

GIS AND RS BASED PHYSIOGRAPHIC ANALYSIS OF SOUTH AHMEDNAGAR DISTRICT

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ABSTRACT

Geographical Information System (GIS) and Remote Sensing (RS) Techniques provides reliable and accurate information of the regions. These techniques are found relevant and rationalize information of the morphology, relief, elevation, slop, drainage patterns etc. features of the region. South Ahmednagar District is situated on decan trap and it is drought prone district. This district has immense variety in physical aspects. Especially south part of district has undulating topography and this types of topography directly and indirectly affects physical and cultural environment of the study area. The aim of present paper is to acknowledge the physiographic of South Ahmednagar District through GIS and RS techniques.

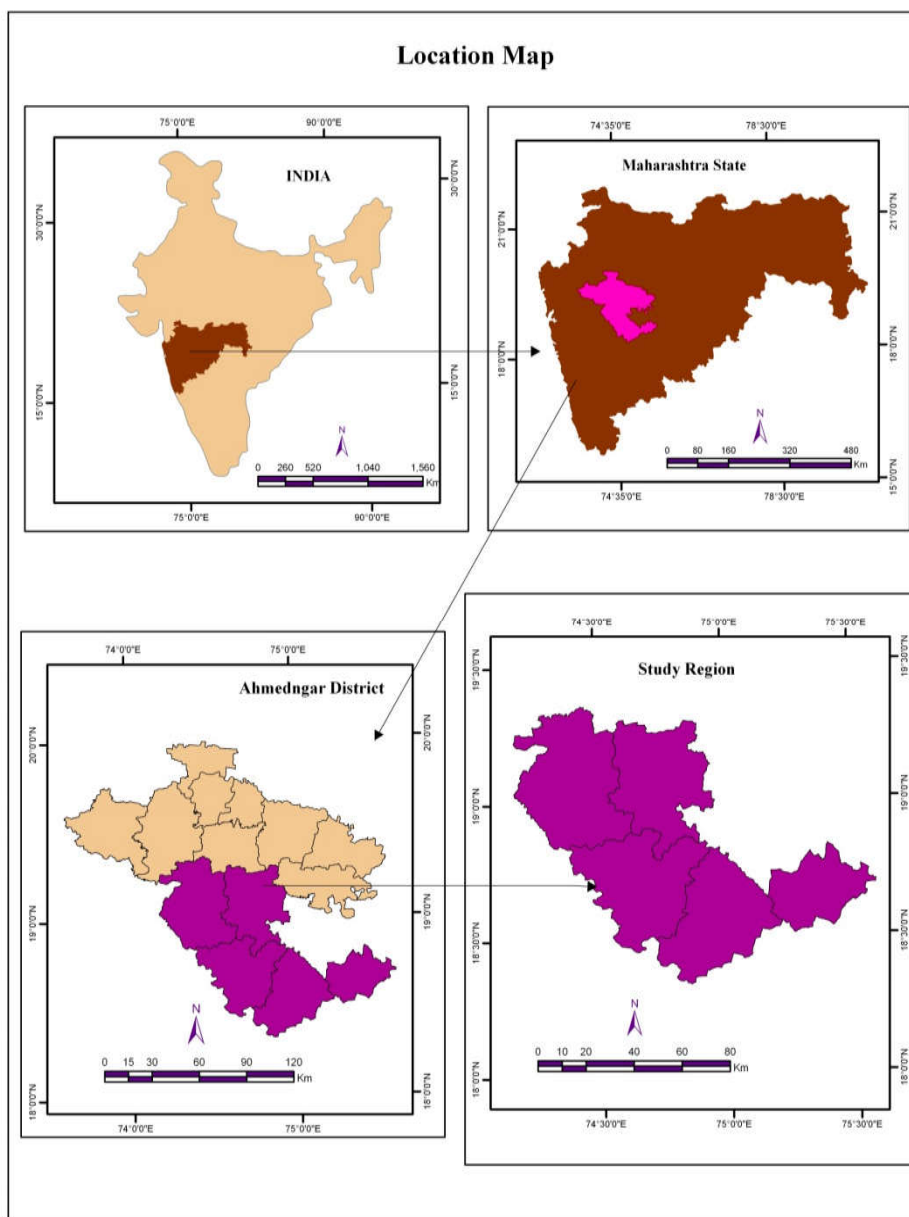
Key Words: Drought, GIS, Morphology, RS, Topography

INTRODUCTION

Physiographic of any region plays important role for the development of a region. Physical aspects are the mirror of socio-economic development of the region. All these abiotic aspect like as morphology, relief, slope, drainage, soil etc. together are the geo-wealth of region (Kale V.S. 2015).Variation of these aspects are directly affects socio-economic condition of the region. The socio-economic condition and its interaction within itself play an important role. That is why it becomes necessary to study how these factors exert their influence. Physical factors do play a vital role in the economic development of the region. The natural resources like relief, drainage, soil, water, forest and climate contribute to the economic development of the region. (Lagad S.J 2020, Kudnar N.S. 2015).GIS and RS are the simplest geographical tools to understand physical structures of the region for resource managements (Bhagat R.S, 2020, Fernandes-da-Silva et.al 2010).This technology can be useful to generating information through toposheets, images and various data sources of the related physical and cultural fartures (Sukirtee S. et.al 2018,) . To understand the rivers patterns and

utility of river basin for soil and water management GIS and RS techniques is powerful tool (Lagad S.J. 2019, Pande, C.B. and Moharir, K. 2017). Physiographic factors has its impact on demographic characteristics (Lagad S.J. 2019, 2018,)

