



RESEARCH ARTICLE

MORPHOMETRIC ANALYSIS OF DASANAPATTI SUB-WATERSHED, PULAMPATTI WATERSHED,
DHARMAPURI DISTRICT

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ABSTRACT

In the present day numerous scarcity of water in and around of the world, have been facing due to the lack of pollution activities via man-made and natural hazards. The quantities analysis of morphological characters of any watershed will be adopted various analyses. In addition to this also the land utilization of any lands with system have adopted in the any kind of approaches or classes. Geospatial techniques were given the solution for sustainable development of the Land and water sectors. In addition also the planning scenario too also. The present paper is deal to morphometric and Dasanapatti sub-watershed of Pulampatti Watershed, Salem district. The study includes filed and Lab analysis for manual tracing methods through SOI and also verified through filed also too.

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INTRODUCTION

The application principals of the mathematical statistic to quantities geomorphology is essential is meaningful conclusion are to be achieved. In practice. A particular geometric by measuring from maps or aerial photographs or by different field surveys. When a sample of say 50 or 100 measurement is thus obtained, the standard methods of frequently distribution analysis are used. The individual measurements, termed verities are grouped into classes, and the nature of the distribution examined. The many geometric properties of drainage basins particularly those having the dimension of length area, volume are characteristically, log normal in distribution, where as others properties, particularly dimensionless rations and angular values Melton collected an extensive body of morph metric data on drainage basin and discusses the sample size-requirement for use in statistical test.

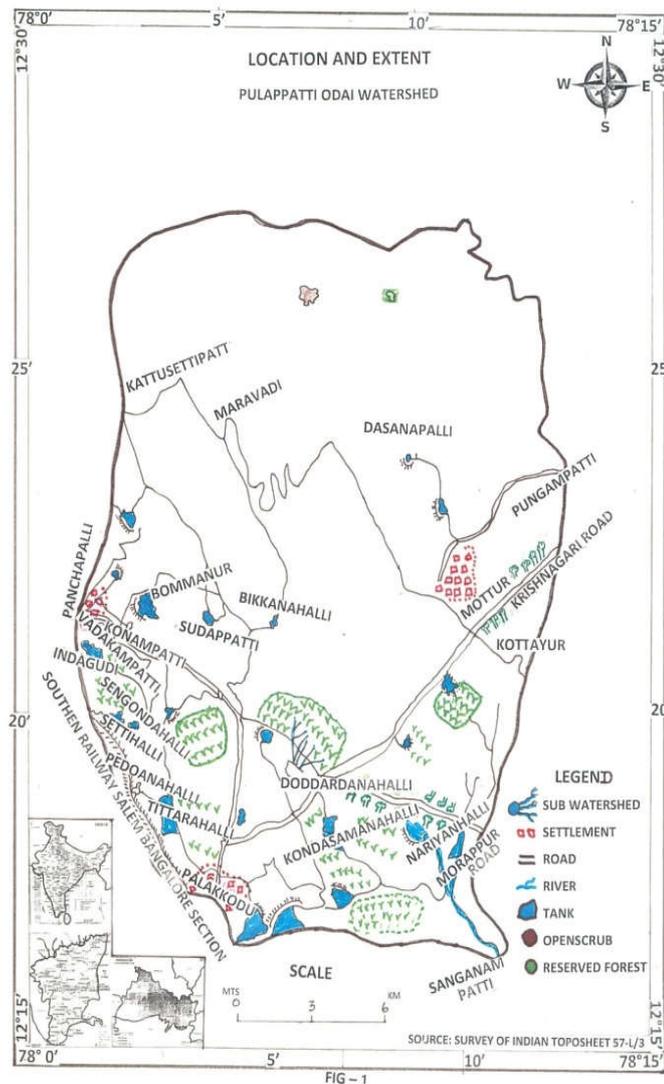
Study area

Pulampatti stream origin from north portion of thumpalappatti with flowing towards south eastern side by are Gendighenhalli, sangenamptti, total area of watershed is 158.3with in a revenue villages. From the boundary of the watershed is flowing from Dharmapuri district major Taluk of the karimanagalam.

