FLOODS AND FLOOD MANAGEMENT

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Flood:

- A flood is a discharge that exceeds the channel capacity of the river and thus, it inundates the adjacent floodplain.
- In other words,a flood is an overflow of an expanse of water that submerges land.
- It usually occurs due to the volume of water within a water body, such as river or stream exceeding the total capacity of the body, and as a result, some of the water flows or sits outside the normal perimeter of the water body.
- When this happens, the channel and the floodplain together allow the passage of the flood waters.

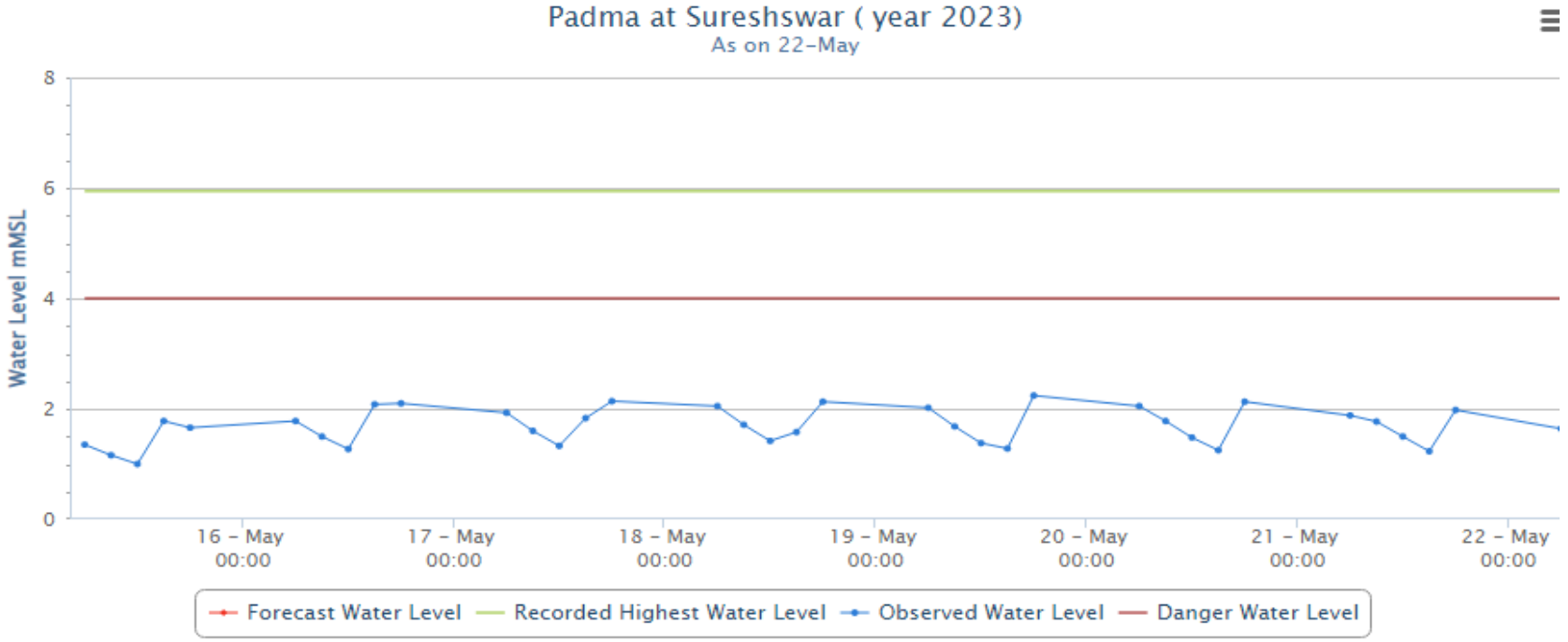
Floodplain:

- A floodplain is the flat lower part of a valley floor, adjacent to the river channel which is inundated by flood flows spilling over the channel bank when discharge periodically exceeds the bankfull stage.
- **Normal flooding**, or what is labelled as annual inundation of the floodplain, does bring benefits to the population who inhabit such plains. Such inundation makes soil more fertile and provides nutrients in which it may be deficient.
- **Periodic flooding** was essential to the well being of such ancient civilizations along the Tigris-Euphrates, the **Nile,** the Indus and the Yellow rivers. However, unwanted inundation of land - perceived as flood - causes many disruptive effects on human settlements and economic activities.

