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Research paper

Study on Surface Runoff Estimation for Puzhal Lake Using GIS

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Abstract

To make greater in grow in land use/cover have lead to environment change in Puzhal Lake and flooding in under areas. environmental condition and the utilization of apparatus for cultivating in the zone are causing issues of soil degradation. Runoff is one in every of most vital hydrological factors that are utilized as a part of numerous common works, anticipating ideal utilization of supplies, sorting out waterways and cautioning flood. Appropriate to the spatial and transient fluctuation of the variables associated with surface runoff, the use of a displaying plan in a GIS ecological gives a productive way to deal with decide zones of concern. Three surface runoff models were connected including: the record strategy, SCS bend number technique, a semi physical way to deal with evaluate the dissemination of surface runoff. The customary SCS-CN strategy for computing the composite curve number devours a noteworthy part of the hydrologic displaying time. Hence, geographic data frameworks (GIS) are presently being utilized as a part of mix with the SCS-CN technique.

Keywords: *Surface, Runoff, Estimation, Puzhal Lake and GIS.*

1. Introduction

Lakes are an essential element of the Earth's landscape. They are to a great degree profitable ecosystems and give a scope of products and enterprises to mankind. They are a noteworthy wellspring of valuable water, as well as stretch out important territories to plants and creatures, direct the hydrological extraordinary occasions (dry spell and surges), impact microclimate, improve the tasteful magnificence of the landscape and offer numerous recreational openings. Most essential and normal type of lake debasement is that of disintegration of water quality because of natural pollution from transfer of local wastewater and other strong squanders. Eutrophication, (i.e.) improvement with supplements, is another major and most far reaching issue in all lakes. Enhancement happens as a result of supplements entering with the runoff from the catchments. Siltation on account of high dregs stack in the runoff caused by breaking down is in like manner a troublesome issue in all provisions and lakes.

The assurance of the runoff esteem is essential for planning of dams, repository administration and forecast of dangers and potential misfortunes caused by flooding. Additionally deciding measure of the runoff is essential in ventures identified with dregs and erosion forms. There are different strategies for evaluating runoff in the bowls that they have insufficient information. Curve Number strategy (SCS-CN) is a standout amongst the most generally utilized methodologies for quick and exact figuring of the bowl surface runoff. This approach includes the utilization of a straightforward experimental recipe and promptly accessible tables and curves. It is a strategy that can fuse the land use for calculation of runoff from rainfall.

2. Methodology

Fig.1 shows the methodology of this study

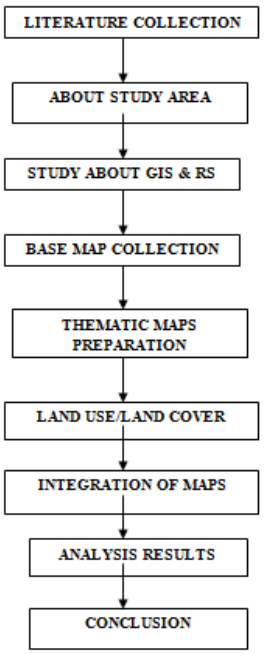


Fig.1: Methodology

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3. About Study Area

Puzhal lake, also known as the Red Hills Lake, is located in Chennai City, Red Hills, Thiruvallur district, Tamil Nadu, South India. Fig.2 shows the study area.



Fig.2: Study area

Fig.3 shows the study area.

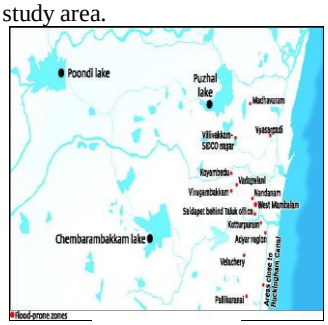


Fig.3: Study area

Fig.4 shows the district map.

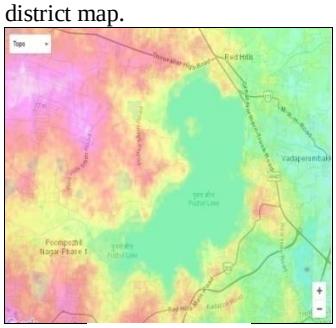


Fig.4: District map

Fig.5 shows the land use pattern.

