Flood Hazard Mitigation

EH 602

River Morphology and Ecology Report

Submission

by

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1 Introduction

Flooding is the most widespread of all natural hazards, often arising from adverse meteorological conditions such as intense or prolonged rainfall in river catchments, storm surges at the coast and in estuaries and storm-generated waves at the coast. Flood is a state of high water level along a river channel.It occurs when the "Geomorphic Equilibrium" in the river system is disturbed because of intrinsic or extrinsic factors or when a system crosses the geomorphic threshold.

It can be natural or human caused , which causes serious disruption of the functioning of a community or a society. floods occur in almost all the river basins of the country.

Around 12 per cent (40 million hectare) of land in India is prone to floods[1].

2 Types and Causes of floods

There are major type of floods,for each type of flood mitigation or risk reduction technique is different.The definition for each river we have defined and what are the causes that they occur.These are the following

2.1 Flash Flood

Flash floods give the least amount of warning time. They are characterized as a rapid and significant rise in water level due to a sudden and intense heavy rainfall event ,from Figure 1we can see the flash flood chicago region. These floods occur when rainfall rates are so high that the ground cannot absorb the water quickly enough to prevent significant runoff and are especially common in areas with steep slopes.Flash floods can also occur due to a dam or levee failure. These floods can occur in less than an hour and can destroy structures, down trees and wash out roads with little to no warning time.

Fig. 1: Flash flood in chicago region

2.2 River Floods

It occurs when water levels in rivers, lakes and streams rise and overflow onto surrounding banks and neighboring land.When this occurs, the flood can cover an enormous area and affect downstream areas even if they did not receive much rain themselves.Ottawa river flood level water is shown in Figure 2

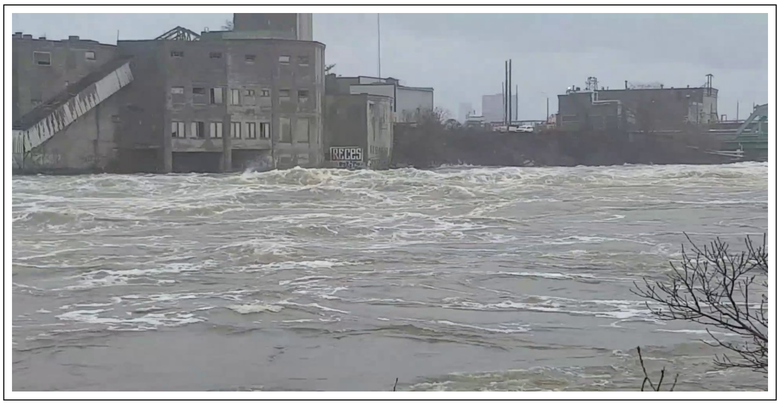

Fig. 2: River flood in Ottawa,May 5th, 2017

Besides heavy rainfall, snowmelt and ice jams can cause rivers to top their banks. Although river flooding can be predicted, its effects, even over a longer period of time, can cause extensive damage to residents living near rivers and streams.

2.3 Coastal Floods

These floods occur when ocean water is pushed inland. Hurricanes and tropical storms can cause large waves as shown in Figure 3 and actually raise the sea level, creating storm surge along beaches.

Fig. 3: Coastal flood due to high tide

Earthquakes can displace large amounts of water that cause waves called tsunamis to rush inland. On a much smaller scale, extremely high tides, sometimes associated with a full moon can cause minor coastal flooding.

2.4 Urban Flood

It occurs when there is a lack of drainage in an urban area or blocking of channels ,Improper land use.Although it can also be caused by flash, river or coastal flooding but most commonly, it is caused by high rainfall rates over developed areas that do not have the ability to absorb the water as in Figure 4. Urbanization can increase water runoff as much as 2 to 6 times over what would occur on natural terrain. These floods can cause high economic damages to businesses and homes.

