Use of ArcGIS to extract river geometry as an input to HEC-RAS for Flood Modelling

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***Abstract*- An approach to generate river cross-sections from the Cartosat 1 a stereoscopic Earth observation satellite Digital Elevation model is discissed. The low resolution and the inadequate vertical accuracy of such global data present difficulties in differentiating features of hydraulic importance, which necessitate pre-processing of the DEMs before they are used. The extracted cross-sections were used in a 1D river modeling tool HEC-RAS/GeoRAS to simulate flood 2017 Banaskantha. Model results are encouraging and show good potential for using the suggested method in the areas of topographic data scarcity.**

***Index Terms*- River Geometry DEM , HEC-GeoaRAS, ArcGIS.**

I. INTRODUCTION

Floods are among the most frequent and destructive natural disasters worldwide. An accurate and reliable flood forecast can provide vital information for land management and emergency response. Flood forecasts are achieved using numerical models that are able to predict the depth, velocity, and arrival time of the flood wave at each point of the valley. In particular, information on river geometry (that is cross-section shape, depth, and width) is critical to the application of these numerical models. However, it is impossible to measure river geometry along the entire river length, especially in large basins. This study developed a method to represent river geometry using a limited amount of time and money. Specifically, this objective can be achieved using available satellite imagery complemented with a few measurements. Moreover, this study showed that flood forecast skill can be improved by combining information from satellite and numerical models.

II. STUDY AREA

The Banaskantha district takes its name from the river Banas, which flows through it. The district is situated in the north western part of the state and lies between north latitudes 23°33' & 24°25', and east longitude 71°07' & 73°02'. The Present Study Area is Downstream of Dantiwada and Sipu Dam Falling in the district Banaskantha, Patan & Kutchh.Both are major irrigation project on banas and sipu river.It has an area of 10,303 sq. km and is bounded by state of Rajasthan in north, Rann of Kutch in west, by Sabarkantha, Mahesana and Patan districts in east, south and south west respectively.

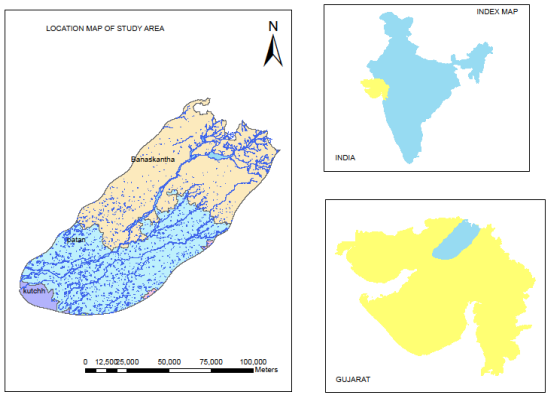

Fig.1. Location Map of Banaskantha

III. METHODOLOGY

HEC-GeoRAS extension has been used under 3D Analyst tool and Spatial Analyst tool in ArcMap Software. The River Geometry is extracted step by step by using various tools available in HEC-GeoRAS Software/extension. The most important thing is to set the coordinate system of the ArcMap. The flow chart of methodology is shown in Fig. 2.

A. Data Collection

Digital Elevation Model (DEM) is the digital representation of the land surface elevation with respect to any reference datum. DEMs are used to determine terrain attributes such as elevation at any point, slope and aspect. Terrain features like drainage basins and channel networks can also be identified from the DEMs. The Cartosat 1 a Digital Elevation Model with 30m Resolution is Downloaded through the BHUVAN ISRO website.

