Hydrological Modelling of small watersheds of South Ponnaiyar Basin in the Soil and Water Assessment Tool (SWAT)

By
Dr.B.S. POLISGOWDAR,
ASSOCIATE PROFESSOR,
COLLEGE OF AGRICULTURAL ENGINEERING, UAS, RAICHUR

INTRODUCTION

- ***Mahatma Gandhi, the father of the nation, had very poignantly said in 1946,"To forget how to dig the earth and tend the soil is to forget ourselves". If we forget to take care of the land in our desperate search for food security we will only harvest disaster***

Department of Land Resources, Ministry of Rural Development, Government of India has identified different types of degraded wastelands

Category wise percentage of degraded land as on 2000 as percentage of total degraded land

Sl.No	Category	Percentage of total degraded land
1	**Gullied & or ravinous Land**	**3.22**
2	**with or without Scrub**	**30.40**
3	**Water Logged & marshy Land**	**2.58**
4	**Land affected by Salinity/Alkalinity-Coastal/Inland**	**3.22**
5	**Shifting cultivation area**	**5.50**
6	**Under utilized degraded notified forest land**	**22.02**
7	**Degraded pastures/ Grazing Land**	**4.07**
8	**Degraded land under plantation crops**	**0.90**
9	**Sands-Inland/Coastal**	**7.84**
10	**Mining industrial wastelands**	**0.20**
11	**Barren rocky/Stony waste/Sheet rocky area**	**0.12**
12	**Steep slopping area**	**1.20**
13	Snow covered and or glacial area	8.73

Source: 1:50000 scale wasteland maps prepared from Landsat (from Wasteland Atlas).
Note: Total wasteland as a percentage of geographical area is 20.16%

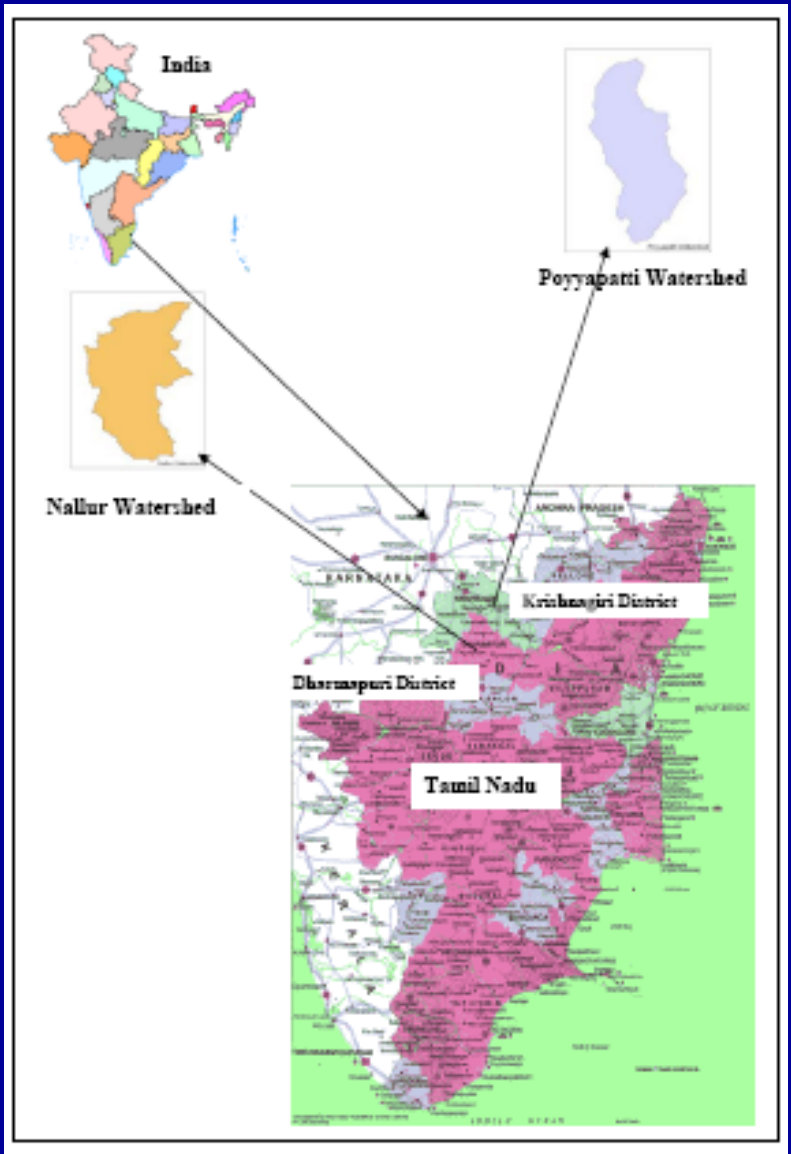
- The problem of sedimentation in reservoirs has become alarming, since the silt deposited in the reservoirs or tanks decreases the capacity of the reservoirs and reduces the utility and life. Sedimentation of reservoirs is a serious problem posing threat to the life of the reservoir, storage capacity of the reservoir for irrigation of the command area and generation of power.
- The studies on the sedimentation problems carried out in 33 reservoirs in Tamil Nadu reveal that there is a loss in capacity of more than 50% in two reservoirs and more than 30% capacity loss in 8 reservoirs (*source: tn.nic.in*).

- Out of total geographical area of 328.6 M ha in India, 103.16 M ha is affected by severe erosion due to water and wind which accounts about 33.4 per cent of total geographical area.
- In Tamil Nadu out of total geographical area of 13.006 M ha, 5.334 M ha (41%) is degraded under different categories and degradation due to water erosion alone is 4.926 M ha (92%of degraded area) (*Source:indiastat.com*).

OBJECTIVES

- To develop a model for estimating runoff and sediment yield from a watershed using Soil Water Assessment Tool (SWAT).
- To test the validity of the calibrated model for another watershed.
- To identify and prioritize sub-watersheds in both selected watersheds based on severity of erosion.

Location Map of Selected Watersheds



General Discription of Watersheds

Nallur watershed

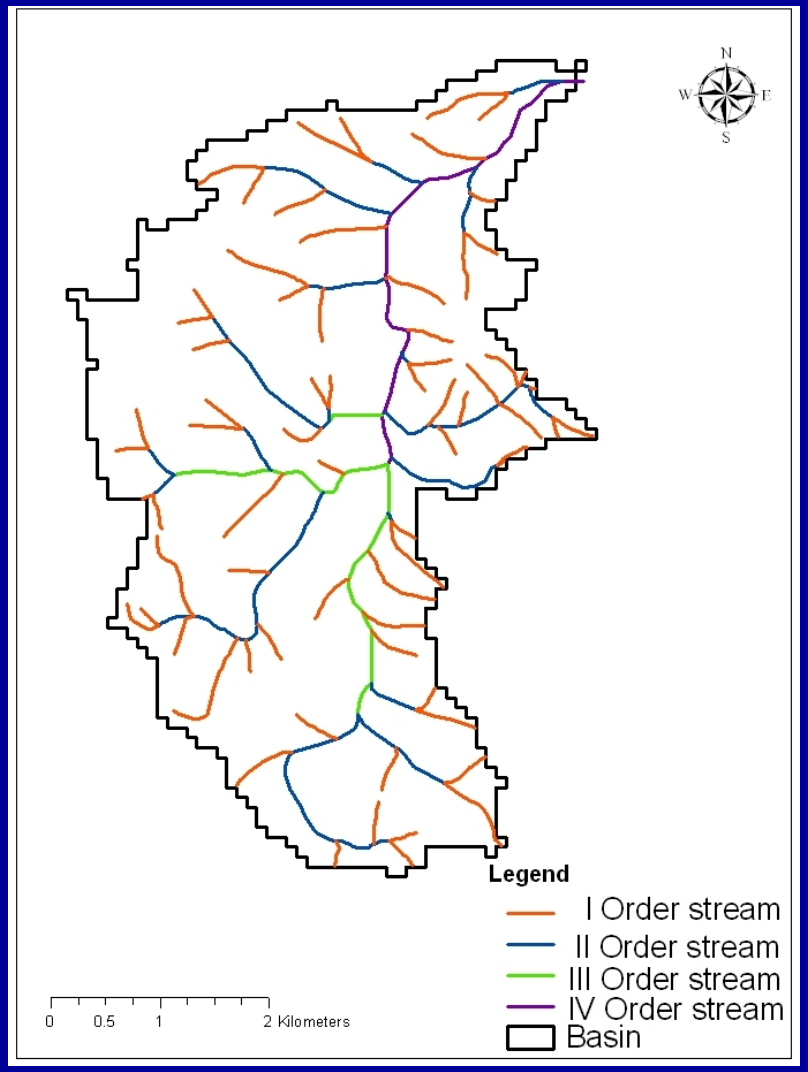
- **No. of subwatershed: 4C1C1b4 (HP), 4C1C1b5(P)**
- **Location : 12^0 42´ N to 12^0 45´N latitudes and 78^0 3´E to 78^0 7´E longitudes.**
- **Area : 2150.58 hectares**
- **Rainfall :1042.14 mm**
- **Temperature :39^0C and 18^0C**
- **Villages :Nallur, Kariasagarthalov, Ragimaganapalli, Kodigatimmanapalli, Kalingavaram, Pudur, Itampatty, Sembarasanapalli and Pattagurubarapalli**

General Discription of Watersheds

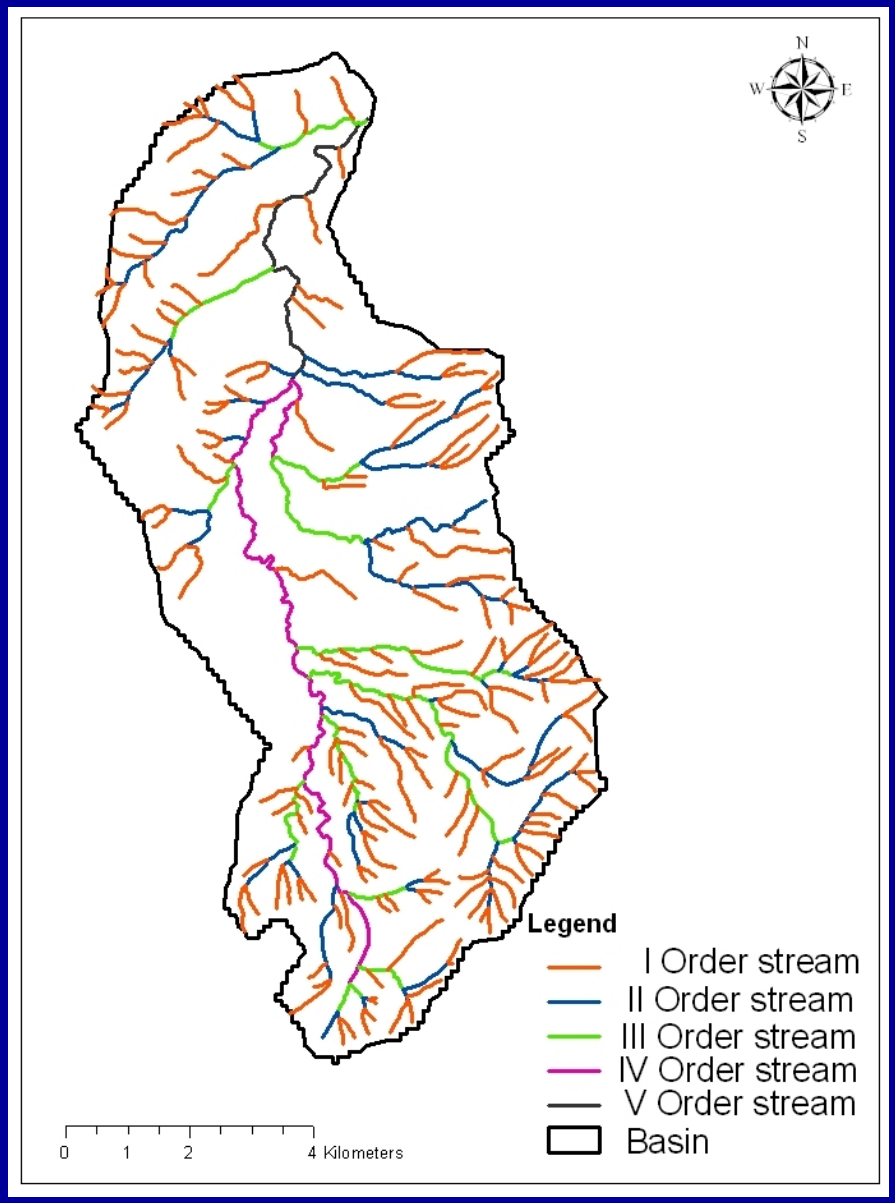
Poyyapatti watershed

- **No. of subwatershed: 4C1C1r4 to 4C1C1r6 and 4C1C1s1 to 4C1C1s9**
- **Location : 59´ N to 12^0 7´ 40’’N latitudes and 78^0 32´E to 78^0 36´E longitudes**
- **Area : 7445.07 hectares**
- **Rainfall :986 mm**
- **Temperature :38.5^{0}C and 19^{0}C**
- **Villages :Poyyapatti, Gudalur, Katpadi, Gopalapatti, Pappinayakkanvalasal, Palayam, Virappanayakkampalli, Shanmugapurum, Mambadi, Veppampatti, Malluttu and Pudinattam**

