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Hydrological Modeling using HEC-HMS

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Abstract: Main aim is to simulate Rainfall-Runoff in Khari catchment of Sabarmati Basin , in Gujarat Region through employing of HEC-HMS model. In this paper Inverse Distance method is used for the meteorological model, SCS-CN method is used to calculate the loss rate and SCS unit hydrograph method have been applied to simulate runoff rate. After calibration & validation, the simulated peak discharge was very closed with observed values.
Key words: Khari, HEC-HMS, Inverse Distance, calibration and validation

I. INTRODUCTION

The flood damages will be increased over the years due to population growth and socio economic development and the climate change due to the global warming effect. so, it is necessary to define methodology to predict the flash flood .For determining flash flood we have to require relationship between rainfall- and runoff data and it is the process which is used for estimating stream flow over river basin. Hydrological model can be classified in to main four categories Determinist, Global, Kinematic, or conceptual. This paper represents methodology of rainfall –runoff model by using HEC-HMS.

II. MATERIALS AND METHODS

A. Data Collection

For Catchment Delineation Shuttle Radar Topography (SRTM) , Digital Elevation Model (DEM) with spatial Resolution of approximately 90 m of Gujarat were obtained from web: [http//:srtm.csi.cgiar.org]
Rainfall and Discharge data was collected from SWDC, Gandhinagar. Land use and Land cover map was obtained from GSOI, Gandhinagar.

B. Methods

It is based on meteorological and physical data processing and on data editing using remote sensing and GIS techniques. It can be divided into Five man stages.

1) DEM processing, topography, and watershed characteristics using Arc Hydro tools in Arc Map.
2) Define soil characteristics of watershed and to compute runoff curve number (CN).
3) Importing the catchment physical characteristics data to HEC-HMS model.
4) Run for simulation and compare simulation flow and observed flow.

C. Description of study area

For present study Khari Catchment of Sabarmati Basin is selected, which is major tributary of Sabarmati River .It covers major part of Sabarkantha District and less in Kheda District. It was originate from Rocks of Arvalli. Flows for distance about 161 km and covers 2595 km². There are three types of slopes are present in catchment area . Low slope is between(0 to 7%) with low altitude. Moderately slope is between(7 to 20%). And steep slope cover (>20%).The mean Elevation is 498m and mean basin slope is 4.67 m/km. Soil Group map for this study area can be classified as four groups like ,Group A covers sandy loam , Group B covers silty clay loam , Group C covers sandy clay loam and Group D covers clay loam and sandy clay. But It covers major part of Soil Group A and Group B.

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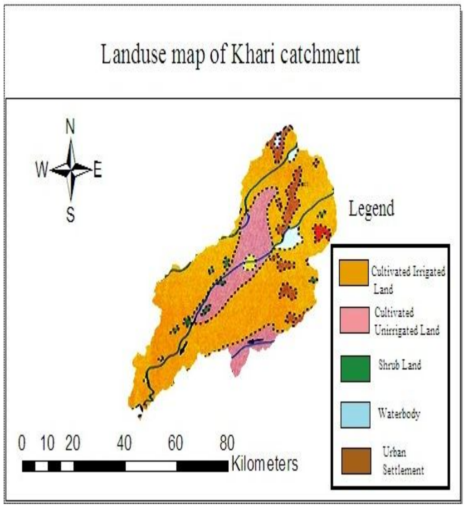


Fig – 1 : Landuse map of Khari Catchment

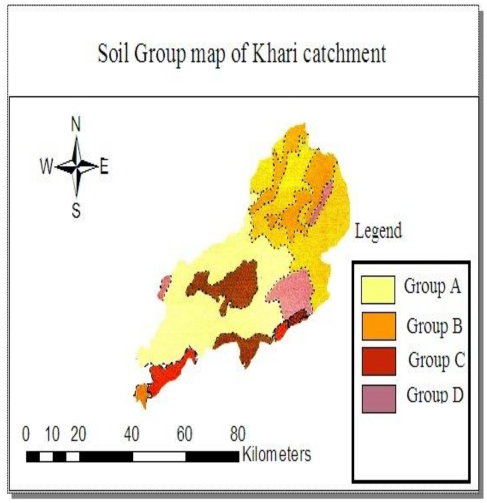


Fig – 2 : Soil Group map of Khari Catchment

D. *Hydro Climatic Characteristics of Catchment area*

An annual Rainfall is occurs with range from 1483.01 mm (max) to 302.20 mm (min) in study area. Average rainfall of catchment for last thirty year is 853.60 mm. Major Seasonal Rainfall occurs during July and August, more variation may possible in September and less rainfall may occur in Jun and October month.

