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WATERSHED CHARACTERISTICS ANALYSIS OF NANGAVALLI AND TOPPAI ODAI, MATTUR TALUK, SALEM DISTRICT

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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 Nangavalli and Toppai Odai, Mettur Taluk, Salem district.

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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: "Landuse/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 nangaveli and topaz ordain exigent western portion of the Metter hill with flowing diverted north eastern size of Metter ' mecheri other places [fig.1] the total area watershed his ^{156km} nearly 50 Revenue villages From foundry of watershed his calling from Salem District the major talk of the watershed his Metter and mecheri the watershed his one of the tributaries caver the study area except 77 45 to 78 0 East latitude and 12 0 to 11 45 of the major physiographic features controlled undulating, structural and pediplane of study areaThe river or streams trains in the undulating zone of Metter talk the study area nearly and table] showing the details of present study area. The present study area located North western portion of Salem district with drain nangavelli and toppai odai there watershed origne from west of study area in addition to the present study area the North portion only controlled by fluvial in nature. The controlling factors of the drainage with lineaments are parallels. The land utilization of any lands is based on soil chartered with soil structure soil productivity and soil capability the present study area major soil grapes are alluvial soil occupied along the river his pottentional crops the mecheri occupied brown with red is soils the north west portion at joining Metter hill soil the soil crops classified NBSS Government of India, all India and land use organization government of India.

RESULT AND DISCUSSION

Introduction

A watershed is an area of land that drains into a common water body, such as a stream, river or lake. A watershed can also be known as a basin or a catchment area. Human activities have a direct influence on the quality and quantity of surface water, groundwater and other natural resources in the watershed. Watershed comprises surface water, groundwater and other natural resources, which are influenced by human activities. Quality and quantity of downstream has direct connection with the upstream activity of stream. The drainage basin is used as an ideal areal unit for geomorphometric analysis because it has inherent limited, convenient and usually clearly defined and unambiguous topographic unit. Moreover, available in a nested hierarchy of sizes on the basis of stream ordering and an open physical system in terms of inputs of precipitation and solar radiation of drainage basin .

Morphometric analysis

Morphometry study constitutes measurement and mathematical analysis of the configuration of the earth's surface and the shape and dimensions of its landforms. GIS techniques are used to compute and measure the morphometric parameters includes bifurcation ratio, stream length, form factor, circulatory ratio and drainage density etc.

Linear aspects of the basin

Stream order

The order of the stream is based on the connection of tributaries. Stream order is used to represent the hierarchical link among stream segments and allows drainage basins to be classified according to size. Stream order is a fundamental property of stream networks as it relates to the relative discharge of a channel segment. A number of stream-ordering systems in the present study have been used which was formulated by Arthur N. Strahler. According to the author, first order streams are having no stream tributaries and that flows from the stream source. A second-order segment is created by joining two first-order segments, a third-order segment by joining two second order segments, and so on. There is no increase in order when a segment of one order is connected by some other lower order. Strahler‟s stream order has been applied by many researchers for river systems. The highest stream order observed in the present study area is fourth order out of observed streams.508.32 first order, 261.3 second order, 121.11third order, 87.8fourth order 31.72 and fifth order14.8 streams were observed. Dendritic drainage pattern formed by the interlinking of streams is observed in the study area which indicates the homogeneity in texture and lack of structural control. Dendritic drainage has a spreading, tree-like pattern with an irregular branching of tributaries in many directions and with any angle. It is observed from the Table 1, that the maximum frequency is in case of first order streams. It is noticed that there is a decrease in stream frequency as the stream order increases (Table 1).

