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REPRESENTATIVE BASIN STUDIES : MORPHOMETRIC ANALYSIS OF SUDDAGEDDA BASIN, ANDHRA PRADESH

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1.0 INTRODUCTION

Every hydrologic design is different because the factors that affect the design vary with location. Thus, it is necessary to make measurements at the design site. Factors such as the following may be important: the size, the slope and the land use of the watershed as well as the water storage and vegetation within the channel. However, the morphometric analysis of the catchment will provide an information on runoff process in the basin.

Though there is a considerable corpus of scientific literature on both theoretical as well as applied geomorphology, one must admit that the experience and the knowledge gained through decades of research, field observations and the laboratory experiments have not found their appropriate application in the areas of resource and environmental management, particularly those involving land and water as their vital components. During the past four decades, the advances made in geomorphology have furthered our understanding of channel properties, its geometry and hydrology. The deserts are much better understood today and so are the coastal areas. Coastal areas are very sensitive in nature and prone to various hydrological problems viz. cyclone, floods, saline water ingress and water logging resulting from impeded drainage or excessive irrigation.

The geomorphologic studies are helpful in regionalising the hydrologic models. Since most of the basins are either ungauged or sufficient data is not available for them, the study on geomorphologic characteristics of such basins become much more important. The linking of geomorphologic parameters with the hydrological characteristics of the basin provides a simple way to understand the hydrologic behavior of different basins.

In this study various morphological aspects such as linear, areal and relief aspects of the Suddagedda basin upto Gollaprolu are evaluated. The drainage network map of the basin is prepared from Survey of India toposheets on 1:50 000 scale.

1.1 Scope of the Study

The Deltaic Regional Centre of NIH and Andhra Pradesh State groundwater department have chosen Suddagedda basin as a representative basin of the east flowing rivers lying between Godavari and Mahanadi deltas and originating in Eastern Ghats of India. As a part of representative basin studies of DRC, Kakinada, the morphometric analysis of the basin is carried out. The catchment area upto Gollaprolu is about 337 sq.km.

Suddagedda being an ungauged catchment, the morphometric analysis of the basin upto Gollaprolu is of immense important. The estimation of such parameters gains further importance in case of hilly/coastal plain catchments because direct measurement of hydrologic data is difficult in such areas. Some of the studies where quantitative morphological parameters have been used to describe hydrologic properties such as runoff response of flow hydrograph etc., are as follows:

- development of empirical formulae using geomorphologic parameters
- regional unit hydrograph studies
- regional flood frequency analysis
- development of geomorphologic instantaneous unit hydrograph
- hydrologic modeling studies

In absence of sufficient network of hydrologic observation sites the geomorphologic parameters derived for the basin may be used for further hydrologic studies which have been the concern of the local administrative and technical forums since years. Floods in the Suddagedda river often submerge the villages parallel to river course (Eenadu Daily News Paper, 1997). The news regarding the floods are always in regional newspapers. Therefore, the studies carried out in the basin may have significant importance in the region.

1.2 Review

The bearing of geomorphology on hydrology is very significant and the relationship between the two is fairly complex. Geomorphological properties of a drainage basin represents its hydrologic behavior. A strong mutual relationship exists between morphological variables and hydrological characteristics, and can be applied to both surface and groundwater regime. To understand the laws of runoff processes in a watershed, hydrologists have been faced with many problems. Specially in respect of ungauged catchment where hydrologic data are rarely available. For ungauged catchments it has been the endeavor of many hydrologists and earth scientists to quantify and relate geomorphologic parameters of naturally shaped river basins to its hydrologic response characteristics.

Horton (1945) laid down the foundation of quantitative geomorphology. With this impacts, and under growing realization that the classical descriptive analysis had very limited scope in practical engineering problems, a few geomorphologists began to attempt quantification of land-form description of the drainage basins. Important revisions to these techniques and concepts were made by Strahler (1957, 1958) in which he defined two general classes of descriptive numbers, they are

1. Linear scale measurements whereby geometrically analogous units of topography can be compared to the size.
2. Dimensionless numbers, usually angles or ratio of length measures whereby the shapes of analogous units can be compared.

Beven and Wood (1983) examined the dynamic nature of runoff contributing areas and their relationship to the geomorphologic structure of catchments. It has been shown that both runoff and flood frequency predictions are very much sensitive to assumption about the nature of the contributing area.

Maxwell (1955) stated that most drainage networks showed a linear relationship with small deviation from the straight line, with logarithm of number of streams was plotted against order.

Horton (1932) postulated that the stream length ratio which is the ratio of mean length of segments of an order to mean length of segments of next lower order tends to be constant throughout the successive orders of a watershed. If this law of stream length is valid, a plot of logarithm of stream length as a function of orders should yield a set of points lying essentially along a straight line. Confirmation of this law seems amply demonstrated by data from many watersheds (Schumm, 1957; Leopold et al, 1956; Broscoe, 1959; Morisawa, 1962).

NIH (1988, 1990, 1991, 1992(i), 1992(ii) and 1993) has carried out hydro-geo-morphological studies of various basins in India. The detailed analysis were made on linear, areal and relief aspects of the basin. The methodology for estimation of each parameter is also discussed.

Rodriguez-Iturbe and Valdes (1979), in their pioneering studies on geomorphologic structure of hydrologic response, first showed how these generalized network characteristics could be used in a linear model structure for routing surface runoff through stream network. Thus the term 'geomorphologic instantaneous unit hydrograph (GIUH) was introduced in the field of hydrologic science. These techniques have added a new dimension to application of geomorphology to the effective rainfall and direct runoff relationship.

2.0 STUDY AREA

Suddagedda is a typical east flowing river lying between rivers Godavari and Mahanadi and having origin in Eastern Ghats and joining Bay of Bengal without forming any delta. The basin lies between latitudes 17° 09 10 and 17° 30' 45 N and longitudes 82° 08 30' and 82° 19' 15' E. The total catchment area is 658.3 sq.km upto river mouth. However, in present study the catchment area upstream of Gollaprolu is being considered for morphometric analysis. The location of the basin is shown in Fig.1. Survey of India toposheets 65K3, K4, K7, K8 and K12 describes the topography of the basin. The study area is demarcated by the 700m and 20m contours, sloping towards south-south east.

