WATER BALANCE STUDY OF WATERSHED (GV-53) USING QSWAT IN AURANGABAD DISTRICT

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Abstract
Study of different elements of hydrological process plays vital role in water management. Analysis of individual micro watershed must be carried out on watershed basis. After understanding the water balance of watershed, one can scientifically formulate strategies for water conservation.
The present study deals with watershed (GV-53) in Aurangabad district .QGIS interface is used to create different thematic layers such as soil, land use etc. DEM for the study area can be extracted in QGIS. Then the analysis of hydrological components has been carried out by using QSWAT 1.3 for time period of 34 years from 1979 to 2013. Daily data of precipitation, temperature, radiation, wind velocity and solar radiation has been processed on monthly time scale. After proper watershed delineation; the graphical and numerical summary of the simulated results for hydrological parameters such as Actual Evapotranspiration, Groundwater Contribution, Potential Evapotranspiration and Surface runoff are represented.
Keywords: QGIS; QSWAT; water balance; Watershed Delineation

I. INTRODUCTION

Water is vital and limited natural resource. The availability of clean water is limited in the area and one of the elements dependent is precipitation which is irregular. In the semi-arid area precipitation is to a lesser degrees and unforeseeable, hence requirement of water for drinking and irrigation become serious issue. For the planning and managing of obtainable resources at watershed scale water regime of region require to be reviewed by using water balance approach. To deal with drought conditions study of availability and demand of water resources is necessary. To acquire this change in storage should be equivalent to difference between inflow and outflow. For any watershed development correlation between physical parameters of watershed and hydrological components is need to study and hence water balance approach is acceptable for watershed management practices.

Components of hydrological cycle can be evaluated by using water balance approach and this study has many applications such as flow forecasting, Agricultural water management, water quality assessment and climate change impact assessment etc. In past years many computer based models developed to study water balance, also many experimental and theoretical studies has been carried out.

George S. [2016] Developed SWAT model for the sub basin, by make use of digital thematic maps, climatic parameters and physical properties of soil as input. Calibration and validation of the system has been achieved by comparing the river flow prediction with the observed values. Z. M. Easton et al. [2010] used a improve version of the SWAT model to forecast runoff and sediment losses from the Basin. The model simulates saturation excess runoff in the basin.

Vidula A. Swami et al [2016] used the open Source Tool Quantum GIS 2.2.0 for generation of maps of the region. The Soil and Water Assessment Tool (SWAT) having an interface with Arc-View GIS software was adopt for the calculation of runoff and sediment yield from watershed. R. Srinivasan et al. [1998] used swat model to helping water resource managers to estimate the impact of management on water

management supplies non point source pollution in watershed and large river basin.

R. Jiang et al. [2011] EXT was approximately evaluated from the water balance equation manipulating measured data. Calculate daily evapotranspiration (ET), base flow, surface runoff and monthly stream flow. R. Srinivasan et al. [6] used SWAT model to evaluate the return flow as a result of introducing canal irrigation in a basin. Through modelling, the return flow has been estimated and validated. The temporal variation of such return flows has also been represented..

K. Balathandayutham [2014] a semi distributed water balance model was developed to simulate mean monthly hydrological processes using land use, soil texture, land use, hydro meteorological and topography, data as input parameters. Estimate evapotranspiration estimates, to simulate the impacts of climate change .Vikash Shivhare et al. [2014] SWAT model used to calculate surface runoff. The SWAT works in conjunction with Arc GIS 9.3. Different parameters Digital Elevation Model (DEM), slope derived from DEM, Landuse/Landcover (LULC) and NBSSLUP soil data and temporal data for precipitation and temperature was used as input for the model to evaluate runoff at the catchment outlet. The model was run and performance of the model in terms of simulated runoff was evaluated using statistical method and compared simulated monthly flow with the observed monthly flow values.

