsometric curve into a single value index of the area-elevation characteristics of a watershed.

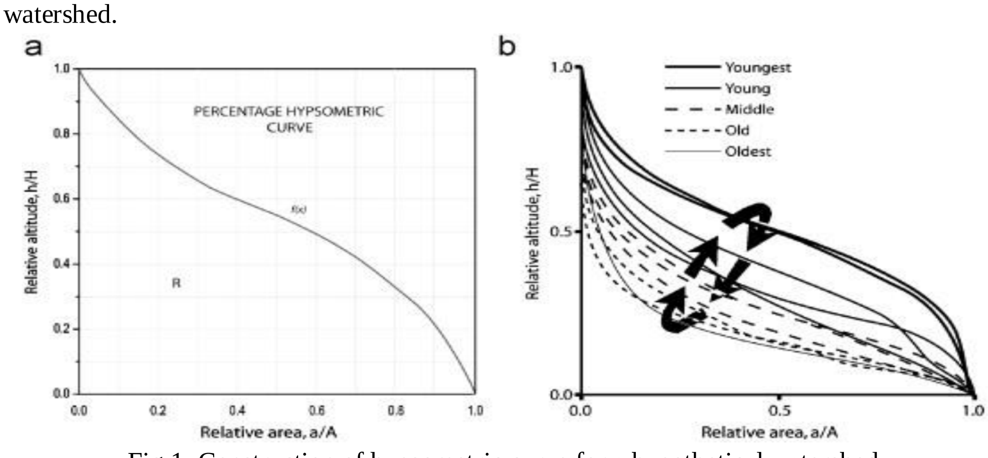


Fig 1: Construction of hypsometric curve for a hypothetical watershed.

The profile factor (Fp) is a second example of a single valued index that can be derived from a hypsometric curve. The profile factor is defined as the ration of the maximum deviation (Dm) of the hypsometric curve from a line connecting the points (0,1) and (1,0) to the length of the line(Ld) this is shown in figure 2.

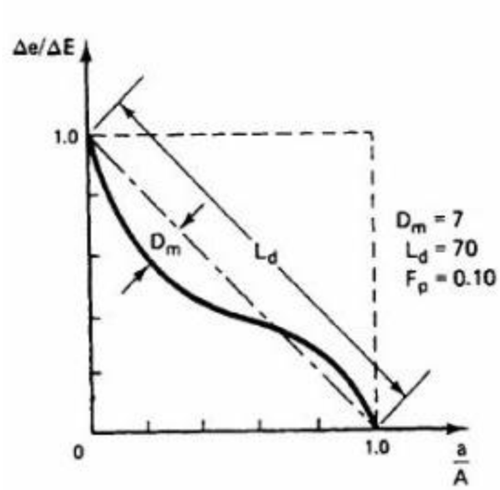


Fig. 2: Estimation of the profile factor for the hypsometric curve

Strahler evaluate different shapes of hypsometric curves through the comparison of different drainage basins and classified basins according to their stages of geomorphic evolution(as: youth stage or convex upward curves, where Hi $\geq$ 0.60), where the watershed is highly vulnerable to erosion and land sliding, equilibrium or mature stage (S-shaped hypsometric curve which concave upward at high elevations and convex downward at low elevations, where 0.30 $\leq$ Hi $\leq$ 0.60); and pereplain (old) or monadnock stage (concave upward curve, where Hi $\leq$ 0.30).

II. STUDY AREA

The study area is Malaprabha Sub Basin of Krishna River situated in between Bagalkot and Gadag district lies geographically between 75º20' to 76º20' East longitude and 15º0' to 16º20' North latitude with basin area of 3705.km^2.Relief from 397m to 814m (As per CARTODEM).Fig.3 shows the location map of the study area delineated based on topography and drainage pattern to understand hydrological process of the basin. The drainage pattern is coarse texture and dendritic drainage pattern at basin level. The annual average rainfall of the area is 631mm. The principal soil types are red loamy and black clay soils. For the delineation of catchment for study area for hypsometric analysis, CARTODEM with 30m resolution (www.bhuvan.nrsc.gov.in) covering district of Bagalkot, Gadag and Koppala are delineated using ArcGIS Software.