Hydrograph:

- A hydrograph is a graph showing the rate of flow versus time past a specific point in a river, channel, or conduit carrying flow. The rate of flow is typically expressed in cubic meters or cubic feet per second. Hydrographs often relate change of precipitation to change of discharge over time.
- The flood hydrograph records the passage of flood water through time at a given point in the river system. The detailed timing and shape of flood hydrographs reflects relationships between climatic and drainage basin control and these can vary from basin to basin and through time within a basin.

- Source: http://www.ffwc.gov.bd/index.php/hydrograph(Flood Forecasting and Warning Center)



River Name	Location	RHWL (mMSL)	Danger Level (mMSL)	21-05 06:00 AM	22-05 06:00 AM
Padma	Sureshswar	5.94	4.00	1.88	1.64

Introduction:

Bangladesh is a land of rivers & cannels. Their number is more than 250. The total river area is about 9380 Km2, which 6.3% of the total area of our country. According to the geological point of view Bangladesh is located in such a zone that can be affected by flood easily.

Bangladesh is a low plane level country. Its geological & climatological situations along with the existence of immense rivers & canals have combinedly made it more flood prone. About 15-20% of the total land area is hilly. The rest of the country is almost plane & mainly originated from river carried alluvium soil.

Over this country three large river systems are flowing:
1) Ganges-Padma system,
2) Brahmaputra-Jamuna system, &
3) Meghna system.


NEPAL
0 50 100 km
0 50 100 mi
Brahmaputra
Rangpur
INDIA
Mymensingh
Sylhet
Rājshāhi
Jamuna
Ganges
Tungi
DHAKA
Comilla
INDIA
Nārāyanganj
Jessore
Meghna
Khulna
Barisāl
Mongla
Chittagong
Kedaradang
BURMA
New Moore Island
Mouths of the Ganges
Cox's Bāzār
Bay of Bengal
88
90
92
26
24
22

The drainage areas of the three major rivers are mentioned below:

Name of river	Length in miles	Area covered in sq miles In Bangladesh	Area covered in sq miles Out of Bangladesh	Total covered area in sq. miles
Ganges	1600	19000	3,78,000	3,97,000
Brahmaputra	1800	18000	2,06,000	2,24,000
Meghna	590	14000	17000	31,000

