International Journal on Emerging Technologies **11**(1): 72-77(2020)

ISSN No. (Print): 0975-8364
ISSN No. (Online): 2249-3255

Conception of Drainage Morphometry by using Remote Sensing and GIS

Hridayesh Varma[1], Jyoti Sarup[2] and S. K. Mittal[3]
[1]Research Scholar, Department of Civil Engineering, MANIT, Bhopal (Madhya Pradesh), India.
[2]Associate Professor, Department of Civil Engineering, MANIT, Bhopal (Madhya Pradesh), India.
[3]Retired Professor, Department of Civil Engineering, MANIT, Bhopal (Madhya Pradesh), India.

(Corresponding author: Hridayesh Varma)
(Received 09 October 2019, Revised 05 December 2019, Accepted 13 December 2019)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Morphometry is the method for estimating the outside shape and measurement of landforms, drainage basin or any other object. This study is an effort to understand the morphometric uniqueness of the Berkheda Nathu basin with an aim to work out the thorough morpho tectonic parameters and their behavior on the hydrogeological state of the area. For natural resource development and management of any drainage basin to meet the basic demands of the society, quantitative assessment of morpho-tectonic parameters for suggesting remedies are the main challenges considered in this study. The investigation discovered that the catchment region is described by dendritic to subdendritic drainage model. The progress of river segments in the catchment region is pretty much effected by precipitation. The whole amount as well as span of all river section is highest in first order streams and decreases as the stream order increases. A quantitative assessment of drainage network is significant aspect of catchment area. The Kolans river catchment area has been taken as a watershed for this work. The different morphometric parameters have been associated by one another to comprehend their primary connection and control over the watershed hydrogeomorphology. The outcome observes by this study will give satisfactory information essential for conclusion making through considered scheduling and definition of prioritizing artificial recharge zone for ground water augmentation.

Keywords: Mophometry, drainage basin, drainage morphometry and GIS.

I. INTRODUCTION

Geomorphology is the study of cause plus development of landforms or attributes cause by physical and chemical process going on at or near the ground surface. Geomorphology decides the differences occurred in earth face from past to present and its contributing causes. Morphology is a discipline and extent of landforms or structure which is quantitative resolve of earth surface [1-3]. The most prominent geomorphic systems of land face are rivers and fluvial process which prompt morphometric changes in basin area. in which, rivers are commonly restricted by topographical nature of basin and its raised area [3]. Morphometric study is the extent and numerical assessment of the land face, profile and aspect of landforms [4-6] comprehension of ground water studies, land processes and erosional features. Remote Sensing and GIS are progressively being utilized for morphometric examination of catchment area of the drain all through the world [10-14]. Various techniques are used to study the morphometric qualities of various drainage basins in India [15-24]. Many Researchers have considered morphometric properties of catchment area of the drain as pointers of structural effect on drainage growth and movement [25-28]. In numerous investigations morphometric study has been utilized to estimate the groundwater of the basins and to demarcate appropriate site for creation of check dams and synthetic sites to recharge ground water [29-33]. Watershed prioritization dependent on morphometric parameters has also been calculated and incorporated in the mapping of high flood potential and erosion prone zones [34-38]. Drainage streak of any basin area presented three dimensional geometry of area and also helps in accepting its growth processes. The streams course drainage basin lead to the drainage model that fully shows structure and lithological parts of rocks present beneath the earth surface as studied by different researchers [2, 8, 39, 7, 40].

There is a research gap in the previous literature review that even a huge data is available on the quantitative assessment of morphometric parameters but there is very less information available showing correlation in morphometric parameters with lithology. “In this study an attempt has been made to relate these two parameters together for watershed development”.

This work shows the relation among plane morphometry and subsurface lithology of a catchment area to generate efficient in order as a division of drainage basin organization. So the target of this case study is to analyze the morphometric parameters of River basin and to find the impact of the primary lithology on the morphometric components of the basin [49-52].