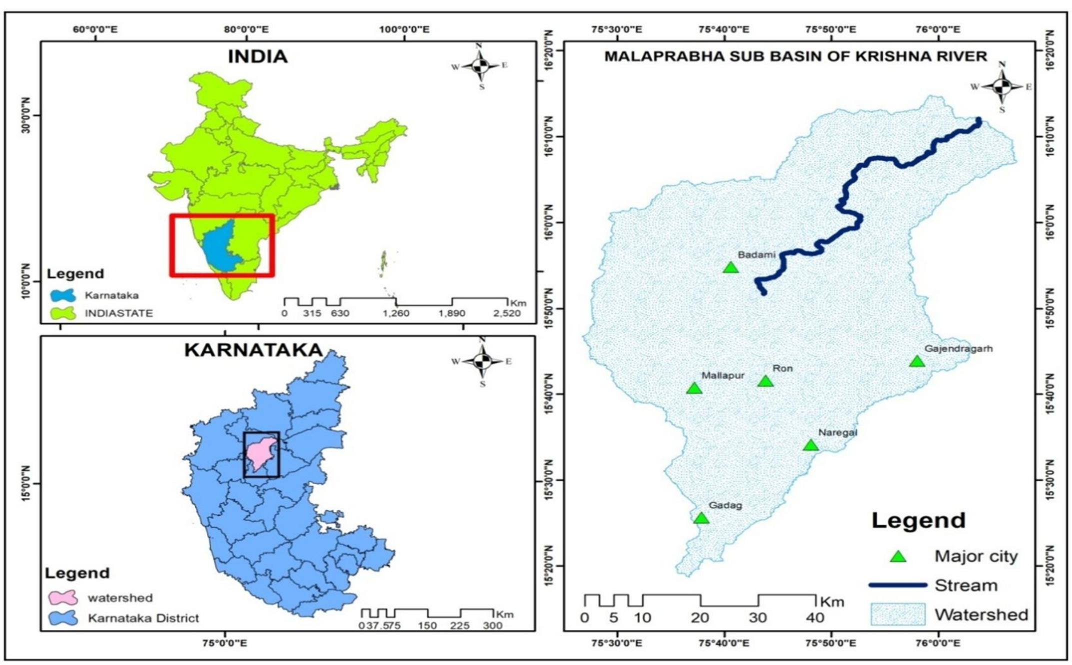
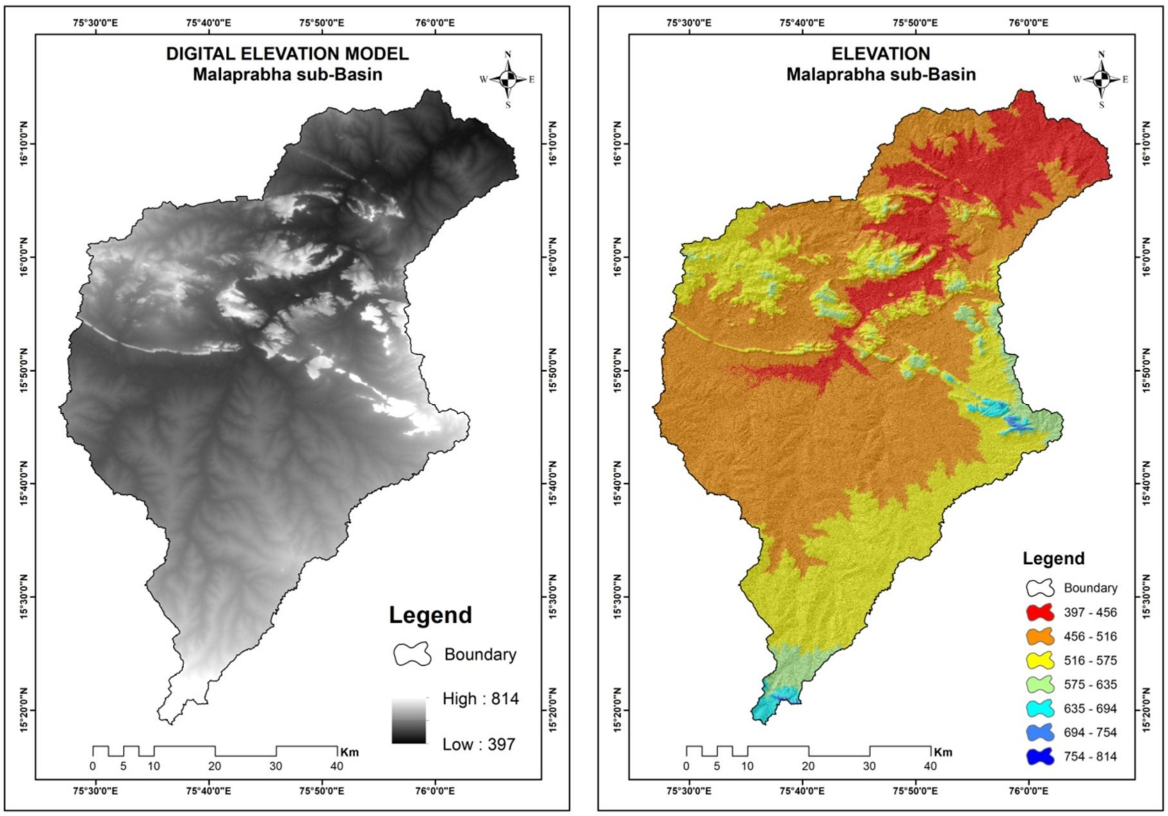


