Application of HEC-GeoHMS as a Tool of Hydrologic Modeling in the Field of Water Resources Engineering

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Abstract--- This paper gives an approach of using Hec-GeoHMS tool for the generation of a hydrologic model. By the application of terrain processing tool of HEC-GeoHMS, user can delineate the stream network and watershed. The modelling of the watershed can be achieved by applying the series of tools available in Hec-GeoHMS. Catchment area of Bhadar-I dam which is situated in Rajkot district is selected as study area. By Use of this tool it is found out that area of Bhadar-I catchment is 2430sq.km which matches the actual data acquired from the government offices. It has been observed that the recent development of the GIS technology has found a great application in the field of water resource engineering. It has been found that the use of HEC-GeoHMS tool yields effective and accurate modelling of any watershed provided that spatial data available for the input are accurate. Hence its use must be encouraged compared to traditional techniques of watershed modelling.

Keywords: GIS, Digital elevation model, watershed delineation, stream delineation, terrain processing

I. INTRODUCTION

The basic purpose of this study is to be able to successfully generate a hydrological model of the Bhadar-I catchment using HEC-GeoHMS. This project will determine accuracy of results derived from the HEC-GeoHMS tool. The Geospatial Hydrologic Modeling Extension (HEC-GeoHMS) has been developed as a geospatial hydrology toolkit for engineers and hydrologists with limited GIS experience. Analyzing digital terrain data, HEC-GeoHMS transforms the drainage paths and watershed boundaries into a hydrologic data structure that represents the drainage network. The program allows users to visualize spatial information, document watershed characteristics, perform spatial analysis, and delineate subbasins and streams.

II. STUDY AREA

River Bhadar is one of the major rivers of Saurashtra region of Gujarat. It drains about 1/7th of the area of Saurashtra. The Bhadar basin is the South Western basin and situated between 21 ° 25’ to 22° 10’ North latitude and 69 ° 45’ to 71 ° 20’ East longitude. Bhadar dam is constructed on river Bhadar mainly for irrigation purpose.

III. METHODOLOGY AND TOOL

DEM is a digital representation of the surface elevations. It allows the evaluation of the altitude at any point. This assessment is based on an extrapolation of contours whose principle constituents are: the level lines are initially treated as a set of points, which each point is defined with an attribute elevation of the curve from which it comes. Then, by interpolation it is possible to determine the end of the altitude values between these points.

Tool	Description
Depressionless DEM	The depression less DEM is created by filling the depressions or pits by increasing the elevation of the pit cells to the level of the surrounding terrain.
Flow direction	This step defines the direction of the steepest decent for each terrain cell.
Flow accumulation	This step determines the number of upstream cells draining to a given cell. Upstream drainage area at a given cell can be calculated by multiplying the flow accumulation value by the grid cell area.
Stream definition	This step classifies all cells with a flow accumulation greater than the user-defined threshold as cells belonging to the stream network.
Stream Segmentation	This step divides the stream grid into segments. Stream segments, or links, are the sections of a stream that connect two successive junctions, a junction and an outlet, or junction and the drainage divide.
Catchment grid delineation	This step delineates a subbasin for every stream segment.
Catchment polygon processing	This step creates vector layer of the subbasins using the catchment grid computed in previous step.
Drainage line processing	This step creates a vector stream layer.
Watershed aggregation	This step aggregates the upstream subbasins at every confluence. This is a required step and is performed to improve computational performance for iteratively delineated subbasins and to enhance data extraction when defining HEC-GeoHMS project.

Table 1: HEC-GeoHMS tool for delineation of watershed

The interpolation is a way to generate information in zones which have no information about it. It is the largest operation in the production of Digital Elevation Model. It determines, after a series of known values, the estimation of additional data in areas not sampled. This result is provided by the calculation and not by the observation.

GIS approach toward hydrological analysis requires a terrain model that is hydrologically corrected.

