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Morphometric analysis of wanoja sub watershed in some part of Painganga River sub basin, Chandrapur District, Maharashtra

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Abstract
Wanoja sub watershed is located in Chandrapur district of Maharashtra. Morphometric analysis of Wanoja sub watershed is carried out to study its drainage characteristics using remote sensing and GIS. The stream order ranges from I to V order having mean bifurcation ratio 3.84. The relief ratio and relative relief is 0.013 and 399. Drainage density is 1.49 km/km^2 which indicate that it has highly resistant, impermeable subsoil material with dense vegetative cover and low relief. The values of form factor and circulatory ratio, suggest that the sub watershed is elongated in shape.

Keywords: wanoja sub watershed, remote sensing and GIS, morphometry

Introduction

In this Project work an attempt is made to study the morphometric analysis of Wanoja sub watershed in some part of Painganga River sub basin. The system of streams which transport water, sediment and other material from catchment is called drainage network (Bowlekar *et al* 2019) [3]. Drainage in any area express the total surface area, upstream of a point on a stream, where the water from rain or irrigation which is not absorbed by ground flows over the ground surface, back into streams, to finally reach that point (Pophare *et al*, 2014, Manjare, *et al* 2014a, Manjare, *et al* 2018) [24, 11, 16]. Morphometry is defined as the measurement of external shape and dimension of landforms (Bowlekar et. al 2019) [3]. Morphometric analysis of a drainage basin and its associated channel network reflect its hydrogeological behavior and constitute base for assessment of groundwater resource potential (Reddy et. al., 2004, Pophare et. al., 2014, Manjare et. al., 2014b, Manjare 2017 Manjare *et al*., 2020) [28, 24, 12, 18, 15]. Geographic Information System (GIS) is powerful tool for computerized mapping and spatial analysis. GIS provides various functions for geographic information to capture, Store, analyze, query, display and output (Bowlekar *et al* 2019, Prakash, K. *et al*., 2016, Prakash, K. *et al*., 2017, Reddy *et al*., 2018, Manjare, 2017, Manjare *et al*., 2019) [3, 25, 26, 28, 17, 15]. GIS is an effective tool to analyze spatial and non-spatial data on drainage, geology, landforms parameters to understand their interrelationship. Morphometric analysis using remote sensing and GIS techniques have been well demonstrated by some of the researchers (Nautiyal, 1994; Srivastava *et al*, 1995; Srivastava, 1997; Nag, 1998; Agarwal 1998; Biswas *et al*., 1999; Sreedevi *et al*., 2001, 2005, Vittala *et al*., 2004, Prakash, K. *et al* 2016, Prakash, K. *et al* 2017, Reddy, 2003, Manjare *et al*., 2020) [23, 33, 32, 21, 1, 2, 35, 36, 39, 25, 26, 27, 15]. As a common conclusion they indicated that remote sensing and geographical information system as powerful tools for studying basin morphometry and continuous monitoring and identification of ground water potential zone (Manjare 2015, Reddy *et al*., 2018, Manjare *et al*., 2014, Shrivatra *et al*., 2021) [13, 18., 12, 17]. Remote Sensing and GIS techniques are the proven systematic device in the delineation, updating and morphometric analysis of drainage basin. The morphometric analysis of basin usually has a relief, areal and linear aspects. But the present study give more importance on the evaluation of morphometric parameters such as stream order (Nu), stream length (Lu), bifurcation ratio (Rb), drainage density (D), stream frequency (Fs), texture ratio (T), elongation ratio (Re), circularity ratio (Rc),and form factor ratio (Rf).

Study Area

The Wanoja sub watershed is part of Painganga River sub basin which is major sub basin of Wardha River of Chandrapur District, Maharashtra. The area fall under Survey of India Toposheet no.56M/1 and 56M/2 and lies 19°48’56”N latitude and 76º03’43”E longitude including with total of about 230.15 sq.km. (Fig.1). The Wanoja sub watershed located in Korpana taluka of Wanoja village. The climate of the district is characterized by a hot summer and general dryness throughout the year except during the south-west monsoon season, i.e., June to September. The temperature rises rapidly after February till May, which is the hottest month of the year.

The mean daily maximum temperature during May is 42.8˚C and the mean daily minimum temperature during December is 12.2˚C.