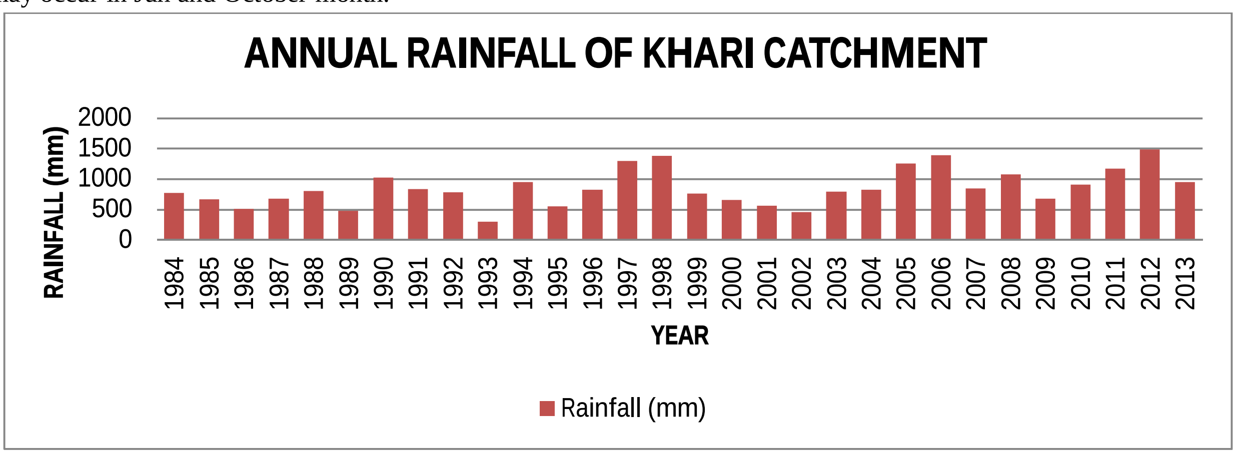


Fig – 3 : Annual Rainfall of Khari Catchment

III. HEC-HMS Model

A. *Model Structure*

In this study SCS-CN loss method will be used to determine loss rate, the SCS unit hydrograph method will be used to calculate runoff rate and simulating process is done by Inverse Distance method for meteorological model. Here, the catchment is divided into eight subbasins.

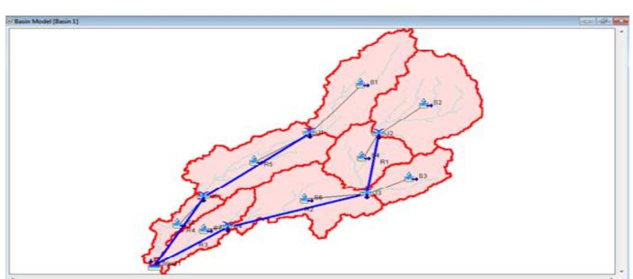


Fig – 4 : HEC-HMS Model

B. Loss method

The CN for watershed can be estimated as function of land use, soil type, soil moisture using tables published by SCS. SCS CN model is given by this equation,

$$Q = \frac{(P - Ia)^2}{(P - Ia) + S} \qquad S = \left(\frac{1000}{CN}\right) - 10)$$

Soil group A has high infiltration and low runoff potential and Soil group B & C has medium infiltration and Soil group D has high runoff potential and low infiltration.

C. Transform method

The SCS developed relationship between time of concentration and lag time.

$T_c = 0.01947\ ^{L0.77}S^{-0.385}$

$T_L = 0.6T_C$

TL = Lag time (min)

Subbasin	Lag Time(min)	CN	Impervious(%)
Subbasin 1	127.741	72.30	6.4
Subbasin 2	129.447	74.51	7.2
Subbasin 3	113.252	71.23	6.2
Subbasin 4	092.400	75.80	7.8
Subbasin 5	129.927	79.93	8.1
Subbasin 6	134.062	72.52	6.6
Subbasin 7	141.852	78.74	7.9
Subbasin 8	134.352	73.32	6.8

D. Meteorological Model

It was designed for real time forecasting , so it has ability to automatically switch from using close gages to using more distant gages when the closer gages stop reporting data. he Latitude and Longitude of the gages is used to determine closeness to one or more nodes specified in each subbasins. For computing Precipitation separate parameter data for each gage are used.