Total *drainage area* 652000

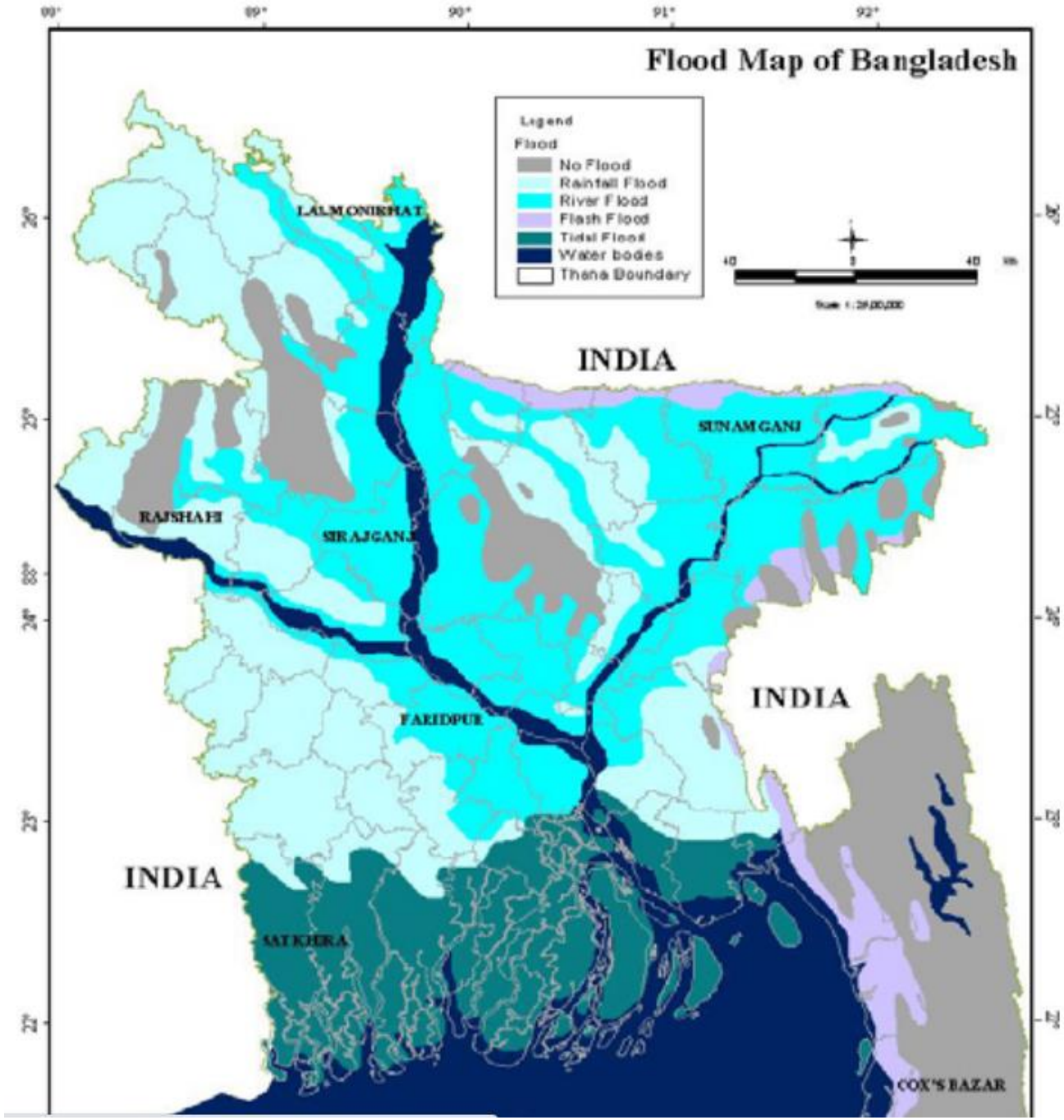
This area is **11.64** (=652000/56000) **times higher than the area of Bangladesh**

During the annual monsoon period, the rivers of Bangladesh flow at about 140,000 cubic meters per second, but during the dry period they diminish to 7,000 cubic meters per second.

Basin areas of the three major rivers:

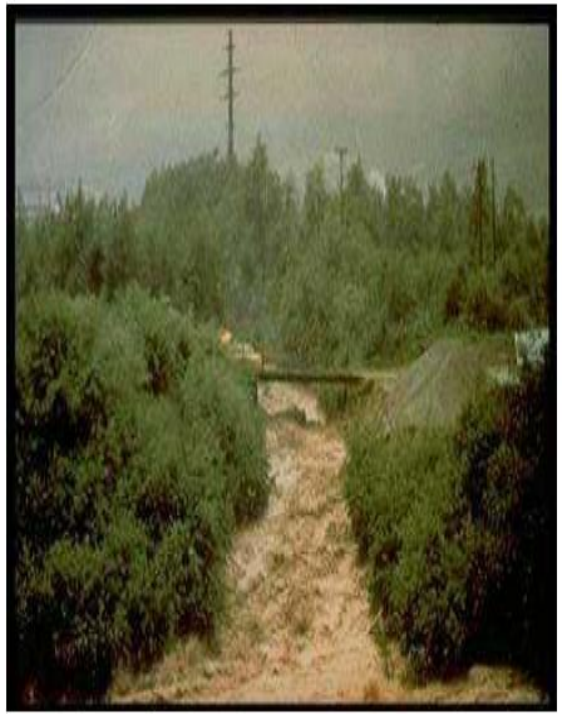
Flood Types:

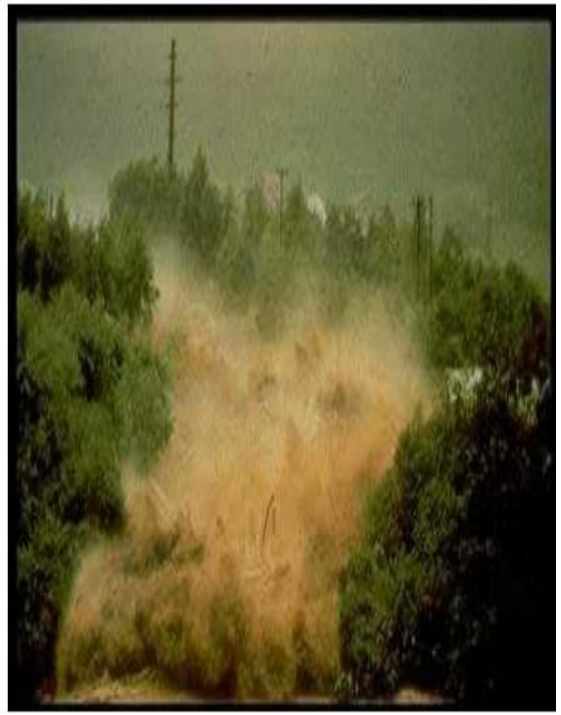
- In Bangladesh, the following types of floods are normally encountered. Area affected by different types of flooding is presented.



Flash Flood from Hilly Areas

- Flash flood prone areas of the Bangladesh are at the foothills.
- Intense local and short-lived rainfall often associated with mesoscale convective clusters is the primary cause of flash floods.
- These are characterized by a sharp rise followed by a relatively rapid recession.
- Often with **high velocities** of on-rush flood damages crops, properties and fish stocks of the wetland.
- Flash flood can occur within **a few hours.**
- In the months of **April and May** flash floods affect the winter rice crop at the harvesting stage, and are common in the districts of Northeast and Southeast regions of the country.





Monsoon Floods or Normal Flood from Major Rivers

- The word flood is generally synonymous with river flood.
- River flood is a common phenomenon in the country caused by bank overflow.
- Of the total flow, around 80% occurs in the 5 months of monsoon from June to October (WARPO, 2004).
- A similar pattern is observed in case of rainfall also.
- As a consequence to these skewed temporal distribution of river flow and rainfall, Bangladesh suffers from abundance of water in monsoon, frequently resulting into floods and water scarcity in other parts of the year, developing drought conditions (IEB, 1998).
- Climatologically, the discharge into Bangladesh, from upper catchments, occurs at different time of the monsoon.
- In the Brahmaputra maximum discharge occurs in early monsoon in June and July whereas in the Ganga maximum discharge occurs in August and September. Synchronization of the peaks of these rivers results in devastating floods.
- Such incidents are not uncommon in Bangladesh. The rivers of Bangladesh drain about 1.72 million sq km area of which 93% lies outside its territory in India, Nepal, Bhutan and China. The annual average runoff of the cross boundary rivers is around 1200 cubic kilometres (WARPO, 2004).

Rain-fed Flood

- This kind of flood generally occurs in many parts of the country but is mainly prevalent in the south-western part of the country.
- This kind of flood also occurs in the flood plains where natural drainage systems have been disturbed either due to human interferences e.g. construction of unplanned rural roads and encroachment of river courses etc or due to gradual decay of the natural drainage system.
- When intense rainfall takes place in those areas, the natural drainage system cannot carry the run-off generated by the storm and causes temporary inundation in many localities.This kind of rain-fed flood is increasing in the urban areas.