Table 1. Stream Orders of Nangavalli and Toppai Odai

Stream orders-nangavalli and toppai watershed					
SW	SO1	SO2	SO3	SO4	SO5
NTSW1	42.1	19.4	12.6	4.42	3.6
NTSW2	56.5	19.41	29.4	5.2	0
NTSW3	40.8	28.2	20.3	3.9	3.4
NTSW4	81.4	40.2	16.7	14.4	3.1
NTSW5	40.5	13.9	8.8	3.8	3.2

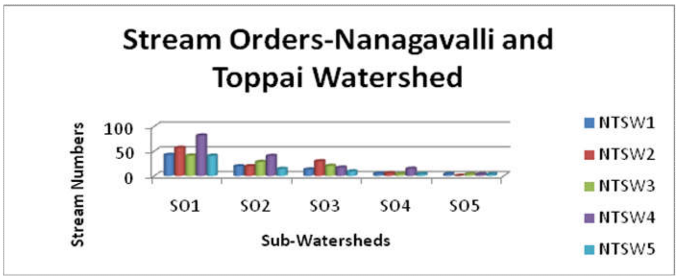


Fig 1. Stream Orders of Nangavalli and Toppai Odai

Bifurcation ratio

In morphometric analysis a generally used topological property is the bifurcation ratio. It is the ratio between the number of stream segments of one order and the number of the next higher order. A mean bifurcation ratio is usually used because the ratio values for different successive basins will vary slightly. With relatively homogeneous lithology, the bifurcation ratio is normally not more than 5 or less than 3. The lower bifurcation ratio values are characteristics of the watersheds which have suffered less structural disturbances. Bifurcation ratio, speculated to be controlled by drainage density, stream entrance angles, lithological characteristics, basin shapes, basin areas etc.

Table 2. Bifurcation Ratio of Sub-Basin in NTSW

SW	Rb1	Rb2	Rb3	Rb4	Rb5
SW1	2.17	1.53	2.85	1.22	3.6
SW2	2.91	0.66	5.65	5.2	0
SW3	1.44	1.38	5.2	1.14	3.4
SW4	2.02	2.4	1.16	4.64	3.1
SW5	2.91	1.57	2.31	1.18	3.2

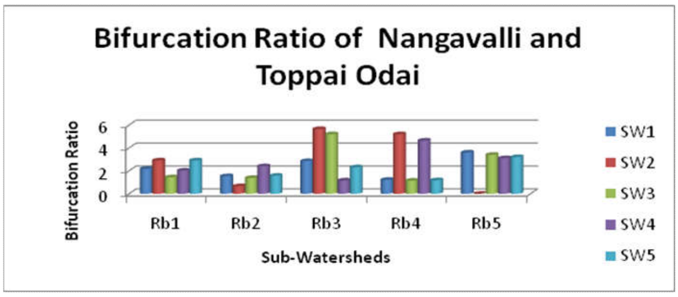


Fig. 2. Bifurcation Ratio of Sub-Basin in NTSW

Stream length

GIS technique is used to count the number of streams of various orders in a sub-watershed and to measure their lengths from mouth to drainage divide (Table 1). The stream length has been computed based on the law proposed by Horton [5]. Generally, the total length of stream segment is maximum in first order streams and decreases as the stream order increases. Total lengths of 5 sub basins are 21.8, 13.8, 18.7, 31.9, and 18.1 km respectively.

Table 3. Stream Length of Sub-Basin in NTSW

Sream lengths-nangavalli and toppai watershed					
SW	SL1	SL2	SL3	SL4	SL5
NTSW1	57	31	8	3	2
NTSW2	48	29	11	4	1
NTSW3	46	31	9	1	1
NTSW4	98	61	20	9	5
NTSW5	46	25	10	6	4

