PROJECT REPORT ON AREAL ASPECTS OF A RIVER BASIN

GGY-SE-3014
RIVER BASIN STUDIES

DEPARTMENT OF GEOGRAPHY

BIMALA PRASAD CHALIHA COLLEGE,NAGARBERA
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Examined
20/12/22

DEPARTMENT OF GEOGRAPHY
NAGARBERA
B.P. CHALIHA COLLEGE

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Areal Aspects of Drainage basin :-

The areal aspects of a drainage basin is the two dimensional properties of the basin. It includes the decription of arrangement of areal elements. It deals with the total area projected upon a horizontal plane contributing over land flow to the channel segment of the given order and includes all tributaries of lower order. It comprieses of drainage density drainage texture. Stream frequency form factor. Circulatory ratio, elongatio ratio and length of over land flow, Drainage Density :-

Horton (1932) introduced the drainage density as an important indicator of the linear scale of land form element in stream eroded topography. 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/km². The drainage density, indicats the closeness of spacing of channels. Thus providing a quantiti measure of the average length of stream channel for the whole basin. it has been observed from drainage density measurement mode over a wide range of geological and climatic type that a low drainage density is more likely to occur in region and highly resistant of highly Perme Subsaid material under dense vegetation coren and where reliet is low. High drainage density is the resultant of week or impermeable subsurfa material. spare vegetation and mountain reliet.

Drainage density →

$$a = \frac{\text{stream length (km)}}{\text{area (km}^2\text{)}} = \text{km/km}^2$$

this can be wall explained with a given drainage basin and table as follow.

1	4	7	10	14	16
2	5	8	11	14	17
3	6	9	12	15	18

Grid no	stream length	drainage density
1	1.1	1.1
2	0	0
3	0	0
4	3.6	3.6
5	4.8	48
6	0	0
7	2.3	2.3
8	5.5	5.5
9	0.3	0.3
10	2.1	2.1
11	1.7	2.1
12	0	1.7
13	0.3	0
14	0.2	0.3
15	0.4	0.2
16	0	0.4
17	0	0
18	0	0
		0

Stream Frequency: Stream Frequency or drainage frequency is the measure of number of stream per unit area (My be square meter, square killometer and so on). For the compatation of stream divided in-to grid square (more community one square mille (kilometers) depending on map scale and areal coverage of the basin and the number of stream frequency. in each grid is counter tabuled and quantified. The data of stream frequency are is studied through isopleth map or choropleth map

$$\text{Stream frequency (SF)} = \frac{\text{Number of Stream}}{\text{area}}$$

From ba/m :

Form factor is defined as the ratio of the basin area to the square of the basin length. this indicated the flow intensity of a basin of defined area (Horton 1943): the form factor value should be always lenthen 0.785 the value corresponding to a perfetly circular basen). The smaller the value of the form factor. with high form factors expersenive longer peak flows of shorter duration, wheged elongated water sheds will . low form factors experiede lower peak flows of longer duration

$$(F_p) = \frac{M}{L_2}$$

where M is the drainage area and L is length thaufase form factor factor is the numerical index commudity used to represent different basin shape.

Circulatory Ratio (R_c)

Curculatory ratio is the of ~~the~~ ratio of the area of a ~~circulatory ratio~~ basin to the area of circle having the same ciculatory as the perimeter of the basin (Miller, 1953). It is influenced by the length and frequency of stream, geological structure land use/ land cover climate and slope of the basin the high values of circulatory ratio shown the late materity stage of topography therefore it is the ratio of the area of the basin (Au) to the area of the ~~cir~~ circle (Ar) having same circumference as the basin perimeter. It is dimensonless theore trolly, the value of circular toy ratio value from of circular tory ratio verco from 0 (in line) to (in a circle.)

$$Rc = \frac{AU}{AC}$$

Length of overland flow

The length of overland flow (L_g) is the length of water over the ground ~~surface~~ befor it gets concentrated into ~~definite~~ most important independent variable affecting hydrologic

hydrologic and physiography development of drainage basin. The length of overland flow is approximately equal to the half of the reciprocal of drainage density. This facts is related inversely to the average slope of the channel and is quite synonymous with the length of sheet flow to a large degree

