ISSN: 2230-9926

Available online at http://www.journalijdr.com

IJDR

International Journal of Development Research
Vol. 07, Issue, 11, pp.17158-17164, November, 2017

ORIGINAL RESEARCH ARTICLE **Open Access**

MORPHOMETRIC ANALYSIS OF KALLARPATTI SUB-WATERSHED, MATHUR TALUK, KRISHNAGIRI DISTRICT

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ARTICLE INFO

Article History:
Received 17th August 2017
Received in revised form
28th September, 2017
Accepted 12th October, 2017
Published online 30th November, 2017

Key Words:
Watershed characteristics analysis,
morphological studies,
Sub-watershed.

ABSTRACT

The land use pattern of a sub watershed is an outcome of both natural and socio-economic factors and their utilization by population in time and space. Land is becoming a scarce commodity due to immense agricultural and demographic pressure. Change in land use is a dynamic process taking place on the surface and it becomes most important factor for managing natural resources. In the current study Remote Sensing technique is used to analyses the Watershed characteristics analysis of Kallarpatti Sub-Watershed, Mathur Taluk, Krishnagiri district.

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Citation: Raja, A., Dr. Gunasekaran, P. and Dr. Ilanthirayan, A., 2017. "Morphometric Analysis of Kallarpatti Sub-Watershed, Mathur Taluk, Krishnagiri District", *International Journal of Development Research*, 7, (11), 17158-17164.

INTRODUCTION

Mohanty, (1994) Analysis of urban land use change using sequential aerial photographs and Spot data. An example of north Bhubaneswar, Orissa. In India as well as in most developing countries, the excessive growth in population and the increased trend towards urbanization have led to many evils such as haphazard growth of industries, unplanned housing and utility networks, conversion of precious agricultural and forest land into urban land etc. Urban Land is one of the important resources provided to man by which necessary human activities are performed. Inaccurate and up to date information about the urban land is indispensable for scientific planning and management of urban resources of an area taking into consideration the potentials and the constraints to the environment. Alphan, 2003: "Land use change and urbanization in Adana, Turkey", Land degradation and Development the rational planning and management of urban is possible through the regular survey of the land use helps in delineating land suitable for various activities. The IRS-LISS and PAN sensor provides high ground resolution and specified spectral resolution data for detailed studies of urban land use and for monitoring land use changes. Brahabhatt *et al.* 2000: "Land use/land cover change mapping in Mahi canal command area, Gujarat, using multitemporal satellite data This study was undertaken for mapping the unplanned development in the Tiruchirapalli town region including its peripheral zones using IRS data and to provide up to-date information to the planners so as to fill up the gap between urban growth and information collection process.

Study area

The mattur odai watershed origin from NE potion of the study area and flowing towards SE of the study area via. Jagadevipalayam, Goddampatty, Madarahalli, cinnappampatty, Mattur,. The total area of watershed is 410sq km.within 10 Revenue village. From the mattur Taluk,krishnagiri district. The major Revenue village, within the mattur and their adjoining places. The study area Extent 78˚15´to 78˚30´ E longitude and 12˚30´to 12˚15 ´latitude N. The major physical futures controlled by the study area are fluvial and ground

water system followed in the most of the study area. (Map No 2.1). Mattur odai watershed is train and locked in the mattur taluk. The mattur odai train NW to SE direction and flowing via jagadevipalayam, goddampatti, madarahalli, cinappampatti, mattur. The river flowing on the NW to SE potion with the length of 46 km. (Map No 2.3). The land utilization of any fertile or dry lands based on the soil and surrounds the nature. The study area major soils Red soil, clay soil, Alluvial soil .The most of the study area is controlled wherever available source of water and fine texture of soil holding fine texture. The study area major settlement of transport and communication mattur odai well connected road and rail transport .the road system well connected in and around of the mattur taluk the major roots and nearest town district. Dharmapuri, and Salem.

Objectives

The present study concentrated the watershed characteristics studies of Kallarpatti sub-Watershed, Mathur odai 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. In addition, study the watershed morphological characteristics in the end.
- To concluded/ derived the status of the watershed / sub-watersheds condition and recent population states of the study area.

MATERIALS AND METHODS

- 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 Population data in 2011 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, remodify and 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.