II. STUDY AREA AND DATA USED

Barkheda Nathu (Kolans River) watershed, is falls under Bhopal and Sehore District, Madhya Pradesh. Geographically the study area is located between

23°04′49.09″N and 77°06′18.13″E and 23°17′57.56″N and 77°18′9.22″E falling in Toposheet of Survey of India No. 55E/3, 55E/4, 55E/7and 55E/8 with a total geographical region of 381.916 sq km. The study area is a part of catchment of Kolans river having up to 5th order drainage, which is starting at near Bamulia Village of tehsil Sehore of Sehore District and its pore point is at Western end part of upper lake near Kalukhedi Village tehsil Huzur of Bhopal District. Up to half catchment of the river, it is flowing as 4th order drainage, near village Intkhedi chap two 4th order drains meet and forms a fifth order drainage.

Data Used:

Survey of India maps numbers.: 55E/3, 55E/4, 55E/7and 55E/8.

IRS-P6 LISS-III Data downloaded from Bhuvan, Indian Geo-Platform of ISRO.

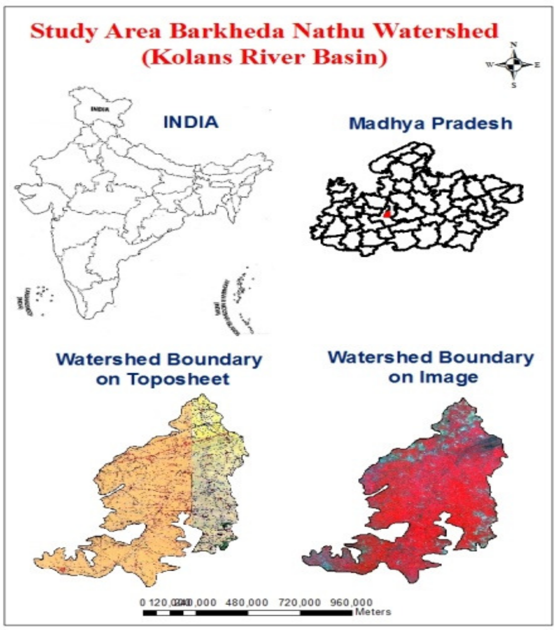

Fig. 1. Study Area.

III. METHODOLOGY

A catchment area of drain or watershed is the area through which surface water pore into a particular water body. The area studied is depicted from rectify, Survey of India topographic maps with no. 55E/3, 55E/4 55E/7 and 55E/8 on the scale of 1:50,000 by the use of GIS software (Fig. 2). ArcGIS is used for the Digitization of the watershed for Morphometric analysis. The parameters were given to make the digital data base for drainage map of the stream basin are river number, river order, river length, river length ratio, division ratio, basin length, basin area, break ratio, elongation ratio, drainage density, stream frequency, form factor and circulatory ratio, etc. These are analysed by using arithmetic relations.

IV. RESULTS AND DISCUSSION

The Kolans stream having a length of 54.62 km and area of 381.916 km^2. In the following points the different morphometric components have been elaborated with regards to obtain the morphometric analysis of the basin. Morphometric analysis of the basin is attaining by deriving linear, above ground release and slope of drainage system and also ground slope of the basin [41, 42].

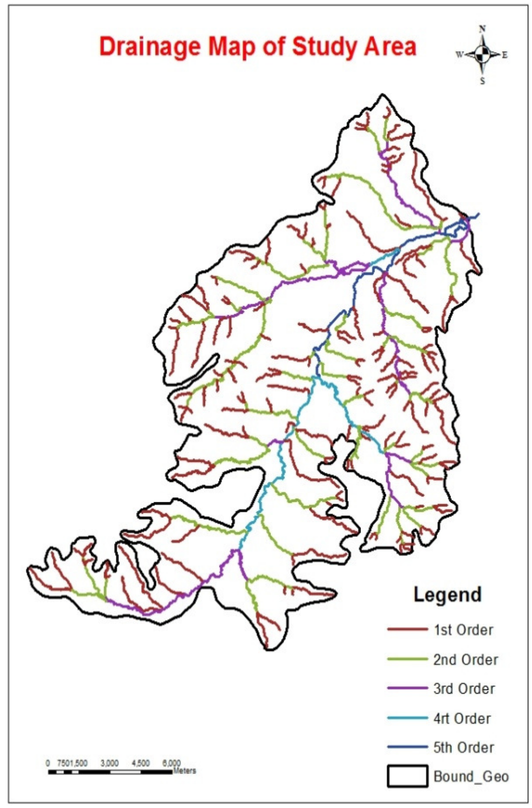

Fig. 2. Drainage Map.

