Morphometic Characteristics of Sub-Watershed In Kothari Watershed Of The Katepurna River Basin, Akola (MS) Using Remote Sensing And GIS

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Abstract:
In this study, the concept of conservation and effective management of groundwater resources on the basis of aquifer system is put forth which may prove to be the best option. For this purpose, the study area Kothari village of the Katepurna River basin, Akola has been selected, in which baseline survey was conducted. To address the issues pertaining to groundwater component, the first and the foremost important step is baseline hydro geological survey of the village Kothari. So, for studying this area and future planning two tools are mostly available i.e. Remote Sensing and GIS (Geographical Information System).
GIS technique are being employed for a verity of studies like well inventory studies, watershed management, integrated management of natural resources.

Keywords: Morphometry, watershed, drainage basin system.

1. Introduction

Watershed is a geographical unit draining at a common point by a system of streams. All lands area everywhere is part of some watershed. Generally, a watershed is all the land and water area, which contributes runoff to a common point. It is a land area that captures rainfall and conveys the flow and runoff to an outlet in the main flow channel. It is topographical delineated area draining in to a single channel. Hence, every watershed is unique in its own shape, size and pattern.

Small watershed contains various kinds of natural resources like soil, water, forest and minerals. The watershed is a nature choice as a unit of natural resources [1] in a watershed is based on maintaining the fragile balance between the productivity functions and conservation practices through monitoring and identifying of critical areas in existing agriculture practices, crop rotation, and the reclamation of underutilized lands [2]. Remote Sensing and GIS [3] are used as very strong tools in prioritizing the watershed developing natural resources database, and reliable information for watershed management, beginning with prioritizing the work, to generating natural resources database and action plan maps, and finally monitoring the watershed and undertaking an impact evolution of these watersheds between pre-and post-treatment periods.
Watershed [4] is complex and delicate systems. Managing them in a way that permits sufficient recharge, maintain the ecosystem, controls flooding and benefits the local community can be a difficult task.

1.1 Objectives

1. To establish total hydro-Geomorphological parameters of Kothari, Katepurna River basin for understanding morphotectonic regime of the study area.
2. To establish preliminary flow stratigraphy of the study area using field mapping, Petrographic and hydrogeomorphic investigations.
3. To establish the hydro geological conditions of the study area and also to prepare preliminary stream order map of the study area.
4. To carry out detailed hydrogeological investigation of study area utilizing geological methods for understanding the groundwater level fluctuation potential of the region.
5. The groundwater potential zones map will be generated through Watershed modeling software and various models will be proposed which in turn will be verified with the yield data to ascertain the validity of the model developed.

6. The groundwater potentiality of the area will be assessed through integration of the relevant layers which include hydro-geomorphology. Lineament, slope, aquifer thickness and clay thickness, in Arc/Info grid environment using remote sensing and GIS techniques.

1.3 Methodology:

For this study purpose the Survey of India toposheets of scale 1: 50,000 are used for delineating the basin boundary, for the preparation of base map and extracting different thematic layers for the various types of analysis namely drainage, contour and water bodies etc.GIS and remote sensing techniques have opened wide range of avenues for effective watershed management [5]. The remote sensing [6] data combined with field survey data can provide a unique and hybrid database for optimal planning and management of watershed. Digitization technique used to digitize drainage, and water body, using ESRI's software like ArcGIS Desktop 10.3 software used for the removing the error from the digitization process such as overshoot, and undershoot.

1.4 Morphometric Analysis:

The Morphometric analysis was carried out to understand the drainage analysis, drainage density and landscape. It helps to understand the interrelationships in morphological system and in process response system. It is necessary to explain the character of the drainage basin in quantitative terms. Further various Erosional surfaces have been demarcated by utilizing flatness, consistency in the height of the ridges and sloping characters.

2. Study area

In order to study the watershed delineation and characteristics, the Kothari watershed of the Katepurna River basin, Akola has been selected. The survey of India topographic sheet at a scale of 1:50,000. With the help of the survey of India topographic sheets, all the drainage including streams order are traced and watershed of Kothari has delineated.