Fig. 4: Urban flood

3 Flood Characteristics and Impacts

The main characteristics of flood are

- **Depth of water**
- **Duration of floods**
- **Velocity**
- **Rate of rise**
- **Seasonality**
- **Frequency of occurrence**

There are also a lot of impact of flood on Built and Natural Environment such as Loss of life and property,Impact on Agriculture ,Disruption of Air / Train / Bus services,Lack of proper drinking water facilities,Communication Breakdown,Electricity Supply Cut off,Health related issues/Increase in Air / Water Pollution,Floods may also affect the soil characteristics.

4 Flood Mitigation

As the technologies are growing,So there may be numerous better techniques for risk reduction measurement.There are two types of mitigation measures are available.

4.1 Structural Mitigation Measures

Where physical structures are constructed or modified to reduce the impact of flooding on individual properties.It includes Infrastructure, dams, levees, bridges and culverts, Maintenance of existing infrastructure, Individual flood proofing measures, Improved traffic access.

4.2 Non-structural Mitigation Measures

There are also a non-structural things,from we can reduced the vulnerability or flood risk.These are like property surveys, land use planning controls, building and development controls, catchment flood modelling, early warning systems, develop a household emergency plan, access to information and warnings, understanding and awareness.

5 Possible Risk Reduction Measures

Mapping of the flood prone area can be the better option.We can go through the historical records and can see the earlier marked height of water level. Land use control also play the major role so we will have to see the population in the area at risk or prone, so that we can relocate people to the safe sites and no major development should be allowed like hospitals,schools etc. in the prone areas. Flood control or reducing the flood damage,this can be done by decreasing the amount of runoff with the help of Reforestation,Protection of vegetation,Clearing of debris and Conservation of ponds and lakes.

Flood proof can also be the option for risk reduction,we can have active and passive flood proof.active flood proof is temporary,so we need to take some action,in active action is taken immediately before the flood event but in passive flood proof this is permanent so longer period,we do not need to take the action immediately before the flood event. Flood Management is also plays a key role.there are two major tier of Flood Management

•**State Level Mechanism**:Water resources departments,flood control board and Private works department etc.

•**Central Government:**Central Water Commission that was named in 1945.

6 Flood Mitigation Techniques

Each technique is different for the different floods that was described above.Some of the techniques for the different floods are described below:

6.1 Flash Flood Mitigation

It is very rapid and gives very least amount of warning time.So,deaths and property losses per unit area can be very high.For flash floods,mitigation strategies alone are not sufficient.Due to flash flood, In November, 1999, 27 people were killed in southwestern France[2]. So 35 researchers from nine countries met in Ravello, Italy at a NATO sponsored Advanced Study Institute and took this initiative and decided four methods to reduce the risk.these points were as

(i)Improvements in forecasts and warnings

(ii)Applying knowledge directly to loss reduction

(iii)Focus on social science links

(iv)Sustainable and long-term mitigation policies

6.2 River Flood Mitigation

There are the two common techniques for river flood mitigation;levees and floodwalls.Levees and flood walls are one of the oldest and most widely used methods of protecting land from floodwater. These serve as artificial high bank of the river and thus prevent the flood water from spilling over to the adjoining land. The flood water is confined between the levees or flood walls and is made to flow down the river without causing any damage to the country side of the levees or flood walls.Levees and floodwalls are located away from the structure or area to be protected, they provide flood protection without altering the building.

6.2.1 Levees

A Levee is an earth dyke or embankment.Levees are most frequently used for flood control because they can be built at relatively low or cost of material available at the site.It is a sort of an earthen dam constructed along the river. Levees are usually built of material excavated from borrow pits parallel to the levee line.

Fig. 5: Levees

6.2.2 Flood Walls

Flood wall is usually made of concrete as shown in Figure 6. .Flood walls are used in developed area where it is difficult to obtain enough land for the construction of levees. Because of flat slopes, levees require very large width. If the land is costly or limited, it is more economical to construct flood walls.

Fig. 6: FloodWalls

These are masonry or concrete walls constructed just on the river bank. If there is a back fill on the land side of the wall, it acts as an earth retaining wall.