Stream network of Nallur watershed



Stream network of Poyyapatti watershed



Geomorphological Characteristics

Property	Nallur	Poyyapatti
Stream order	4	5
Bifurcation ratio	2.59	2.57
Stream length ratio	2.22	1.95
Main valley length, km	12.09	21.50
Main stream length, km	12.05	21.41
Watershed area, sq. km	21.50	74.45
Drainage area of SMS, sq. km	21.25	73.25
Stream area ratio	4.92	4.33
Drainage density (D) km/sq.km	0.22-2.55	0.11-2.37
Stream frequency No./sq. km	0.05-5.55	0.01-3.95

Details of basin shape parameters for selected watersheds

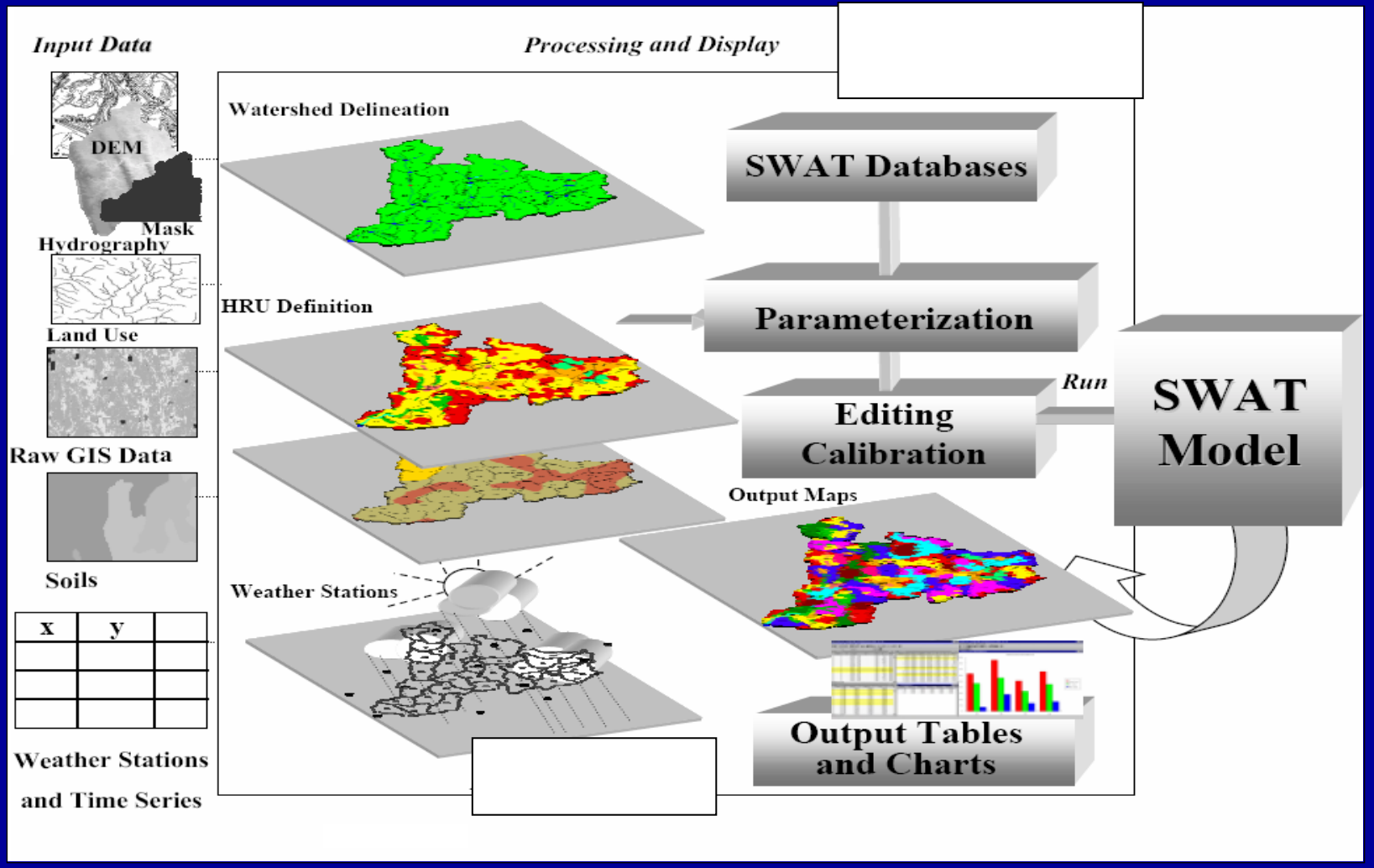
Sl. No	Basin shape parameters	Nallur	Poyyapatti
1	Form factor (Rf)	0.15	0.16
2	Circulatory ratio (Cr)	0.01	0.004
3	Elongation ratio (Er)	0.24	0.26
4	Compactness coefficient (Cc)	1.97	1.83
5	Elpticity index (Ei)	5.33	4.88

Derivation of mean stream slope and basin relief for selected watersheds

Sl. No	Watershed	Main stream slope	Main stream slope	Basin relief	Basin relief
1	Nallur	0.007	1 in 143	0.012	1 in 83
2	Poyyapatti	0.02	1 in 50	0.02	1 in 51

Modelling Runoff and Sediment

Representation of Arc SWAT model in a flow chart



Theoretical consideration in SWAT

$$SW_t = SW_o + \sum_{t-1}^{t} (R_{day} - Q_{surf} - E_a - w_{seep} - Q_{gw})$$

$$Q_{surf} = \frac{(R_{day} - I_a)^2}{(R_{day} - I_a + S)} \qquad S = 25.4\left(\frac{1000}{CN} - 10\right)$$

$$Q_{surf} = \frac{(R_{day} - 0.2S)^2}{(R_{day} + 0.8S)}$$

$$q_{peak} = \left(\frac{CiA}{3.6}\right)$$

The modified universal soil loss equation (Williams, 1995) is used tocompute the sediment yield from each subbasin:

$$sed = 11.8\left(Q_{surf}.q_{peak}.area_{hru}\right)^{0.5}.K_{USLE}.C_{USLE}.P_{USLE}.LS_{USLE}.CRFG$$

$$K_{USLE} = \frac{0.00021.M^{1.14}.(12-OM)+3.25.(c_{soilstr}-2)+2.5(c_{perm}-3)}{100}$$

$$C_{USLE} = \left\{\left[\ln(0.8)-\ln\left(C_{USLE,mn}\right)\right].\exp\left(-0.00115.rsd_{surf}\right)+\ln\left(C_{USLE,mn}\right)\right\}$$

$$LS_{USLE} = \left(\frac{L_{hill}}{22.1}\right)^{m}.\left(65.41.\sin^{2}\left(\alpha_{hill}\right)+4.56.\sin\alpha_{hill}+0.065\right)$$

$$m = 0.6.\left[1-\exp\left(-35.835.slp\right)\right] \qquad slp = \tan\alpha_{hill}$$

Steps involved are

- Defining land use data set
- Reclassifying the land use layer
- Defining the soil data set
- Reclassifying the soil layer
- Reclassifying the slope layer
- Overlaying land use, soil and slope layers

Model Evaluation

The coefficient of determination (r2) describes the proportion of the total variance in the observed data that can be explained by the model.

$$r^2 = \left\{ \frac{\sum_{i=1}^{N} \left(O_i - O_{avg}\right)\left(S_i - S_{avg}\right)}{\left[\sum_{i=1}^{N} \left(O_i - O_{avg}\right)^2\right]^{0.5} \left[\sum_{i=1}^{N} \left(S_i - S_{avg}\right)^2\right]^{0.5}} \right\}^2$$

The deviation of runoff volumes, *DV*,

$$D_V(\%) = \frac{V - V'}{V} 100$$

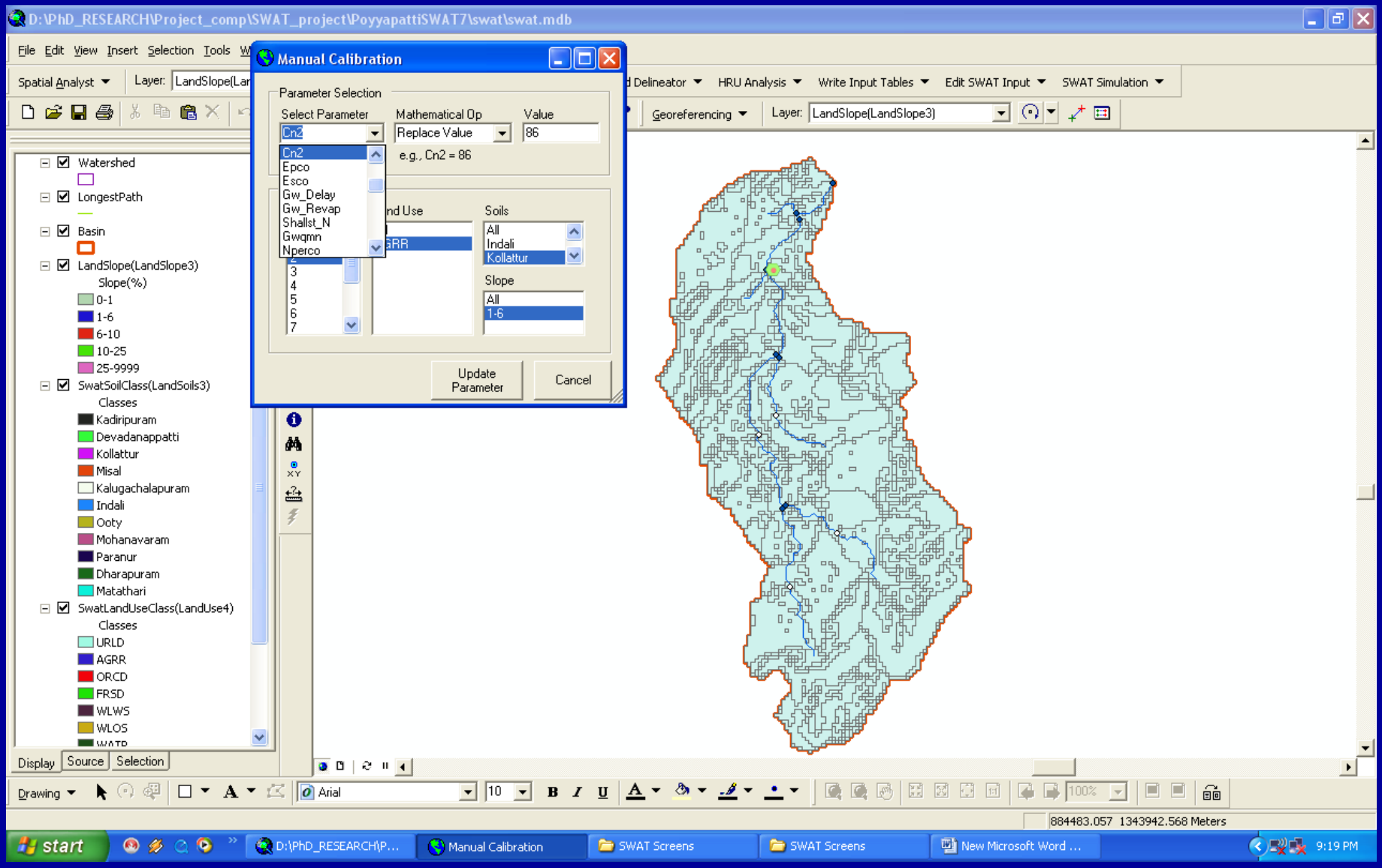
Sutcliffe coefficient or coefficient of simulation efficiency (COE) (Nash and Sutcliffe, 1970):

$$COE = 1 - \frac{\sum_{i=1}^{n} \left(Q_i - Q'_i \right)^2}{\sum_{i=1}^{n} \left(Q_i - Q \right)^2}$$

Root mean square error (RMSE), defined as (Thomann, 1982).

$$RMSE = \sqrt{\left\{ \frac{\sum_{i=1}^{N} \left(O_i - S_i \right)^2}{N} \right\}}$$

Model Calibration



- **Model Validation**
- **Identification and Prioritization of Critical sub-watersheds**

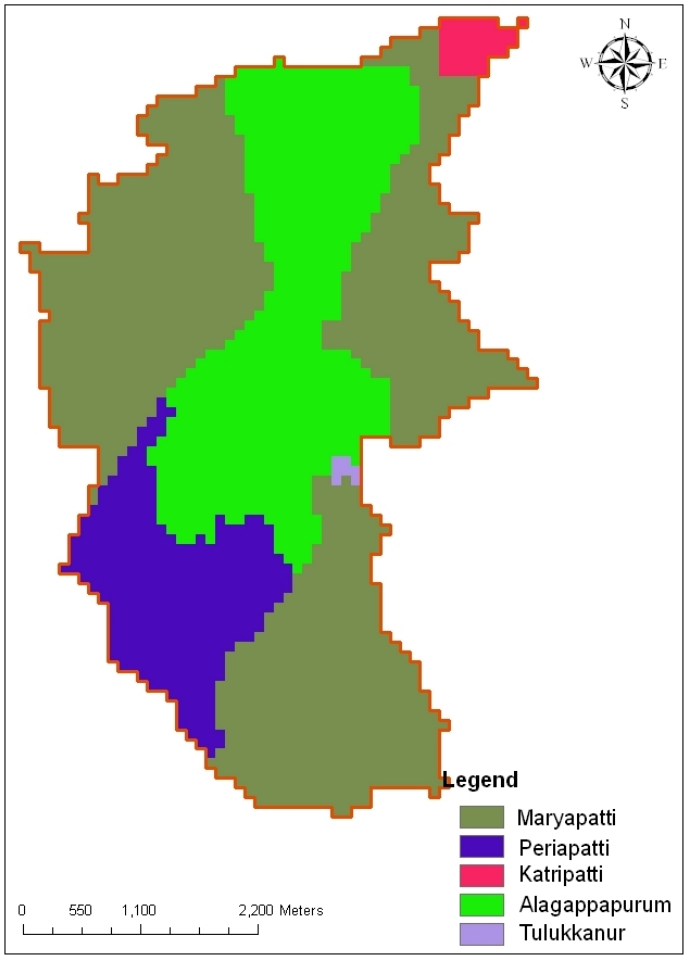
Soil Erosion rate and the corresponding soil erosion class (Singh *et al*. 1992)

Soil erosion rate range (Mg $ha^{-1}yr^{-1}$)	Soil erosion class
0-5	Slight
5-10	Moderate
10-20	High
20-40	Very High
40-80	Severe
>80	Very Severe

Physical characteristics of soils for Nallur watershed

Soil series	Coarse sand 0.1-2 mm (%)	Fine sand 0.05-0.1 mm (%)	Total sand (%)	Silt (%)	Clay (%)	Texture	Organic matter (%)
Alagappapuram	41.90	13.30	55.20	15.20	29.60	Sandy clay loam	0.40
Katripatti	64.35	12.85	77.20	15.40	7.40	Sandy loam	0.70
Maryappatti	54.00	8.20	62.20	14.93	22.87	Sandy clay loam	0.90
Periyapatti	36.40	10.10	46.50	18.20	35.30	Sandy Clay	0.50
Tulukkanur	49.70	25.50	75.20	3.60	21.20	Sandy clay loam	0.60

Soil series distribution for Nallur watershed



Sl. No.	Soil series	Area (ha)	% area
1	Alagappapuram	632.96	29.43
2	Katripatti	33.45	1.56
3	Maryappatti	1179.81	54.86
4	Periyapatti	298.51	13.88
5	Tulukkanur	5.85	0.27
Total		2150.58	100

Sandy clay loam soil covers 84.56 per cent,

sandy clay 13.88 per cent and

sandy loam covers 1.56 per cent of the total area.

