CLIMATE CHANGE AND WATER AVAILABILITY IN PERIYAR VAIGAI BASIN

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Option A

The assignment will make use of Soil Water Assessment Tool (SWAT) model, which is a distributed or physically based model. Using this model the hydrology of Vaigai Basin is modeled to study the impact of Climate Change on the hydrology of Vaigai basin.

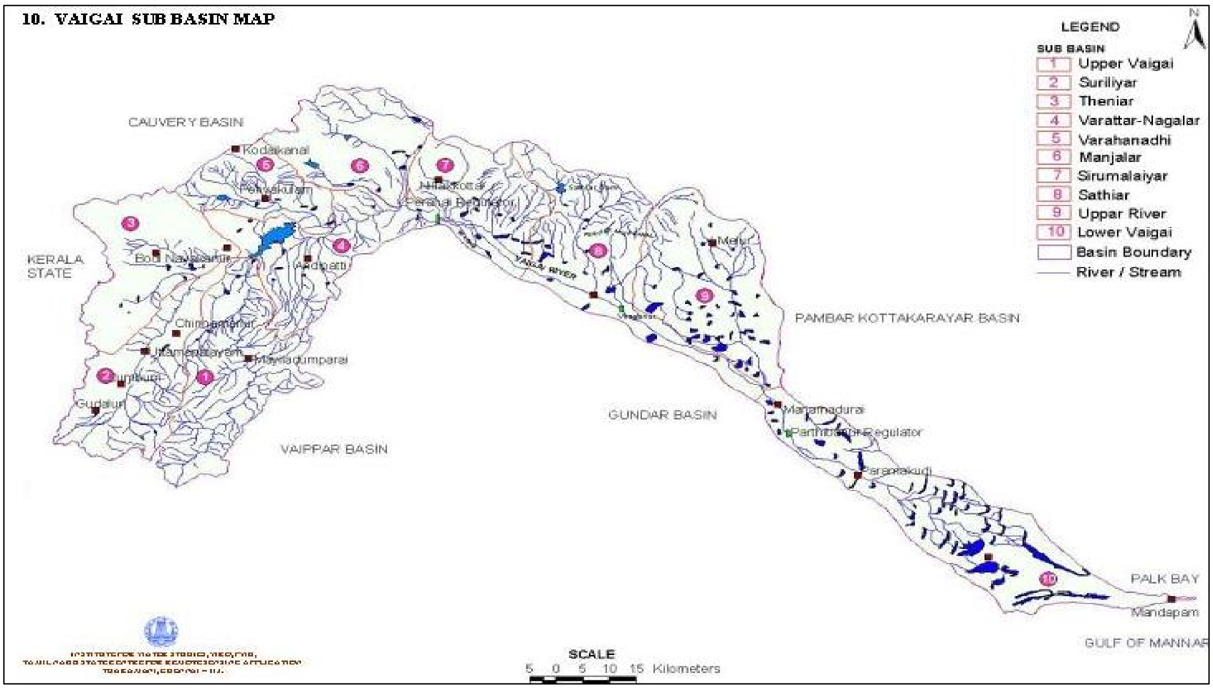
Key words : Vaigai Irrigation System – history – rainfall distribution – analysis – SWAT – hypothetical climatic conditions

Vaigai Reservoir

Vaigai River Basin is the second largest basin in Tamil Nadu State. The basin lies between 9°15' to 10°20' N Latitude and 77°10' to 79°15' E Longitude. The total basin area is 7393 KM^2. The Length of Vaigai basin is 250 KM and width varies from 6 to 50 KM. Vaigai is the main river and it originates from Varushanad area in eastern side of Western Ghats. The Vaigai basin consists Two Irrigation systems namely old vaigai system (Vaigai old Anicut system) and Periyar System (Periyar Main Canal System). The project area covers a non-contiguous area of about 130,000 ha out of which the project serves about 81,000 ha.

Vaigai is not an abundant flowing river, even in favourable seasons. The flow in the river is intermittent and seasonal. The irrigation was carried out by diverting the river water through stream channels from the river storing the river water in tanks. There are 374 tanks and total culturable command area (CCA) of them is 1,36,109 Acres. But the tanks were inadequately filled by the periodical rains and are always liable to fail at the moment of the farmers greatest need.

