ESTIMATION OF RUNOFF FOR REDHILLS WATERSHED USING SCS METHOD AND GEOGRAPHIC INFORMATION SYSTEM.

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INTRODUCTION

A watershed is the area covering all the land that contributes runoff water to a common point. It is a natural physiographic or ecological unit composed of interrelated parts and functions. In India the availability of accurate information on runoff is scarce .However in view of the quickening watershed management programme for conservation and development of natural resource and its management in the runoff information assumes great relevance. A good runoff model includes spatially variable parameters such as rainfall, soil types and land use /land cover etc(Kumar;1997).Identification of runoff is of critical importance where the basic reservoirs support drinking water needs of the populance as in the case with the Red hills lake, which is an important source of water supply to Chennai city,India .In this study the Soil Conservation Service Curve number (SCS CN method)(SCS;1972) also known as hydrologic soil group method was used, this method is a versatile and popular approach for quick runoff estimation and is relatively easy to use with minimum data and it gives adequate results(Chatterjee et al2001;Ashish et al 2003;Gupta and Panigrahy 2008).Generally the model is well suited for small watersheds of less than 250km ^{2} and it requires details of soil charecteristics land use and vegetation condition(Sharma et al 2001).However advances in computational power and the growing availability of spatial data from remote sensing techniques have made it possible to use hydrological models like SCS cure number in spatial domain with GIS (Moglen 2000).The model has been found to perform well without much calibration. In the present study , the runoff from SCS(Soil Conservation Services) curve Number model modified for Indian Conditions has been used by using conventional database and GIS for Red hills watershed.

STUDY AREA

The study area namely the Redhills, fig 1; watershed, situated near Chennai, India is located between 80° 3′ 45″ E to 80°11′40″ E longitude and 13° 6′5″ N to 13° 12′25″ N latitude with an elevation ranging from Zero to 42 m above MSL(Mean Sea Level) and extends over an area of 83.59 km 2.The watershed receives an average rainfall of 152.42 mm and more than 80% of the rainfall is received during the NE monsoon (October-December).The minimum and

maximum temperature varies in the range of 22°C to 39°C. In Redhill Reservoir fed by watershed has a maximum capacity of 94.45 MCM.

Study area

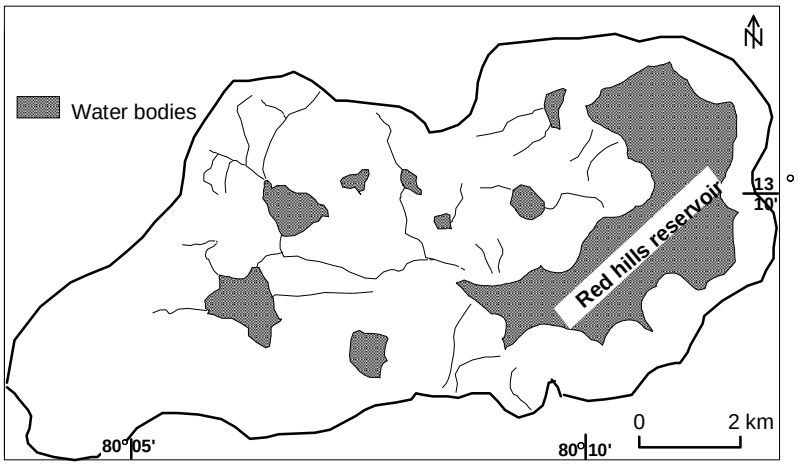

Fig. 1

METHODOLGY

The conventional Land use/Land cover map, soil of the watershed was (fig 1 & 2) used to demarcate landuse class and soil combinations in the study area from which different curve number values were assigned and the weighted value of CN for the whole watershed was worked out. The CN value for AMC II condition can be converted into CN values for AMC I and AMC III. Substituting the value of curve number in equation 1 the retention capacity S was calculated. The direct runoff of the watershed was calculated using formula 2

$$S = \frac{25400}{CN} - 254 \longrightarrow (1)$$

$$Q = \frac{(P - 0.3\,S)^2}{(P + 0.7\,S)} \longrightarrow (2)$$

Where,

Q = Runoff depth (mm)
S = Maximum recharge capacity of watershed after 5 days antecedent rainfall
Ia = 0.3 S (Intila abstraction of rainfall by soil and vegetation, mm)
CN = Curve number
Where

$$CN = \frac{\sum [(N_i \times A_i)]}{A}$$

CN_i = Weight curve number from 1to any number

A_i = Area with curve number CN_i
A = Total area of the watershed.

