Preliminary Investigation of Flood Damage by Using GIS Tools

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Abstract

In different regions of Karnataka, floods have increased dramatically, affecting millions of people and inflicting huge economical damage. Flood hazard maps are important to integrate geospatial and temporal data in a same computational environment that allows risk assessment, modeling and decision support. This paper discusses different levels of integration approaches between GIS and hydrological models and presents a case study, in which all the tasks of creating model input, editing data, running the model, and displaying output results are available within GIS.

Keywords
Geographic Information Systems (GIS); Flow Direction Models; land use and land cover model; Krishna Bheema River Basin

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Introduction:

Flood is a natural hazard resulting from extreme geophysical events to create an unexpected threat to human life and property. Flood risk steams from the likelihood that a major hazards event will occur unexpectedly and that it will impact negatively on the people and their welfare. India is one among the most natural disaster-prone regions of the world and which causes losses of more than Rs.1000 crore as a result of flood and cyclone damage annually. Most of the cities/agriculture lands are located near rivers and flood -plains as they are convenient and attractive locations for settlements and other agro-economic activities, which results in huge flood damages.

Flood management planning is a very important which helps to rescue the flood affected people to mitigate the problem of flood and to take necessary preventive measures. It is a planned and integrated management approach with the help of Remote sensing and Geographic Information System and data on socio economic characteristics to render right suggestions to the people. The study describes an efficient & scientific approach with suitable illustrations of map and real time flood inundations. The areas, which are highly flood affected, are delineated. The central focus in this field revolves around delineation of flood zones and preparation of flood hazard maps for the vulnerable areas. This project deals with the use of new imagery data as an up to date and affordable source of information for establishing the necessary information for flood management.

I. FIELD STUDIES

River Krishna is the fourth biggest river among the river basin in India. Krishna River is about 1300km long, it feeds command area of different reservoirs constructed in states of Maharashtra, Andhra Pradesh, Telangana and Karnataka. Birth of Krishna River is in the Western Ghats near Mahabaleshwar at an elevation of 941m with its latitude and longitude as 17 59’ 18.8”N and 73 38’16”E respectively.

Location map of the study area

In the present the study area corresponds to Northern part of Karnataka of the Krishna-Bheema River basin, comprising nearly 6,000 acres and situated in Vijayapura district. It is the study area with a stretch of 8kms on the river banks of Padnur and Gubbewad villages of Indi Taluk, Vijayapura.

This place has been hit with floods in 2009 and 2019. And these floods have made a huge loss for the mankind and yield of the crops. Heavy downpour, poor inland drainage, drainage congestion, reduction in effective water ways of rivers or other water channels, unregulated supply of water from Maharashtra side are the reasons behind the severe flood.

II. LABORATORY WORK/ ANALYSIS

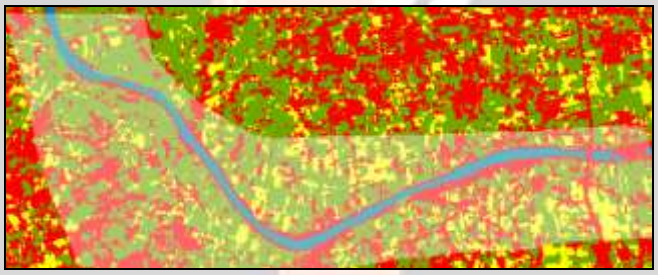

Fig 1. Land cover and land use

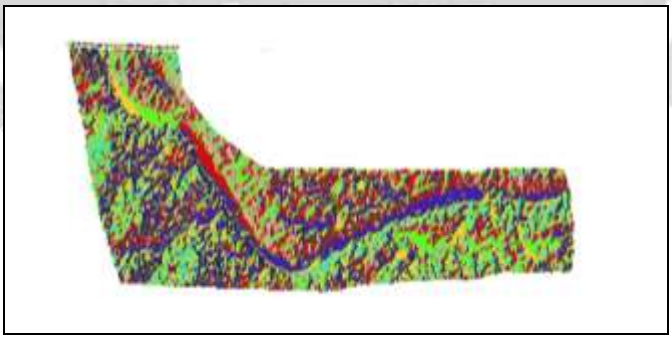

Fig 2. Flow Direction

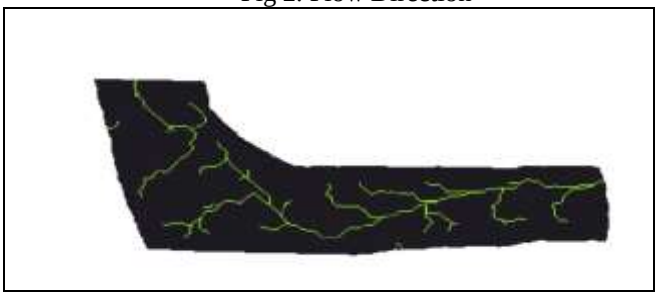

Fig 3. Flow Accumulation

Maps were prepared by exercising the DRASTIC model in ArcGIS 10.3 software.
The extraction of the file LC08_L1TP_146048_20210503_20210508_01_T1.tar is done by using USGSexplorer.Then its been added the data in ARC GIS10.8.