$\therefore$ L_g (length of overland flow) $= \frac{1}{2D_d}$

where D_d = drainage density

The concept of overland flow is a similar to the concept of surface runoff but these two are quite different hydrological phenomena

Length of overland flow is actualy that flow of precipitation water which moves over the land surface leading to the outlet of water shed channel is regussed as the surface run off. The overland flow is significant in the smaller watersheds, but

Stream length ratio (R_L)

Stream order	Number of steam	total lenght stream	mean lenght of stream
I	23	$35.68 = \frac{35.68}{23} = 1.55$	$\frac{1.55}{0} = 0$
II	7	$28 = \frac{28}{7} = 4$	$\frac{4}{1.55} = 2.58$
III	2	$18 = \frac{18}{2} = 9$	$\frac{9}{4} = 2.25$
IV	1	$6 = \frac{6}{1} = 6$	$\frac{6}{9} = 0.67$

$$\text{Stream lenght ratio} = \frac{\text{mean lenght of stream}}{\text{mean lenght stream of Proceeding class}}$$

It is a ratio of the mean lenght of a stream of a stream of a given order to on the mean lenth of the next lower order stream in the some basin

$$R_L = \frac{\bar{L}_u}{\bar{L}_{u-1}}$$

where $\bar{L}_u$ is the mean lenth of all steam Segment of a given order.

$\bar{L}_{u-1}$ = mean lenth of the next lower order.

The stream length ratio between ~~the steam of different order~~ of the study area doenot follow any trent in different sub-~~wathe~~ watershed.

a second order ~~&~~ Stream. It is not untill one stream combines a second order ~~&~~ stream with another stream of the same order that the resulting stream increases by as order of magnitude.

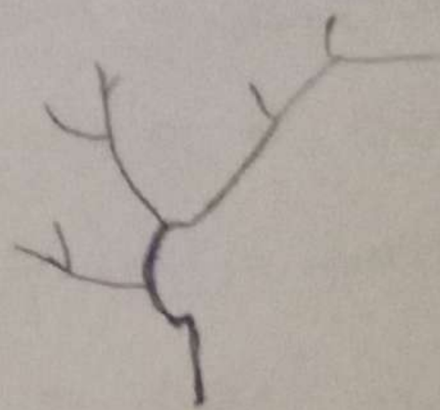

Fig: Horton Stream ordering

<u>Stream length</u>

The stream is represented by its total length of stream of a specific order. The length of a stream is the distance mesured along the stream chennel from the source to a given point or to the outlet a distance that may be measured on a map or from areal photo-graph.

mean stream lenght (MSL): ~~It~~ is a ratio of total stream lenght of a particular order and total namber of stream segments of that same order and total namber of stream segments of that same order $MSL = \frac{L_u}{N_u}$

Bi-bureaution ratio:

Biburеaution ratio (R_b) whic is related to the branching pattern of the drainage map work is dibline as a ratio of the namber of stream of a given order to the namber of stream the next higher order and is expressed in froms of the folloueing equation $R_b = \frac{N_u}{N_{u+1}}$

where,

N_u = Number of stream of a given order

N_{u+1} = Number of the stream of the higher order

Stream order	namber of steam	bibbureation Ratio
I	110	$\frac{110}{28} = 3.92$
II	28	$\frac{28}{7} = 4$
III	7	$\frac{7}{3} = 2.3$
IV	3	$\frac{3}{1} = 3$
V	1	$\frac{1}{0} = 0$

Bibureation ratio dimensionless Propenti of the drinage basin is suppar to be controld by drinage density, lithologycal, charactorestic, basin sobe. basin sabe basin area etc. Bibureation ratio help in interpiting the shabe of the basin on indetilin

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Areal Aspects of Drainage Basin:-