Fig 3: Study area Map of Malaprabha sub basin.

III. METHODOLOGY

CARTODEM Geo-referenced with Universal Transverse Mercator projection (WGS 1984, Zone 43N) were acquired from the bhuvan.nrsc.gov.in and basin boundary extracted using Arc GIS tools. Then by using the Spatial Analyst Module an CARTO DEM (30m resolution) was established. Then the drainage networks for Malaprabha sub Basin were generated using the Arc GIS software package. Stream order was assigned to each stream following the stream ordering system developed by Strahler. The entire Malaprabha sub Basin was found of seven order.

The main watershed area, perimeters, and length of watershed were measured using GIS software. At stream order level and, along the main stream length hypsometric curve and Profile factor, maximum elevation, minimum elevation, were calculated using CARTODEM in GIS software. The attribute feature classes that accommodate these values were utilized to plot the hypsometric curves for the Malaprabha sub Basin.



(a) (b)

Fig 4: (a)Digital Elevation Model and (b) Slope Map of Malaprabha Sub basin

IV. RESULTS AND DISCUSSION

1) *Hypsometric Curves (HC):* Hypsometric curve is obtained by plotting the relative area (a/A) along the abscissa and relative elevation (h/H) along the ordinate. The relative area is obtained as a ratio of the area above a particular contour (a) to the total area of the watershed above the outlet (A). Similarly, referring the below fig, considering the watershed area to be bounded by vertical sides and a horizontal base plane passing through the outlet, the relative elevation is calculated as the ratio of the height of a given contour (h) from the base plane to the maximum basin elevation (H), (up to the remote point of the watershed from the outlet) (Sarangi et al., 2000 and Ritter et al. 2002). The hypsometric integral is obtained from the hypsometric curve and is equivalent to the ratio of the area under the curve to the area of the entire square formed by covering it. It is expressed in percentage units and is obtained from the percentage hypsometric curve by measuring the area under the curve. This provides a measure of the distribution of landmass volume remaining beneath.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
Volume 7 Issue VII, July 2019- Available at www.ijraset.com

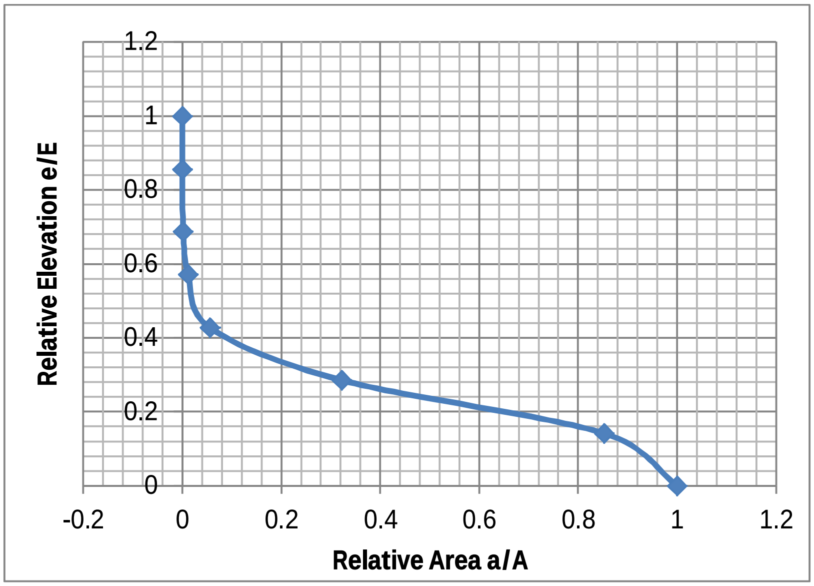


Fig 5: Hypsometric Curve of the Malaprabha Sub Basin

2) *Estimation of hypsometric integrals (Hsi):* The hypsometric integral (Hsi) was estimated using the elevation relief -ratio method. The relationship is expressed as,

$$E \approx H_i = \frac{Elevmean - Elevmin}{Elemax - Elevmin}$$

where, E is the elevation-relief ratio equivalent to the hypsometric integral His, Elevation mean is the weighted mean elevation of the watershed estimated from the identifiable contours of the delineated watershed. Elevation maximum and Elevation minimum are the maximum and minimum elevations within the watershed. The hypsometric integral is expressed in percentage units. However, this method was observed to be less cumbersome and faster than the other methods in practice for His.