The study area of Kothari, Katepurna River basin is located within the Akola district of Maharashtra covered under the Survey of India toposheet no.55H/2 and bounded by latitude 20° 45' - 20° 30' and longitude 77° - 77° 15'. The Akola district falls in the Western part of Vidarbha region and it is bounded by Amravati in the East, Washim in the South and Buldana in the West. The total geographic area of Kothari is **50.749sq km**. (Fig 2.1).

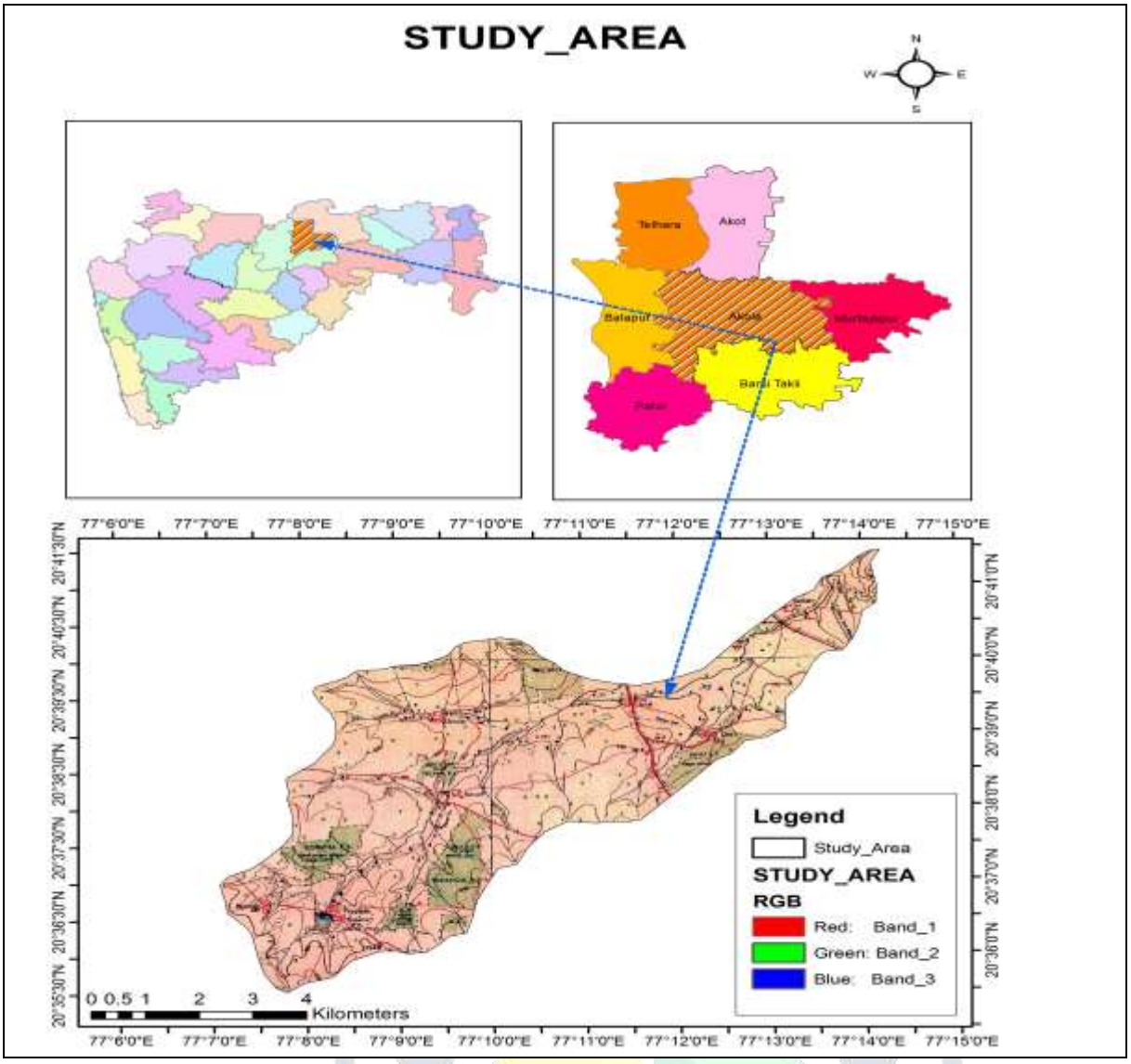


Fig. no. 2.1: Location Map of Study Area

3. Result and analysis

The result of the work has been presented in the following sections and discussion of each item of results has been done simultaneously.

