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Hypsometric Analysis of Selected Subwatersheds of Ag2 Watershed in Krishna River Subcatchment

N Ashokkumar and B Maheshwara Babu
College of Agricultural Engineering, Raichur 584 101, Karnataka

ABSTRACT

Hypsometric analysis aims at developing a relationship between horizontal cross section area of the subwatershed and its elevation in a dimensionless form. In the present study hypsometric curve is obtained by plotting the relative area (a/A) along the abscissa and relative height (h/H) along the ordinate. The hypsometric integral is obtained from the hypsometric curve and is equivalent to the ratio of 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 the curve. The hypsometric integral of 11 subwatersheds i.e., Ag2k, Ag2m, Ag2n, Ag2p, Ag2q, Ag2s, Ag2t and Ag2w were found to be 0.413, 0.50, 0.532, 0.485, 0.461, 0.531, 0.55 and 0.469. The eight subwatersheds have hypsometric integral value in the range of 0.413 to 0.582 and accordingly have geological stage of development of equilibrium (mature stage). These 8 subwatersheds were susceptible to less erosion. The hypsometric integral of Ag2r, Ag2u and Ag2v were found to be 0.628, 0.918 and 0.772. The 3 subwatersheds have hypsometric integral value in the range of 0.628 to 0.918 and accordingly have geological stage of development of inequilibrium (young stage). These three subwatersheds were susceptible to severe erosion.

Key words : Geologic Stage, Hypsometric Analysis,Subwatershed.

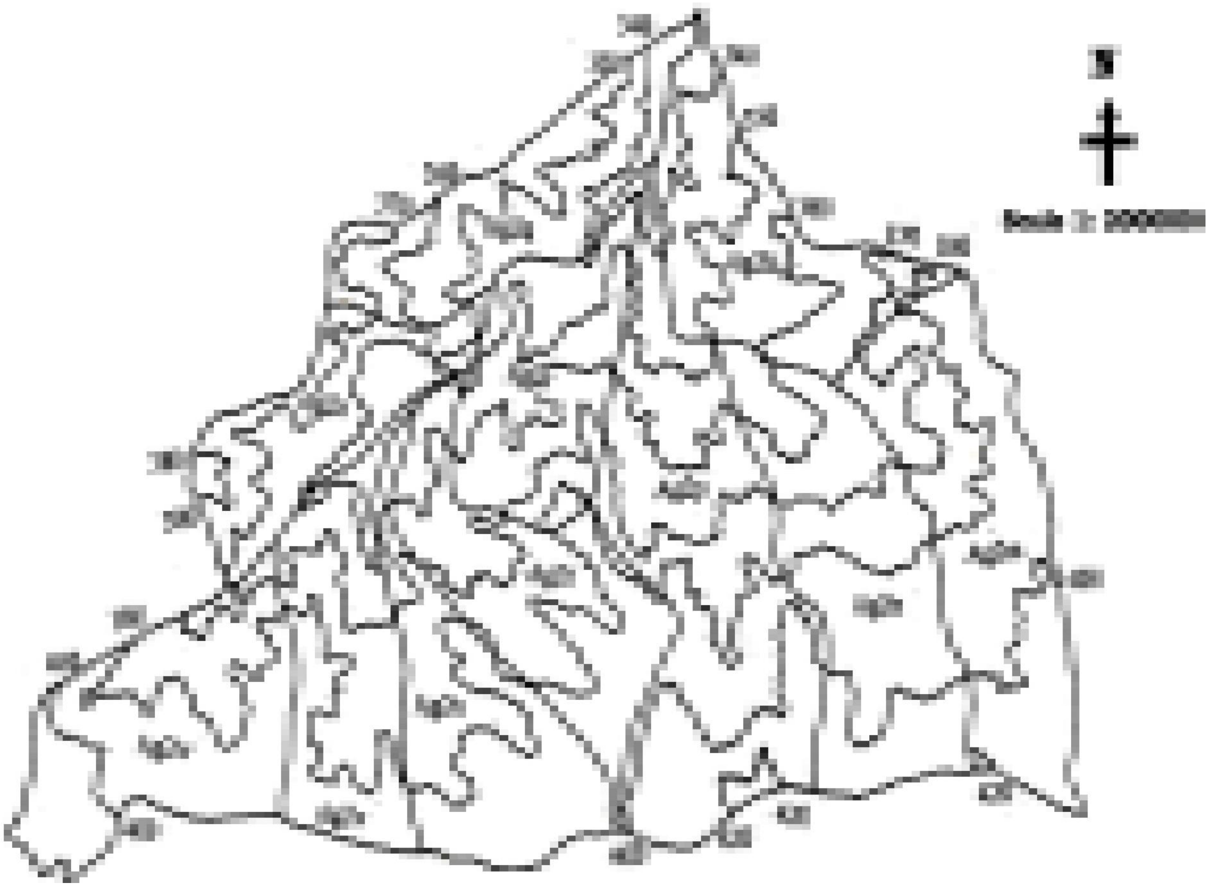
Hypsometric (Area-Altitude) analysis is the relationship between horizontal cross sectional area of drainage basin and its elevation.Harlin (1984) observed that the hypsometric curve, an expression of overall basin slope, could be combined with the basin area and / or relief to promote transferable hydrologic models, as it had given good results. Pathak (1991) stated that the hypsometric integral is a parameter that shows how mature a watershed. Hypsometric curve and the values of the hypsometric integral are important elements in determinating the topographic form and geologic structure of a watershed. Raju *et al.*, (2002) reported that the hypsometric integral values are used to evaluate geologic stage of development of the watershed. Hypsometric integral for Kotgir watershed is 0.6219, which signifies that the Kotgir watershed is in inequilibrium stage.Pradhan and Senapati (2002) studied that for all the 9 watersheds in Hirakud catchment.This is an indication that the portion of Hirakud catchment in Orissa state has reached a geological mature stage and are in an inequilibrium condition. Goel (2003) conducted a hypsometric analysis conducted for the Soan catchment lies in lower Shivaliks in district of Himachal Pradesh. The hypsometric analysis reveals that 92.3% area lies between 300-600m reduced level. The data of drainage density, drainage texture, catchment slope, limniscate ratio, basin circulatory, form factor and elongation ratio of the 32 subcatchments of Soan were used for regression analysis and the correlation coefficient of drainage texture and slope with drainage density were found to be 0.762 and 0.617, respectively.