RESULTS AND DISCUSSION

Sub-Watershed

The present study relevent the mathur odai, found along the Taluk of Kirshnagiri District, for there sub divided four sub watersheds Kallarpatti, Mathur, Jegadevipalayam, Veppalampatti are given below and s widen the physio and cultural aspects of watershed. Kallarpatti located southern edge of the study area. It extend 78 21'- 78 E latitudes and longitudinally 12 21' – 12 25' N of region. The region are derived Physiography. Physiography is mainly location with semi – plateau region with fully open scrub forest lands. The fluvial system only corbelled the kallarpatti zone. Mathur sub watershed – ii is found in the south – eastern portion of the percent study area. It extend 78 24' – 78 26' E latitudes and 12 23' – 12 28' N longitudes of the regions. The regions are physiography features are plain with semi – plateau occupied the open lands with or without scrubs of regions. The mathur river flowing with adjacent area of other sub watersheds. The present sub watershed is located North Eastern portion of the study area. They are extend 78 18' – 78 23' E latitudes and 12 23' – 12 27' N longitudes of the sub watershed-(MSW3). The physiography of the study area plain with semi – plated in nature of the study area. The fluvial system are controlled the physical characteristics of the study area. The sub watershed – IV veppalampatti located north western portion of the mathur watershed. It extend 78 15' – 78 20' E latitudes and 12 21' – 12 27' N longitudes of the study areas. The physiography of the sub watershed – IV are plain with plateau are the map or relief features. It other words the plain with open scrub present in the study area.

Morphometric analysis of the sub-watersheds

Kallarpatti Sub-Watershed (SW1) - Morphometric Analysis

Introduction

The Kallarpatti (SW1) sub-watershed is one of the Mathur 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 104 sq.km and stream length of the watershed is22.6sq.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 (SW1) Kallarpatti sub-Watershed total number of streams found is209 out of which 121 is of first order,57 of second, 23of third order, 7 of fourth.7 and fifth is 1. The watershed wise number, order and length are given in Table 1. It reveals that maximum number of streams is found in First order (121) and minimum number found in fifth order (1), it is also noted that first order streams are highest in number in all micro watersheds while highest order has the lowest number. The (SW1) Kallarpatti sub-Watershed covering an area 104.

Stream Length (Lu)

Average length ratio is 0.262 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.

Table 1. Stream Orders and Stream Numbers MSW1

Stream Orders	No of Streams	Bifurcation Ratio	z	Mean Length(km)	Length ratio	Mean ratio
1	121	2.12	83.6	0.37	0.47	
2	57	2.47	73.5	0.32	0.40	
3	23	3.28	41	0.18	0.30	0.262
4	7	12	21.3	0.09	0.40	
5	1	0	7	0.03	0	

Stream Length Ratio (RI)

Table 2. Area Ratio- Kallarpatti (SW1)

Stream Orders	Stream Numbers	Area in Km2	Mean area	Area Ratio
1	121	0.83	0.36	0.88
2	57	0.73	0.32	0.53
3	23	0.41	0.17	0.52
4	7	0.21	0.09	0
5	1	0.7	0	0
Total		2.28		

Linear Aspects

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

Table 3. Linear Parameters of the Kallarpatti (SW1)

Linear parameters of kallarpatti sub-watershed					
SW	Fs	Dd	Td	Rb	LOF
MSW1	2	0.027	4.64	15.87	3.57

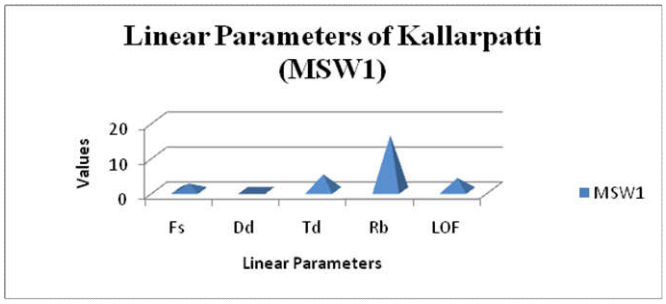

Fig. 1. Linear Parameters of Kallarpatti(SW1)

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 1 (144 km/km2) and Stream order 2 (56 km/km2) produces more runoff in comparison to others (Table 4).