Floods Due To Storm Surges

- This kind of flood mostly occurs along the coastal areas of Bangladesh over a coastline of about 800 km along the southern part.
- Continental shelves in this part of the Bay of Bengal are shallow and extend to about 20-50 km.
- Moreover, the coastline in the eastern portion is conical and funnel like in shape. Because of these two factors, storm surges generated due to any cyclonic storm is comparatively high compared to the same kind of storm in several other parts of the world.
- In case of super-cyclones maximum height of the surges were found to be 10-15 m, which causes flooding in the entire coastal belt. The worst kind of such flooding was on 12 Nov 1970 and 29 April 1991 which caused loss of 300,000 and 138,000 human lives respectively (FFWC, 2005).
- Coastal areas are also subjected to tidal flooding during the months from June to September when the sea is in spate due to the southwest monsoon wind.

Apart from the above mentioned four types of natural floods, there are five other types of floods caused by different kinds of human interventions in the fluvial environment (Brammer 2004). These are:

- **Breaching of an embankment** : This occurs when there is a difference of several meters between the water level outside the embankment or a polder and the land level inside the embankment and there is a **breach in the embankment** leading to a sudden rush of water inside the embanked area.

- ***'Public cuts'*** *in flood protection embankments :*This refers to deliberate breaching of embankments by people living outside the embankments in order to save their crops and homesteads from high river flood. Often, people living inside the embankments also cut or breach them in order to drain water ponded behind an embankment after heavy rainfall.
- ***Cuts in Coastal Embankment Project polders:*** Shrimp farmers in the coastal region cut these embankments or polders to allow brackish water onto their land. The breaching action causes salinization of the soil and negates the very purpose of the polders.
- ***Release of water from a dam :*** Exceptionally heavy rainfall over the catchment area of the Kaptai dam may fill up the reservoir with the danger of overtopping or breaching, and could require a rapid release of water from the dam causing damage to crops and property in the downstream section.

In Satkhira district, shrimp farmers bring saline water into farmland by pumping it from the nearby Kholpetua, a tidal river (Image: Abu Siddique)

- ***Ponding of water behind road, railway or flood embankments:*** This is a common phenomenon in Bangladesh after heavy rainfall, especially along road transport routes. Inadequate provision for drainage through culverts and bridges (including many in the state of disrepair) have disturbed and adversely affected regional or local hydrological conditions; the consequence being drainage congestion and flooding.

GENERAL PATTERN

- The Brahmaputra starts rising in March due to snowmelt on the Himalayas, which causes a first peak in May or early June.
- It is followed by subsequent peaks up to the end of August caused by the heavy monsoon rains over the catchments.
- The response to rainfall is relatively quick, resulting in rapid increases of water level.
- The Ganga starts rising gradually in May-June to a maximum sometime in August.
- High water levels are normally sustained until mid September.
- The Meghna may not attain its annual peak until August-September.
- The upper Meghna carries only about 10% of the flow in the Ganga and Brahmaputra.
- The total volume of runoff in the GBM is determined by the net precipitation over all the catchments.
- The normal sequence of floods with flash floods in the eastern hill streams during the pre-monsoon period in the months of April and May. High floods occur if the peaks of the Ganga and Brahmaputra coincide; this may happen during August-September.

Every year about 20 % of the cultivable area is inundated more than one meter about 4 to 6 months period

Situation deteriorates during floods of higher magnitude

Catastrophic floods: 1987,1988, 1998, 2004

Casualties in 1998 floods

- ***Over 60% area inundated***
- ***Over 30 million people affected***
- ***Over 4300 km of roads damaged***
- ***Food grain loss 2.2 million tons***
- ***270 thousands fish farms washed away***
- ***More than 3000 industries were affected***

Flooding reduces economical activities and enhances poverty

Flood Frequency Analysis

- The records of flood hydrographs can be analyzed to demonstrate important properties about the magnitude and frequency.
- This involves flood frequency analysis, which determines the recurrence interval (or return period) for floods of a given size at a particular location within a river system.
- Recurrence intervals are one of the most important concepts in flood analysis and are a critical consideration in connectivity.
- The recurrence interval is the average period of time between two successive floods of a particular magnitude or discharge.