Hydrological soil group of the study area

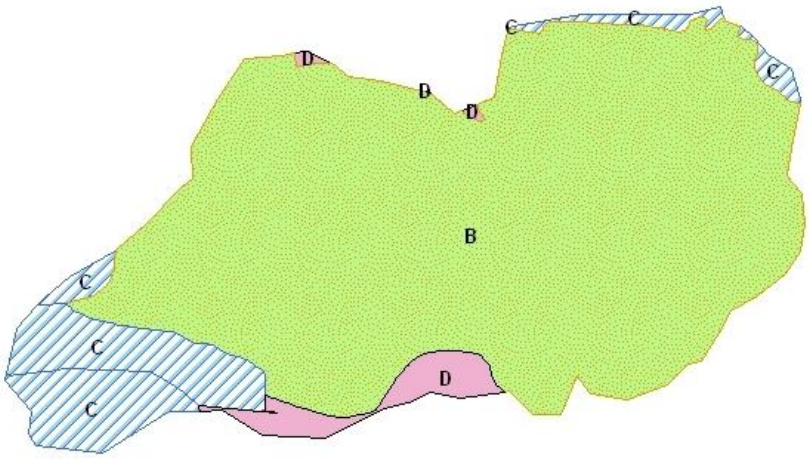

Fig. 1

Landuse and soil map of 2005

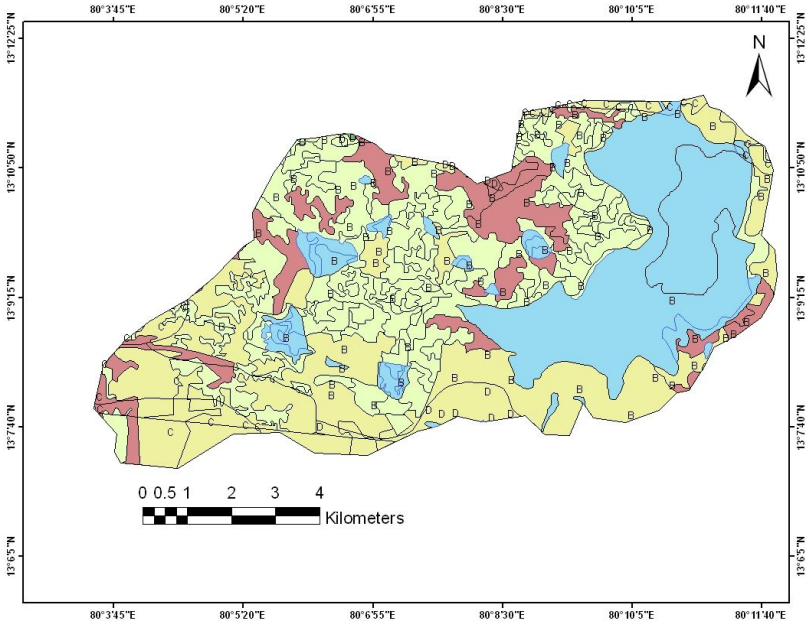

Fig. 3

Landuse and soil map of 2005

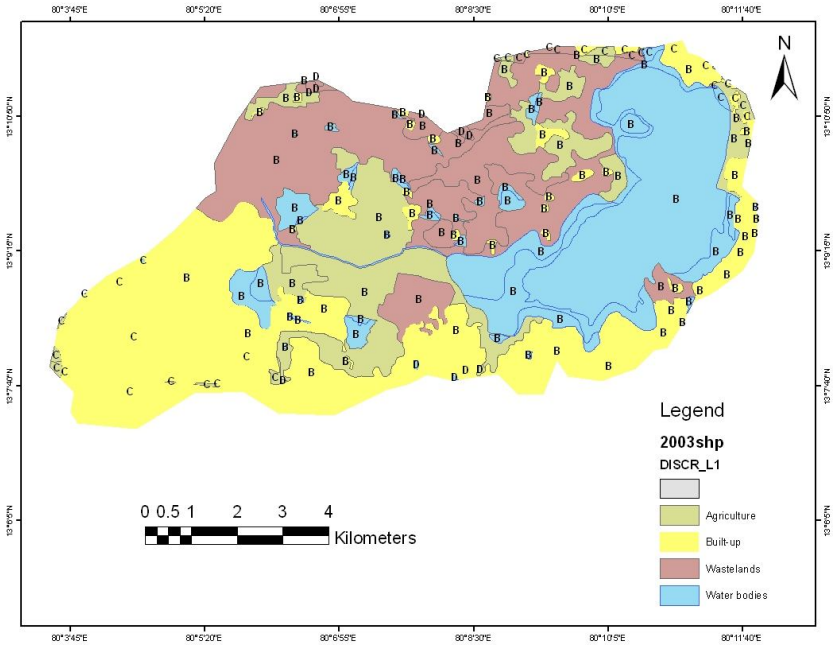

Fig. 4

RESULTS AND DISCUSSION

A very large part of the Redhills watershed falls under Hydrologic Soil Group B 70.37 km 2 while soil group C carries an area of 10.66 km 2 and D group 2.57 km 2. The land cover categories for the year 2000,2003 & 2005 are given in table -1

year	Argicultural land (km^2)	Water bodies(km^2)	Waste land(km^2)
2000	28.75	21.18	20.69
2003	28.75	21.17	9.13
2005	23.92	23.12	20.69

Table. 1 Landuse categories for the years 2000, 2003 and 2005

Using the landuse and soil maps the weighted curve number values obtained are 61.61, 67.05&69 for the years 2000, 2003 &2005 respectively. The monthly as well as annual runoff estimated using the above equations are given in table 2. It is seen that a minimum about 100mm rainfall per month is required to generate any runoff. The runoff area percentage of rainfall sharply increases in the significance increase in rainfall. In drought years such as 1999 and 2003 the runoff generated were very low and their results in the reservoir remain dry for most part of the year causing stoppage of piped water supply in Chennai city.

