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| **Integrated Approach for Flood Modeling using Arc GIS, HEC-GeoRAS – A Case Study on Purna River of Navsari District of Gujarat State** |
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|  **Abstract**  |

This research work indicates the advancement of flood modeling using Arc GIS and HEC GeoRAS software in the field of water resources engineering and flood management. The methodology is applied to Purna River, Navsari district, Gujarat, India. In this research, we have used satellite, topographic, contour map, hydraulic and hydrologic data for flood modeling. In this paper first part of the methodology followed by preprocessing data involved to develop DEM (Digital Elevation Model) using contour data, Georeferencing, and Shapefile in Arc GIS software. After that, these all geometry data are imported into HEC RAS through HEC GeoRAS interface in ArcGIS environment. This research demonstrates the flood mapping approach for disaster authorities by modeling using past data required in HEC-RAS. This methodology is also used to develop flood risk map in Arc GIS environment for the study area. From this research, we can conclude that with GIS technology combine with the computed model the flood mitigation is very beneficial for disaster management after mapping the extent of the flood.

**Keyword- Arc GIS, HEC-RAS, HEC GeoRAS, Flood, D. E. M, G.I.S, R. S** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

# Introduction

Flood and its impact on the communities.

A flood can be characterized as any near measure of high water stream that overtops the non-characteristic or regular banks in any part of a waterway or stream. At the point when a bank is overtopped, the water dinners over the flood plain zone and for the most part turns into a risk to individuals and society. Generally, flood is likely the most expansive, rehashing, calamitous and frequent exposure of the world. Our India is a standout amongst the most detectably terrible flood impacted nations on the planet, being second on the planet after Bangladesh and records for 1/fifth of in general passing incorporate on account of flood India. Flood is a natural disaster cause damage to people and lives surrounding region. Hazarikad and Samarakoond (2010) present that Gin-Ganga river and Kalu-Ganga river, Sri Lanka locate the ocean between Gulf of Mannar and Bay of Bengal, these rives are experiencing two monsoon season due to high wind flow on the river. A surrounding region having a good land pattern for crop and agriculture use, Sri Lanka Disaster management authorities are working to mitigate the flooding event. Dhruvesh and Mrugen (2010) demonstrate that Surat is fast growing city of India and it is located near River Tapi, He develops the Remote sensing (RS) and Geographical Information system (GIS) because of Surat city of India is situated near River Tapi, a watershed water enter in to city with minimum time period due to high rainfall during monsoon season results in flooding, its damages losses of lives and valuable properties. They use Geography techniques to mitigate the flood because water is entering into Surat city during high rainfall during monsoon. Zerger and Wealands (2004) explain that cyclone, industrialization, urbanization are the main factor to responsible for flood and it is lead to damage to valuable properties surrounding the region in North Australia. Lee and Choi (2003) demonstrate that the central part of Korea is highly vulnerable to flood due to typhoons and high rainfall cause dame loss of lives. Disaster authorities of Korea develop a flood mitigation plan to minimize the flood. Debasis and Bipul (2012) examine that the wetland is also a major factor for the occurrence of flooding, the Remote sensing (RS) and Geographical Information system (GIS) technology are using for natural drainage in the wetland.

# Study area

The study area is the Purna River basin near Navsari district is located in the southern part of Gujarat State, India. It is one of the most vital districts in Gujarat State separated from Valsad district. Navsari district lies between Latitude 20°32’ & 21°05’ North and Longitude 72°42’ & 73°30’ East It are limited by Surat district in the north, Dangs district in the east. Valsad region in the South and the Arabian Sea in the west region. Navsari district has a geographical area of about 2210.97 km2. Map of Navsari district in Gujarat, India is shown in (Figure 1).The River Purna rise in the Saputara hills of the Western Ghats near the village of Chinchi in Maharashtra. The length of the river from its starting point to discharge in the Arabian Sea is about 180 km. The main branches of the Purna River are Dhodarnala, Barnala, Nagihparnala, Zankari River, Girna River, and Dumas khadi. The catchment area of the Purna basin is 2431 km2. The basin lies between 720º 45’ to 740 º 00’ East zone longitudes and 200º 41’ to 210º 05’ North zone latitude and Basin map of Purna are shown in (Figure 2).