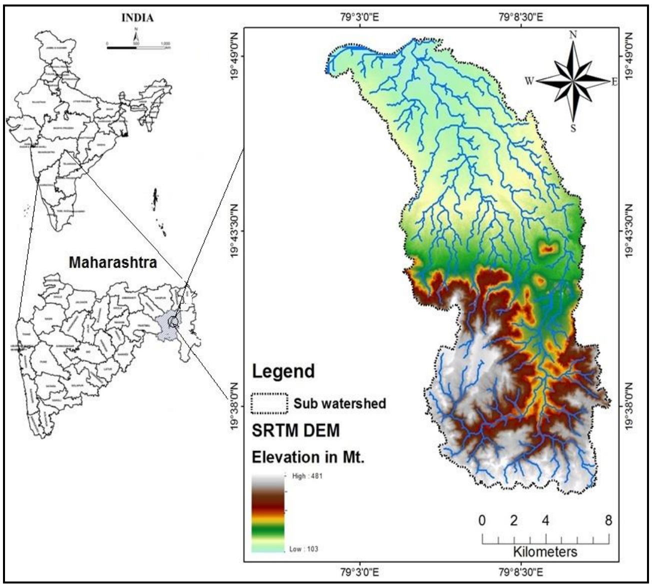

Fig 1: Location map of the study area

General Geology
Geologically, Chandrapur District is a part of Gondwana sedimentary basin. Lithologically, Chandrapur district presents a variety of stratigraphic unit right from Archean to recent alluvium and laterites. The rocks are intruded by several dykes, trending NE–SW, are exposed in the eastern part of Chandrapur district (Satapathy *et al*., 2008) [30]. The Vindhyan Sediments, Lower Gondwana Sediments, Deccan Traps, Alluvium and soil mainly constitute the geology of the area. The study area is underlain by limestone of Painganga group along the western extremity of the study area with dissected outcrops along central, northern and eastern parts of watershed. Limestones, Shale of Paninganga group are noticed in the remaining parts of watershed unconformably followed by Deccan basalt. The Painganga group of rock are overlain by the Deccan trap basaltic lava flows of Sahyadri Group (Upper Cretaceous of Paleogene age), which cover Southern part of the study area (A. P. Dharashivkar *et al* 2014) [7].

Geology of the study area
Limestone/ Shale
Limestone and shale with bands of limestone and shale are seen in the study area. Limestone in the study area is dolomitic in nature. The shales are of white to grey in colour and soft in nature and can be seen northern part of the study area (Fig.2).

Laterite
Laterite is rich in iron and aluminum oxides, formed by weathering. Laterites are commonly seen as over Deccan Traps. It is generally Reddish brown in colour and hard, thickness varies from a few cm. to 8 m. Laterite in the study area are seen in small patches towards southern part (Fig.2).

Basaltic lava flow
The igneous activity during upper Cretaceous period released tremendous outburst of volcanic energy resulting in the eruption of thick series of lava and associated pyroclastic materials.
The basalt rock is solidified lava flow of upper Cretaceous to Eocean period. In the study area most of basaltic lava flow can be seen in southern part. The nature of the rock is hard, compact and weathered (Fig. 2).