Redhills Watershed Rainfall and Runoff in mm

YEAR	(mm)	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEP	OCT	NOV	DEC	TOTAL
1999	RAINFALL	21	0	0	2	11	4	0	0	20.6	201	203	40	502.6
	RUNOFF	0	0	0	0	0	0	0	0	0	14.43	3.58	18	36.02
2000	RAINFALL	0	359	0	12	35	80	71	173	67	174	183	67	1221
	RUNOFF	0	78.7	0	0	0	12	0	0	0	26.27	17.1	0	133.88
2001	RAINFALL	10	0	0	7	12	24	92	58	102	428	347	261	1341
	RUNOFF	0	0	0	0	0	0	7.13	0	0	124.1	44.1	51.8	227.1
2002	RAINFALL	47	0	0	0	66	30	122	131	117	293	352	18	1176
	RUNOFF	0	0	0	0	0	0	9.62	11.2	12.35	33.68	104	0	170.48
2003	RAINFALL	0	0	0	3	0	16	106	99.8	119	192	69	71	675.3
	RUNOFF	0	0	0	0	0	0	0.87	0	32.08	4.77	0	0.33	38.05
2004	RAINFALL	19	0	0	0	245	45	29.4	28	213	249	338	0	1166.4
	RUNOFF	0	0	0	0	44.6	0	0	0	43.21	24.68	121	0	233.13
2005	RAINFALL	0	0	0	92.5	26	35	87	131	212	756	579	480	2398.5
	RUNOFF	0	0	0	35.2	0	0	4.6	7.8	23.63	374.1	202	215	862.39
2006	RAINFALL	0	0	4	0	0	135	44	126	152	543	295	31	1330
	RUNOFF	0	0	0	0	0	14	0	19.2	36.03	239.5	41.6	0	350.65

Table 2

ACKNOWLEDGEMENT

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