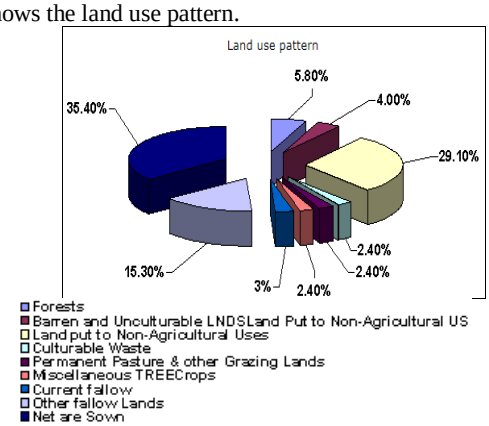


Fig.5: Land use pattern

4. Rain Water Inflow into Dry Puzhal Lake

Soil Conservation Service (SCS) display was utilized for the estimation of runoff from a farming watershed specifically the Red slopes watershed, which is around 83.59 km^2 and part of Korattaliyar waterway bowl catchment, arranged in Thiruvallur locale of Tamil Nadu state in India. Fig.6 shows the satellite map of Puzhal lake.

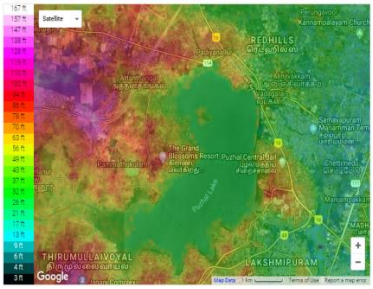


Fig.6: Satellite map of Puzhal lake

Fig.7 shows the topography.

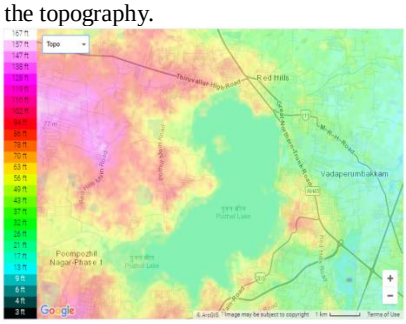


Fig.7: Topography

4.1. SURFACE RUNOFF

Surface runoff (otherwise called overland stream) is the stream of water that happens when overabundance storm water, dissolve water, or different sources streams over the Earth's surface. Runoff that happens on the ground surface before achieving a channel is additionally called a nonpoint source.

4.2. Generation

Fig.8 shows the surface runoff from a hillside after soil is saturated.



Fig.8: Surface runoff from hillside

Surface runoff can be produced either by rainfall, snowfall or by the softening of snow, or icy masses. Snow and ice sheet liquefy happen just in territories sufficiently frosty for these to shape for all time. Normally snowmelt will crest in the spring and ice sheet soften in the mid year, prompting articulated stream maxima in waterways influenced by them.

4.3. Rainfall Data

Table 1 shows the monthly average rainfall data.

Table 1: Monthly average rainfall data

Monthly average rainfall data at Red hills Area (2013-2016) (Average) in mm													
YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
2013	0	44.2	22.7	3.5	1.4	71.7	145.9	170.7	241.8	215.7	119.8	27.6	1064.9
2014	0	0.1	0	0	17.5	85.2	101.3	121.9	136.1	245	191.5	127.3	1026.8
2015	1.4	0	0.5	54.4	24.5	57	163.2	172.7	88.3	178.2	995.6	419.3	2155.2
2016	0.33				186.53	133.93	36	14.40	249.20	7.0	34.87	210.9	873.46

5. GIS Result

Fig.9 shows the location of the Puzhal Lake.

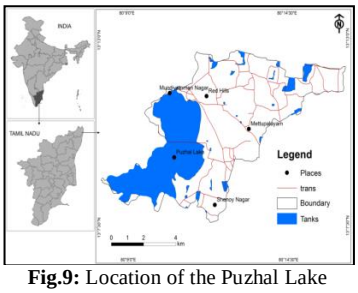


Fig.9: Location of the Puzhal Lake

Fig.10 shows the IRS P6 LISS III satellite data.