The recurrence interval is a measure of how often an event is expected to occur based on the probability of exceeding a given stage threshold (annual exceedance probability).

To calculate recurrence intervals the following equation is used:

where *Tr* is the return period (years) and *P* is the annual exceedance probability.

$$T_r = \frac{1}{P}$$

National Plans and Policies: Travelling a long way

- *1964, IECO Master Plan*
- *1972, IBRD Plan*
- *National Water Plan 1, 1986*
- *National Water Plan 2, 1991*
- *Flood Action Plan, 1989-95*
- *BWFMS, 1995*
- *National Water Policy, 1999*
- *Guidelines for PWM, 2000*
- *NWMP, 2004*
- *National Flood Workshop, 2004*
- *Coastal Zone Policy*
- *Coastal Zone Plan, 2005*
- *Climate Change Strategy 2008*

There is no shortage of national policies, plans and frameworks – there is shortage of their proper application and integration/implementation

Flood Management : Planning Initiatives

- Bangladesh has a long history of water resource planning initiatives for over 40 years.
- Bangladesh tries to deal with flood and disaster with structural and non-structural measures.
- Systematic structural measures began by implementing flood control projects in sixties after the colossal flood of 1963.
- Non-structural measures have introduced in seventies. Flooding is a natural phenomenon, which cannot be prevented.
- Complete flood control is not in the interests of most Bangladeshi farmers. The flood control measures and policies should be directed to mitigation of flood damage, rather than flood prevention.

Chronological Development of Water Management

MPO National Water Plan-1 1986
MPO National Water Plan-2 1991

NWP marks the systematic planning practice in Bangladesh

NWP -I , 1987 has set the following investment priorities:

(i) Minor irrigation schemes, LLP, STWs and DSSTWs
(ii) Major irrigation schemes (FCDI)
(iii) Deep tubewells (DTW)
(iv) Flood Control and Drainage Scheme (FCD).

In NWP-II, a detailed investment programme were prepared. The 20 year (1991-2010) public investment programme gave more emphasis to FCD than NWP Phase-1. Both NWP's made important contributions to the knowledge and understanding of the water resources of Bangladesh. However the report was not accepted by the Government..

Chronological Development of Water Management

Flood Action Plan 1989-95

After the disastrous floods of 1987 and 1988, Government as well as development partner's attention were once again focused to the flood problem which initiated the Flood Action Plan. Noteworthy features of FAP are : 26 Studies were conducted.

- Attention was paid to **urban FCD and non-structural flood proofing**, though agriculture remained the main focus of regional plans;
- **Social, environmental and fisheries impacts and people's participation** were given particular emphasis.
- Emphasized formulation of **National Water Strategy**

Chronological Development of Water Management

Bangladesh Water & Flood Management Strategy-1995

The BWFMS was the major strategy follow-up to FAP and became the working policy document for the water sector. It recommended a 5 year programs involving:

- Preparation of National Water Policy
- Preparation of a National Water Management Plan.
- Strengthening of water sector organizations responsible for planning, construction, operation and maintenance

Policy Statement in NWPo - Related to Disaster Management

- **Develop early warning and flood-proofing systems to manage natural disasters like flood and drought**

- **Designate flood risk zones and take appropriate measures to provide desired levels of protection for life, property, vital infrastructure agriculture and wetlands.**

Guidelines for Protection

- **Regions of economic importance will be fully protected against floods.**
- **Other critical areas, will be gradually provided reasonable degree of protection against flood.**
- **In the remaining rural areas, with the exception of those already covered by existing flood control infrastructure, the people will be motivated to develop different flood proofing measures such as raising of platform for homesteads, market places, educational institutions, community centers, etc., and adjusting the cropping pattern to suit the flood regime.**

Policy Statement in NWPo - Related to Disaster Management

- A system of cost recovery, pricing, and economic incentives/disincentives is necessary to balance the supply and demand of water.