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 4. It has been observed that low drainage density 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 1 and Stream order 2 because of impermeable sub surface material and mountainous relief. Low Dd value for Stream order 3 and 4 indicates that it has highly permeable sub surface material and low relief.

Table 4. Stream Frequency- Kallarpatti (SW1)

Stream Order	Stream Number	Area in km2	Stream Frequency
1	121	0.84	144
2	57	0.74	77
3	23	0.41	56
4	7	0.22	31
5	1	0.7	1.42
Total		2.91	309

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 4.64 in the Kallarpatti (SW1) sub-watershed catchment of Mathur 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 supposed to be controlled by drainage density, stream entrance angles, lithological characteristics, basin shape, basin area etc. (Singh 1998) Bifurcation values are ranging from 15 to 17 The higher values of 1 and 3 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 Kallarpatti (SW1) point out the quicker runoff process, than other Sub-Watersheds. The Length of the over land flow of Kallarpatti (SW1) is 3.57.

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 (Table4.6). The observation shows that the MSW1(16.64) watersheds are highly elongated while as the watersheds MSW1, MSW2 and MSW3 are less elongated. The values of form factor for Mattur 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 Kallarpatti (SW1)

Shape parameters of mattur watershed					
SW	Ff	Re	Rc	Cc	Bs
MSW1	16.64	0.02	2.31	1.15	0.08

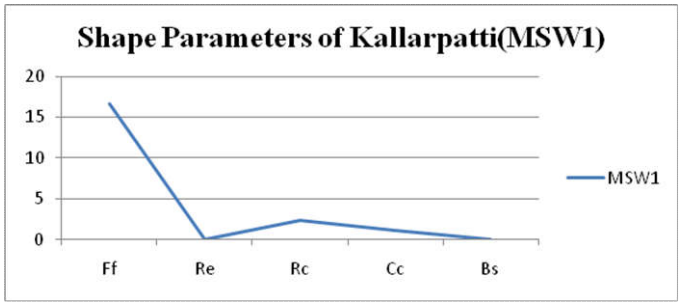

Fig. 2. Shape Aspects of Kallarpatti (SW1)

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 (Schumn, 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 0.8 are usually associated with high relief and steep ground slope (Strahler, 1964). Shape of the Table No 4.6 Shape Aspects of Kallarpatti (SW1) found to be elongated have low elongation ratio and less elongated have high elongation ratio. In the watershed, these values are less than 0.02 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 value2.31 for Table No 4.6 Shape Aspects of Kallarpatti (SW1)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 Table No 4.6 Shape Aspects of Kallarpatti (1.072) 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 from360 meters. The watershed have been divided into high, medium and low relief regions in which Table No 4.6 Shape Aspects of Kallarpatti (SW1) 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.