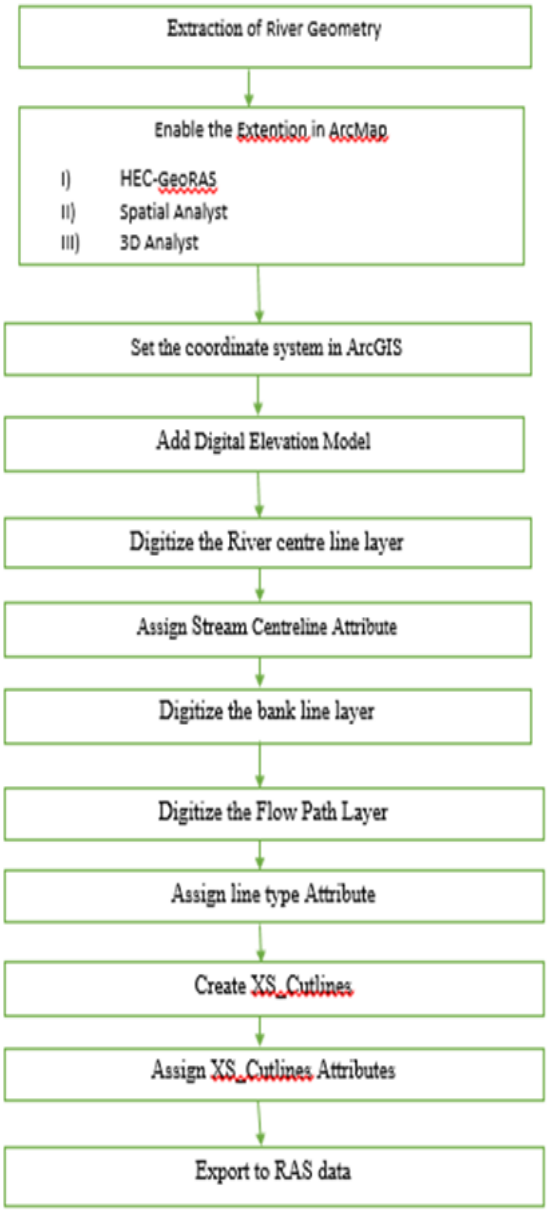

Fig.2. Procedure of Preparing River Geometry

B. River Centerline

The Stream Centerline layer should be created first. Select RAS Geometry | Create RAS Layer | Stream center line as shown in fig Fig. 3 shows the River Centreline

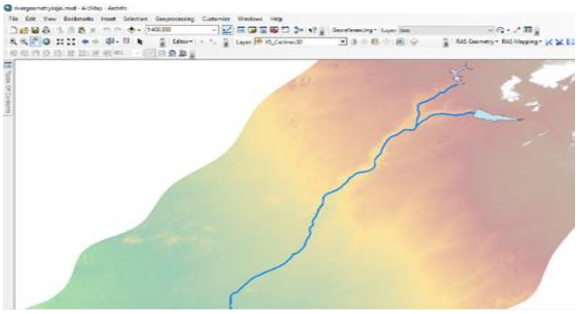

Fig.3. Stream Centre line

C. Stream Centerline Attributes

It is necessary ti assign River and Reach name to the centre line that we have drawn.

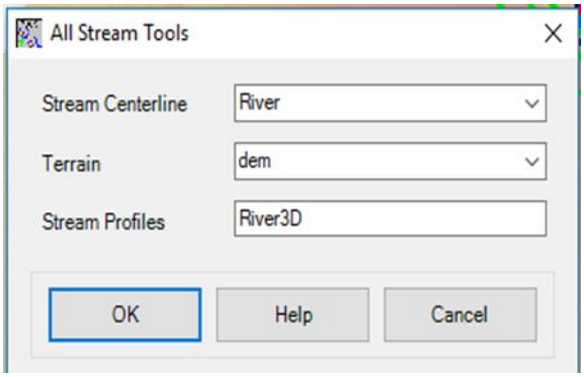

Fig.4. Stream Centerline Attributes

D. Bank Lines

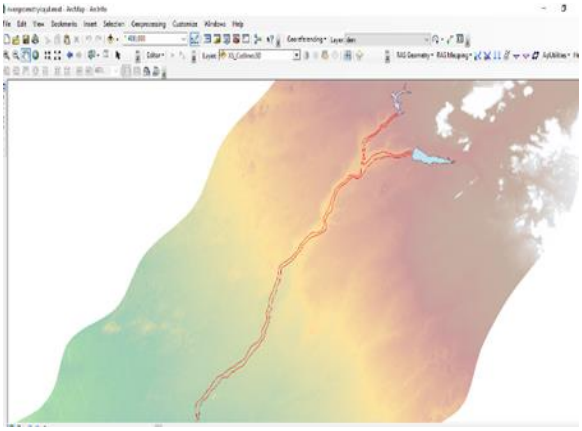

Fig.5. Bank lines

E. Flow Path Lines

The flow path layer contains three types of lines: centreline, left overbank, and right over bank. If the river centreline that we created earlier lie approximately in the centre of the main channel

(which it does), it can be used as the flow path centreline.

