TOPIC: -

DISASTER MANAGEMENT FOR FLOODS.

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FLOOD AND ITS IMPACTS: -

Origin of the word flood stems from the old English word Flōd, that is related to the dutch word vloed and German Flut all of which means "to flow". Flood is the overflow of water beyond a normal level that submerges adjoining land areas which are usually dry. Floods are termed as disasters when submergence in the adjoining areas affects human beings or animals with associated loss.

Flood is a hydro-meteorological phenomenon having widespread occurrence across the globe with varied severity and dimensions. Many of the disaster reports have highlighted the impacts of flood with another high-profile disaster like earthquake and declares that flood incidences in the world are nearly eight times more than that of earthquakes and the number of people affected by floods is nearly 12 times more. There are different perceptions of flood for different stakeholders. For common people, it means devastation, destructions, damage, starvation, loss of lives, damage to properties and infrastructures, etc. Those living in urban areas may treat this phenomenon as disruption in their normal functioning of society. The government machinery and policy planners treat this situation as a factor of retardation in developmental planning with additional overburden on economy and additional expenditure on rescue, relief, rehabilitation, mitigation, etc.

The International Commission on Irrigation and Drainage (1995) has defined "flood" as "relatively high flow in a river markedly higher than the usual". The World Meteorological Organization (WMO)/UNESCO International Glossary of Hydrology (WMO 1974) defined flood as "rise, usually brief in the water level of a stream or water body to a peak from which the water level recedes at a slower rate" and "relatively high flows as measured by stage height or discharge."

TYPES OF FLOODS: -

Floods are classified in various ways depending upon the nature, severity, and sources of inundation-

Riverine flooding occurs due to various reasons but primarily due to heavy precipitation or glacial melt with resultant runoff. The increased discharge in river channels with decreasing carrying capacities leads to overflow causing inundation in the adjoining low-lying areas. **Flash flooding** is an unprecedented situation that occurs in hilly regions and sloping lands where torrential heavy precipitation, thunderstorm, or cloud burst commonly occurred without any prior warning. This sometimes creates huge loss of lives and damage to properties.

Urban flooding occurs in regions, where developmental planning has not been in tune with the geo-morphological, ecological, and environmental set up, that results in the increased vulnerability of urban areas. Many urban agglomerations in India are suffering from the problem of flooding even after moderate rainfall. The situation aggravates when rainwater mix up with drain water causing additional problems including spread of epidemics.

Coastal flooding occurs due to a number of reasons like cyclones and associated storm surge, high tides, tsunami, etc., wherein the low-lying areas in coastal tracts are inundated, as a result of which losses occur on a larger scale. In addition, salinity increases in the coastal groundwater and wells.

Glacial Lake Outburst Flood (GLOF) occurs in the downstream of glacial regions, where glaciers holding large quantities of water suddenly release them due to melting of ice jam. Glacial outburst is one of the prime reasons of flash floods in some of the Himalayan Rivers. **Cloud Burst Flooding** is the manifestation of climate change and hydrological imbalance that primarily occurs in the form of sudden heavy rainfall. Cyclonic circulations in monsoon may also lead to cloud burst. Cyclone and storm surge flooding mainly occurs in coastal areas due to rainstorms associated with low-pressure systems. Movement of cyclonic storms in quick succession leads to severe flooding, especially in low-lying coastal areas.

WHAT AFFECTS FLOODS: -

Floods are affected by many factors which include: Extreme rainfall; Construction of dams; Rivers behavior and embankments. The other significant reasons include congestion in the drainage channels due to roads, railways, canals, the haphazard growth of industrial and urban establishments may also create flood in a given location. Lack of forests (or deforestation), local water systems, landslides, soil erosion, destruction and/or creation of natural dams, earthquakes, glaciers, sea tides and climate change are some of the factors aggravating of creating flood situation in the country. The flood protection in one area could also result in the floods of other areas. For example, construction of embankments in few areas can increase flood occurrences downstream or upstream. Embankments often act as flood transfer mechanisms as they transfer floods from a given area to their downstream areas. The floods that occur in a given area due to breach of embankments therefore are different to floods in the absence of embankments. During embankment overtopping, the floods are usually sudden, with greater speed, can have increased quantity of sand and could inundate for a longer time as compared floods to during the absence of embankments.