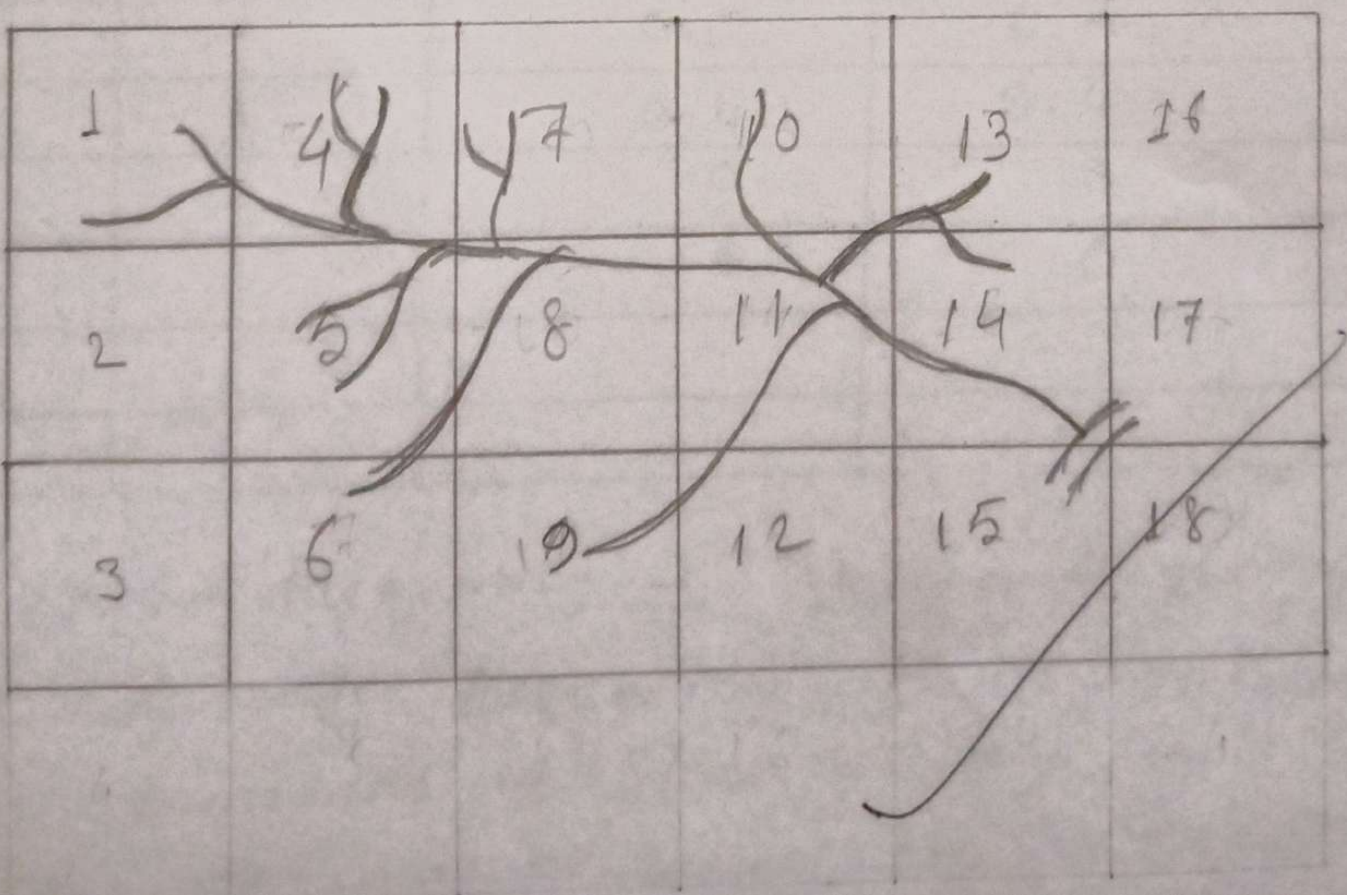
The areal aspects of a drainage basin is the two dimensional properties of the basin. It includes the description of arrangement of areal elements. It deals with the total area projected upon a horizontal plane contribtating over land flow to the channel segment of the given order and includes all tributaries of lower order. It comprises of drainage density drainage texture, stream frequency, from factor, circulatory ratio. elonation ratio and length of overland flow.

Drainage Density:- Horton (1932) introduced the drainage density as an important indicator of the linear scale of land from elements in stream in stream eroded topography. 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. The drainage density, indicates the closeness of spacing density, indicates the ~~of~~ closeness of spacing of channels. Thus providing a quantitative measure of the average length of stream channels for ~~the average length~~. the whole basin. It has been observed from drainage density measurement made over a wide range of geological and climatic types that a low drainage density is more likely to occur permeable subsoil material under dense vegetation cover and where relief is low. High drainage density is the resultant of week or impermeable subsurface material. sparse vegetation and mountaineous relief. low drainage density leads to coarse drainage texture while high drainage density leads to fine drainage texture, (Strobler, 1964)

Hence drainage density refers to total stream lengths per unit area. R.E. Horton (1945) defined drainge density as a ratio of total length of all stream Segments in a given drainage basin to the total area of that basin and thus it can be defined as ~~fol~~ follows:-

$$\text{Drainage density } D_d = \frac{\text{Stream length (km)}}{\text{Area } (km^2)} = km/km^2$$

This can be well explained with a given drainage basin and table as follow.