$$W_a = \frac{1/dA^2}{1/dA^2 + 1/dD^2 + 1/dE^2 + 1/dC^2}$$

W_a = Weight assigned to gage A;

d_A = Distance from node to gage A;

d_D = Distance from node to gage D;

d_E = Distance from node to gage E;

so, $P_{node}(t) = W_A P_A(t) + W_C P_C(t) + W_D P_D(t) + W_E P_E(t)$

IV. CONCLUSION

The Khari catchment is divided into 8 sub basins. Rainfall data of 15 Rain gauge Stations and Runoff data of 8 stream gauge stations are used for event based model simulation calibration and validation. The model was calibrated for different rainfall events of last ten years from which the model giving the most suitable result for calibration is adopted here. Here, The calibration results for August 2012 Rainfall event and validation result for July2012 rainfall events are discussed. From the Simulation Result of Calibrated event of August 2012 , it can be seen that model gives 13.45% Deviation in Vol. of Runoff and 10.65% Deviation in Peak Runoff. And while From the Simulation Result of Validated event of July 2012, it can be seen that model gives 15.04% Deviation in Vol. of Runoff and 8.64% Deviation in Peak of Runoff. We can conclude that the Vol. of Runoff and Peak of Runoff were simulated with more Variations. It was observed that high loss occurs in Sub basin 1, Sub basin 2, Sub basin 3, Sub basin 4, Sub basin 5 and from the optimized parameters values it can be seen that in Sub basin 6, Sub basin 7, Sub basin 8 Curve Number values were optimized up to 80 to 99.So it will be less initial losses in Sub basin 6, Sub basin 7, and Sub basin 8.

Fig 5 & 6 shows the graph of calibration process done from July (13 to 20)

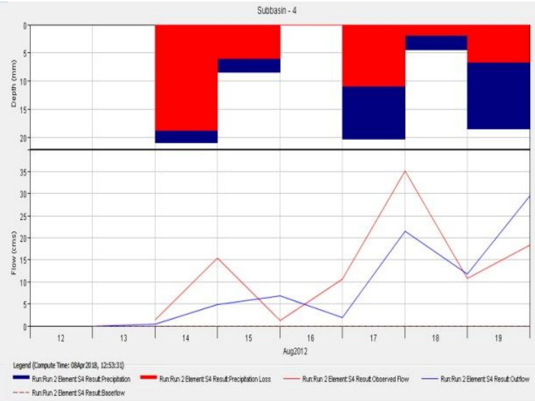
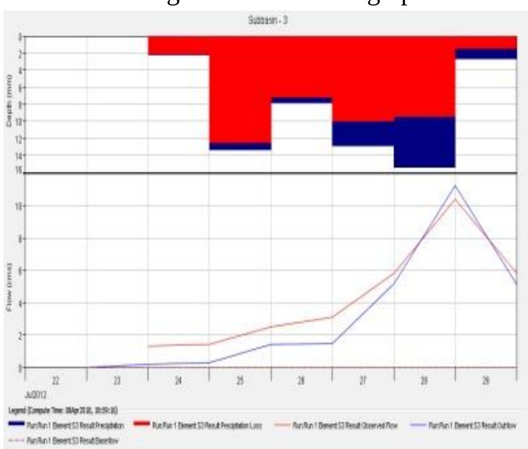


Fig – 5 : Calibration of Sub-basin 3

Fig - 6 : Calibration of Sub-basin 4

Fig 7 & 8 shows the graph of validation process done from July (23 to 30)



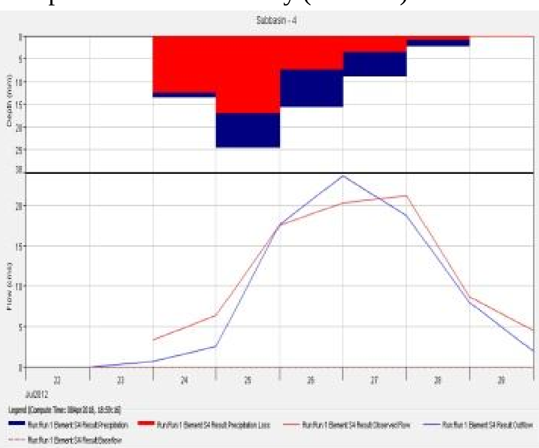


Fig – 7: Validation of Sub-basin 3

Fig-8: Validation of Sub-basin 4

REFERENCES

[1] Hydrological modeling in semi arid region using HEC-HMS case study in Sefra watershed , ksour mountains (SW-ALGERIA) , From Journal of Fundamental and Applied Science , ASCE (2017)

[2] Event and Continious Hydrological modeling with HEC-HMS , From journal of Irrigation and Drainage engineering , ASCE (2016)

[3] Hydrological modeling of watershed using HEC-HMS software and Arc-GIS, From the Journal of Advance Scientific and Technical Research , ASCE (2013)

[4] Flood Forecasting in arid and semi arid region using continuous hydrological modeling, From Journal of Fundamental and Applied Science (2012)