Flood Management
Indian Context

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Flood – A Disaster

Flood is considered the most destructive natural disaster (in terms of)

- Economic Loss
- Spatial Extent

WORLDWIDE DISASTERS

100%

FLOODS

44%

RIVERINE FLOODS

24%

GENERAL FLOODS

14%
Floods - Global Context

Tangible & Intangible Impacts

In 2021, more than 50 severe flood events around the world caused combined economic losses of US$ 82 billion

- Loss of Lives: 12,800 deaths yearly (WMO Report)
- Destruction of Crops & Livestock
- Damage to Property & Infrastructure
- Impacts on Social and Economic activities
- Interruption to mobility & communications
- Water contamination & health issues
- Psychological effects of loss of life, displacements, and property damage - a long lasting impact, difficult to assess

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Floods - Indian Context

National Commission on Floods estimated the total area liable to floods in the country as ~0.4 million km².

Average Annual Damage due to flood (1953-2018)

- Loss of Life: 1654
- Loss of Cattle Life: 6,18,248
- Monetary Damages USD 706 million
- House Damages: 1.2 Million

(Source: NITI Ayog, 2021)

India is 2.4 times smaller than Australia
Flood Protection Measures: Structural

- **Dams, Reservoirs and High Flow Diversions** - to store flood water or to divert it from the area to be protected
- **Channel Improvement Works** - to increase discharge carrying capacity and to pass flood water adequately
- **Embankments (4459KM), Levees and Flood Walls** - to stop the flood water from entering the areas to be protected
- **Catchment Area Treatments** - to induce holding of water in the catchment temporarily
- **River Interlinking** - to divert water from water-surplus to water-deficient basins
Flood Protection Measures: Non-Structural

- Flood Plain Zoning & Land use planning
- Flood Hazard Maps
- Flood Forecasting and Early Warning System
- Dam Safety and Emergency Action Plan (Disaster Relief Forces)
- Soil conservation Afforestation
- Social Awareness and Capacity Building
- Flood Insurance
Learning Lessons - 5 Case Studies

Uttarakhand
- Population - 11 Million
- Floods in 2013
- Poor share of storm water drains & sewer flowing into them
- Encroachment of Water bodies

Mumbai (Maharashtra)
- Population - 21 Million
- Floods in 2005 & 2017
- Raising Sea levels
- Poor infrastructure planning
- Extensive Urban flooding

Bengaluru (Karnataka)
- Population - 13 Million
- Floods in 2017
- Out of 285 water bodies only 65 are left as of today
- Poor Drainage systems
- Sewerage flow into water bodies

Chennai (Tamil Nadu)
- Population - 11.5 Million
- Floods in 2015
- Illegal construction in open areas and catchment areas of water bodies
- Poor Rain water harvesting Systems

Guwahati (Assam)
- Population – 1.2 Million
- Floods every year
- Brahmaputra flood plains – Low lying areas
- Poor waste management system
- Absence of integrated storm water management system

Sydney - 5.4 Million
Melbourne - 5.1 Million
Adelaide - 1.3 Million
Uttarakhand - Key Take Aways (Learning Lessons)

• Regulate Construction within the flood plain of the river - Flood Plain Zoning Act
• Disaster Impact Assessment (DIA) to be made compulsory besides EIA (for clearance of all hydropower)
• Landslide risk zonation mapping to be conducted
• Scientific Techniques to be undertaken for effective stabilization of slopes in shear and weak zones
• Blasting for developmental activities - to be avoided as it may destabilize the weak rocks in mountainous regions
• Community based disaster management system to be put in place
• Establishment of emergency communication system - to ensure last mile connectivity
Mumbai - Key Take Aways

Introduction to “IFLOW” Management System

Integrated flood warning system - known as IFLOWS-Mumbai comprises six modules, namely data assimilation, flood, inundation, vulnerability, risk and dissemination.

It incorporates weather models from National Centre for Medium Range Weather Forecasting (NCMRWF), India Meteorological Department and field data from the rain gauge network stations.

