

Hypsometric Study Using DEM and GIS: A Case Study of Ekrukh Lake Watershed, Solapur (Maharashtra)

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Abstract - The present study focuses on a hypsometric curve by using GIS and Remote sensing technique for the Ekrukh Lake watershed. The hypsometric curve shows that relationship between relative area and relative elevation, which are helpful for the climatological and geological study for topographical changes. In this work, the geologic stage of watershed and erosion tendency of the watershed determined by hypsometric analysis. The result of present work reveals that, Geographical Information System (GIS) provides foremost tools for acquire all parameters and their information. This hypsometric analysis shows that the present watershed is in mature stage and has 44 % HI value. The outcome of data can be useful for conservation of soil and water in watershed systems.

Keywords — Ekrukh Lake Watershed, GIS & Remote sensing, Hypsometric

I. INTRODUCTION

The degradability of land and change of topology in the watersheds areas are carried out by weathering processes, tributary erosion patterns and sediments transportation due to surface runoff. In which we try to examine the geological stage and to study the influence of unstable various forcing factors such as geological and climatic factors on watershed topology. The hypsometric studies of various watersheds have been evaluated in detailed by the many researchers [1], [2], [3], [4]. The hypsometric analysis study is entreating due their dimensionless parameter that tolerates condition of watersheds [5]. In the hypsometric studies, hypsometric curves (HC) and hypsometric integrals (HI) are crucial parameters of watershed condition [3]. The hypsometric analysis method firstly introduced by Langbein [6] to show relationship between elevation and area. Researcher Strahler [7] explained the shapes of the hypsometric curves and divided it as youth, mature and peneplain or distorted. This hypsometric curve shows various stages of watershed, which indicates erosion status of watershed (Fig.1).

In the hypsometric studies, HI values are mostly indicates that how the watershed or landscape supports to tectonic activity. These HI values are used to know the range and level of landscape or watershed. Theses value varies from 0 to 1. The high HI values (≥ 0.55) indicate to minor eroded “young” and low values (≤ 0.35) are related to old, highly eroded landscapes, and lastly the intermediate HI values (~ 0.5) are related to dynamic equilibrium and shows balanced between erosion and tectonic processes [7], [8], [9].

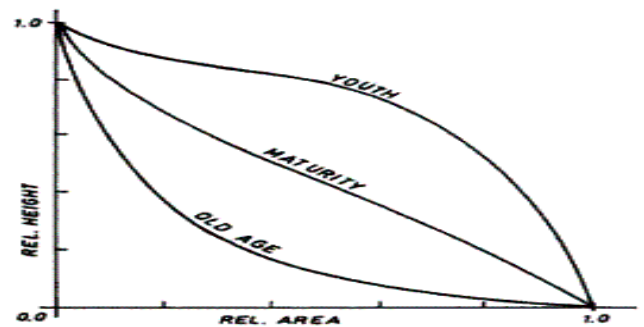


Figure 1: Hypsometric curve showing different stages of landscape evaluation

II. MATERIALS AND METHODS

2.1 Data & Software used for present study:

Data	Type Scale	Source of Data	Software
ASTER DEM (C	30 m	earthexplorer.usgs.gov	ArcGIS-10

2.2 Study Area

Ekrukh lake watershed is one of the major source of drinking water of Solapur city. It is locally called as Hipparga Lake. Ekrukh Lake Watershed is located at 17.7402569°N 75.9149802°E near the Tale Hipparge village, North Solapur, Solapur, Maharashtra. The Ekrukh lake, the largest artificial lake buildup in the Bombay Presidency. The construction work started in 1866, and

closed in December 1869. The total area of Ekrukh Lake Watershed is covered 425.50 Sq. Km (Fig. 2). Ekrukh Lake is formed by an earthen dam and it has three major canals for domestic and agriculture.

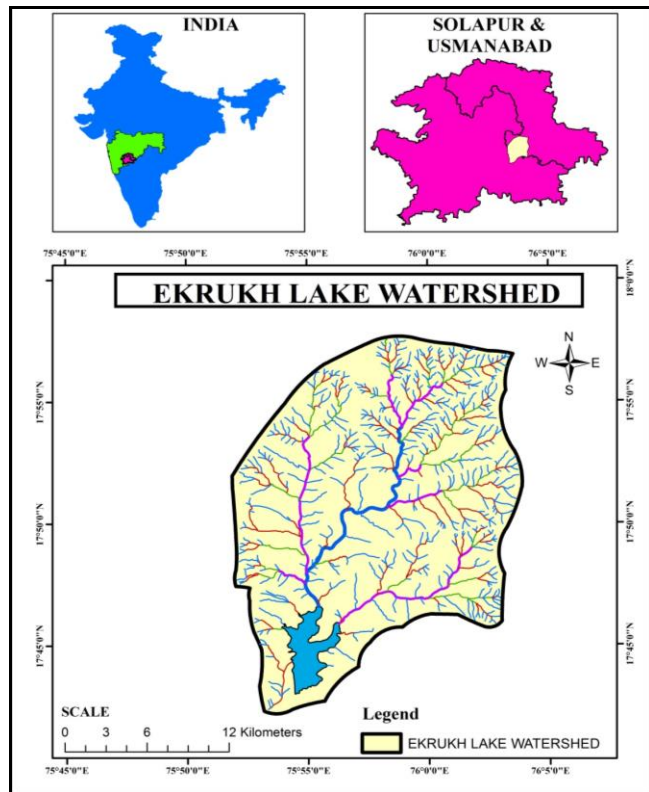


Figure 2: Location Map of Ekrukh Lake Watershed

2.3 Methodology

In the present work, researcher has used DEM data for delineation of watershed area by using ArcGIS 10. The Digital Elevation Model (DEM) processed to generate the natural drainage network system of the watershed using the hydrology tool. The derived drainage system of the Ekrukh Lake watershed is shown in Figure 4. The drainage network ordering was carried out by using the Strahler's stream ordering scheme [10]. The hypsometric curve is derived from hypsometry tool which is extension added in ArcGIS 10. The processed DEM gives the information of relative data about hypsometry curve. The attribute data consist of processed DEM were used to plot the hypsometric curve of the present study area from which the hypsometric integral was estimated (Fig.3).