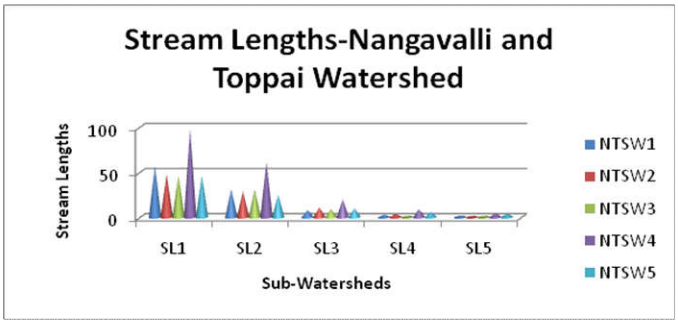


Fig. 3. Stream Length of Sub-Basin in NTSW

AREAL ASPECTS OF THE BASIN

Geometry of Basin shape

The shape of watershed is dependent on size of basin and length of master stream of the basin and basin perimeter. Thus shape of a basin affects stream flow hydrographs and peak flows. The important parameters describing the shape of the basin are form factor (F), circulatory index (C) and elongation ratio (R).

Horton's form factor (F)

Form factor is defined as the ratio of the area of the basin to the square of the length of the basin. The value of „F" generally changes from 0 (highly elongated shape) to 1 (perfect circular shape). Therefore, higher the value of form factors, more the circular the shape of basin and vice-versa.

F = A/ L2

Horton"s form factor for 5 sub basins is 0.25,0.63,0.27,0,108 and 0.42 respectively. The present sub basins are having values near to 0 rather than 1. Thus, shapes of the all sub basins are more or less elongated. Elongated basins with low form factor indicate that the basin will have a flatter peak of flow for longer duration. Flood flows in elongated basins are easier to control than of the circular basins.

V.C. Millers Circularity Index (C) (1953)

Circulatory index is the ratio between the area of the basin and the area of the circle having the same perimeter as that of the basin.

C = Area of the basin/Area of the circle with same perimeter as the basin

The value of „C" generally changes from 0 (a line) to 1 (circle). The higher the value of „C", more the circular shape of the basin and vice versa. The value of „C" Circularity index of 1st, 2nd and 3rd, 4th 5th 5 sub basins is 2.72, 2.60, 2.18, 2.61, and 2.91 respectively.

S.A. Schumm's (1956) Elongation ratio (R)

Elongation ratio (R) is the ratio between the diameter of the circle having the same area (as that of the basin) and the maximum length of the basin.

R = Diameter of the circle with same area as basin /Basin length
Or F = H/4 R2

The values of „R" for 1st, 2nd and 3rd and 4th 5th sub basins are 0.02, 0.115, 0.19, 0.29, and 0.13 respectively.

Stream frequency (Fs)

Stream frequency is the measure of number of streams per unit area also called drainage frequency. Stream frequency of basin area is 2.11. and that of 5 sub basins are 0.69, 0.92, 0.97, 1.44, 0.48 respectively. Stream frequencies primarily depend on lithology of the basin and the texture of drainage network. The sub basins 1st and 2nd and 3d having poor categories of stream frequency and that of sub basin 5th is very poor.

Table 4. Linear Parameters of the NTSW

Linear parameters-nangavalli and toppai watershed					
SW	Fs	Dd	Td	Rb	LOF
NTSW1	0.69	0.18	1.86	9.2	0.55
NTSW2	0.92	0.115	2.4	14.42	0.86
NTSW3	0.97	0.19	2.12	12.56	1.19
NTSW4	1.44	0.29	3.66	13.08	0.34
NTSW5	0.48	0.13	1.42	11.17	0.77