The watershed is study one of the area total 78°0'East to 78° 15' East longitude and 12° 13' north to 12° 30' north of longitude the major physical feature has controlled to the structural paddy and fluvial process in the study area. In general physical any area may be mountain plants and plain from the present study area major to relief order like upland and plain. The study area located in the ported of karimangaiaim (tk) and there adjutants place they pulampatti odai agricultural trended from thumpallapatti dam flow village name thumpalapatti river flowing an NN and SE with length at 55km. In general the study flow from the Boomanur revenue villages located between Sudappatti and Bikkanhalli of the sub-watershed. The physical features of the watershed are plateau and plain zone in nature. The mostly the sub-watershed adopted micro level tanks with perennial one. The sub-watershed extend Latitudes 78° 0' 12'-780° 5' E, Longitudes 12° 15'-12°0 28'N fall in the zone. The most of the watershed fall in plain with without scrub area. Soil of the watershed is found in the red color in nature of the area. The favorable soil condition is supported to the potential agricultural activities. The Land use and Land cover of the sub-watershed is found the one more check dam around the area with perennial one. The pattern of the land use some of the Plantation crops with plantation in nature because of the nearer the sugar industries. The drainage of the sub-watershed is found around the area many small tanks. The surrounded other villages like, Panchapatti, Vadakampatti, Konampatti etc. The drainage of the bommanur is river, canal and tank system fall under the linear patterns of the drainage.

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From the sub-watershed also many tank system, the all objects nearer the panchapalli dam.

Aim and Objective

The present study concentrated the Watershed characteristics studies of Dasanapatti Sub-Watershed environment or follows To collect the base information of study area around the watersheds population with their habitués. To delineated and Mapping of study area in manual tracing and interpretation, In addition to this Map prepares land use /land cover, Drainage with these characteristic conditions. To concluded/ derived the status of the watershed / sub-watersheds condition and recent population status of the study area.

RESEARCH METHODOLOGY

The following Research Methods based on the objectives on follows. To collect base line information of study area includes the population in all, watershed condition, Temperature, rainfall and other essential. To collect all other hydrological data s concern area. To delineated and mapping base map with scale of 1:50000 on the linear scale, based on the base map, to feature draw and Interpretation other thematic Maps. To visit and check the wherever doubt from the bases work of the study, correct based nature study. To collect the reference with based the present study compare and added the additional information. Final and summarized all the works.

RESULT AND DISCUSSION

Introduction

In general the study flow from the Dasanapalli revenue villages located between Oungampatti and Maravadi the sub-watershed. The physical features of the watershed are located food hills with plateau in nature, other wards open scrub with forest occupied. The mostly the sub-watershed adopted micro level tanks with perennial one. The sub-watershed extend Latitudes $78^{\circ} 6' - 78^{\circ} 9' E$, Longitudes $12^{\circ} 21' - 12^{\circ} 10' N$ fall in the zone. The most of the watershed fall in plain with scrub and open land area. Soil of the watershed in general classification is hill based one like hill soil even if some of the adjacent place of the sub-watershed is found the sum of dry crops zone. The favorable soil condition is supported to the potential agricultural activities. The Land use and Land cover of the sub-watershed is found the one more check dam around the area with perennial one. The pattern of the land uses some of the food crops with plantation in nature. The surrounded other villages like sudappatti with their adjacent small hamlets. The drainage of the area tank with canal irrigation system. The many of the tank water from K.R Dam and their adjacent water sources of the sub-watershed. The Dasanapatti sub-watershed is one of the Pulampatti watershed for study the morphological characters of the study. It is located in the north eastern side of the main watershed. According to the C.B.Jagadeesh given the work of morphometric analysis of a vrishavathi sub-watershed upstream side of gali anjaneya temple using GIS. The region is fully occupy for fertile resources of water and as well as the soil. The land utilization and Land use is fine setup one. The morphological study would adopt in various approaches. The area of the sub-watershed is 16.8 sq.km and stream length of the watershed is 14.4 sq.km .

Stream Number and order(U)

For stream ordering Horton's Law was followed by designating an un-branched streams as first order stream, when two first order streams joint it was designated as second order, two second order join together to form third order and so on. This is the most important parameter for drainage basin analysis, in the study area (PSW) sub-Watershed total number of streams found is 252 out of which 133 is of first order, 107 of second, 10 of third order, 2 of fourth. The watershed wise number, order and length are given in Table 4.1. It reveals that maximum number of streams is found in First order (133) and minimum number found in fourth order (2), it is also noted that first order streams are highest in number in all micro watersheds while highest order has the lowest number. The sub-Watershed covering an area 16.8 .