6.2.3 Advantages

Levees and floodwalls can protect a building and the surrounding area from inundation without significant changes to the structure if the design flood level is not exceeded.
There is no pressure from floodwater to cause structural damage to the building.These barriers are usually less expensive than elevating or relocating the structure.

6.3 Coastal Flood Mitigation

In coastal flood due to high tide and Tsunami,There are advanced automated process for global wave/tide forecasts that takes global wind data and feeds into numerical wave models at global and regional level.It measures forecast of wave height, period and direction planning day-to-day coastal construction activities.There are two types of advance techniques is applied.

6.3.1 Flood water pumping

There is also the risk of coastal storm surge overtopping or breaching levees that could result in flood waters being trapped for extended periods. Although it is difficult to estimate the amount of surge water that can become trapped behind a levee under these circumstances, it is likely to be large volumes. Low cost wind powered pumps can be considered to bring some relief to this type of flooding.Wind powered water pumps can usually operate even in light winds and Table 1 below provides information on the amount of pumping capacity that can be generated by the 6 meter diameter model in Figure 7. For safety of operations it is recommended that 6 meter diameter windmills' wind wheel should be located at least 6 meters above any obstructions within a 120 meters radius.

Fig. 7: The 6m dia. windmill tower, Adapted from [3])

Also, if the windmill tower is located in areas subjected to high winds, the wind wheel should be located high enough to avoid damage caused by blowing debris, building materials, trees, etc.

There is also pumping capacities based on various wind speeds is calculated in nearby Atlantic City the average annual wind speed is 9.8 m/s which qualifies as a strong wind.

Table 1: Pumping capacities based on various wind speeds.

Serial no.	Common Wind Environment	Pumping Capacity (gallons per hour)
1	Strong winds (above 7.0 m/s)	56,982 gallons
2	Medium winds (4.5 to 7.0 m/s)	31,340 gallons
3	Light winds (1.6 to 4.5 m/s.)	14,245 gallons

6.3.2 Wetlands Restoration

Situated between the suggested levee system and the Delaware Bay are salt marshes Figure 8 which, if healthy, can provide for significant surge attenuation [4]). It is suggested that these salt marshes (approximately 75,000 acres) be restored, enhanced and protected as part of the regional approach to flood mitigation.

Fig. 8: Wetlands in the Study Area (Adapted from NJ Land-use Maps))

Part of the effort of to restore the existing marshes should include the installation of living shorelines or hybrid living shorelines along the bay or estuary edge to help protect existing marshes where possible [5]. Any efforts to reduce coastal surge and wave will result in savings on the cost of new or elevated levees

6.4 Urban Flood Mitigation

'digital city' is the way of improving the preparation for natural disasters . In this respect, the application of hydroinformatics technologies in urban water systems plays a vital role .Increasingly, city managers are turning to the collection, archiving and analysis of data for their urban areas, especially through facilities offered by advanced geographic information systems (GIS) and remote sensing[2]. GIS maps of areas at risk are valuable information and communication facilities in their own right as in Figure 9.They can delineate flood plains, zone areas for protection from flooding and identify plans for different types of land use;see Yang and Tsai (2000).