Erodibility factor of soils for Nallur watershed

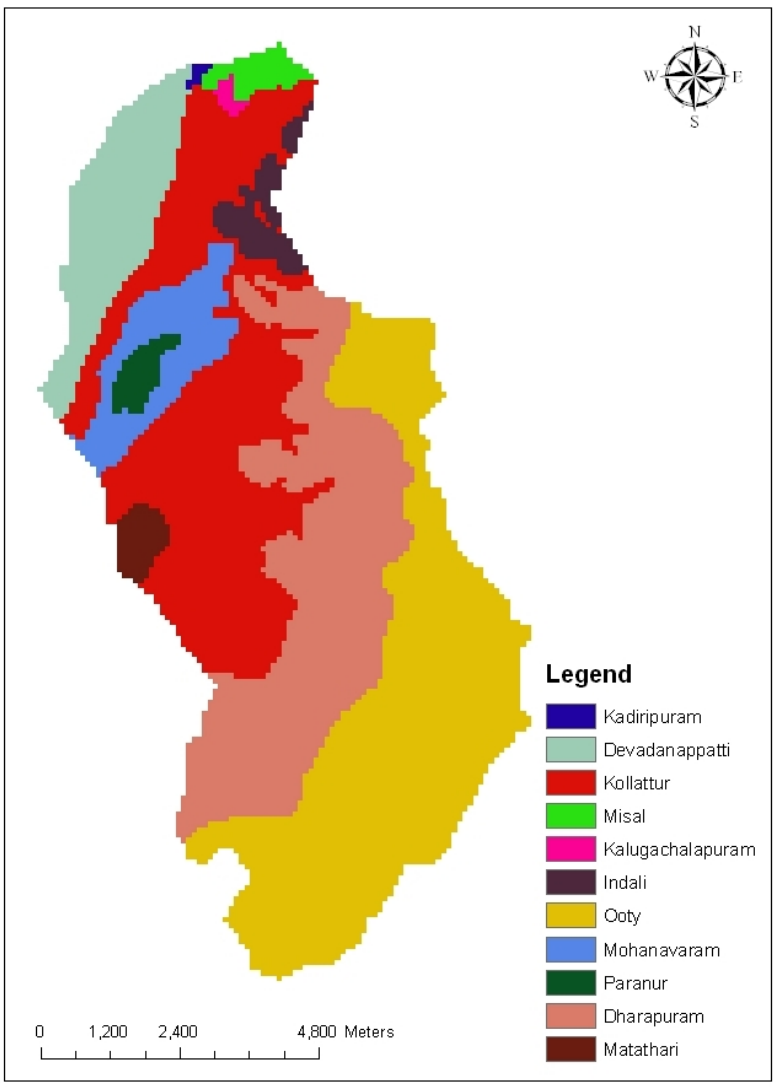
Soil series	Coarse sand 0.1-2 mm (%)	Silt+ VF Sand (%)	Organic matter (%)	Structure	Structure code	Permeability	Permeability code	Erodibility factor
Alagappa puram	41.90	28.50	0.40	Subangular blocky	4	Moderate	3	0.20
Katripatti	64.35	28.25	0.70	Medium granular	3	Rapid to very rapid	1	0.16
Maryappatti	54.00	23.13	0.90	Subangular blocky	4	Rapid	1	0.11
Periyapatti	36.40	28.30	0.50	Angular blocky	4	Slow	5	0.23
Tulukkanur	49.70	29.10	0.60	Medium granular	3	Rapid to very rapid	1	0.18

Hydrologic soil group classification for Nallur watershed

Soil series	Texture	Infiltration class	Depth class	Drainage	Permeability	Hydrologic soil group
Alagappapuram	Sandy clay loam	Low	Very deep	Poorly drained	Moderate	C
Katripatti	Sandy loam	Moderate	Deep	Well to excessively drained	Rapid	B
Maryappatti	Sandy clay loam	Low	Very deep	Well drained	Rapid	C
Periyapatti	Sandy clay	Low	Deep	Poorly drained	Slow	C
Tulukkanur	Sandy clay loam	Moderate	Deep	Well to excessively drained	Rapid	B

- It is observed from the table that out of 84.56 per cent coverage of sandy clay loam soil, about 84.29 per cent area is under hydrologic group ‘C’ followed by sandy clay (13.88%) again under group ‘C’ and 1.83 per cent area is under group ‘B’. In all 98.17 per cent of the total area is under hydrologic group ‘C’ indicating that the maximum area can produce moderately high runoff.
- When compared with soil erodibility factor ‘K’ and hydrologic soil groups, it was observed that 29.7 per cent area is with higher ‘K’ value (0.2 to 0.23) + hydrologic group ‘C’ which shows that a significant area of Nallur watershed is susceptible for higher rate of soil erosion.

Soil series map of Poyyapatti watershed



Sl. No.	Soil series	Area (ha)	% area
1	Devadanappatti	607.88	8.16
2	Dharapuram	1698.22	22.81
3	Indali	168.90	2.27
4	Kadiripuram	10.87	0.15
5	Kalugachalapuram	21.74	0.29
6	Kollattur	1920.63	25.8
7	Matathari	91.98	1.24
8	Misal	95.32	1.28
9	Mohanavaram	399.68	5.37
10	Ooty	2345.40	31.5
11	Paranur	84.45	1.13
Total		7445.07	100

clay loam soil covers an area of 39.66 per cent followed by sandy clay loam soil 28.07 per cent and sandy loam 24.24 per cent. The rest is covered by sandy clay (5.37 %), silty clay (1.24 %), loamy sand (1.13 %) and clay (0.29%).

Physical characteristics of soils for Poyyapatti watershed

Soil series	Coarse sand 0.1-2 mm (%)	Fine sand 0.05-0.1 mm (%)	Total sand (%)	Silt (%)	Clay (%)	Texture	Organic matter (%)
Devadanappatti	30.90	11.20	42.10	19.28	38.62	Clay loam	0.78
Dharapuram	68.00	9.20	77.20	10.00	12.80	Sandy loam	0.80
Indali	46.10	5.00	51.10	18.00	30.90	Sandy clay loam	0.82
Kadiripuram	68.33	8.67	77.00	6.00	17.00	Sandy loam	0.70
Kalugachalapuram	24.65	10.35	35.00	22.00	43.00	Clay	0.65
Kollattur	49.27	15.50	64.77	14.34	20.89	Sandy clay loam	0.62
Matathari	10.30	2.00	12.30	43.20	44.50	Silty clay	0.43
Misal	45.27	34.20	79.47	2.88	17.65	Sandy loam	0.60
Mohanavaram	37.55	10.95	48.50	13.00	38.50	Sandy clay	0.91
Ooty	30.70	9.50	40.20	24.70	35.10	Clay loam	1.50
Paranur	61.50	19.50	80.65	8.88	10.47	Loamy sand	0.61

Erodibility factor of soils for Poyyapatti watershed

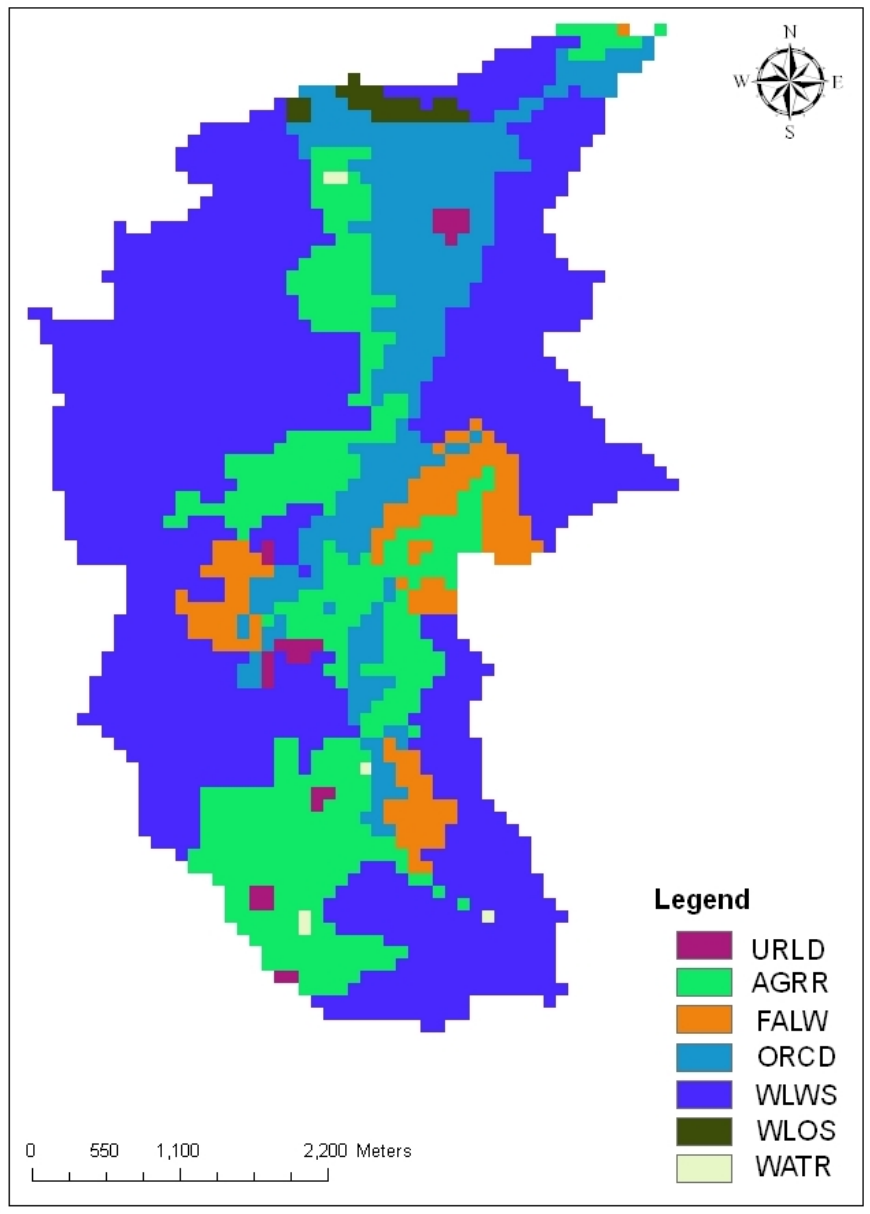
Soil series	Coarse sand 0.1-2 mm (%)	Silt+VF Sand (%)	Organic matter (%)	Structure	Structure code	Permeability	Permeability code	Erodibility factor
Devadanappatti	30.90	30.48	0.78	Subangular blocky	4	Rapid	2	0.20
Dharapuram	68.00	19.20	0.80	Granular	3	Rapid	2	0.14
Indali	46.10	23.00	0.82	Weak subangular blocky	4	Medium	3	0.15
Kadiripuram	68.33	14.67	0.70	Weak, medium, subangular blocky	4	Rapid	2	0.11
Kalugachalapuram	24.65	32.35	0.65	Weak, medium, subangular blocky	4	Slow	5	0.25
Kollattur	49.27	29.84	0.62	Weak, subangular blocky	4	Medium	3	0.23
Matathari	10.30	45.20	0.43	Moderate, medium subangular blocky	4	Slow	5	0.31
Misal	45.27	37.08	0.60	Weak fine granular	2	Rapid	2	0.22
Mohanavaram	37.55	23.95	0.91	Subangular blocky	4	Rapid	2	0.14
Ooty	30.70	34.20	1.50	Weak, coarse	3	Rapid	2	0.13
Paranur	61.50	28.38	0.61	Subangular blocky	4	Very Rapid	1	0.18