Study Area



Map No. 1.1 Location Map of Study Area

Ahmednagar District is situated partly in Godavari Basin and partly in Bhima Basin occupying central part of Maharashtra state. Ahmednagar is the largest district of Maharashtra State with geographical area of 17,418 sq.kms. It covers 5.66 % area of

Maharashtra state with 14 tahesil and 1591 villages. As per 2011 census the total population of the district is 45,43,159 persons, consisting 4.2% of the state. Ahmednagar district has occupied somewhat central position in the state of Maharashtra. 'It is surrounded by Nasik district to the north, Aurangabad district to the north-east, Bid district to the east, Osmanabad and Solapur district to the South, Pune district to the west and Thane district to the north-west.

For the present study south part of Ahmednagar district is selected. The part of south Ahmednagar district lies between $18^{\circ} 8' 20''$ to $19^{\circ} 21' 20''$ North latitude and $74^{\circ} 8' 20''$ to $75^{\circ} 35' 10''$ East longitude. South boundary of the study area is formed by Bhima river, west is delineated by Ghod river and east boundary conformed by Sina river. The study area is situated on decan trap of India. As per 2011 census population of study area is 16,68,358 persons.

DATA COLLECTION AND METHODOLOGY

Present research is depends on secondary source of data. The secondary data information is collected from record of Grampanchyat, Panchayat Samitti . Some data is collected from several published research papers and Ph.D. Theses. For collection of data, topic related books and journals are referred. For the data related to various physical, socio-economic and demographic characteristics District Census Handbooks is referred (1981-2011). Toposheets are also used as a secondary data for study purpose. In addition the researcher discussed with state government departments like Soil Conservation offices, District Groundwater Department and officials.

Methodology and techniques

The present investigation aims at understanding of physiographic analysis of the South Ahmednagar District. For this purpose different aspects like physical setup are taken into consideration. Geographical Information System (GIS) and Remote Sensing (RS) techniques are also used for understanding ground truth.

For the generation of base map in GIS, toposheets, tahesil cadastral maps and satellite images are used.

The South Ahmednagar districts is covered in the Survey of India toposheets numbers **47J/** 1,5,6,9,10,11,13,14,15, **47 I/** 3,4,7,8,11,12,15,16, **47 N /** 1,2,3,5,6,10 and **47 M/** 8 of 1:50,000 scale.

Cadastral tahesils map of census 1991 of the Nagar, Parner, Shrigonda, Karjat and Jamkhed are used as base maps.

All mentioned toposheets and satellite images namely IRS 1C/1B (NRSC, Hyderabad) are mosaic and details such as contour of 20 Mt. interval, drainage, tahesils and village boundaries are digitized in ArcGIS 9.3_x software. Various maps are prepared including contour, drainage, stream ordering, slop and aspect. Shuttle Radar Topographic Mission (SRTM) DEM data of 30 Mt. spatial resolutions are used to create digital elevation models of the south Ahmednagar district and proposed village watershed of the study area in ArcGIS 9.3_x, ERADAS IMAGINE 9.2 software.

OBJECTIVES

1. To analysis physical features of the study region with the help of modern techniques.
2. To understand physical characteristics of the study region.