Fig. 1: Navsari district, Gujarat, India



Fig. 2: Line diagram of Purna River (Sources: www.cwc.nic.in)

# Data used

Dhruvesh and Mrugen (2010) demonstrate that satellite data are very beneficial to detect the flood extent to mitigate the flood activities. Smith (1997) used active and passive remote sensing data to determine the stage, discharge and water surface area of River. Daxikar, et al. (2008) were used GIS data set (e.g. TIN - triangular irregular network and GRD image), also use census population, Orthophotography, land use data which can be used in ArcGIS software for flood mapping and it is very advantageous for disaster authorities to take a decision. Topography data are like a contour map of 1:10000 scales, land use a land cover image, bathymetric cross-section data of Purna basin obtain from irrigation department Navsari district. Water level and discharge data obtain from Central Water Commission (CWC) Surat.

# Methodology

The methodology consists of data collection and data required for River flood modeling. Based on Hydraulic and hydrologic data use in Arc GIS and HEC-RAS environment a conceptual model develops as in (Figure 3)



Fig. 3: Conceptual Diagram of Methodology

## Arc-GIS software

ArcGIS is a geographical information system (GIS) for working with maps and geographic information. It is used for creating and using maps, compiling geographic data, analyzing mapped information, sharing and discovering geographic information, using maps and geographic information in a range of applications, and managing geographic information in a database.

## HEC-GeoRAS

HECGEO-RAS is a set of procedures, tools, and utilities for processing geospatial data in ARC-GIS using a graphical interface. The interface allows the preparation of geometric data for import into HEC-RAS and processes simulation results exported from HEC-RAS

## HEC-RAS (Hydrologic Engineering Center River Analysis System)

HEC-RAS is a known to program that model the hydraulics of water flow through natural rivers and other channels. HEC-RAS is a computer program for modeling water flowing through systems of open channels and computing water surface profiles. HEC-RAS finds particular commercial application in floodplain management.

## Pre-processing (Arc-GIS & HEC-GeoRAS)

For the pre-processing of the data, software HEC-GeoRAS and ArcGIS is used. HEC-GeoRAS is an extension used with Arc GIS. It is specially designed to process geospatial data for use with the Hydrological Engineering Center River Analysis System (HEC-RAS). It allows the creation of a HEC-RAS import file containing geometric attribute data from an existing digital elevation model (DEM) and complementary data sets. The results exported from HEC-RAS will be further processed in the GIS environment. By means of HEC-GeoRAS, an import file have been created the geometry of the discharging watersheds into the floodway.

Following steps are followed by Arc GIS software.



Fig. 4: Conceptual Diagram for Pre-processing Methodology

1. Georeferencing: is the process of assigning spatial coordinates to data that is spatial in nature.
2. Shapefile: format is a popular geospatial vector data format for geographic information system (GIS) software.
3. Mosaic: Mosaic is useful when two or more adjacent raster datasets need to be merged into one entity.

## HEC-RAS - Model Execution

In this phase, the geometric data created are imported in the HEC-RAS. Then add all data required for model execution process in HEC-RAS. (Figure 5) indicate the HEC-RAS import file from ArcGIS environment, there cross sections are provided called as HEC GeoRAS geometry in ArcGIS environment to detection of flood for a particular cross-section.

# Result and discussion

As per contour information, Digital Elevation Model (DEM) creates which gives 30-meter resolution and it is exactly at a satisfactory limit. After that Georeferencing procedure is completed, at that point after the shapefile and the mosaic procedure has been done which gives in the form of a map. This map demonstrates the elevation height of the area under study. After that HEC Geometry information must be characterized in Arc GIS condition. At long last, This Arc GIS information is exported to HEC-RAS for flood modeling. Results got from ArcGIS and in HEC-RAS are as in (Figure 5, Figure 6, and Figure 7).



Figure 5. Georeference shapefile of Navsari district and Purna River, Gujarat, India



Figure 6. HEC GeoRAS Geometry window in ArcGIS



Fig. 7: Import GIS database file in HEC-RAS

# Conclusion

The examination contemplates shows the utility of Arc GIS and HEC-RAS combined utilized for flood modeling. Future extension lies to measure the flood at each cross section by applying hydraulic, hydrologic data and boundary condition in HEC-RAS environment for the study area. More Besides, we can propose the development bank close to the stream of the study area to disaster authorities and to create floodplain map, flood hazard map for Navsari district under varying scenarios.

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