3.1 Morphometric analysis of the study area of Kothari, Katepurna river basin:-

The detailed Morphometric analysis of Kothari, Katepurna river basin reveals the predominance of dendritic, trellis and parallel drainage patterns with the presence of 4th order stream. On the basis of projection of the stream channel system to the horizontal plain, various Morphometric parameters such as stream order, length of stream, area of basin and arrangement etc. were computed (Table 3.1).

3.2 Stream Order

The information of stream order number is useful in relating to the size of its contribution to the watershed. The smallest unbranched stream segment was designated as the first order steam, the one formed by the merging of two such order segments as the second order , the one formed by the merging of two such second order streams segment as the third order stream and so forth. The trunk stream through which all the discharge of water and sediment passes[7] therefore, the stream segment of the highest order. The stream order is a measure of the degree of stream branching within a watershed. Each length of stream is indicated by its order (for example, first-order, second-order, etc.).

The concept of stream order is used to computer other indicators of drainage character.

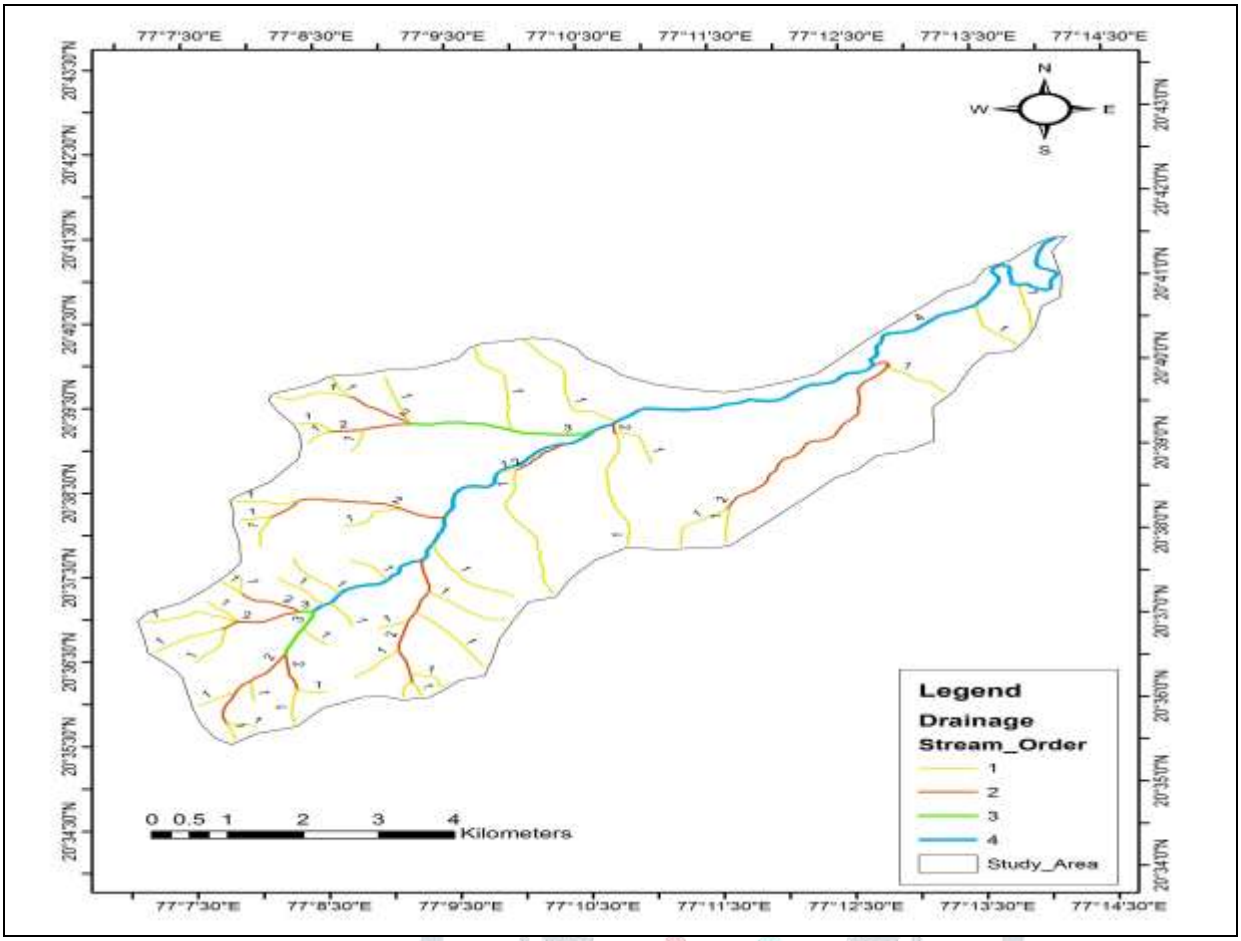


Fig. no.3.2: Stream Order Map of Study Area

3.3 Stream Number

After the drainage network element has been assigned their order numbers, the segment of each order will be counted and the number of the stream segment present in that order is found out. The number of streams decreases as the stream order increases.

In order to study the drainage characteristics in detail and to understand the structural control, drainage analysis has been carried out using digital map on 1:50,000 scale.

