THE FLOOD PROBLEM AND MITIGATION METHODS IN BANGLADESH

M Monowar Hossain

Department of Water Resources Engineering,
Bangladesh University of Engineering and Technology

Background

Bangladesh is a country of rivers having an area of about 144,000 sq. km.; the environment and livelihood of 150 million people is mainly dependent on rivers and its resources.

There are 230 rivers which occupy about 7% of the total land area of Bangladesh.

The country is part of the Bengal delta, formed by the complex influence of three major river systems:

the Ganges,
the Brahmaputra,
the Meghna

The combined basin area of these great river systems is about **1.72 million sq. km.** and spread over

China,

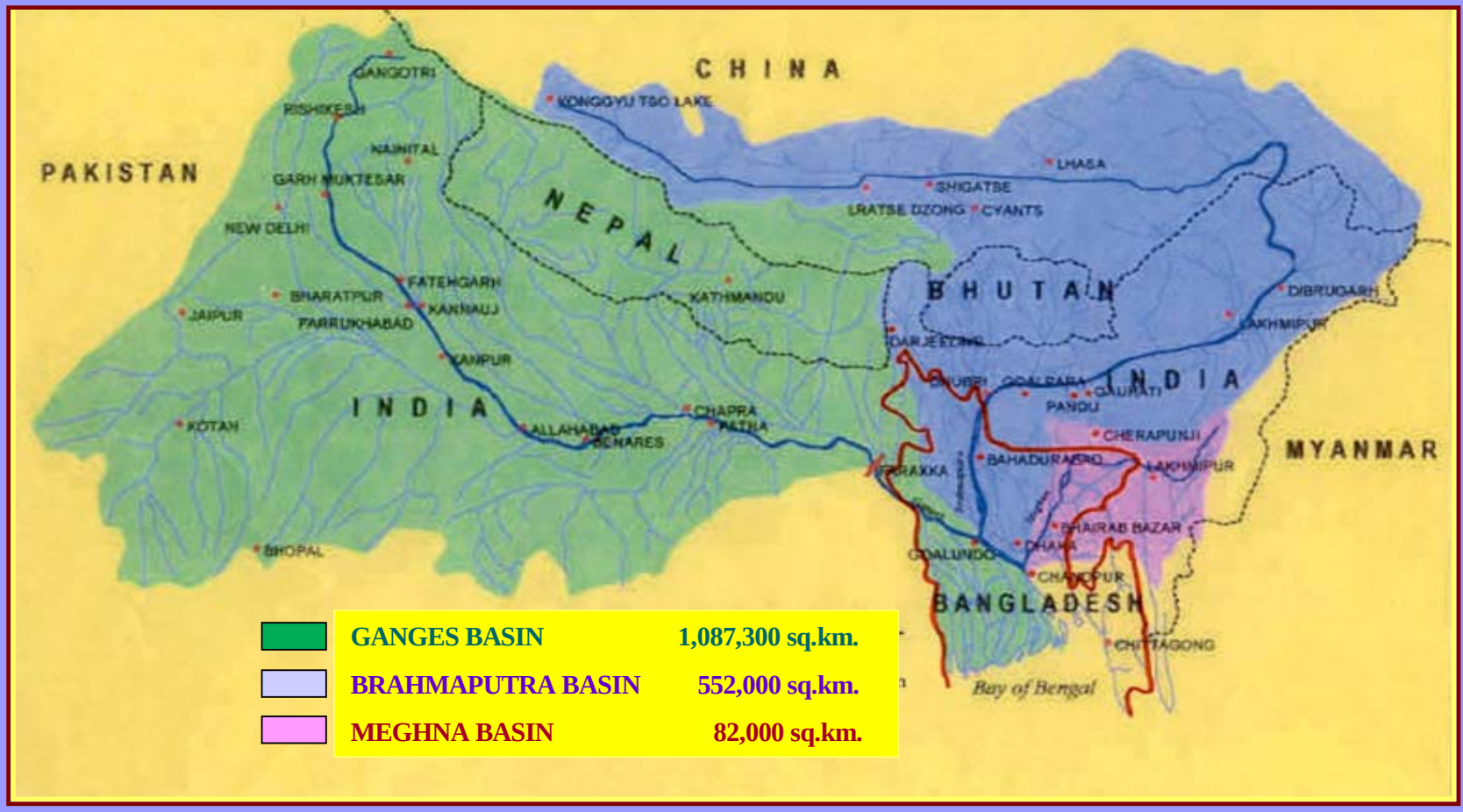
India,

Nepal,

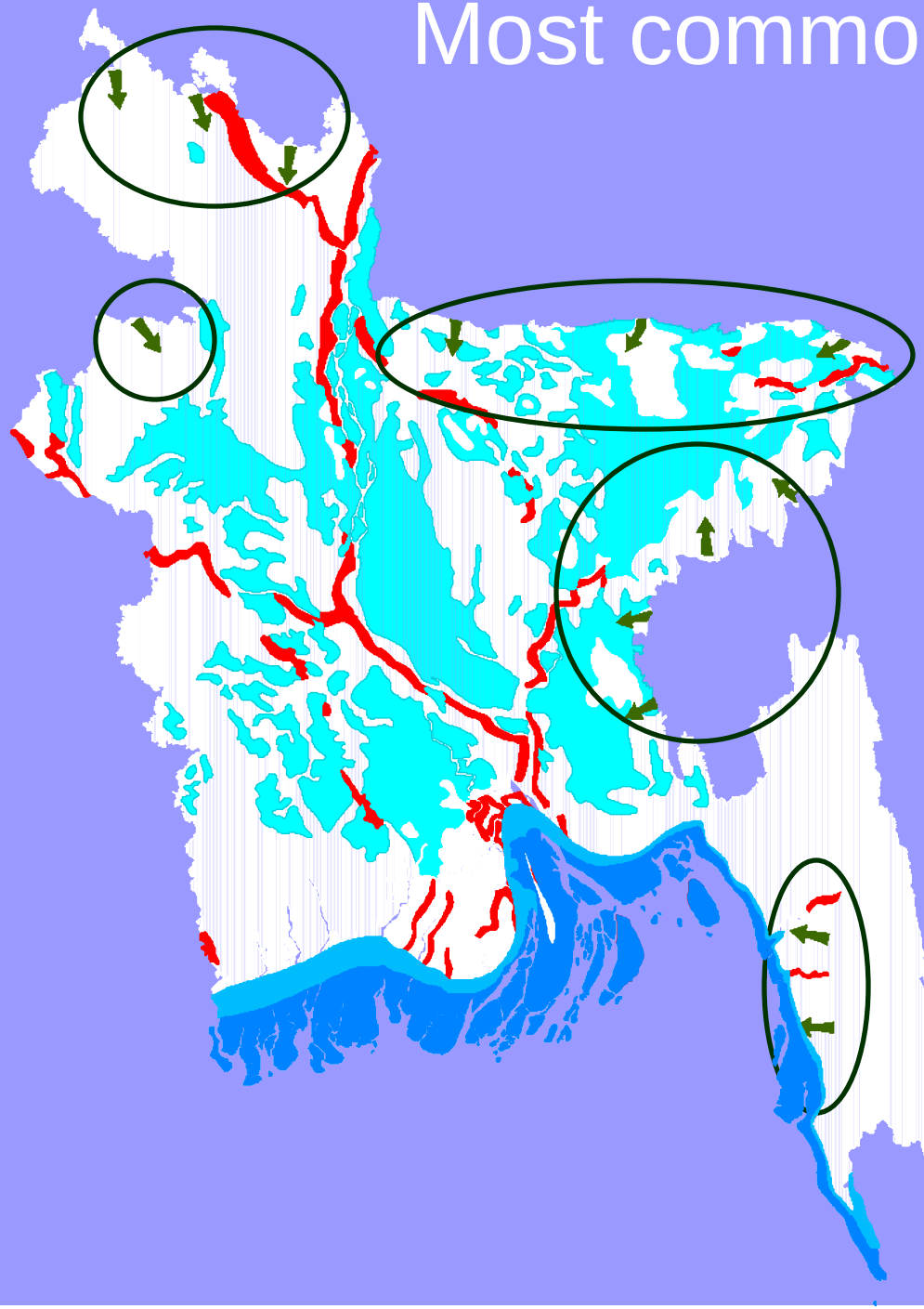
Bhutan and

Bangladesh.