Grid no	Grid are	Stream length	drainage density
1	—	1.1	1.1
2	—	0	0
3		0	0
4		3 6	3.6
5		4 8	4.8
6		0	0
7		2.3	2.3
8		5.5	5.5
9		0.3	0.3
10		2.1	2.1
11	1km	1.7	1.7
12		0	0
13		0.3	0.3
14		0.2	0.2
16		0.4	0.4
17		0	0
18		0	0

*.. Stream frequency :- Stream frequency or drainage frequency is the measure of numbers of Streams per unit are ~~(...)~~ may be square of Streams per ~~km~~

(maybe square meter, square kilometer and so on). For the computation of stream frequency (SF), the basin is conviniently divided into grid square (more commonly one square mile/kilometer) depending on map scale and areal coverage of the basin and the number of streams in each grid is counted, ~~table~~ tabuled, and quantified. The data of stream frequency are classi~~fication~~-fied into certain categories depending upon the nature of data. The spatial pattern of stream frequency is studied through isopleth map or choropleth map.

$$\text{Stream frequency (SF)} = \frac{\text{Number of streams}}{\text{Area}}$$

Grid no	Grid area	No. of stream in the grid	stream frequency SF $\frac{\text{No. of stream}}{\text{Area}}$
1	$1 km^2$	0	0
2		2	2
3		0	0
4		2	2

* ~~From~~ ~~the~~ factor:-

From factor is defined as the ratio of the basin area to the square of the basin length. This factor indicates the flow intensity of a basin of a defined area (Horton, 1945). The from factor value should be always less than 0.785 (the value corresponding to a perfectly circular basin). The smaller the value of the from factor the more elongated will be the basin. Basins with high from factors experience larger peak flows of shorter duration, whereas elongated water sheds will low from factors experience lower peak flows of longer duration

$$F_f = \frac{M}{L^2}$$

where 'M' is the drainage area and L is length.

Therefore form is the numerical index commonly used to represent different basin shapes.

~~ॐ~~

x. Circulatory Ratio (Rc)

circulatory ratio is the ratio of the area ~~of~~ of a basin to the area of circle having the same ~~basin~~ circumference as the perimeter of the basin (Miller 1953). It is influenced by the length and ~~fr~~ frequency of stream geological structures land use/land cover, climate and slope of the high value of circulatory ratio shows the late maturely stage of topography. Therefore it is the ratio of the area of the basin (Au) to the area of the circle (Ac) having some circumference as the basin perimeter. It is dimensionless. Theoretically, the value of circulatory - ratio varies form 0 (in line) to 1 (in a circle).

$$R_c = \frac{A_n}{A_c}$$

x. Elongation Ratior (Re)

Schumm (1956) defined elongation ratio as the ratio of diameter of a circule of the Some area as the drainage basin and the maximum length of the basin. values of Re generally vary from 0.6 to 1.0 over a wide variety of climate and geologis types. Re values close to unity comes pond typically to segions of low & relet, wheres values in the range 0.6 – 0.8 are usually associated with high ~~relet~~ and Steep ground Slope. (Stranlar 1964). Thine values can be grouped into three categories namely.

(a) Circular :- (>0.9), (b) oval (0.9–0.8) ~~less elongated (<0.7)~~

~~Therefore it is defined as the radio of diameter of a circle of the~~

same area as the basin to the maximum basin length. It is also a dimensionless parameter

$$R_e = \frac{D_c}{L_{bm}}$$

where R_e = elongation ratio

D_c = diameter of circle which area is same to the given drainage basin

L_{bm} = maximum basin length.

Higher the value of elemention ratio more circular shape of the basin and vice-verse. (value close to 1.0 are typical of regions of very low relif to 1.0 are typical of region of very low relief, whereas that of 0.6 to 0.8 are usually associated with high relief and steep ground slope.

