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A study of slope characteristics of lower Girna basin in Jalgaon district, (MS) using RS and GIS environment

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Abstract

The Present study deals with results of slope area variation and its characteristics. Development of landforms depend on climate and its processes on the ground surface in particular area. The present study aims to analyze the slope and its characteristics of Lower Girna basin. Girna river is main tributary of Tapi river. River Girna is flowing across the Chalisgaon plateau where land surface elevation is 630 meters, then this river turns northward to feed river Tapi in Jalgaon district having land surface elevation is 173 meters. The distance between Malegaon plateau and river Tapi is 178 km. considering the highest and lowest elevation, this river is flowing on the slope having 2.57 meters per kilometer. The watershed has ribbon shape, stretching north to south. Girna watershed has great importance in respect of agriculture. Once this area was well known with banana and sugarcane cultivation. At present due to scarcity of ground water, this area became a dry. To flourish and enhance previous greenery, to control rich agricultural soil erosion and to replenish aquifer, slope analysis is essential. Researcher has analyzed slope of lower Girna basin with the help of Remote sensing, digital data and geographical information system.

Present study reveals that the slope area is uneven distributed thorough out the lower Girna basin. It is observed that fringe of mountain, small and large hills, small pockets of plateau, plain river basin and badland formation are the physiographic characteristics found in the study area. Monotonous plain has covered highest area (57.18) in middle part of Lower Girna basin, while undulated and moderate slope has lowest area.

Keywords: Watershed, Slope, GIS, SRTM, ArcMap, IDW

Introduction

The study area is a south-western part of Jalgaon district located in the north of Maharashtra state. High variability rainfall, acute variation in temperature, variation in the depth of ground water level etc are the characteristics of the study region. Changing climate affects adversely on agro-economic condition of the farmers. Considering the back ground scenario of study region, researcher has attempted to analyze slope of Lower Girna Basin.

Slope analysis of river basin is most significant for the development and management of watershed and it leads to understand the physical setting of river basin. Slope is an area of land that makes a definite angle to horizontal landscape. In geomorphology landscape is made up of slope units. The slope may be defined as the vertical inclination between the hilltop and valley bottom, stands with the horizontal line and expressed generally in the degrees. (Strahler - 1964)

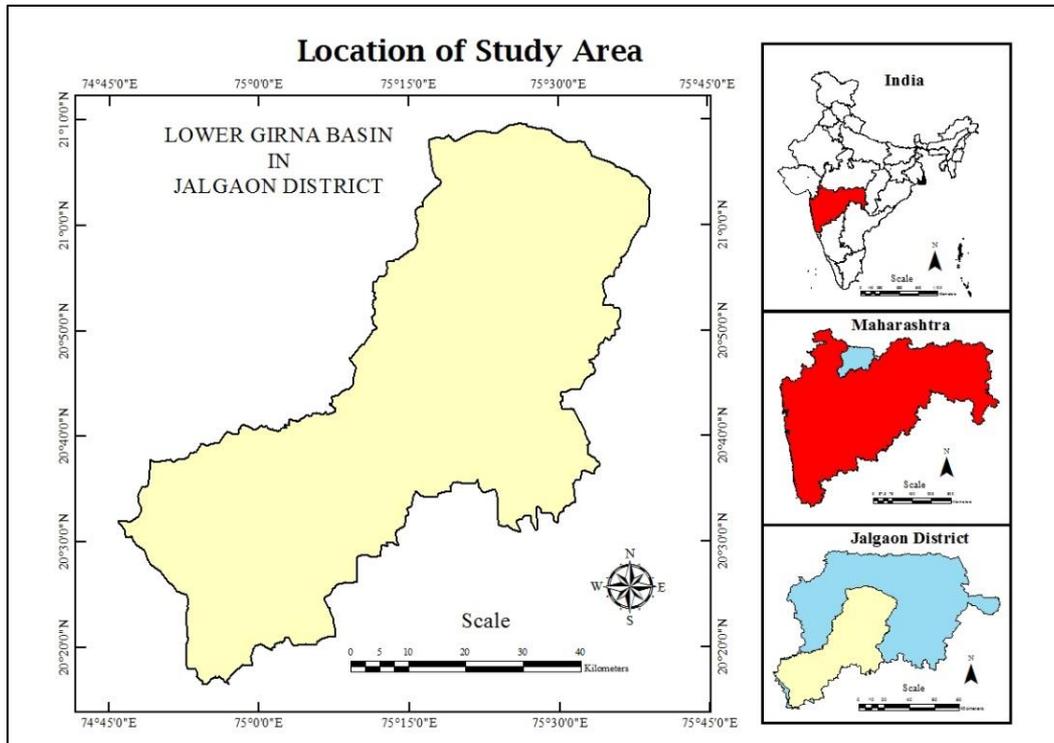
Objectives of present study

- 1) To investigate the slope of lower Girna basin
- 2) To classify different slope zones of lower Girna basin
- 3) To study the general characteristics of slope