Bangladesh being the lowest riparian country with low topography in the basin, these three major rivers discharge into the **Bay of Bengal** through the heart of Bangladesh.


CHINA
PAKISTAN
NEPAL
BHUTAN
INDIA
INDIA
MYANMAR
BANGLADESH
GANGOTRI
RISHIKESH
NAINITAL
GARH MUKTESAR
NEW DELHI
BHARATPUR
FATEHGARH
KANNAUJ
JAIPUR
FARRUKHABAD
KANPUR
KOTAH
ALLAHABAD
CHAPRA
PATNA
BHOPAL
KONGGYU TSO LAKE
LHASA
SHIGATSE
LHATSE DZONG
GYANTS
KATHMANDU
DARJEELING
DIBRUGARH
LAKHIMPUR
PANDU
CHERAPUNJI
BAHADURABAD
LAKHIMPUR
BHAIRAB BAZAR
DHAKA
CHANDPUR
CHITTAGONG
Bay of Bengal
GANGES BASIN 1,087,300 sq.km.
BRAHMAPUTRA BASIN 552,000 sq.km.
MEGHNA BASIN 82,000 sq.km.

Most common natural disasters



River Flood

River Bank Erosion

Flash Flood.

Surge height >1m

Surge height <1m

Flood

Flood is relatively high flow of water that overtops the natural or artificial banks in any of the reaches of a stream.

When banks are **overtopped**, water spreads over the floodplain and generally causes untold sufferings for

- inhabitants,
- damage to crops,
- vegetation,
- infrastructures,
- adverse impact on national economy etc

Flood Types

- Flash flood
- Flood due to local rainfall
- River flood and
- Coastal flooding

Flooding in Bangladesh

Severe floods are caused by mainly three factors:

local intense rainfall,
huge trans-boundary inflows and
cyclone induced surges.