Hydrologic soil group classification for Poyyapatti watershed

Soil series	Texture	Infiltration class	Depth class	Drainage	Permeability	Hydrologic soil group
Devadanappatti	Clay loam	Very low	Moderately deep	Well drained	Rapid	D
Dharapuram	Sandy loam	Moderate	Moderately deep	Excessively drained	Rapid	B
Indali	Sandy clay loam	Moderate	Deep	Well drained	Medium	B
Kadiripuram	Sandy loam	Moderate	Deep	well drained	Rapid	B
Kalugachalapuram	Clay	Very low	Very deep	Imperfectly drained	Slow	D
Kollattur	Sandy clay loam	Low	Deep	moderately well drained	Medium	C
Matathari	Silty clay	Very low	Deep	Poor	Slow	D
Misal	Sandy loam	Moderate	Very deep	Moderately well drained	Rapid	B
Mohanavaram	Sandy clay	Moderate	Deep	Well drained	Rapid	C
Ooty	Clay loam	Moderate	Very deep	Excessively drained	Rapid	D
Paranur	Loamy sand	High	Moderatel deep	Excessively drained	Very Rapid	A

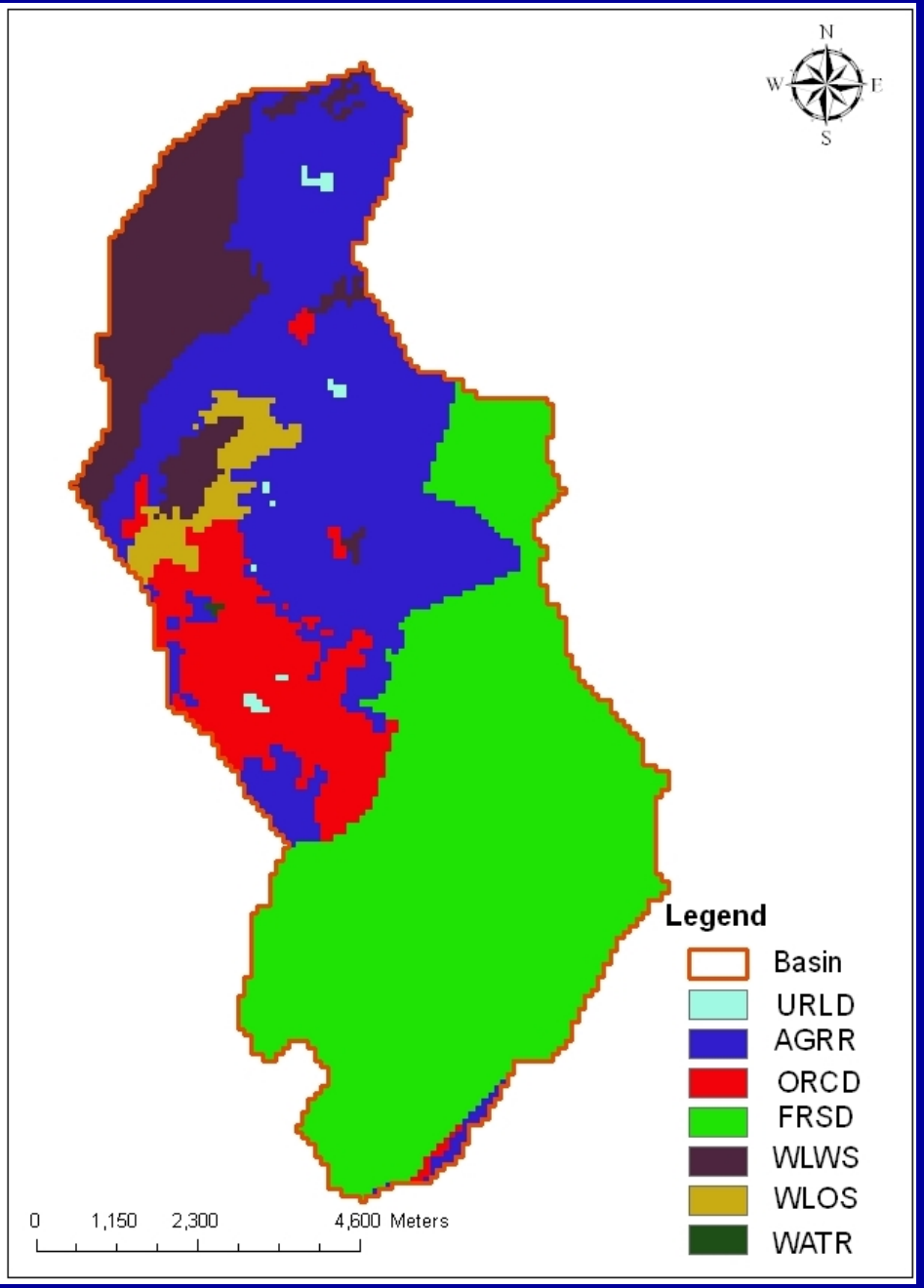
- 41.19 per cent of the area is under hydrologic group ‘D’ followed by 31.17 per cent under group ‘C’,
- 26.51 per cent under group ‘B’ and
- 1.13 per cent under group ‘A’.
- This indicates that maximum area (72.36%) of Poyyapatti watershed has a potential to produce high to moderately high runoff

Landuse distribution for Nallur watershed



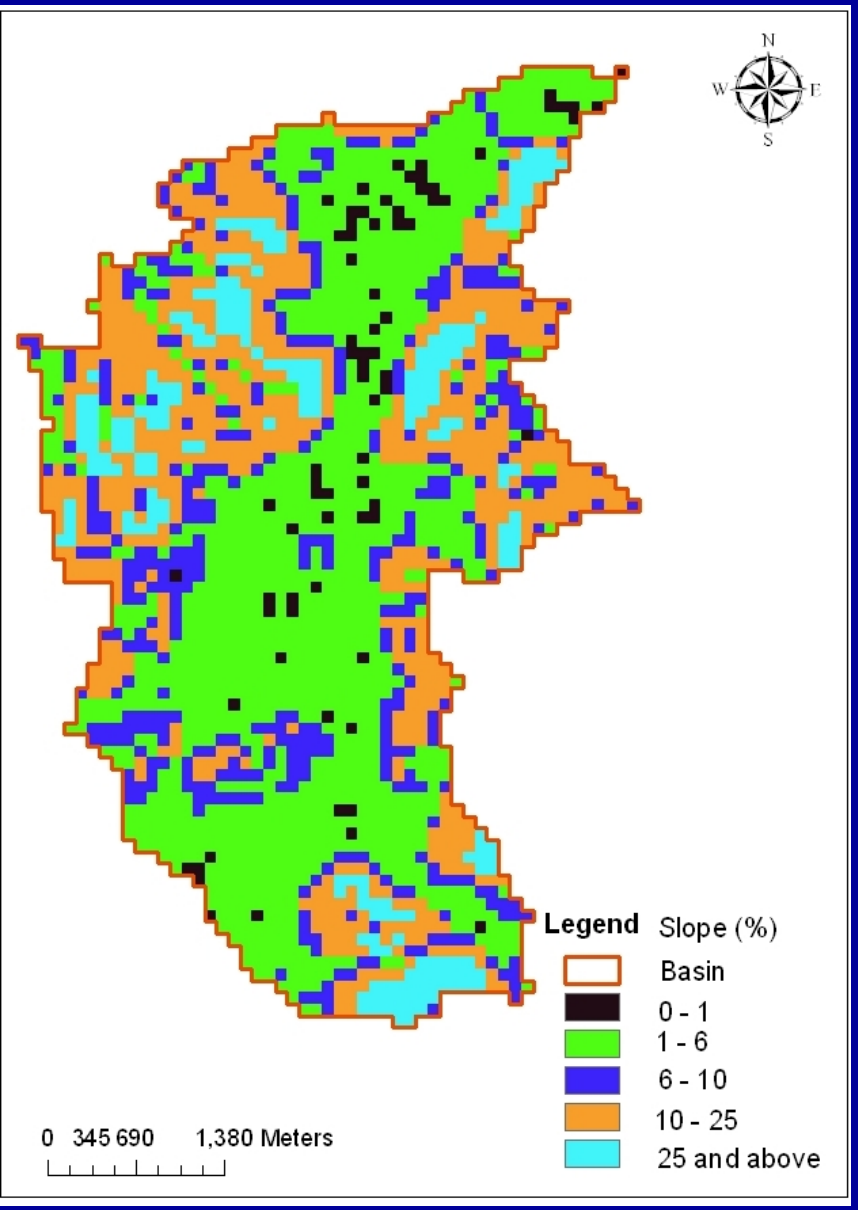
Sl. No.	Land use	Area (ha)	% area
1	Builtup (URLD)	22.58	1.05
2	Agriculture land (AGRR)	431.45	20.06
3	Fallow (FALW)	128.77	5.99
4	Orchard (ORCD)	306.87	14.27
5	Waste Land With Scrub (WLWS)	1234.99	57.43
6	Waste Land Without Scrub (WLOS)	20.90	0.97
7	Water bodies (WATR)	5.02	0.23
Total		2150.57	100

Landuse distribution for Poyyapatti watershed



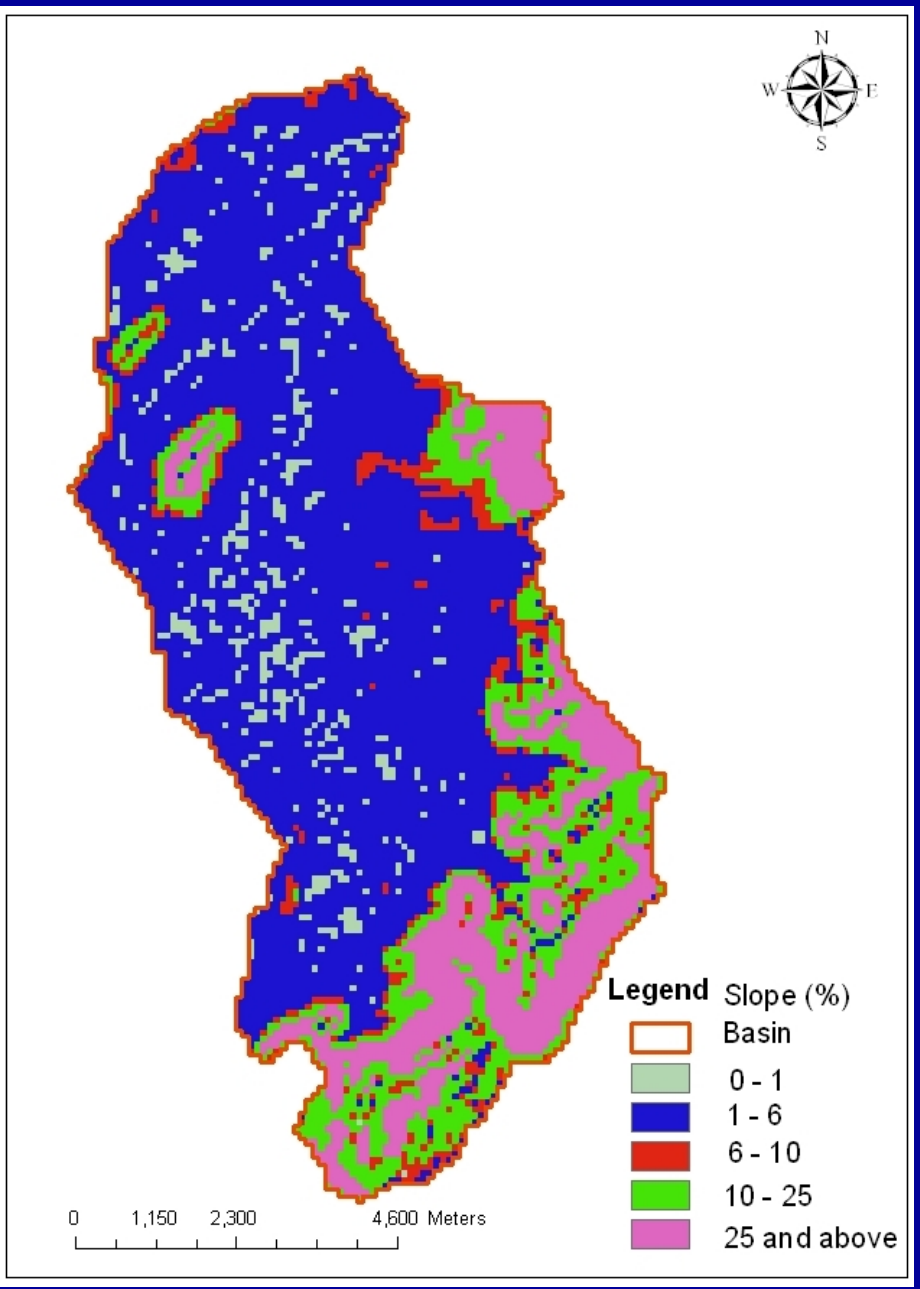
Sl. No.	Land use	Area (ha)	% area
1	Builtup (URLD)	25.92	0.35
2	Agriculture land (AGRR)	2228.34	29.93
3	Orchard (ORCD)	755.04	10.14
4	Forest-Deciduous (FRSD)	3413.16	45.84
5	Waste Land With Scrub (WLWS)	830.30	11.15
6	Waste Land Without Scrub (WLOS)	188.97	2.54
7	Water bodies (WATR)	3.35	0.04
Total		7445.07	100

Slope distribution for Nallur watershed



Sl. No.	Slope class (%)	Area (ha)	% area
1	0 - 1	62.71	2.92
2	1 - 6	961.57	44.71
3	6 - 10	357.87	16.64
4	10 - 25	574.43	26.71
5	25 and above	193.99	9.02
Total		2150.57	100.00