Stream Length(Lu)

Average length ratio is 1.55 and comparing with first, second, and third order it is observed to be indicating that water flow in the source region is limited which is due to semi- arid environment. Length ratio of 1st order is high which indicates higher surface flow. It can be seen from the table.1 that as the order increases mean length also increases and so ratio increases.

Stream Length Ratio(RI)

Linear Aspects

Linear parameters include stream frequency, drainage density, drainage texture, bifurcation ratio and length of overland flow

Table 1. Stream Orders and Numbers— Dasanapatti

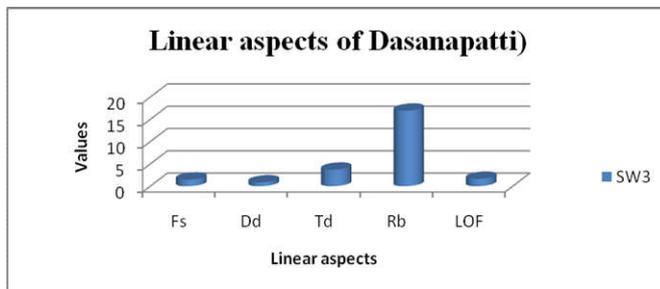
| Stream Orders | No of Streams | Bifurcation ratio | Total Length (km) | Mean Length (km) | Length ratio | Mean ratio |
|---------------|---------------|-------------------|-------------------|------------------|--------------|------------|
| 1 | 133 | 1.24 | 19.69 | 0.13 | 5.61 | |
| 2 | 107 | 10.7 | 105.8 | 0.73 | 0.10 | |
| 3 | 10 | 5 | 11.6 | 0.08 | 0.5 | 1.55 |
| 4 | 2 | 0 | 7 | 0.04 | 0 | |
| | | | 144 | | | |

Table 2. Area Ratio- Dasanapatti

| Stream Orders | Stream Numbers | Area in km ² | Mean Area | Area Ratio |
|---------------|----------------|-------------------------|-----------|------------|
| 1 | 133 | 0.2 | 0.018 | 50 |
| 2 | 107 | 10 | 0.90 | 0.01 |
| 3 | 10 | 0.12 | 0.01 | 6 |
| 4 | 2 | 0.7 | 0.06 | 0 |
| Total | 252 | 11.02 | | |

Table 3. Linear Parameters

| LINEAR ASPECTS OF DASANAPATTI SUB-WATERSHED | | | | | |
|---|------|------|-----|-------|------|
| SW | Fs | Dd | Td | Rb | LOF |
| SW3 | 1.49 | 0.85 | 3.7 | 16.94 | 1.66 |

**Fig.1. Linear Parameters**

Stream Frequency (Fs)

The Stream frequency is defined as the total number of stream segments of all orders per unit area (Horton, 1932). Generally high stream frequency is related to impermeable sub surface material, sparse vegetation, high relief and low infiltration capacity of the region. The stream frequency of all stream order is mentioned in Table 3. The study revealed that the Stream orders 1st Sub -watersheds have 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 Stream order 3 and 4 has low stream frequency because of low relief. Highest value of stream frequency noted for Stream order 2 (10.19 km/km²) and Stream order 3 (8.62km/km²) produces more runoff in comparison to others (Table .4).

Table 4. Stream Frequency

| Stream Order | Stream Number | Area in km ² | Stream Frequency |
|--------------|---------------|-------------------------|------------------|
| 1 | 133 | 1.96 | 1.38 |
| 2 | 107 | 10.5 | 10.19 |
| 3 | 10 | 1.16 | 8.62 |
| 4 | 2 | 7 | 0.28 |
| Total | 252 | | |

Drainage Density (Dd)

The drainage density is the stream length per unit area in a region (Horton, 1945 and Strahler, 1952). It is an essential element of drainage morphometry to study the landscape

dissection, runoff potential, infiltration capacity of the land, climatic condition and vegetation cover of the basin. Drainage density of the watershed is given in Table 3. It has been observed that low drainage density (0.85) is found to be associated with regions having highly permeable subsoil material under dense vegetative cover, and where relief is low while as high values of drainage density are noted for the regions of weak or impermeable subsurface materials, sparse vegetation and mountainous relief (Nag 1998). Hence in this study high drainage density was found in Stream order 4 and Stream order 3 because of impermeable sub surface material and mountainous relief. Low Dd value for Stream order 1,2 and 4 indicates that it has highly permeable sub surface material and low relief.