A. Stream Order (μ)

The main pace in drainage basin study is to assign orders to all the streams. The digit of river steadily reduces with raise in stream sort [44]. The drainages are classify up to fifth order in the drainage basin. Particulars of stream sort of numerous tributaries of Kolans River are shown in the (Fig. 2). The most stream order occurrence is studied in case of lower most order i. e. first order streams and then for second sort. Hence, it is observed that there is a decrease in stream occurrence as the flow sort increases. Total 172 drainages of first order are present in the watershed, which is followed by 53 drainages of second order and then 10, 3 and 1 number of drainages of 3rd, 4th and 5th order respectively.

B. Stream Number (N_μ)

The tally of drainages in given array is known as stream figure. Horton's law suggest that “The number of streams of various orders in a given basin tends that there exists a geometric relationship between the average length of streams of a given order and the corresponding order is known as bifurcation ratio” [2]. The stream rate is conversely relative to stream order and stream number is frankly relative to size of contributing basin and to the channel measurement. Tributary numeral according to order is given in the (Table 1).

Table 1: Stream number as per stream order.

Stream Order (Nµ)	I	II	III	VI	V
No. of Stream	172	53	10	3	2

C. Stream Length (Lµ)

It is the full length of drainages of each of the successive sort in the basin tends to estimate a straight geometric sequence in that first word is the regular length of the first order. Bedrock is of porous type then only slight figures of comparatively longer streams are created in a well sapped basin area. If the bed rock is less porous then large figure of smaller span of streams in the basin are developed. Stream length for basin area is calculated and given in the following table (Table 2).

Table 2: Stream length as per drainage order.

Stream Order	I	II	III	VI
Stream length (Lµ) (Km)	231.62	133.72	60.64	27.19

D. Mean Stream Length (L_{sm})

It shows the quantity of part of drainage system and its causative face [44].

For given study area mean stream span has been calculated by separating the total stream length of sort by the figure of Stream segment in the order (Table 3) and it is found that L_{sm} varies from 1.35 Km to 10.8 Km for the region studied.

E. Stream Length Ratio (RL)

Horton's law of stream length says that mean stream length section of each of the successive order of a basin tends to fairly accurate a direct geometric chain with stream rising higher sort of stream. The river length ratio has major significance with surface flow and release and erosion phase of the basin [2, 6]. For this study Stream Length Ratio is given Table 4.

F. Bifurcation Ratio (Rb)

It is associated to the tributary outline of a drainage system and is explained as the proportion between the total numbers of drainages of one sort to that of the next upper order in a drainage basin (Table 4). The mean bifurcation ratio, is the average of *Rb* of all orders, is 3.345. This value of mean bifurcation ratio suggests the lithological heterogeneity, upper permeability and smaller structural command in the area.

Table 3: Mean Stream Length calculated for study area.

Steam Order	I	II	III	VI	V
No. of stream	172	53	10	3	2
Stream length (Km)	231.62	133.72	60.64	27.19	21.59
Cumulative. Stream length (Km)	231.62	365.34	425.98	453.17	474.76
Mean Stream Length(Lsm)	1.35	2.52	6.06	9.06	10.8

Table 4: Bifurcation Ratio calculated for study area.

