INTERNATIONAL SWAT CONFERENCE

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SWAT-MODFLOW, AN OPTIMIZATION MODEL FOR CONJUNCTIVE USE OF SURFCE AND GROUNDWATER OF NAGARJUNA SAGAR CATCHMENT

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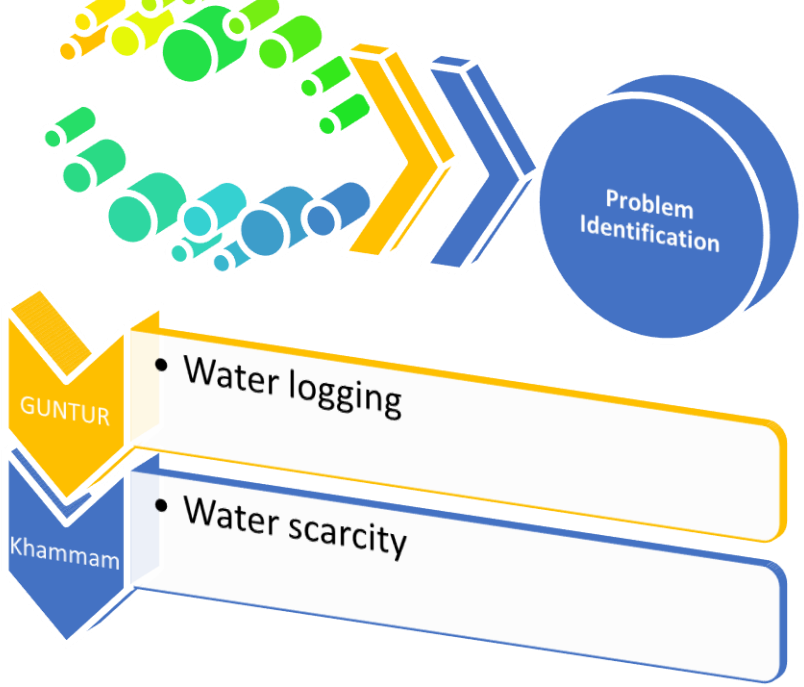
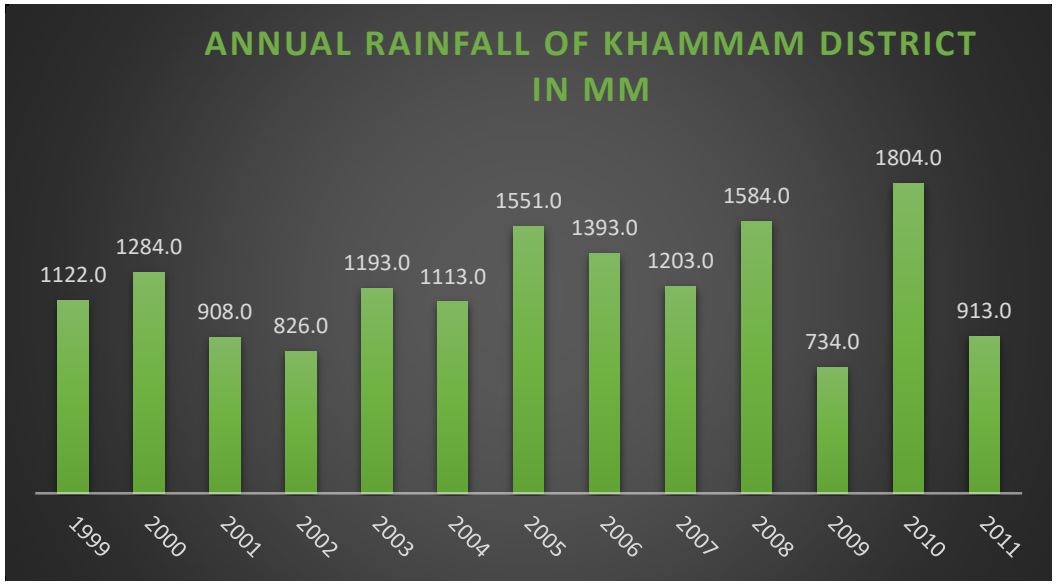
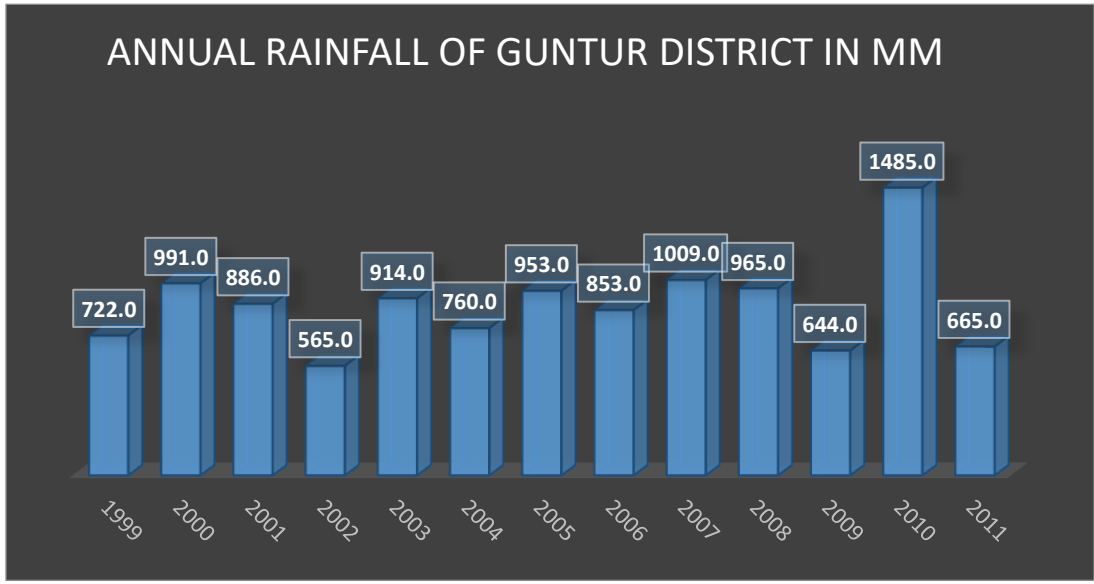
Date: 10-Jan-18

OVERVIEW

- Problem identification
- Objectives
- Study area
- Data collection
- Model setup
- Results and conclusion

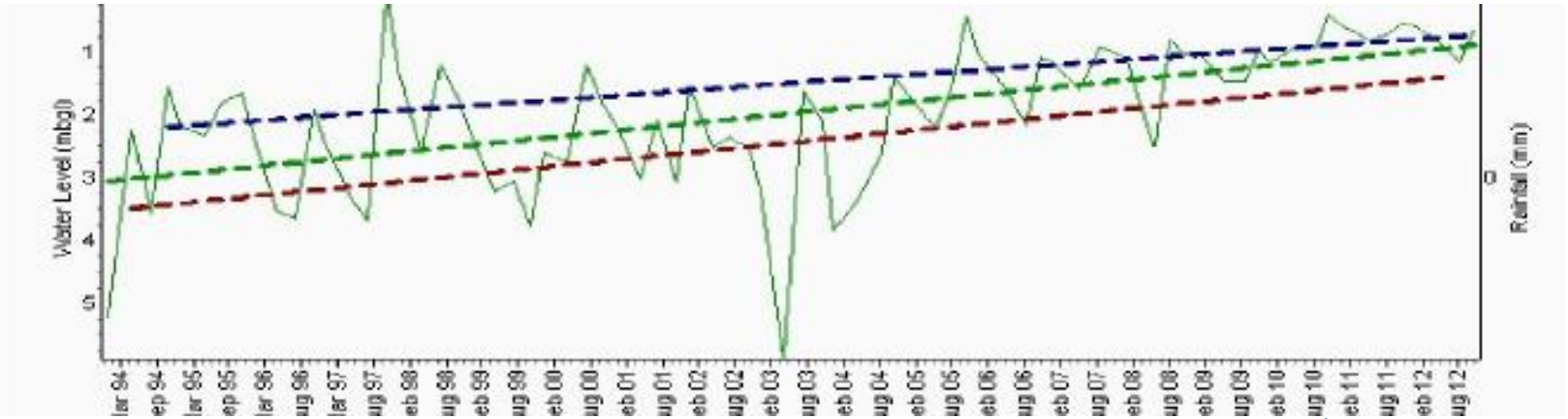






Source: *Indian Meteorological Department and Directorate Of Economics And Statistics*

Raising and falling trends of Ground water levels

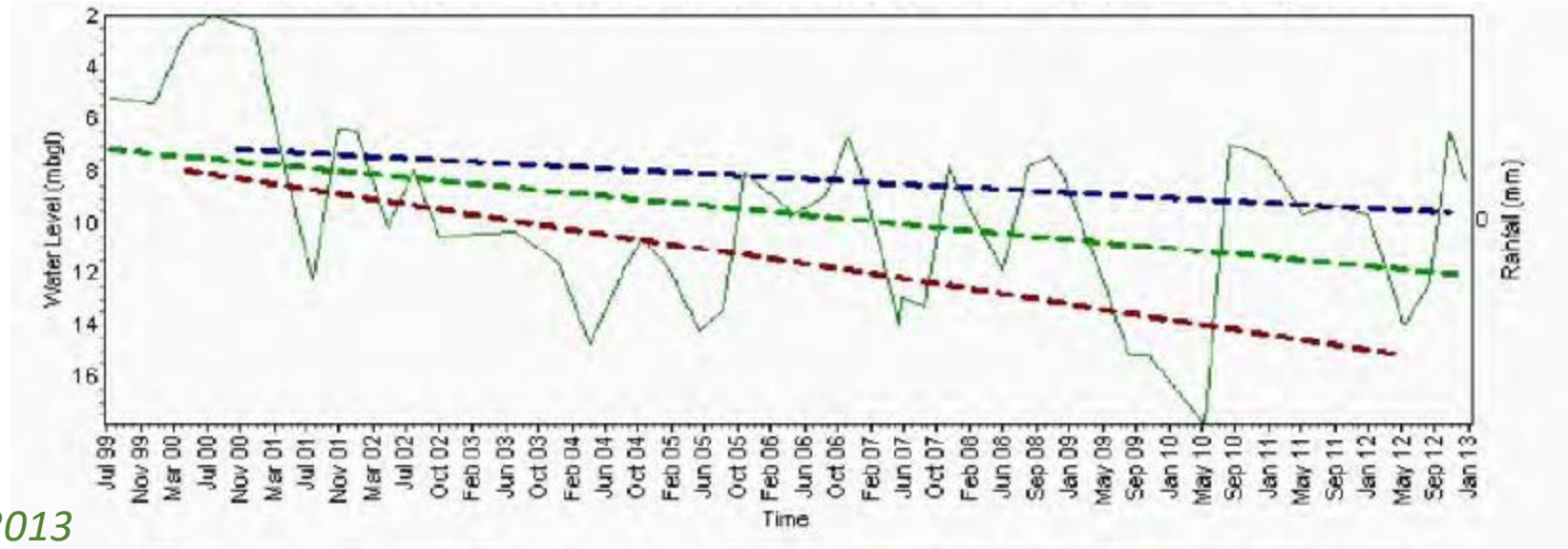


--Average water level trend
--pre monsoon water level trend
-- Post monsoon water level trend

Guntur

Khammam

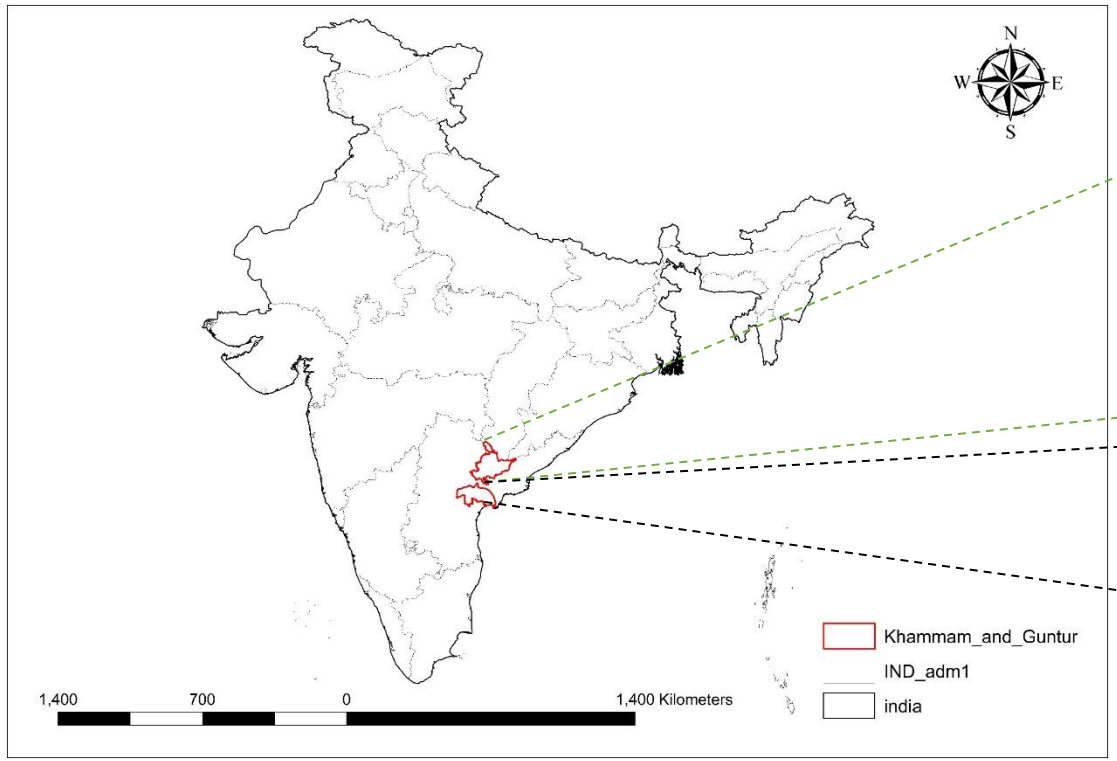
- No significant fall of water table noticed in Guntur district when compared to Khammam
- About 83% of the wells are showing general rising trend of 0.0015 to 0.7684 m/year and the rest 17% of the wells are showing falling trend varying from 0.0101 to 0.4833m/year in Guntur District



Source: Central Ground water department, 2013

Study area

Khammam(Telangana)



Guntur(Andhra Pradesh)

Objectives

- To develop and test the feasibility of the integrated modelling framework for surface and groundwater hydrological models (SWAT-MODFLOW)

Data collection

DEM

- srtm.csi.cgiar.org

Soil and LULC

- www.waterbase.org

Climate data

- https://globalweather.
- tamu.edu/#pubs

SWAT

MODFLOW

- Specific storage
- Specific yield
- Aquifer thickness
- Hydraulic conductivity

Source: *Central Ground water department, 2013*

CONJUNCTIVE USE

Combined use of surface water & groundwater

To optimize resource use

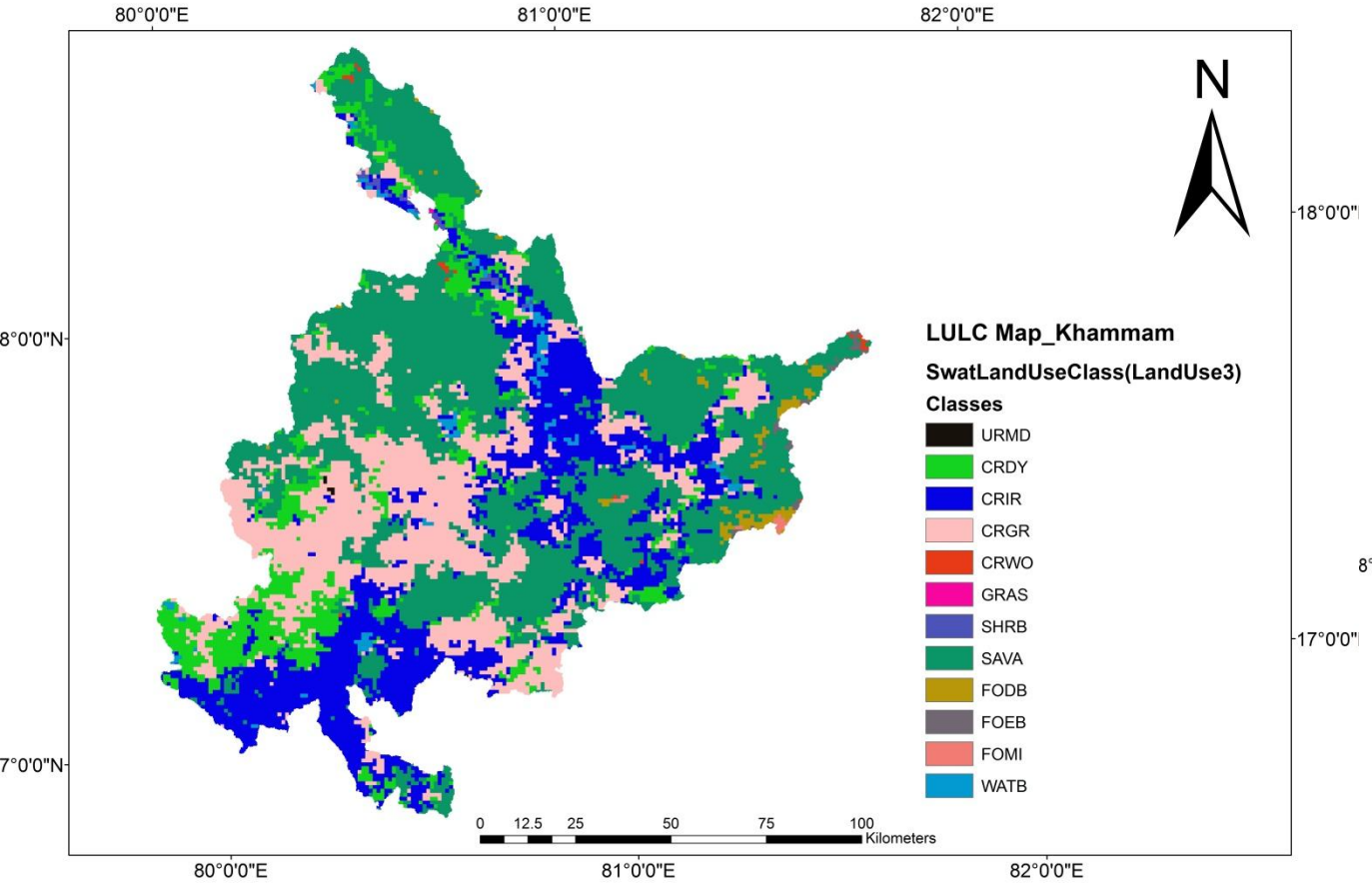
minimize adverse effects of using a single source.

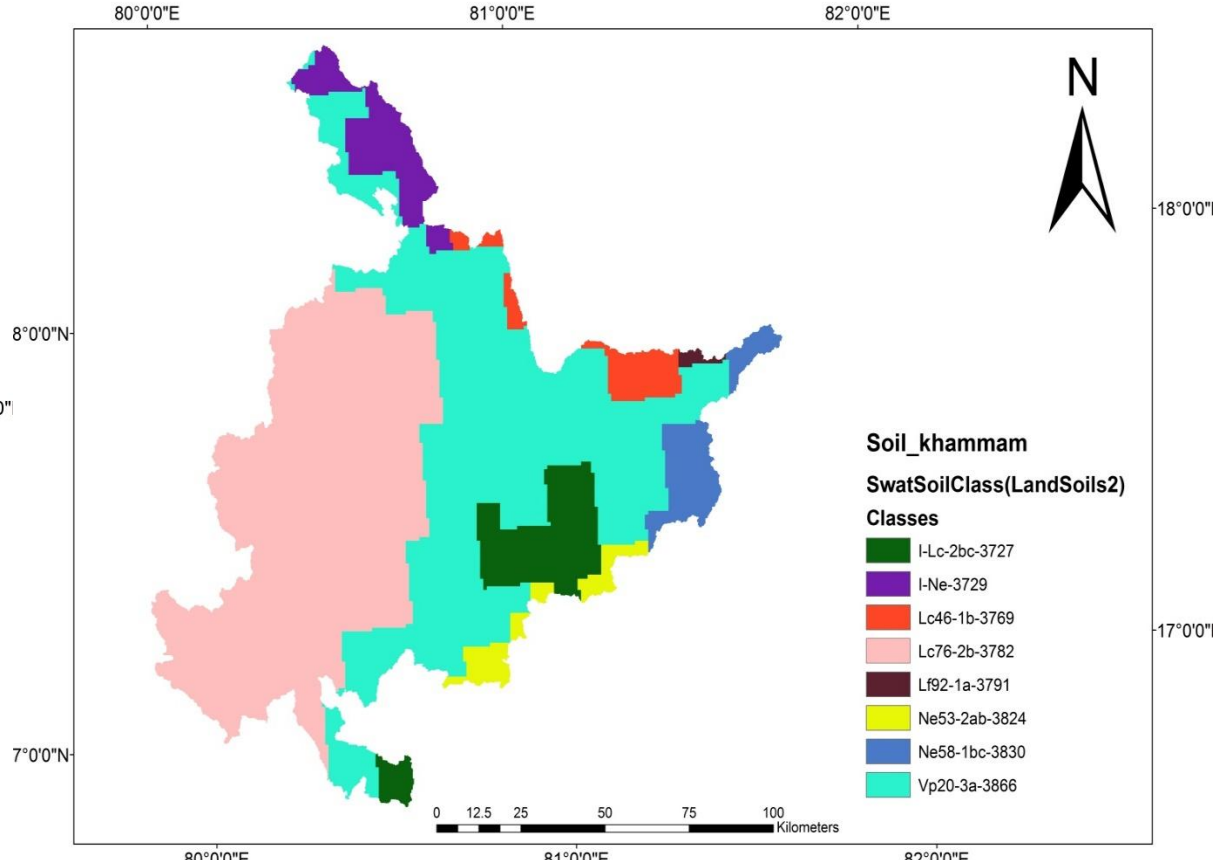
SWAT-MODFLOW is an integrated hydrological model that couples SWAT land surface processes with spatially-explicit groundwater flow processes

It helps to develop optimum conjunctive use model

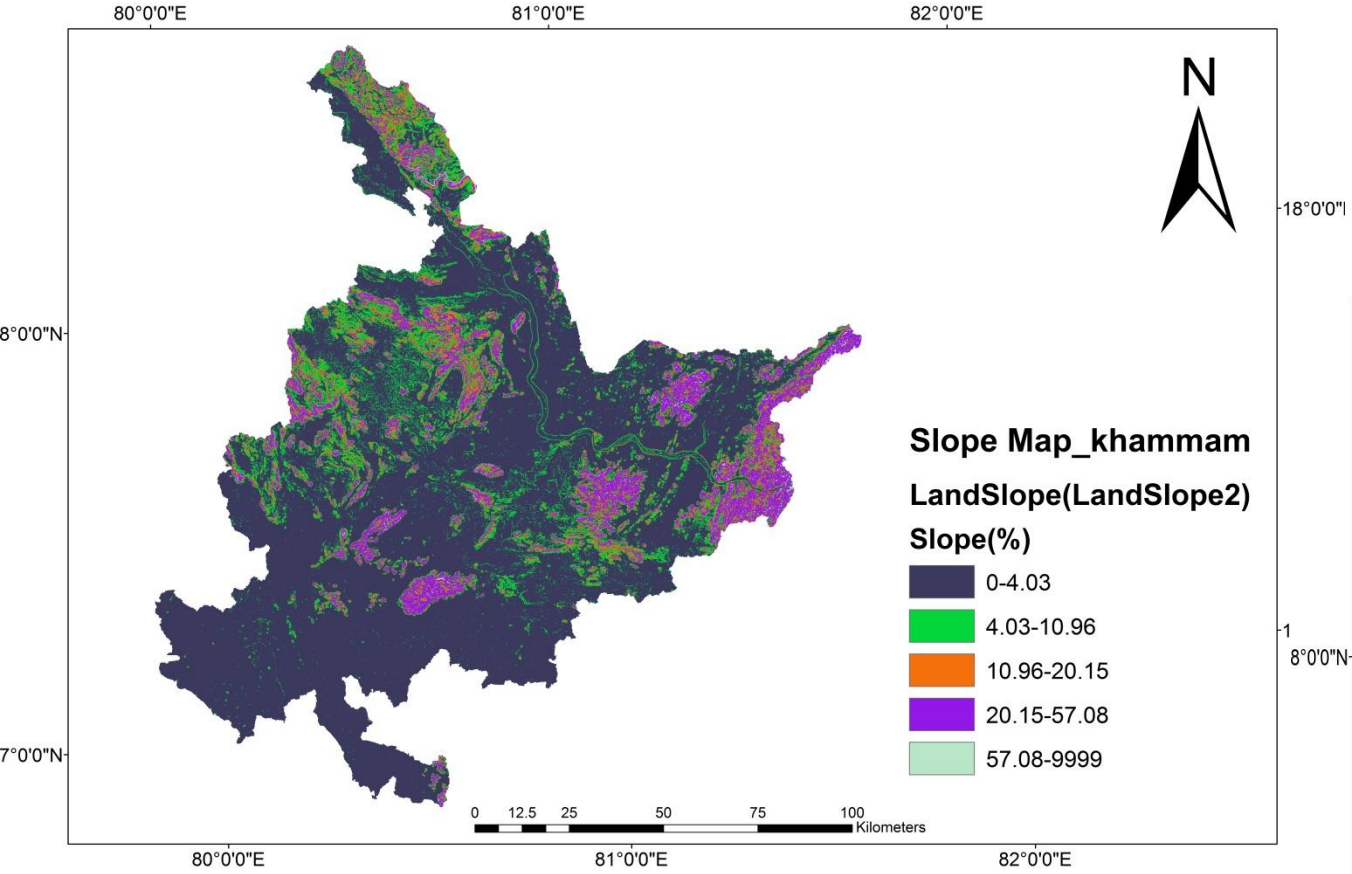
SWAT model setup

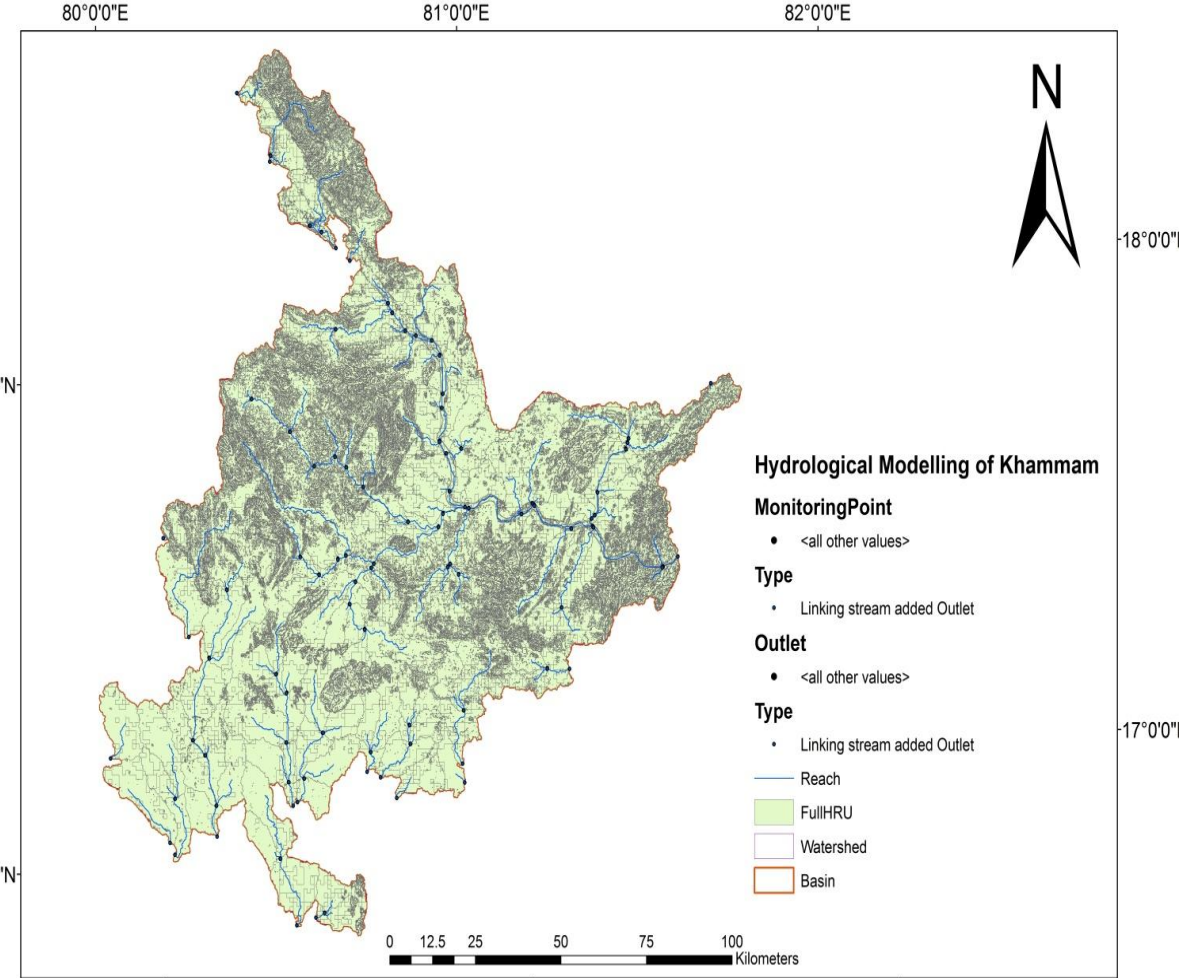
KHAMMAM



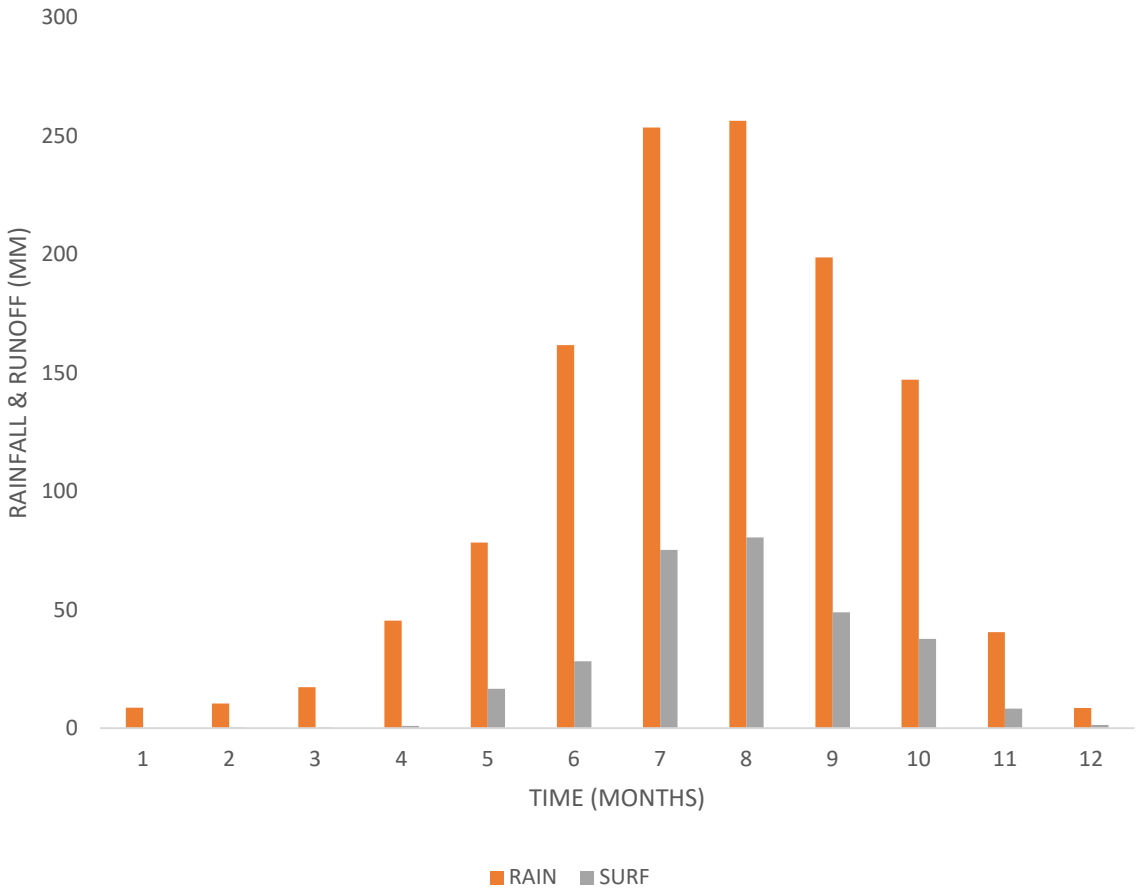


SWAT model setup





SWAT- RESULTS

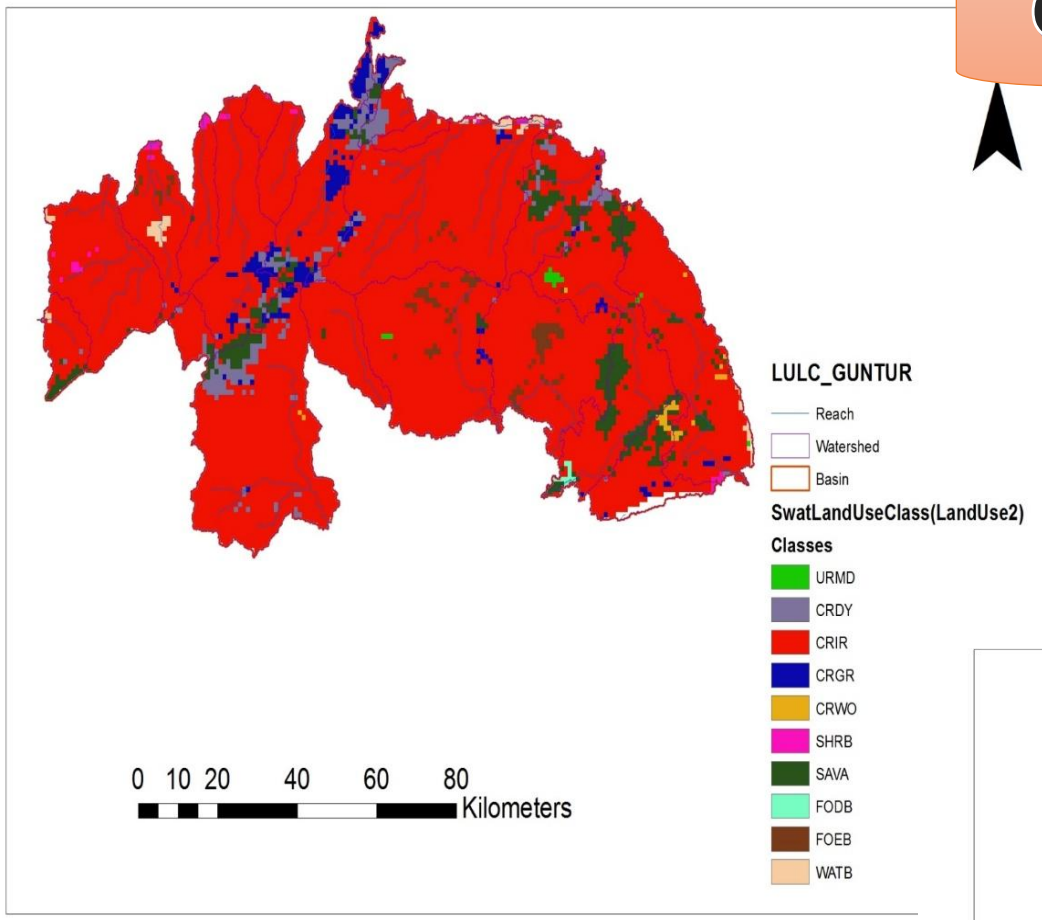


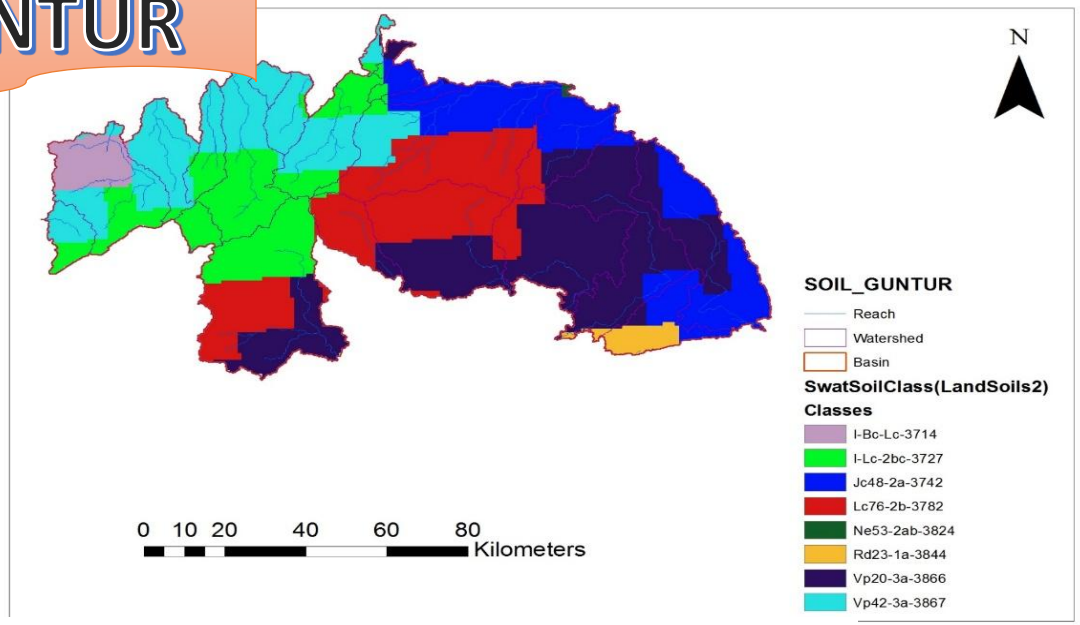
PRECIPITATION = 1226.4 MM
SURFACE RUNOFF Q = 298.82 MM
GROUNDWATER (SHAL AQ) Q = 240.5 MM
GROUNDWATER (DEEP AQ) Q = 14.71 MM
REVAP (SHAL AQ => SOIL/PLANTS) = 39.36 MM
DEEP AQ RECHARGE = 14.74 MM
TOTAL AQ RECHARGE = 294.83 MM
TOTAL WATER YLD = 564.85 MM
PERCOLATION OUT OF SOIL = 295.08 MM
ET = 621.3 MM
PET = 1967.8 MM

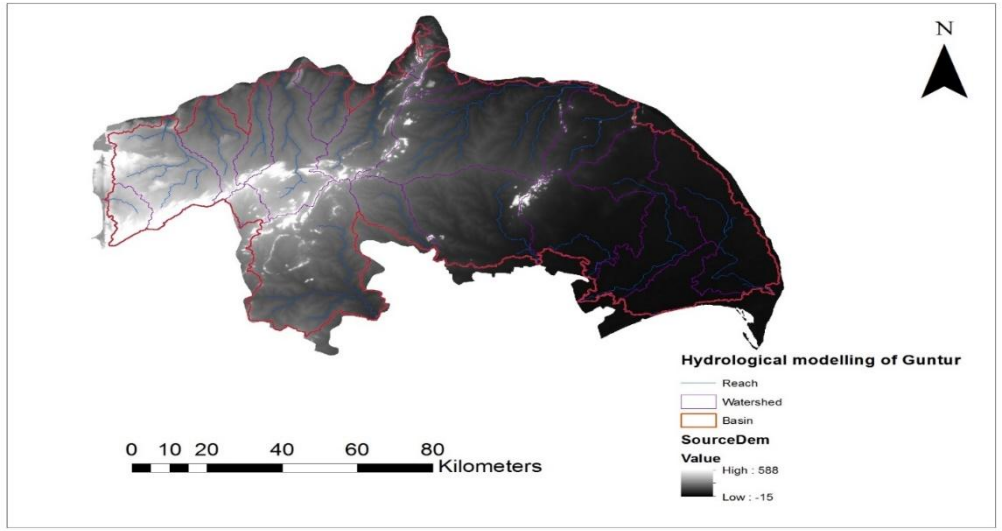
SWAT model setup

WORKDONE

GUNTUR



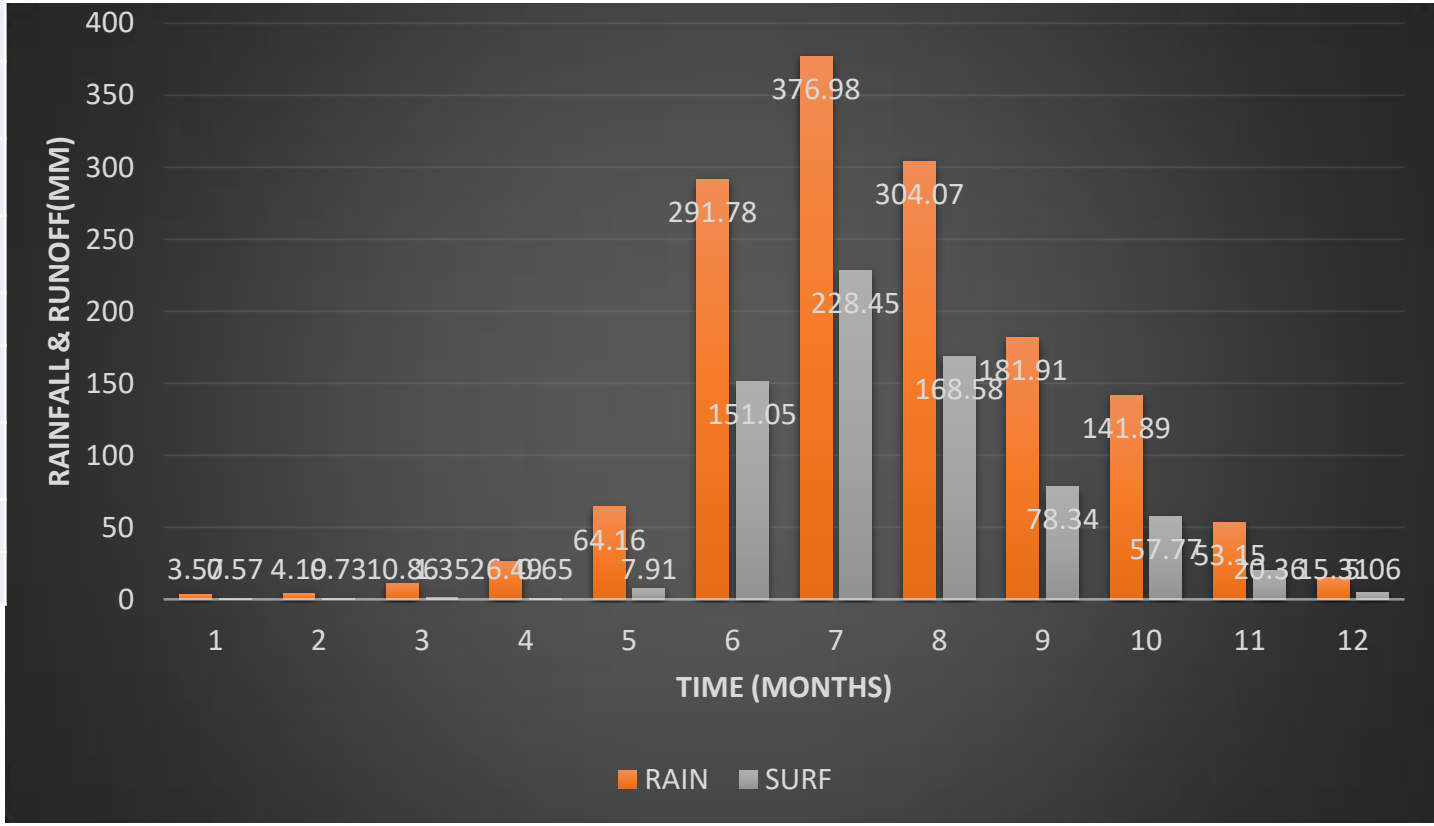




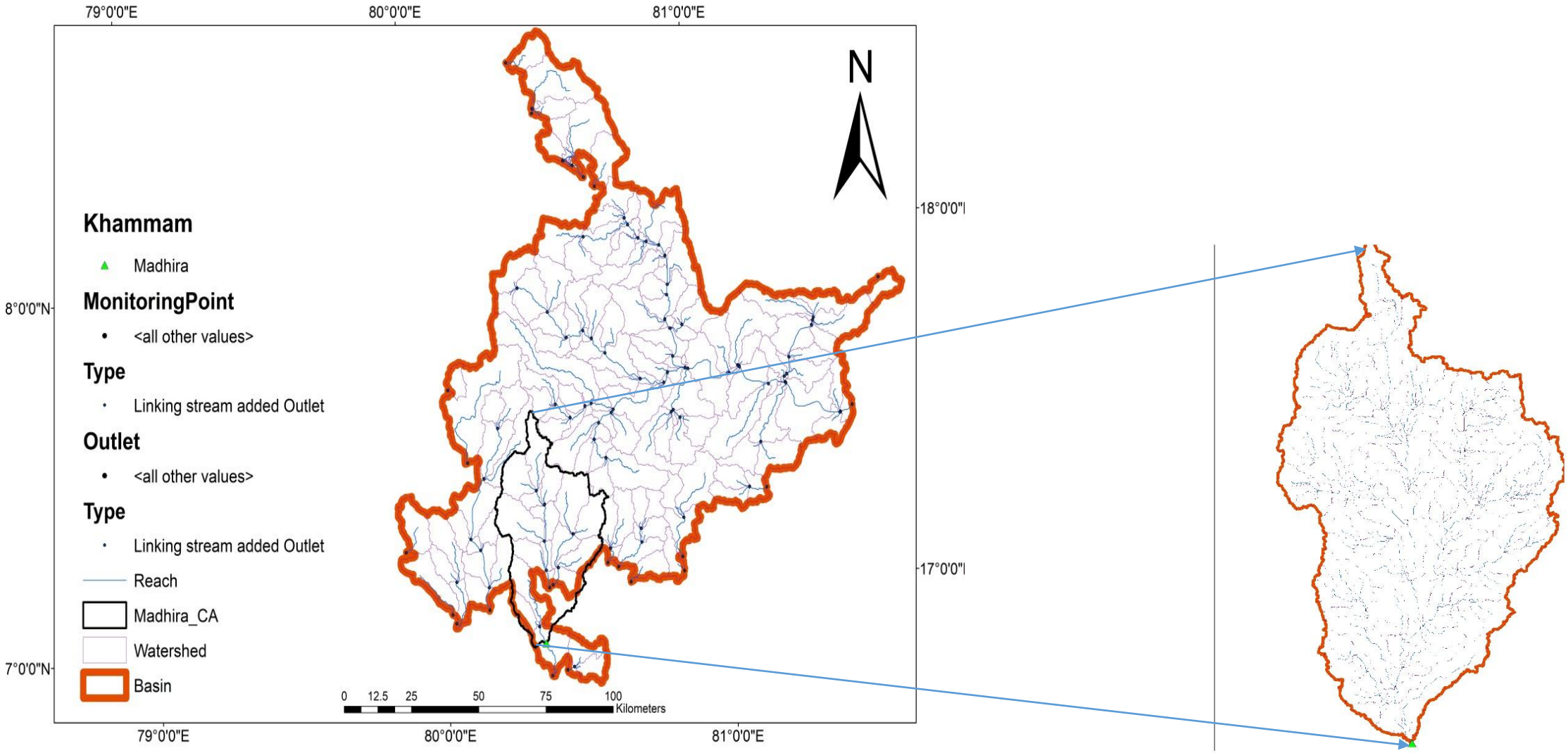
SWAT- RESULTS

Rainfall-Runoff analysis of Guntur

PRECIPITATION = 1474.4 MM
SURFACE RUNOFF Q = 720.84 MM
GROUNDWATER (SHAL AQ) Q = 152.13 MM
GROUNDWATER (DEEP AQ) Q = 9.59 MM
REVAP (SHAL AQ => SOIL/PLANTS) = 32.51 MM
DEEP AQ RECHARGE = 9.63 MM
TOTAL AQ RECHARGE = 192.65 MM
TOTAL WATER YLD = 885.96 MM
PERCOLATION OUT OF SOIL = 192.70 MM
ET = 557.3 MM
PET = 1930.6MM



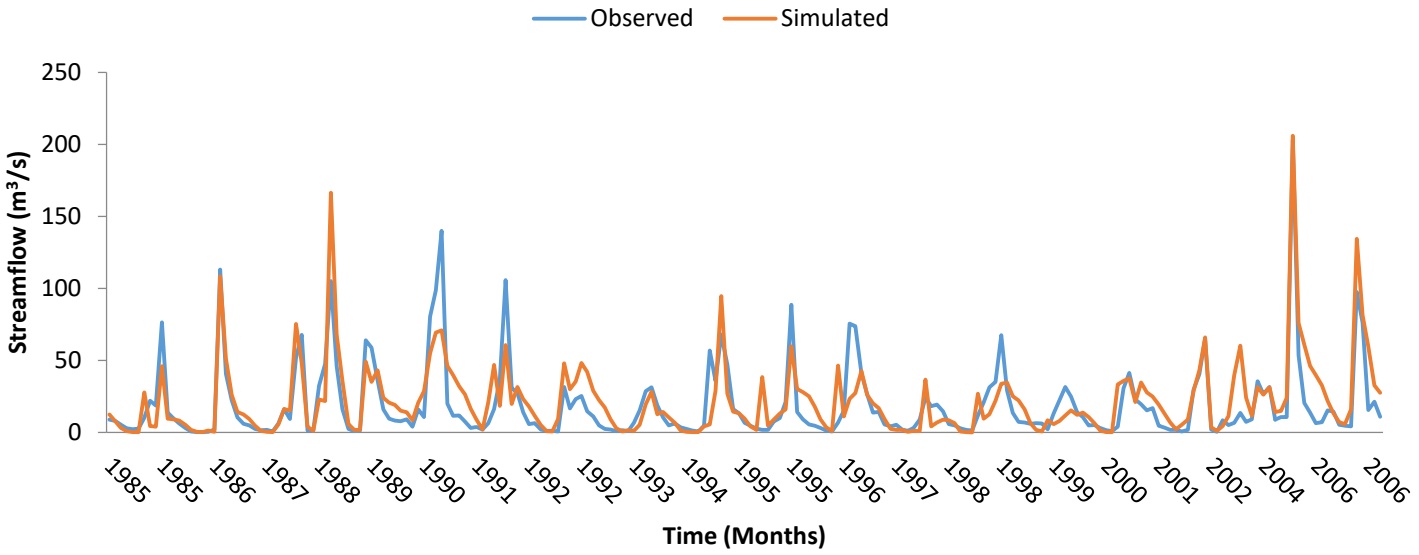
Hydrological modelling of Madhira Sub basin (Khammam)



Calibration parameters- SWATCUP-Madhira

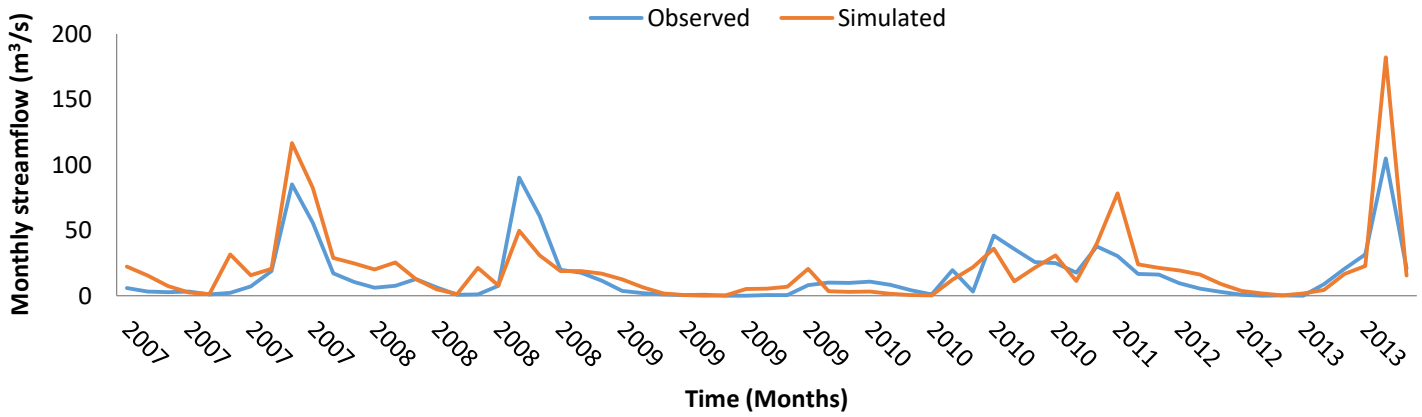
Sl.No	Parameter_Name	Fitted_Value	Min_value	Max_value
1	R__CN2.mgt	-0.084562	-0.100000	-0.010000
2	V__GW_DELAY.gw	175.730774	30.0	180.000000
3	A__GWQMN.gw	20.300001	80.000000	50.000000
4	A__REVAPMN.gw	42.884624	350.000000	100.000000
5	V__GW_REVAP.gw	0.163692	0.100000	0.180000
6	R__SOL_K(..).sol	0.145000	0.300000	0.200000
7	R__SOL_AWC(..).sol	0.338615	0.200000	0.400000
8	V__ESCO.bsn	0.733346	0.700000	0.850000
9	V__EPCO.bsn	0.572385	0.400000	0.700000

Calibration and validation graphs of Madhira



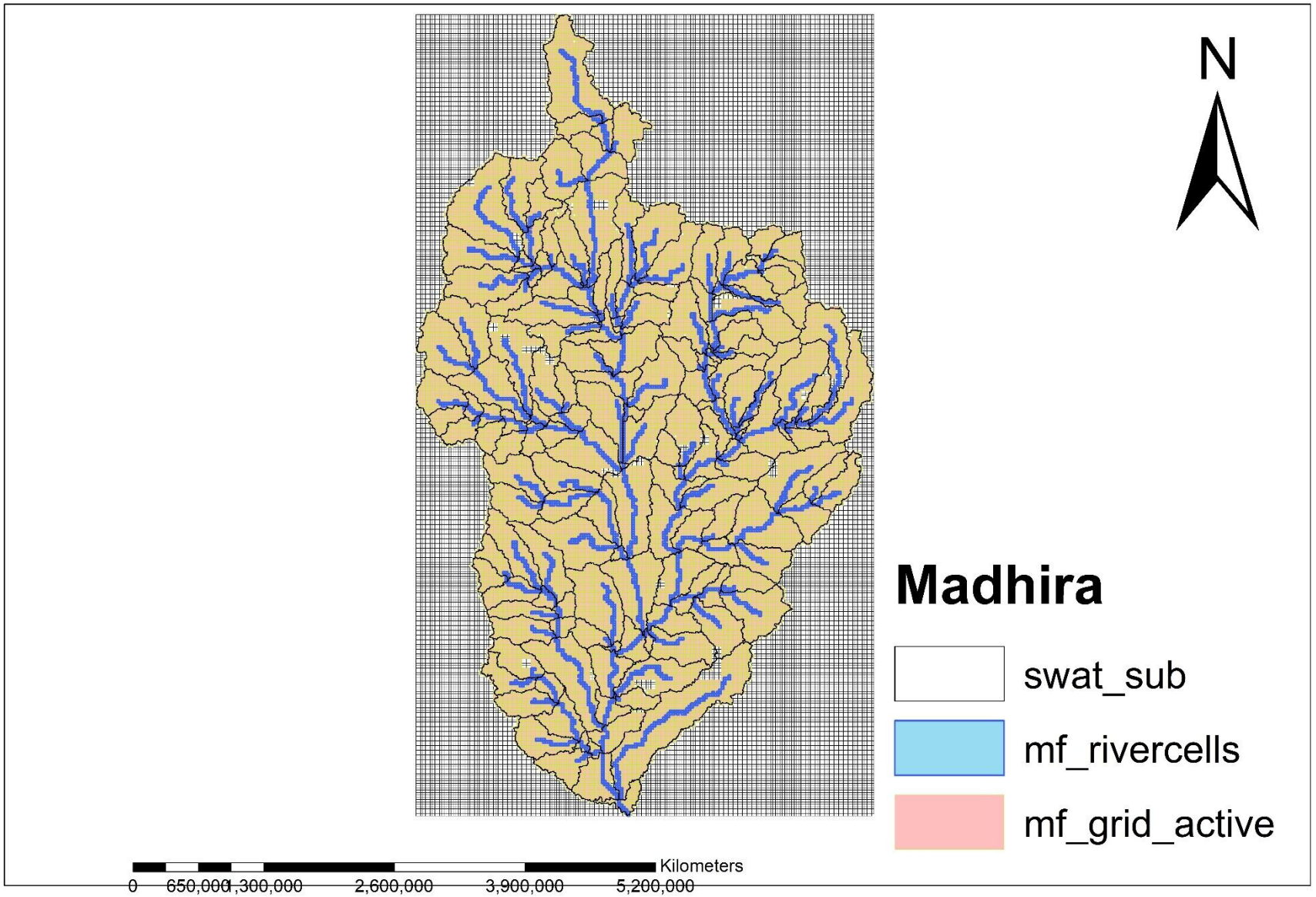
	Calibration		Validation	
Objective Function	R^2	NSE	R^2	NSE
	0.67	0.63	0.7	0.43

Calibration period: 1985 – 2006
Validation period : 2007 -- 2013

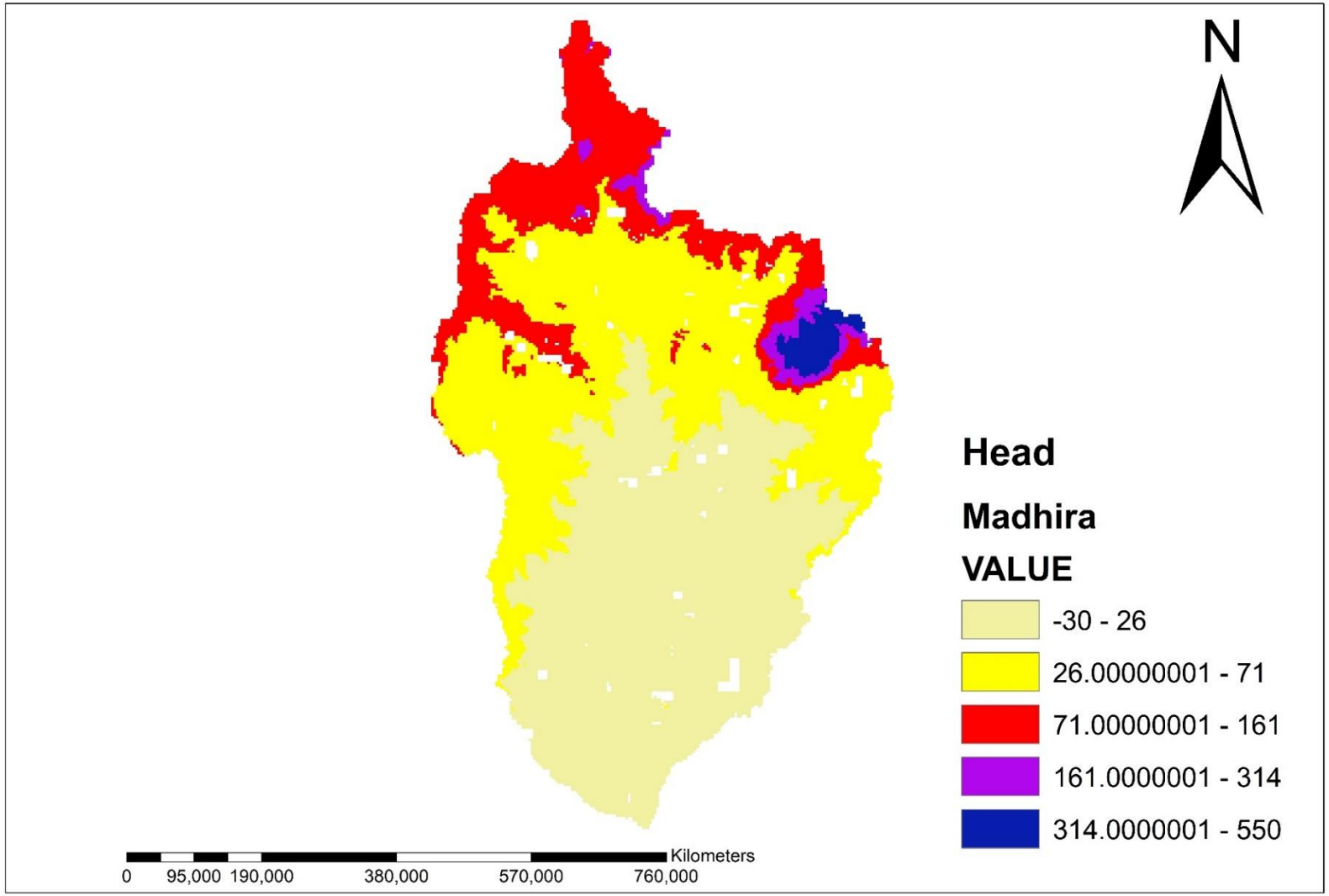


SWAT-CUP has been used for model calibration and validation

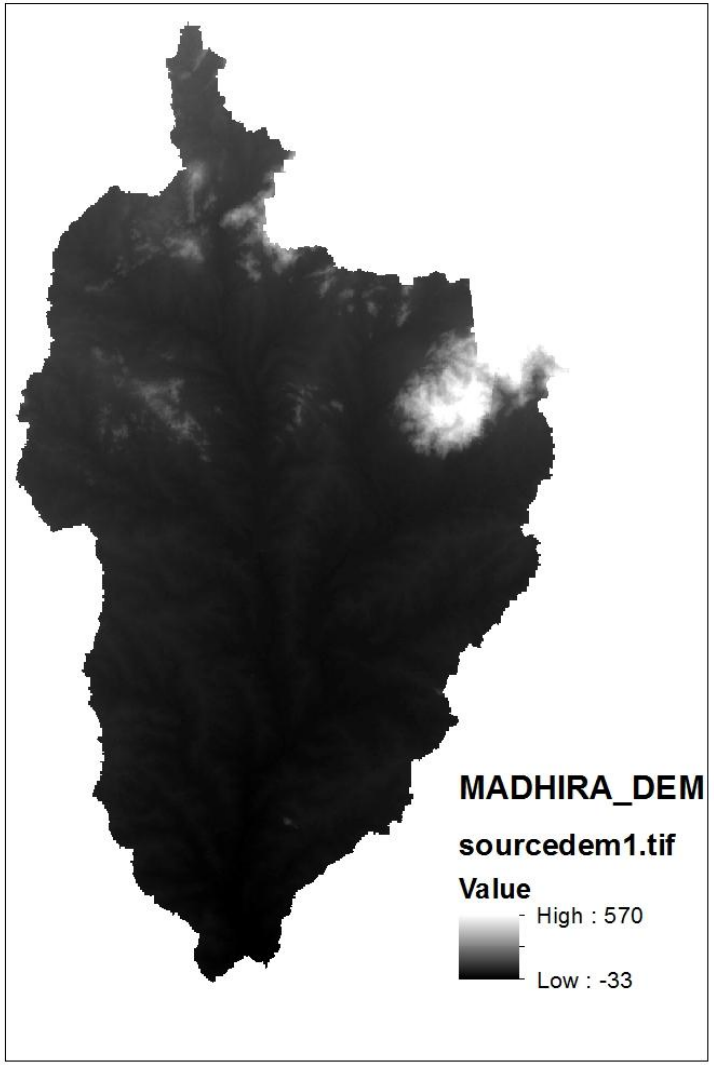
SWAT-MODFLOW of Madhira



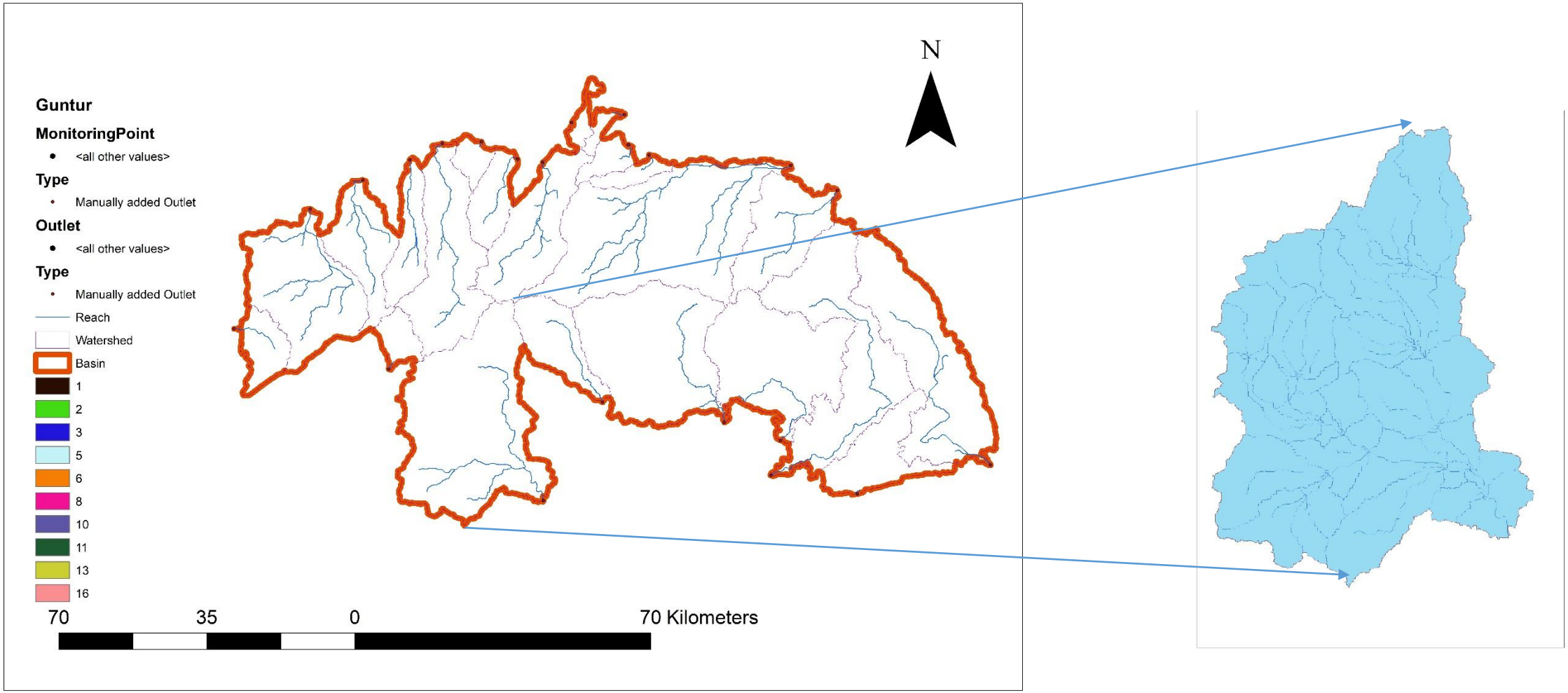
SWAT-MODFLOW of Madhira



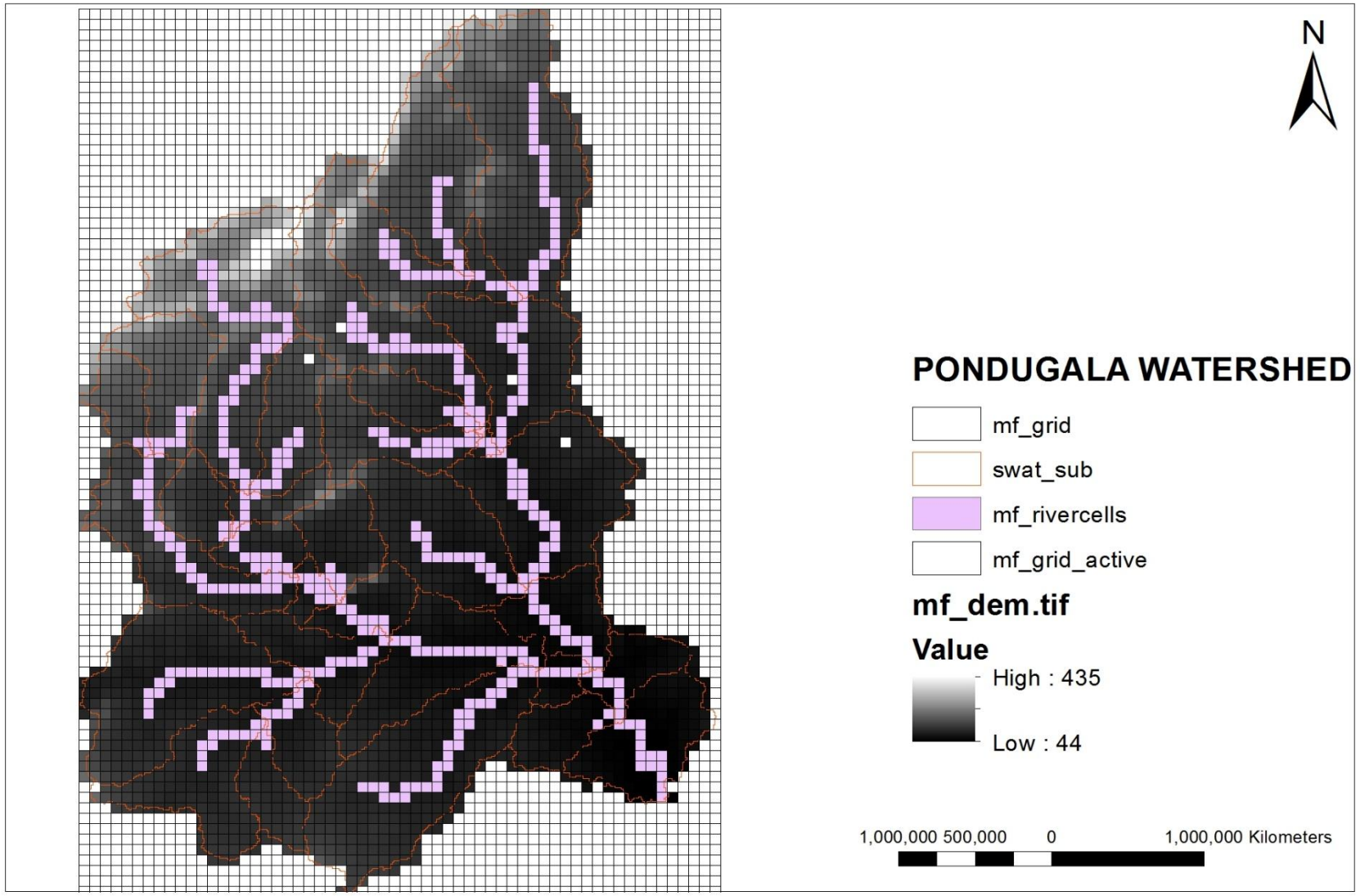
Madhira DEM



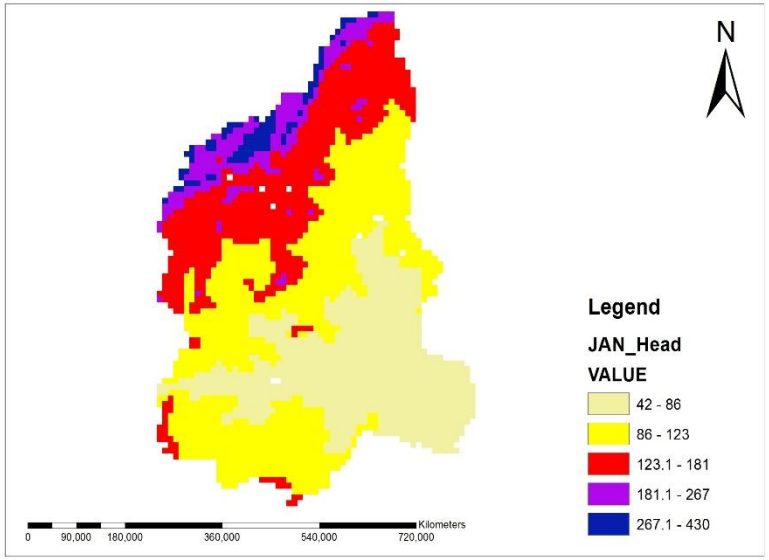
Hydrological modelling of Pondugala sub basin