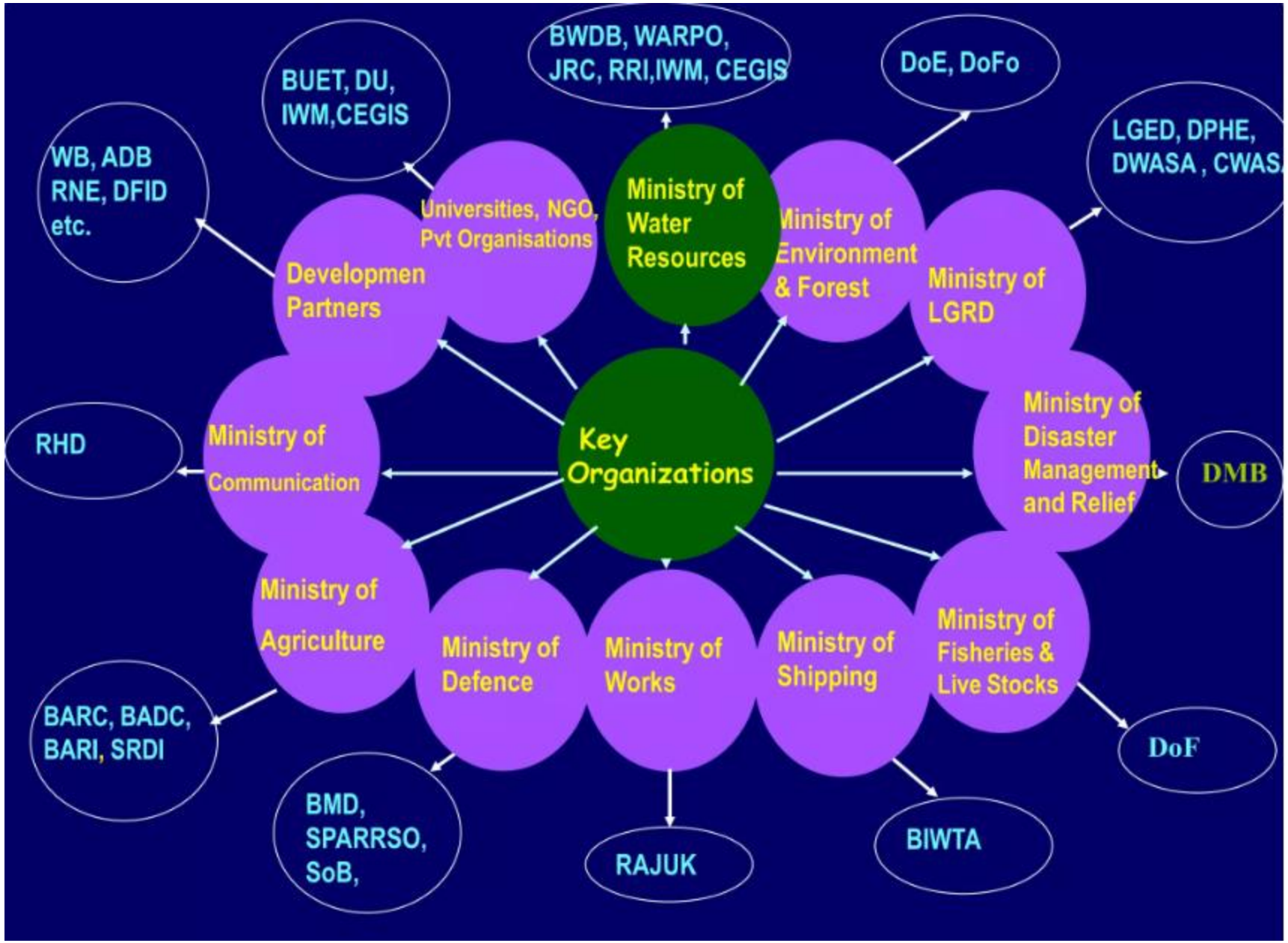
- Cost recovery of services such as flood control, drainage, irrigation, and wastewater treatment has not been considered adequately

- Cost recovery for FC and FCD projects is not envisaged in this policy. In case of flood control, drainage, and irrigation (FCDI) projects water rates will be charged for O&M as per Government rules.