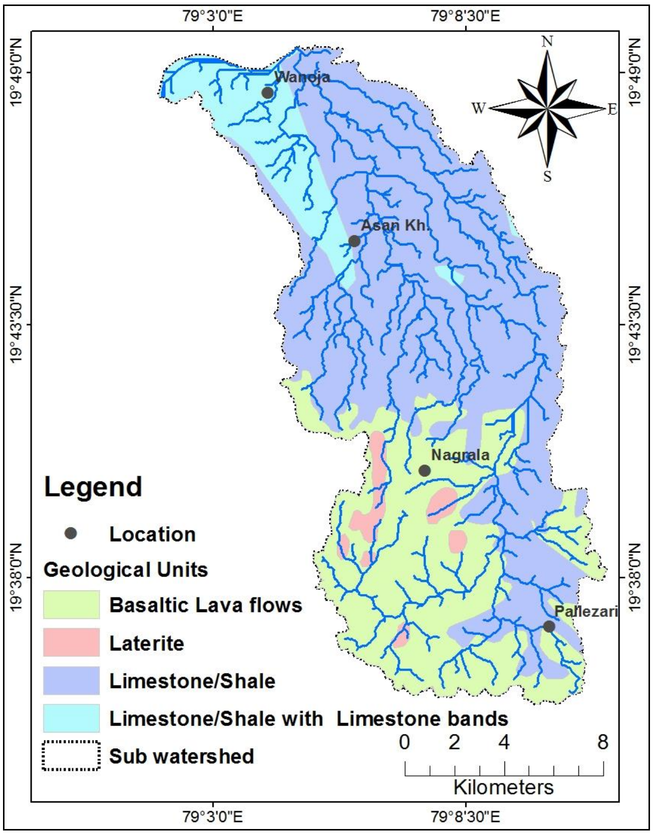

Fig 2: Geological map of the study area

General Geomorphology
Geomorphology is the study of landforms, their processes, form and sediments at the surface of the earth. Advancements in remote sensing from satellites and GIS mapping has been benefited geomorphologist greatly over the past few decades which allowing them to understand global distribution. Study includes looking at landscape to work out how the earth surface processes, such as air, water and ice can mould the landscape. The geomorphology map has been prepared by visual interpretation, satellite image, DEM and field studies. There are five geomorphic units are found in study area *viz*., denudational hills, plateau, pediments, pediplain and alluvial plain.

Geomorphic units in the study area
Denudational hills
Weathering, erosion and mass wasting collectively called as denudation. It is an exogenic process. A denudational hill is resulting from scarp retreat and pediplanation. It is an isolated low relief hill formed due to differential erosion so that a more resistant formation stands as residue like small hill. Such hills in the study area can be seen in northern part near Pallezari and Nagrala Village (Fig.3).

Plateau
Plateau is high plain or tableland is an area of highland consisting of a flat terrain, which is raised sharply above the

surrounding area on at least one side. In the study area plateau cover mostly south east and south west part. Moderate to thick soil cover, appreciable zone of weathering and less dissection are main characteristics of this landform. In the study area it is observed cover southern part of watershed near Kusumbi and Jiwati village (Fig.3).

Pediplain

Pediplain is relatively flat rock surface formed by the joining of several pediments, it is usually form in arid or semi-arid climates and formed in last stage of landform evolution. Pediplain in the study area are seen in central part near Asan village (Fig.3).

Pediments

A pediment also known as a concave slope or waning slope, is a very gently sloping inclined bedrock surface. It is basically a concave surface sloping down from the base of a steeper retreating desert cliff, escarpment or surrounding a monadock but may persist after the higher terrain has eroded away. Pediments in the study area are seen in southern part (Fig.3).

Alluvial plain

Alluvial plains, a level or gently sloping flat or a slightly undulating land surface resulting from extensive deposition of alluvial material by running water and are created by the deposition of sediment over a long period of time by one or more rivers coming from highland regions from which alluvial soil forms. In the study area alluvium can be observed towards the northern part of watershed near Wanoja village (Fig.3).

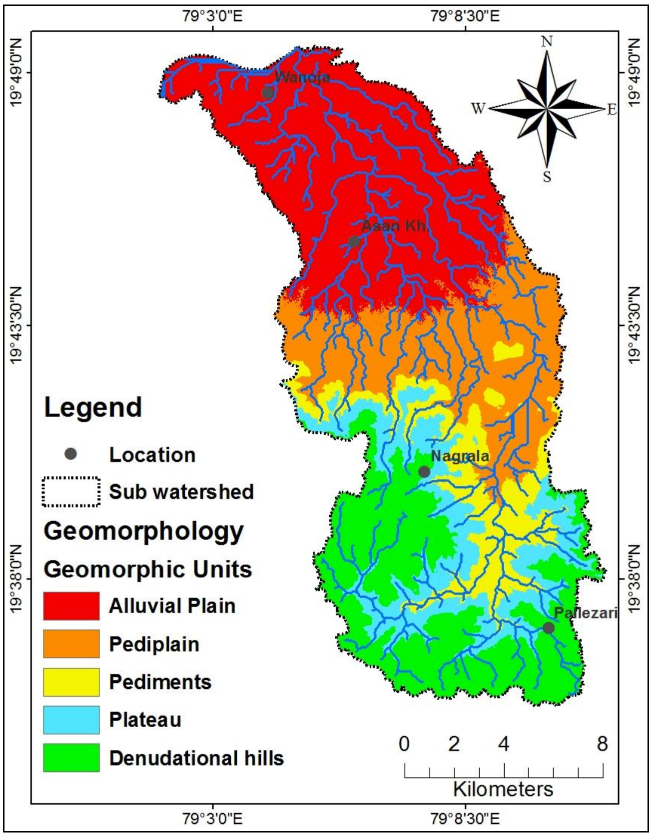

Fig 3: Geomorphological map of the study area

Data Used

Morphometric analysis of Painganga River was carried out using SOI toposheet 56M/1 and 56M/2 on 1:50,000 scale. The analysis includes stream order, stream length, stream length ratio, elongation ratio, circulatory ratio, drainage density, drainage texture, bifurcation ratio, etc. An integrated use of multispectral satellite data, DEM (Digital Elevation Model), and SOI toposheets were utilized for the generation of database and extraction of numerous drainage parameters. District resource map for Nagpur district, Maharashtra have been procured from GSI, Central region, Nagpur.