Drainage Texture (Dt)

The Drainage texture is defined as the total number of stream segments of all orders per perimeter of the area (Horton, 1945). The drainage texture depends upon a number of natural factors such as climate, rainfall, vegetation, rock and soil type, infiltration capacity, relief and stage of development (Smith, 1950) and classified drainage into five classes i.e., very coarse (<2), coarse (2-4), moderate (4-6), fine (6-8) and very fine (>8). The drainage texture found to be very coarse, value is 3.7 in the Dasanapatti sub-watershed catchment of Pulampatti Watershed.

Bifurcation ratio (Rb)

Bifurcation ratio related to the branching pattern of the drainage network is defined as a ratio of the number of streams of a given order to the number of streams of the next higher order. Bifurcation ratio is (16.94) supposed to be controlled by drainage density, stream entrance angles, lithological characteristics, basin shape, basin area etc. (Singh 1998) Bifurcation values are ranging from 1.2 to 3.6. The higher values of 2 and 5 order streams indicate well developed stream network. The bifurcation values in the 2nd and 4th order are low compared to the overall bifurcation ratio of the basin. Bifurcation values ranging from 17 to 20 suggest that it is a natural river system where uniformity is seen with respect to climate, rock type and stage of development. The purpose of stream ordering is not only to index size and scale but also to afford an approximate index of the amount of stream flow which can be produced by particular network.

Length of overflow Land (Lo)

It is one the most important independent variables affecting hydrological and physiographical development of a drainage

basin. It is the length of water over the ground before it gets concentrated into definite stream channels and is equal to half of drainage density (Horton, 1945). Length of overland flow relates inversely to the average channel slope. The shorter length of over land flow for PSW point out the quicker runoff process, than other Sub-Watersheds. The Length of the over land flow of PSW is 1.66.

Shape Parameters

Shape parameters include form factor, shape factor, elongation ratio, compactness ratio and circulatory ratio.

Form Factor (Ff)

Form factor is defined as the ratio of basin area to the square of the basin length (Horton, 1932). The values of form factor would always be less than 0.7854 (perfectly for a circular basin). High value of form factor stating the circular shape of the basin and Smaller the value of form factor more elongated will be the basin. Form factor value (Table 6). The observation shows that the PSW3(14) watersheds are highly elongated while as the watersheds PSW1, PSW2 and PSW4 are less elongated. The values of form factor for Pulampatti catchment indicates that the whole catchment is elongated. The elongated watershed with low value of form factor indicates that the basin will have a flatter peak flow for longer duration. Flood flows of such elongated basins are easier to manage than from the circular basin.

Table 6. Shape Aspects of Dasanapatti

| SHAPE ASPECTS OF DASANAPATTI SUB-WATERSHED | | | | | |
|--|----|------|------|------|------|
| SW | Ff | Re | Rc | Cc | Bs |
| SW3 | 14 | 0.91 | 2.47 | 1.23 | 0.07 |

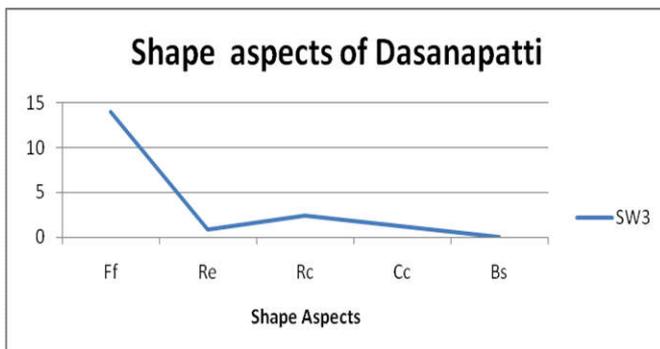


Fig.2. Shape Aspects of Dasanapatti

Elongation ratio (Re)

The elongation ratio is defined as the ratio between the diameter of the circle of the same area as the drainage basin and the maximum length of the basin (Schumm, 1956). Analysis of elongation ratio indicates that the areas with higher elongation ratio values have high infiltration capacity and low runoff. A circular basin is more efficient in the discharge of runoff than an elongated basin (Singh et al., 1997). The values of elongation ratio generally vary from 0.6 to 1.0 over a wide variety of climate and geologic types. Values close to 1.0 are typical of regions of very low relief, whereas values in the range 0.6 to 0.11 are usually associated with high relief and steep ground slope (Strahler, 1964). Shape of the PSW1 found to be elongated have low elongation ratio and less elongated

have high elongation ratio. In the watershed, these values are less than 0.91 and hence all the Sub-watersheds are generally elongated in shape.