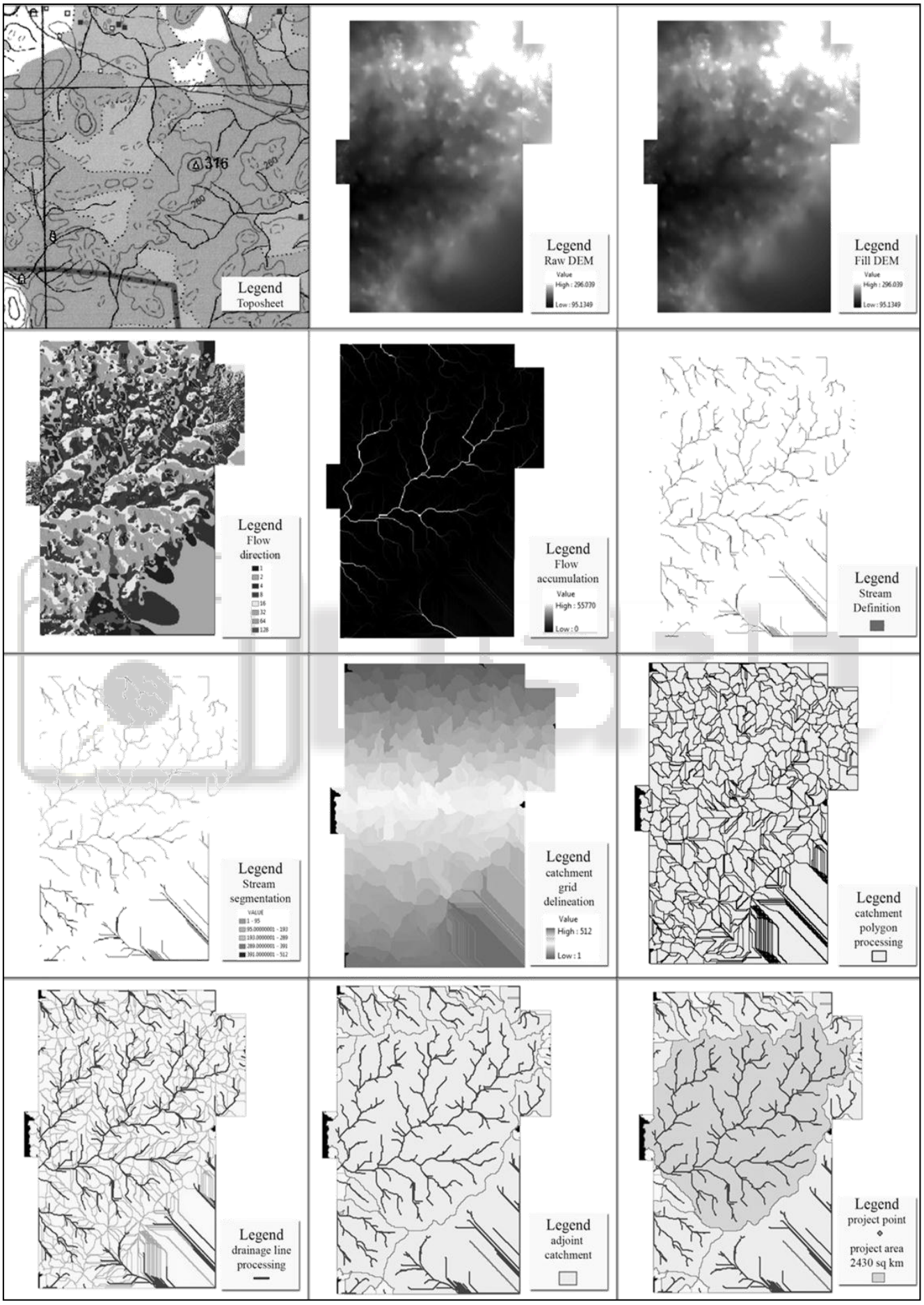

Fig. 1: Procedure of watershed delineation

A hydrologically corrected DEM is used as an input to derive eight additional datasets that collectively describe the drainage pattern of the watershed and allows for stream and sub basin delineation. The first five datasets are grid layers that represent the flow direction, flow accumulation, stream network, stream segmentation and watershed delineation. The next two dataset are vector layers of the watershed and streams. The last two dataset, the aggregated watersheds, is used primarily to improve the performance in watershed delineation.

After the terrain processing is complete, another two tools namely project point and project area is to be processed under HEC-HMS project setup. The project area layer is used to show the upstream drainage area for the outlet point and the project point layer shows the location of outlet point. Here Bhadar-I is characterized as project point.

IV. RESULT AND DISCUSSION

Figure 1 shows various stages of generation of watershed. The result shows that shape of catchment generated in HEC-GeoHMS is similar to that observed catchment. Area of the catchment generated is analogous to the data acquired from the government office.

V. CONCLUSION

The development of HEC-GeoHMS has provided significant results. After the model of watershed generated, it is found out that result matches observation. The methodology adopted in this study allowed us to determine the hydrological parameters and verify the geometry of the watershed.

This study reveals that the use of geographical information system (GIS) and the HEC-GeoHMS tool proves to be an easy and accurate way of modelling hydrological processes and must be encouraged in the field of water resource engineering and management.

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