IRS LISS -3 Satellite Image

Linear Imaging Self-Scanning Sensor 3- LISS III is a remote sensing satellite camera from ISRO, India. The LISS – III camera provides multispectral data in 4 bands. The spatial resolution for visible (two bands) and near infrared (one band) is 23.5 meters with a ground swath of 141 kms. The fourth band (short wave infrared band) has a spatial resolution of 70.5 meters with a ground swath of 148 kms. The repetitively of LISS – III is 24 days. Satellite image of IRS LISS- 3 has been downloaded from BHUVAN, NRSC, and ISRO Govt. of India department of space and rectified in Arc GIS 10.3.1(version) (Fig.4).

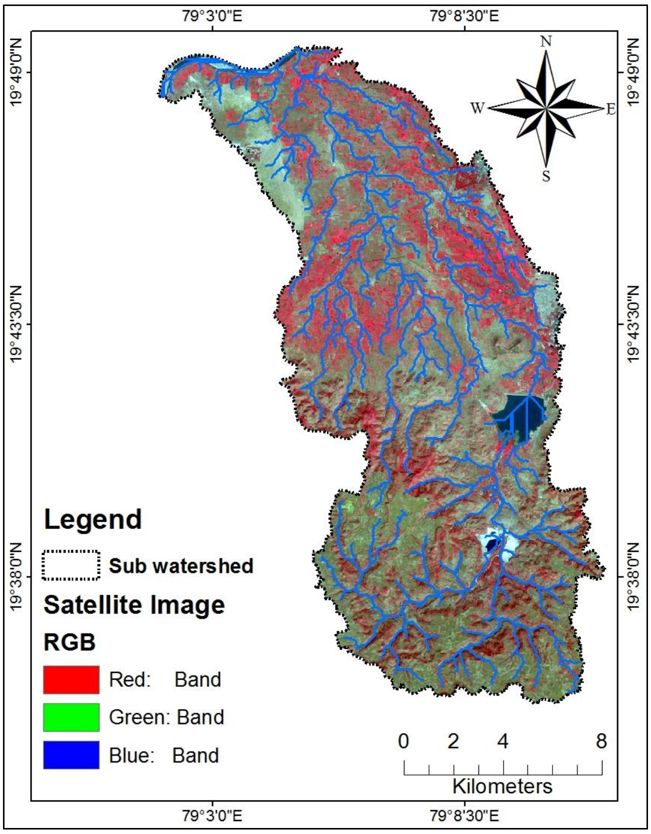

Fig 4: IRS LISS-3 Satellite Image of 23.5 mt. spatial resolution map of the study area

Methodology

GIS and remote sensing techniques are the technique which is widely used for prioritization and morphometric analysis of basin. All the thematic maps have been prepared using Arc GIS 10.3.1 software. The remotely sensed data is geometrically rectified with respect to Survey of India (SOI) topographical maps at 1:50000. Horton's law is followed by designating an un-branched stream for stream ordering as when two first order stream confluence it forms second order, when two second order meets it forms third order stream and so on. The number of streams of each order are counted and recorded. Morphometric parameters are calculated or computized using ARC GIS Software. Stream length, area, perimeter, number of streams and basin length are the fundamental parameter derived from drainage layer. The values of morphometric parameters namely; stream length, bifurcation ratio, drainage density, stream frequency, form factor, texture ratio, elongation ratio, circularity ratio and compactness constant are calculated based on the formulae suggested by (Horton, 1945, Miller, 1953, Schumn, 1956, Strahler, 1964) [9, 20, 31, 38]. According to (Waikar *et al* 2014) [40], a quantitative, morphometric analysis of a drainage basin is considered to be the most satisfactory method because it enables (i) to understand the relationship among different aspects of the drainage pattern of the basin, (ii) to make a comparative evaluation of different drainage basins developed in various geologic and climatic regimes and (iii) to define certain useful variables of drainage basins in numerical terms. The required necessary data sources for morphometric analysis were carried out through the use of Indian remote sensing satellite (IRC-1C) LISS III and SOI toposheets. The SOI toposheets and digital satellite data were geometrically rectified and georeferenced by taking ground control points (GCPs) by using UTM projection and WGS 84 datum. This study has following steps illustrated in. With the help of conversion tools in the arc tool box, the data is converted in to raster to vector form. Coverage tool and personal Geodatabase tools were used in the area to estimate stream length. Topology tool was used to edit line errors like polygon, point and node of overlapping, dangles, and gaps for accuracy. With the help of data management tools projection and transformation was made by registering of raster image with satellite image and topographical map.