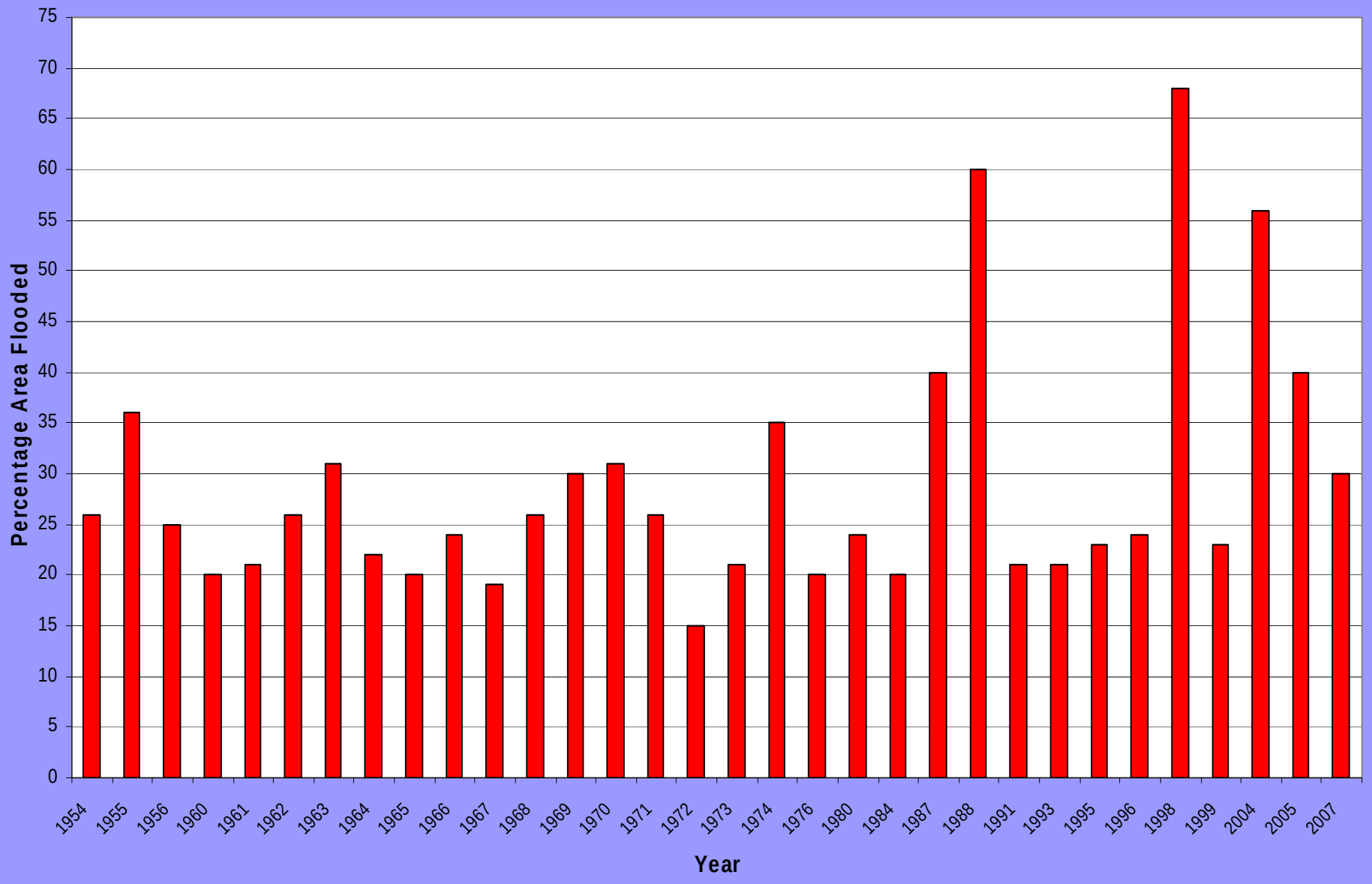
Synchronisation of local rainfall and trans-boundary flows in the major rivers cause severe floods.

Coastal flooding occurs in **April-May** and **October-November** when intense pre and post monsoon cyclonic winds funnel waters into the Bay of Bengal, producing tidal waves up to **5 m or more above normal high tide** with associated wind speed **over 220 km/h.**

Severe floods occurred in 1954, '55, '70, '74, '84, '87, '**88**, '**98**, **2004** and 2007.

Severe coastal flooding occurred in the year 1822, 1876, 1897, 1942, 1950, **1970**, 1974, 1988, **1991**, 1994, 1995 and **2007**.

Based on the historic records, it appears that the frequency, magnitude, and duration of floods have increased substantially during the last few decades. For example, all major floods covering more than **35%** of the country occurred after 1974.