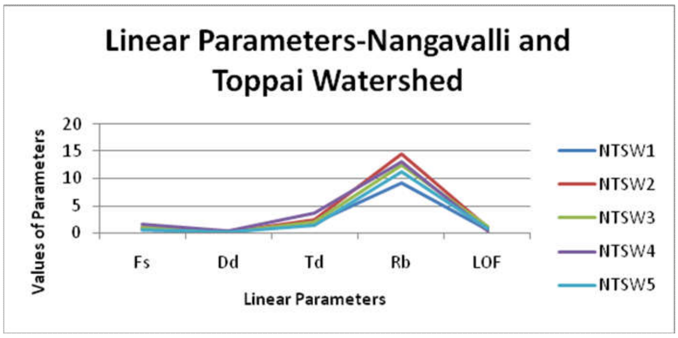
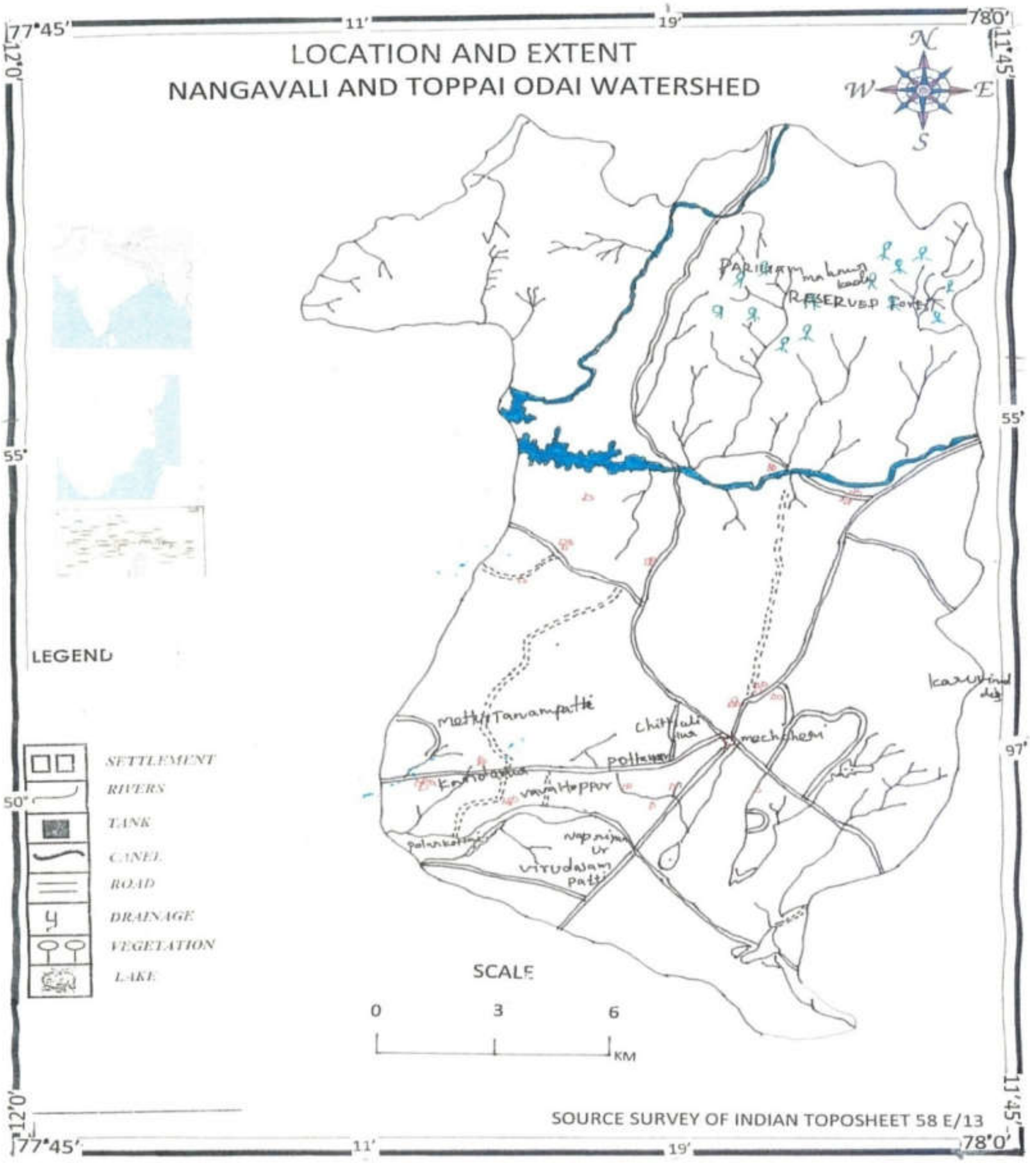