2.1 Drainage

The stream origins at Vatangi reserved forest area in Rajavommangi mandal of East Godavari Dist., Andhra Pradesh at an elevation 700m and flows southward and joins many rivulets on its way near Gokavaram where a reservoir called Subbareddy Sagar is formed. Further, traveling southwards it is joined on its left bank by Konda Kalva near Tatiparthi village and is called 'Suddagedda River'. The drainage pattern in the basin is denditric in the upstream of the basin. However, the drainage pattern is not clear in the downstream side. Being the plain terrain (coastal zone) the exact demarcation of catchment boundary is very difficult. The drainage network map of the basin upto Gollaprolu is shown in Figure 2. But with limited field verifications the catchment area up to Gollaprolu is calculated as 337 Sq.km.

2.2 Hydrogeology

A major portion of the proposed basin is underlain by Khondalites, Granites and Charnokites. The central and western parts of the basin is underlain by alluvium. The southern part of the basin is underlain by Khondalite schite for rocks, basaltic formation of Tirupathi sandstones. Groundwater in the crystalline rock is restricted to

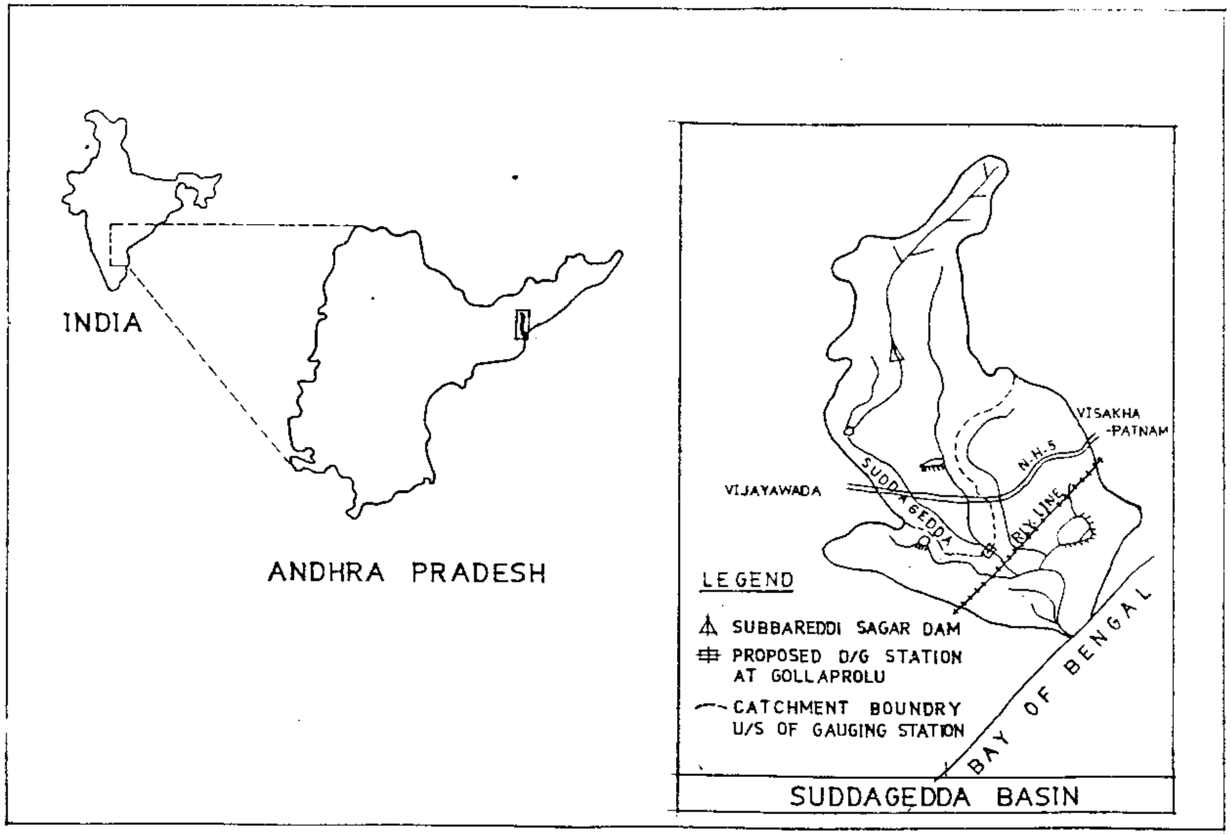

FIG.1 LOCATION MAP OF THE BASIN

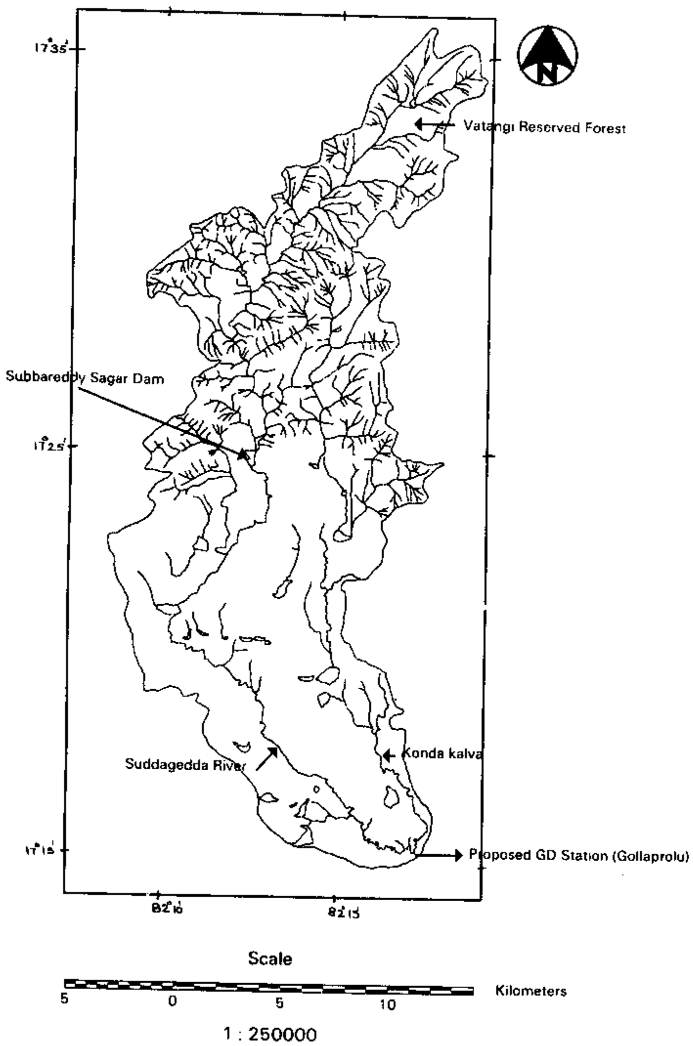

Fig 2. Drainage network of the Suddagedda basin

weathered and fractured zones and is being exploited mostly by dugwells, dug-cum borewells (SGWD,1993).

2.3 Soil and Land use

The predominant soils in the basin are black clay, red and light brown red soils. Towards the northern part of the basin, red soils are predominant in the hilly tracts and valley portions wherein the middle part of the basin light brown soils and towards southern part black soils are predominant. The main crops are paddy, banana, sugarcane, chilies and cotton. The total area irrigated under surface water sources is 6981 hectares, out of which an extent of 1758 hectares is under minor irrigation tanks (SGWD,1993).

2.4 Climate

The basin falls under tropical climate with hot summers and cold winters. The basin receives about 80% of the annual rainfall during the monsoon season (June-October). The region experiences four distinct seasons of climate viz., winter season (Nov-February), summer season (March-May), Southwest monsoon season (June-October) and post monsoon season (Nov-Dec). May is the hottest month with a maximum daily temperature touching 40°C. December is the coldest month with minimum temperature falling to 16°C.

3.0 COMPUTATION OF MORPHOMETRIC PARAMETERS

The morphometric analysis of Suddagedda basin upto Gollaprolu has been carried out using the drainage map prepared from Survey of India toposheets on 1:50,000 scale. The methodology for measurement of various morphometric parameters are presented in the following sections. The linear aspects were studied using the methods of Horton(1945), Strahlar(1953) and Chroley(1957). The areal aspects using those of Schemm(1956), Strahlar(1956, 1968), Chroley(1957), Miller(1953) and Horton(1932) and the relief aspects employing the techniques of Horton(1945), Schumm(1954) and Strahlar(1952).

3.1 Evaluation of Morphometric Parameters

Various morphometric parameters can be broadly classified into three categories:

1. Linear aspects of channel
2. Areal aspects of the basin
3. Relief aspects of the catchment

3.1.1 Linear aspects of the channel

Length of Main Channel (L)

This is the length along the longest water course from the outflow point of designated sub-basin to the upper limit to the catchment boundary.

Length of the main channel between the outlet and point nearest to the centre of gravity (L_c)

It is the length of the channel measured from the outlet of the catchment to a point on the stream nearest to the centroid (CG) of the basin.

Determination of Centre of Gravity of the basin

The centroid of the Suddagedda basin has been determined using the following steps:

(i) A cardboard piece was cut in the shape of Suddagedda basin.

(ii) The C.G was located on the catchment shape cardboard piece using point balance standard procedure.

(iii)The cardboard piece marked with centre of gravity was superimposed over the catchment plan.

(iv)By pressing a sharp edge pin over the C.G of the card board piece it was marked on the catchment.

Stream orders

The first step in drainage basin analysis is designation of stream orders, following a system introduced by Horton and slightly modified by Strahler. Assuming that one has an available channel network map including all intermittent and permanent flow lines located in clearly defined valleys, the smallest finger tip tributaries are designated as order 1. Where two first order streams join a channel segment of order 2 is formed. In other words, when two streams of order 'w' join, a stream of order 'w+1' is created and when two streams of different orders join, the channel segment immediately downstream has the higher order of the combining streams.

After the drainage network elements have been assigned their order numbers, the segments of each order are counted to yield the number, 'N_w', of segments of the given order 'w'. It is obvious that the number of stream segments of any given order will be fewer than for the next lower order but more numerous than for next higher order. The ratio of number of segments of a given order N_w to the number segments of the higher order N_{w+1} is termed the **Bifurcation ratio(R_b)**

$$R_b = \frac{N_W}{N_{W+1}}$$

The bifurcation ratio will not be precisely the same trom one order to the next, because of channel variations in watershed geometry, but will tend to be a constant throughout the series. Based on this observation , Horton has established 'law of stream numbers' which states that the number of stream segments of each order forms an inverse geometric sequence with order number, or

$$N_W = R_b^{k-w}$$

where, k is the order of the trunk segment.

When number of streams is plotted against order in a semilog scale, most drainage networks show a linear relationship with small deviation from a straight line, and hence verifying the law.

Stream Lengths

Mean length $\overline{L}_u$ of a stream segment of order 'u' is a dimensional property revealing the characteristic size of components of a drainage network and its contributing basin surfaces. Channel length is measured with curvimeter directly from the map and therefore represents the true length somewhat shortened by the projection upon a horizontal plane.