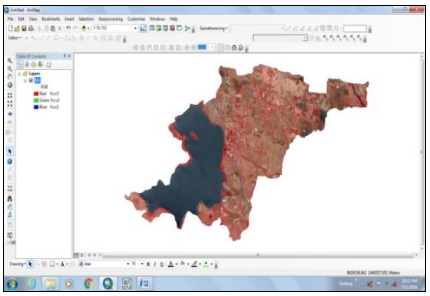


Fig.10: IRS P6 LISS III satellite data

Fig.11 shows the drainage map.

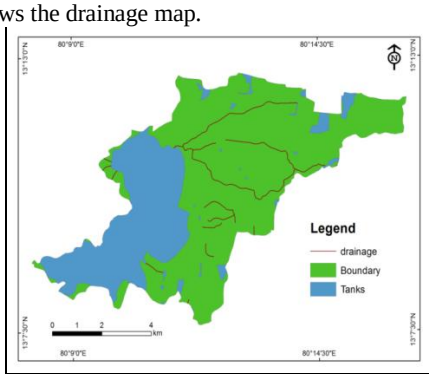


Fig.11: Drainage map

Fig.12 shows the drainage density map.

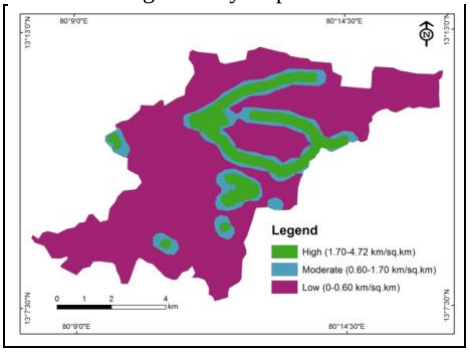


Fig.12: Drainage density map

Fig.13 shows the geomorphology.

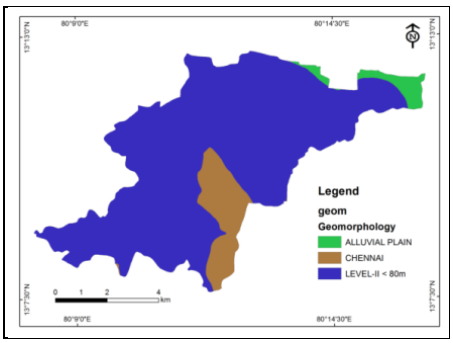


Fig.13: Geomorphology

Fig.14 shows the lithology map.

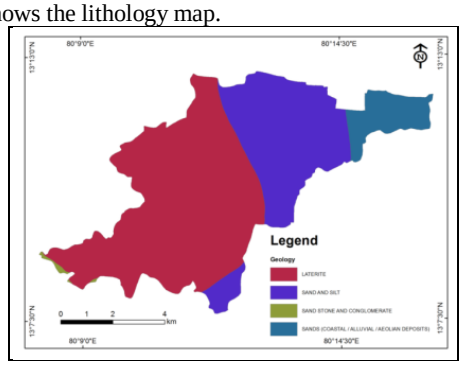


Fig.14: Lithology map

Fig.15 shows the soil order map.

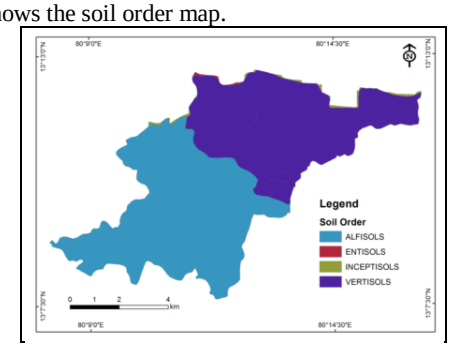


Fig.15: Soil order map

Fig.16 shows the land use / land cover map.