Fig. 4. Linear Parameters of the NTSW

Drainage Density (Dd)

Drainage density is the most important property of drainage morphometry, which is the total stream length of channel per unit area of drainage basin. Drainage density is a measure of how frequently streams occur on the land surface. It reflects a balance involving erosive forces and the resistance of the ground surface, and is thus related directly to climate, precipitation, permeability, lithology, and vegetation. A drainage density varies from less than 5 km/km^2 when slopes are gentle, low rainfall, and permeable, fractured, highly jointed bedrock.



On other hand, values of more than 500 km/km^2 in upland areas are possible where rocks are impermeable, slopes are steep, and high rainfall. The drainage density of overall basin is 0.905 and for sub basins 1st, 2nd, 3rd 4th 5th are 0.18, 0.115, 0.19, 0.29 and 0.13 respectively.

Table 5. Shape Parameters of NTSW

Shape parameters-nangavalli and toppai watershed					
SW	Ff	Re	Rc	Cc	Bs
NTSW1	0.25	0.02	2.72	1.36	3.96
NTSW2	0.63	0.115	2.6	1.36	Jan-00
NTSW3	0.27	0.19	2.18	1.09	3.64
NTSW4	0.108	0.29	2.61	1.3	9.25
NTSW5	0.42	0.13	2.91	1.45	2.34

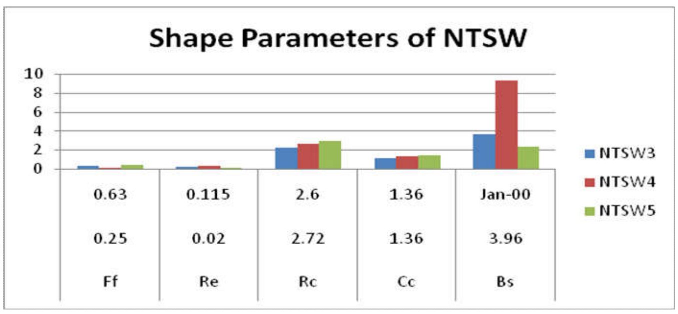


Fig. 5. Shape Parameters of NTSW

Drainage Texture

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. Drainage texture is used to indicate relative spacing of the streams in a unit area along a linear direction. The soft or weak rocks unprotected by vegetation produce a fine texture, whereas massive and resistant rocks cause coarse texture. The finer drainage textures observed in arid climatic condition and coarser is in a humid climate. The texture of a rock is commonly dependent upon vegetation type and climate. Drainage texture is the product of Drainage density and stream frequency. The drainage texture of the whole basin is 11.46, while those of the 5 sub-basins are 1.86, 2.40,2.12,3.66, and 1.42 respectively (Table 4). The first sub basin is showing good relationship with drainage texture than second and third sub basin.

Conclusion

In the present study, morphometric features of drainage are identified and mapped by Manual methods of data.

The study of Nangvalli and Toppai odai, proves to be competent tools in morphometric analysis and provide very high accuracy of mapping & measurement. The drainage density and stream frequency are the decisive factor for the morphometric classification of drainage basins. These are controllers of the runoff pattern, sediment yield and other hydrological parameters of the drainage basin. The drainage density of NTSW watershed, and sub-basins, reveal that the subsurface strata are permeable. This is a characteristic feature of coarse drainage as the density values are less than 0.13. The highest order of stream is Second order. The numbers of lower order streams are more than the higher order streams. The low value of bifurcation ratio (9.2) indicates that the drainage of the basin is not affected by structural disturbances. This is possibly due to small area occupancy of the sub basin. The steam length decreases with the order increases. The morphometric analysis shows that the basin is having elongated in shape. Drainage network of the basin exhibits as mainly dendritic type which indicates the homogeneity in texture and lack of structural control.

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