In the present study the stream lengths measured using curvimeter has been verified through GIS technique. The base map has been digitized and GIS analysis were done using the ARC/INFO software. To obtain the mean length $\overline{L}_u$ of order u, the total cumulative length of the 'u' order streams is divided by the number of segments N_u of that order, thus:

$$\overline{L}_u = \frac{\sum_{i=1}^{N} L_u}{N_u}$$

Length of Overland Flow $(\overline{L_0})$

Surface runoff follows a system of down slope flow paths from the drainage divide to the nearest channel. This flownet comprising a family of orthogonal curves with respect to the topographic contours, locally converges or diverges from parallelism depending upon position in the basin. Horton (1945) defined length of overland flow $(\overline{L_0})$ as the length of flow path, projected to the horizontal, of nonchannel flow from a point on the drainage divide to a point on the adjacent stream channel. According to this, length of overland flow is one of the most independent variables affecting both hydrologic and physiographic development of drainage basins. Horton recommended using half the reciprocal of drainage density (D) for the average length of overland flow, $\overline{L_0}$, for the entire watershed,

$$\overline{L_o} = \frac{1}{2D}$$

Stream length ratio (R_L)

This is the ratio of the mean stream segment of order u to the mean segment of order (u-1),

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

The value of R_L ranges normally between 1.5 to 3.5 in natural networks.

Basin Perimeter (P)

It is measured along the divides between basins and may be used as an indicator of basin size and shape.

Fitness Ratio (F)

The ratio of main channel length to the length of the basin perimeter is fitness ratio, which is a measure of topographic fitness.

Wandering Ratio (R_W)

Wandering ratio is defined as the ratio of the main stream length to the valley length. Valley length (L_v) is the straight line distance between outlet of the basin and the farthest point on the ridge.

Watershed eccentricity (τ)

The watershed eccentricity is given by the expression

$$\tau = \frac{\sqrt{(|(L_c^2 - W_c^2)|)}}{W_c}$$

where τ = Watershed eccentricity, a dimensionless factor

L_c = straight length from the watershed mouth to the centre of mass of the watershed in the same unit. This parameter is different from the earlier defined L_C, which measured the curved length of the channel from the mouth to a point near to CG.

W_c = Width of the watershed at the centre of mass and perpendicular to L_c.

3.1.2 Areal aspects of the basin

The parameters which are governed by the area of the drainage basin are classed as areal aspects of the basin.

Drainage Area (A)

Drainage area is defined as collecting area from which water would go to a stream or river. The boundary of the area is determined by ridge separating water flowing in opposite directions. However, in plains /coastal areas the delineation of ridge line is very difficult. However, with limited field checks the catchment area upto Gollaprolu has been delineated on 1:50,000 scale . The area of the basin is measured by digital planimeter and verified through digitized map.

Drainage Density (D)

An important indicator of the linear scale of land forms elements in stream eroded topography is drainage density 'D' introduced by Horton.

$$D = \frac{\sum_{i=1}^{k} \sum_{i=1}^{N} L_u}{A}$$

Thus D is simply the ratio of total channel-segments length cumulated for all orders within a basin to the basin area. This ratio may be thought of as an expression of spacing of channels. If geometrical similarity exists between two drainage systems, their drainage densities will be related in the same ratio as inverse of the linear scale ratio. Thus, broadly considered, drainage density is simply one of several linear measures by which the scale of features of the topography can be compared.

Constant of channel maintenance (C)

Schumm (1954) had used the inverse of drainage density as a property termed constant of channel maintenance

$$C = \frac{1}{D}$$

Specifically, the constant 'C' tells the number of square feet (or sq.km) required to sustain one linear foot of channel.

Stream Frequency (F)

Horton introduced stream frequency (or channel frequency) 'F' as the number of stream segments per unit area

$$F = \frac{\sum_{i=1}^{N} N_i}{A}$$

Where, N = total segments of all orders, A = drainage area of the basin

Circularity ratio (R_C)

Basin circularity ratio is defined as the ratio of the basin area to the area of a circle having circumference equal to the perimeter of the basin. This method is introduced for visualising the shape of the basin.

Elongation ratio (R_E)

Elongation ratio is another parameter introduced to analyze the basin shape. This is defined as the ratio of diameter of circle having area equal to the basin area to the basin length. This ratio varies from 0.6 to 1 over a wide variety of climatic and geological regimes.

Watershed shape factor (R_S)

Watershed shape factor is defined as the ratio of main stream length (L) to the diameter (d) of a circle having the same area as the watershed.

$$R_S = \frac{L}{d}$$

Compactness ratio (R_k)

Basin shape has been defined by an alternative descriptor based on perimeter rather than area. The compactness ratio is the ratio of the catchment perimeter (P) to that of equivalent circle having area as that of the basin.

$$R_k = \frac{0.282P}{\sqrt{A}}$$

Unity shape factor (R_U)

Unity shape factor is defined as the ratio of the basin length (L_b) to the square root of the basin area (A).

$$R_U = \frac{L_b}{\sqrt{A}}$$

Form Factor (R_F)

Horton defined form factor as the ratio of basin area (A) to the square of basin length (L_b) , R_f , is a dimensionless parameter and is computed as

$$R_F = \frac{A}{L_b^{\,2}}$$

The indices such as circularity ratio, elongation ratio, watersheds shape factor and unity shape factor are the measures to compare basin shapes. Basin shape is very important factor influencing the peak flow and other hydrograph characteristics such as steepness of rising and recession limbs, the time spread of hydrograph etc.,

3.1.3 Relief Aspects of the Basin

Relief aspects are the functions of the elevation or elevation difference at various points in a catchment or along the channels.

Basin relief (H)

Basin relief 'H' is the elevation difference between reference points defined in any one of the several ways. Maximum relief (total relief) within a region of given boundary is simply the elevation difference between the highest and lowest points.

Relief ratio (R_f)

When basin relief 'H' is divided by the horizontal distance on which it is measured . These results a dimensionless ratio called relief ratio. This measure talks on the overall steepness of the drainage basin and is an indicator of the intensity of erosion processes operating on the slopes of the basin.

Relative relief (R_r)

Relative relief is defined as the ratio of the basin relief (H) expressed in similar units to the basin perimeter (P). The expression for computing this parameter is:

$$R_r = \frac{100H}{P}$$

This is an indicator of the general steepness of a basin from summit to the outlet. It has an advantage over the relief ratio in that it is not dependent on the basin length which is questionable parameter in spreaded basins. When the main channel consists of two branches more or less equal catchment the channel slopes are taken as the mean of the two values calculated separately and weighted with the appropriate catchemnt area.