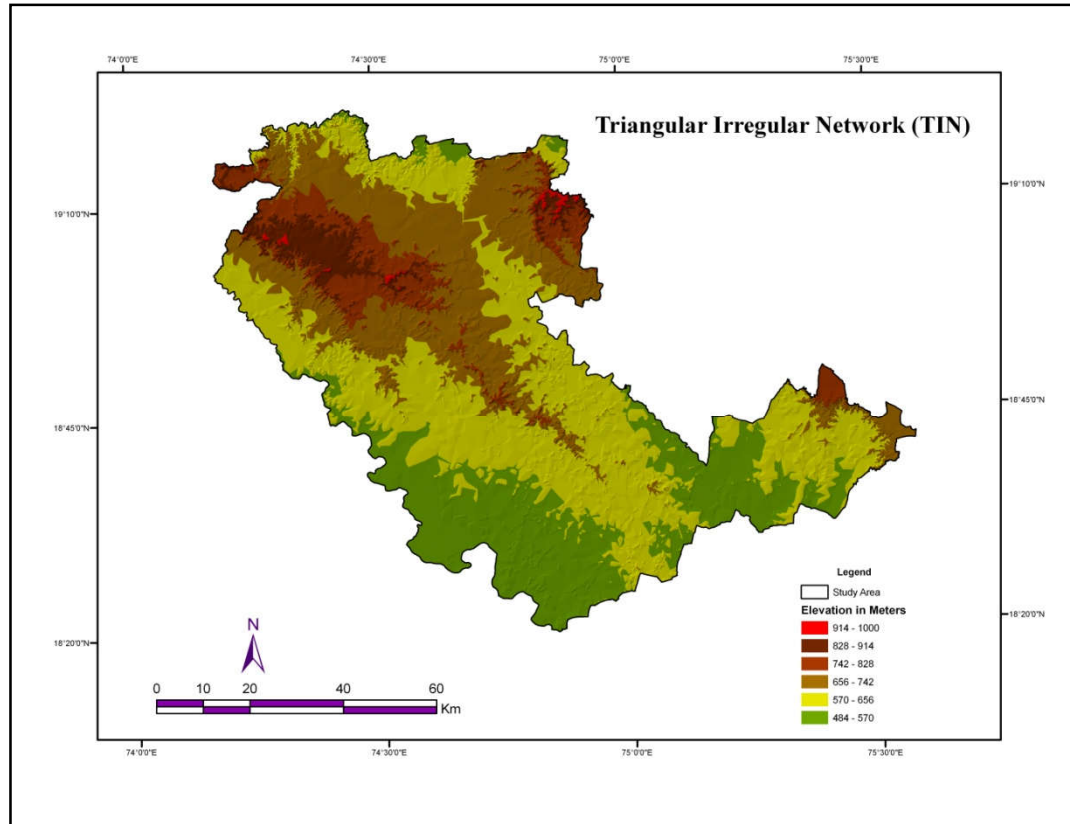
RESULT AND DISCUSSION

1.1 Relief

The relief of the south Ahmednagar District has an immense variety, not to be witnessed to the same extent in many other districts of the State. This is on account of its size. As South Ahmednagar region comes under the part of Harishchandragad which runs north-west to south-west direction. West range of the Harishchandragad runs through Parner and Karjat tahesils and some hill ranges are on the east border of the study region, such as Nagar and Jamkhed tahesil. Topography of study region is discussed with following different maps.

Download and Fill Error from Raw ASTER Data

All relief maps of present study have extracted from the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) data which is downloaded through U.S. Geological Survey (USGS) website. This downloaded raw data has some sinks and peaks error, which are removed with the help Arc Hydro Extension Tool



Map No. 1.2 Triangular Irregular Network (TIN) map of South Ahmednagar district.

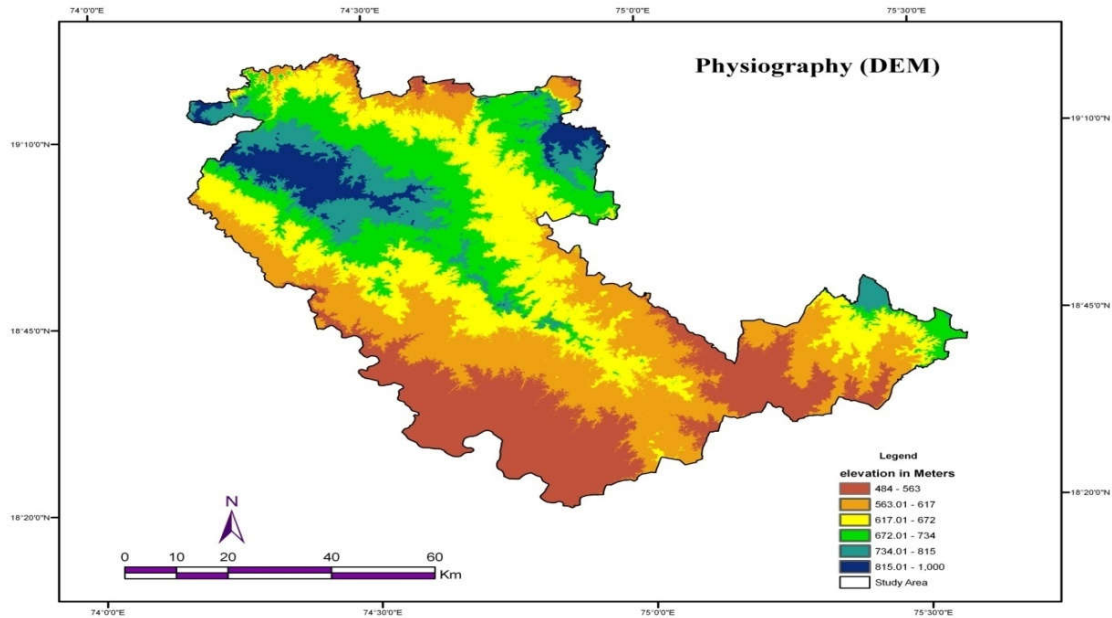
The Triangulated Irregular Network (TIN) was first invented by Phil Mellor whilst studying Sociology at University of Edinburgh in 1947. The first triangulated irregular network program for GIS was written by W. Randolph Franklin, under the direction of David Douglas and Thomas Peucker (Poiker), at Simon Fraser University in 1973. The TIN is a digital data structure used in a Geographic Information System (GIS) for the representation of surface. The TIN is a vector-based representation of the physical land surface or sea bottom, made up of irregularly distributed nodes and lines with three-dimensional coordinates (x , y , and z) that are arranged in a network of non overlapping triangles. TINs are useful for preparation of elevation data Digital Elevation Model (DEM). The advantage of using a TIN over a raster DEM in mapping and analysis is that the points of a TIN are distributed variably based on an algorithm that determines which points are most necessary to an accurate representation of the terrain. Therefore data input is, flexible and fewer points need to be stored in a raster DEM, with regularly distributed points. A TIN may be less suited than a raster DEM for certain kinds of GIS applications, such as analysis of a

surface slope and aspect. A TIN comprises a triangular network of vertices, known as mass points, with associated coordinates in three dimensions connected by edges to form a triangular tessellation. Three-dimensional visualizations are readily created by rendering of the triangular facets. In regions where there is little variation in surface height, the points may be widely spaced whereas in areas of more intense variation in height the point density is increased.