Natural dams created by landslides or Glacial Lakes and their outbursts/ overflow may lead to a large quantity of water flowing in the streams quickly leading to flash floods. In the Himalayan region, such natural dams/ glacial lake overflows during the rainy season could also be aggravated by multiple landslides due to decreased stability of soil.

EVOLUTION OF FLOOD RISK MANAGEMENT: -

Earliest civilization regarded floods as uncontrollable and therefore established their critical infrastructures on highlands. Settlements were built on the artificial mounds. A system of flood early warning was developed and flood-sensitive land use planning approaches were adopted. As the demand for food increased and the need for greater agricultural production realized, fertile floodplains were used for better farm produce and people began residing in the flood plains making their permanent settlements.

In due course of time, flood was treated as a challenge rather than inconvenience. Engineering solutions like dykes and other control measures began taking shape. Attempts were also made to "deal with floods" through structural protection and diversion of flood flow, but flood damages continued to rise. Thus the need of paradigm shift emerged from adopting both structural and non-structural mitigation measures, thus the concept of Flood Risk Management emerged. In recent years, the flood risk management has continued to evolve into adaptive measures to manage flood risk, keeping in mind the ecosystem services and the necessity to look beyond flood management to coastal or integrated basin watershed management.

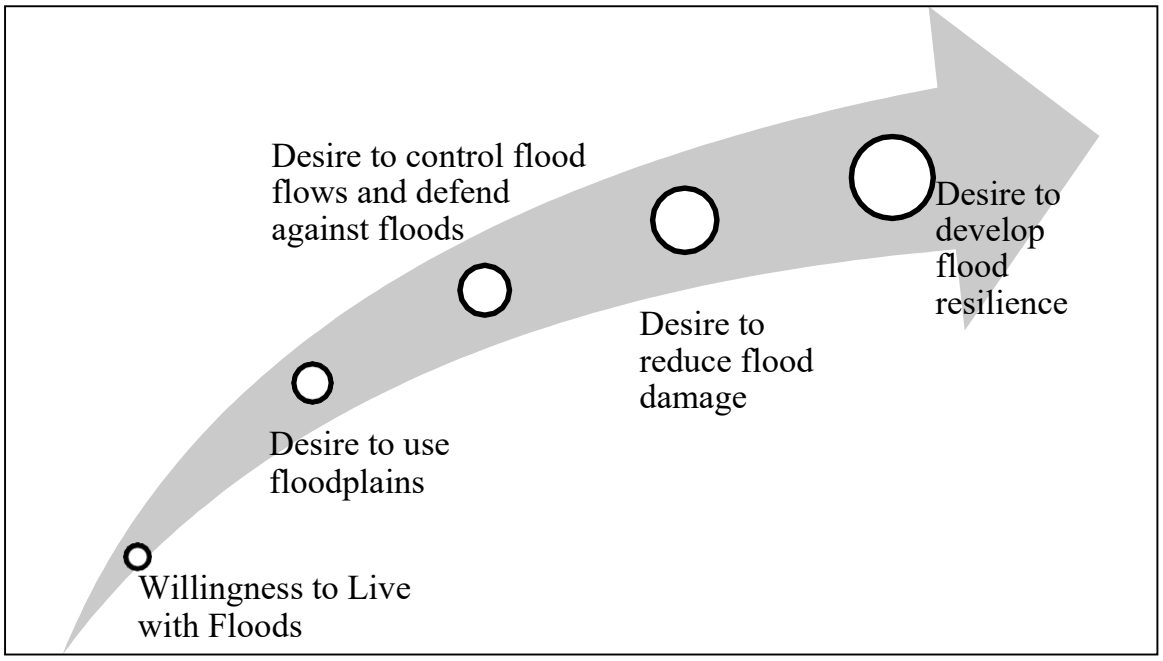

Figure:1: Evolution and development off Flood management.