Ruggedness Number (R_N)

To combine the qualities of slope steepness and length, a dimensionless ruggedness number 'HD' is formed as the product of relief 'H' and drainage density 'D' , where both terms are in the same units. The areas of low relief and high drainage density are ruggedly featured as areas of higher relief having less dissection.

Hypsometric curve

Hypsometric curve is the relation of horizontal cross sectional drainage basin area to the elevation. This was developed in its modern dimensionless form by Langbein. Taking the drainage basin to be bounded by vertical sides and a horizontal base plane passing through the mouth, the relative height 'y' is the ratio of height of a given contour 'h' to the total basin height (relief) H. Relative area 'x' is the ratio of horizontal cross sectional area 'a' to the entire basin area, A. The percentage hypsometric curve is a plot of the continuous function relative height 'y' to relative 'x'.

Average slope of the watershed (S_a)

Erodibility of a watershed can be studied and can be compared from its average slope. More the percentage of slope more is its erosion, if all other things are kept constant. the average slope of the watershed is determined by the following formula:

$$S_a = \frac{HL_{ca}}{10A}$$

where S_a = average slope of watershed in percent

H = maximum watershed relief in meters

L_{ca}= average length of the contour in Km.

A = drainage area of the watershed in sq. km.

The average length of the contour is given by,

$$L_{ca} = \frac{\sum L_c}{n}$$

where, L_c = length of each contour in Km

n = number of clearly identifiable contours

4.0 RESULTS AND DISCUSSIONS

The Suddagedda basin upto Gollaprolu has been considered for morphometric analysis. The stream ordering of the basin has been done using Strahler's ordering scheme. It was observed that the river upto Gollaprolu is a fifth order stream. The number of different streams were counted and total length of the each order stream was measured and presented in Table 1. It is also observed from the table 1 that the mean lengths which have been computed as the ratio of the total length of specific order of streams and the total number of streams of that order are 0.56, 0.82, 1.69, 3.10 and 50.90 km for order one, two, three, four and five respectively. It can be seen from Table 1 that the number of streams of a given order decreases with the increase in order. The stream length ratio and bifurcation ratio are 1.563 and 4.4 respectively. These dimensionless parameters are very useful in synthesizing hydrograph characteristics. The measure of length upto centroid may be useful in the regional unit hydrograph studies. Further, these linear measure will also be useful to describe the various hydrological properties of the basin. Fig. 3 shows the variation of stream number with stream order on semi-log plot. The negative slope of the line confirms the law of stream numbers indicating reduction of number from lower to higher ordres. Fig 4 shows a semi log plot of the total stream length and stream order. The negative slope indicates the Horton's law of stream lengths. Fig. 5 shows a semi-log plot of the quantitative of stream order Vs average stream length. The plot shows the increasing trend in average length with increasing order following Horton's law of stream length. The other linear aspects of the basin are given in Table 1.

Various areal parameters evaluated for Suddagedda basin up to Gollaprolu are given in Table 2. The drainage area up to Gollaprolu is 337 sq.km. The basin drainage area is considered to be one of the important gemorphological characteristics and has been used frequently in various hydrological studie· The other areal measures presented in Table 2 have effect on peak and shape of the basin hydrograph and may be used in modeling the hydrological response of the basin when flow records are not available.

Table 1 : Linear aspects of Suddagedda basin up to Gollaprolu (lengths are in km.)

Sl No.	Name of the Parameter	Symbol	Value
01	Length of the main channel (curved length)	L	60.00
02	Length of the basin or Valley length	L_b or L_v	35.74
03	Length of the channel (curved) between the outlet and a point near to C.G	L_C	28.50
04	Straight length from watershed mouth to the CG of the basin	L_c	18.13
05	Width of the basin at the CG and perpendicular to the L_c	W_c	14.07
06	Total number of streams of		
	order 1	N_1	469
	order 2	N_2	113
	order 3	N_3	33
	order 4	N_4	9
	order 5	N_5	1
07	Total number of streams of all orders	N_w	625
08	Bifurcation ratio	R_b	4.40
09	Total lengths of channels of		
	order 1	L_1	263.0
	order 2	L_2	92.4
	order 3	L_3	56.0
	order 4	L_4	27.9
	order 5	L_5	50.9
10	Total length of streams of all orders	L_u	490.2
11	Mean lengths of streams of		
	order 1	$\bar{L}_1$	0.56
	order 2	$\bar{L}_2$	0.82
	order 3	$\bar{L}_3$	1.69
	order 4	$\bar{L}_4$	3.10
	order 5	$\bar{L}_5$	50.90
12	Length of overland flow	$\bar{L}_o$	0.34
13	Stream length ratio	R_L	1.563
14	Basin perimeter	P	120.00
15	Fitness ratio	F	0.50
16	Wandering ratio	R_w	1.67
17	Watershed eccentricity	τ	0.812