Morphometric Analysis

Morphometry is the measurement and mathematical analysis of the configuration of the earth surface, shape and dimension of its landforms (Clarke, 1966) [6]. This analysis can be achieved through the measurement of linear aspects of the drainage networks, aerial aspects of the drainage basins and relief aspects of channel networks and slopes contribution (Nag and Chakraborty, 2003) [22]. The morphometric analysis of a watershed provides valuable information regarding the watershed characteristics, regional topography, drainage pattern, basin geometry, nature of bedrock and groundwater potential zones etc. It is also found to be of immense utility in watershed prioritization and conservation of natural resources at watershed level. Application of drainage morphometry is very significant in understanding the landform processes, soil physical properties and erosional characteristics. Drainage characteristics of many river basins and sub-basins in different parts of the globe have been studied using conventional methods (Horton, 1945; Strahler, 1957) [9, 37]. Geographical Information System (GIS) techniques are now-a-days used for assessing various terrains and morphometric parameters of the drainage basins and watersheds, as they provide a flexible environment and a powerful tool for the manipulation and analysis of spatial information. These morphometric parameters impart information on various terrain factors like nature of bedrock, infiltration capacity, runoff, and denudation characteristics of the area morphometric analysis has been carried out parameters like bifurcation ratio (Rb), stream order(Nu), stream length (Lu), Mean stream length (Lsm), stream length Ratio (RL) are linear parameters, basin relief (Bh), relief ratio (Rh) and ruggedness number (Rn) are relief parameters and drainage density (Dd), stream frequency (Fs), texture ratio (T), form factor (Rf), circulatory ratio (Rc) are aerial parameters (Table 1). In the given study morphometric analysis of the Wanoja sub watershed were carried out using remote sensing and GIS techniques for water conservation.

Table 1: Formulae adopted for computations of morphometric parameters

	Morphometric Parameters	Formula/Definition	References
Linear	Stream order (U)	Hierarchical order	Strahler,1964 [38]
	Stream Length (LU)	Length of the stream	Horton, 1945 [9]
	Mean stream length (Lsm)	Lsm=Lu/Nu; Where, Lu=Mean stream length of a given order (km), Nu=Number of stream segment.	Horton, 1945 [9]
	Stream length ratio (RL)	RL= Lu / Lu-1 Where, Lu= Total stream length of order (u), Lu-1=The total stream length of its next lower order.	Horton, 1945 [9]
	Bifurcation Ratio (Rb)	Rb = Nu / Nu+1 Where, Nu=Number of stream segments present in the given order, Nu+1= Number of segments of the next higher order	Schumn,1956 [31]
Relief	Basin relief (Bh)	Vertical distance between the lowest and highest points of basin.	Schumn,1956 [31]
	Relief ratio (Rh)	Rh= H/L_b where, H = Basin relief and L_b= Length of basin	Schumn,1956 [31]
Areal	Drainage density (Dd)	Dd=L/A Where, L=Total length of stream, A= Area of basin.	Horton, 1945 [9]
	Stream frequency (Fs)	Fs=N/A Where, L=Total number of stream, A=Area of basin	Horton, 1945 [9]
	Texture ratio (T)	T=N1/P Where, N1=Total number of first order stream, P=Perimeter of basin.	Horton, 1945 [9]
	Form factor (Rf)	Rf=A/(Lb)2 Where, A=Area of basin, Lb=Basin length	Horton, 1945 [9]
	Circulatory ratio (Rc)	Rc=4πA/P2Where A= Area of basin, π=3.14, P= Perimeter of basin.	Miller, 1953 [20]
	Elongation ratio (Re)	Re=√(Au/π)/ Lb Where, A=Area of basin, π=3.14, Lb=Basin length	Schumn, 1956 [31]
	Drainage texture (Dt)	Rt = ∑Nu/P Where, Nu= Total no. of stream segments of all orders, P= Perimeter of basin	Horton, 1945 [9]

Linear aspects

The linear aspects of morphometric analysis of basin include stream order, stream length, mean stream length, stream length ratio and bifurcation ratio.