Table 1: Values of Hypsometric Integral for Malaprabha sub basin watershed area

Class interval(m)	Elevation, ei (m)	Area, ai (km^2)	cumulative (km^2)	Elevation Difference (m)	a/A	e/E	Hypsometric Integral
814	814	0	0	417	0	1	0.50
754-814	754	0.31	0.31	357	0.00008	0.86	
684-754	684	6.05	6.36	287	0.002	0.69	
635-684	635	36.4	42.76	238	0.012	0.57	
575-635	575	165.56	208.32	178	0.056	0.43	
516-575	516	984.93	1193.25	119	0.322	0.29	
456-516	456	1966.57	3159.82	59	0.853	0.14	
397-456	397	544.78	3704.6	0	1	0	
	603.88						

V. CONCLUSIONS

The present study demonstrate the effectiveness of remote sensing and GIS techniques is used for basin development, based on the Hypsometric analysis of basin, expresses the difficulty of denudational processes and the rate of morphological changes. Therefore it is useful to understand the erosion status of watersheds and prioritize them for responsibility soil and water protection measures.

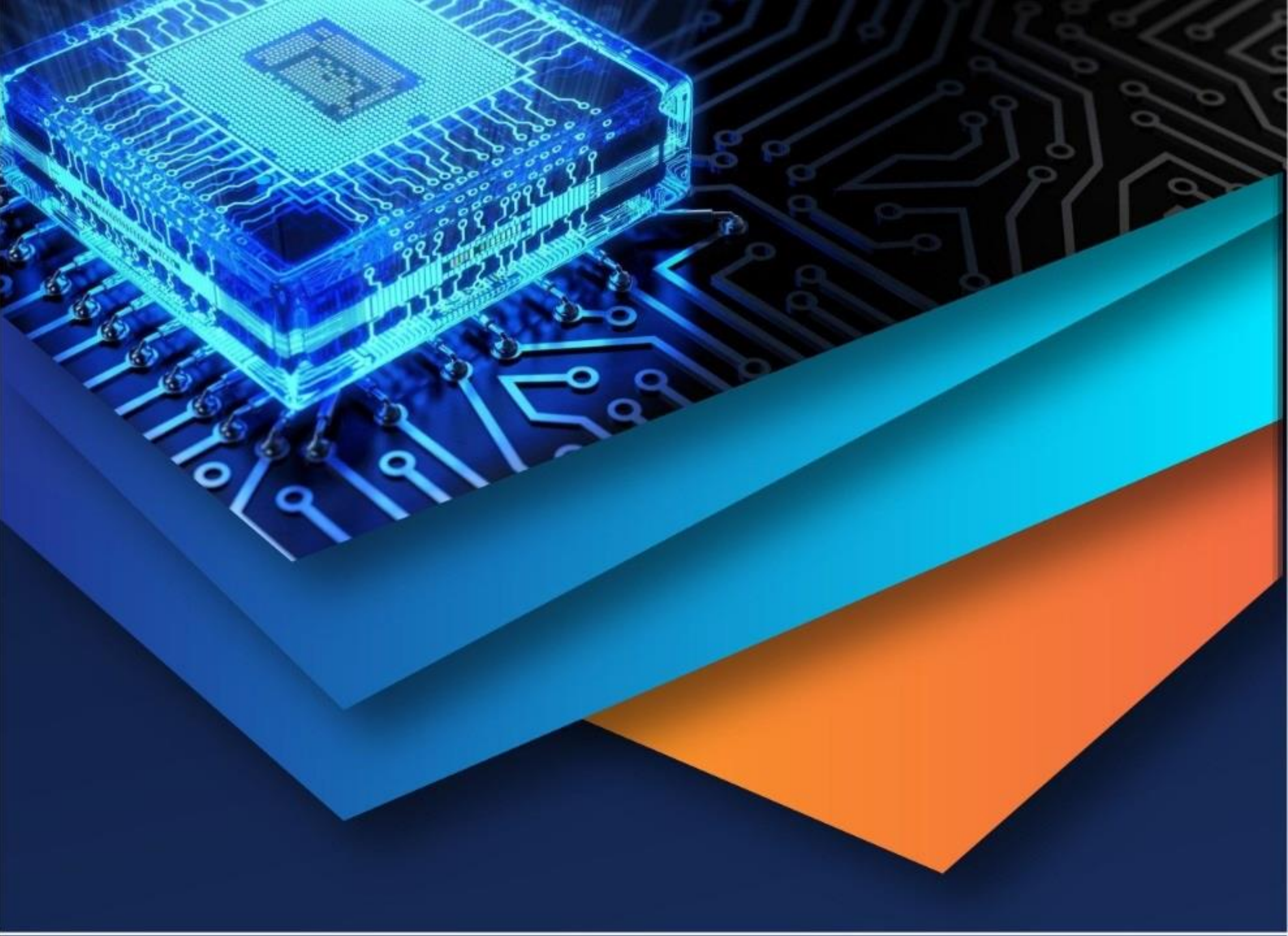
The results of Malaprabha Sub Basin hypsometric integral value is 0.50 (i.e. approaching monadnock stage) needs minimum mechanical and vegetative measures to hold sediment loss but may require more water harvesting type structures to conserve water at appropriate locations in the watershed for conjunctive use of water.