Vaigai dam is a balancing reservoir in which both Periyar water and Vaigai natural flows are impounded. Vaigai credit stored in the Vaigai reservoir is distrinuted in the ratio of 2:3:7 respectively based on the extent of old ayacut.



Objective of the study

- This study involves the simulation of the hydrological cycles for few years backed by the data collected.
- This simulation will help in quantification of the impact of climate change on the hydrology of the Vaigai basin.
- These predicted climate change impacts may induce additional stresses and shall need various adaptation strategies to be taken up.
- The strategies may range from change in land use, cropping pattern to water conservation, flood warning systems, etc.

The procedure of the model

1. Watershed Delineation
2. HRU Analysis
3. Weather Data Input
4. SWAT Simulation

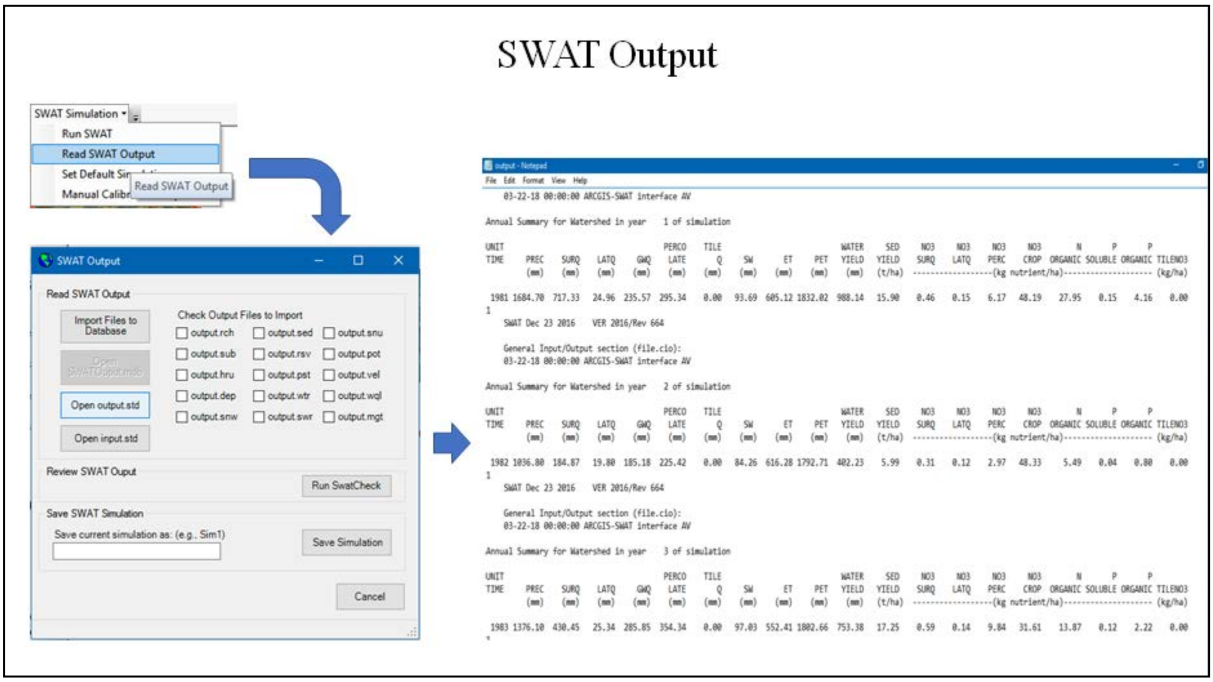
Data Used

The following input data are required for the model of hydrology for Vaigai Basin:

1. Digital Elevation Model (DEM)
2. Land Use Data
3. Soil Data

4. Weather Data
    a) Temperature
    b) Wind Speed
    c) Relative Humidity
    d) Solar Radiation
    e) Rainfall

If the SWAT model is run, the following will be the output



Climate Change and its effect on Water availability in Ponnaniar Reservoir System

Climate change is a phenomenon we can no longer deny as its effects have become increasingly evident worldwide. The impacts of climate change on water availability and water quality will affect many sectors, including energy production, infrastructure, human health, agriculture, and ecosystems. Water resources are among the most vulnerable sectors to be affected by the climate change. In order to minimize the adverse impacts of climate change on water resources and attaining its sustainable development and management, there is a need for developing rational adaptation strategies.