Steam Order	I	II	III	VI	V
No. of stream	172	53	10	3	2
Stream length (Km)	231.62	133.72	60.64	27.19	21.59
Cumulative. Stream length (Km)	231.62	365.34	425.98	453.17	474.76
Mean Stream Length	1.35	2.52	6.06	9.06	10.8
Bifurcation Ratio (Rb)	3.25	5.3	3.33	1.5	
Mean Bifurcation Ratio (Rbm)	3.345				
Stream Length Ratio (RL)		1.87	2.4	1.5	1.19

G. Drainage Density (Dd)

It is defined as the calculation of the whole stream span in a specified basin region to the whole region of the basin [44]. The quantity of drainage density is a useful numerical measure of landform direction and runoff probable [46, 47]. The *Dd* less than 2 shows extremely coarse Dt, between 2 and 4 as common Dt, between 4 and 6 as moderate Dt, between 6 and 8 as fine Dt and more than 8 as extremely fine drainage texture. For this study area Drainage Density is 1.24

It is calculated by following formula:

$$Dd = L\mu / A$$

where, Dd = Drainage Density, Lµ = Total Stream Length of Order µ, A is Area of the Basin (Km^2).

H. Drainage Texture (Dt)

It is defined as cumulative of result of drainage density and stream occurrence [47]. The drainage quality based upon several natural features such as weather, plants cover and density, earth type infiltration capability [48].

Drainage Texture Ratio for given study area is 1.28 which is calculated by given formula:

$$T = N\mu / P$$

where, T is Drainage Texture Ratio, Nµ = Total number of stream section of all order and P is Perimeter (Km^2).

I. Stream Frequency (Fs)

It is summation of all drainage segments of all orders per unit area. Fundamentally it depends upon the basin

lithology and indicates specific touch of the drainage system. Stream occurrence is density serves as a instrument in starting erosional process in service over an area; more exactly, in relation to stream guidelines and their individuality provides data that explain the sequence of relief development and amount of severity in region [8]. For this study area Stream Frequency is 0.63.
It can be calculated by following formula:

$$Fs = N\mu / A$$

where is, Fs = Stream Frequency, Nμ = Total number of Stream segment of all order and A is area of the basin (Km^2).

J. Elongation Ratio (Re)
It is the proportion of a diameter of a circle has the same area equal to the basin to most basin length [49]. To obtain idea of the hydrological nature of drainage basin for calculation of basin form acting a very important part.
It can calculate by following equation:

$$Re = 2(A/\pi)/Lb$$

where is Re = Elongation Ratio, A is area of the basin (Km^2) and Lb is Basin Length.
The value of Re for study area is found to be 3.56 indicates relatively high infiltration capacity and low runoff.

K. Circularity Ratio (Rc)
It is the ratio of an area of basin and area of circle having identical circumference since the perimeter of region [8]. As per Miller, it is an important ratio that shows stage of drainage due to difference in the aspect and relief pattern of the catchment area [44]. Circularity relation of the watershed is 13.02. This indicates the old stage of the life cycle of the branch division. This can be calculated by the given formula:

$$Rc = A^* \pi^* A/P2$$

where Rc = Circularity Ratio, A is area of the basin (Km^2) and P is Perimeter (Km).

V. CONCLUSION

Morphometric analysis of drainage system is precondition to any hydrological study. Therefore, it is said that resolve of stream network's behavior and their relation with one another is very important for many water resource studies. The study come across that GIS based methodology in assessment of drainage morphometric components at river basin level is more suitable and convenient than the usual methods. Methodology based on GIS encourages study of various morphometric components and to investigate the connection among the drainage morphometry and characteristics of lithology, landforms, soils and weathered lands. On the basis of drainage orders the watershed has been classified as fifth order basin. This study is very helpful for development of Ground water augmentation and watershed management.
The Study has come out with the results that Barkheda Nathu Watershed has the capacity to perform further stream network development and augmentation activities for watershed management plans, by which the capacity of water storage and ground and surface water uses can be enhanced.