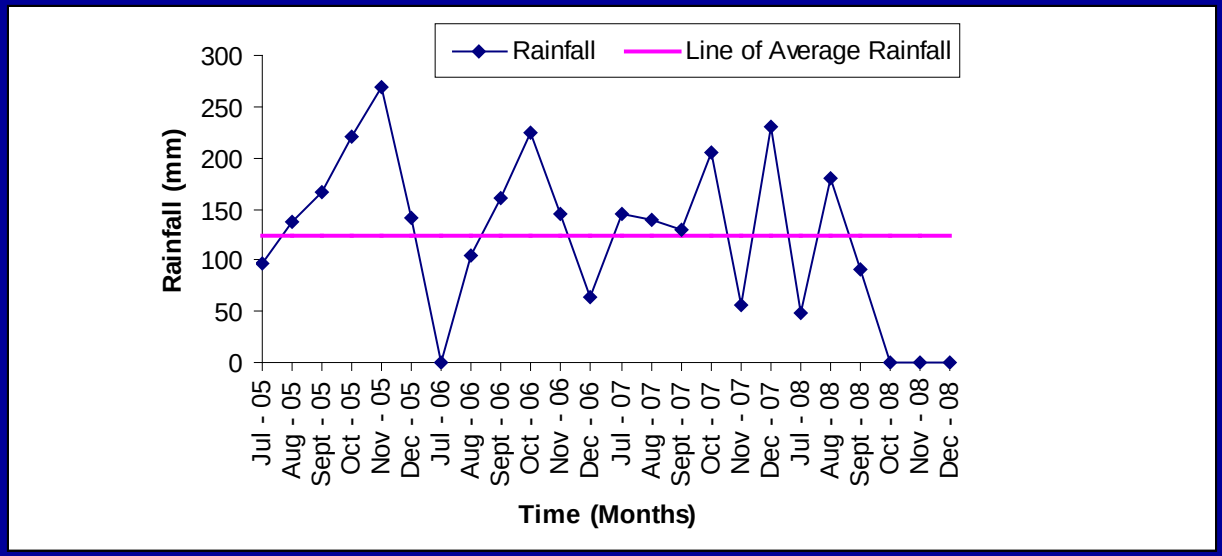
Slope distribution for Poyyapatti watershed

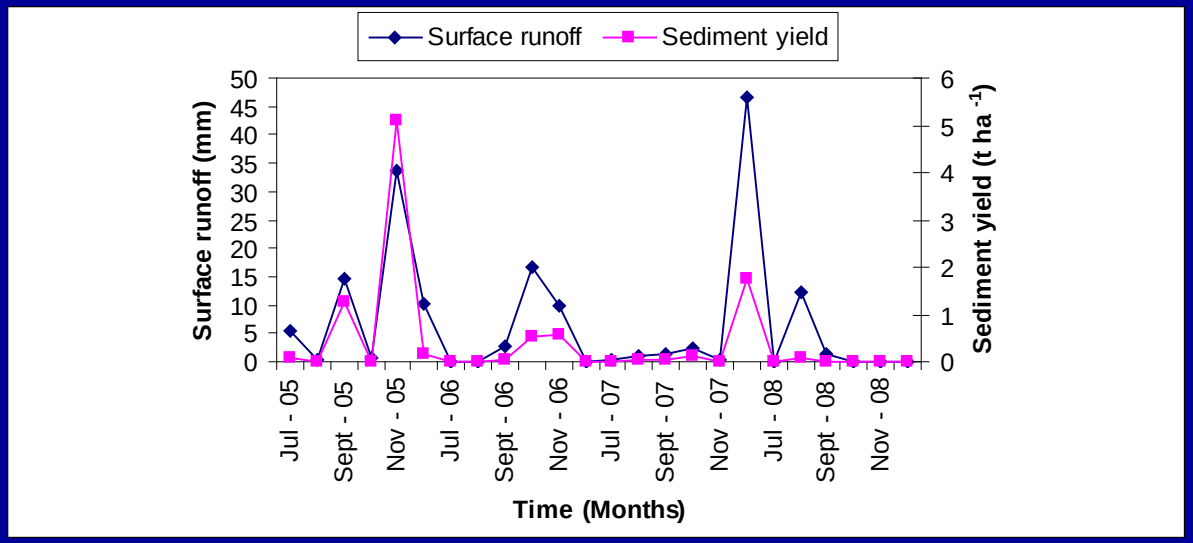


Sl. No.	Slope class (%)	Area (ha)	% area
1	0 - 1	448.18	6.02
2	1 - 6	4563.70	61.30
3	6 - 10	405.53	5.45
4	10 - 25	954.05	12.81
5	25 and above	1073.62	14.42
Total		7445.07	100.00

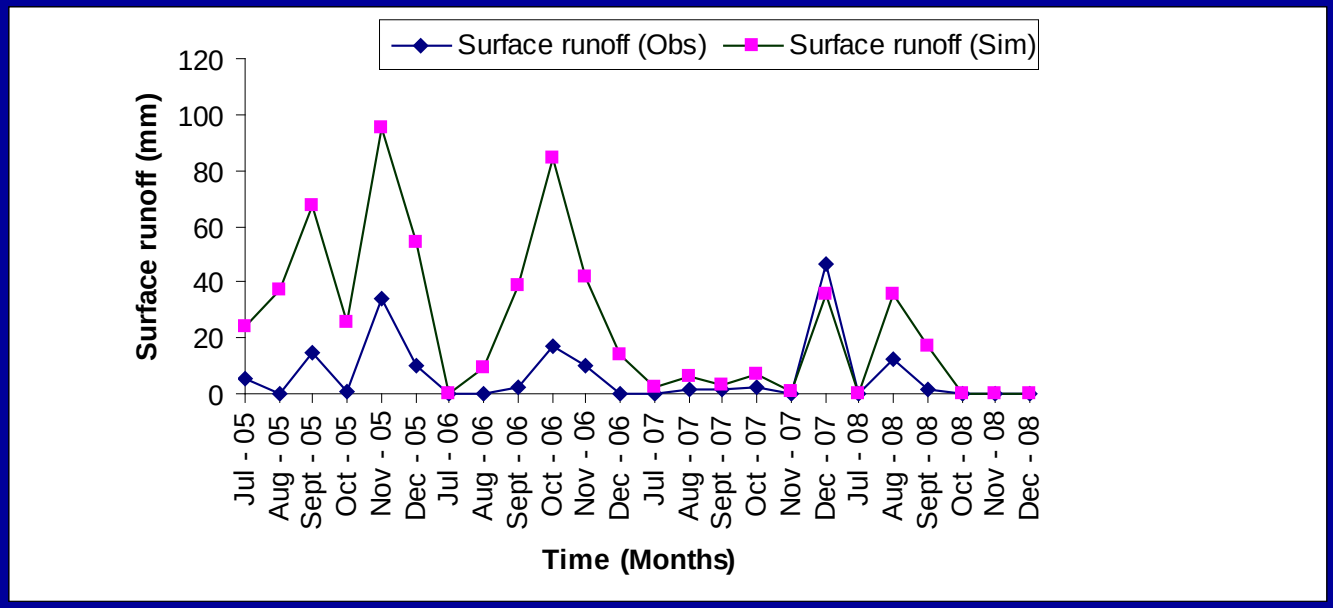
Modelling Runoff and Sediment for Poyyapatti Watershed

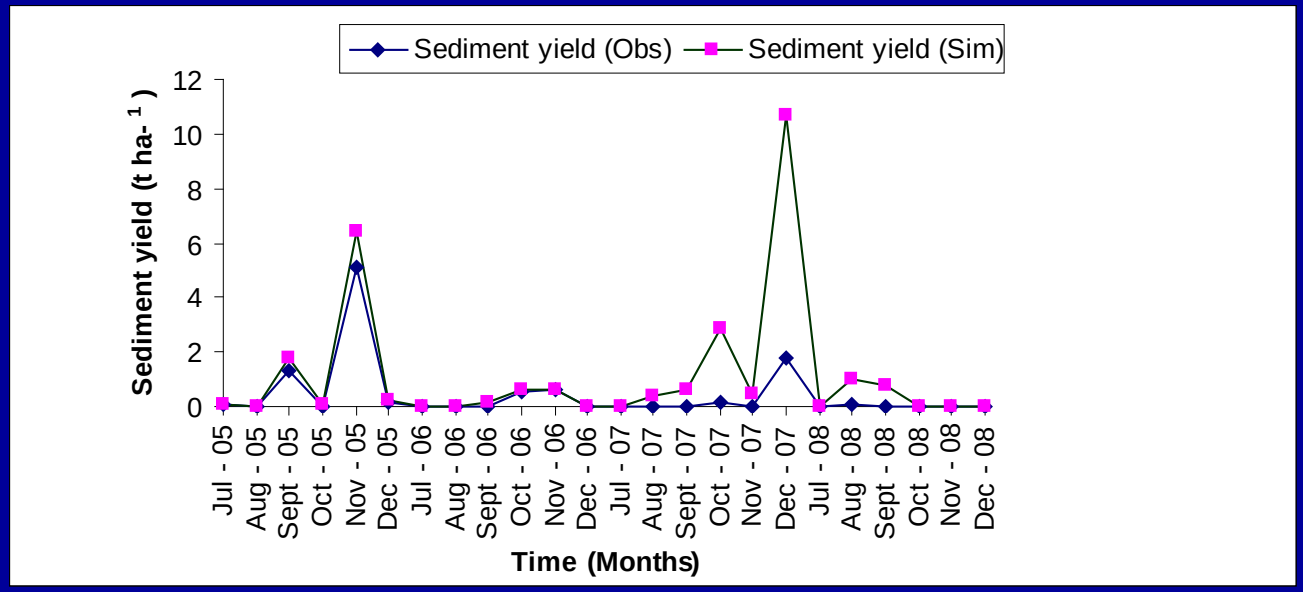
Observed rainfall, surface runoff and sediment yield





Model Default Run





Input parameters selected for calibration of surface runoff and sediment yield

Parameter name	Model process	Discription	Model range
CN2	Flow	Curve number for AMC-II	± 10%
SOL_AWC	Flow	Soil available water capacity	± 0.04
USLE_C	Sediment	Universal soil loss equation C factor	0.0001 to 1
USLE_P	Sediment	Universal soil loss equation P factor	0.1 to 1
CH_N1	Flow/sediment	Mannings' n for tributary channel	--
CH_K1	Flow/sediment	Effective hydraulic conductivity for tributary channel alluvium, mm/hr	--
CH_N2	Flow/sediment	Mannings' n for main channel	--
CH_K2	Flow/sediment	Effective hydraulic conductivity for main channel alluvium, mm/hr	--

Calibrated curve number (CN) for the sub-watersheds of Poyyapatti watershed

Sub-watershed	Default CN (weighted values)	Calibrated CN (weighted values)
1	84.12	74.80
2	82.05	77.10
3	81.27	73.52
4	82.18	73.42
5	81.62	74.69
6	82.22	77.95
7	80.40	75.38
8	75.82	68.25
9	78.28	72.86
10	67.92	58.12
11	83.00	77.00
12	71.08	61.58
13	78.12	70.68

The main channel input file *(.rte)* for Poyyapati watershed

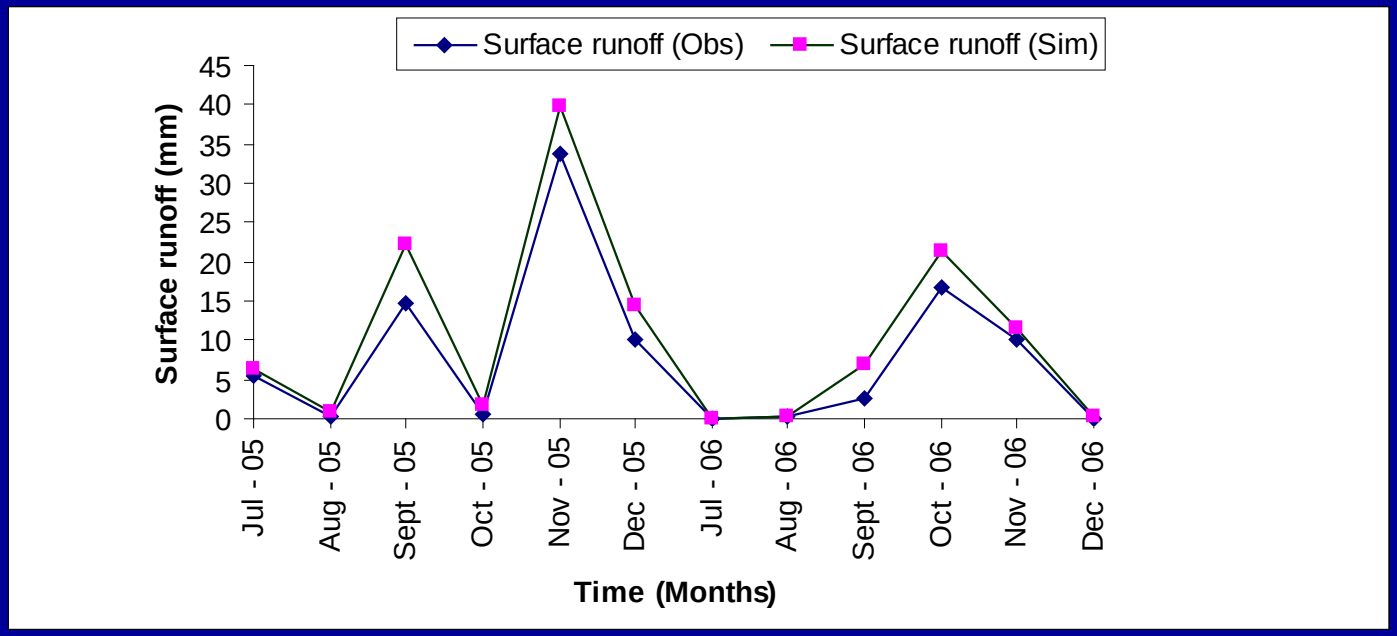
Sub-watershed No.	CH_W(2) (m)	CH_D (m)	CH_S(2) (m per m)	CH_L(2) (km)	CH_N(2)	CH_K(2) (mm hr^{-1})	CH_COV 0-1 1=no veg cover	CH_WDR
1	3.86	0.27	0.004	1.203	0.05	6.0	0.2	14.30
2	17.12	2.22	0.003	1.609	0.05	6.0	0.2	7.68
3	16.02	1.7	0.007	1.841	0.05	6.0	0.2	8.95
4	3.66	0.26	0.006	1.149	0.05	6.0	0.2	14.06
5	14.78	1.66	0.004	2.831	0.05	6.0	0.2	8.90
6	5.86	0.35	0.008	1.819	0.05	6.0	0.2	16.43
7	11.64	0.98	0.007	2.664	0.05	6.0	0.2	11.87
8	4.14	0.28	0.007	1.884	0.05	6.0	0.2	14.64
9	10.34	0.89	0.007	2.611	0.05	6.0	0.2	11.61
10	6.05	0.36	0.009	1.873	0.05	6.0	0.2	16.61
11	5.49	0.34	0.012	2.272	0.05	6.0	0.2	16.08
12	6.90	0.39	0.007	2.589	0.05	6.0	0.2	17.35
13	5.02	0.32	0.010	2.306	0.05	6.0	0.2	15.61