MATERIAL AND METHODS

The present investigation was conducted for selected subwatersheds in the Ag2 watershed of the Krishna river basin in Raichur taluka of Karnataka. The Ag2 watershed is situated in the lower reach of Krishna river subcatchment. Agro-climatically, the Ag2 watershed belongs to the Northern-Eastern dry zone in Northern Karnataka, which is categorized as one having a semiarid tropical climate.Geographically, the map showing contours of selected subwatersheds in Ag2 watersheds is show in Fig 1.

Hypsometric analysis aims at developing a relationship between horizontal cross section area of the subwatershed and its elevation in a dimensionless form. Hypsometric curve is obtained by plotting the relative area (a/A) along the abscissa and relative height (h/H) along the ordinate. The relative area is obtained as a ratio of the area above a particular contour to the total area of the subwatershed above the outlet. Similarly, considering the subwatershed area to be bounded by vertical sides and a horizontal base plane passing

Fig 1. Map showing contours of selected subwatersheds in Ag2 watershed.



through the outlet, the relative height is calculated as the ratio of the height of a given contour (h) from the base plane to the maximum subwatershed elevation (H). The hypsometric integral is obtained from the hypsometric curve and is equivalent to the ratio of 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 of the curve. The slope of hypsometric curve is likely to change with the stages of the basin development. Three stages of the basin development and hypsometric curves for them, which also show the characteristic curves of erosion cycle are given as under:

1) Inequlibrium stage (hypsometric integral is greater than or equal to 0.60)

2) Equilibrium stage (hypsometric integral ranges between 0.35 and 0.60)

3) Monadnock stage (hypsometric integral drop below 0.35)

The inequilibrium stage is also referred as young stage, which reveals that, the basin under development. The equilibrium stage is the mature stage development. The monadnock phase occurs particularly, when isolated bodies of resistant rock from prominent hills are found above the subdued surface. For determination of hydrologic variables, such as precipitation, evaporation etc., with respect to the altitude is useful by the hypsometric curve.

RESULTS AND DISCUSSION

Hypsometric analysis is carried out to determine the geomorphic stage of the basins. It gives the preliminary information on the extent of erodability of the watershed. In order to prepare a comprehensive erosion control programme one should know the amount of hydraulic load of watershed being to erosion. This can be achieved by means of hypsometric analysis of drainage basin. Hypsometric (Area-Altitude) analysis is the relationship of horizontal cross sectional area of

Table 1. Estimated hypsometric integral values of 11 subwatersheds in Ag2 watershed

S.No	Sub-watershed name	Area (km^2)	Maximum elevation (m)	Minimum elevation (m)	Mean elevation (m)	Slope (%)	Hypsometric integral	Geologic stage
1	Ag2k	34.03	380	330	355	11.85	0.413	Mature stage
2	Ag2m	46.30	420	360	390	12.46	0.500	Mature stage
3	Ag2n	47.75	420	340	380	19.47	0.582	Mature stage
4	Ag2p	62.56	420	330	375	17.37	0.485	Mature stage
5	Ag2q	30.23	370	330	350	16.00	0.461	Mature stage
6	Ag2r	30.58	370	330	350	12.40	0.628	Young stage
7	Ag2s	27.51	380	340	360	15.73	0.531	Mature stage
8	Ag2t	35.85	400	340	370	25.60	0.550	Mature stage
9	Ag2u	33.83	380	350	365	44.20	0.918	Young stage
10	Ag2v	31.18	380	350	365	18.30	0.772	Young stage
11	Ag2w	41.84	400	360	380	22.50	0.469	Mature stage

drainage basin to elevation. The estimated hypsometric integral values of 11 subwatersheds in Ag2 waterhed is tabulated in Table 1.

From the Table1, the eight subwatersheds (Ag2k, Ag2m, Ag2n, Ag2p, Ag2q, Ag2s, Ag2t and Ag2w) have hypsometric integral value in the range of 0.413 to 0.582 and accordingly have geological stage of development of equilibrium (Mature stage). The eight subwatersheds were susceptible to less erosion. The three (Ag2r, Ag2u and Ag2v) subwatersheds have hypsometric integral value in the range of 0.628 to 0.918 and accordingly have geological stage of development of inequilibrium (young stage). These three subwatersheds were susceptible to severe erosion.

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