Study Area

Girna watershed is extended between 20°16'26" N to 21°09'36" N latitudes and 74°45'37" E to 75°39'14" E longitudes (Map No.1), stretching north-east, south-west direction and covering an area of Chalisgaon, Bhadgaon, Pachora, Parola, Erandol, Dharangaon and Jalgaon tehsils of the Jalgaon tehsils.

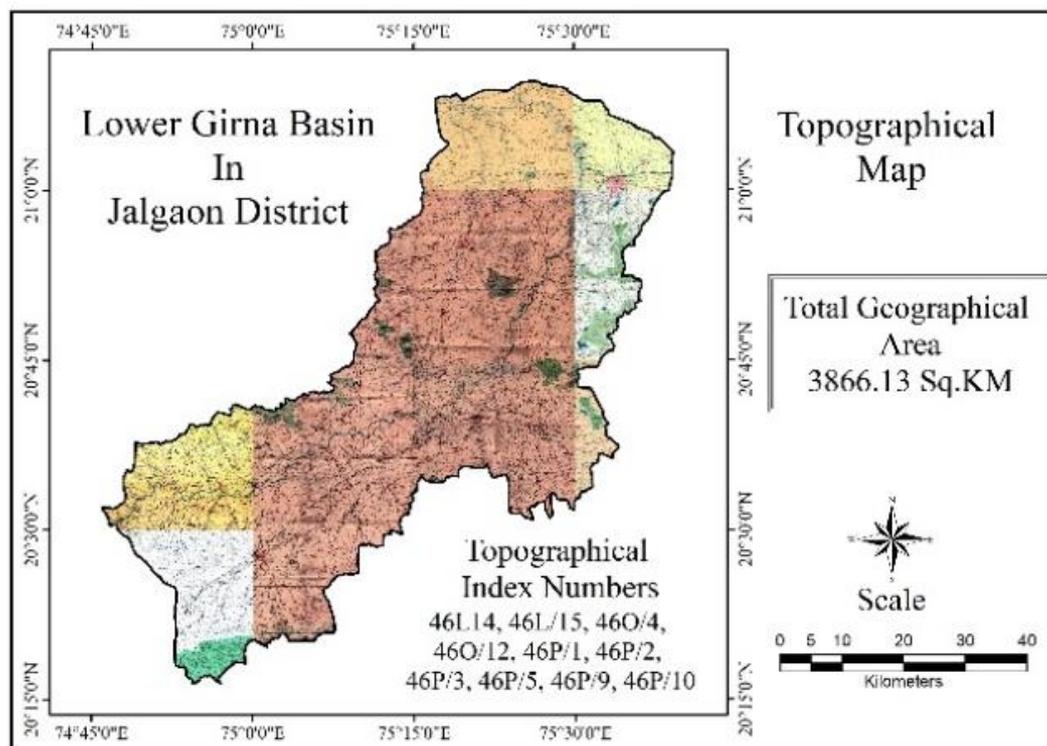
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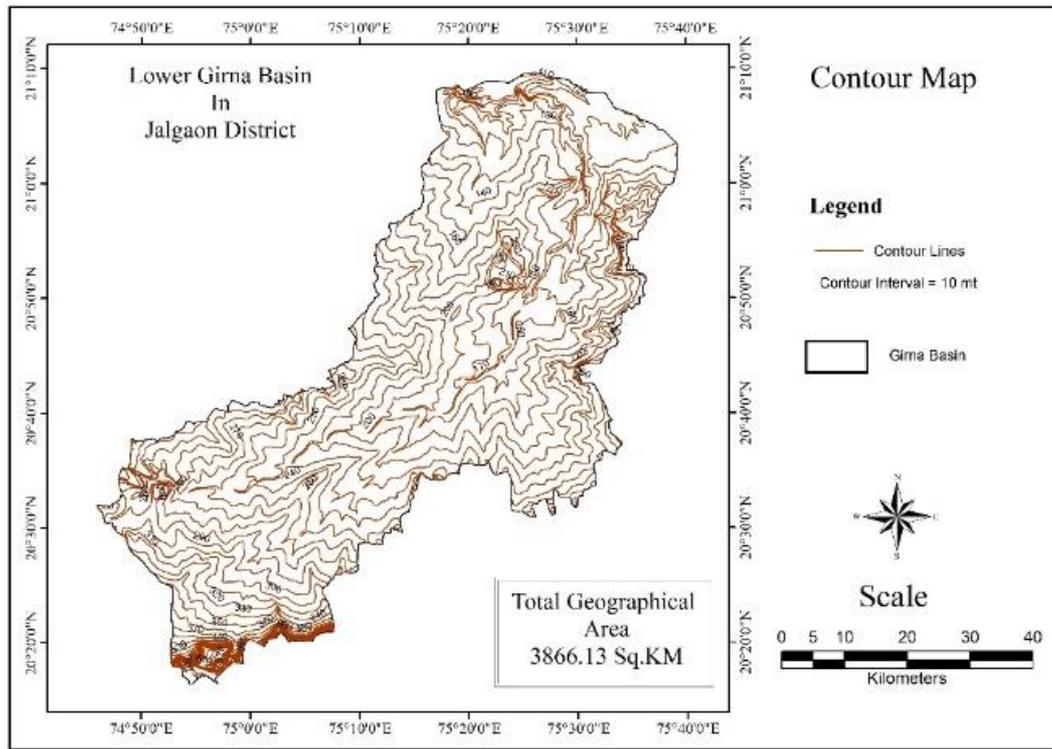
Map No. 1: Location Map of Study region