FLOOD RISK MANAGEMENT: -

Flood disaster refers to the occurrence of a catastrophic flood that brings about adverse impact to humans, animals and the economy. Flood Risk of a particular geographic area or a community refers to the possible consequences of all flood combinations in that particular area. Flood risk management denotes the effort taken by various agencies in managing the risk of floods and the process of reducing the adverse impacts of the flood events (disaster).

Flood Risk has two main components:

1) Probability of the occurrence of inundation taking into consideration the intervening mechanisms like levees, floodwalls etc.
2) Impact/ Consequences that reflects the vulnerability (or the potential to experience harm) and the exposure (quantifying the number of structures/ people/ area that could be exposed to the flood event)

In order to have an effective flood risk management in place, there is a need to adopt Flood Risk Management Strategies, that consist of the following components:

- **Flood Risk Prevention** aims to decrease consequences of flood event by decreasing exposure of property and people by measures that discourage or prohibit development in flood prone/ high flood risk areas. The focus of this strategy is to "keep people away from water" (Raadgever, et al., 2016) by restricting the construction of buildings in flood prone areas.
- **Flood Defense mechanism** includes measures to decrease probability of flooding incidents. The measures could be structural or a blend of structural and non-structural measures such as dykes, embankments, or increasing capacity of existing water channels, increasing up-stream water retention and focusing on "keeping water away from people".
- **Flood Risk Mitigation** mechanisms decrease the magnitude or severity of impacts through measures in the vulnerable areas that includes flood zonation, regulations for flood proof buildings etc.
- **Flood Preparation and Response** measures involve the development of early warning systems, flood disaster management and response plans and effective preparedness and utilization of resources to respond to floods to alleviate suffering during the flood event (disaster)
- **Flood Recovery** includes the reconstruction activities, compensation of losses through public or private insurance schemes integrating flood risk prevention, defense and mitigation into the activities.

Flood risk Management involves various processes in the four facets of Disaster Management. In the mitigation stage, measures like assessment of flood risk, incorporating flood risk in land use planning, planning and constructing measures like levees, embankments, reservoirs etc. and adopting nonstructural measures (flood zonation) for flood prevention and enhancing the natural water retaining capacity of the flood plains/ urban area can be undertaken. The preparedness activities include the strengthening of communities to deal the emergent situations of floods as well as behavioral changes to adhere to flood zones as well as awareness generation towards Do's and Don'ts during floods. The response activities include undertaking rescue and relief activities to alleviate sufferings of flood affected communities. The recovery after flood incident must ensure resilient reconstruction and planning for budgeting reconstruction activities.