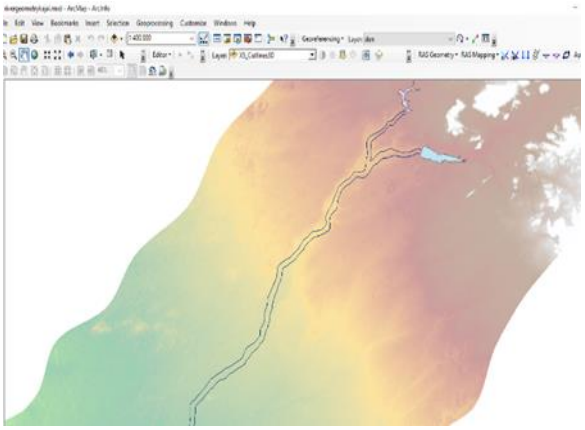

Fig. 6 Flow Path lines

F. Assign line type Attributes:

It is necessary to Assign the Line type attribute i.e right, left or centre.

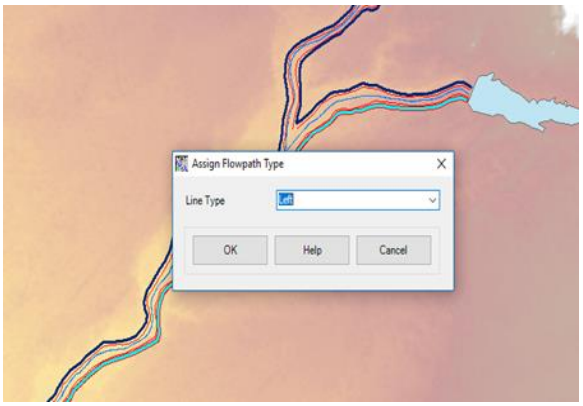

Fig.7. Line type Attribute

G. XS_Cutlines

Cross-sections are one of the important inputs to HEC-RAS. The Cross-section cut lines extract the elevation data from the DEM which will create a ground profile across channel flow. the HEC-RAS attributes such as bank stations, d/s reach length are computed by the intersection of the XS_cutlines the layers such as centreline and flowpaths. Therefore, adequate number of cross section should be created.

Certain guidelines must be followed in creating cross-section cutlines:

1. They are digitized perpendicular to the direction of flow;
2. Must span over the entire flood extent to be modeled; and
3. Always digitized from left to right (looking downstream).

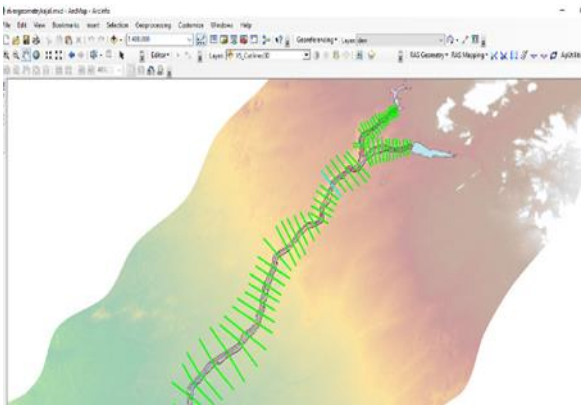

Fig.8. XS_Cutlines

D. XS_Cutlines Attributes

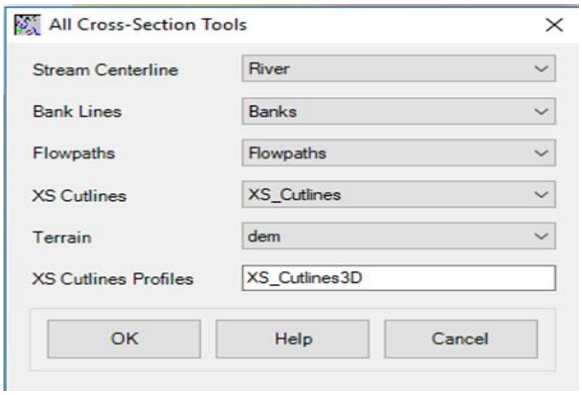

Fig.9. XS_Cutlines Attributes

VI. CONCLUSIONS

The approach used for extraction of river cross-sections from freely available satellite DEM (the CARTOSAT 1 DEM) for Extraction of river Geometry was discussed. The methods are useful where accurate river cross-sections and detailed floodplain information from surveying or high resolution aerial images are not available. It clearly Showa that HEC-GeoRAS with ArcGIS is very important tool to extract the river geometry for flood modelling.

V. ACKNOWLEDGEMENT

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