COURSE : DISASTER MANAGEMENT (MA/ MSc PART I)
Paper : IV
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Topic : Flood Mapping with GIS & Remote Sensing

INTRODUCTION :

Floods are among the most frequent and costly natural disasters in terms of human hardship and economic loss. So, a reliable flood map is one of the latest concerns of flood management. In flood management, preparing maps of flooded area is the latest concern. Different approaches have been taken already for potential flood mapping. Depending on the estimated depth of inundation, flood risk maps are prepared. So,

the most important indicator of flood management is flooded depth (Islam et al., 2001, 2000; Townsend et al., 1998). It is important to classify the phenomenon of river flooding for identifying flood depth and have significant implications for formulating the GIS model. In the initial stage, to measure the depth of inundation (Townsend et al., 1998), the concept of topographical convergence or wetness index was used (Wolock et al., 1995). But it has a limitation that when a slope tends to zero, the wetness index becomes undefined.

In recent years, NOAA AVHRR imageries have been more popular, innovative and cost effective solution for flood management (Islam et al., 2001). The process of measuring flood depth from NOAA AVHRR imageries simply by the tonal difference of the flood water. Using supervised classification Islam et al. (2001) assessed, the flood affected area was subdivided into the different depth of flood zones. AVHRR data was superimposed over a DEM to identify the training sets accurately. The risk of the flood has been measured by calculating a weighted score for each land use, physiographic and geologic division of the country. The methodology is that; it assigns greater weight to the categories of deeper flood depth in an exponential manner.

Digital Elevation Model (DEM) in Flood Management

Digital Elevation Model (DEM) is a 3D representation of terrain's surface. DEMs picture the flood zone with flood depth. Furthermore, water depth is calculated by subtracting water level from the elevation of each cell in a raster. Though it has some drawbacks like high dependency on remotely sensed data. 1M vertical error of DEM model may generate 100s sq. a kilometer in flood estimation. In hydrological modeling, it is important for DEMs to recognize errors. In flood mapping, this issue has been addressed from the significant point of view (Hunter et al., 1995). DEMs requires a flat terrain for flood mapping, multi-date SAR imaginaries can be used as an alternative for monsoon Asia. Namely, Multi date Radar sat imaginaries were used a monsoon Asia to draw a complete picture flood (Chen, 1999). This particular process

creates a visual image of inundation from river channel to the adjacent low elevated area of the flood plain. Multi date Radar

sat image can be used as an alternative though it has limitation for determining flood depth. Recent days, LIDAR (Light Detecting and Ranging) sensor is used for flood management. In addition, this technology is also very popular for creating DEMs for more likely for flood areas. This sensor can directly read the difference between landform and used as a strong tool for accuracy (Sanyal et al., 2004). Although it provides with more accurate data with the location, the accuracy decreases with the density of vegetation cover of the ground (Hodgson et al., 2003). However, LIDAR sensor is used for flood mapping in the extremely plain flood plains. Though LIDAR data is more expensive than the SAR imaginaries, sometimes it provides more accurate and necessary data for flood mapping in the extremely flat flood plains (Sanyal et al., 2004). Resolution of LIDAR data depends upon the intensity of laser pulse. More laser pulse means more resolution. To make the survey more accurate, increasing of laser pulse also increases the cost of the data exponentially. Herold et al. (2006) in a case study for utilization of GIS during flood emergencies, Estimates of peak-flow magnitude for ungauged stations were obtained by statistical means, performing several regressions on the basin variables. This "regression" method is processed on two test-zones situated in North and South America.

Applicationof GIS and Remote Sensing for Pre and Post Flood Management

The natural disasters are inevitable and it is almost impossible to fully recoup the damage caused by the disasters. But it is possible to minimize the potential risk by early warning strategies, preparing and implementing developmental plans. With the help of RS imageries and interpreting the data capturing from
RS imageries in GIS and creating suitable framework can mitigate flood risk. Earth observation satellite providers required a database for pre disaster preparedness programs and post-disaster preparedness programs. They provide comprehensive, synoptic and multi temporal coverage of large areas in real time. Although flood has shown in the last few decades a drastic increase in magnitude and frequency, capturing these pattern it can be observed that there has been a dramatic improvement in technical capabilities to mitigate its effects. Disaster management consists of two phases. First one is taking place before the flood occurs, which is disaster prevention and disaster preparedness. The second one is taking place after the flood occurs, which are disaster relief, rehabilitation, and reconstruction.

1. In the flood prevention phase, GIS is used to manage the large volume of data with the help of RS imageries which are needed for the hazard and risk assessment.

2. In the flood preparedness phase, it is a tool for the planning of evacuation routes, for the design of centers for emergency operations, and for the integration of satellite data with other relevant data in the design of disaster warning systems.

3. In the flood relief phase, GIS is extremely useful in combination with Global Positioning System (GPS) in search and rescue operations in areas that have been devastated and where it is difficult to find one's bearings.

4. In the flood rehabilitation phase, GIS is used to organize the damage information and the post-disaster census information, and in the evaluation of sites for reconstruction.

The International Centre for Integrated Mountain Development (ICIMOD) has prepared flood inundation maps in view of the floods and landslides that this year's (24 and 29 June and 5 July 2017) monsoon has triggered in Bangladesh. The maps have been prepared using Advanced Land Observing Satellite 2/ Phased

Array L-band Synthetic Aperture Radar (ALOS-2/PALSAR) and Sentinel-1 satellite images made available by the Japan Aerospace Exploration Agency (JAXA) and the European Space Agency (ESA). Hence, GIS and Remote Sensing is a useful tool in flood management if it is used effectively and efficiently.