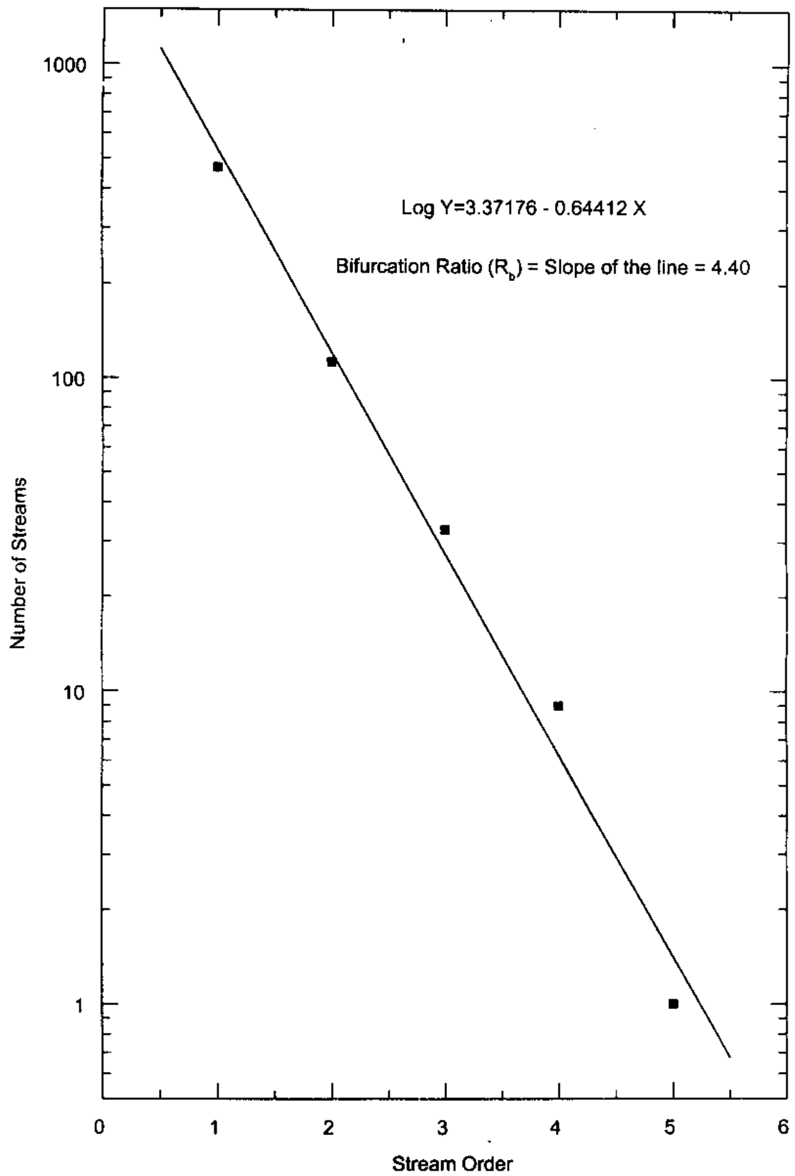

Fig 3 Variation of stream numbers with order

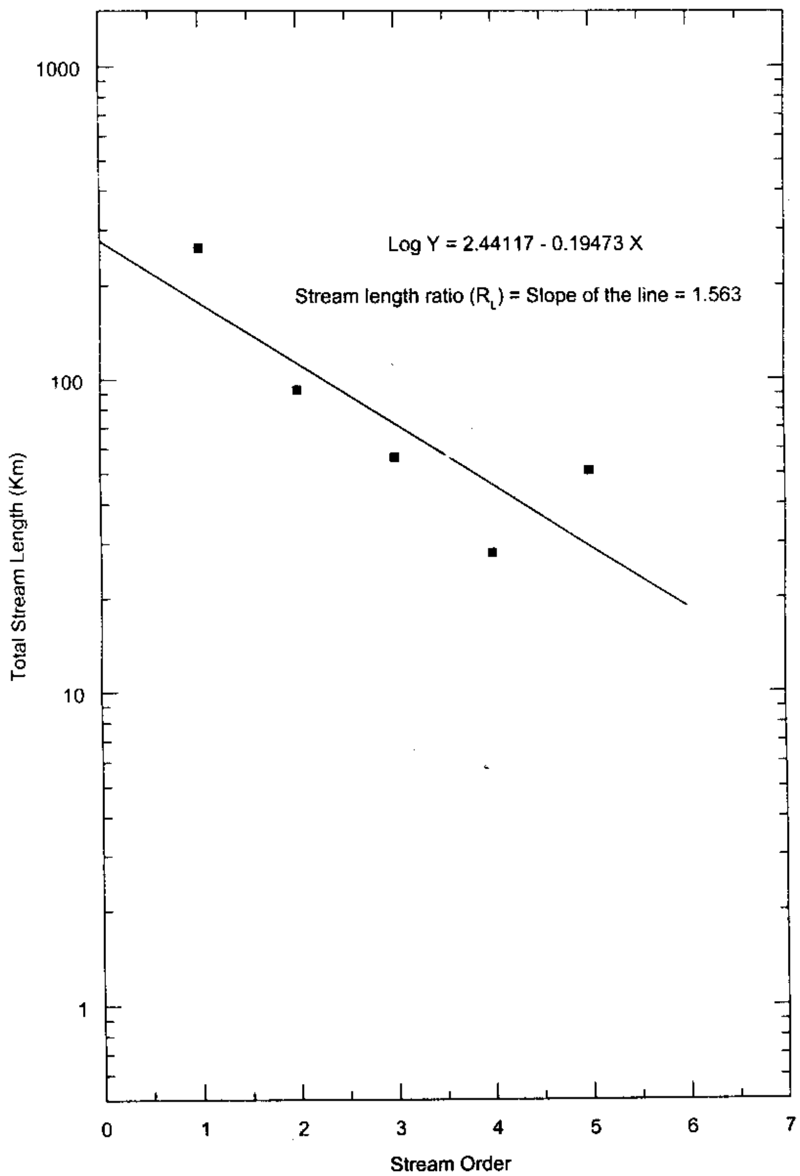

Fig 4 Variation of total stream length with order

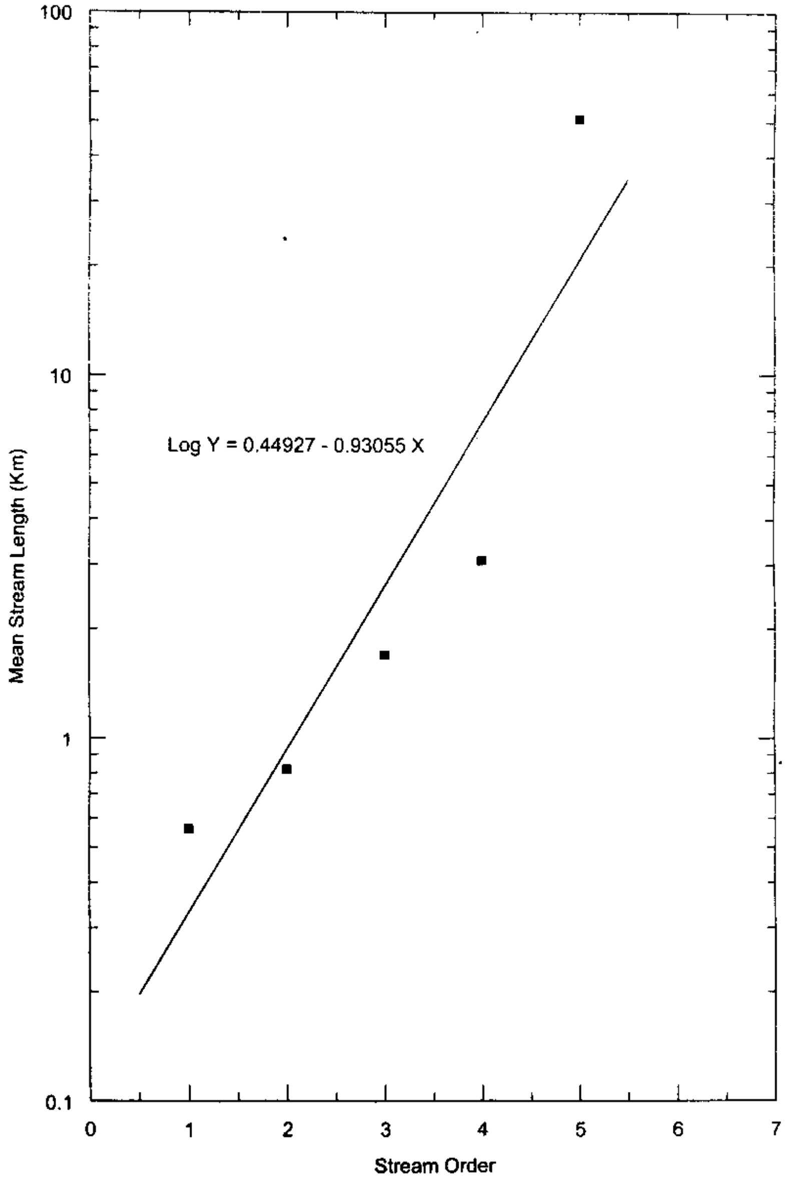

Fig.5. Variation of mean stream length with stream order

Table 2. Areal aspects of the Suddagedda basin up to Gollaprolu (areas in sq.km)

Sl No	Name of Parameter	Symbol	Value
01	Drainage area	A	337
02	Drainage density	D	1.453
03	Constant of channel maintenance	C	0.688
04	Channel segment frequency	F	1.853
05	Circularity ratio	R_C	0.295
06	Elongation ratio	R_E	0.579
07	Watershed shape factor	R_S	2.880
08	Compactness ratio	R_k	1.843
09	Unity shape factor	R_u	1.945
10	Form factor	R_f	0.265

Table 3. Relief aspects of the Suddagedda basin upto Gollaprolu

Sl. No.	Name of Prameter	Symbol	Value
01	Basin relief	H	0.690 km
02	Releif ratio	R_f	0.0193
03	Relative Relief	R_r	0.60 %
04	Ruggedness number	R_N	1.0026
05	Average basin slope	R_s	6.8 % or 0.068

