# *ESTIMATION OF SEDIMENT YIELD IN KILIYAR SUB-WATERSHED USING SWAT MODEL*


Presented by

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# Introduction

- Soil erosion is one of the most pressing issues facing on developing countries.
- Soil erosion is defined as “detachment” transportation and deposition of soil particles from one place to another under influence of wind or water.
- Sedimentation is defined as any fragmented material, which is transported or deposited by water, air or ice as natural agents.
- A number of studies have been carried out to investigate the erosion process and its governing with physical factors. Based on these studies, numerous computer-based models have been developed to estimate the rate of sediment yield.

- Hence, Arc- SWAT model was selected and it processes through which hydrologically and it estimates the soil loss to the area of the Kiliyar sub watershed.
- SWAT could be used to identify the Vulnerable area and it used to adopt a best management practices through over the sub watershed

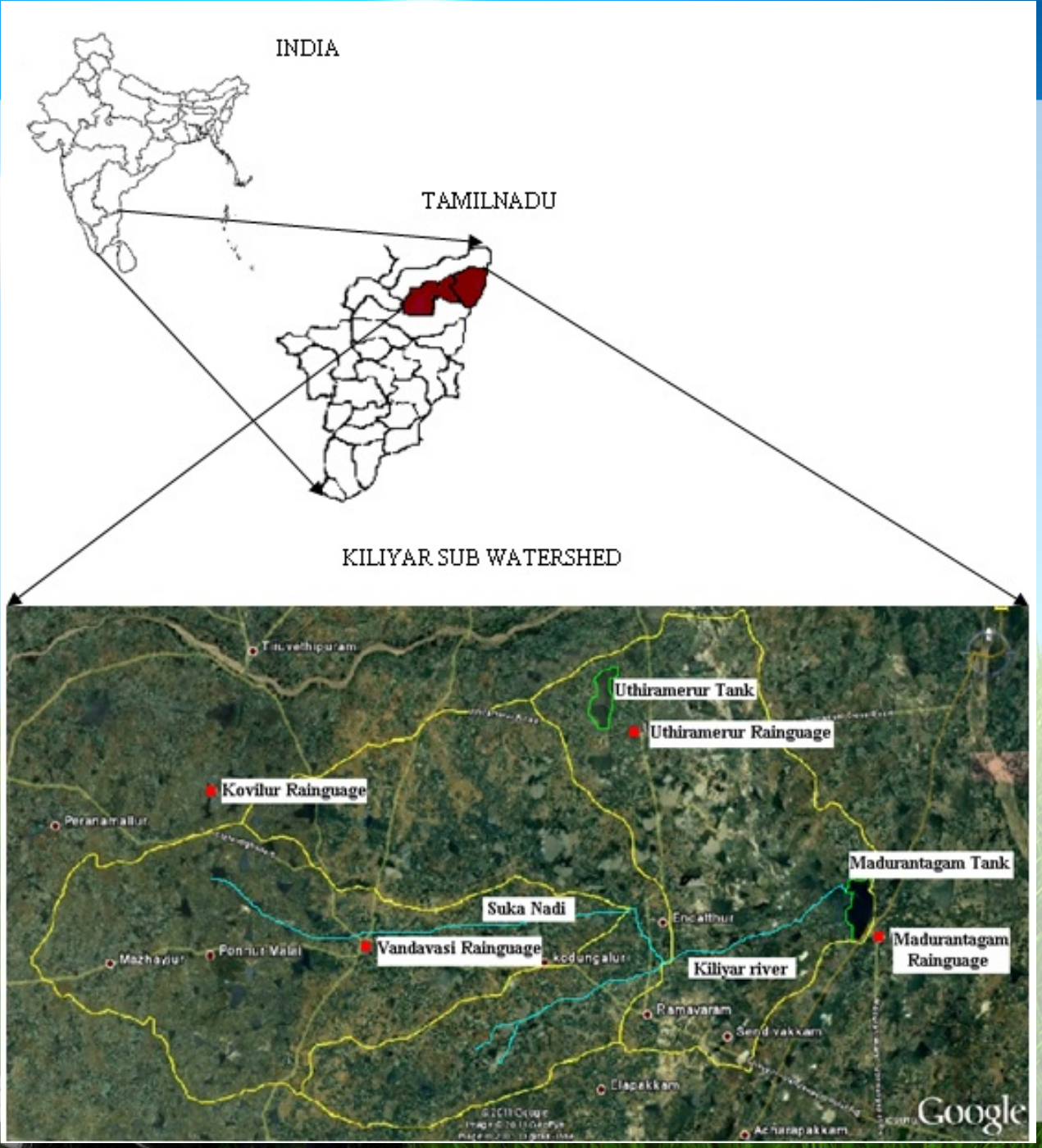
# OBJECTIVE

- To develop a sediment transport model for Kiliyar sub watershed using SWAT.
- To identify the vulnerable area of erosion and suggest suitable watershed conservation measures for the Kiliyar sub-watershed.

# STUDY AREA DESCRIPTION

- The study area was chosen as Kiliyar sub watershed and it is located in both Thiruvannamalai and Kanchipuram districts.

| | |
|---|---|
| Basin | - Palar |
| Watershed | - Cheyyar |
| Sub watershed | - Kiliyar |
| State | - Tamil Nadu |
| District | - Thiruvannamalai, Kanchipuram |
| Toposheets | - 57P/6, 57P/7, 57P/10, 57P/11,57P/14,57P/15 |
| Latitude | - 12º41’9”N and 12º22’32”N |
| Longitude | - 79º 53’26” E and 79º25’10”E |
| Area | - 939.91 $km^2$. |




•Kiliyar River has early named as Suganadhi and it has originated from Iythukinaur.

•The flow of river passes through a Arasampet,Vallam, Mazhayiur, Berthur,Maruthavadi, Kilarapakam, Alappakam, Kuvalai, Sempondi.

•Maximum flood was occurred at the year of 1985.

•we have a three rain gauge station such as Madurantakam, Vandavasi, Uthiramerur.

•Agriculture is a main occupation in this area . They mainly cultivating a crops such as Paddy, Sugarcane, Groundnut.

# PRESENT STATUS OF KILIYAR RIVER

# MODEL DESCRIPTION

SWAT – Soil and water assessment tool .

- It is a river basin or watershed model, scale model has predict the land management practices on water, sediment yield and agricultural chemical complex yield in large complex through the watershed area.
- SWAT model has predict the long term sediment yield to their catchment areas and it has calculated the value of sediment yield through input data.

ArcSWAT – ArcGIS – ArcView extension and graphical user input interference for SWAT