Hypsometric integral was derived by using standard equation mathematically proved by Pike and Wilson [11], [12]. This integral also known as Elevation Relief Ratio (ERR). The equation of hypsometric integral is as below:

$$HI = \frac{H_{mean} - H_{min}}{H_{max} - H_{min}}$$

Figure 3: Hypsometric Integral Formulae

Where,

HI = Hypsometric Integral

Hmean = Mean Elevation value,

Hmin = Minimum Elevation Value,

Hmax = Maximum elevation value

All the hypsometric integral factors were derived by using zonal statistics tool in ArcMap10. After the obtaining all factors researcher examined the hypsometric integral.

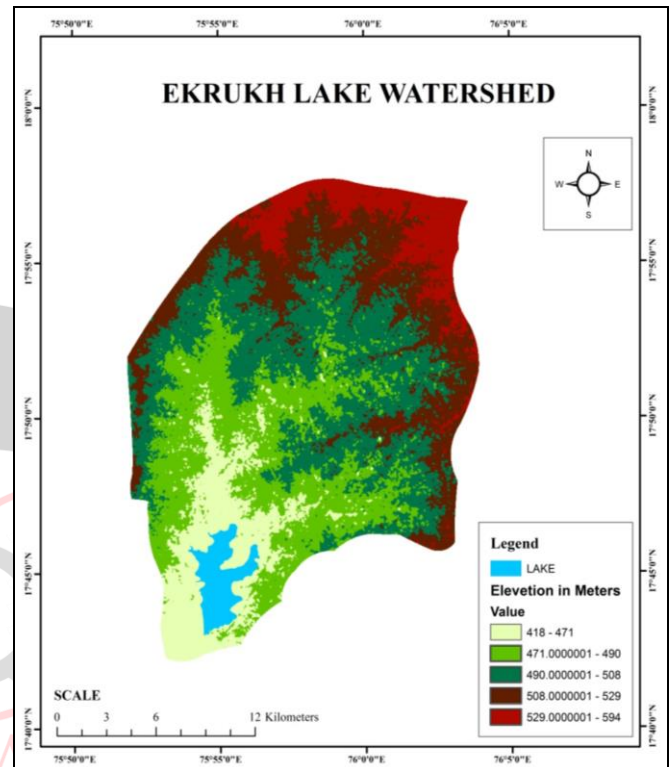


Figure 4: Digital Elevation Model of EKRUKH LAKE WATERSHED

III. RESULTS AND DISCUSSION

The result of hypsometric analysis shows that, a hypsometric curve of Ekrukh Lake Watershed of its drainage basin attends the mature stage from the youth stage. The curve of this watershed shows in "S" shaped and that denotes matured stage. This also shows that, meandering takes place in the main canal. This is due to soil erosion and down slope erosion movement of eroded material. The graph of the hypsometric curve, which is Elevation against Area of Ekrukh Lake Watershed, represented in the Figure 5.

The HI value of Ekrukh Lake Watershed is 44% that related with a dynamic equilibrium and shows the balance between erosion and tectonic activity in equilibrium status.

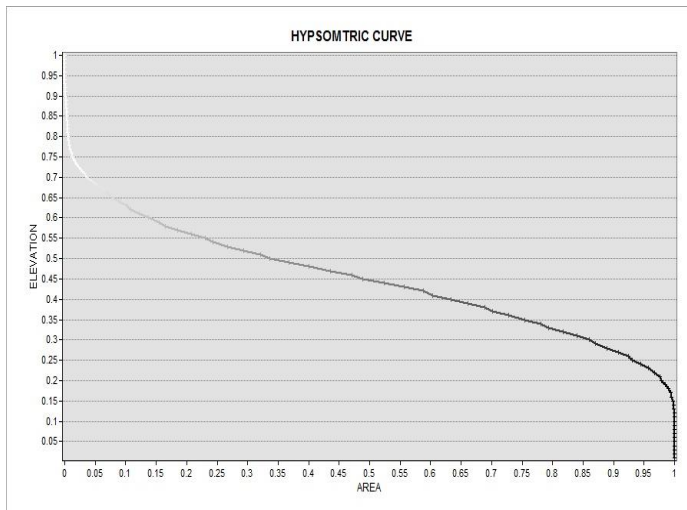


Figure 5: Hypsometric Curves of Ekrukh Lake Watershed

IV. CONCLUSION

Hypsometric analysis of the Ekrukh Lake watershed shows that, the degree of denudation processes and rate of morphological changes are useful to know the erosion status of the Ekrukh lake watershed. The present watershed is in the mature stage and observed that meandering takes place in the main canal. The result of hypsometry analysis is useful for the control of soil loss or sediment yield through increasing vegetation cover in the study area. This also endeavors for soil and water conservation.

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