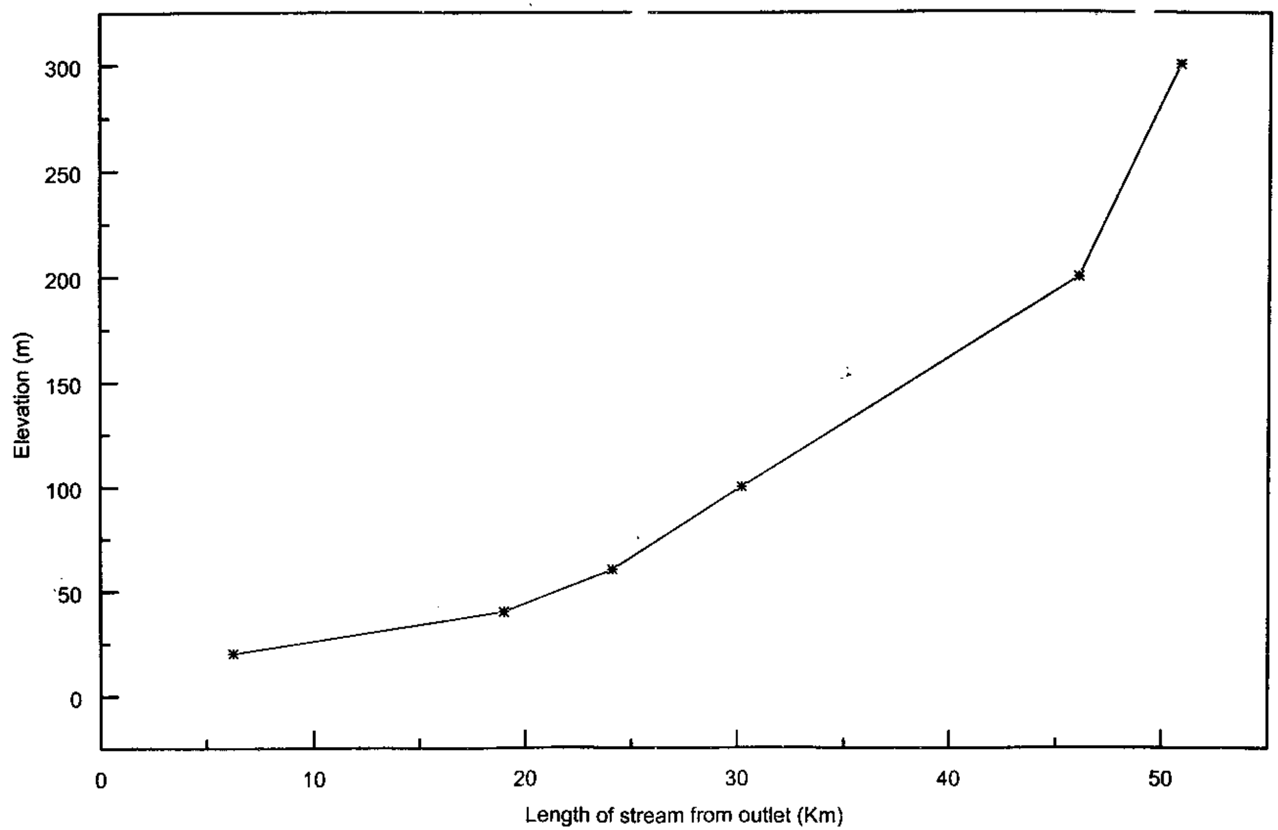

Fig.6. Slope map of Suddagedda Basin upto Gollaprolu

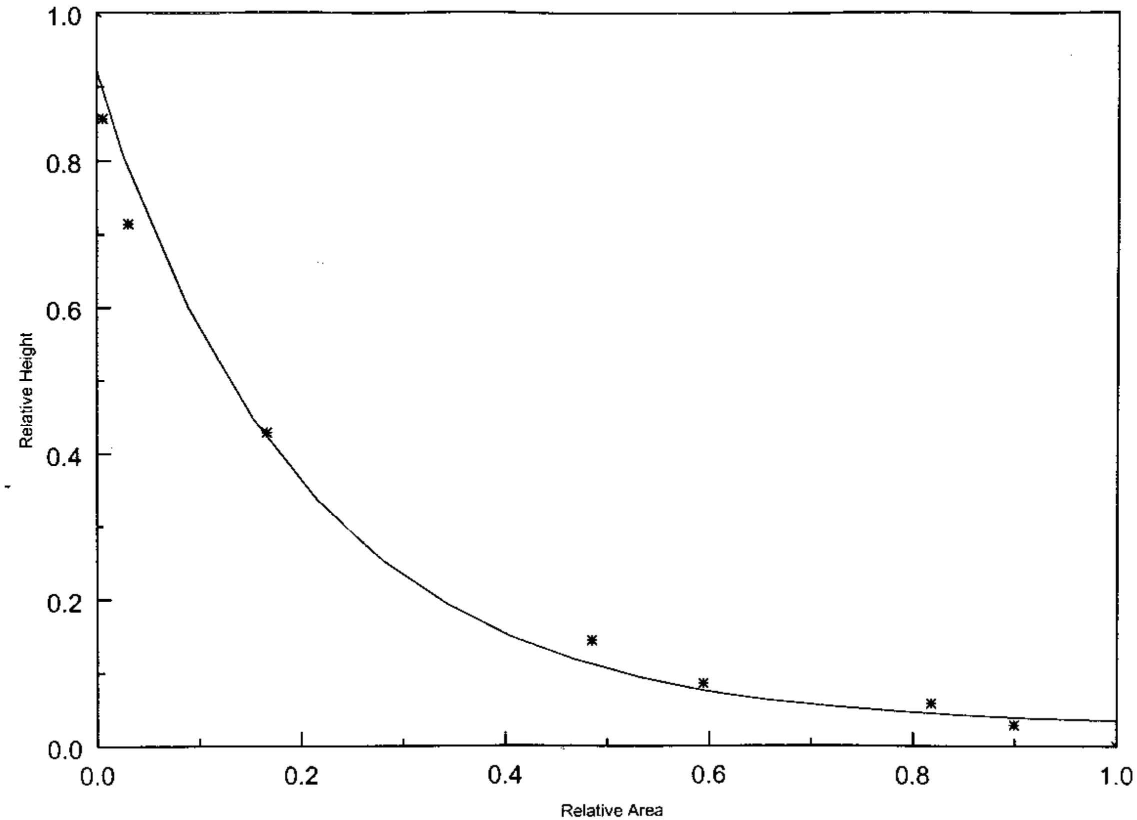

Fig 7 Hypsometric curve of the Suddagedda basin upto Gollaprolu

Some of the important parameters classified under relief aspects of the basin have been computed and presented in Table 3. The relief measures of the basin which are mostly non-dimensional have significant effect on overland flow governing the flow processes. Fig. 6 shows a general slope map of the Suddagedda basin in the direction of basin mouth to the extreme point at basin divide on the upstream. The average slope of the basin upto Gollaprolu is 6.8%. The Hypsometric curve of the basin is also prepared and shown in the Fig. 7.

5.0 CONCLUSIONS

The report is a part of representative basin studies in the Suddagedda basin. In this report various morphometric properties covering linear, areal and relief aspects of the catchment have been discussed in detail. Methodology to evaluate these parameters has also been described

The hydrogeomorphological properties as suggested by many investigators have been estimated from a toposheet manually which is very tedious. Therefore it is felt that use of a digitizer where basic map data can be quickly, accurately and inexpensively converted into a form for automatic machine data processing would be helpful. The drainage pattern in the upstream of the basin is clear but in the middle and outlet portions pattern is not clear due to plains. However, with limited field checks catchment boundary has been delineatd upto Gollaprolu. The catchment area is around 337 sq. km. The basin under study is a fifth order basin with moderate slopes. The drainage density of the basin is 1.453. The average basin slope upto Gollaprolu is calculated as 6.8%. The bifurcation ratio and stream length ratio of the basin are 4.40 and 1.563 respectively.

In Suddagedda basin, the existing network of hydrometeorological observation is not sufficient. Till now there is no measured discharge data available in the basin. Therefore it is difficult to develop reliable design flood hydrograph. Now, the estimated morphometric parameters of the basin upto Gollaprolu may be useful in developing the synthetic geomorphologic instantaneous unit hydrograph or for the development of an empirical flood formulae.

The morphometric characteristics of Suddagedda basin will provide a simple means to compare it with other basins to regionalise the experimental results in the east coastal regions of India.

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