3.4 Bifurcation Ratio:

It is the ratio of the number of streams of given order to the number of streams of the next higher order. The results indicate the negative co-relation of stream order with the total number of streams present. The average bifurcation ratio computed for the study area is 4.18 for first order stream, 3.66 for second order stream and 3.00 for third order stream, indicating probable structural control on the lithology. Studies of many stream networks confirms the principal that in a region of uniform climate, one order to the next. The value of bifurcation ratio tends to remain constant from one order to the next. The value of bifurcation ratio between 3 and 5 characteristics of natural stream system.[8a and 8b].

Table 3.1:- Dimensions of Drainage basin exposed in the Study area:

3.5 Drainage Density:

This is one of the most important Morphometric variable invented by Horton which is the ratio of the total length of all streams in a basin to area of the drainage basin. The drainage density of the basin is 1.535 and results indicate that the drainage density is low in the plains indicating fine drainage texture, hard rock present, more run off and high infiltration rate. Whereas, it is comparatively low in the hilly terrains showing step indicating the coarse drainage texture and high infiltration rate[8c].

3.6 Drainage Frequency:

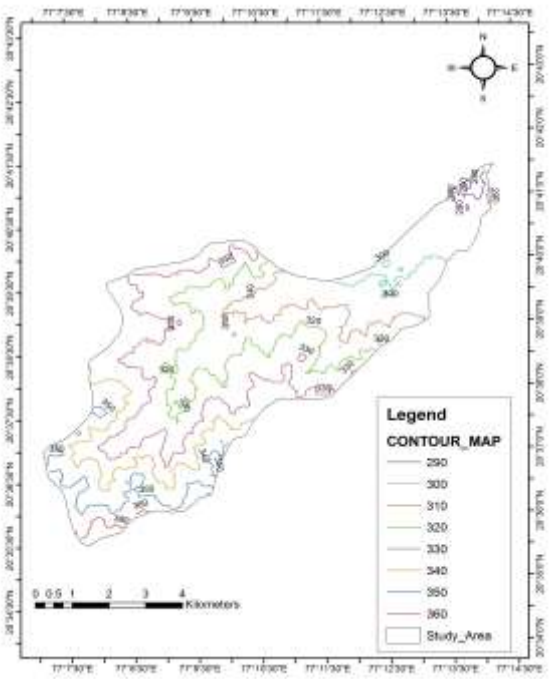
Drainage frequency is the ratio of the total number of stream of channels of all orders in the basin to the area of the whole basin. The results indicate the predominance of drainage frequency in the plateau and plain regions whereas it is low on step slopes due to the presence of pinnate drainage pattern. The drainage frequency computed in the study area is 1.201.