SWAT requires particular information about meteorological parameters, topography, soil type, vegetation, and land use for a watershed. Physical processes correlated with water movement can be examined. It is modified model spatially based on hydrological response units involve both, physical and conceptual technique. The general water balance equation is a central part of SWAT. SCS curve number method is use to calculate Surface runoff. Penmen- Moneith method is use to estimate Potential evapotranspiration. In QSWAT output the simulated results are visualized statically, graphically and numerically.

II. STUDY AREA

GV-53 watershed is the study area which lies in Aurangabad district of Maharashtra fig (1) having longitude 75° 26'44" and 75° 37' 28" and latitude 19° 24' 36'' and 19° 41' 28''. Total area of the watershed is 266.2 km^2. The area falling under toposheet bearing no. 43-3 published by survey of India on a 1:50000 scale. The average annual rainfall recorded is less than 625 mm.

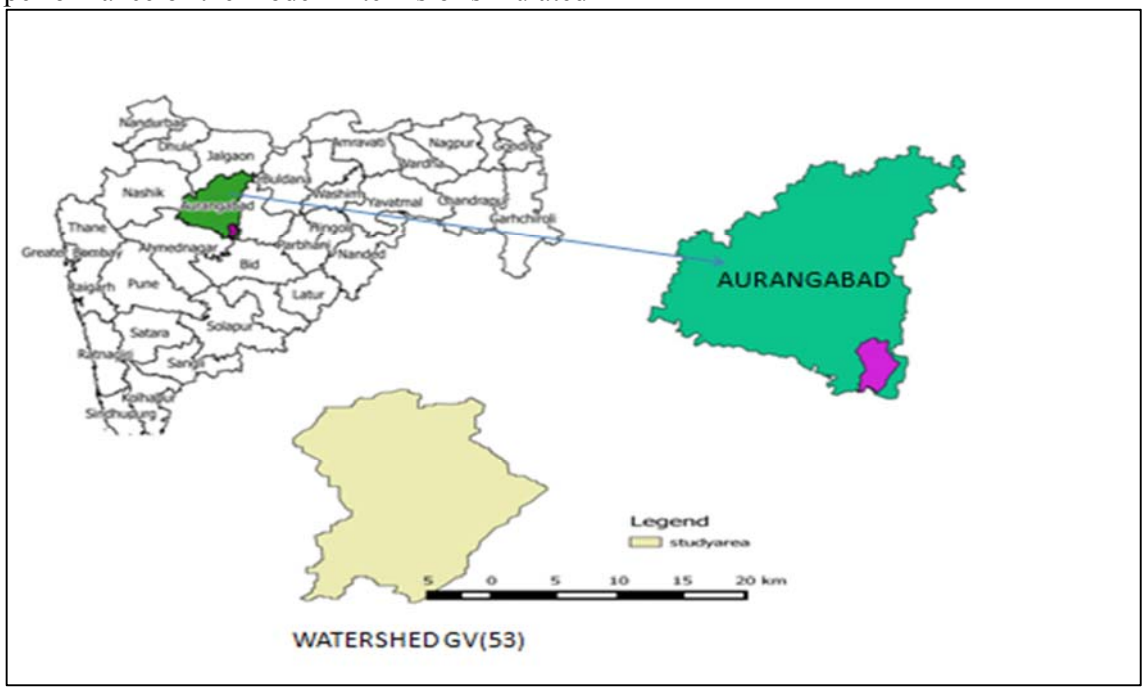

Fig1.Map showing location of study area

Objective:

The main objective is to study the water balance for small watershed by using QSWAT for the period of 34 years. The rest of the objectives necessary to achieve this are to study the physical characteristics of watershed by using QGIS interface and to study the applicability of QSWAT model to the small watershed (GV-53) in Aurangabad.

III. METHODOLOGY

The Methodology used for doing SWAT analysis of study area is described in figure 2

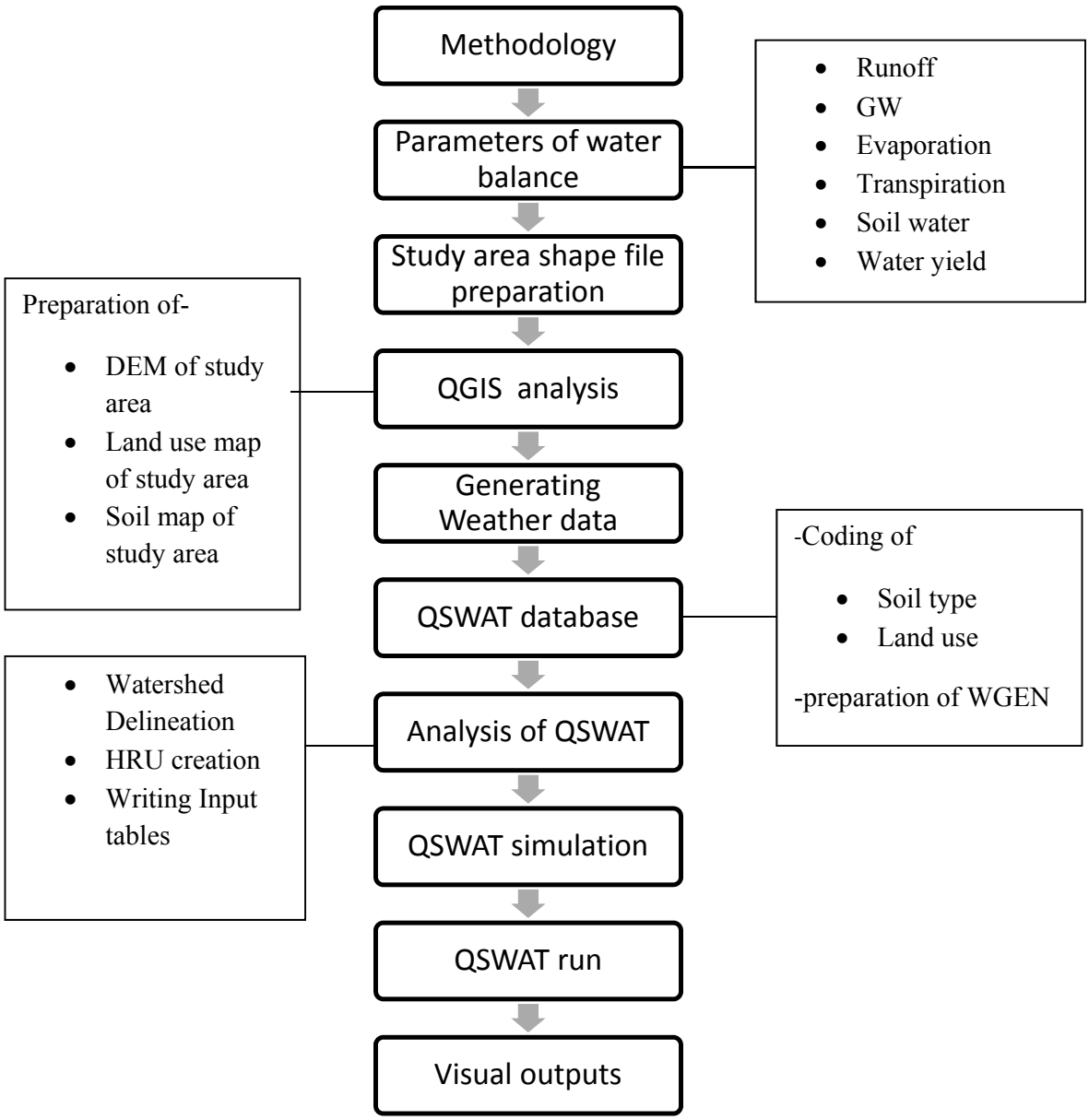

Fig.2 Flow chart of Methodology for QSWAT Analysis

For SWAT model data necessary as input is watershed boundary map, soil map, land use map and weather data of study area. Toposheet with scale 1:50,000 of study area were collected from Survey of India department and georeferenced in QGIS. By using boundary map, DEM of watershed Dem of study area extracted from 30m X 30m digital elevation model for Aurangabad which is downloaded from http://earthexplorer.usgs.gov.in.

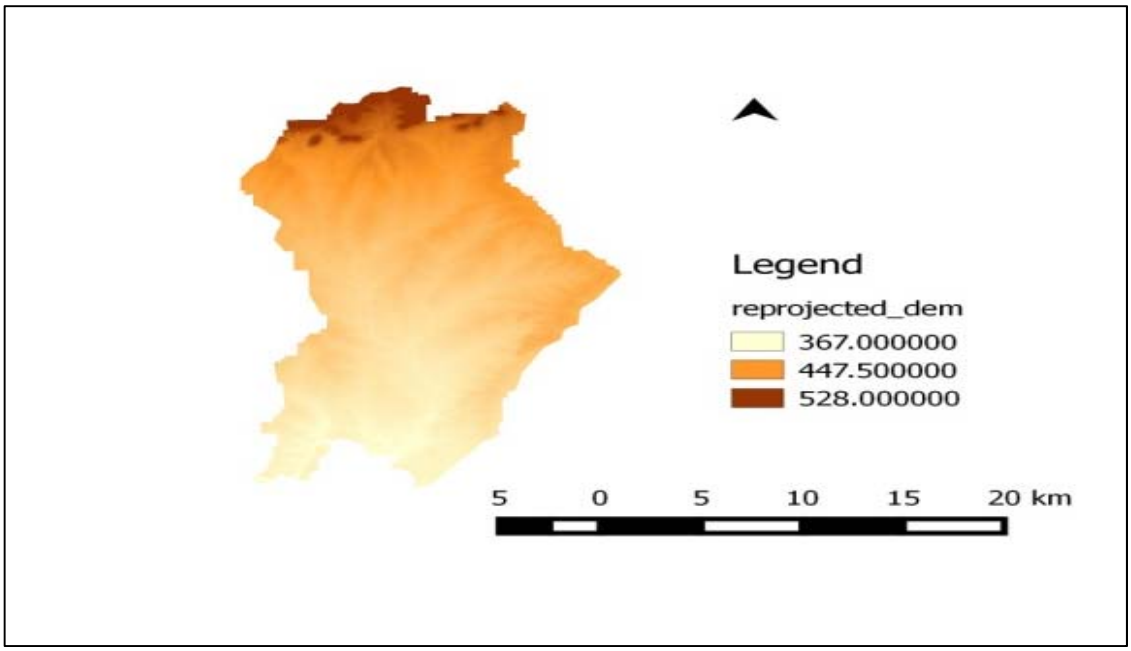

Fig. 3 DEM of study area

The Water Base website has on its *Data* page http://www.waterbase.org/download_data.html maps for soil and land use covering most of the world, and QSWAT comes with lookup tables for these maps (global soils and global land uses) already prepared and stored in the project database. Land use map and soil map downloaded and extracted from this website of global data.

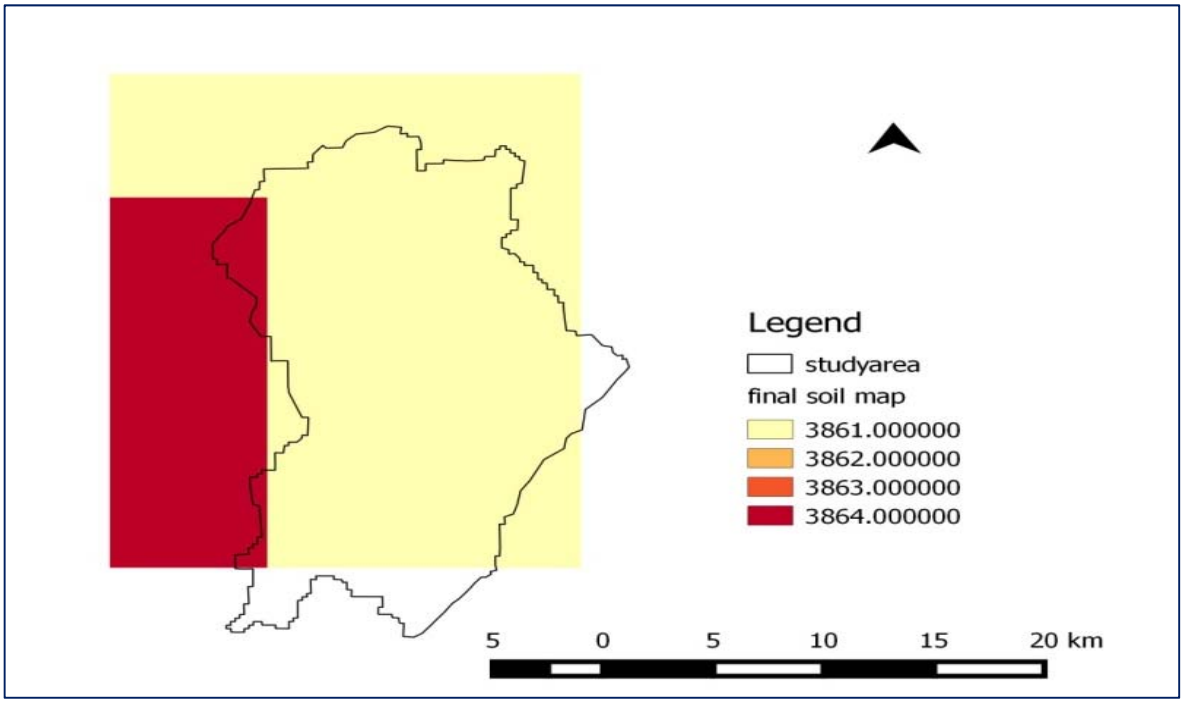

Fig. 4 Soil map of study area

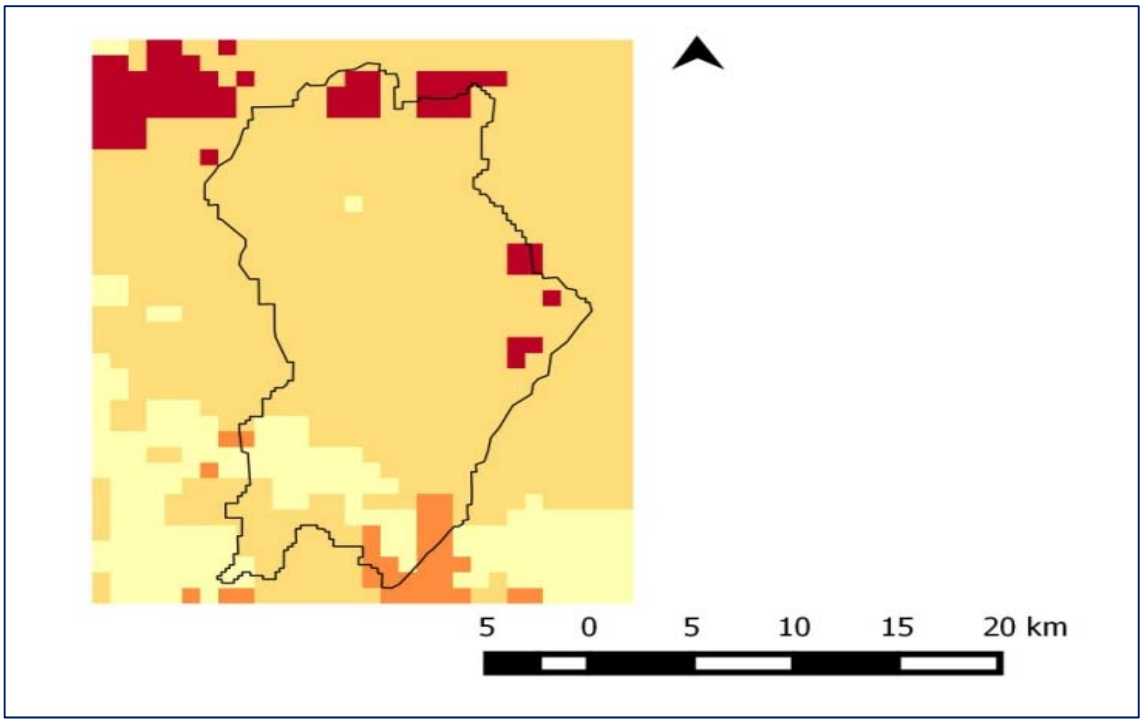

Fig. 5 LULC map of study area

From http://globalweather.tamu.edu site weather data for stations within the study area was downloaded. Daily data available for station such as precipitation (mm) ,wind velocity (m/s), temperature (^{0}C), solar radiation (MJ/ m2) has been used. Various parameters related precipitation, temperature, dew point were estimated. With the help of Microsoft excel calculation of TMPMN, TMPMX, SOLARAV, TMPSTDMX, WNDAV has been performed. Using customized software called pcpstat.exe and dewpoint.exe Precipitation related parameters and dew point were computed. Then all the results are borrowed to the WGEN_watershedgan.xls file.

The important part of the SWAT model is water balance the basic equation is

$$P-R-E-T-G = \Delta S$$

In this P=precipitation, R=surface runoff, E=evaporation, T= transpiration, G= net groundwater flow out of the catchment and ΔS = change in storage

In SWAT model evapotranspiration is calculated by using Penman-Monolith method and surface runoff computed with the help of SCS Curve number method. Watershed gets divided into multiple sub-basins in watershed delineation, and then water balance parameters for each sub-basin were computed.

IV. RESULTS

After successful running swat the simulated results are obtained. Annually, daily, monthly and yearly basis results can be visualized. It gives all hydrological components average amount of precipitation, potential evapotranspiration, actual precipitation, surface runoff, soil water content, groundwater contribution, water yield for each sub basin. The output obtained is as shown in figure 6 and figure

7.

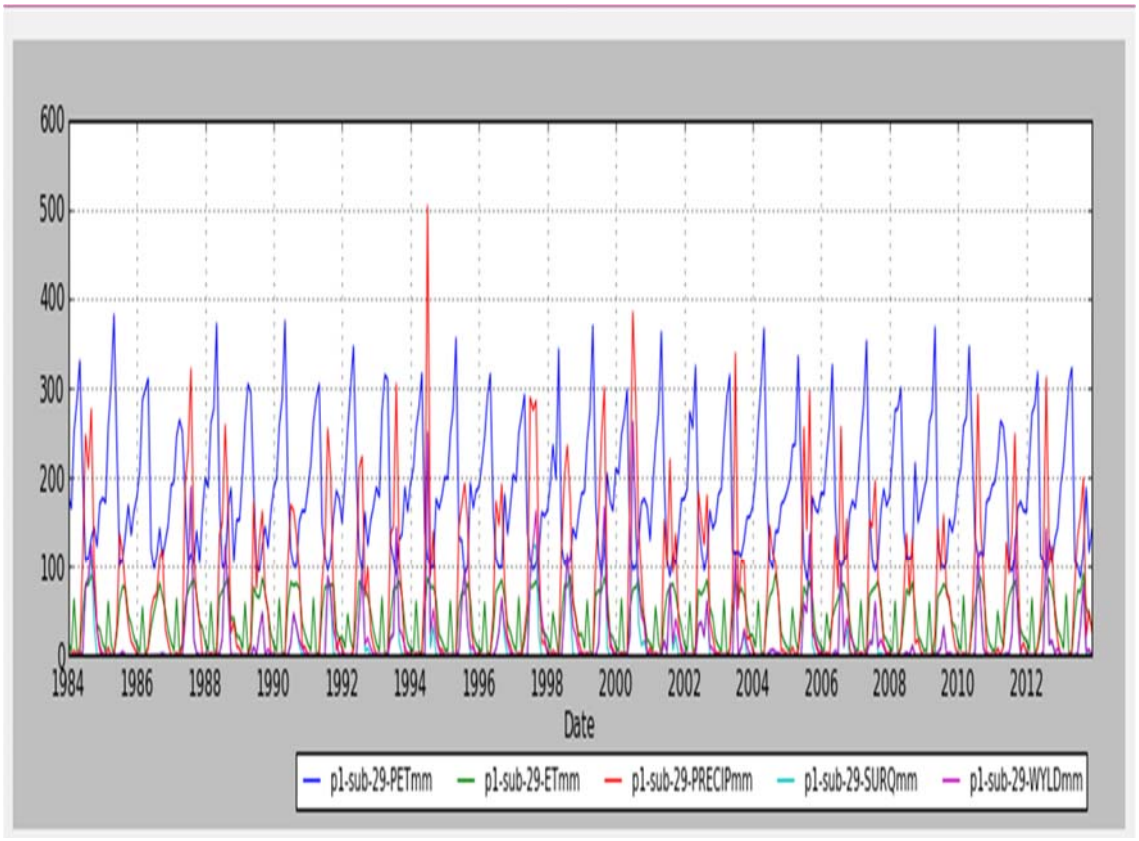

Fig.6.Graph showing variation of all the parameters for 2013 for subbasin-29

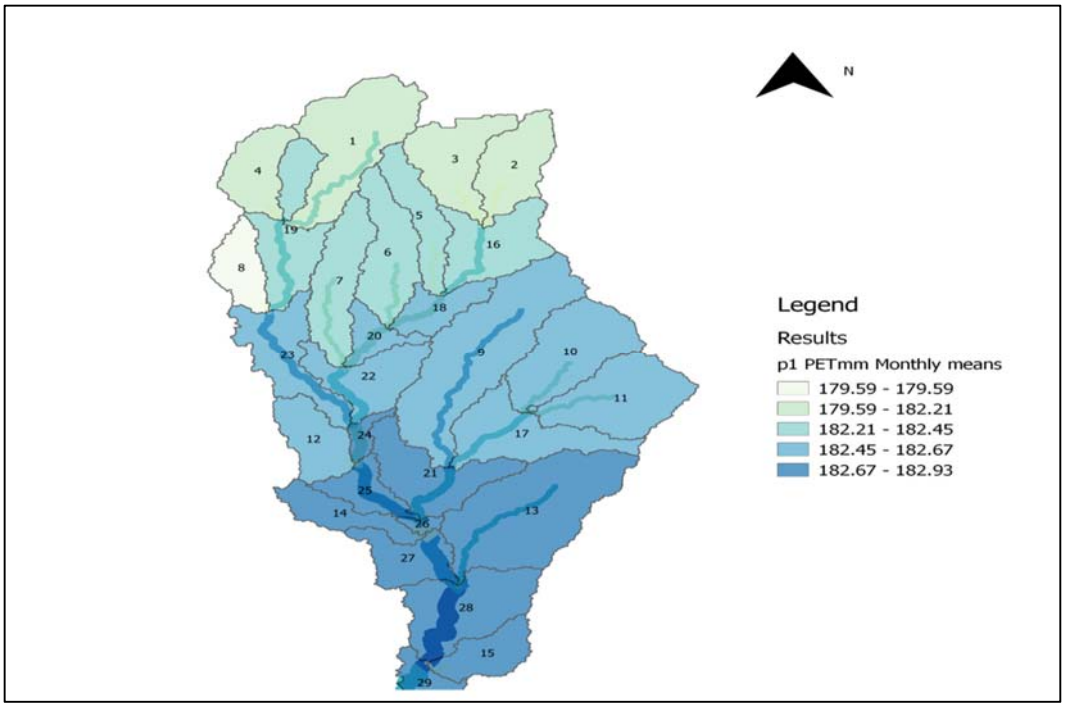

Fig.7 Monthly Potential evapotranspiration in mm

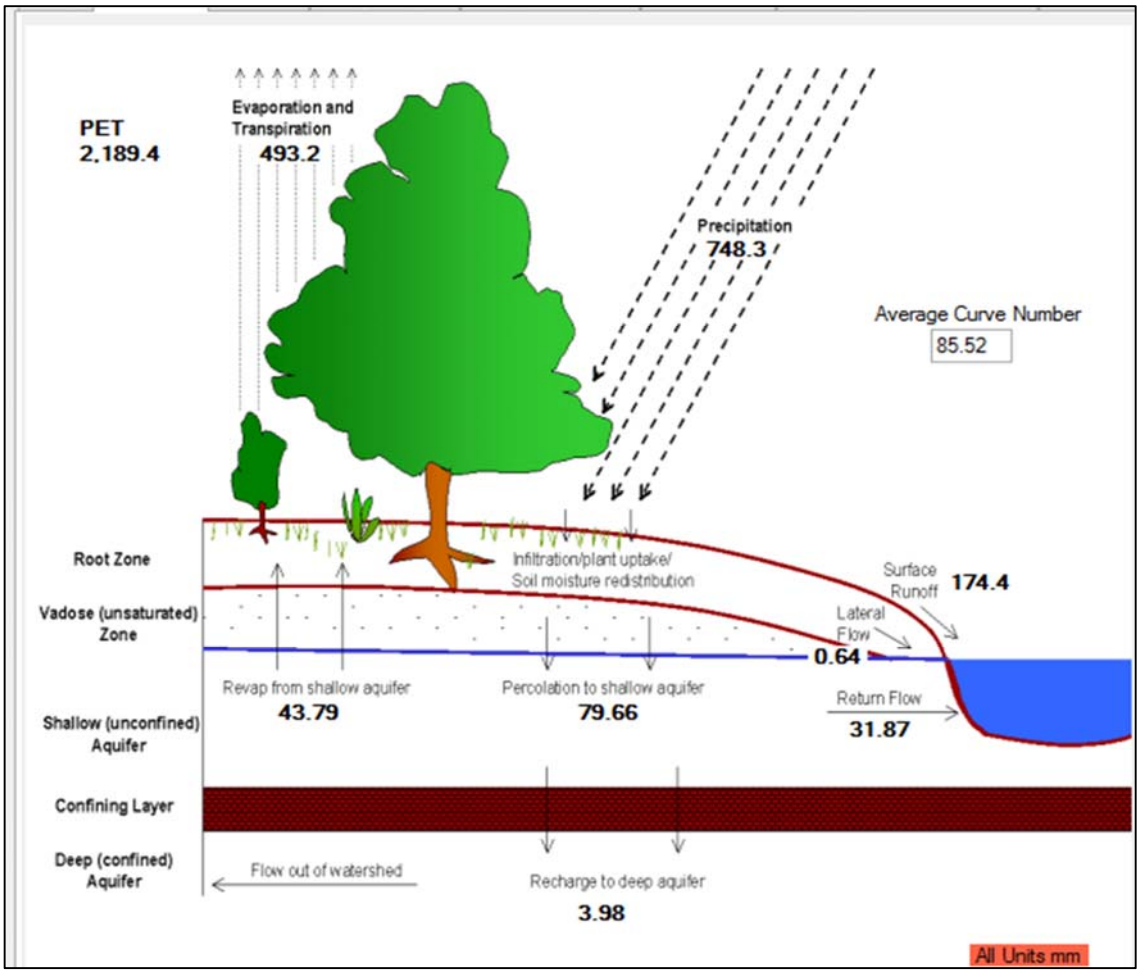

Fig.8 The hydrology of study area can be visualized after running SWAT check

V. CONCLUSION

Water regime of the particular region is well understood by estimation of resources. Water balance is finest way of find out accessibility of water in different parameters of hydrological cycle and variations in between these parameters. The open-source geospatial techniques were utilized to create different thematic maps of study area influence land use, soil, drainage, and slope used as input for swat model. Swat model proves as a powerful tool in simulating the hydrology of large basins at watershed scale. This provides simulated results of each parameter. The evaluated parameters can be used for many other purposes of study such as agricultural water management, climate change impact assessment, flow forecasting, water quality assessment etc. This water balance study minimizes possibility of drought and mismanagement, and hence will lead to a proper utilization of accessible water resource.

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