Stream order (Nu)

The first step in the drainage basin analysis is designation of stream orders which is not only the index, the size and scale, but also to afford and approximate index of the amount of stream flow, which can be produced by a particular network, stream order, number. The first order stream is one which, at each confluence, has the greatest volumetric flow and is perennial stream. When two first order stream join, second order stream formed i.e., when two lower order stream joins, then the higher order stream form (Strahler, 1957) [37]. Wanoja Sub watershed have fifth order stream (Fig.5).

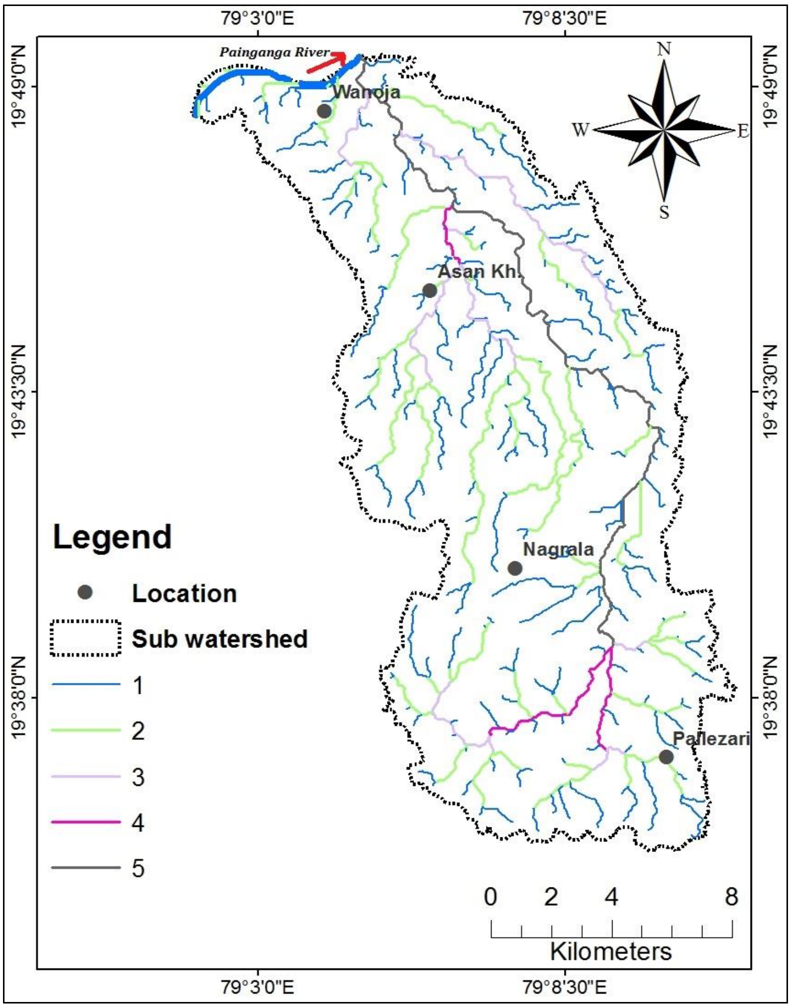

Fig 5: Stream ordering map of the study area

Stream number (Nu)

As the order increases, the number of stream segments decreases. The higher amount stream order indicates lesser permeability and infiltration. Stream number is directly proportional to size of contributing watershed**,** to channel dimensions. It is obvious that the number of streams of any given order will be fewer than for the next lower order but more numerous than for the next higher order. The number of streams decreases as the stream order increases. In the present study the order wise stream numbers estimated are given in the (Table 2).

Table 2: Calculation of different linear morphometric parameters of Wanoja sub watershed

Watershed	Basin Area (km^2)	Stream order (u)	Number of Streams (Nu)	Total length of streams in km (Lu)	Log Lu	Log Nu
Wanoja Sub watershed	230.15	I	199	158.02	2.19	2.29
		II	53	106.10	2.02	1.72
		III	10	36.53	1.56	1
		IV	3	12.82	1.10	0.47
		V	1	29.80	1.47	0

Mean stream length (Lsm)

Mean stream length (Lsm) is the characteristics property of drainage network and associated surface as per (Strahler, 1964) [38]. This has been calculated by dividing the total stream length of order (u) by the number of streams of segments in the order. In general, the ratio of Lsm increases with increasing order of streams (Mahala, 2019) [10]. Mean stream length of this basin is represented in (Table 3).

Stream length ratio (Rl)

The stream length ratio can be defined as the ratio of the mean stream length of a given order to the mean stream length of next lower order and has an important relationship with surface flow and discharge. Generally, it tends to be similar throughout the different orders (Waikar *et al* 2014) [40].