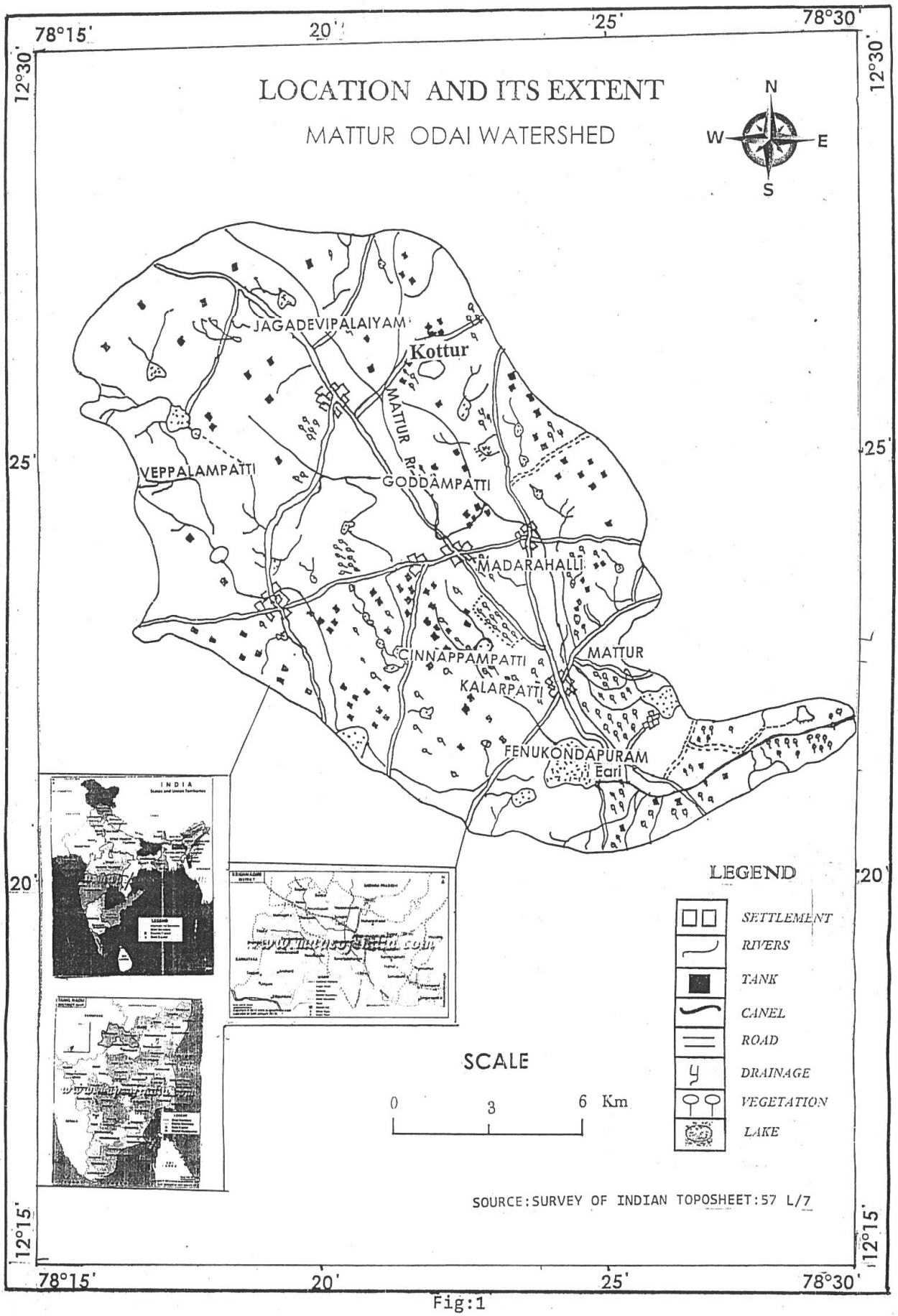
LOCATION AND ITS EXTENT
MATTUR ODAI WATERSHED
N
W
E
S
78°15'
20'
25'
78°30'
12°30'
12°15'
JAGADEVIPALAIYAM
Kottur
MATTUR R.
VEPPALAMPATTI
GODDAMPATTI
MADARAHALLI
CINNAPPAMPATTI
KALARPATTI
MATTUR
FENUKONDAPURAM
Eari
INDIA
LEGEND
SETTLEMENT
RIVERS
TANK
CANEL
ROAD
DRAINAGE
VEGETATION
LAKE
SCALE
0
3
6 Km
SOURCE:SURVEY OF INDIAN TOPOSHEET:57 L/7