INPUT FOR Arc SWAT MODEL

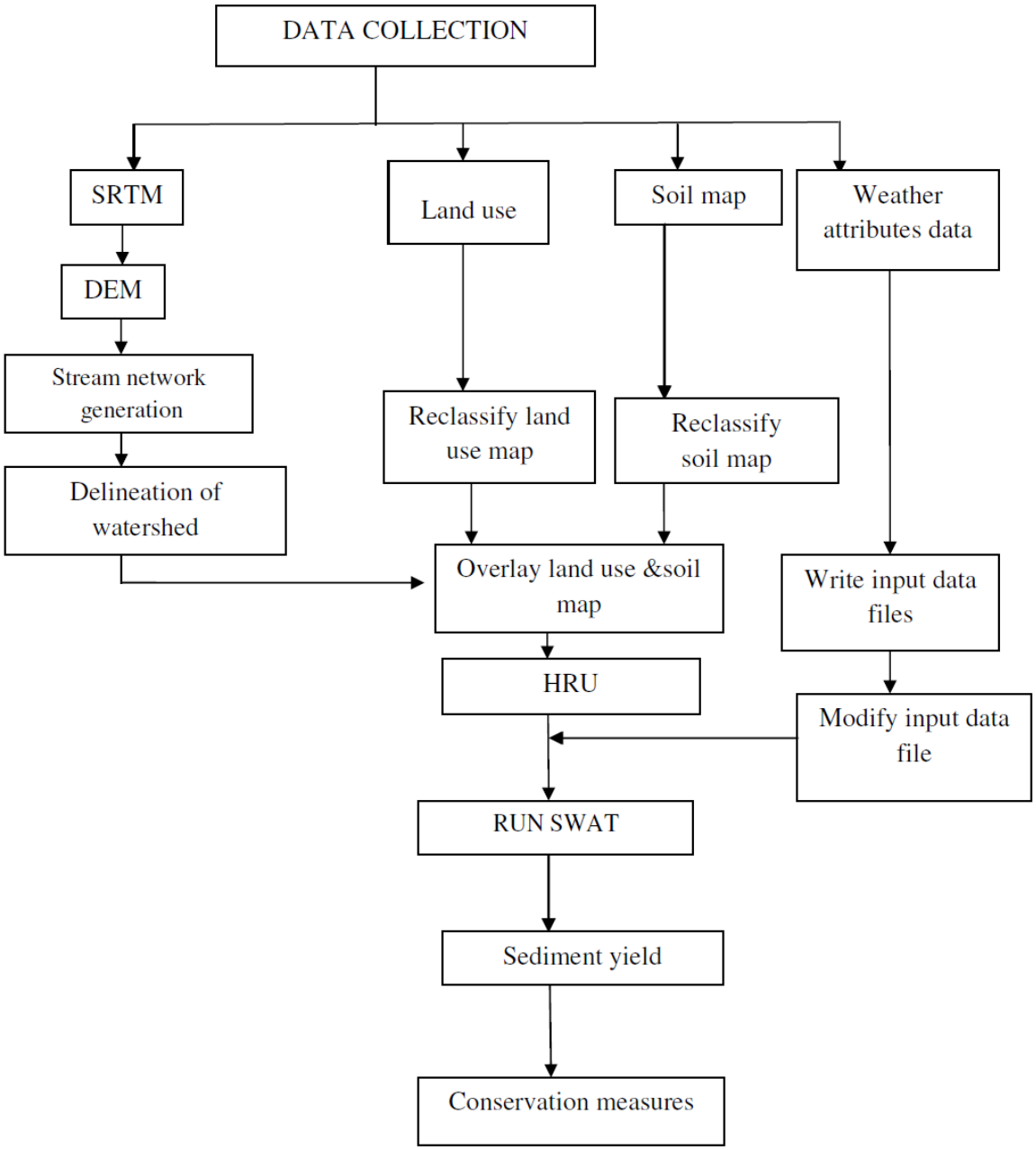
Map
- ✓ Soil map
- ✓ Land use map
- ✓ DEM( Digital elevation model)

Thematic layers

Metrological data
- ✓ Rainfall
- ✓ Relative humidity
- ✓ Sun Shine
- ✓ Wind speed
- ✓ Temperature

Database format

# METHODOLOGY


DATA COLLECTION
SRTM
DEM
Stream network generation
Delineation of watershed
Land use
Reclassify land use map
Soil map
Reclassify soil map
Weather attributes data
Overlay land use &soil map
Write input data files
HRU
Modify input data file
RUN SWAT
Sediment yield
Conservation measures

# TECHNO SOCIO ANALYSIS

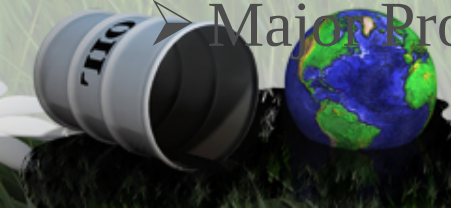
- Social impacts refers to the changes in land use, cropping pattern, farmers perception towards soil erosion etc, are studied. In this study, social impact assessment is carried out in vulnerable areas through questionnaire survey.
- The questionnaire survey is conducted in Arasampattu, Mampattu, Beruthur with a sample size of 15 respondents. The obtained data are interpreted in the form of a pie chart to analyse the social impacts faced by local farmers due to erosion.
- It's categories into

➢ Types of crops

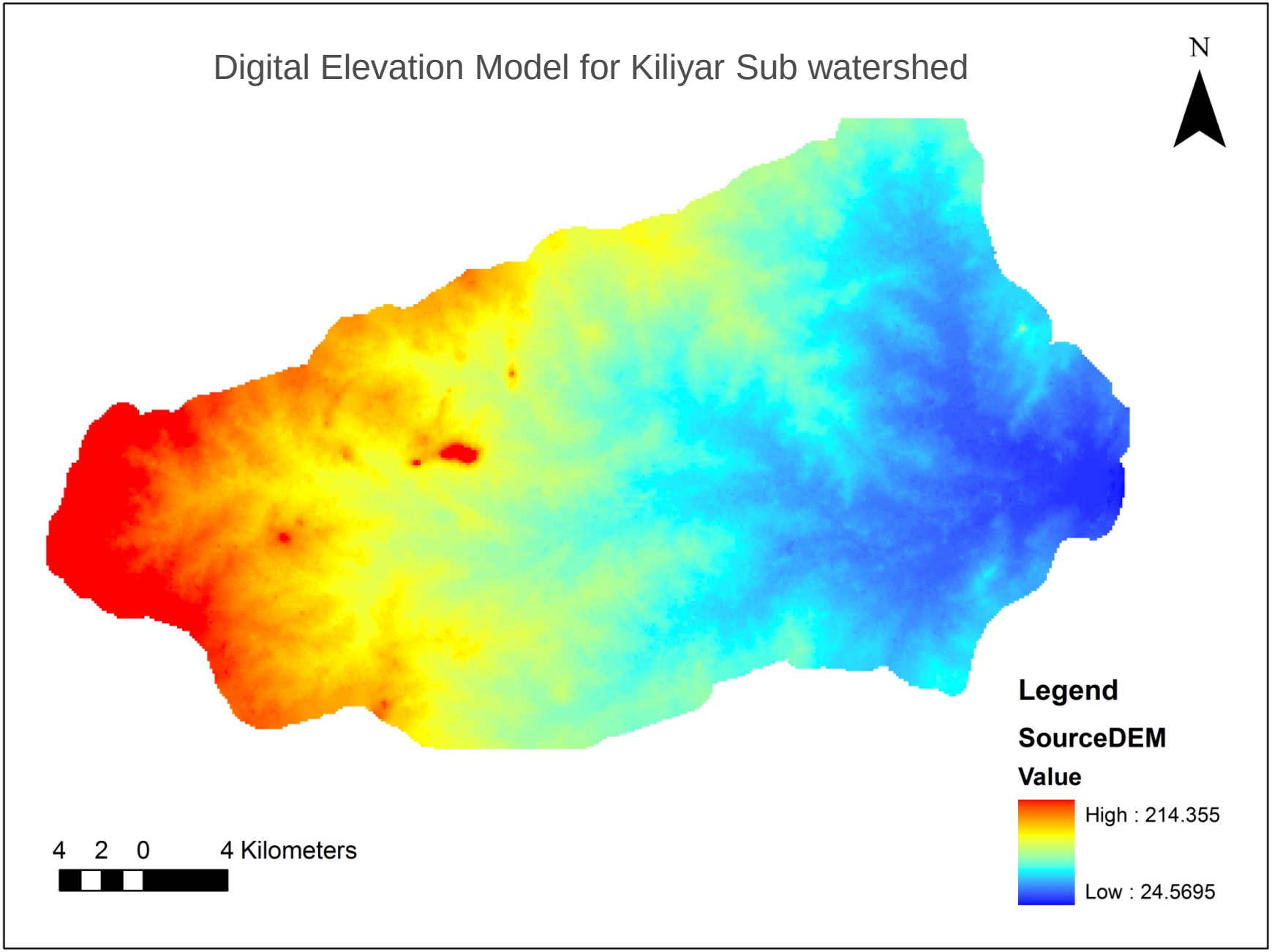
➢ Land holdings

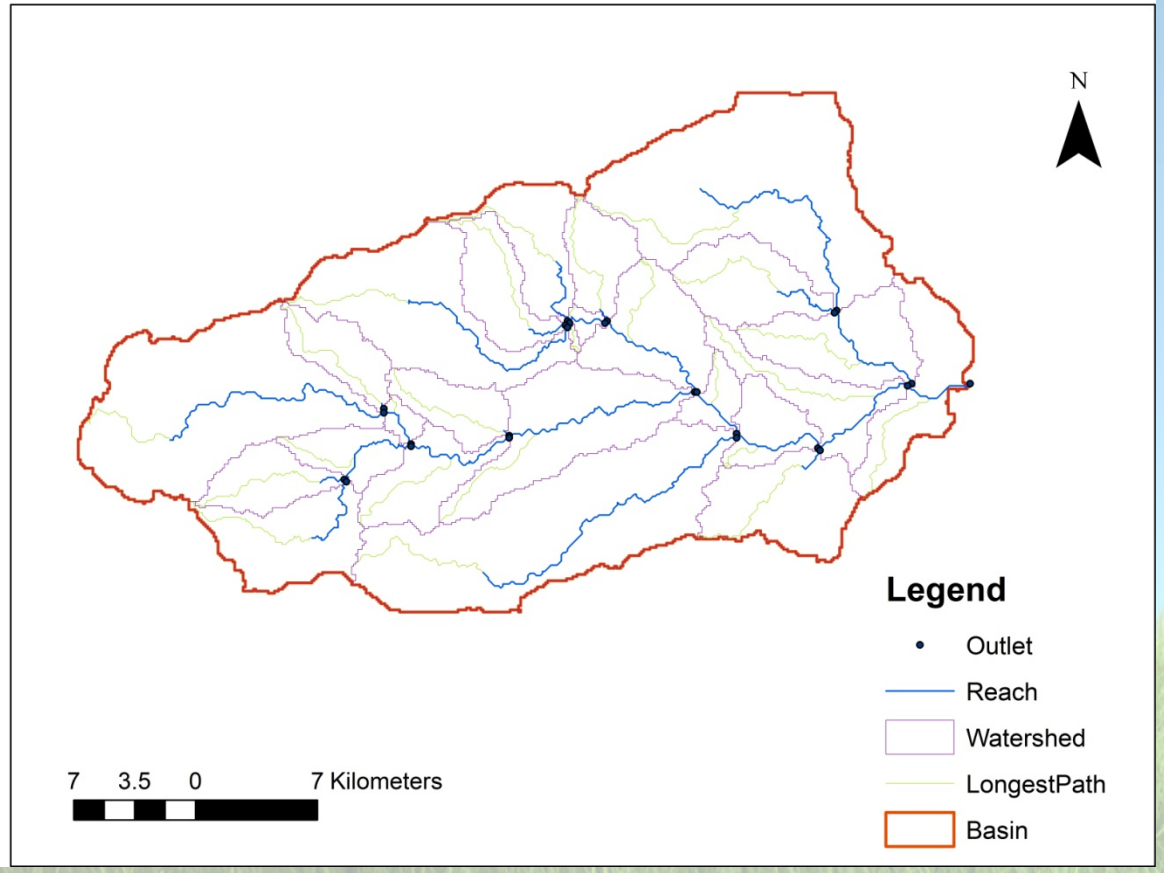
➢ Major Problem faced due to soil loss

➢ Major Problem faced during flood



# RESULTS

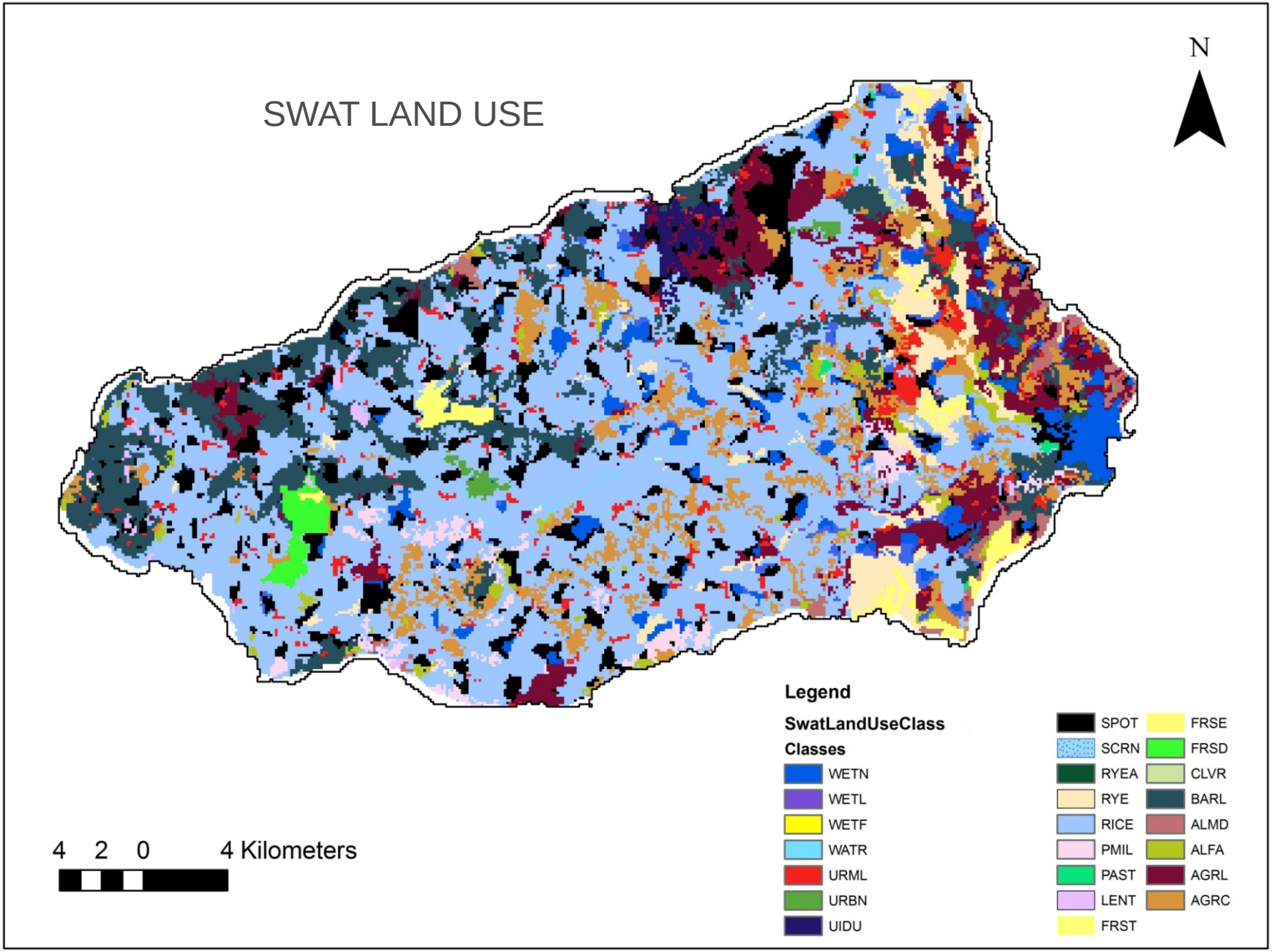

Digital Elevation Model for Kiliyar Sub watershed
N
Legend
SourceDEM
Value
High : 214.355
Low : 24.5695
4 2 0 4 Kilometers



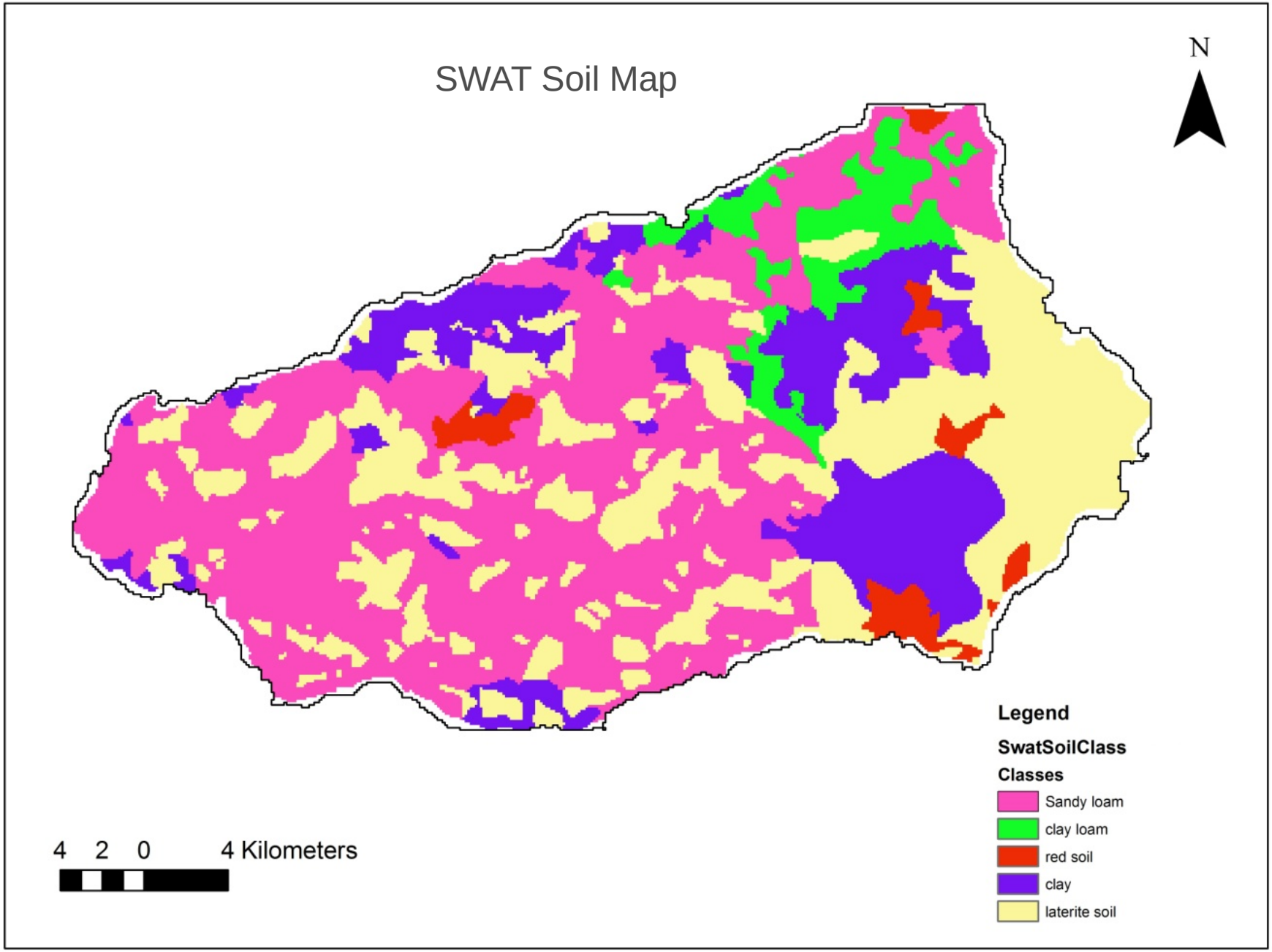

Drainage network map of Kiliyar Sub Watershed

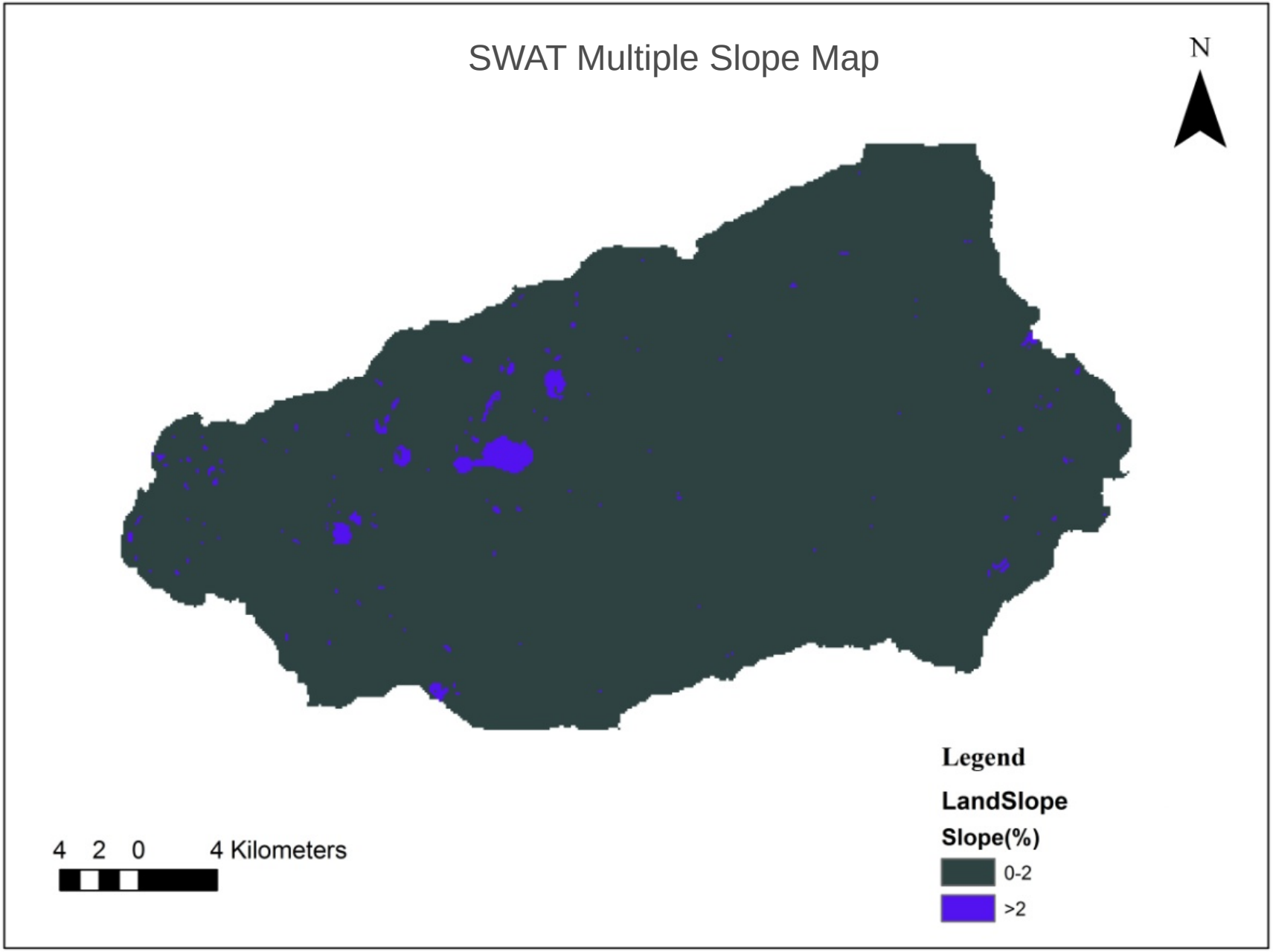
Based on the Digital Elevation Model of the watershed is delineated using Arc SWAT. Figure shows the nodal points of the stream flow network which is derived from SWAT using DEM. It determines the outlet, junction of river, longest path to stream and watershed boundary.

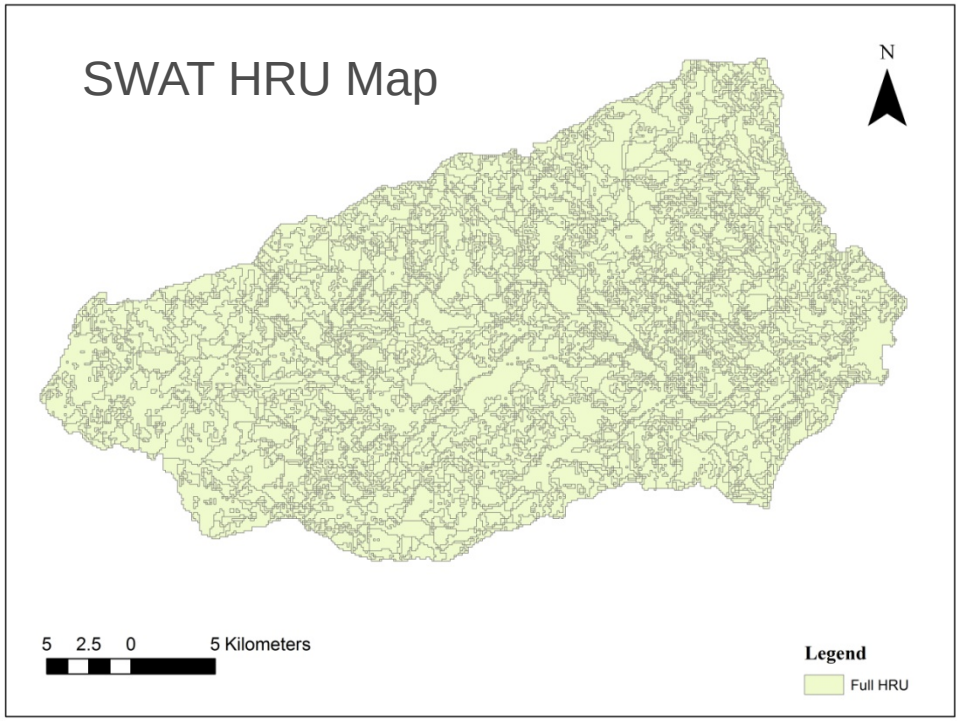
- ✓ Area of Kiliyar sub watershed – 939.91km$^2$


SWAT LAND USE
N
Legend
SwatLandUseClass
Classes
WETN
WETL
WETF
WATR
URML
URBN
UIDU
SPOT
SCRN
RYEA
RYE
RICE
PMIL
PAST
LENT
FRST
FRSE
FRSD
CLVR
BARL
ALMD
ALFA
AGRL
AGRC
4 2 0 4 Kilometers

| S.No | Land use | Percentage of landuse |
|---|---|---|
| 1 | Built up area | 4.35 % |
| 2 | Agriculture | 63.37% |
| 3 | Forest | 9.87% |
| 4 | Wastelands | 14.84% |


SWAT Soil Map
N
Legend
SwatSoilClass
Classes
Sandy loam
clay loam
red soil
clay
laterite soil
4 2 0 4 Kilometers


SWAT Multiple Slope Map
N
4 2 0 4 Kilometers
Legend
LandSlope
Slope(%)
0-2
>2




Hydrological Response Unit (HRU) are areas within a watershed that respond hydrologically similar to given input. It is a method of representing the spatial heterogeneity of a watershed.

Arc- SWAT defines the HRU with respect to their sub basin. In this study area, there are 25 sub basin which is divided into 244 HRU units.

# Creation of Data Base

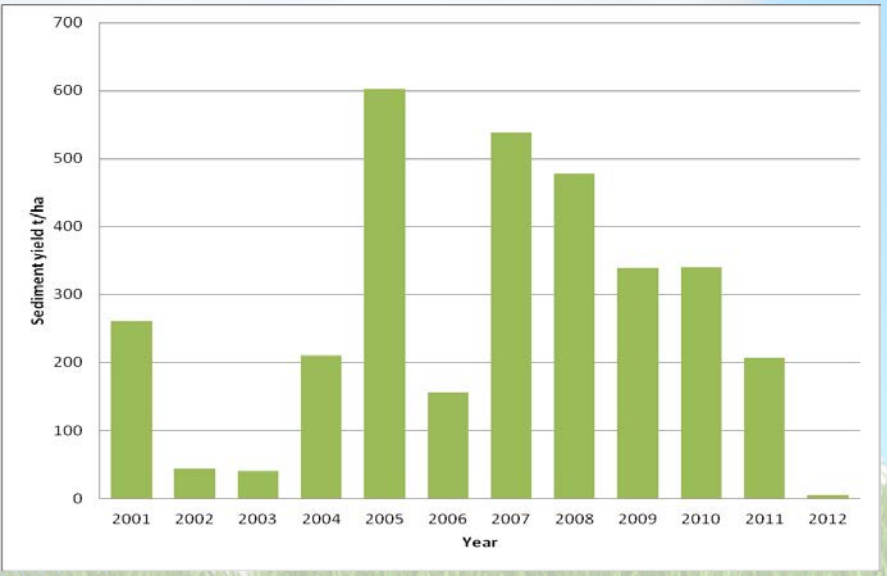
- Weather database for the last twelve years (2001 - 2012 ) was stored in the SWAT data base through SWAT's weather data input interface.
- Daily rainfall data was stored in dbase tables. Look up tables were prepared for linking the weather station location and rain gauge location to weather database and rainfall data respectively

# Rainfall and Sediment Yield for the Period of 2001-2012

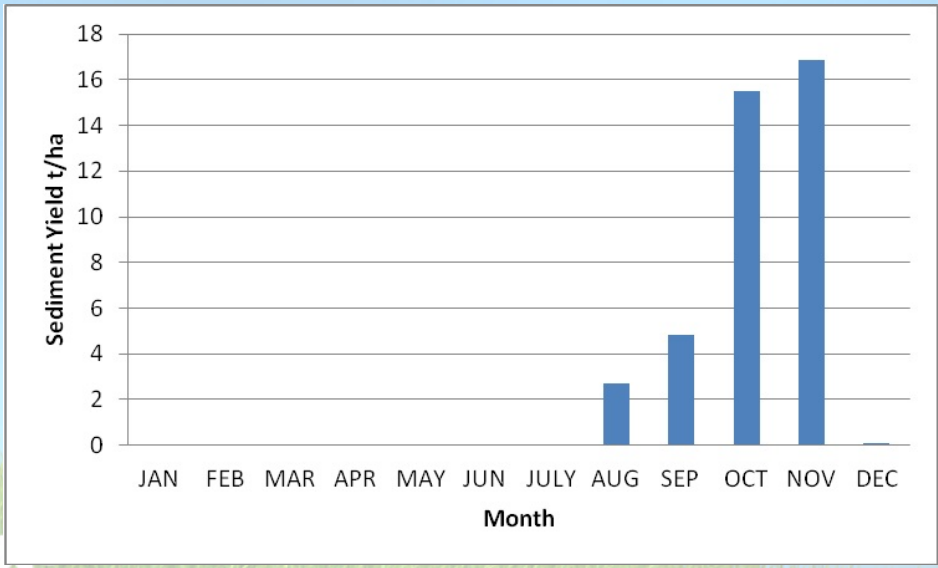
| S.No | Rainfall Year | Rainfall (mm) | Sediment yield (t/ha) |
|---|---|---|---|
| 1 | 2001 | 1484.3 | 260.897 |
| 2 | 2002 | 815.3 | 43.631 |
| 3 | 2003 | 792.5 | 40.008 |
| 4 | 2004 | 1232.4 | 210.652 |
| 5 | 2005 | 1671.6 | 601.87 |
| 6 | 2006 | 1011.5 | 156.438 |
| 7 | 2007 | 1580.6 | 538.366 |
| 8 | 2008 | 1552.6 | 478.253 |
| 9 | 2009 | 1259.1 | 339.352 |
| 10 | 2010 | 1259.2 | 340.636 |
| 11 | 2011 | 1220.6 | 207.389 |
| 12 | 2012 | 50.86 | 4.867 |

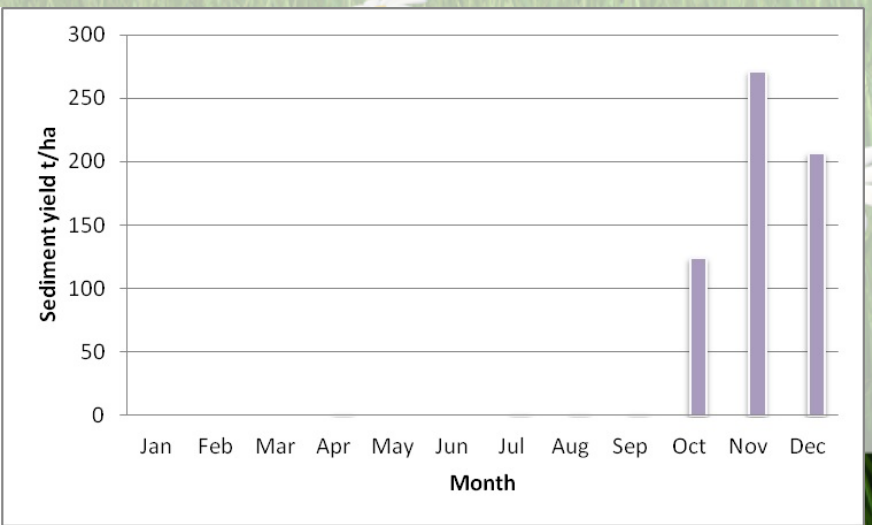
# SEDIMENT YIELD ANALYSIS

Annual sediment yield of 2001-2012




Annual sediment yield of 2003




Annual sediment yield of 2005

# Erosion Impacts in the sub basin

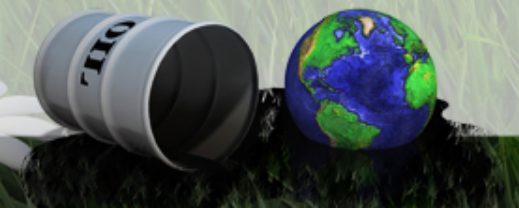
| S.No | No of Subbasin | Area of Subbasin (ha) | Total annual average sediment yield (t/ha/year) | Range of sediment yield (t/ha) | Range of soil erosion |
|---|---|---|---|---|---|
| 1 | 10 | 41164.64 | 0 | 0 | Nil |
| 2 | 5 | 14189.65 | 238.36 | 0-250 | Slight |
| 3 | 4 | 7939.14 | 355.472 | 250-360 | Moderate |
| 4 | 3 | 19813.38 | 439.865 | 360-450 | Severe |
| 5 | 3 | 10884.19 | 481.713 | 450-600 | Very Severe |

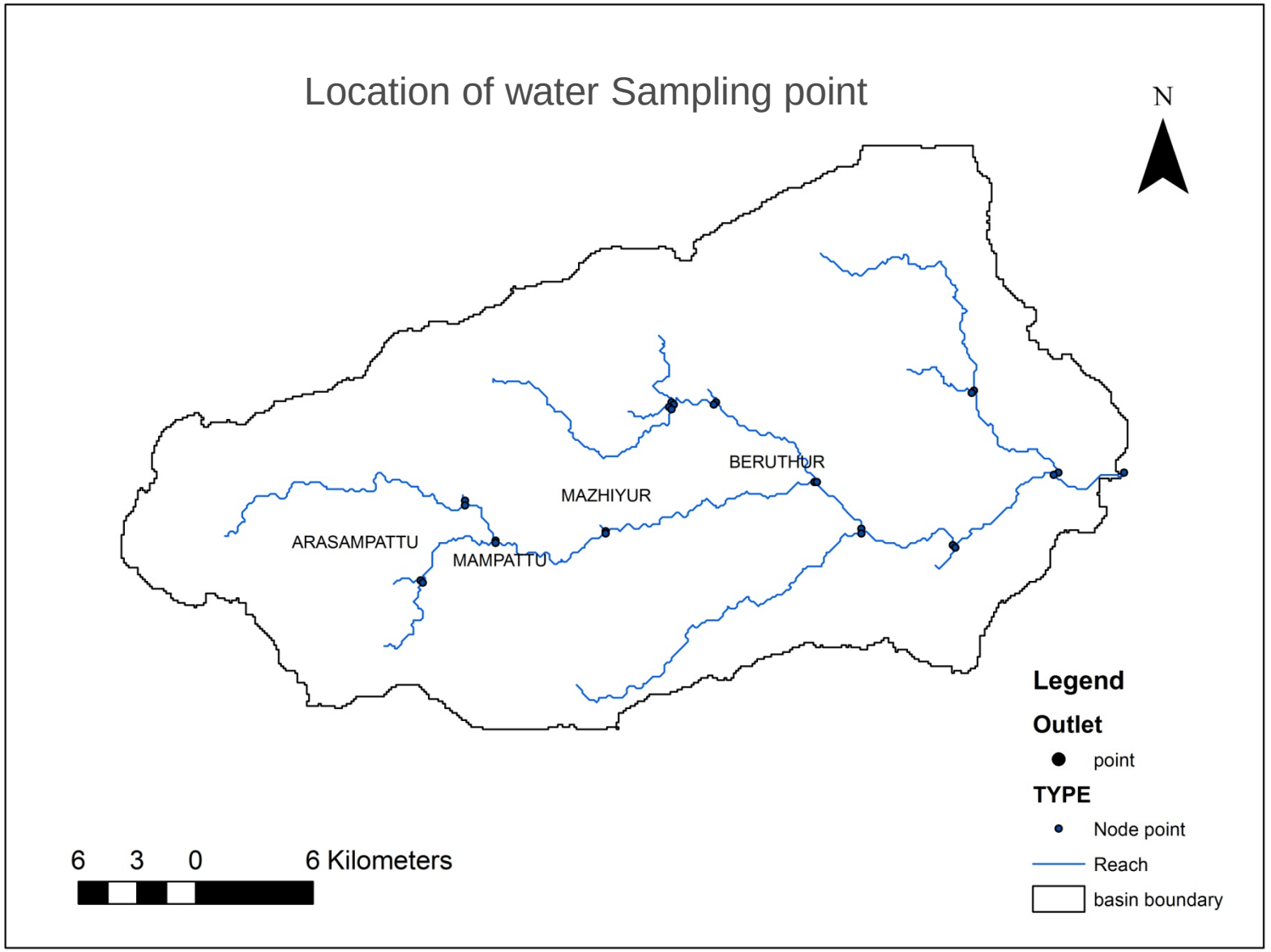
# WATER SAMPLES

- In this study, some of the confluence points are selected in the river stream. The location of confluence points such as Arasampattu, Mampattu, Vallam, and Beruthur.

- The water samples are collected for the period of four months (December to March).

- The bottle is rinsed twice before the water samples are collected in the stream along the direction of flow.