As shown in (Table 3), the stream length ratio for 1st order and 2nd order stream is found to be 2.53, for 2nd and 3rd order 1.82, for 3rd and 4th order 1.16 and for 4th and 5th order 6.97. The variations in stream length ratio in the study area were due to variations in slope and topography.

Table 3: Calculation of different linear morphometric parameters of Wanoja sub watershed

Sub water shed	Mean Stream Length (Lsm)					Stream length ratio (Rl)			
	I	II	III	IV	V	II/I	III/II	IV/III	V/IV
Wanoja Sub Watershed	0.79	2.00	3.65	4.27	29.80	2.53	1.82	1.16	6.97

Bifurcation ratio (Rb)

Bifurcation ratio (Rb) may be defined as the ratio of the number of stream segments of given order to the number of segments of the next higher order. It is calculated by dividing the number of streams in the lower order by the number in the higher of the two orders; the bifurcation ratio of large basins is generally the average of the bifurcation ratio of the stream order within it. The bifurcation ratio, for a given density of drainage lines, is very much controlled by basin shape and shows a very little variation (ranging between 3 and 5) in homogeneous bedrock from one area to another (Chorley, 1969, 1985) [4, 5]. As shown in (Table 4), bifurcation ratio varies from 3.00 to 5.3. Mean bifurcation ratio is 3.84. These differences are depending upon the geological and lithological development of the drainage basin (Bowlekar *et al* 2019) [3]. The hypothetical minimum value of two is rarely approached under natural conditions. Abnormally higher bifurcation ratios might be expected in regions of steeply dipping rock strata where narrow strike valleys are confirmed between hogback ridges. Elongated basins with higher bifurcation ratios yield a low but extended peak flow while rounded basins with low ratios procure sharp peak. The bifurcation ratio is of fundamental importance in drainage basin analysis as it is the foremost parameter to link the hydrological regime of a watershed under topological and climatic conditions. Throughout the series it helps to have an idea about the shape of the basin as well as in the runoff behavior. In the present study, the higher values of Rb indicates strong structural control on the drainage pattern, while the lower values indicative of watershed that are not affect by structural disturbances.

Table 4: Calculation of Bifurcation ratio of Wanoja sub watershed

Sub Watershed	Stream order(u)	Bifurcation ratio				Mean Bifurcation ratio
		I/II	II/III	III/IV	IV/V	
Wanoja Sub Watershed	Rb = Nu/Nu+1	3.75	5.3	3.33	3.00	3.84

Relief aspect

Relief ratio (Rh)

The maximum relief to horizontal distance along the longest dimension of the basin parallel to the principle drainage line is termed as relief ratio. Relief ratio has direct relation between the relief and channel gradient. The Rh normally increases with decreasing drainage area and size of watersheds of a given drainage basin. Relief ratio measures the overall steepness of a drainage basin and is an indicator of the intensity of erosion process operating on slope of the basin. The R_h value of the Wanoja sub watershed is 0.013.

Relative relief (Rbh)

Relative relief is difference between summit level, the highest altitude for a given area and base level, and lowest altitude for a given area (Melton, 1957) [19]. The relative relief of Wanoja sub watershed is 399.

Aerial aspect

It deals with the total area projected upon a horizontal plane contributing overland flow to the channel segment of the given order and includes all tributaries of lower order. It comprises of drainage density, drainage texture, stream frequency, form factor, circularity ratio, elongation ratio and length of overland flow.

Basin area (Au)

The drainage basin area is one of the important parameters like that of the length of drainage basin. The area of a given order is defined as the total area projected on a horizontal plane contribution overland flow to the channel segments of the given order, which includes all tributaries of the lower order. The drainage basin area is 230.15 sq. Km.

Stream frequency (Fs)

Stream frequency is the number of streams segment per unit area and relates to the importance to ground water recharge characteristics in a river basin. It is obtained by dividing the total number of stream to the total drainage basin area. The stream frequency for the study area is 1.15 (Table 5). High stream frequency because of the fact that it falls in the zone of fluvial channels and the presence of ridges on both sides of the valley which results in highest stream frequency while as watersheds.