Fig:1

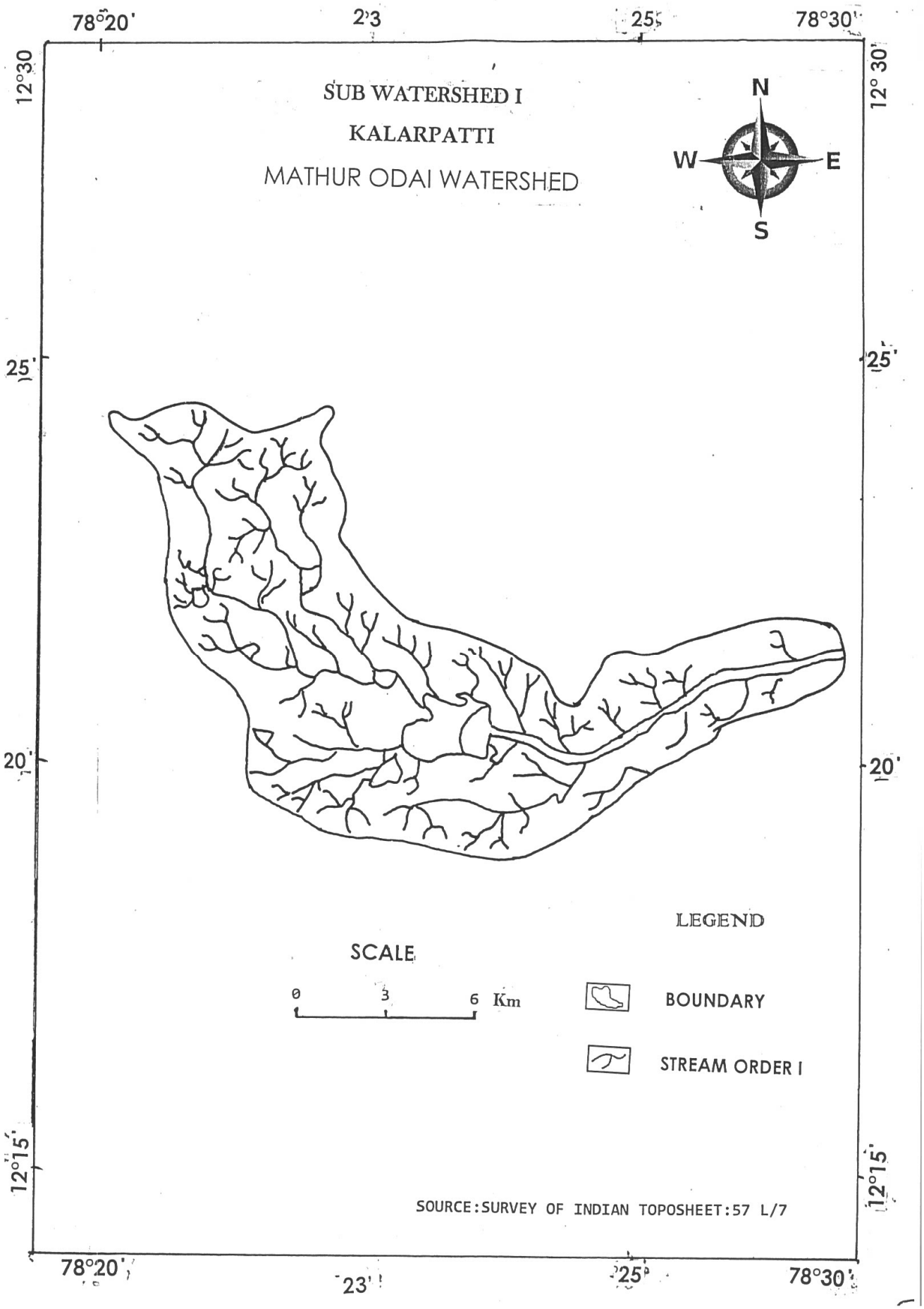
78°20'
23'
25'
78°30'
12°30'
25'
20'
12°15'
SUB WATERSHED I
KALARPATTI
MATHUR ODAI WATERSHED
N
W
E
S
LEGEND
SCALE
0 3 6 Km
BOUNDARY
STREAM ORDER I
SOURCE:SURVEY OF INDIAN TOPOSHEET:57 L/7

Table 7. Areal Aspects of Kallarpatti (SW1)

Relief aspects of kallarpatti sub-watershed				
SW	Basin Relief	Relief Ratio	Relative Relief	Ruggedness Number
SW1	360	1.59	8	0.009

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 1.59. It was noticed that the lower values of relief ratio for Kallarpatti (SW1) 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 8 The Kallarpatti (SW1) 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 Kallarpatti (SW1)0.009,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.

Conclusion

Kallarpatti sub-Watershed total number of streams found is209 out of which 121 is of first order,57 of second, 23of third order, 7 of fourth.7 and fifth is 1. Highest value of stream frequency noted for Stream order 1 (144 km/km2) and Stream order 2 (56 km/km2) produces more runoff in comparison to others. Hence in this study high drainage density was found in Stream order 1 and Stream order 2 because of impermeable sub surface material and mountainous relief. Shape parameters include form factor, shape factor, elongation ratio, compactness ratio and circulatory ratio. 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.

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