A hydrological model Soil and Water Assessment Tool (SWAT) was used to simulate runoff in the Vaigai basin for current climatic conditions, and for prescribed hypothetical climatic conditions that represent a range of possible climate changes that is likely to be expected in the current century.

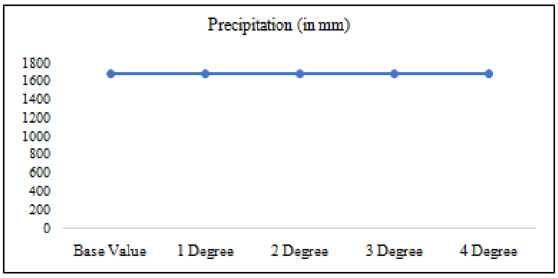
Annual summary of hydrological outputs of Periyar Vaigai basin for the year 2008 (representing 75% dependability of rainfall) as simulated by SWAT model has been worked out and the monthly hydrology of Ponnaniar basin has also been calculated.

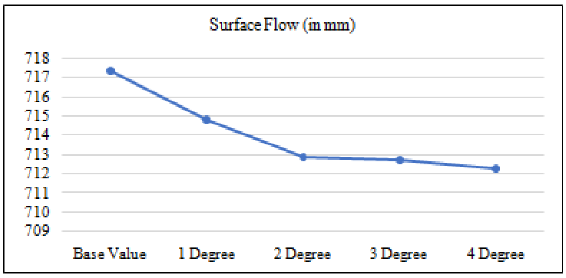
The model was run for two climatic conditions, i.e. 1^0 incremental change in temperature from the base temperature and changes in precipitation with -40%, -20%, and +20%, +40%. Totally eight scenarios were considered for the study to assess the impact of climate change in Periyar Vaigai System. The model executed for Periyar Vaigai Basin current climatic conditions, and for prescribed hypothetical climatic conditions that represent a range of possible climate changes. The hypothetical changes in climate included changes in mean seasonal and annual temperatures of +4°C, upto 1°C and changes in precipitation of -40%,-20%, and +20%, +40% (a total of eight scenarios) .These changes in climate were computed by uniformly changing current values of daily temperature and precipitation by the specified amounts for all months of the year (2008). The current and altered time series of daily temperature and precipitation were input to a hydrological model to simulate changes in components of surface flow, lateral flow, ground water flow, percolation, soil water, evapotranspiration, potential evapotranspiration and water yield are presented in Table.

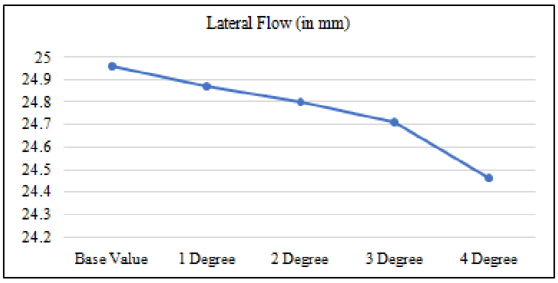
The following table shows the change in value of various hydrological parameters with the base value for temperature change:

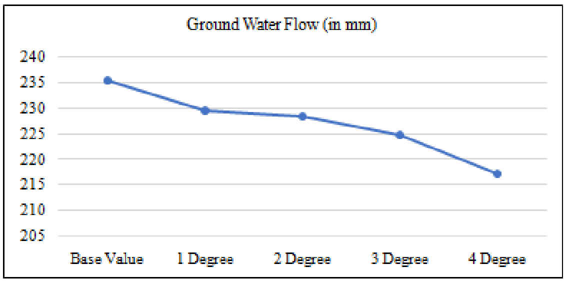
Parameters	**Base Values**	**1°C Increase**	**2°C Increase**	**3°C Increase**	**4°C Increase**
Precipitation (mm)	1684.7	1684.7	1684.7	1684.7	1684.7
Surface Flow (mm)	717.33	717.78	717.82	717.69	717.24
Lateral Flow (mm)	24.96	24.87	24.80	24.71	24.46
Groundwater Flow (mm)	235.57	229.66	228.62	224.92	217.23
Percolation (mm)	295.34	289.80	289.42	286.31	279.01
Soil Water (mm)	93.69	93.03	92.38	91.72	91.08
Evapotranspiration (mm)	605.12	613.98	617.04	621.03	629.18
Potential Evapotranspiration (mm)	1832.02	1889.18	1947.15	2005.95	2065.60
Water Yield (mm)	988.14	979.39	976.35	972.35	964.20