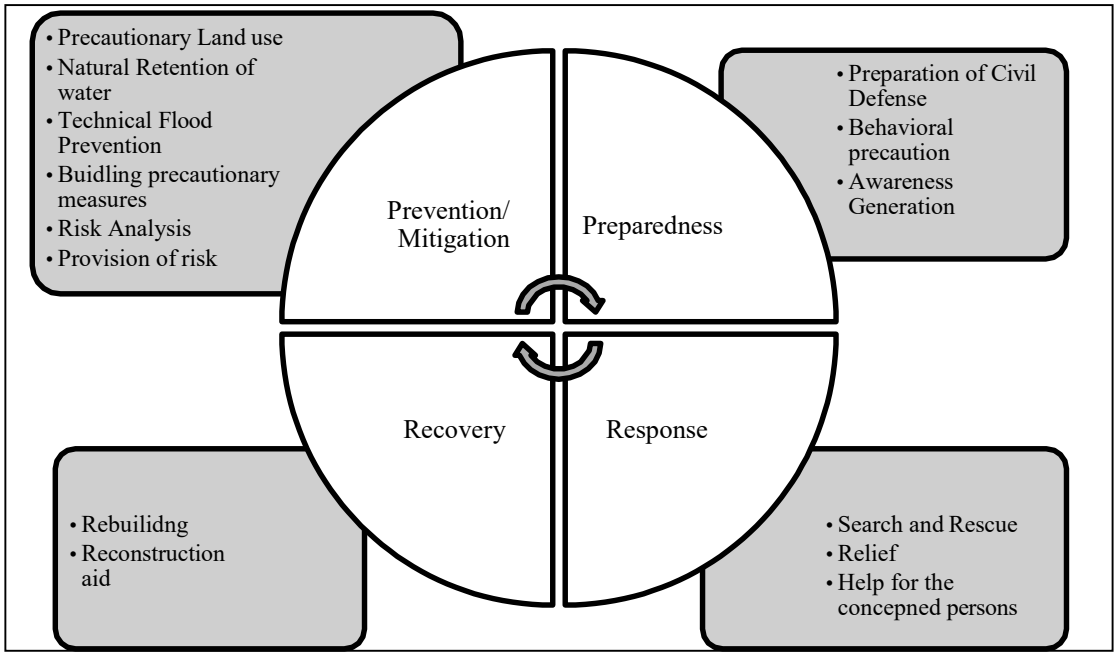

Figure:2: Flood Risk Management Adapted from (SECOM).

CHARACTERISTICS OF BETTER FLOOD RISK MANAGEMENT

1) **Monitor, Review and Adapt** -Flood risk management activities are implemented in such a way that new knowledge is incorporated and the capacity addition and infrastructure/ strategies have scope for modification.
2) **Understand whole system Behavior and societal goals-** so that the development in the geographical area and the possible changes in land use/ land planning patterns are considered in a participatory method for setting short-term and long-term goals
3) **Use knowledge of risk and uncertainty** to prioritize strategies and activities, and ensuring that investments are proportionate to the intended societal risk reduction with structured evaluation process
4) **Implement the portfolio of activities and institutions to deliver objectives** to reduce flood risk and innovative strategies are planned and implemented in order to achieve flood risk reduction.

It is also essential that a proper system must be in place to analyze the effectiveness of any intervention planned.

For example, Embankments remain the main structural risk reduction technique. Without embankments, the floodwater may spread over a larger area and sediments build up over time, but stay more or less constant beyond a certain time. However, in the case of embankments, population may settle close to the embankment due to the perception of safety under the structures. Further, the embankment needs continuous maintenance including dredging and repair. In sediment-laden rivers, sediment build up would be significant and would need to be raised over time on a regular basis. The sediment also rapidly builds up within the embankment and raises water levels within the embankment above the altitude of the surrounding land. Any breach in this case would result in significant potential energy getting converted into kinetic energy increasing the speed of the water discharge due to breach.

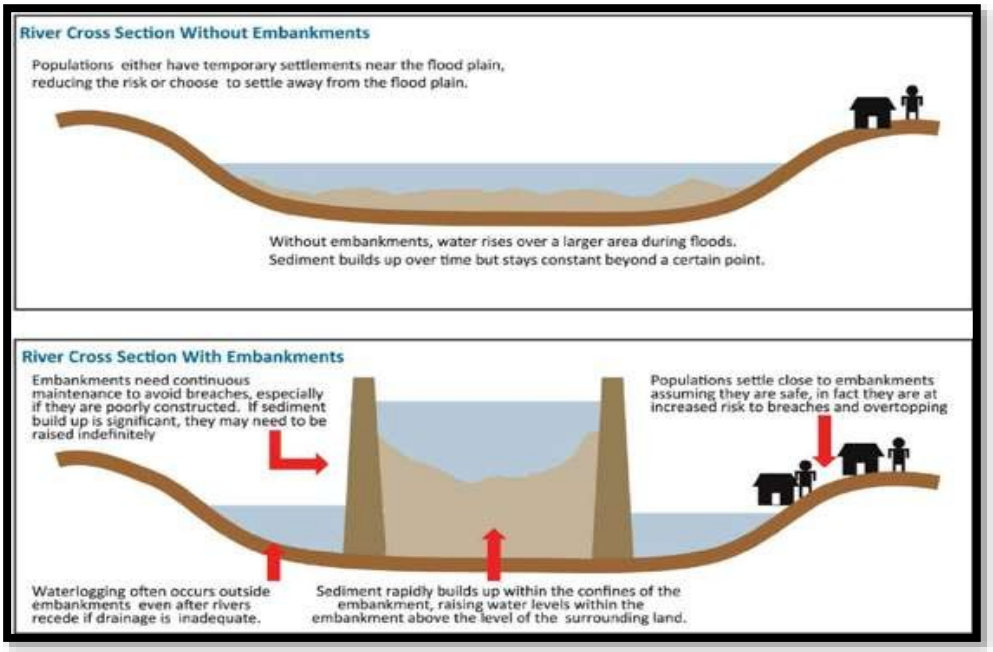

Figure:3: Schematic of embankments in Sediment Laden Rivers.