Circularity Ratio (Rc)

Circularity ratio is defined as the ratio of the area of the basin to the area of a circle having the same circumference as the perimeter of the basin (Miller 1953). High value of circulatory ratio indicates the maturity stage of topography. The value 2.47 for PSW3 indicates very less circular in shape than the other sub-watersheds.

Compactness Coefficient (Cc)

It is defined as the basin perimeter divided by the circumference of a circle to the same area of the basin. Compactness coefficient is directly proportional to the erosion risk assessment i.e. lower values signifies less vulnerability for risk factors, while higher values indicates great vulnerability and represents the need of implementation of conservation measures. So the study reveals that PSW3(1.23) are moderate prone to erosion risk in the whole catchment.

Shape Factors (Bs)

It is the ratio of the square of the basin length (Lb) to area (A) of the basin (Horton, 1945) and is in inverse proportion with form factor (Rf).

Relief aspects of the Watershed

The relief aspects of sub-watershed are also important in water resources studies, direction of stream flow analysis and denudation conditions of the watershed. Relief aspects like basin relief (H), relative relief (Rp), relief ratio (Rh) and ground slope or ruggedness number (Rn) were measured.

Basin Relief (H)

Basin relief is described as the elevation difference between the reference points i.e. maximum vertical distance between highest (divide) and the lowest (outlet) located in the drainage basin. Schumm (1956) measured it along the longest dimension of the basin parallel to the principle drainage line. The relief for sub-watershed varies from 400 to 800 meters. The watershed have been divided into high, medium and low relief regions in which PSW3 are having Lowest basin relief. The lower relief of these sub-watersheds indicates high gravity of water flow as well as infiltration and low runoff conditions as well as sediment down the slope.

Table 7. Relief Aspects of Dasanapatti

| SW | Basin Relief | Relief Ratio | Relative Relief | Ruggedness Number |
|-----|--------------|--------------|-----------------|-------------------|
| SW3 | 700 | 4.86 | 10.29 | 823.52 |

Relief Ratio

Relief Ratio is the ratio of basin relief to the horizontal distance on which relief was measured (Schumm, 1956). According to Schumm (1956), there is a direct relationship between the relief and gradient of the channel. It measures overall steepness of the watershed and is also considered as an indicator for the intensity of erosion process occurring in the watershed. High value of relief ratio is the characteristics of

the hilly region. The relief ratio for watershed 4.86. It was noticed that the lower values of relief ratio for PSW3 indicated less slope and low relief.

Relative Relief (Rr)

Relative Relief (Rr) is the ratio of relief (H) to the perimeter of basin. It is an important morphometric variable used for the general estimation of morphological characteristics of terrain. The relative relief for watershed 10.29. The PSW3 having higher relative relief have higher runoff potential than others.

Ruggedness number (Rn)

Ruggedness number (Rn) is the product of drainage density (Dd) and basin relief (H) (Strahler, 1957; Melton, 1958) in the same unit. The highest value of ruggedness was observed in PSW3 (823.52), in which both total basin relief and drainage density values are high, i.e., in these sub-watersheds slope is very steep linked with its slope length. The sub-watersheds having low relief but high drainage density are ruggedly textured as areas of higher relief having less dissection. The higher ground slopes in case of above sub-watersheds lying in upper reach of the basin specify lower time of concentration of overland flow and the possibilities of soil erosion will be higher in these sub-watersheds. In relief aspect calculation, some of the linear (length, perimeter, etc.) and shape (drainage density) parameters are applied. Thus, the morphometric description has shown substantial role in differentiating the

hydro-topographical behavior of the watershed through the analysis of linear, areal and relief aspects of the sub-watersheds.

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