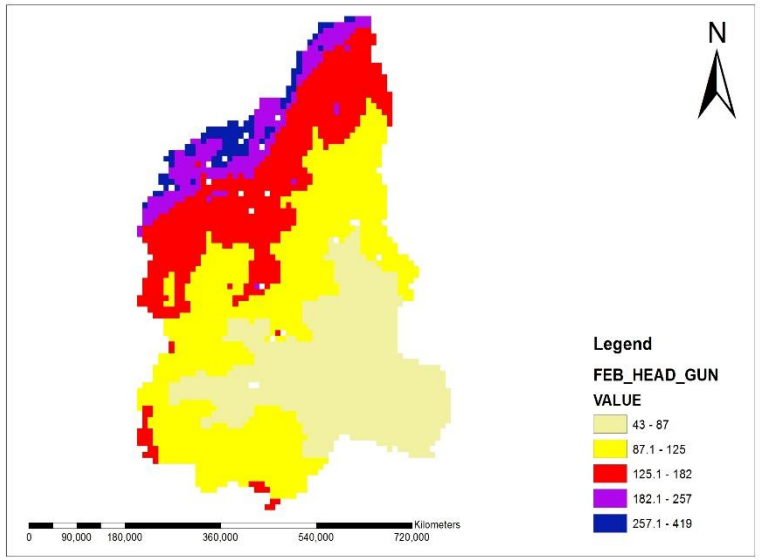


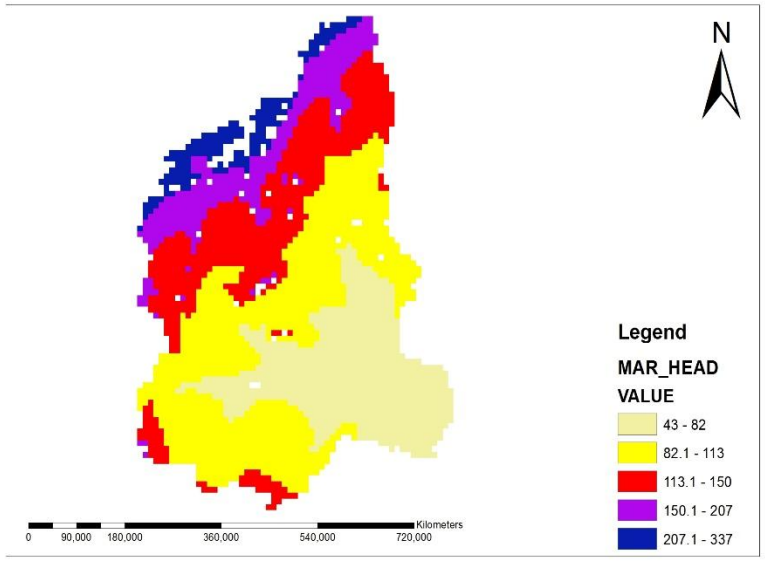
SWAT-MODFLOW

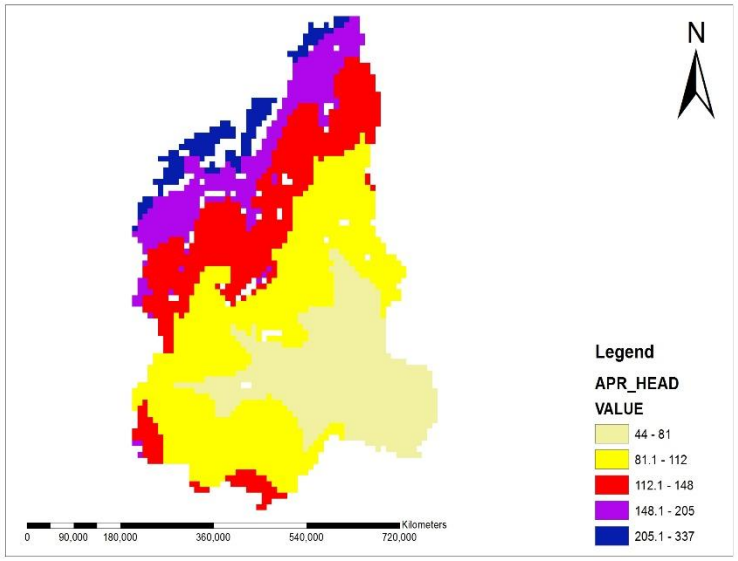


SWAT-MODFLOW

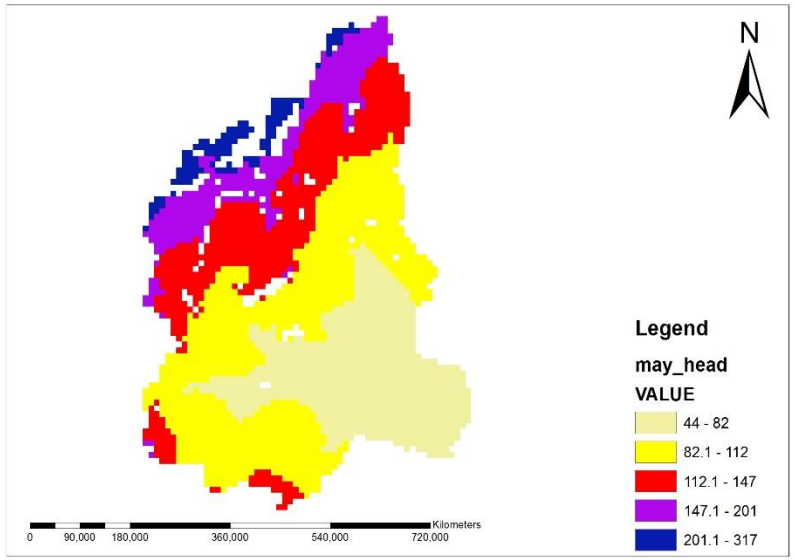


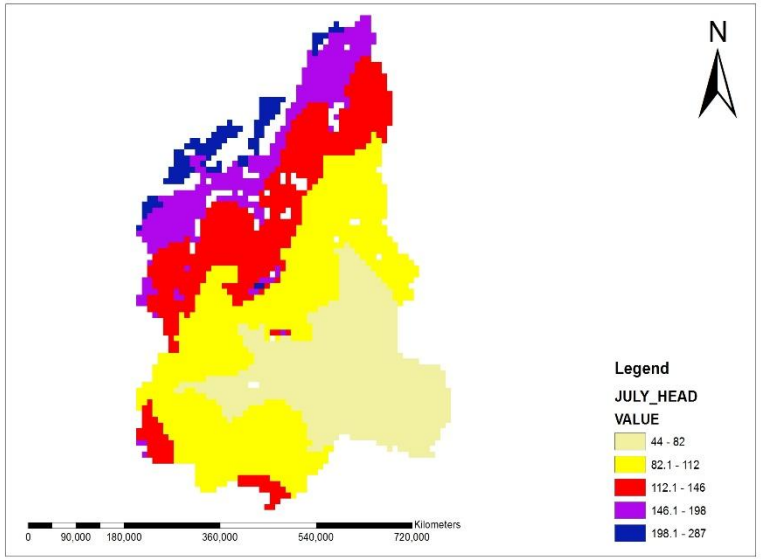


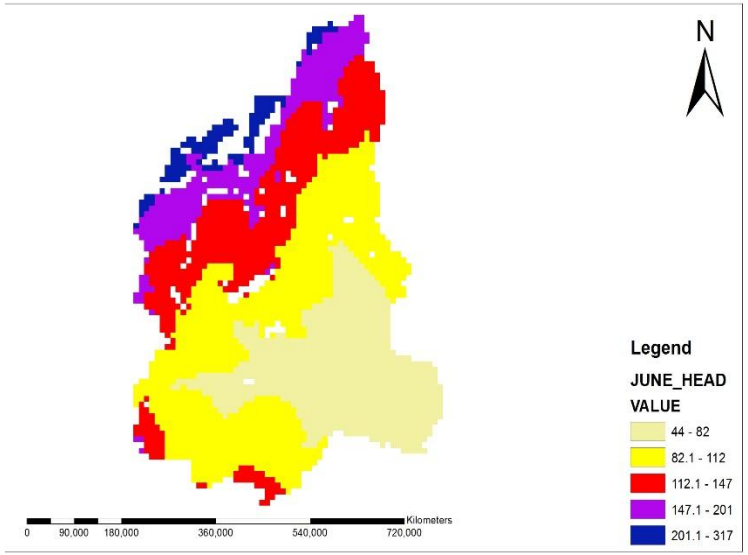


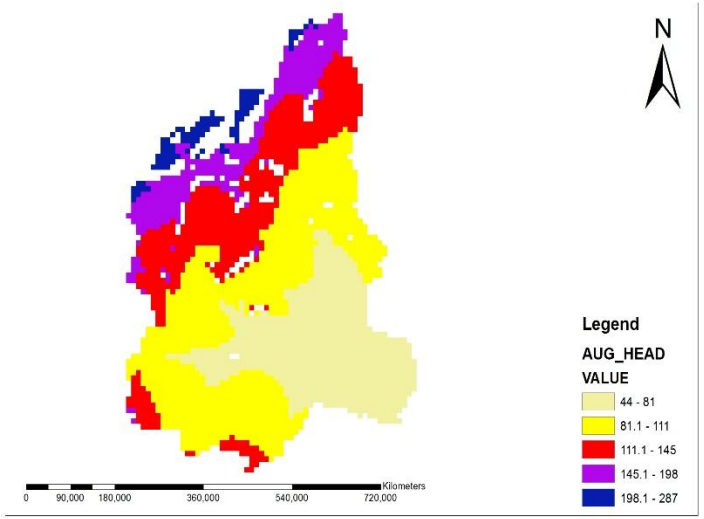


SWAT-MODFLOW

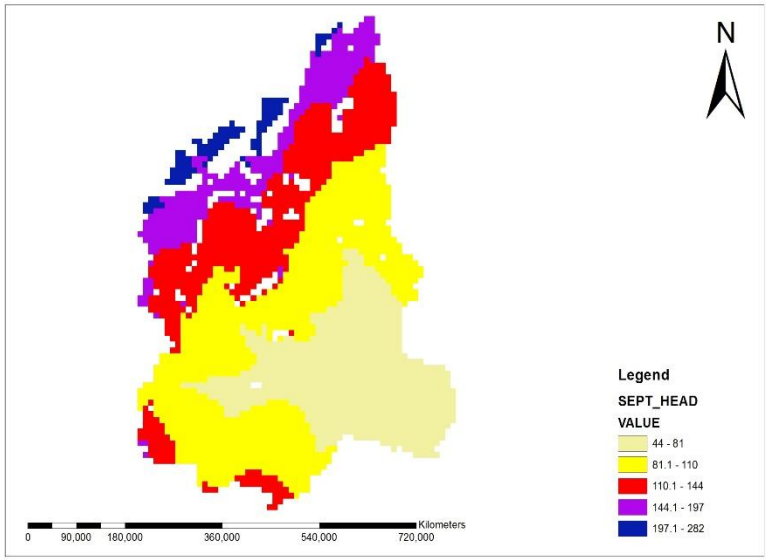


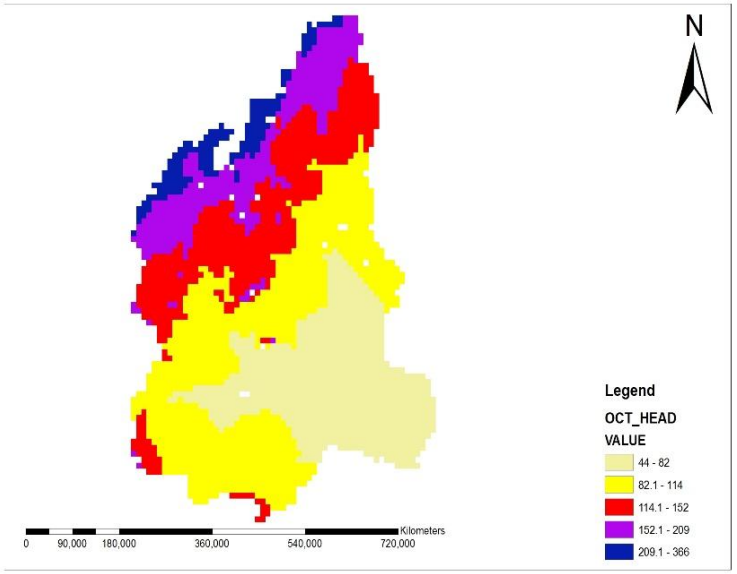


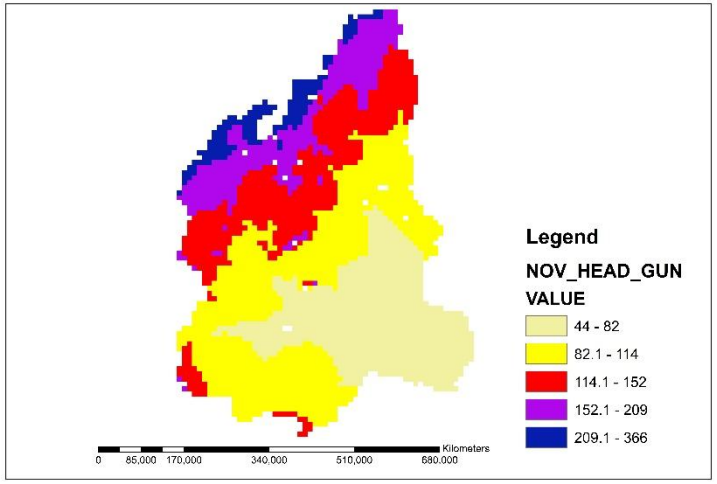


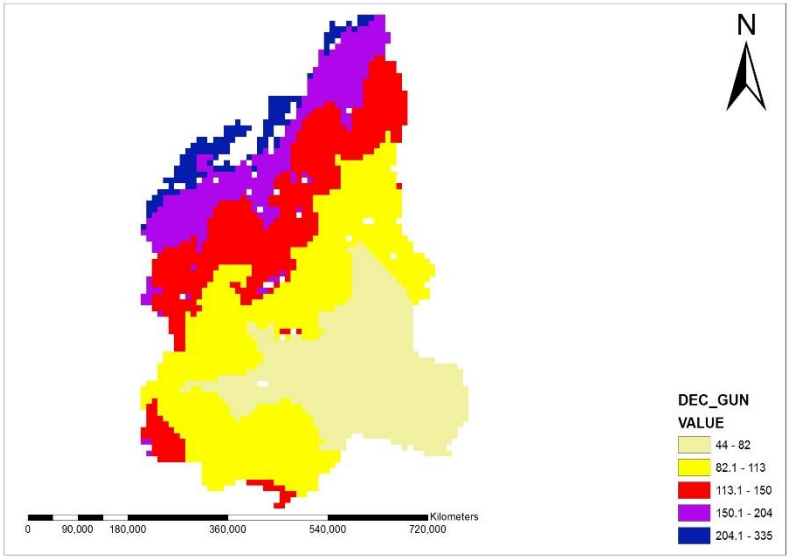


SWAT-MODFLOW









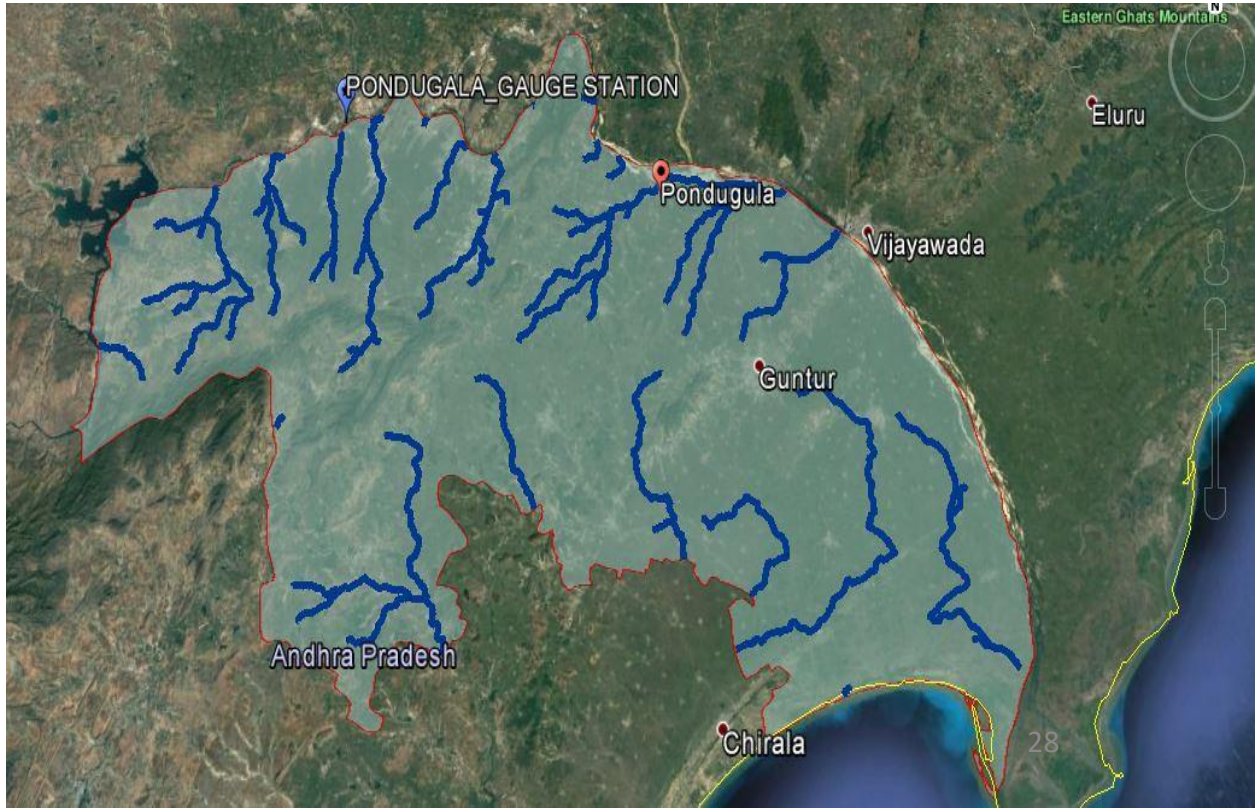
Conclusion

- SWAT-MODFLOW setup has been carried out for Pondugala(Guntur) and Madhira (Khammam) watershed.
- The calibration and validation results of Madhira shows good relation between observed and simulated.
- It is observed that surface runoff of Guntur district shows high values when compared to Khammam District.
- The ground water levels of Khammam and Guntur was estimated using SWAT-MODFLOW.