- This GIS based decision support system has all relevant details - such as land topography, land use, infrastructure, population, lakes, creeks and data on river bathymetry (study of the beds or floors of water bodies).
- The system has provisions to capture the urban drainage within the city and predict the areas of flooding in advance so that the civic body can issue alerts in advance.
Bangalore - Key Take Aways (Learning Lessons)

- Bengaluru was once known as “City of Lakes” is now called the “City of Information Technology”
- In 1980 there were 285 lakes which has reduced to around 65 in 2022.
- Illegal Construction on river beds & SEZ areas – Rapid Urbanization cause for urban flooding
- Alterations to Land use pattern to be restricted
- Need to expand and remodel the drainage system
- Restoration drive to be conducted for lakes and other water bodies
- Low lying areas to be reserved for parks and less human activities
- Valley zones connecting the lakes are to be strengthened to ensure the continuation of hydrological functions of the drains and flood plains
- Restrict the sewerage flow in the remaining water bodies
Assam - Key Take Aways

Introduction to Concept of Sponge City - “Nature based solutions”

The basic principle of **sponge cities** is to give water enough room and time drain into the soil where it falls, rather than channeling it away as quickly as possible and sequestering it in huge dams

- **Roads to be made of Porous** asphalt instead of concrete
- **Afforestation** - Adding more parks, trees, other greenery or natural drainage can boost a city's absorbency
- **High rise muddy lands** to protect animals from drowning (Kaziranga National Forrest)
- **Conversion of existing infrastructure** like schools to flood shelters for emergency exit plan
GIS-based evacuation plans, including current flood water flow, emergency routes, water depth, obstacles and possible search and rescue (SAR) interventions, were prepared.

Preparation of Flood Risk Maps highlighting availability of grocery stores, restaurants, public utilities, food storage units, hospitals, residential homes for elderly people, high flood prone areas, etc.

Development of Local flood plain maps, to inform construction practices (e.g., selection of appropriate materials for walls and floors)

Chennai - Key Take Aways (Learning Lessons)

- Special Drive to clean channels leading to water tanks is undertaken before the monsoon season
- Massive exercise for desilting 22,899 tanks and 11,446 Km of water bodies were taken up
- Introduction of Chennai Mega City Development Mission - Integrated Storm Water Drain Project and Smart City Project (Constructed 8,835 drains spanning an area of 2051 square km)
- A total of 6,960 recharge pits were created & defunct borewells were also converted as recharge pits

Coastal Flood Warning System App ("CFLOWS-Chennai")

- Web GIS-based decision support system.
- Used both for mitigation planning operations & for real time aspects like relief work

Significance
WAY Forward - Digitalization

“AI Based Solutions for Flood Mitigation”

• As per McKinsey Report, India is No. 1 in Digital Adoption Index in the World.
• The initiate taken by the Government of India such as “Digital India” is a big win as technology is the need of the hour to transform to a connected nation.
• Government of India took a generational leap and launched the 5G services in India yesterday which has opened up avenues in the field of Artificial Intelligence, Augmented Reality, Virtual Reality & Internet of Things.
• This has led to the revolutionary step in exploring AI based solution for flood mitigation.
• Some of these solutions are being explored in states of Karnataka, Bihar & Delhi as a pilot project.
Technology for Flood Mitigation

Some of the AI Based solution are as follows:-

• AI powered flood forecasting techniques can be utilized to predict future events like floods with accuracy prior to 72 hours

• AI can help in circulating flood warnings in a very short time as compared to traditional methods and hence can avoid 30 to 50% damage
Google's AI-powered Flood Forecasting Model

Google's AI-powered Flood Forecasting Model was created to address the issue of the world's most prevailing disaster - Riverine Floods.

**Step 1**
First of all, the probability of a river to flood is determined.

**Step 2**
Inputs such as precipitation and water level gauge measurement are taken from Governments & disaster management agencies.

**Step 3**
Designing of Hydrological Model (Predictions of water level in rivers).

**Step 4**
Designing of Invasion Model (Identifies the areas most likely to be hit by floods).

**Step 5**
Using Machine learning, all data are combined to generate its output by forecasting the river water level at some stage in the future.

- With this system, the flood prediction accuracy is 75% where the error rate for the Hydrological model is just 12 centimeters, whereas that of the Invasion model is just 100 meters.
- AI system delivers reliable flood information in real-time and warns the residents through Google Maps or Google search to enable them to take defensive measures.
Bihar government is circulating flood alerts with a lead time of 72 hours using Google's AI-powered Flood Forecasting Model through Google earth and Google maps applications. Residents get alerts three days in advance to take precautionary measures. As an outcome of these efforts, floods resulted in just 25 deaths in Bihar in 2020 that was 130 in number in 2019.
Thank You!
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