A TIN is typically based on a Delaunay triangulation, but its utility is limited by the selection of input data points: well-chosen points will be located so as to capture significant changes in surface form, such as topographical summits, breaks of slope, ridges, valley floors, pits, and cols.

Although usually associated with three-dimensional data (x , y , and z) and topography, TINs are also useful for the description and analysis of general horizontal (x and y) distributions and relationships.

For the present study TIN map is made as a base map of Digital Elevation Model which shows hills in Parner tahesil. Peaks of the hills are shown by red colours which are seen at Vadgaon Darya and near Jamgaon in Parner tahesil with the height about 1000 mt. Another one peak is seen in east border of Nagar tahesil near Agadgaon village. Lowest region is shows by bottle green and yellow colour which is seen south-west and south-east region of study area. Area of low height covers about 60 percentage areas from the study region.



Map No1.3 Triangular Irregular Network (TIN) map of South Ahmednagar district.

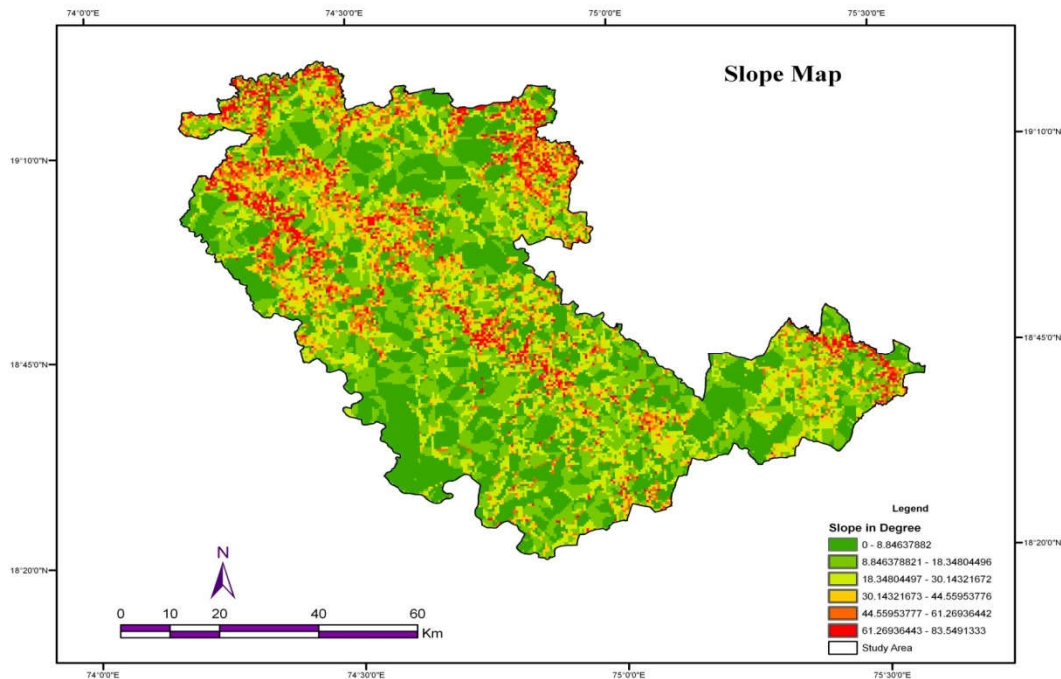
Digital Elevation Model (DEM) is a digital model or 3D representation of a terrain surface commonly for a planet (including Earth), moon, or asteroid created from terrain elevation data. Any digital representation of the continuous variation in relief over space is known as a DEM.

In other words a DEM is a topographical map in digital format, consisting, of not only a DEM, but also the types of land use, settlement drainage etc. DEM represents a regular array (imposing or well- ordered series) of uniformly spaced elevation data. Alternative source for DEM come from satellite images, Radar data and Light Detection and Ranging (LIDAR) data. The quality of a DEM can influence the accuracy of terrain measures including slope and aspect. DEM user can not add new sample points, as the grid is fixed with a given cell size. All cells have to be resample with heavy cost in terms of time and size requirement.

Extraction of DEM from ASTER data

DEM is extracted from the ASTER data downloaded from the USGS website. DEM was generated from ASTER data and is given in fig 1.3. This data was extracted from area shape file of study region. For that spatial analysis tool option was used and extracted DEM by mask.

In this Digital Elevation Model blue colour shows highest elevation and brown colour shows the low elevation. Mostly moderate elevated area is seen in this map which covers 50 percentage areas. Highly elevated area has seen north-west Parner, west and north east Nagar tahesil. Low elevated region is south Shrigonda, Karjat and Jamkhed tahesils.