Sub basin parameters of tributary channel of Poyyapatti watershed

Sub watershed No	HRU TOT	SUB_KM, (km)	SUB_LAT (degrees)	SUB_ELV, (m)	CH_L1, (km)	CH_s1, (m per m)	CH_W1, (m)	CH_K1, (mm hr^{-1})	CH_N1
1	4	6.220	12.114	322	5.597	0.009	3.86	4.5	0.075
2	2	1.597	12.120	301	2.207	0.006	1.70	4.5	0.075
3	5	2.658	12.106	305	2.857	0.011	2.31	4.5	0.075
4	6	5.710	12.085	334	5.613	0.009	3.66	4.5	0.075
5	4	6.664	12.085	349	6.117	0.092	4.02	4.5	0.075
6	3	5.476	12.069	372	6.023	0.070	3.57	4.5	0.075
7	4	7.006	12.060	345	6.714	0.009	4.14	4.5	0.075
8	5	6.990	12.055	384	5.764	0.062	4.14	4.5	0.075
9	4	2.592	12.049	362	3.752	0.011	2.28	4.5	0.075
10	4	1.956	12.034	384	3.304	0.025	1.92	4.5	0.075
11	2	11.20	12.021	451	5.891	0.060	5.49	4.5	0.075
12	3	6.730	12.023	384	5.272	0.068	4.04	4.5	0.075
13	3	9.640	11.995	545	5.995	0.069	5.02	4.5	0.075

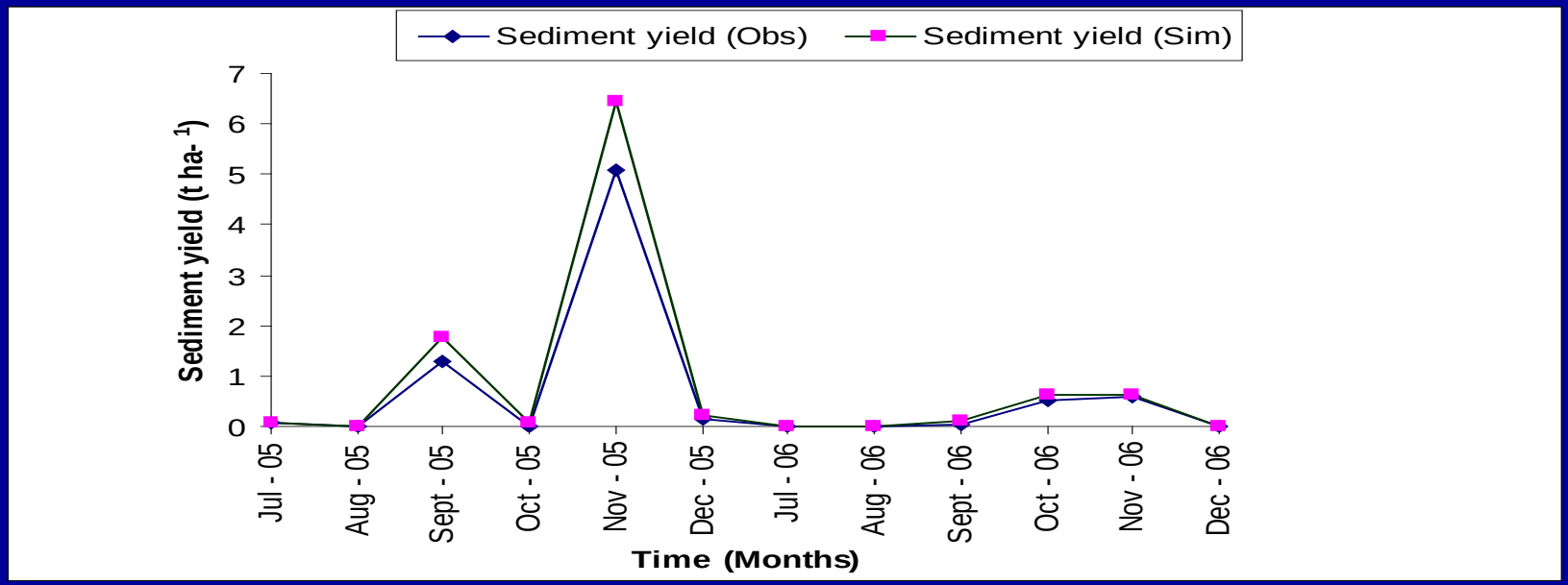
comparison between observed and simulated monthly surface runoff at Poyyapatti during calibration period (2005-06)

Statistical Parameters	Surface Runoff	
	Observed	Simulated
Mean (mm)	7.89	10.46
Standard Deviation (mm)	7.59	9.066
Sum (mm)	94.74	112.5
Coefficient of determination (r^2)	0.966	
Deviation, D (%)	-18.746	
Simulation Efficiency (E)	0.785	
RMSE (mm)	2.275	



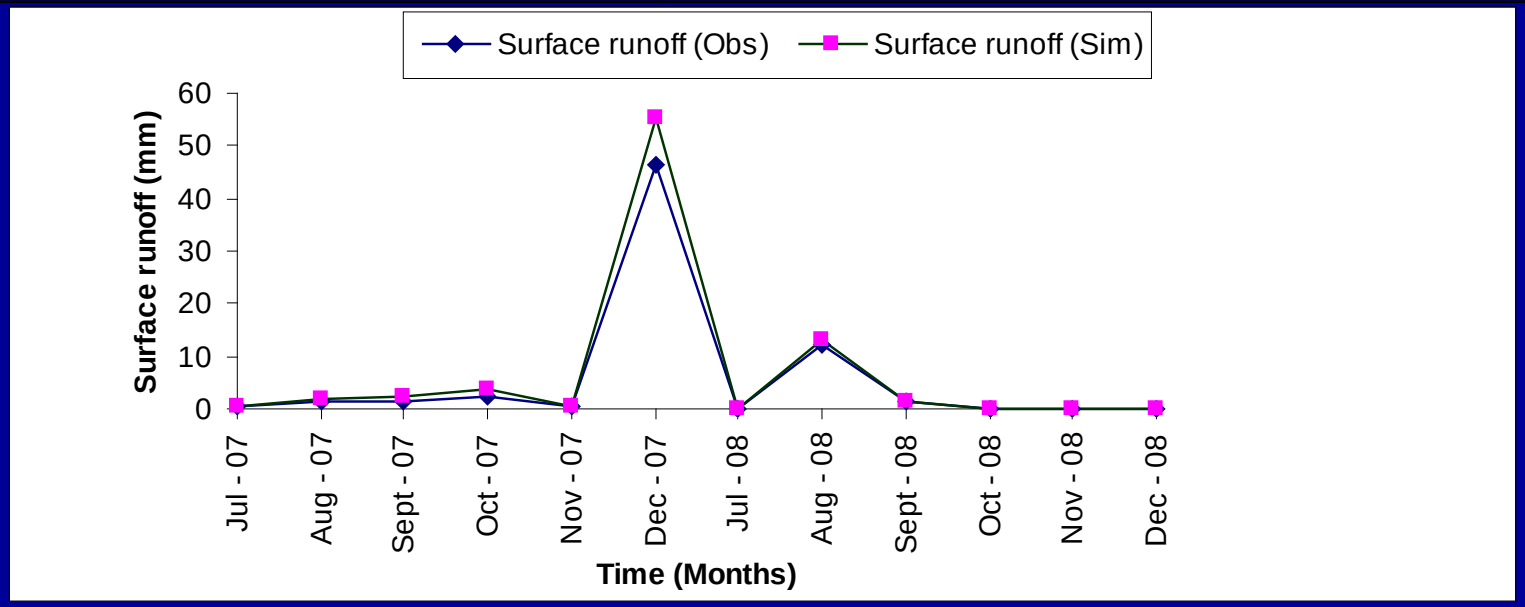
comparison between observed and simulated monthly sediment yield at Poyyapatti during calibration period (2005-06)

Statistical Parameters	Surface Runoff	
	Observed	Simulated
Mean (t ha^{-1})	0.646	0.833
Standard Deviation (t ha^{-1})	0.960	1.213
Sum (t ha^{-1})	7.76	9.17
Coefficient of determination (r^2)	0.997	
Deviation, D (%)	-18.17	
Simulation Efficiency (E)	0.882	
RMSE (t ha^{-1})	0.212	



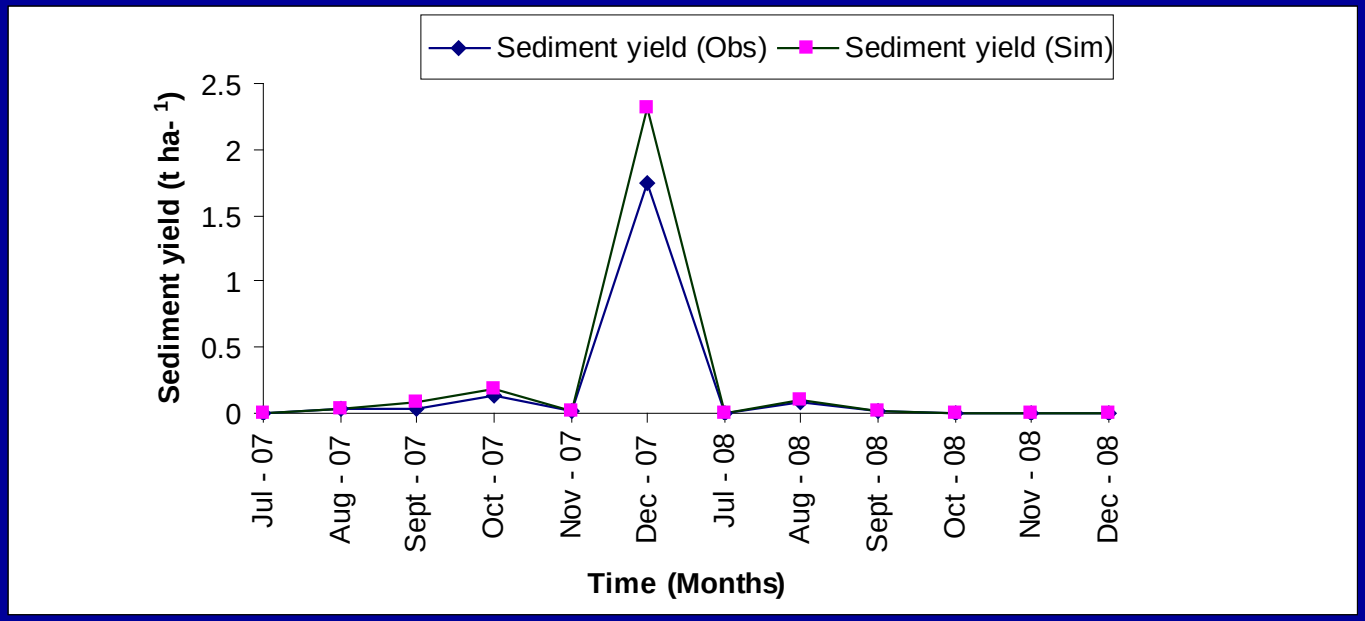
comparison between observed and simulated monthly surface runoff at Poyyapatti during validation period (2007-08)

Statistical Parameters	Surface Runoff	
	Observed	Simulated
Mean (mm)	4.74	5.63
Standard Deviation (mm)	7.79	9.21
Sum (mm)	56.83	67.56
Coefficient of determination (r^2)	0.951	
Deviation, D (%)	-18.893	
Simulation Efficiency (E)	0.950	
RMSE (mm)	0.21	