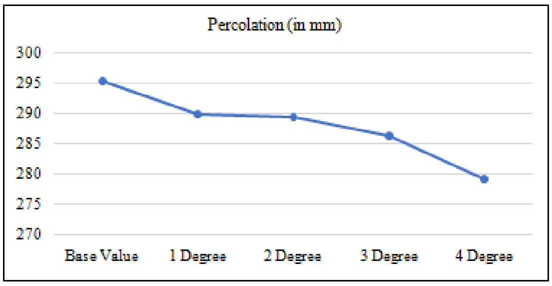
The outcome of the study is shown below graphically .....

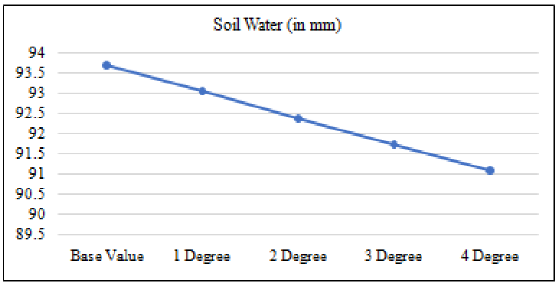


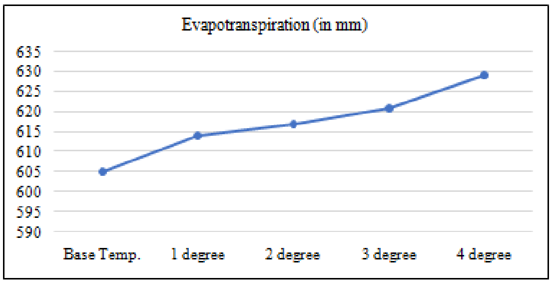


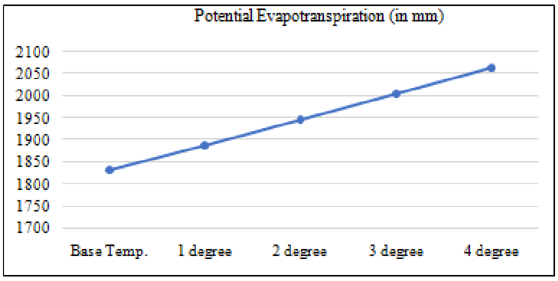








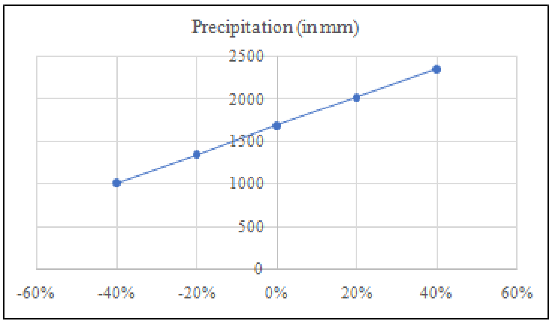


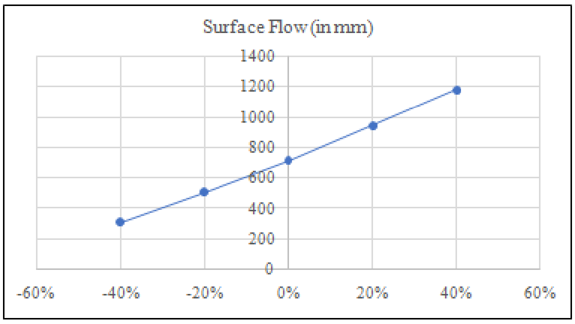


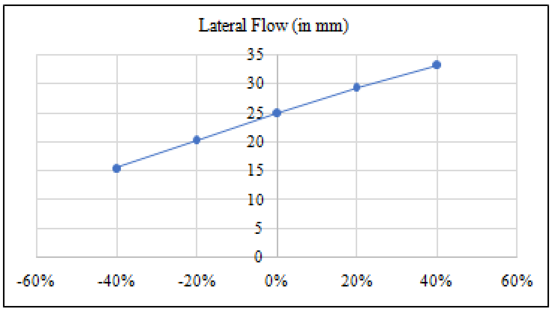
The following table shows the change in value of various hydrological parameters with the base value for rainfall change:

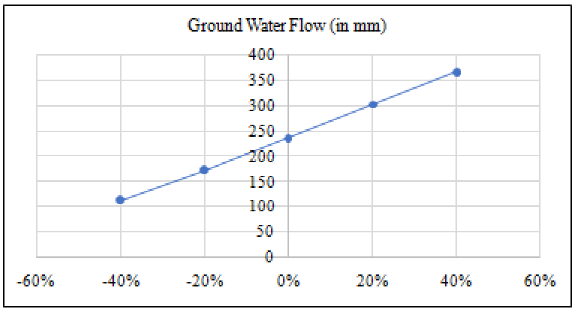
Parameters	Base Values	+ 20%	+ 40%	- 20%	- 40%
Precipitation (mm)	1684.7	2021.64	2358.58	1347.76	1010.82
Surface Flow (mm)	717.33	942.89	1181.30	507.53	312.16
Lateral Flow (mm)	24.96	29.29	33.21	20.31	15.54
Groundwater Flow (mm)	235.57	302.11	366.12	172.49	113.18
Percolation (mm)	295.34	371.39	444.55	223.47	158.09
Soil Water (mm)	93.69	96.98	99.18	88.21	78.61
Evapotranspiration (mm)	605.12	632.61	651.64	560.21	498.61
Potential Evapotranspiration (mm)	1832.02	1832.02	1832.02	1832.02	1832.02
Water Yield (mm)	988.14	1287.11	1595.88	708.21	446.47

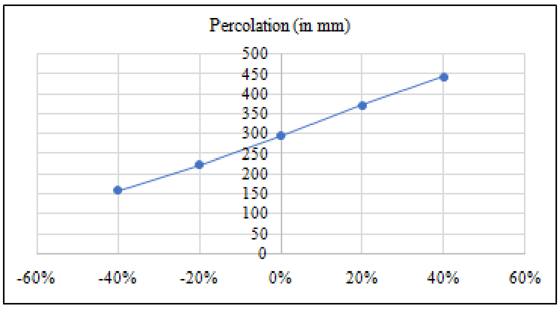
The outcome of the study is shown below graphically .....

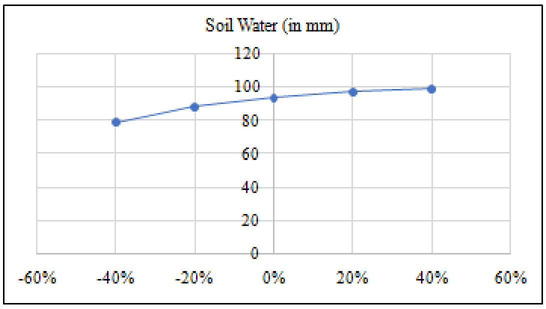


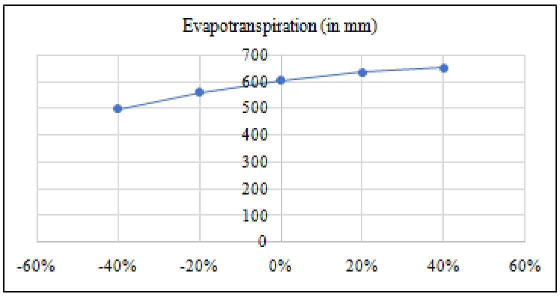


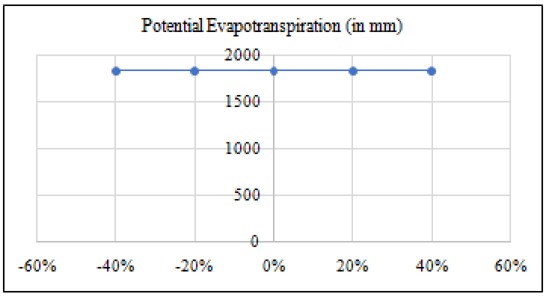












Summary

- An overall decrease in surface runoff, groundwater flow, lateral flow, percolation etc. and increase in evapotranspiration were observed due to temperature change.
- It indicates an overall scenario of decrease in inflow to streams, rivers and reservoir storage thus leading to scarcity in availability of water resources.
- A directly proportional change in the precipitation, surface flow, groundwater flow etc. were also observed.
- It indicates that this scenario can lead to flood or drought situation in extreme cases.
- This calls for an improved, scientific water management practices by the administrators and the beneficiaries.

Reference

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