Sometimes dam itself may cause disasters especially due to sudden release of high quantity of water. Therefore, development and disaster management both must be utilized and visualized to understand and work towards flood risk management.

FLOODS IN INDIA: -

In the entire Indian subcontinent, the flood gains the status of disaster, when normal channels of rivers are breached or flow in excess of their carrying capacity. Flood is a recurrent phenomenon in India that normally starts with the onset of monsoon; however, due to localized hydro-meteorological aberrations, specific flooding occurs in the localized areas. The United Nations International Strategy for Disaster Reduction (UNISDR) Report 2015 observed that out of the average annual loss of 9.8 billion USD in India, about 7.4 billion USD are accounted by the damage caused by floods. Rashtriya Barh Ayog (RBA) constituted in India to assess the flood situation in the country has listed the flowing situations for flooding:

- Streams flowing in excess of the transporting capacity
- Backing up of water in tributaries
- Heavy rainfall
- Ice jams or landslides blocking stream courses
- Heavy localized rainfall
- Cyclones and typhoons

Out of the total geographical area of 329 million hectares, about 40 million hectares is liable to floods in India as estimated by RBA in 1980. Subsequently, the 11th five-year plan working group has compiled the area liable to flood as 45.64 million hectares. It is estimated that about 25 out of 36 states and union territories are flood prone in the country. The areas stretching north to south from the extra peninsular regions to the tip of the peninsula and from extreme desert regions of the west to the east coastal regions and northeastern regions are all prone to floods in varying magnitude and nature. There are about 22 major river basins in India, out of which four major river basins are typically known as flood-prone basins:

1. Brahmaputra and Barak basin
2. Ganga basin
3. North West River basins
4. Central India and Deccan river basins

The Brahmaputra basin covering northeastern states, northern part of West Bengal, and Sikkim is affected by severe and recurrent floods. The entire catchment area of this basin receives heavy rainfall from June to September. The frequently occurring earthquakes and landslides in hills upset the flow regime of rivers causing imbalance in flow dynamics. In addition, spilling of rivers, drainage congestion and tendency of some of the rivers to change courses also cause flooding. In Assam and Tripura, flooding primarily occurs due to inundation by spilling of Brahmaputra and tributaries as well as bank erosion along the Brahmaputra

FLOOD MANAGEMENT INITIATIVES: –

Flood as a disaster has long been a matter of concern for policy planners in India as it brings benefit as well as losses for communities. The annual floods in the Indo-gangetic plains maintain the fertility of soil by depositing silt containing different minerals carried out from different parts of the mountains. They bring additional water for irrigation, thereby contributing to enhanced fertility in the region, whereas the same flood in larger dimension or in unprecedented situation seriously affects communities living in the floodplain or low-lying areas. In other parts of the country, the flooding occurs due to heavy torrential rainfall combined with poor drainage, that causes disasters in the society resulting in the loss of lives populations and infrastructures. The recent examples are Uttarakhand flood (2013) and J&K flood (2014). In order to prevent this hydro-meteorological phenomenon attaining the status of disasters, there is a need to adopt a comprehensive, integrated, and scientific approach.