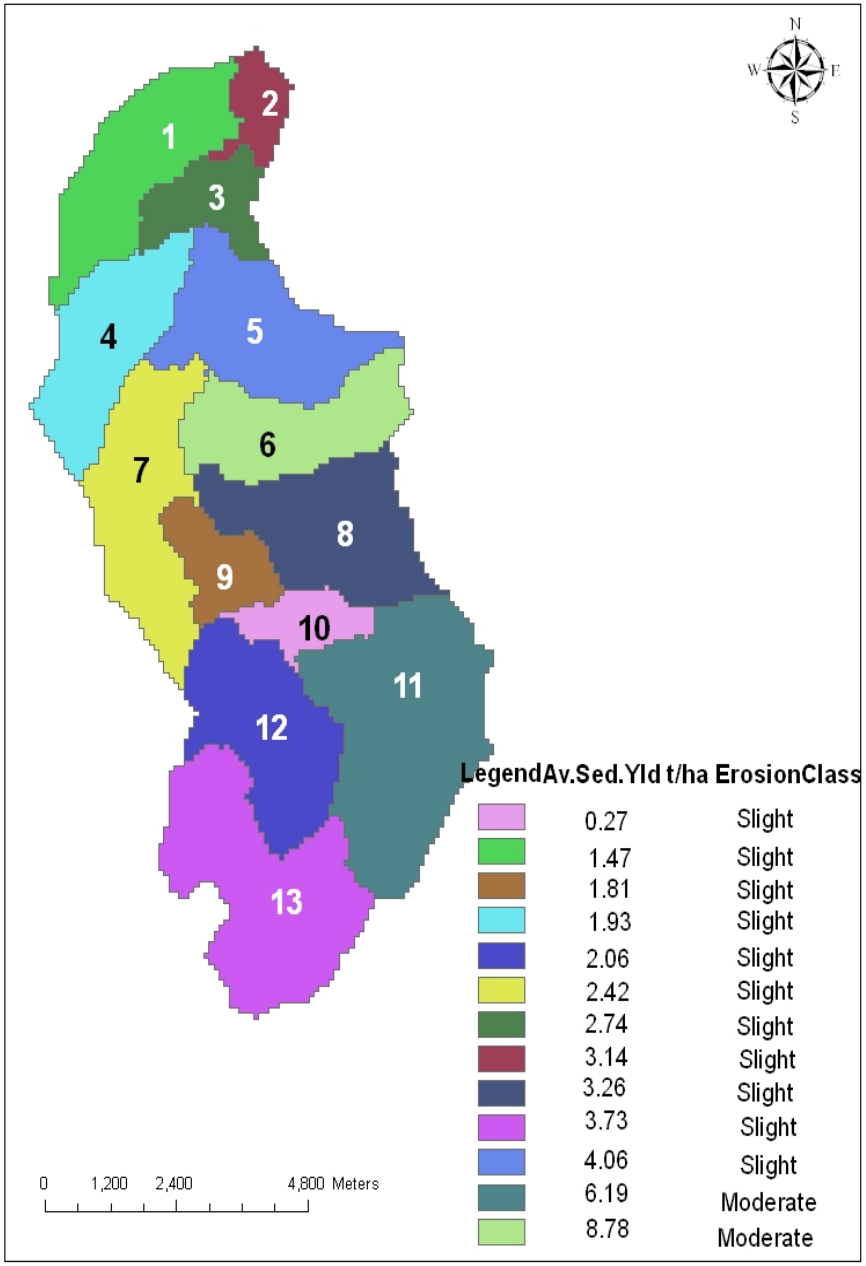


comparison between observed and simulated monthly sediment yield at Poyyapatti during validation period (2007-08)

Statistical Parameters	Surface Runoff	
	Observed	Simulated
Mean (t ha^{-1})	0.17	0.22
Standard Deviation (t ha^{-1})	0.35	0.46
Sum (t ha^{-1})	2.07	2.47
Coefficient of determination (r^2)	0.965	
Deviation, D (%)	-19.321	
Simulation Efficiency (E)	0.866	
RMSE (t ha^{-1})	0.081	



Identification and Prioritization of critical sub-watersheds



Sub-watershed	Area (ha)	Weighted average of Sediment yield (t ha^{-1})	Soil erosion class
1	622.09	1.47	Slight
2	159.70	3.14	Slight
3	265.90	2.74	Slight
4	571.09	1.93	Slight
5	666.41	4.06	Slight
6	547.68	8.78	Moderate
7	700.69	2.42	Slight
8	699.02	3.26	Slight
9	259.21	1.81	Slight
10	195.66	0.27	Slight
11	1120.44	6.19	Moderate
12	673.10	2.06	Slight
13	964.08	3.73	Slight

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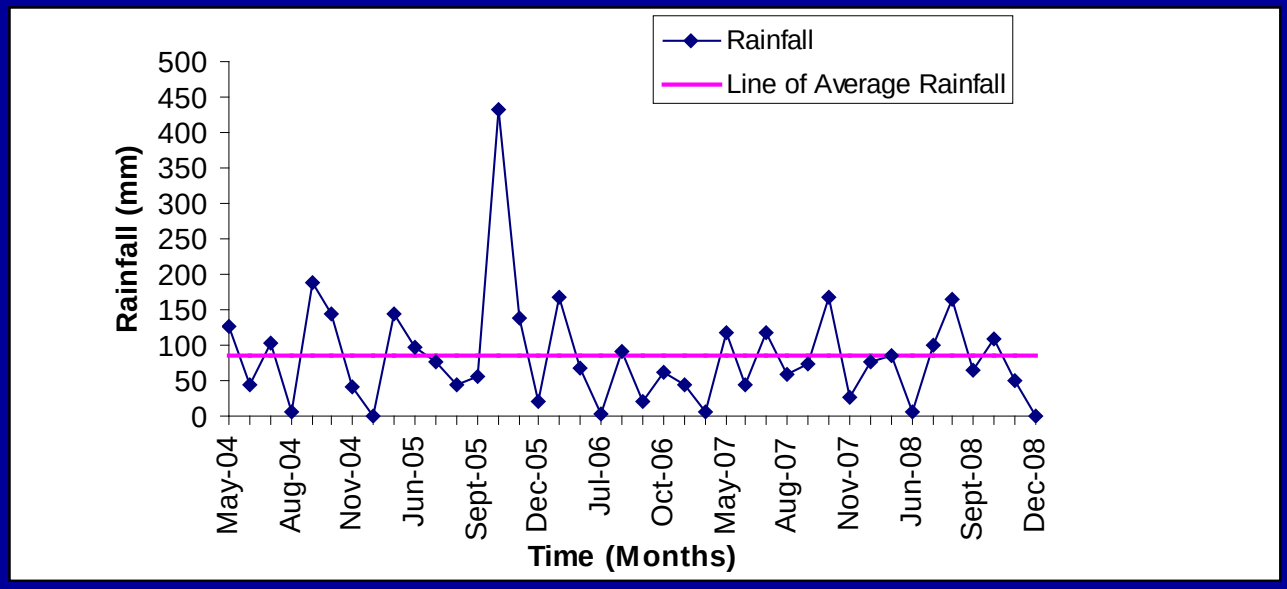
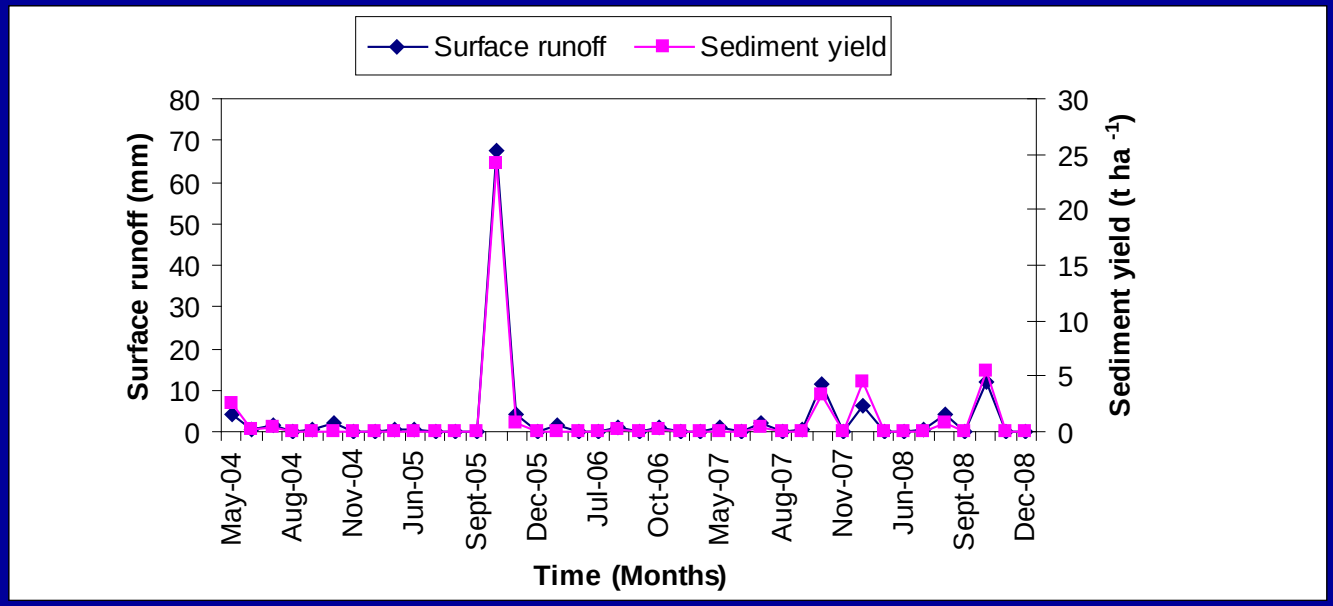
Model Validation for Nallur watershed

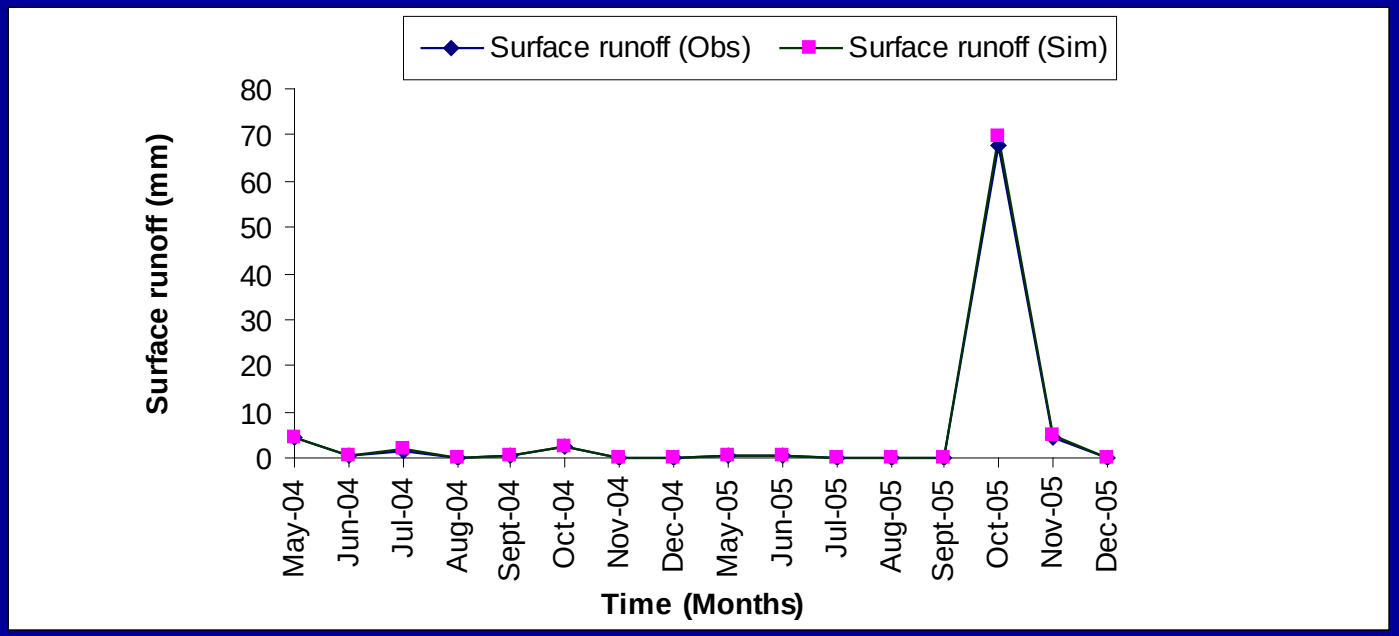
Observed rainfall, surface runoff and sediment yield for Nallur watershed