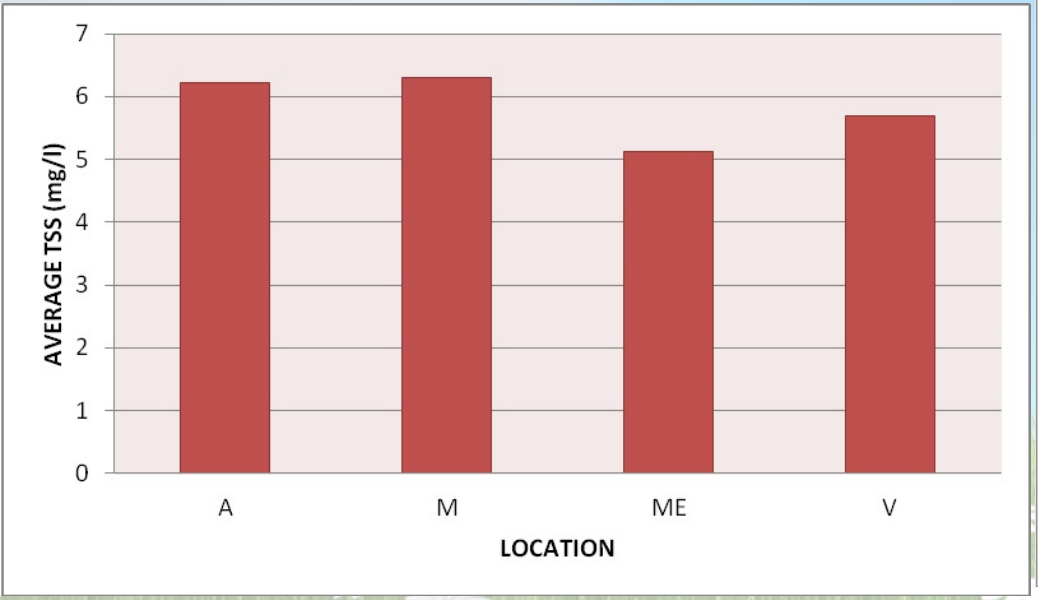


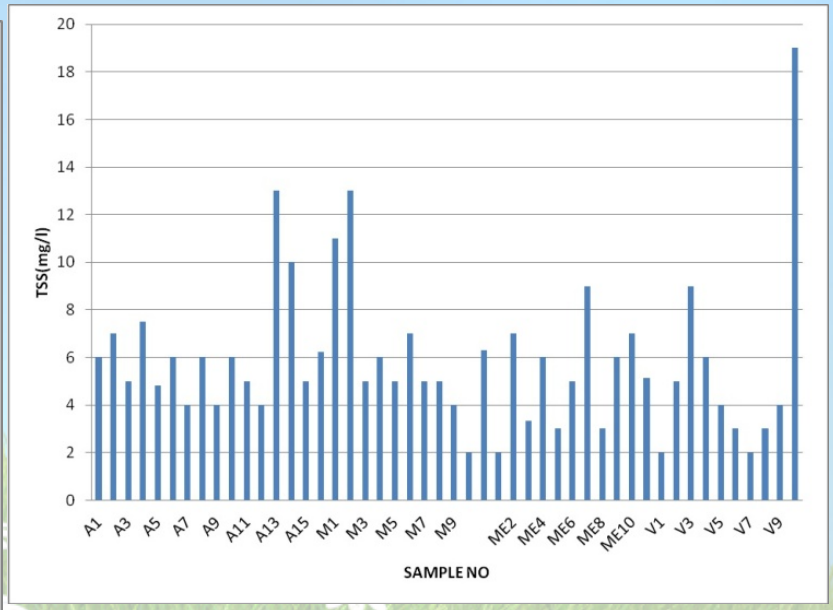

Location of water Sampling point
N
BERUTHUR
MAZHIYUR
ARASAMPATTU
MAMPATTU
6 3 0 6 Kilometers
Legend
Outlet
point
TYPE
Node point
Reach
basin boundary

| S.No | ID | LOCATION | Avg TSS (mg/lit) |
|---|---|---|---|
| 1 | A | Arsampattu | 6.22 |
| 2 | M | Mampattu | 6.3 |
| 3 | ME | beruthur | 5.13 |
| 4 | V | Vallam | 5.7 |

# Water Sample Analysis

Average Value of TSS for each location



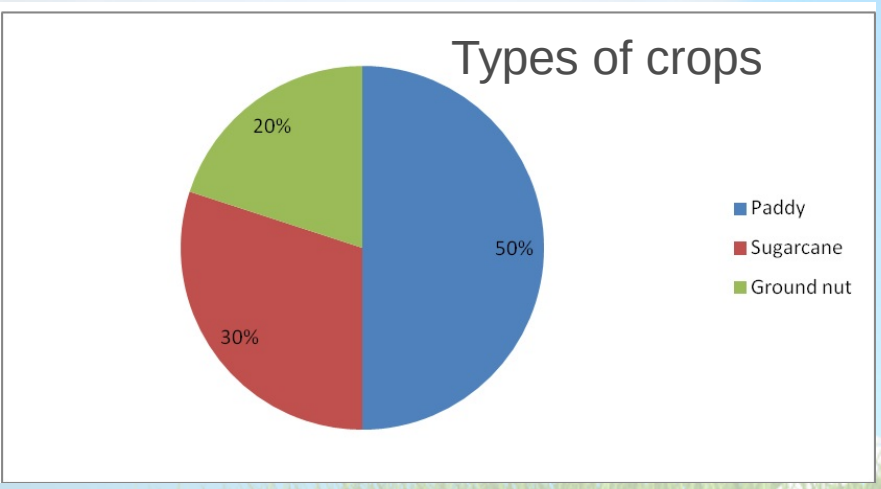

TSS for each location

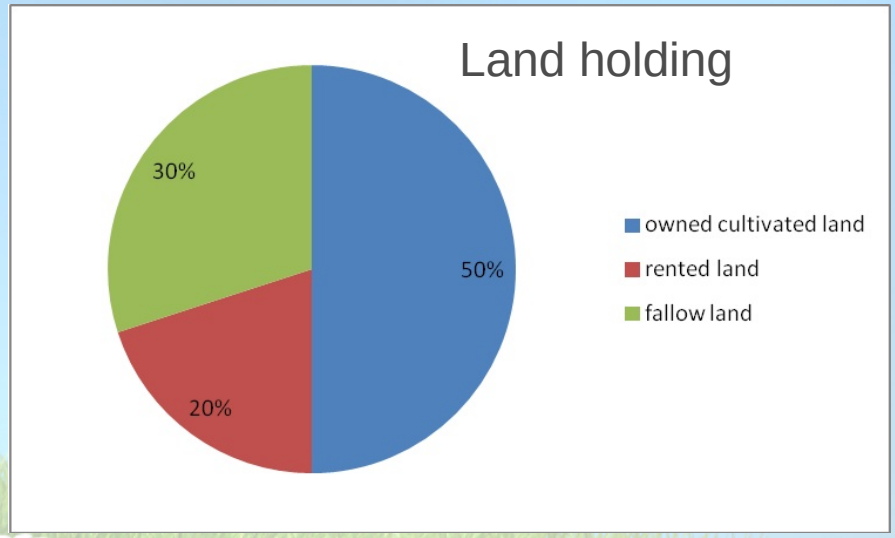
# Comparison of Observed and model value of TSS

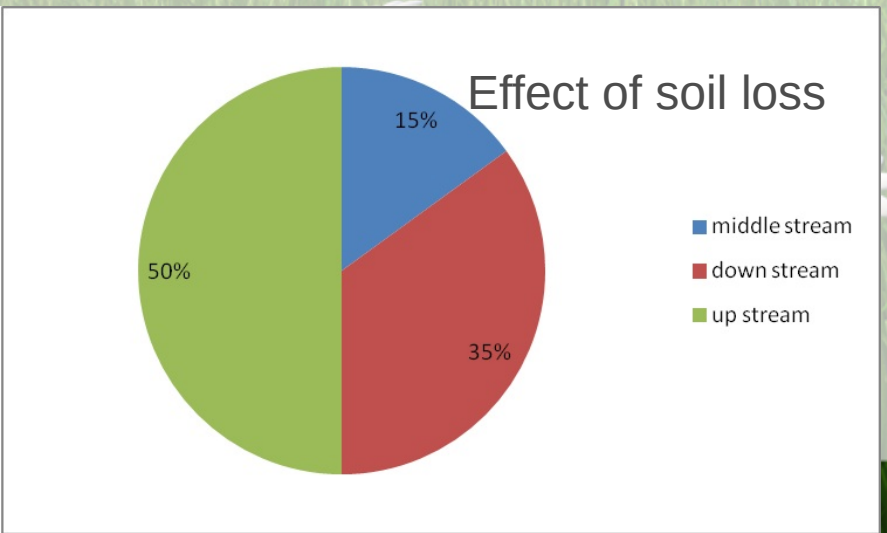
| S.No | Year | TSS ( mg/litre) |
|---|---|---|
| 1 | 2001 | 6765.36 |
| 2 | 2002 | 4070.52 |
| 3 | 2003 | 3769.52 |
| 4 | 2004 | 9668.95 |
| 5 | 2005 | 12355.82 |
| 6 | 2006 | 6290.85 |
| 7 | 2007 | 8954.68 |
| 8 | 2008 | 8853.41 |
| 9 | 2009 | 6375.42 |
| 10 | 2010 | 6365.26 |
| 11 | 2011 | 5924.76 |
| 12 | 2012* | 605.65 |