The total geographical area covered by this sub basin is about 3875.11 sq.km area of district out which about 43.51 Sq. km (1.12%) is occupied by the channel of Girna River. The total length of Girna river in study area is 178.32 km. Highest elevation of this sub basin is found towards the south-western part of the study region (630 meters from MSL), while lowest elevation is found 173 meters on the place where river Girna fed to river Tapi.

Materials and Methods: The following study is related to Slope analysis, for this purpose the area of lower Girna basin is selected. To demarcate catchment area of Girna sub basin, contour lines delineation of micro watersheds, survey of India topographical maps covering entire study region (Map No. 2) having numbers (46L14, 46L/15, 46O/4, 46O/12, 46P/1, 46P/2, 46P/3, 46P/5, 46P/9, 46P/10) are obtained from the regional office of Survey of India.



Map No. 2: Topographical map



Map No. 3: Contour map

To bring out the more clear-cut details, topographical maps at the scale of 1:50000 are used and computed. The ArcMap 10.2 is also used to get the result of slope analysis. All the SOI topographical maps are rectified and mosaic using data management tools of ArcMap software. The study area is demarcated and clipped according to water divide shown in topographical maps. The Shuttle Radar Topographic Mission Data (SRTM) is freely downloaded from Bhuvan websites and used to extract contour lines. With the help of DEM map 10 meters Contour interval lines are extracted and prepared the contour map of study region (Map No. 3). Horizontal and vertical lines are created using Fishnet technique and it is superimposed to draw the grid line on all over study area. Contour lines which crossing the grid line are counted manually and create table. Using contour lines

and fishnet grids contour data is obtained. This obtained data is compiled with help of excel sheet and Wentworth’s method is used to calculate tan value. Tan value is used to create map with the help ArcGIS software. Inverse distance weighted (IDW) tool is used to create slope category thematic map of Lower Girna basin.