RESULTS:
Here the above file is converted to raster format, later on it's been classified as the images and used the land cover spatial analyst tool and extracted the Fig.1 data. Then by using flow direction analyst tool Fig.2 data has been identified i.e., And finally, the flow accumulation data is extracted by using the flow accumulation tool and resulted with Fig.3.

III. DISCUSSION

3.A. *DIGITAL ELEVATION MODEL (DEM)*

A digital elevation model (DEM) is a 3D computer graphics representation of elevation data to represent terrain, commonly of a planet, moon, or asteroid. A "global DEM" refers to a discrete global grid. DEMs are used often in geographic information systems, and are the most common basis for digitally produced relief maps.

While a digital surface model (DSM) may be useful for landscape modelling, city modelling and visualization applications, a digital terrain model (DTM) is often required for flood or drainage modelling, land-use studies, geological applications, and other applications, and in planetary science. DEM is often used as a generic term for DSMs and DTMs, only representing height information without any further definition about the surface. Other definitions equalise the terms DEM and DTM, equalise the terms DEM and DSM, define the DEM as a subset of the DTM, which also represents other morphological elements or define a DEM as a rectangular grid and a DTM as a three-dimensional model (TIN). Most of the data providers (USGS, ERSDAC, CGIAR, Spot Image) use the term DEM as a generic term for DSMs and DTMs. Some datasets such as SRTM or the ASTER GDEM are originally DSMs, although in forested areas, SRTM reaches into the tree canopy giving readings somewhere between a DSM and a DTM). It is possible to estimate a DTM from high resolution DSM datasets with complex algorithms (Li *et al.*, 2005). In the following, the term DEM is used as a generic term for DSMs and DTMs.

A Digital Elevation Model (DEM) is a representation of the bare ground (bare earth) topographic surface of the Earth excluding trees, buildings, and any other surface objects.

DEMs are created from a variety of sources. USGS DEMs used to be derived primarily from topographic maps. Those are being systematically replaced with DEMs derived from high-resolution lidar and IfSAR (Alaska only)

data.

3.b. *FLOW DIRECTION*

Flow direction means the direction the stream flows in each cell. If "Force edge cells to flow outward" is checked, the cells on the edge of DEM will be treated as flowing outward across the elevation surface. One of the keys to deriving hydrologic characteristics of a surface is the ability to determine the direction of flow from every pixel in the raster. The Flow Direction raster function takes a surface as input and creates a raster of flow direction from each pixel to its steepest downslope neighbour.

3.c. *FLOW ACCUMULATION*

The Flow Accumulation tool calculates accumulated flow as the accumulated weight of all cells flowing into each downslope cell in the output raster. ... Cells with a high flow accumulation are areas of concentrated flow and may be used to identify stream channels.

The results of Flow Accumulation can be used to create a stream network by applying a threshold value to select cells with a high accumulated flow. In both examples, all cells that have more than 100 cells flowing into them are assigned 1; all other cells are assigned No Data.

Run the Flow Accumulation tool.

1. Navigate to Spatial Analyst Tools > Hydrology > **Flow Accumulation**.
2. Use the output from Step 2 as the 'Input **flow** direction raster'.
3. Specify the location of the Output **accumulation** raster.
4. Click OK. The **flow accumulation** lines are displayed in the map.

IV. CONCLUSION

- The GIS based studies indicate that floods have created a huge risk for the humanity and loss of yield
- The other main factor is the drainage congestion, poor in land drainage in the upstream side.
- The studies have been more effective using Digital Terrain Model.

REFERENCES

[1] GIS based DRASTICA model for Assessment of groundwater vulnerability in Bangalore region, India, Swetha. A, Dr Sampath Kumar, Dr Raja Laxmi M

[2] James W Merchant, "GIS -Based Groundwater Pollution Hazard Assessment", *2004*.

[3] A Rahaman, "A GIS based drastic model for assessing groundwater in shallow aquifer," Elsevier, 2008

[4] K Voudouris, "Assessment of Insrinsic Vulnerablity using the drastic model and GIS " European waters 2010.

[5] R Lathamani, " Evaluation of aquifer vulnerability using drastic model and GIS", Elsevier, 2015

[6] Aquifer Vulnerability Studies using DRASTICA Model 1, Amadi, A. N., 2, Olasehinde, P. I., 3, Nwankwoala, H. O., 4,Dan-Hassan, M. A. and 5,Okoye, N. O. 1Department of Geology, Federal University of Technology, Minna, Nigeria 2Department of Geology, University of Port-Harcourt, Nigeria 3Rural Water Supply and Sanitation Department, FCT Water Board, Garki, Abuja, Nigeria