* Length of overland flow (Lg)

The length of overland flow (Lg) is the length of water over the ground surface before it gets concen trated into definite stream channel (Horton 195) ~~flow~~ Lg is one of the most important independent variables affecting by drologic and physiographic development of drainage basin. The length of overland flow is approximitely equal to the half of the reciprocal of drainage density. This faiter is related inversely to the ~~a~~ average slope of the channal and is quite synonymous with the length of sheet flow to a large ~~chagr~~ degree.

$$\therefore Lg \text{ (length of overland)} = \frac{1}{2D_d}$$

where D_d = drainage density.

The concept of overland flow is similar to the concept of surface run but theres two are quite different hydrological phenomenon.

Length of overland flow is actually

that flow of presipitated water which ~~mome~~ over the land surface leanding to the ~~stream~~ channels whereas the channel flow reaching to the outlet of water shed is referred as the surface run ~~off~~ the overland flow is significant in the smaller ~~wa~~ water sheds but ~~runoff~~ is in bigger watersheds the length and depth of overland flow are small.

— x — x —

ASSIGNMENT

PAPER : GGY - HC – 3014
(RIVER BASIN STUDIE)

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AREAL ASPECTS

OF A

RIVER BASIN

Examined

20/1/12

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AREAL ASPECTS OF A RIVER BASIN

The areal aspects of a drainage basin is the two dimensional properties of the Basin. It includes the description of arrangement of the basin elements. It deals with the total area projected upon a horizontal plane contributing over land included all tributaries of lower order. It comprises of drainage density, drainage textures, stream frequency, from factor, circulatory ratio, elongation ratio and lengh of overland flow.

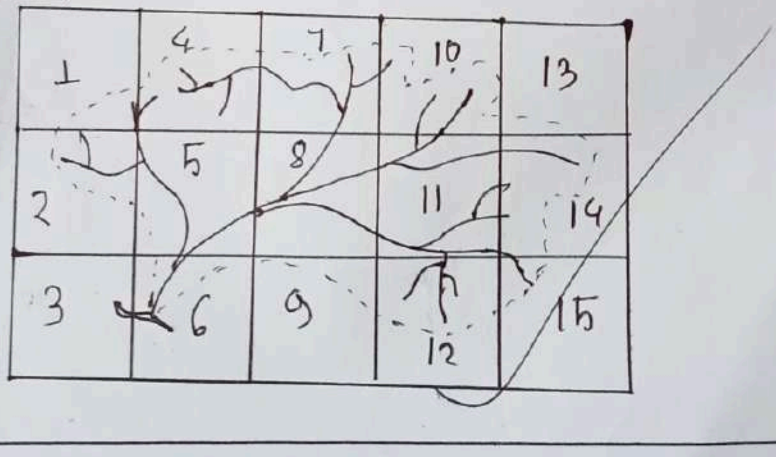
DRAINAGE DENSITY (Dd)

Horton (1932), Introduced the drainage density (Dd) as an important indicator of the linear Scale of land from elements in stream order topography. It is the ratio of total channel segment length cumulated for all order within a basin to the basin area, which is expressed in term of km/km^2. The drainage density, indicates the closeness of spacing of channels, thus providing a quantitative measure of the avarage length of stream channel for the whole basin. It has been observed from drainage density measurment made over a wide range of geologic and climate type that a low drainage density is more likely to occur in region and highly resistant of highly permeable subsoide malerial under devevegetation cover and where relief is low high drainage density is the resultant of weak or impermeable sub surface material, sparse vagetation and mountaineous relief. low drainage density leads to coarse drainage density leads to coarse drainage texture while high drainage density leads to fine drainage texture (Strahler 1964)

Hence drainage density refers to total stream lengths per unit area. R.E Horton (1945) defined drainage density as a ratio of total length of all stream segments in a given drainage density as a ratio of total length of all stream segments in a given drainage basin to the total area of that basin and thus it can be defined as follows – Drainage density $= Dd = \frac{\text{Stream length (km)}}{\text{Area } (km^2)} = km/km^2$

This can be well explained with a given drainage basin and table as follow.