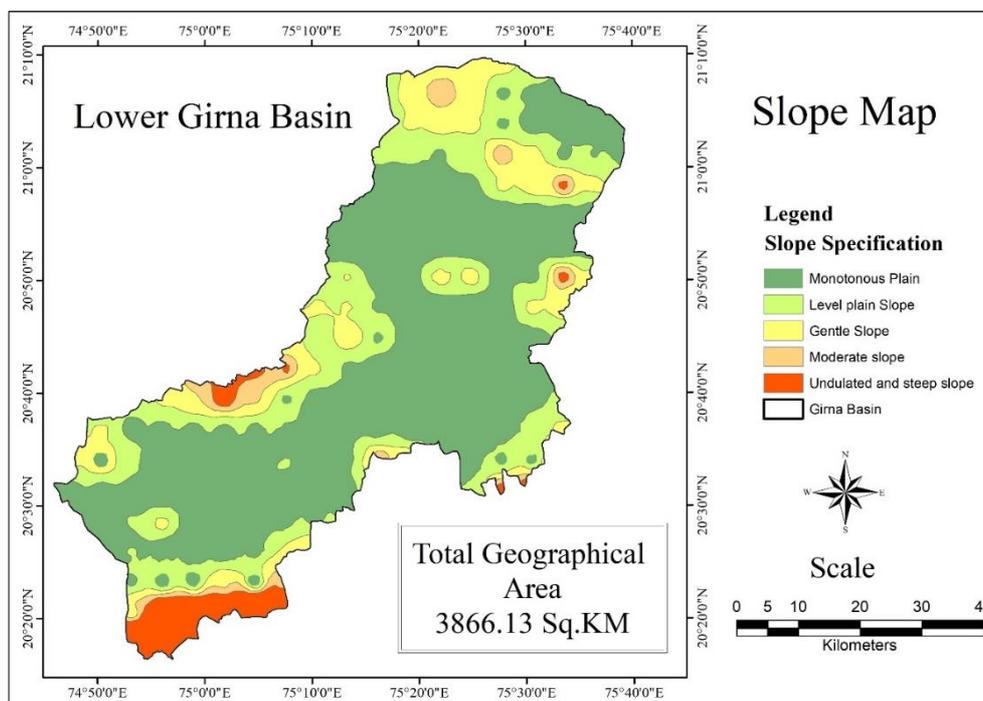
On this map 5 sq.km grids are superimposed and counted crossing of contours in each and every grid as per given in Wentworth’s average slope analysis method cited as below.

$$\tan \theta = \frac{\text{contour crossing number (cn)} \times \text{contour interval (ci)}}{636.6 (WK)}$$

Considering the figures of slope, researcher has grouped all these figures in five categories given as below.

Table 1: Slope and area of lower Girna Basin in Jalgaon district

Sr.	Slope in Degree	Specification	Area of Slope (sq.km)	Area in %
1	Less than 5	Monotonous Plain	2210.82	57.18
2	5- 10	Level plain Slope	860.78	22.26
3	10 - 15	Gentle Slope	516.32	13.36
4	15 - 20	Moderate slope	118.16	3.06
5	More than 20	Undulated and steep slope	160.05	4.14



Map No. 4: Slope Map of Lower Girna Basin

Slope Area

The study area is conveniently divided into five categories considering the degree of slope. Each category has 5 degrees of slope. The study region is characterized by monotonous plain to undulated steep slope as shown in Table No. 1 with the help of ArcMap. Area of each slope category is in square kilometers and their proportion is obtained with the help of attribute table from ArcMap.

Map No. 3 is prepared and showing slope condition of each category.

1. **Monotonous Plain:** This slope category has less than 5 degrees, covering 2210.82 sq km area of study region. It is to note that more than 57 % area falls under this category. Map No. 3. Is showing monotonous plain area. This area is suitable for agriculture, especially for irrigated crops. Monotonous plain area is found along both sides of river Girna.
2. **Level Plain Slope:** This is also a plain area has covered more than 860 sq km area of the study region contributing 22.26%. Spatial distribution of this slope area is found in the north and central west part of study region, adjacent to monotonous plain area.
3. **Gentle slope:** Gentle slope area has 10 to 15 degrees slope covering 516.32 sq km contributing 13.56%. Slope (Map No. 3) is showing small pockets of this slope category area found in the north, center west area of the study region.
4. **Moderate:** Moderate slope is found along the steep slope near Chalisingaon and Parola tehsils. Moderate slope covering 3.06 % area in the Lower Girna basin.
5. **Undulated Steep slope:** Undulated steep slope area has covered insignificant area (4.14%) found in the north central west and southern part of study region.

Concluding remarks

Slope is very important factor in the physiographical setting of the study area. Wentworth's method is used to get results of slope in the present study. Monotonous plain area is found along both side of river Girna this area is very rich in

fertile soil. If irrigation facilities are to be provided, it will help to increase in agricultural production. Monotonous area has acquired 57.18 percent area belongs to well agriculture. Monotonous plain area has covered 2210.82 sq. km of Lower Girna basin. It is clearly shown that the agricultural activities are dominantly reflected in respect of cotton and banana crops. Level plain area is also favorable for the agriculture and related activities. It has covered 860 sq km area (22.26%). There are small patches of gentle slope spread all over the study area. Moderate and steep slope is found near the Ajanta hilly ranges in Chalisingaon tehsils and small undulated hills are also found near the south of Jalgaon city. This study reveals geomorphological features of the study area. Slope plays vital role in the field of settlement, agriculture, and spatial distribution road and rail network. So, slope can be assessed for the regional development. Lower Girna basin is well fertile and helps agricultural production due to most of leveled area.

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