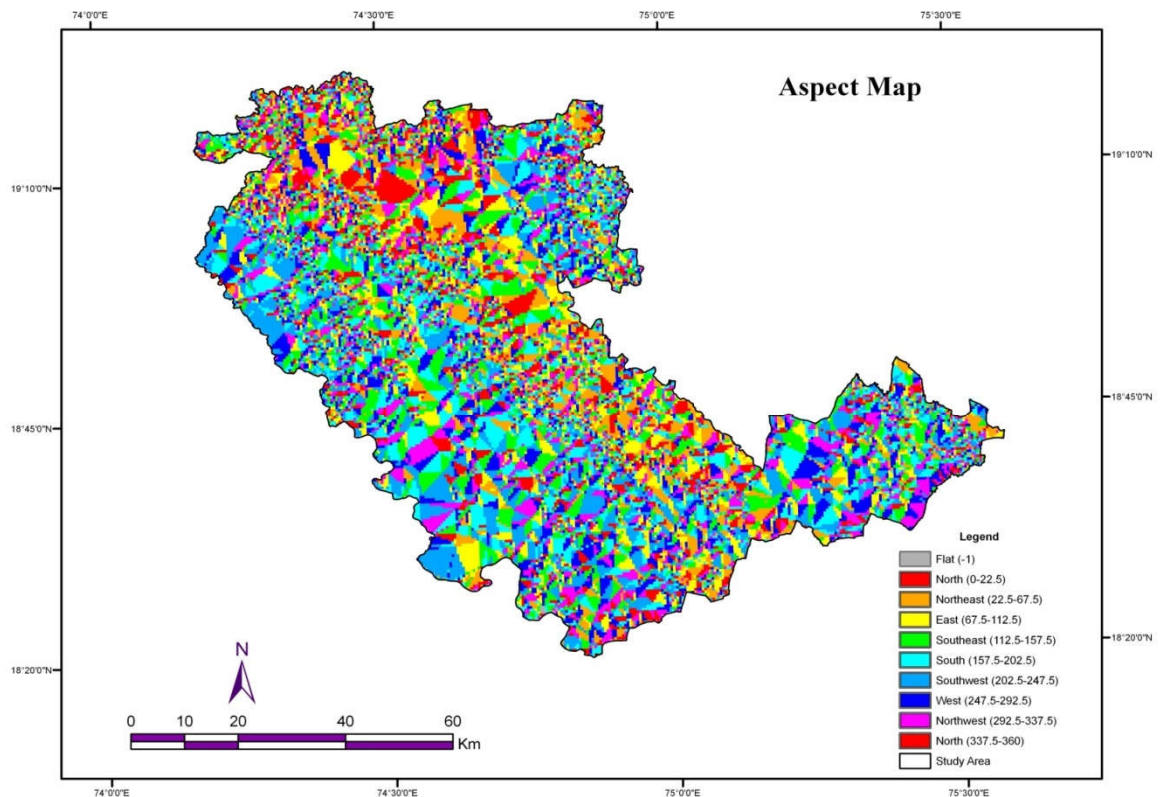


Map No. 1.4 Slop map of South Ahmednagar district.

A map indicating the topography of an area along with an analysis of topographic Features have influenced and may continue to influence land development. Slope and Aspect play a regular role in hydrologic modeling, snow cover evaluation, soil mapping, landslide delineation, soil erosion and predicative mapping of vegetation communities. Slope is defined by a plane tangent to a topographic surface, as modelled by the DEM at a point. Slope is classified as a vector; as such it has a quantity (gradient) and a direction (aspect). Slope gradient is defined as the maximum rate of change in altitude ($\tan \theta$), aspect (γ) as the compass direction of this maximum rate of change. More analytically, slope gradient at a point is the first derivative of elevation (Z) with respect of the slope (S), where S is in the aspect direction (γ). At the same time

the first derivative of a function (i.e. S stands for slope) at a point can be defined as the slope (angular coefficient or trigonometric tangent) of the tangent to the function on that particular point.

Red colour shows high degree of slope in this region. Highest slope has shown in Kamergoan to Akolner middle and Agadgaon, Kapurwadi, Shendi and Jeur village north east and Ghospuri, Gundegoan in south region of Nagar tahesil. Koregan, Kolgoan, Limjewadi Pisora and Takali Lonar villages of North- East Shigonda. Bewadi, Kaudana, Kombhali, Walwad and Supa villages from Karjat tahesil. Takali Dhokeshwar, Pimpalgaon Rota, Dongar darya, Babhulwadi Doran villages from Parner tahesil. This whole region shows 44 to 80 degree slope; these all are series of Balaghat. Yellow to green colour shows low degree of slope about 0 to 40 degrees.



Map No.1.5 Aspect map of South Ahmednagar district.

The present Aspect map shows the direction and of the slope of each place. Flat area of this study region is shown by gray colour. Red colour shows the north direction having

the angle of 22° . Yellow colour shows the direction of slope from 22° to 112° . The bottle green shows the south east direction of slope. Sky blue shows south to south west direction of slope with degree of 157° to 247° . Remaining pink and red colours show the north to north west direction of slope up to 360° angle. Generally the direction of the slope seen in this map has north east and south west side of the hill range which runs north west to south west side. It means its start from Parner ends at north -west of Karjat tahesil.

1.2 Drainage Pattern

Rivers are the important natural resource of the region. This plays crucial role to improve socio-economic and culture life of rural people. The drainage of Ahmednagar district belongs to two major river systems of Maharashtra, the Godavari in the north and the Bhima in the south. Apart from these two main rivers which flow on the northern and southern boundaries of the district, a number of tributaries rising within the district drain to south-eastwards.