- Evaluation of management strategies has to be carried out with the help of Linear programming model.

Calibration parameters- SWATCUP-Pondugala

Sl.No	Parameter_Name	Fitted_Value	Min_value	Max_value
1	:R__CN2.mgt	-0.179200	-0.190000	-0.150000
2	V__GW_REVAP.gw	0.065167	0.050000	0.180000
3	R__SOL_AWC(..).sol	0.350000	0.500000	0.500000
4	R__CN2.mgt	-0.059567	-0.120000	-0.050000
5	V__ESCO.bsn	0.124667	0.000000	0.200000
6	R__CN2.mgt	-0.126500	-0.150000	-0.120000
7	V__ALPHA_BF.gw	0.304133	0.250000	0.330000
8	V__EPCO.bsn	0.421333	0.300000	0.700000
9	A__GWQMN.gw	260.333344	200.000000	300.000000
10	V__GW_DELAY.gw	34.950001	30.000000	75.000000
11	A__REVAPMN.gw	88.266670	40.000000	120.000000
12	12:R__RES_K.res	-0.400333	-0.800000	-0.300000

Janpahad
Damarcherla
Vadapalle
Wazirabad
PONDUGALA_GAUGE STATION
Kotha Palle
Irkigudem
Srinagar


Eastern Ghats Mountains
PONDUGALA_GAUGE STATION
Eluru
Pondugula
Vijayawada
Guntur
Andhra Pradesh
Chirala

N
Janpahad
Damarcherla
Vadapalle
Wazirabad
PONDUGALA_GAUGE STATION
Kotha Palle
Irkigudem
Srinagar