REFERENCES

[1]. Hajam, R. A., Hamid, A., & Bhat, S. (2013). Application of morphometric analysis for geo-hydrological studies using geo-spatial technology–a case study of Vishav Drainage Basin. *Hydrol Current Res*, *4*(3), 1-12.
[2]. Horton, R. E. (1945). Erosional development of streams and their drainage basins; hydrophysical approach to quantitative mor- phology. *Bull Geol Soc Am., 56*, 275-370.
[3]. Sapkale, J. B. (2013). Cross Sectional and Morphological Changes after a Flood in Bhogawati Channel of Kolhapur, Maharashtra. *Indian Geographical Quest*, *2*, 68-78.
[4]. Clarke, J. I. (1966). Morphometry from maps. Essays in geomorphology. *Heinmann, London*, 235-274.
[5]. Agarwal, C. S. (1998). Study of drainage pattern through aerial data in Naugarh area of Varanasi district, UP. *Journal of the Indian Society of Remote Sensing*, *26*(4), 169-175.
[6]. Reddy, G. E., Maji, A. K. & Gajbhiye, K. S. (2002). "GIS for morphometric analysis of drainage basins. *GIS India, 11*(4), 9-14.
[7]. Mueller, J. E. (1968). An introduction to the hydraulic and topographic sinuosity indexes. *Annals of the Association of American Geographers*, *58*(2), 371-385.
[8]. Rai, P. K., Mohan, K., Mishra, S., Ahmad, A., & Mishra, V. N. (2014). A GIS-based approach in drainage morphometric analysis of Kanhar River Basin, India. *Applied Water Science*, *7*(1), 217-232.
[9]. Eze, E. B., & Efiong, J. (2010). Morphometric parameters of the Calabar river basin: Implication for hydrologic processes. *Journal of Geography and Geology*, *2*(1), 18-26.
[10]. Williams, P. W. (1972). Morphometric analysis of polygonal karst in New Guinea. *Geological Society of America Bulletin*, *83*(3), 761-796.
[11]. Mesa, L. M. (2006). Morphometric analysis of a subtropical Andean basin (Tucuman, Argentina). *Environmental Geology*, *50*(8), 1235-1242.
[12]. Lyew-Ayee, P., Viles, H. A., & Tucker, G. E. (2007). The use of GIS-based digital morphometric techniques in the study of cockpit karst. *Earth Surface Processes and Landforms*, *32*(2), 165-179.
[13]. Altın, T. B., & Altın, B. N. (2011). Development and morphometry of drainage network in volcanic terrain, Central Anatolia, Turkey. *Geomorphology*, *125*(4), 485-503.
[14]. Buccolini, M., Coco, L., Cappadonia, C., & Rotigliano, E. (2012). Relationships between a new slope morphometric index and calanchi erosion in northern Sicily, Italy. *Geomorphology*, *149*, 41-48.
[15]. Vittala, S. S., Govindaiah, S., & Gowda, H. H. (2004). Morphometric analysis of sub-watersheds in the Pavagada area of Tumkur district, South India using remote sensing and GIS techniques. *Journal of the Indian Society of Remote Sensing*, *32*(4), 351-362.
[16]. Chopra, R., Dhiman, R. D., & Sharma, P. K. (2005). Morphometric analysis of sub-watersheds in Gurdaspur district, Punjab using remote sensing and