VI. ACKNOWLEDGEMENTS

The authors are thankful to Dept. of Geoinformatics, School of Environmental Science and Public Health and Sanitation Management Karnataka State Rural development and Panchayat Raj University, Gadag for extending laboratory facilities to out of this research

REFERENCES

[1] Dr. Chaitanya Pande, Kanak Moharir and Rajeshwari Pande(2014) Assessment of Morphometric and Hypsometric study for watershed development using spatial technology – A Case Study of Wardha river basin in the Maharashtra, India
[2] Horton R.E., (1945) Erosional Development of Sreams and their drainagebasins: Hydrophysical approach to quantitative morphology, Bull. Geological Society of America, Vol. 56.
[3] Omvir Singh, Arjamadutta Sarangi and Milap C Sharma(2012) Hypsometric Integral Estimation Methods and Its Relevance on Erosion Status of North-Western Lesser Himalayan Watersheds
[4] Ohmori, H. (1993). Changes in the hypsometric curve through mountain building resulting from concurrent tectonics and denudation.
[5] Pradeep.P ; Dr. M.S.Vinaya (2016) GIS based hypsometric analysis on evolution of river, Krishnagiri district, Tamilnadu.
[6] Ritter, D.F., Kochel, R.C. and Miller, J.R. (2002) Hypsometric Analysis of Wadi Mujib-Wala Watershed (Southern Jordan) Using Remote Sensing and GIS Techniques
[7] Sarangi and Bhattacharya (2000). Comparison of Artificial Neural Network and regression models for sediment loss prediction from Banha watershed in India
[8] Shailesh Kumar Sharma, Sanjay Tignath, SaritaGajbhiye, Rupesh Patil. (May 2013).“Use of geographical information system in hypsometric analysis of Kanhiya Nala watershed”. International Journal of Remote Sensing & Geoscience (IJRSG), 2, 30-35.
[9] Singh, O. (2009).”Hypsometry and Erosion Proneness: A Case Study in the Lesser Himalayan Watersheds”. Journal of Soil and Water Conservation, 8, 53-59.
[10] Sivakumar.V, Biju. C and Benidhar Deshmukh (2011) Hypsometric Analysis of Varattaru river basin of Harur Taluk, Dharmapuri District Tamilnadu using remote sensing and GIS technologies.
[11] Strahler, A.N. (1952).”Hypsometric (area-altitude) analysis of erosional topography”. Geological Society of America Bulletin, 63, 1117- 1141.
[12] Strahler A.N, (1964) Quantitative Geomorphology of Drainage Basin and Channel Networks, Handbook of Hydrology edited by VenTe Chow, McGrawl Hill, Secion 4–II.
[13] YahyaFarhan, Adel Elgaziri, IbtisamElmaji, Intisar Ali. (2016). “Hypsometric Analysis of WadiMujib-WalaWatershed(Southern Jordan) Using Remote Sensing and GIS Techniques”. International Journal of Geosciences, 7, 158-176.



10.22214/IJRASET

INDEX COPERNICUS 45.98

IMPACT FACTOR: 7.129

TOGETHER WE REACH THE GOAL

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY