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Sediment Yield Evaluation by Using QSWAT

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Abstract: Sediment yield is the amount of sediment eroded from the land surface by runoff and delivered to a stream system or at the basin outlet over a period of time. Estimates of sediment yield are needed for studies of reservoir sedimentation, river morphology and planning of soil and water conservation measures. The present study has been carried out by using Soil Water Assessment Tool (SWAT) for GV – 48 area located in the Gangapur Taluka of Aurangabad district. SWAT requires large number of input parameters. Digital maps viz. Digital elevation model, soil map, Land use land cover map required for input of SWAT have been prepared by using QGIS. From various Government agencies and sources; all the required thematic maps and attribute information of study area have been collected. The simulated result is obtained which can be visualize statically, graphically and numerically.

Keywords: Watershed, Sediment Yield, Quantum Geographic Information System (QGIS), Soil Water Assessment Tool (SWAT)

1.Introduction

To superscript the issues related with sustainable rainwater management for improving livelihoods watersheds act as an entry point. To assign water management issues, we need to quantify and analyse the different elements of hydrologic processes taking place at that area. Undoubtfully, this analysis should be carried out on a watershed basis as all these processes are happening within individual micro watersheds. We can scientifically formulate strategies for soil and water conservation only after better understanding the temporal and spatial variation of these hydrologic components. For any watershed the process of sedimentation and erosion is significant, so it is very important to identify the causes and sources of erosion. Different management practices carried out to reduce the erosion rate for this, identification of sources of erotion is important.

To quantify the sediment yield from the watershed GV- 48 a physics-based, semi-distribted watershed model, Soil and Water Assessment Tool (SWAT) model was used. This study aimed to model the hydrological processes to calculate sediment yield of watershed GV – 48 which is carried out by using SWAT model. The SWAT (Soil and Water Assessment Tool) model is a river basin model developed by US Department of Agriculture - Agricultural Research Service (ARS) in Temple, Texas. The SWAT model is a physically based, long term simulation, continuous time, deterministic, lumped parameter, and originated from agricultural models with spatially distributed parameters operating on a daily time steps. Impact of land management practices on water, sediment and agricultural chemical yields (nutrient loss) in complex and large watersheds with varying land uses, soils and management conditions over a long period of time can be predicted conceptually to achieve main objective of this project work.

2.Literature Review

Rokhsare Rostamian, etall(2008); performed runoff and sediment model,Model calibration and uncertainty analysis with sequential uncertainty fitting (SUFI-2),it is the program interfaced with SWAT, in the package SWAT-CUP (SWAT Calibration Uncertainty Programs) for Beheshtabad (3860 km2) and Vanak (3198 km2) watersheds in the northern Karun catchment in central Iran. They have estimated prediction uncertainty (P factor) ranged from 0.31 to 0.86 for Beheshbad and 0.71 to 0.80 for Vanak. Also standard deviation (D factor) ranged from 0.3 to 1.1 for Beheshbad and 0.77 to 1.16 for Vanak. These results indicate a fair model calibration and uncertainties.

Manoj K. Jain,etall(2013); stimulated stream runoff and sediment load by make use of SWAT model in Gumera river basin upstream of Lake Tana, Ethiopia. To assess the capability of model for evaluation of stream runoff and sediment yield of study area, performance evaluation carried out by statistical and graphical methods.

Lemma Tufa Bokan,etall(2015); selected conceptual,distributed and continuous time SWAT2012 Model to simulate the runoff and sediment yield from Kulekhani watershed, in Bagmati river basin, Nepal. For performance evaluation they have plotted a time series of observed and simulated value and statistical measures of coefficient of determination (R2) and the Nash-Sutcliffe efficiency (NS).

Umit Duru (2015); applied a SWAT tool for the portion of Ankara River catchment, which comprises of area 4932 km2 in the central Anatolia region of Turkey. They Summarized there research for better understanding of which factors determine sediment yield rate to reservoirs which facilitate estimation of the probable lifespan of a reservoir and appropriate mitigation measures for limiting the reservoir sedimentation.

2.1 Objective of the Study

1. To check the relevancy of SWAT model for watershed GV-48.
2. To forecast the sediment yield of watershed GV- 48 and collate the result with existing studies.
3. To examine the impact of land use change on sediment yield under different condition.

3. Methodology

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3.1 Data collection and analisis:

Location of the study area Watershed GV-48 is a significant drainage system contributing to Jayakwadi Dam. Watershed area is bounded by North latitudes 19.57° and 19.72° North longitude 74.95 ° and 75.26° East, falls in the Gangapur Taluka of Aurangabad district in Maharashtra. Geographical area of the watershed is 236km2. The main occupation of the village is agriculture as 95.75% of the total watershed area comes under cultivation.

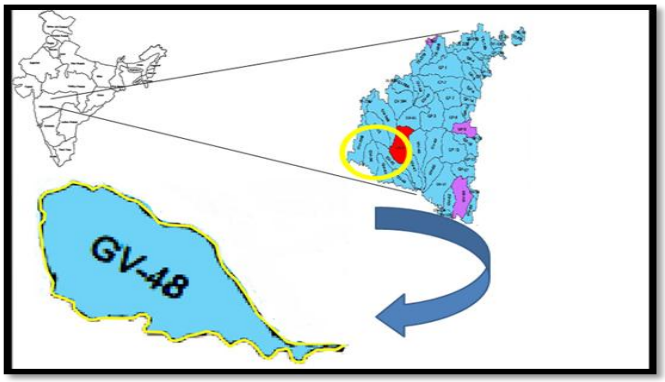

Fig. 3.1 Location of Study Area GV-48

3.2 General Geology And Hydrogeology:

The area experiences Moderately Tropical type of climate. Average annual rainfall of the area is about 796.13mm.The study area comes under formations of Deccan Trap Basalt of Maharastra. Due to continuous atmospheric action both weathererd basalt and separated sediments are rapidly disintegrated and converted in to an end product of weatherizes i.e. soil. the main constituent of rock is Fe,Mg,Mn.therefore the soil forms mafic minerals shows pasty, dark black, humus rich and more ferrite. It is more fertile and namely called as Black Cotton soil.

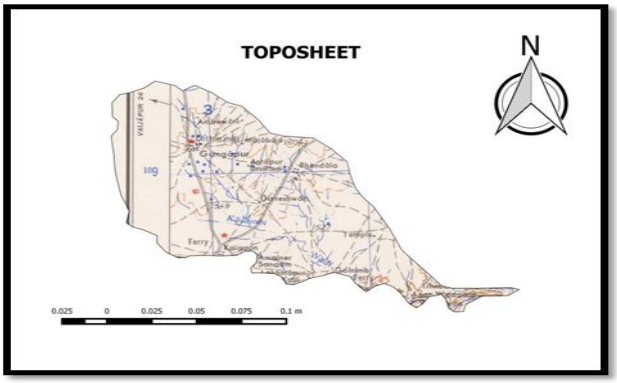

Fig.3.2 Toposheet of study area

3.3 Digital Elevation Model:

To delineate the watershed and sub basins, to determine drainage networks SWAT uses the digital representation of the topographic surface. DEM is the digital representation of the topographic surface. A 90m by 90m resolution DEM was downloaded from SRTM. Fig 3.3 shows DEM of GV – 48. Sub basin parameters such as slope gradient, slope length of terrain and the stream network characteristics such as channel length, width and slope were calculated for the base village area and used by the model.

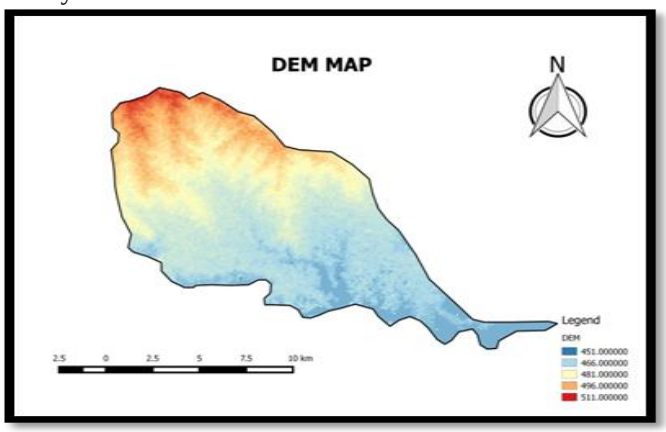

Fig. 3.3 Digital elevation Model of study area

3.4 Land Use/Land Cover Map:

A land use map was created by recording the crop type on each plot in the watershed and by identifying the land cover on areas other than cultivated fields. Land use land cover map extracted from bhuvan map.detailed classification of various soil types among the study area shown in Fig. 3.4.

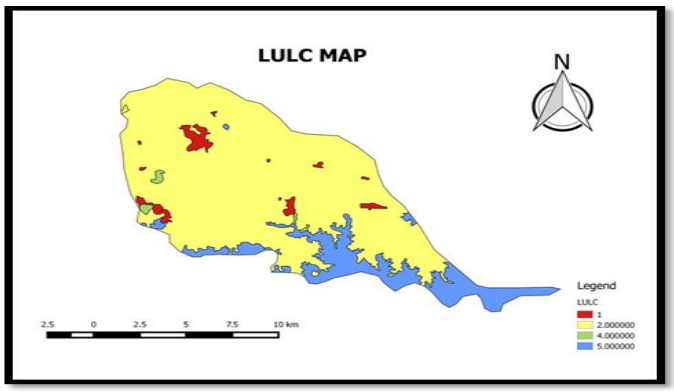

Fig 3.4 LULC map of study area

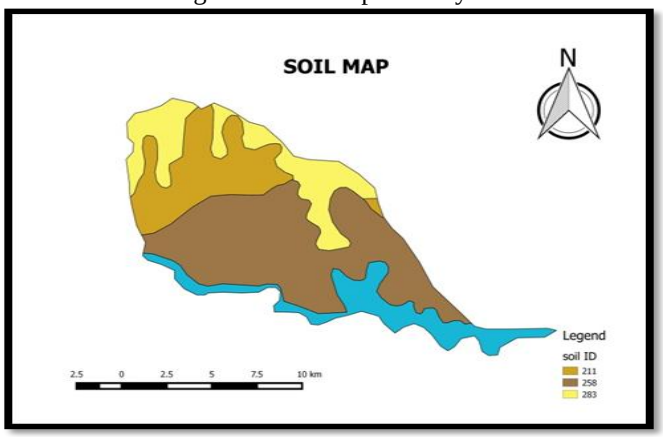

Fig 3.5 Detailed soil Map of study area

4. Result and discussion

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After successful running SWAT the simulated result is obtain. The results can be visualized on basis of totally, annually daily, monthly and yearly .it gives all type of hydrological components for each subbasin.

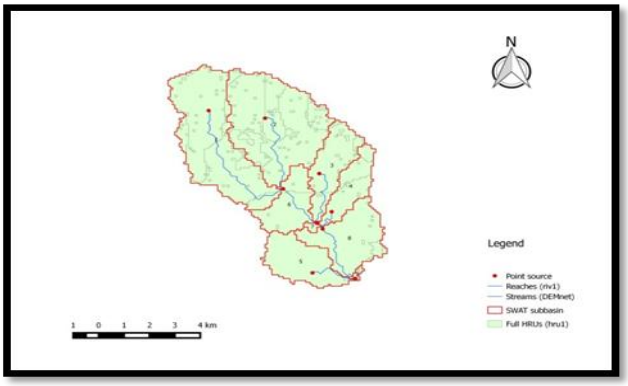

Fig 4.1 Monthly evapotranspiration in mm

In present study, the 9 subbasins are obtained. The total watershed area under subbasins is 54.48km^2. The output can be visualized graphically, statically and numerically. The graphically representation of various parameter of subbasin 1 is given as below fig4.2