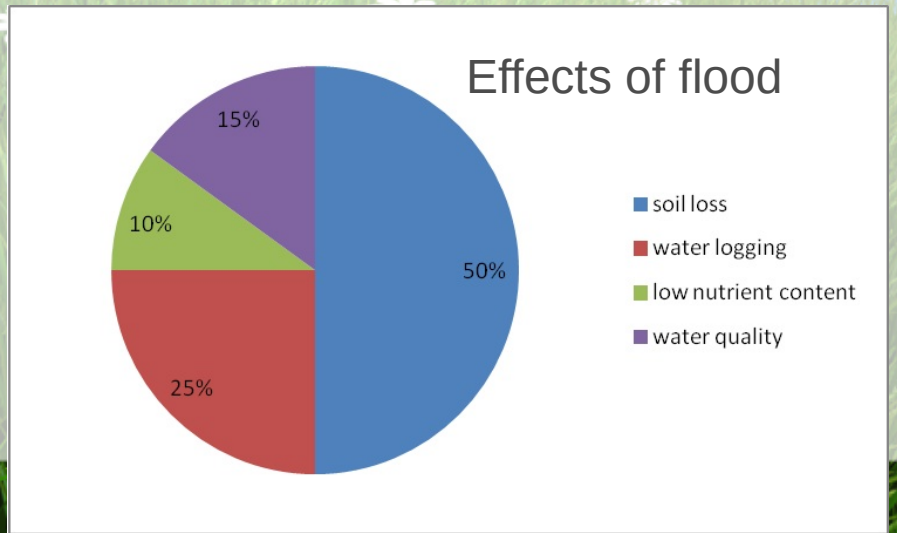
| S.No | Date | Observed value | Model value |
|---|---|---|---|
| 1 | 02-12-2011 | 6.01 | 8.80 |
| 2 | 04-12-2011 | 7.21 | 8.33 |
| 3 | 08-12-2011 | 11.36 | 11.80 |
| 4 | 11-12-2011 | 23.25 | 23.83 |
| 5 | 15-12-2011 | 2.38 | 7.29 |
| 6 | 19-12-2011 | 7.20 | 7.00 |
| 7 | 22-12-2011 | 2.35 | 5.80 |
| 8 | 25-12-2011 | 5.25 | 6.89 |
| 9 | 02-01-2012 | 5.63 | 6.32 |
| 10 | 08-01-2012 | 4.80 | 5.60 |
| 11 | 11-01-2012 | 5.32 | 4.99 |
| 12 | 24-01-2012 | 3.33 | 8.36 |
| 13 | 02-02-2012 | 3.45 | 3.45 |
| 14 | 06-02-2012 | 8.99 | 9.65 |
| 15 | 10-02-2012 | 6.63 | 10.67 |
| 16 | 13-02-2012 | 4.32 | 10.78 |
| 17 | 17-02-2012 | 4.12 | 15.35 |
| 18 | 23-02-2012 | 6.81 | 10.69 |
| 19 | 28-02-2012 | 4.76 | 5.62 |
| 20 | 03-03-2012 | 3.89 | 2.45 |
| 21 | 06-03-2012 | 3.65 | 11.56 |
| 22 | 20-03-2012 | 3.86 | 10.81 |
| 23 | 25-03-2012 | 19.32 | 16.29 |
| 24 | 30-03-2012 | 7.51 | 5.45 |

# TECHNO SOCIAL ANALYSIS



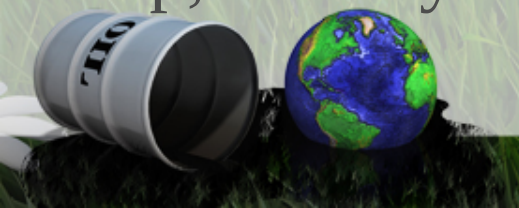



# Conservation Measures

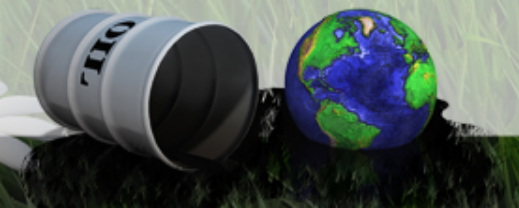
- Since 11.58% of the area has been identified as vulnerable area and it could be treated as one of the priority areas and conservation measures chosen according to the conditions of slope, soil etc.
- Various conservation practices that could be taken up in the vulnerable areas are: Permanent and Semi- Permanent check dams, Establishing field bund, farm- pond, Earthen gully plugs, Channel farming, Agro forestry, Agro horticulture, Grass- seeds sowing along the field bunds, Pipe outlet for field bunds, Disc Plough, Farm pond outlet, Crop rotation, Brushwood dams, Brush packing, Gabions, Wattling, Rip-rap, Salinity management and Terracing.



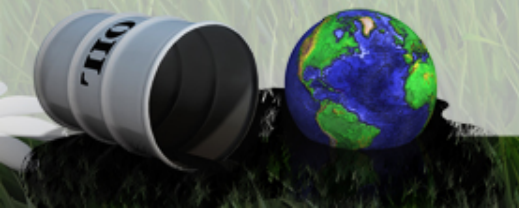
# CONCLUSION

Based on the analysis to estimate the sediment yield for Kiliyar watershed, the following conclusions are arrived.

- The observed total suspended solids values of the four sample locations at Arasampattu, Vallam, Mampattu, Berthur are 6.22 mg/l, 6.3 mg/l, 5.13 mg/l and 5.7 mg/l respectively. The amount of suspended particles was relatively too low.
- The rainfall analysis was done in a period of twelve years from 2001-2012. The maximum rainfall of 1671.6 mm is occurred in the year of 2005 and the minimum rainfall of 792.5 mm is occurred in the year of 2003.
- The hydrological analysis of the study area using SWAT model generates 244 HRU and 25 subbasins for the sedimentation analysis.



- Different type of thematic maps such as DEM (Digital Elevation Model), Landusemap, Soilmap and weather attributes prepared in ArcGIS and classified in ArcSWAT as model input. The weather attributes data were entered into database format and it is used to derive the sediment yield based on MUSLE formula ( Modified Universal Soil Loss Equation).
- The Arc SWAT is used to derive the sediment yield for the entire watershed. The maximum sediment yield was obtained for the year 2005 and it works out to be 601.87 t/ha and the minimum sediment yield was obtained for the year 2003 and it works out to be 40.008 t/ha.



- The results shows that ten sub basin were not affected by the soil erosion which is 43.79 % of the total area. Similarly five basin are slightly affected by the soil erosion in the Kiliyar sub-watershed which is 15.09% of the total area. Moderate soil erosion has occurred in nearly 8.45% of the total area and as far as sub basin is concerned it takes 4 sub basin out of 25 sub basin. Also three sub basins each in severe and very severe are affected by soil erosion which is 21.08% and 11.58% of the total area respectively.
- The model values were compared with the observed values for the period of four months. It is inferred that the model values are higher than the observed values. There is no data avaialbe for the perious months and data collected during the study periods are not enough for the calibration. Hence it is very difficult to match the model values with the observed values. Howverr the model may be improved by adding more observation data with space and time in the future.
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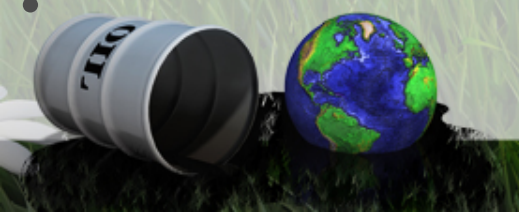

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THANK YOU