The drainage map (1.6) shows that the study area is bounded by various rivers. The South boundary of study area is formed by Bhima river, west is delineated by Ghod river and east boundary is confirmed by Sina river.

Bhima River:

Bhima covers the major part of the south Ahmednagar district comprising the greater part of Nagar and Parner tahesils, the whole of Shrigonda, Karjat and Jamkhed tahesils. It enters into the district near the village Sangvi Dumala in the Shrigonda tahesil and for some 60 Kms. forms continuous part of the boundary between Ahmednagar and Pune districts. The river receives, on its left bank, waters of the Ghod river and further east it is joined by the Saraswati, Lohkera and the Nani river. The course of the Bhima in the district is continuously to the south-east. The banks of the river are generally low. The river-bed is sandy, crossed here and there by rocky barriers. There are many deep pools but during summer the stream dwindles down to an insignificant stream. The chief tributaries of the Bhima in the district are the Sina and Ghod rivers.

Mula River

The Mula rises on the eastern slopes of the Sahyadri between Ratangad and Harishchandragad. For the first 25 Kms, it flows parallel to the Pravara draining the southernmost Kotul valley of Akola taluka. The river is incised in a deep valley almost from its source and its steep valley-sides are highly dissected by deep gullies formed by mountain torrents which rush into the main stream. Skirting the large market village of Kotul it takes a bend to the south, winding past the rocky precipitous slopes at the foot of Baleshwar hills. It then flows through the south-west parts of Sangamner tahesil and follows an easterly course between Parner, Rahuri and Nevasa tahesils flowing in a deep bed between rugged hills on the north and the tableland of Vasunda on the south. It then takes a sudden turn to the north-east and enters the plains in the same direction for another 30 km. It joins the Pravara at the village of Sangam. The total length of the river from its source to its confluence with the Pravara is 145 Kms. except in lower parts of its course on account of an entrenched Corse; the Mula is used for agriculture only in alluvial flats on the foot of the rugged ledges jutting into the river-bed.

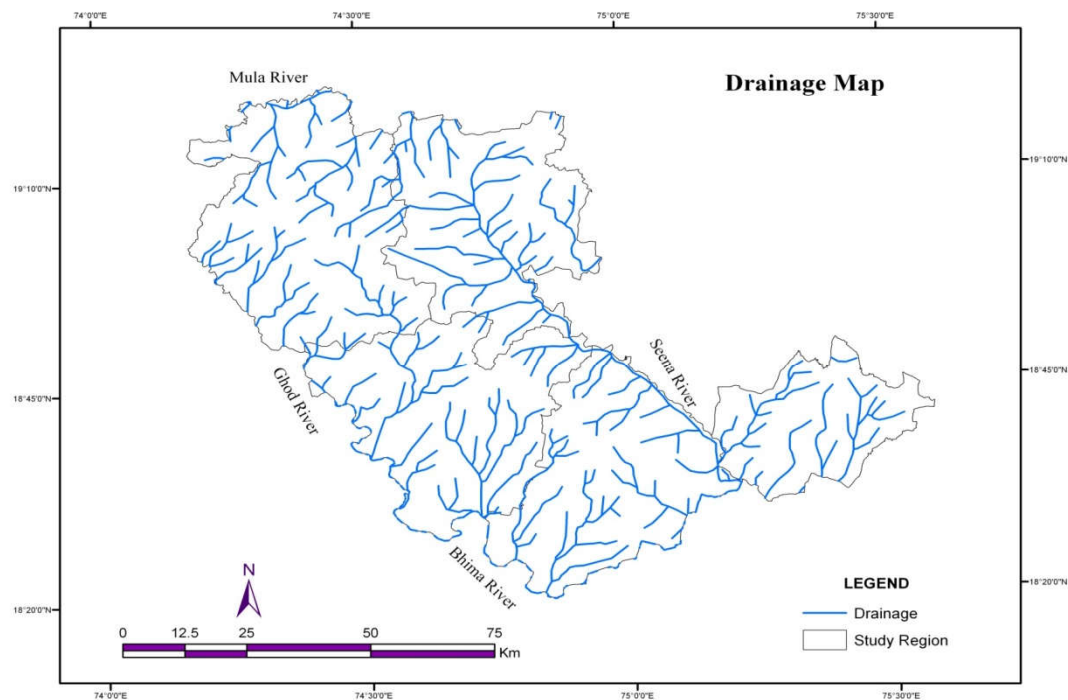
The Ghod

The Ghod River, the main left-bank tributary of the Bhima, rises on the slopes of the Sahyadri in Junnar tahesil of Pune district. It flows in a south-easterly direction for over 80 Kms. and forms part of the south-western boundary of Pune district. Near the cantonment township of Shirur, it receives, on its left bank, the Kukdi river and further down its volume is increased by the waters of the Hanga and the Pathal rivers. The streams which drain into it the waters of Parner and Shrigonda tahesil on the right bank are few on account of the proximity of the water-shed which makes the drainage small. The banks of the stream are low and its bed is generally rocky. In the summer months, the stream is easily fordable but during rains cannot be crossed without boats. The Ghod falls into the Bhima near the village Sangavi Dumale in Shrigonda tahesil.