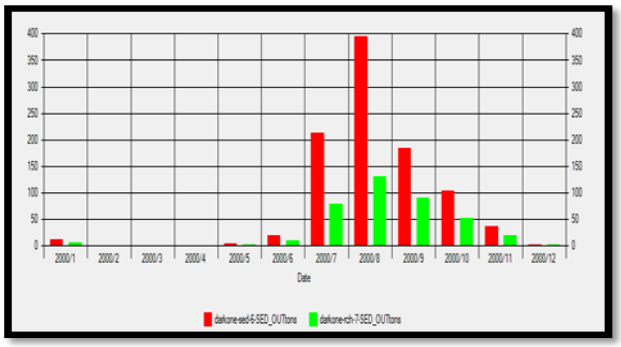

Fig 4.2 Graphical presentation of variations of sedimentation in 2000 for subbasin 6 and subbasin 7

Potential evapotranspiration, actual precipitation, surface runoff , Water yield average amount of precipitation Groundwater contribution of subbasins on monthly basis are visualized as follow fig 4.3

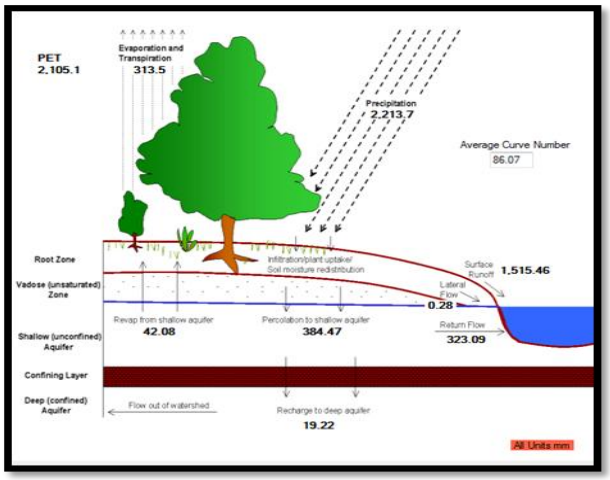

Fig 4.3 Hydrology of study area by SWAT checker

The total area under the 14 sub basins is 54.48 km2. For sub basin 1 the agricultural land is 53.75 ha. and forest area is 86.36 ha. which is 2.77 % and 4.45 % of the total watershed area.
Average monthly basin values of rainfall, surface runoff, water yield, sediment yield, evapotranspiration and potential evapotranspiration are obtained for the basin using SWAT Check. The percentage area covered by the watershed of different land use area is obtain by the SWAT. It can be visualized by report viewer. The HRU analysis for subbasin 1 is as below; From table no.4.1 its seem that quantified values of rain, sediment yield and water yield, ET, PET are average annual monthly basin values.The result shows that there is increase in discharge during wet month, and decrease during dry period.

MON	RAIN (MM)	SNOWFALL (MM)	SURFQ (MM)	LATQ (MM)	LATQ (MM)	WATERYIELD (MM)	SEDYIELD (T/HA)	PET (MM)
1	3.27	0	0	0.02	5.96	6.47	0	159.8
2	0.58	0	0	0.01	1.1	2.71	0	196.88
3	2.62	0	0	0.01	0.73	2.59	0	280.56
4	3.95	0	0	0.01	0.53	3.78	0	353.27
5	7.47	0	0.13	0.01	0.53	6.12	0.01	404.45
6	127.07	0	38.02	0.01	36.97	40.82	2.66	165.71
7	168.5	0	65.28	0.01	70.81	45.97	5.04	67.78
8	175.79	0	68.9	0.02	91.55	44.29	5.41	55.47
9	168.72	0	62.32	0.02	107.96	48.97	4.65	73.71
10	95.32	0	32.31	0.03	87.32	42.42	2.42	126.85
11	31.2	0	6.17	0.02	44.68	24	0.42	128.73

12	3.94	0	0.53	0.02	21.38	10.9	0.02	138.05

Table 4.1 Average monthly basin values

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