- Investigate thoroughly important flood control and management issues, such as the efficacy of coastal polders, for guiding future policy on structural interventions.

- Undertaking any special study, as may be required, for fulfilling the objectives and programmes envisaged in the NWPo and the Bangladesh Water and Flood Management Strategy (BWFMS).

National Water Management Plan, December 2001


BWDB, WARPO, JRC, RRI,IWM, CEGIS
BUET, DU, IWM,CEGIS
DoE, DoFo
LGED, DPHE, DWASA , CWAS
WB, ADB RNE, DFID etc.
Universities, NGO, Pvt Organisations
Ministry of Water Resources
Ministry of Environment & Forest
Ministry of LGRD
Developmen Partners
RHD
Ministry of Communication
Key Organizations
Ministry of Disaster Management and Relief
DMB
Ministry of Agriculture
Ministry of Defence
Ministry of Works
Ministry of Shipping
Ministry of Fisheries & Live Stocks
BARC, BADC, BARI, SRDI
DoF
BMD, SPARRSO, SoB,
RAJUK
BIWTA

Flood Management : Planning Initiatives

- **Flood Forecasting and Warning Systems:** The Bangladesh Meteorological Department (BMD) and the Flood Forecasting and Warning Center (FFWC) provide flood forecasts and early warnings based on meteorological data, river levels, and rainfall patterns. These warnings help authorities and communities take preventive measures in flood-prone areas.
- **Flood Control Infrastructure:** Bangladesh has invested in constructing flood control infrastructure, including embankments, polders, and flood control channels. Embankments are built along riverbanks to prevent riverine floods from overflowing into nearby areas. Polders are low-lying areas enclosed by embankments to control water levels. Flood control channels help redirect floodwaters and relieve pressure on vulnerable areas.

Flood Management : Planning Initiatives

- Flood Shelter and Evacuation: The government has established flood shelters in flood-prone regions to provide temporary refuge to affected communities during floods. Evacuation plans are in place to relocate people to safer areas before the floodwaters rise. Community awareness programs help educate people about evacuation procedures and the importance of early preparedness.
- Integrated Water Resources Management: Bangladesh emphasizes integrated water resources management to balance water supply, flood control, and agriculture. This approach involves coordinated planning, regulation, and development of water resources to address flood management, irrigation, and hydroelectric power generation needs.

Flood Management : Planning Initiatives

- Resilient Infrastructure and Building Codes: In recent years, Bangladesh has focused on constructing resilient infrastructure, including roads, bridges, and buildings, to withstand flooding. Building codes have been developed to ensure structures can withstand flood-related challenges and maintain their functionality during and after flooding.
- Afforestation and Wetland Conservation: Reforestation and wetland conservation projects help improve natural water retention capacity and mitigate floods. Planting trees along riverbanks and protecting wetlands can help reduce erosion, regulate water flow, and provide habitats for biodiversity.

Flood Management : Planning Initiatives

- Community-Based Adaptation: Community participation and engagement are crucial in flood management. Community-based organizations, such as community flood management committees, play an active role in flood preparedness, early warning dissemination, and local response. These committees collaborate with government agencies and NGOs to develop and implement flood management plans.

How to reduce flooding

-Mitigation
- oInsurance (more developed)
- oDisaster aid (less developed)

-Protection
- oFlood abatement
- oFlood control (levees, flood control dams)

-Adaption
- oLand use planning
- oPreparedness
- oForecasting and warning