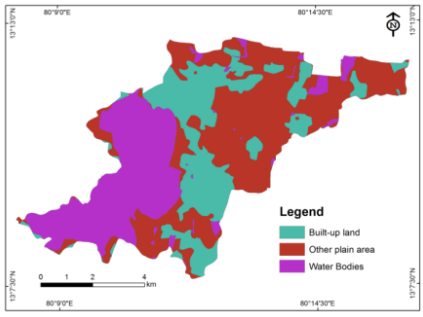


Fig.16: Land use / land cover map

5.1. Evaluating Curve Number

Table 2 shows the soil group and corresponding soil texture.

Table 2: Soil group and corresponding soil texture

Soil group	Runoff description	Soil texture
A	Low runoff potential because of high infiltration rates	Sand, loamy sand and sandy loam
B	Moderately infiltration rates leading to Moderately runoff potential	Silty loam and loam
C	High /moderate runoff potential because of slow infiltration rates	Sandy clay loam
D	High runoff potential with low infiltration rates	Clay loam,silty clay loam,sandy clay, silty clay and clay

Table 3 shows the Runoff curve number for combinations of different land cover and hydrological soil groups

Table 3: Runoff curve number for combinations of different Land cover and hydrological soil groups

Hydrologic soil Group				
Land cover/Land use	A	B	C	D
Built up	74	85	90	92
Cropland	72	81	88	91
Fallow land	77	86	91	94
Forest	43	65	76	82
Waste land	77	86	91	94
Water body	98	98	98	98

Table 4 shows the runoff estimation of themes.

Table 4: Runoff estimation of themes

Layers	Theme weight	Feature classes	Feature weight
Drainage density	20	Low (0-0.60 km/sq.km)	4
		Moderate (0.60-1.70 km/sq.km)	6
		High (1.70-4.72 km/sq.km)	9
Geomorphology	20	Alluvial plain	9
		Chennai	8
		Level II <80m	6
Lithology	20	Laterite	9
		Sand and silt	8

Fig.17 shows the runoff condition of the Puzhal Lake.

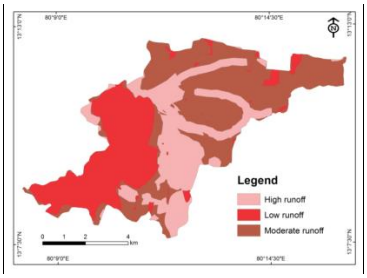


Fig.17: Runoff condition of the Puzhal Lake

5.2. Annual Rainfall Data and Runoff Estimation

Annual Precipitation = 2155.2mm (as per given rainfall data)

Table 5 shows the annual rainfall and runoff for Puzhal Lake.

Table5: Annual rainfall and runoff for Puzhal Lake

Year	Rainfall (mm)	Surface runoff(mm)
2013	1064.9	978.80
2014	1025.8	939.89
2015	2155.2	2066.76
2016	873.46	788.590

Fig.18 shows the rainfall surface runoff relationship based on year for Puzhal Lake.

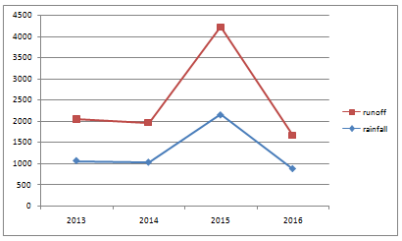


Fig.18: Rainfall surface runoff relationship based on year for Puzhal Lake

From SCS Curve number, the maximum runoff for the Red hills (Puzhal Lake) was estimated to be 2066.76 mm in the year 2015 at the time of Flood in Chennai and minimum runoff of 788.590 mm in the year 2016. Table 1 shows the annual rainfall and runoff for Red hills (**Puzhal Lake**) the period 2013 to 2016.

6. Conclusion

The total estimated surface runoff is mainly used to plan for efficient proper water and land management in Puzhal lake study area. Toward this path, rainfall– runoff model will help in knowing the measure of runoff with the goal that the other editing example can be recommended for the accessible water. The total outcome from surface run off encourages us to take up give water preservation measure. Water administration practices can be characterized in to two gatherings to be specific vegetative measures and building measures. Both these measures are fundamental and similarly critical. The thematic maps i.e. drainage and slope outline utilizing GIS condition help in surge administration. The surge peril maps created can help in prediction of flooding stretches of the waterway for a given precipitation hyetograph and the varieties for the investigation territory.

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