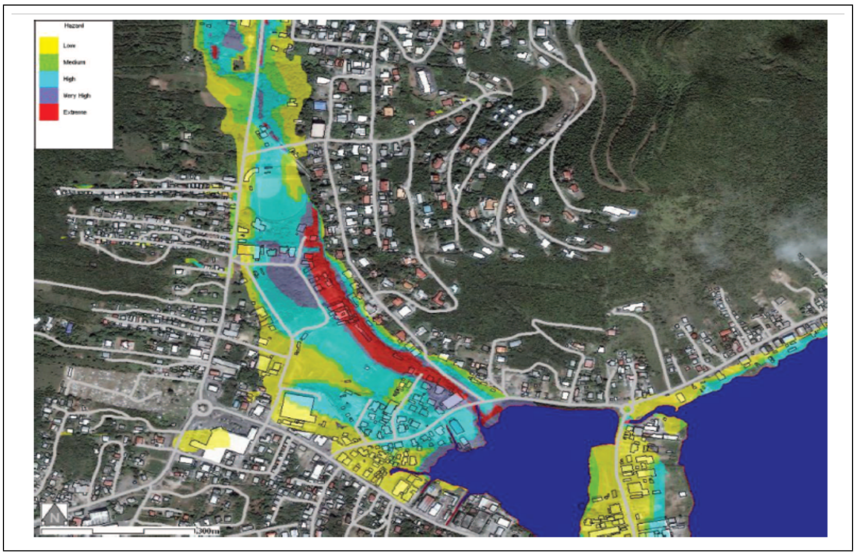

Fig. 9: Modelled flood hazard data in a GIS system,UNESCO-IHE 2007

The knowledge gained can then be transformed into a set of effective and acceptable actions to be taken by all who are affected.

The main features of the "digital city" system are:

(1) a GIS-based system, (2) a centre for data storage, (3) data (not only spatial and temporal data but also city plans, regulations, standards, etc.), (4) models for each urban water process, which permit the interaction between them, (5) data and results manipulation tools, communication tools and an interface shell (which could be run on either a web-based or a standalone platform),

Geo-referenced results from 1D or even 1D-2D coupled models can readily be used to communicate the risk of flooding and to gain insights into the nature of floods and their impacts on communitiesFigure 10.So using Digital Terrain Model,there can be better data model to measures the flood water affected areas and we can map prone areas,it is very helpful technique and new technology[2].2D and three dimensional (3D) GIS flood inundation maps based on results from a hydrodynamic model are given in Figure 9 and Figure 10. Such material is invaluable for demonstrating the probable impact of an impending flood to residents. Therefore the need to combine appropriate technological advances and digital data, not only to develop effective disaster management plans but also to communicate accurate and understandable information

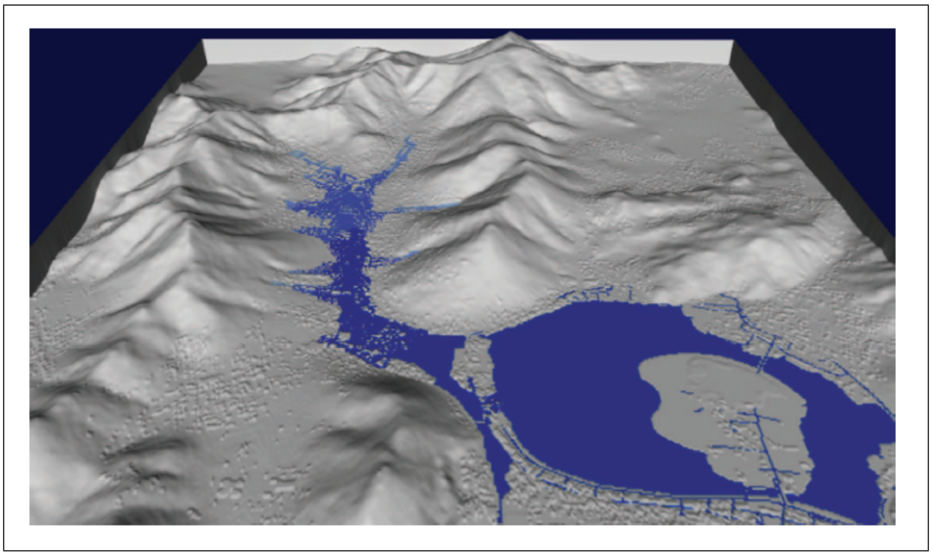

Fig. 10: 3D view of the water surface using DTM

and knowledge to those concerned. The 'digital city' concept provides, in effect, the 'central knowledge content' between domain data, such as generated by point monitoring stations, network systems, weather radars, satellite image processors, models, city policies, regulations and so on.

Future Aspects

As the technology is growing,The chances to have better techniques are also increases.We can have many advances remote sensing and GIS system technology that can reduce the risk due to floods and can also give a better approach for early warning and detection of flood.Water are our good natural source,We can also know about the advantages to have a flood for some habitat , in agriculture and for environment.

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