Drainage Density (Dd)

According to (Horton, 1945) [9], the closeness of spacing of channel within a basin is drainage density. Drainage density is a quantity used to describe physical parameters of basin. It is the ratio of total channel segment length cumulated for all order within a basin to the basin area, which is expressed in terms of km/km^2. High drainage density is the resultant of weak or impermeable subsurface material, sparse vegetation and mountainous relief. Low drainage density leads to coarse drainage texture while high drainage density leads to fine drainage texture. Drainage density has long been recognized as topographic characteristic of fundamental significance. This arise from that fact that drainage density is sensitive parameter which in many ways provides the link between the form attributes of the basin and the processes operating along stream course (Gregory and Welling, 1973) [8]. From (Table 5), it is observed that the drainage density is 1.49 km/km^2 which indicate that it has highly resistant, impermeable subsoil material with dense vegetative cover and low relief.

Drainage Texture (Dt)

The drainage density and drainage frequency have been collectively defined as drainage texture. It is important to geomorphology which means that the relative spacing of drainage lines. Drainage texture shows the relative spacing of the drainage line. As the drainage texture is less than 8, it shows fine drainage texture (Bowlekar *et al* 2019) [3]. As represented in (Table 5), the drainage texture of the catchment is 2.56 found to be very coarse to cores drainage texture.

Form factor (Rf)

The ratio of the basin area to the square of basin length is called the form factor. It is a less property and is used as a quantitative expression of the shape of basin form. The elongated basin with low form factor indicates that the basin has flatter peak for longer duration. The flood flowing in such elongated basins are easier to manage than of the circular basin. The values of form factor in study area are 0.26 as shown in (Table 5) which shows the watersheds are elongated in nature.

Circulatory Ratio (Rc)

It is directed by the length and frequency of streams, geological structures, land use/ land cover, climate and slope of the basin. It is the ratio of the area of the basins to the area of circle having the same circumference as the perimeter of the basin. The values of circularity ratio vary from zero (for a line) to one (for a circle). The value of circulatory ratio is 0.26 as shown in (Table 5) which indicating that they are elongated.

Elongation ratio (Re)

(Schumm 1956) [5] defined elongation ratio as the ratio of diameter of a circle of the same area as the drainage basin and the maximum length of the basin. The value of elongated ratio varies from zero (highly elongated shape) to one (circular shape), and high elongation ratio of a basin indicates active denudational process with high infiltration capacity and low run-off in the basin, whereas lower Re values indicate higher elevation of the basin susceptible to high head-ward erosion along tectonic lineaments. The elongation ratio of the study area is 0.58 as shown in (Table 5) it indicates that the watershed falls in the elongated category.

Table 5: Calculation of different aerial morphometric parameters of Wanoja sub watershed

Morphometric parameters	Symbol/formula	Result in the study area
Basin Area (sq. km)	A	230.15
Perimeter (km)	P	103.81
Stream frequency	$Fs = N/A$	1.15
Texture ratio	$T = N1/P$	1.91
Basin length (km)	Lb	29.29
Elongation ratio	$Re=2\sqrt{(A/\pi)}/Lb$	0.58
Circularity ratio	$Rc=4\pi A/P^2$	0.26
Form factor ratio	$Rf=A/(Lb)^2$	0.26
Drainage density (Dd)	$Dd = Lu/A$	1.49
Drainage Texture	$Rt = \sum Nu/P$	2.56

Conclusion

The morphometric analysis was carried out in the course of measurement of linear, areal and relief aspects of basins. The morphometric analysis of the drainage networks of the sub-basins of the study area show dendritic to sub-dendritic patterns with very fine to coarse drainage texture. Remote sensing and GIS techniques are appropriate tools for determination and quantitative analysis of morphometry. Drainage is one of the most significant elements of landforms study, has been analyzed in the study. The observed, drainage texture is 2.56 indicates the coarse drainage texture. Basin with a higher drainage density received large runoff than smaller drainage density. The value of drainage density is 1.49 indicate more precipitation. The basin elongation ratio is 0.58 which indicates that the basin is elongated shape and less prone to overflowing. The mean bifurcation ratio is 3.84 which indicate dendritic to sub dendritic drainage type. In the present study area the impact of structure, processes and factor are clearly observed on the land forms which give a complex appearance to slope profile. In slope summit plateaus are bordered by the steep escarpment slope, which are followed by the talus slope or debris slope with convex profile. A pediment particularly in the foot hills region then the debris slope, where as in the other parts the pediments slope is absent. The hilly terrain with steep slope is more extensive than the low angled gentle pediment slope. The slope element from the study area is dependent on variables such as stratigraphy, structure, inherited form, climate and basal erosive activity of river. The slope information is useful in understanding the topography, geomorphology, soil types and their erodibility, surface drainage etc.

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