3.7 Contour map:

A contour map is a map illustrated with the contour lines. Area consist of eight contours with 10 m interval having values290m, 300m, 310m, 320m, 330m, 340m, 350m and 360m, in order.

3.8 Slope map:

In the figure of slope map as work a model and imulates how the terrain looks with the surface structure. The analysis reveals that the south western part of the study region is hilly and undulating as compare to north east part[8,9 and10].



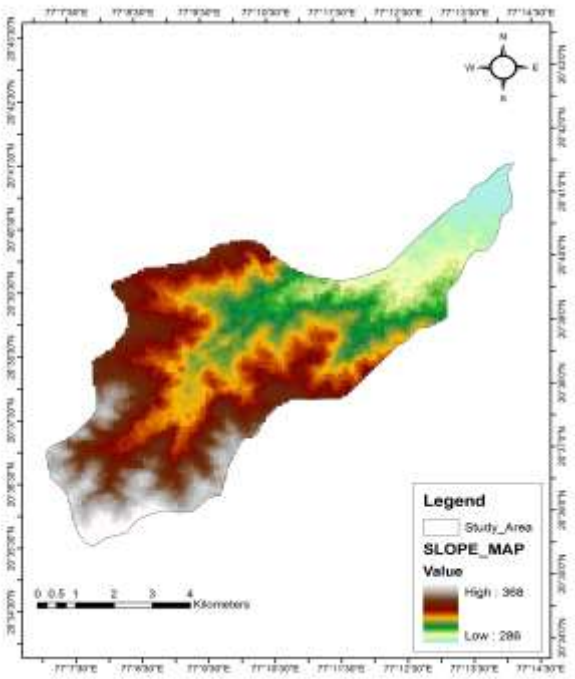


Fig. no.3.2: Contour Map of Study Area **Fig. no.3.2: Slope Map of Study Area**

4. Conclusion:

Morphometric characteristics of a river basin reflect its hydrological behavior and are useful in evaluating the hydrologic response of the basin. Quantitative morphometric analysis facilitates understanding of the drainage development, surface run-off generation, infiltration capacity of the ground and groundwater potential.

The earth's surface have been arranged into watersheds, naturally on which Hydrologists and Geomorphologist are interested in the study of spatial variability in a watershed. Morphometric parameters are of great utility in lake basin evaluation, watershed prioritization, soil and water conservation, and natural resources management at micro level. These can be better studied and explained through quantitative analysis. Morphometric studies in the field of hydrology were initiated during 1940s and 1950s. Morphometry is the measurement and mathematical analysis of configuration of the Earth's surface and the shape dimensions of its landforms. Drainage morphometric analysis gives overall view of the terrain information like hydrological, lithological, slope, relief, variations in the watershed, ground water recharge, soil characteristics, flood peak, rock resistant, permeability and runoff intensity and is useful for geological, hydrological, ground water projection, civil engineering and environmental studies.

Morphometry represents the topographical expression of land by way of area, slope, shape, length, etc. These parameters affect catchment stream flow pattern through their influence on concentration time . The study area Kothari, Katepurna River basin is located in the Akola district of Maharashtra covered under the Survey of India toposheet no.55H/2 and bounded by latitude 20° 45' - 20° 30' and longitude 77° - 77° 15'. Most of the watershed area is covered by black cotton soil and Deccan trap. In this studied, the detailed Morphometric analysis of Kothari, Katepurna river basin reveals the predominance of dendritic, trellis and parallel drainage patterns with the presence of 4th order stream Due to GIS software it is possible to find out stream line on which the structures are to be planned, slope direction, topography, hills is very important factor is useful for analysis and decision making in the watershed area. For successful implementation of this project participation of local people, government officers, and funding agencies is must. As these techniques are eco-friendly, the development due to this in future will be sustainable [11and 12].

The outcome of the present study might be helpful for providing, the GIS information to the local governing agencies and administrative bodies for the assessment, management, administration, planning, and sustainable utilization of groundwater and artificial recharge in the near future.

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