The Ghod project comprises an earthen dam across the Ghod river at Chinchani in Shirur tahesil of Pune district and two canals, the left bank canal to irrigate 17,000 hectares and the right one 7,000 hectares. The left bank canal benefits the Parner and Shrigonda tahesil for irrigation.

Sina River

The Sina has two chief sources, one near Jamgaon about 20 km. west of the town of Ahmednagar and the other near Jeur about 16 Kms. to its north-east. The Ahmednagar city, a head quarter of the district is located on the left bank of Sina. The city of Ahmednagar is situated on the left bank of the river. The river forms boundary between Ahmednagar on the one hand and Beed on the other. On the left, it receives the waters of Mahekri, and joins the Bhima on the Karnatak State border. The banks of the Sina are low and its bed sandy. After heavy rains, its flow is somewhat rapid, as is shown by the directness of its course. During summer, the river becomes dry (Ahmednagar District Gazetteer 1976)



Map No. 1.6 Drainage map of South Ahmednagar District

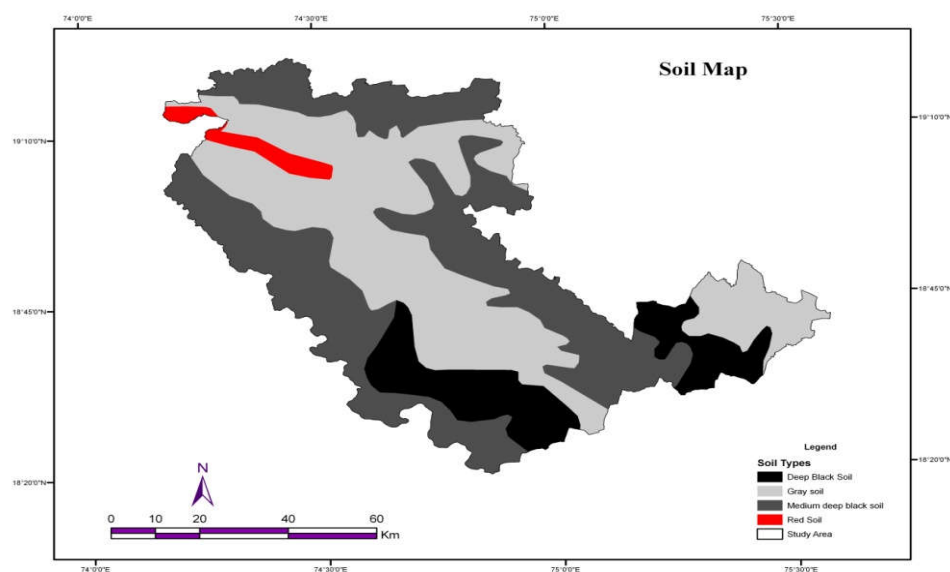
1.3 Soil

Soil is a very important natural resource because agriculture productivity is basically depends on the fertility of soil. In study area there is diversity with respect to geographical setting. Generally, soil formation is mainly related to the parent rock

material, surface relief, climate, natural vegetation and biotic elements. Map (1.7) shows soil types of study area which are classified into four groups

1. Deep black soil
2. Medium deep black soil
3. Gray or inferior quality locally known as *barad* including white or *pandhari* soil.
4. Red or *tambat* soil.

Generally the large part of the study area is covered with gray soil, which is very poor in fertility. In the study area specially two barren tracts may be noticed, one on the borders of Karjat and Shrigonda and the other north of a line drawn east to west through Takli Dhokeshwar in Parner. Over the plateau in many part of Parner, north as the slopes down to the Mula, central part of Ahmednagar plateau, and eastern part of Jamkhed area covered with gray soil. Kahnur Pathar hills in Parner tahesil covered with red or *tambat* soil. West boundary of Shrigonda and Karjat lying in Ghod and Bhima river basin has medium deep black soil and occasional patches of deep black fertile soil are seen only in low lying area of Karjat. East boundary of study area, partly situated on Sina river basin, has medium deep black soil. Fairly black soil is seen only in low lying of Karjat and Jamkhed tahesil.



Map No. 1.7 Soil Map of South Ahmednagar District.

CONCLUSION

1. South Ahmednagar district is situated on Decan trap region times Basalt lava flow. 70 percent area of the study region covers by Basaltic hard rock. Due to this type of topography ground water recharge capacity of the region is low.
2. Digital Elevation Model shows the elevation variation in the study area. Elevation is high in north- west part of the region at Vadgaon Darya and Jamgaon (1000 Mt.) in Parner tahesil and north-east border of Nagar tahesil at Agadgaon village. Low elevation is found in south Shrigonda (563 to 617 Mt.), west Karjat tahesils at the bank of Bhima river and south-west region of Jamkhed tahesils at the bank of Sina river (484 to 563 Mt.)
3. Slop map shows undulation of the study area. Major hills are found in north and north-east part of study area. Middle West range of the Harishchandragad range runs through Parner and Karjat tahesils divided study area in to two parts. In the west part of the study area slop direction is towards south and in the east part slop direction is from north-east to south-west. Generally direction of slop is mainly towards south in the channel of the rivers Bhima and Sina.
4. Bhima is Major River in the study area. About 80% area is covered by Bhima Basin. This river has dendritic river pattern, and its tributary also follow same pattern. It drains from continuously north-west toward south and supplied water to the area of nearby. All rivers of the study area are non-perennial rivers, during the summer, the rivers are dry and some are dry in whole year.
5. According to the map of soil types large part of the study area is covered with gray soil, which has very low fertility. Area lying Bhima, Ghod and Sina has medium black soil and occasional patches of deep black soil are seen in low lying area of Karjat and Jamkhed Tahesils.