GIS techniques. *Journal of the Indian Society of Remote Sensing*, *33*(4), 531-539.
[17]. Vijith, H., & Satheesh, R. (2006). GIS based morphometric analysis of two major upland sub-watersheds of Meenachil river in Kerala. *Journal of the Indian Society of Remote Sensing*, *34*(2), 181-185.
[18]. Rudraiah, M., Govindaiah, S., & Vittala, S. S. (2008). Morphometry using remote sensing and GIS techniques in the sub-basins of Kagna river basin, Gulburga district, Karnataka, India. *Journal of the Indian society of remote sensing*, *36*(4), 351-360.
[19]. Bagyaraj, M., Gurugnanam, B., & Nagar, A. (2011). Significance of morphometry studies, soil characteristics, erosion phenomena and landform processes using remote sensing and GIS for Kodaikanal Hills, a global biodiversity hotpot in Western Ghats, Dindigul District, Tamil Nadu, South India. *Research Journal of Environmental and Earth Sciences*, *3*(3), 221-233.
[20]. Malik, M. I., Bhat, M. S., & Kuchay, N. A. (2011). Watershed based drainage morphometric analysis of Lidder catchment in Kashmir valley using geographical information system. *Recent Research in Science and Technology*, *3*(4), 118-126.
[21]. Thomas, J., Joseph, S., Thrivikramji, K. P., & Abe, G. (2011). Morphometric analysis of the drainage system and its hydrological implications in the rain shadow regions, Kerala, India. *Journal of Geographical Sciences*, *21*(6), 1077-1088.
[22]. Magesh, N. S., Jitheshlal, K. V., Chandrasekar, N., & Jini, K. V. (2012). GIS based morphometric evaluation of Chimmini and Mupily watersheds, parts of Western Ghats, Thrissur District, Kerala, India. *Earth Science Informatics*, *5*(2), 111-121.
[23]. Singh, P., Thakur, J. K., & Singh, U. C. (2013). Morphometric analysis of Morar River Basin, Madhya Pradesh, India, using remote sensing and GIS techniques. *Environmental Earth Sciences*, *68*(7), 1967-1977.
[24]. Pareta, K., & Pareta, U. (2012). Quantitative geomorphological analysis of a watershed of Ravi River Basin, HP India. *International journal of remote sensing and GIS*, *1*(1), 41-56.
[25]. Nag, S. K., & Chakraborty, S. (2003). Influence of rock types and structures in the development of drainage network in hard rock area. *Journal of the Indian Society of Remote Sensing*, *31*(1), 25-35.
[26]. Das, J. D., Shujat, Y., & Saraf, A. K. (2011). Spatial technologies in deriving the morphotectonic characteristics of tectonically active Western Tripura Region, Northeast India. *Journal of the Indian Society of Remote Sensing*, *39*(2), 249-258.
[27]. Bali, R., Agarwal, K. K., Ali, S. N., Rastogi, S. K., & Krishna, K. (2012). Drainage morphometry of Himalayan Glacio-fluvial basin, India: hydrologic and neotectonic implications. *Environmental Earth Sciences*, *66*(4), 1163-1174.
[28]. Demoulin, A. (2011). Basin and river profile morphometry: A new index with a high potential for relative dating of tectonic uplift. *Geomorphology*, *126*(1-2), 97-107.
[29]. Sreedevi, P. D., Subrahmanyam, K., & Ahmed, S. (2005). The significance of morphometric analysis for obtaining groundwater potential zones in a structurally controlled terrain. *Environmental Geology*, *47*(3), 412-420.
[30]. Narendra, K., & Rao, K. N. (2006). Morphometry of the Meghadrigedda watershed, Visakhapatnam district, Andhra Pradesh using GIS and Resourcesat data. *Journal of the Indian Society of Remote Sensing*, *34*(2), 101-110.
[31]. Avinash, K., Jayappa, K. S., & Deepika, B. (2011). Prioritization of sub-basins based on geomorphology and morphometricanalysis using remote sensing and geographic informationsystem (GIS) techniques. *Geocarto International*, *26*(7), 569-592.
[32]. Mishra, A., Dubey, D. P., & Tiwari, R. N. (2011). Morphometric analysis of Tons basin, Rewa District, Madhya Pradesh, based on watershed approach. *Earth Science India*, *4*(3), 171-180.
[33]. Jasmin, I., & Mallikarjuna, P. (2013). Morphometric analysis of Araniar river basin using remote sensing and geographical information system in the assessment of groundwater potential. *Arabian Journal of Geosciences*, *6*(10), 3683-3692.
[34]. Javed, A., Khanday, M. Y., & Rais, S. (2011). Watershed prioritization using morphometric and land use/land cover parameters: a remote sensing and GIS based approach. *Journal of the Geological Society of India*, *78*(1), 63-75.
[35]. Patton, P. C., & Baker, V. R. (1976). Morphometry and floods in small drainage basins subject to diverse hydrogeomorphic controls. *Water Resources Research*, *12*(5), 941-952.
[36]. Diakakis, M. (2011). A method for flood hazard mapping based on basin morphometry: application in two catchments in Greece. *Natural hazards*, *56*(3), 803-814.
[37]. Wakode, H. B., Dutta, D., Desai, V. R., Baier, K., & Azzam, R. (2013). Morphometric analysis of the upper catchment of Kosi River using GIS techniques. *Arabian Journal of Geosciences*, *6*(2), 395-408.
[38]. Romshoo, S. A., Bhat, S. A., & Rashid, I. (2012). Geoinformatics for assessing the morphometric control on hydrological response at watershed scale in the Upper Indus Basin. *Journal of Earth System Science*, *121*(3), 659-686.
[39]. Chorley, R. J., Schumm, S. A. & Sugden D. E. (1984). Geomorphology. *Methuen, London*, *122*(5), 575-576.
[40]. Strahler, A. N. (1957). Quantitative analysis of watershed geomorphology. *Trans Am Geophys Union*, *38*, 913– 920.
[41]. Magesh, N. S., Jitheshlal, K. V., Chandrasekar, N., & Jini, K. V. (2012). GIS based morphometric evaluation of Chimmini and Mupily watersheds, parts of Western Ghats, Thrissur District, Kerala, India. *Earth Science Informatics*, *5*(2), 111-121.
[42]. Nautiyal, M. D. (1994). Morphometric analysis of a drainage basin using aerial photographs: A case study of Khairkuli basin, district Dehradun, UP. *Journal of the Indian Society of Remote Sensing*, *22*(4), 251-261.
[43]. Kramm, T., & Hoffmeister, D. (2019). A relief dependent evaluation of digital elevation models on different scales for northern Chile. *ISPRS International Journal of Geo-Information*, *8*(10), 1-25.
[44]. Strahler, A. N. (1964). Part II. Quantitative geomorphology of drainage basins and channel