Flood disaster management approach is essentially required in India because it affects the normal functioning of societies or communities, but above all, the optimal utilization of land and water resources is of vital importance to bring prosperity in the country. On the account of unique and varied geo-climatic condition right from the extra peninsula in the north to peninsular tip in the south and from Arunachal Pradesh in the east to the extreme western Thar Desert, the nature and scope of flood risk varies greatly; therefore, the risk management strategies and disaster management plan during the flood disaster must address all the topographical, geographical, and climatic conditions to effectively combat the potential threats. The "National Water Policy" has suggested that there should be a master plan for flood control and management, for each flood-prone basin. It is essential to promote watershed management practices through water management, soil conservation, catchment area development, etc. to reduce the intensity of floods. The systematic approach of flood management and mitigation in India at the policy level was started by the Government of India in the year 1954 after the unprecedented floods in different parts of the country. A policy statement by the Ministry of Planning, Irrigation, and Power was placed before the parliament under two separate categories – "floods in India (problems and remedies)" and "the floods in the country." The objective was to suggest a comprehensive framework for the management of flood disasters in the country. Since then, various committees have been constituted from time to time to suggest recommendations, strategies, and policies on various flood management and mitigation issues.

Though several good policy initiatives were taken by the government of India to minimize the menace of floods in the country, the one which is of greater significance was the constitution of Rashtriya Barh Ayog (RBA). In 1976, the government constituted RBA under the chairmanship of Mr. Jaisukhlal Hathi, the then governor of Punjab/Haryana, to look into the contemporary situation of floods in the country and to carry out in-depth study of the long- term flood management approach. This was the most comprehensive study of flood carried out by any committee since independence. It looked into various flood problems and submitted its report in 1980 with 207 recommendations covering almost all the aspects of flood management. However, the implementation of recommendations by different states remained mostly under the slow pace. In order to review the progress of implementation of

RBA, few committees were further constituted including an expert committee setup in 2001 by the Ministry of Water Resources under the chairmanship of Sri R. Rangachari. The committee reviewed each of the recommendations of RBA and opined that its implementation has been slow which requires more attention by the concerned stakeholders. The committee further suggested 40 out of 207 recommendations to be taken up on priority basis. In many of the recommendations listed in previous pages by different committees/ commissions, it was strongly felt that practically it is not possible to protect all areas against high flood and structural mitigation measures alone cannot be considered as appropriate for flood management, there should be a combination of both structural and nonstructural measures on flood mitigation, so that overall losses could be minimized.

INDIAN RIVERINE FLOOD MANAGEMENT- GANGES AND BRAHMAPUTRA: -

The case of flood management in the river Ganga and the Brahmaputra is complex due to the geo-morphological set up of the two major basins. The water flows into these two rivers from the Himalayan mountain ranges. This water basin consists of a lot of sediments. In addition, the ongoing tectonic processes leading to seismic activity make it difficult to undertake watershed management interventions. Traditional soil conservation mechanisms like increase in forest cover becomes difficult as the source of sediments are in the higher ranges, sometimes above the tree line. The high rate of sedimentation also makes it difficult to utilize reservoirs for capturing and storing sediments/ excess discharge of water and would require sophisticated systems for downstream sediment flushing. In the downstream, continued raising of embankments produce excess risk of overtopping due to excess sedimentation. The force of water and the occurrence of silt, leads to scouring of embankments and generally result in the breaching of embankments well before the designed lifetime of the embankments. The geomorphological make of the upstream also leads to occasional cloudburst that bring significant downpour of rainfall in short durations which may lead to multiple landslides thereby increasing the silt contents of flood waters.

CONCLUSION: -

Flood is the overflow of water beyond a normal level that submerges land areas which are usually dry. Floods are affected by many factors apart from rainfall, dams, rivers, and embankments. Earliest civilization regarded floods as uncontrollable and located critical infrastructures on high land. In recent years, the flood risk management has continued to evolve into adaptive measures to manage flood risk, keeping in mind the ecosystem services and the necessity to look beyond flood management to coastal or integrated basin watershed management. Flood risk management denotes the efforts by various agencies in managing the flood risk and the process of reducing the adverse impacts of the flood event (disaster). Flood Risk Management Strategies consist of Flood Risk Prevention, Flood Defense mechanism, Flood Risk Mitigation, Flood Preparation and Response, Flood Recovery.

Indian government has taken various steps towards flood risk management through policy measures and institutional mechanisms.