Author Contribution

Conceptualization and design of research depends on secondary data. Research is work is GIS and RS techniques and analyse in ArcGIS 9.3_x, ERADAS IMAGINE 9.2 software (SJL).

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REFERENCES

1. **Ahmednagar District Gazetteers**, (1976), Gazetteers Department,
2. **Bhagat R.S. (2020)** GIS Based Physiographic Analysis and Its Consequences: A Case Study of Wainganga Sub Basin, Maharashtra India, New Trends and Innovation in Geography, BJS College,
3. **Bhagat R.S. and Lagad S. J. (2013)** Rainfall Analysis of Drought Prone Area in Ahmednagar District .Vidyavati Prakashan, 8-13
4. **District Census Handbook** (1981-2001).
5. **Fernandes-da-Silva, Vedovello, R., Ferreira, C.J., Cripps, J.C., Brollo, M.J., Fernandes, A.J. (2010)** Geo-environmental mapping using physiographic analysis: constraints on the evaluation of land instability and groundwater pollution hazards in the Metropolitan District of Campinas, Brazil, Environmental Earth Sciences, 61 (8), pp. 1657-75 <http://dx.doi.org/10.1007/s12665-010-0480-z>
6. **Kale V.S. (2015)**, Indias Geo-wealth, geomorphological heritage and geomorphodiversity: Assessment, classification and promotion, Journal of India Geomorphology, V. 3, 10-24
7. **Kudnar, N. S. (2015)** “Linear Aspects of the Wainganga River Basin Morphometry Using Geographical Information System”. Monthly Multidisciplinary Online Research Journal Review of Research, 1-9.
8. **Lagad S. J. (2016)** Role of water conservation in rural development – A Case Study of Model Village Hivare Bazar in Ahmednagar District, Minor Research Project Submitted to UGC, New Delhi
9. **Lagad S. J. (2017)** Potential Propose Selected Village Watershed in Karjat Tahesil- Using GIS Techniques, Peer Revived International Research Journal of Geography, Maharashtra Bhogolshasta Sanshodhan Patrika, 34 100-105

10. **Lagad S. J. (2017)** Role of Water Conservation in Rural Development- A Case Study of Model Villages in South Ahmednagar District, Ph.D Thesis Submitted Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur.
11. **Lagad S. J. (2018)** Application of GIS and Remote Sensing for Selecting of Watershed Sites- A Case Study of Rajani Village in Nagar Tahesil, Literature and Social Sciences,04(02) 94-96
12. **Lagad S. J. (2018)** Demographic Development Pre & Post Watershed Development of Model Watershed Village Hivarebazar In Nagar Tahesil, IJRSS 8 (12) 353-65
13. **Lagad S. J. (2019)** A Study of the Problems of Milk Producers in Karmala Taluka, Dist. Solapur, International Journal of Multifaceted & Multilingual Studies, 05(02) 97-101
14. **Lagad S. J. (2020)** Physiographic Analysis of the Hivare Bazar Village Using GIS and RS Techniques, Studies in Indian Place Names 40 (3), 5528-36.
15. **Lagad S. J. and Bhagat R.S. (2016)** Agriculture Productivity of Model Watershed Villages in Pre and Post Watershed Development – A Case Study of South Ahmednagar District, Application of Remote Sensing & GIS In the Assessment of Land-Use 88-92
16. **Lagad S. J. and Kamble B (2020)** Geo-Political Dispute Between India and China and Its Impact on Bilateral Trade, Studies in Indian Place Names, 40(60) 2215-27.
17. **Lagad S. J.(2019)** Population Distribution in South Ahmednagar, Research Methodology in Social Sciences, 51-56
18. **Lagad S.J. (2019)** Milk Producers Scenario in Karmala Taluka, Dist Solapur, Research Journey SI-108, Swatidhan Publication 158-65
19. **Lagad SJ (2019)** Analysis of Population Characteristics of South Ahmednagar District. (IJRAR) 6 (1), 804-06
20. **Lagad SJ 2019.** Demographic Development Pre and Post Watershed Development of Model Watershed Village Ralegansiddhi in Parner Tahesil, Peer Revived International Research Journal of Geography, Maharashtra Bhogolshastra Sanshodhan Patrika, 37. 1., 37-48
21. **Pande, C.B. and Moharir, K. (2017)** GIS Based Quantitative MorphoMETRIC Analysis and Its Consequences: A Case Study from Shanur River Basin Maharashtra India. Applied Water Science 7, 861-71 <http://doi.org/10.1007/s13201-015-0298-7>

22. **Sukirtee S, Arya VS, Bhat MA (2018)** Geoinformatics for the Physiographic and Land Use/Land Cover Mapping of Siwani Area, Bhiwani District (Haryana), International Journal Of Chemical Studies 6(5)1156-64
23. .www.census2011.co.in
24. www.ahmednagar.ac.in.