networks. *Handbook of Applied Hydrology: McGraw-Hill, New York*, 82-84.
[45]. Kelson, K. I., & Wells, S. G. (1989). Geologic influences on fluvial hydrology and bedload transport in small mountainous watersheds, northern New Mexico, USA. *Earth Surface Processes and Landforms*, *14*(8), 671-690.
[46]. Montgomery, D. R. & Dietrich, W. E. (2011). “Where do channels begin? In Drainage basin morphometry for identifying zones for artificial recharge: A case study from Gagas River Basin, India.
[47]. Smith, K. G. (1950). Standards for grading texture of erosional topography. *American journal of Science*, *248*(9), 655-668.
[48]. Mahadevaswamy, G., Nagaraju, D., Siddalingamurthy, S., Nagesh, P. C., & Rao, K. (2011). Morphometric analysis of Nanjangud taluk, Mysore District, Karnataka, India, using GIS Techniques. *International Journal of Geomatics and Geosciences*, *1*(4), 721-734.
[49]. Schumm, S. A. (1956). Evolution of drainage systems and slopes in badlands at Perth Amboy, New Jersey. *Geological society of America bulletin*, *67*(5), 597-646.
[50]. Das, S., Patel, P. P., & Sengupta, S. (2016). Evaluation of different digital elevation models for analyzing drainage morphometric parameters in a mountainous terrain: a case study of the Supin–Upper Tons Basin, Indian Himalayas. *SpringerPlus*, *5*(1), 1-38.
[51]. Gosavi, V. E., Thakhur, P. K., & Kumar, K. (2018). Study of drainage system and its hydrological implications using geo-spatial techniques: A morphometric analysis in Mohal Khad Watershed of Kullu District, Himachal Pradesh, India*, International Journal of Advanced Research* (*IJAR*), *6*(12), 456-463.
[52]. Dikpal, R. L., Prasad, T. R., & Satish, K. (2017). Evaluation of morphometric parameters derived from Cartosat-1 DEM using remote sensing and GIS techniques for Budigere Amanikere watershed, Dakshina Pinakini Basin, Karnataka, India. *Applied Water Science*, *7*(8), 4399-4414.

How to cite this article: Varma, Hridayesh, Sarup, Jyoti and Mittal, S. K. (2020). Conception of Drainage Morphometry by using Remote Sensing and GIS. *International Journal on Emerging Technologies*, *11*(1): 72–77.