FOR example –



Grid no.	Grid Area	Stream length	Drainage Density
1		0	0 km/km²
2		1	1 "
3		0	0 "
4		3	3 "
5		1.1	1.1 "
6	1 km²	1	1 "
7		1.2	1.2 "
8		2	2 "
9		0	0 "
10		2	2 "
11		4	4 "
12		1.3	1.3 "
13		0	0 "
14		3.2	3.2 "
15		1	1 "

STREAM FREQUENCY :- stream frequency or drainage frequency is the measure of number of stream per unit area (may be square meter, square kilometer and so on). For the computation of stream frequency (SF), the basin is conviniently divided into grid squares (more commonly one square mile/kilometer) depending on map scale and areas coverage of the basin and the numbers of stream in each grid is caunted, tabulated and quantified. The data of stream frequency are classified into certain categories depending upon the nature of data. The spatial pattern of stream frequency is studied through isopleth map or choropleth map.

$$\text{Stream frequency (SF)} = \frac{\text{Number of Stream}}{\text{Area}}$$

Stream frequency (Fs) is expressed as the total number of stream segments of all orders per unit area. It exhibits possitive correlation with drainage density in the watershed indicating an increase in stream population with respect to increase in drainage density.

FORM FACTOR :→ Form factor is defiend as the ratio of the basin area to the square of the basin length. This factor indicates the flow intensity of a basin of a defined area (Horton, 1945). The form factor value should be always less than 0.785 (The value corresponding to a perfectly circular basin). The smaller the value of the form factor the more elongated will be the basin. Basins with high form factors experceive larger peak flowes of shorter duration, whereas elongated water sheds will low from factors experience lower peak flowes of longer duration.

$$(F_f) = \frac{M}{L^2}$$

where M is the drainage are and L is Length. Therefore form factor is the numerical index commonly used to represent different basin shapes.

CIRCULATORY RATIO(Rc) :-> circulatory ratio is the ratio of the area of a basin to the area of circle having the same as the perimeter of the basin (miller 1953) It is influenced by the length and frequency of streams, geological structures land use/land cover climate and Slope of the basin. The high value circulatory ratio shows the late maturity stage of topography. Therefore it is the ratio of the area of the basin (Au) to the area of the circle (Ac) having same circle ferens as the basin perimeter. It is dimensionless. Theoretically, the value of circulatory ratio varies from 0 (in line) to 1 (in a circle)

$$R_c = \frac{A_u}{A_c}$$

ELONGATION RATIO (Re) :→ Schumm (1956)

defined elogation ratio as the ratio of diameter of a circle of the same area as the drainage basin and the maximum length of the basin. values of Re generally very from 0.6 to 1.0 over a wide variety of climate and geologic types. Re values close to unity correspond typically to regions of low relief, where as values in the range 0.6–0.8 are usually associated with high relief and steep ground. Slopek Strahler 1984). These values can be grouped into three categories namely.

(a) circular (>0.9), (b) ovalue (0.9–0.8)
(c) less elogated (<0.7)

Therefore it is defined as the ratio of diameter of a circle of the same area as the basin to the maximum basin length. It is also a dimensionless parameter

$$Re = \frac{Dc}{L_{bm}}$$

where Re = elongation ratio
Dc = diameter of circle which area

flow reaching to the outlet of watershed is refessed as the surface runoff. The over land flow is significant is the smaller watersheds, but runoff is in bigger watersheds the length and depth of overland flow are small.

LENGTH OF OVERLAND FLOW (Lg) :- The length of overland flow (Lg) is the length of water over the ground surface before it gets concentrated into definite stream channel (Horton 1945). Lg is one of the most important independent variables affecting hydrologic and physiographic development of drainage basin. The length of overland flow is approximately equal to the half of the resiprocal of drainage density. This factor is related inversely to the average slope of the channel and is quite synonymous with the length of sheet flow to a large degree

$$\therefore L_g \text{ (Length of overland flow)} = \frac{1}{2D_d}$$

where D_d = drainage density

The concept of overland flow is similar to the concept of surface run-off but these two are quite different hydrological phenomena.

Length of overland flow is actually that flow of precipitated water which moves over the land surface leading to the stream channels whereas the channel is same to the given drainge basin

Lbm = maximum basin length.

Higher the value of elongation ratio more circular shape of the basin and vice-vessa (values close to 1.0 are typical of regions of very low relief whereas that of 0.6 to 0.8 are usullay associated with high relief and steep ground slope.