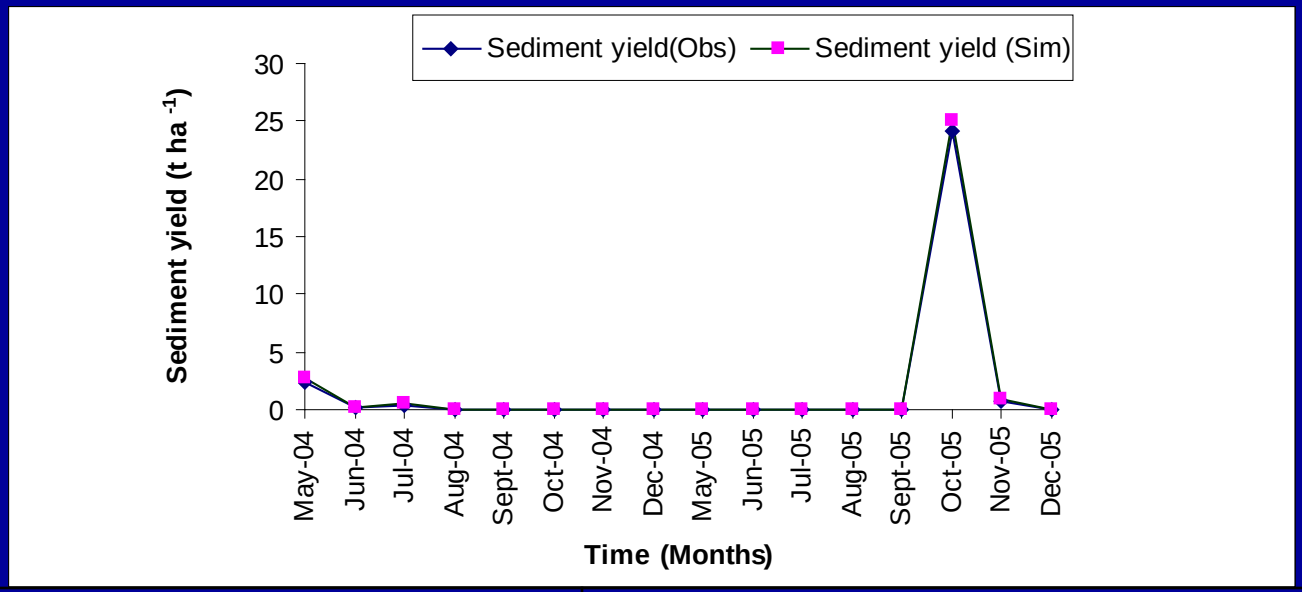
Surface runoff validation

Statistical comparison between observed and simulated monthly surface runoff (May-December) at Nallur during validation period (2004-05)



Statistical Parameters	Surface Runoff	
	Observed	Simulated
Mean (mm)	5.74	6.01
Standard Deviation (mm)	12.38	12.77
Sum (mm)	45.94	48.10
Coefficient of determination (r^2)	0.91	
Deviation, D (%)	-4.70	
Simulation Efficiency (E)	0.89	
RMSE (mm)	0.38	

Sediment yield validation for Nallur Watershed

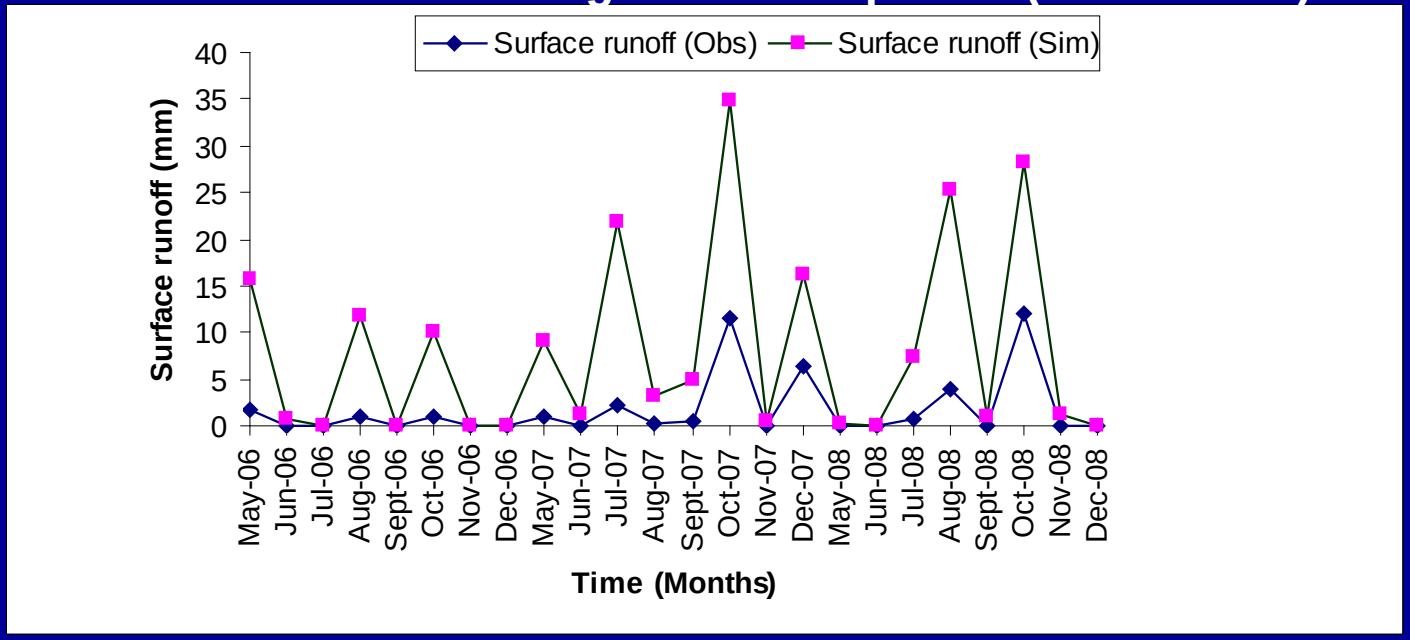


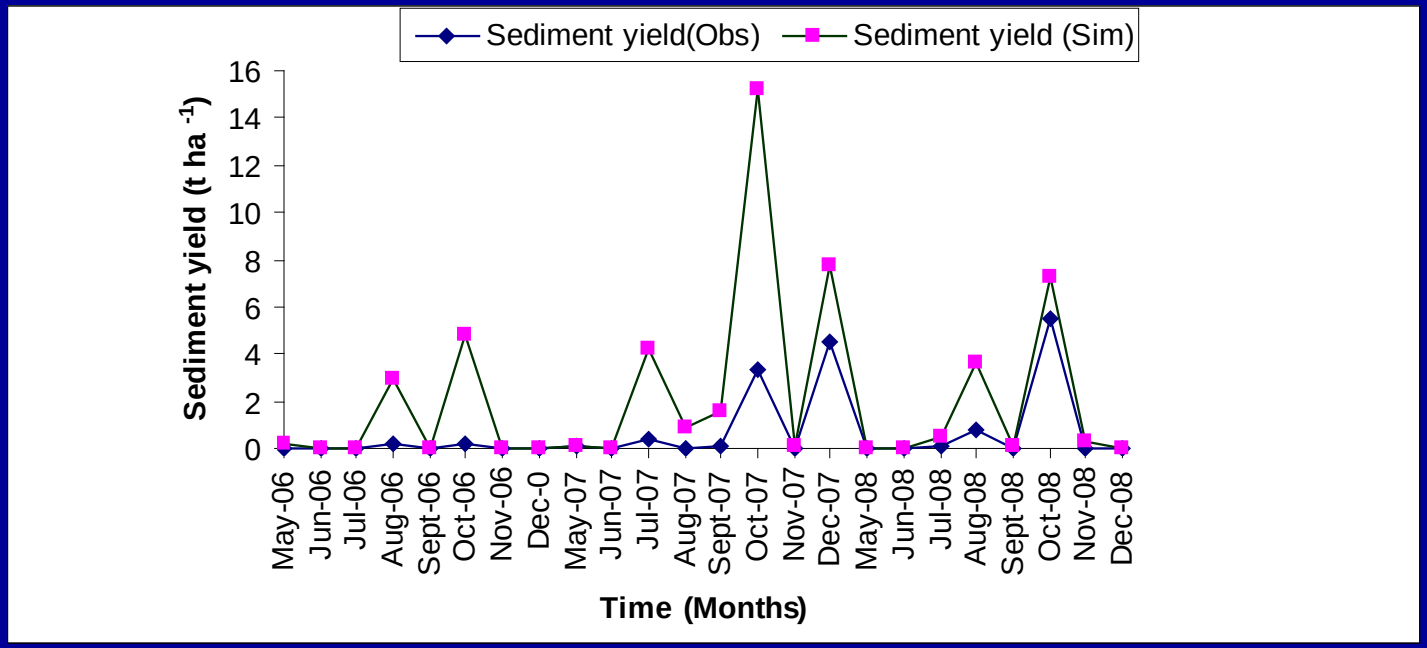
Statistical Parameters	Sediment yield	
	Observed	Simulated
Mean (t ha^{-1})	1.95	2.06
Standard Deviation (t ha^{-1})	4.18	4.32
Sum (t ha^{-1})	15.59	16.48
Coefficient of determination (r^2)	0.89	
Deviation, D (%)	-12.78	
Simulation Efficiency (E)	0.98	
RMSE (t ha^{-1})	0.08	

Executed soil and water conservation works at Nallur watershed

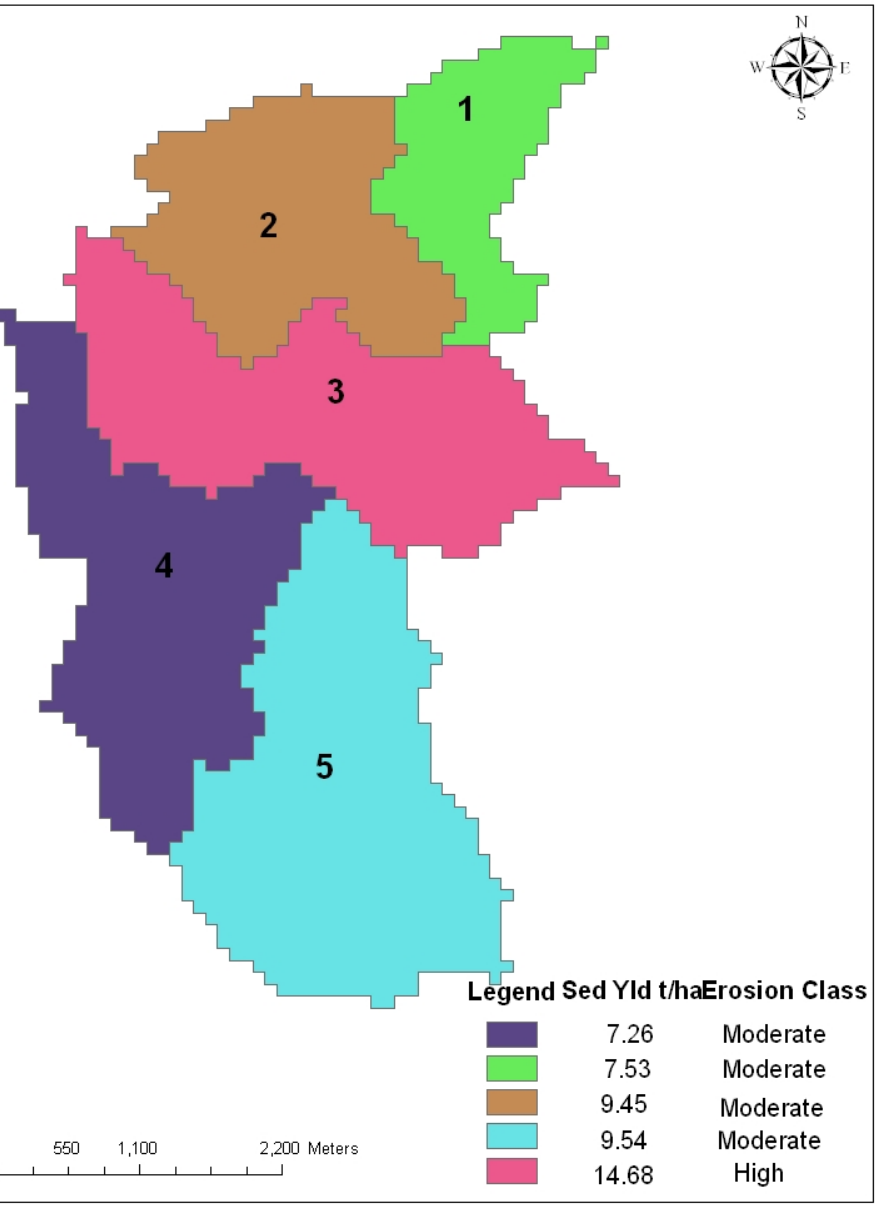
Sl. No	Soil conservation measures	Nos./Area (ha)
1	Contour bunding	50.11
2	Horticulture plantation(Mango, Sapota, Tamarind)	80.21
3	Agro-forestry (Teak)	291.02
4	Drainage line treatment- Upper reach	14 Nos
5	Drainage line treatment- Middle reach	16 Nos
6	Drainage line treatment- Lower reach	56 Nos
7	Water harvesting structure	3 Nos
8	Farm pond	4 Nos
9	Silt detention tank	11 Nos

Observed (Obs) and Simulated (Sim) surface runoff (mm) and sediment yield (t ha-1) at Nallur watershed during validation period (2006 - 2008)





Identification and prioritization of critical sub-watersheds for Nallur watershed



Subwarshed	Average surface runoff, mm	Average sediment yield, t ha^{-1}	Soil erosion class
1	31.83	7.53	Moderate
2	31.14	9.45	Moderate
3	32.87	14.68	High
4	29.97	7.26	Moderate
5	25.53	9.54	Moderate

Nallur Watershed

- The coefficient of determination of 0.91, Nash-Sutcliffe simulation efficiency values of 0.89, root mean square error of 0.38mm and overall deviation values of -4.7 per cent for surface runoff and corresponding values of 0.89, 0.98, 0.08 t $ha^{-1}$and -12.78 for sediment yield simulation indicated a close agreement between observed and simulated values. This shows that the SWAT model can be applied for predicting monthly surface runoff and sediment yield for another watershed having similar agro-climatic conditions as that of Poyyapatti watershed.
- Across the 5 sub-watersheds in case of Nallur watershed average sediment yield rate was found to be maximum (14.68 t ha^{-1}) in sub-watershed no. 3 and was categorised under high priority and the average sediment yield rate were in the range of 7.26 to 9.54 t ha^{-1} for the rest of sub-watersheds which were placed under moderate priority.

THANK YOU