Year wise Flooded Area in Bangladesh

Flooded village 1988

Dhaka City Flood 1988

Flooded

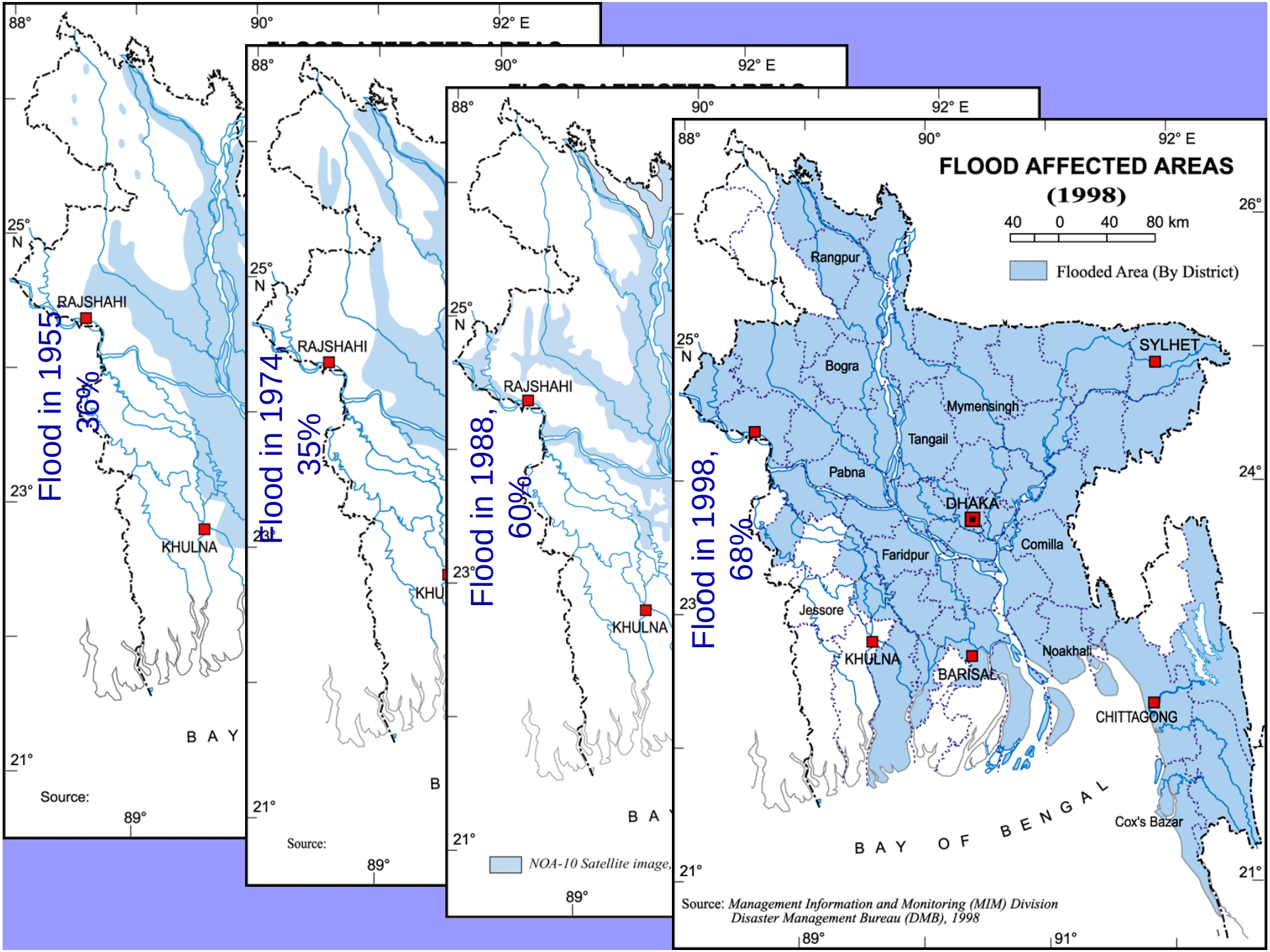
City, 2004

Flooded city, 2004

Flooded village 2007

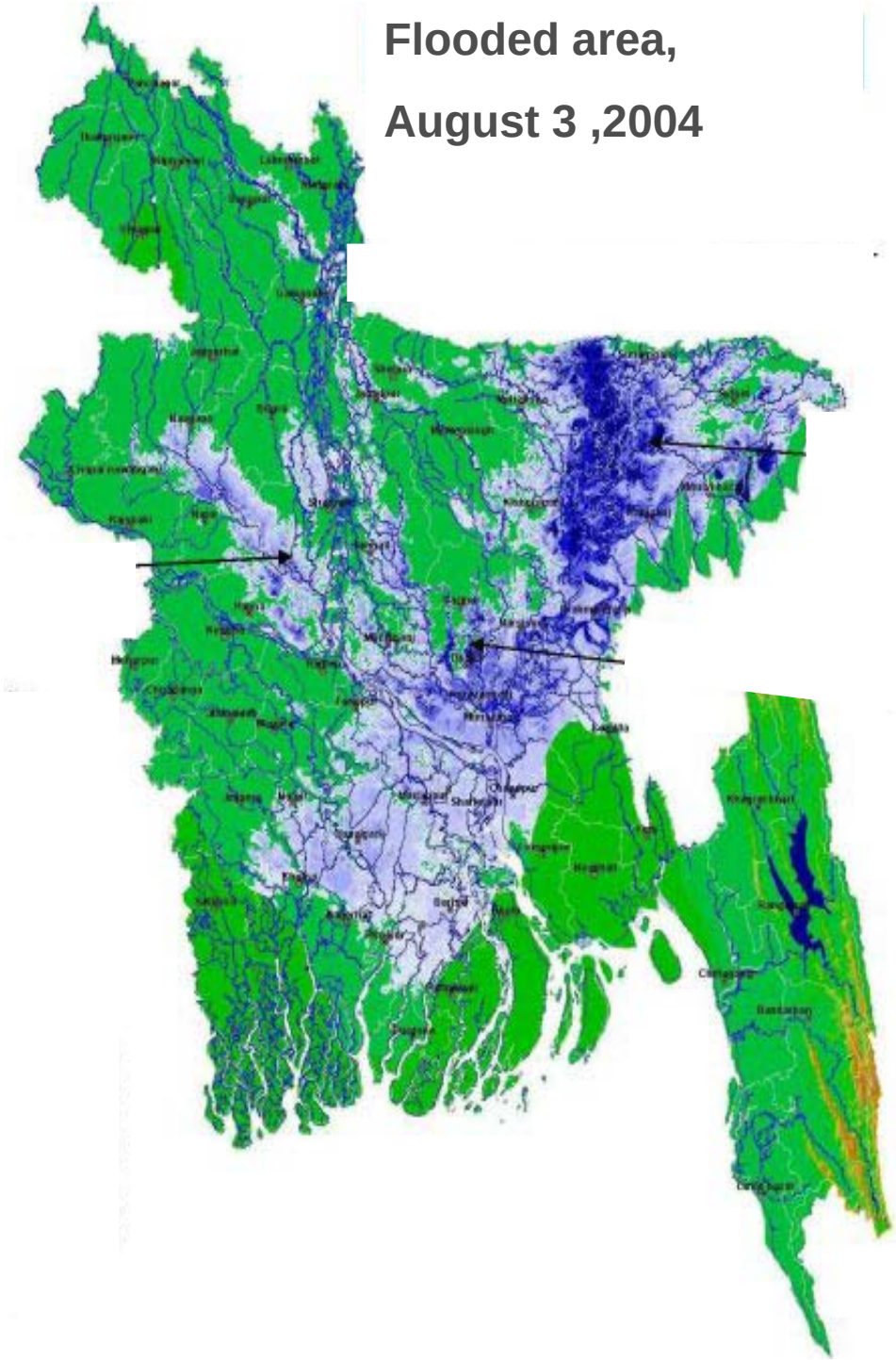
Flooded village 2007

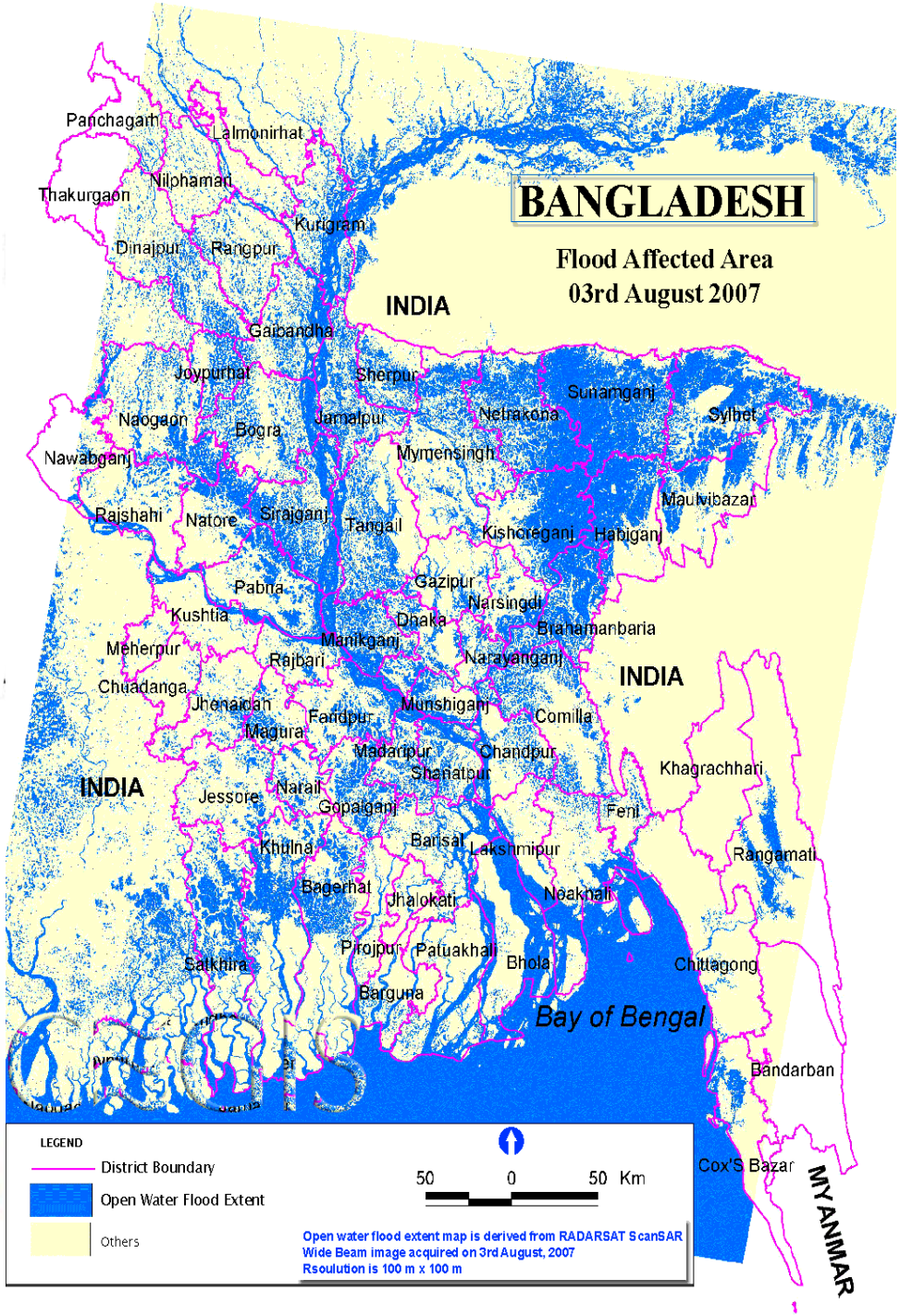
Over 3,400 people perished due to 250 km/h winds of Sidr that swept though coastal area of Bangladesh in November 2007.


Flood in 1955, 36%
Flood in 1974, 35%
Flood in 1988, 60%
Flood in 1998, 68%
FLOOD AFFECTED AREAS
(1998)
40 0 40 80 km
Flooded Area (By District)
RAJSHAHI
KHULNA
DHAKA
SYLHET
CHITTAGONG
BARISAL
Rangpur
Bogra
Mymensingh
Tangail
Pabna
Faridpur
Comilla
Jessore
Noakhali
Cox's Bazar
B A Y O F B E N G A L
NOA-10 Satellite image
Source: Management Information and Monitoring (MIM) Division
Disaster Management Bureau (DMB), 1998
88°
90°
92° E
89°
91°
25° N
23°
21°
26°
24°

Flooded area,

August 3 ,2004





Flood Damage

In case of most severe floods, 60% or more land area of the country is affected.

This brings untold sufferings to the poor and colossal damage and destruction to properties and infrastructures amounting to the tune of billion dollars.

The damage caused by such floods usually takes a very long time (decades) to repair or restore the damaged economy for a country like Bangladesh.

The 1988 flood resulted in a total damage to the national economy of approximately US$2 billion, and it was estimated that 45 million people were directly affected (Brammer, 1990).

The cost of direct damage for 1998 flood was US$ 2.8 billions (World Bank, 2002).

In 2004 the flood damage was estimated to be US$ 2 billion (Hye, 2007).

Flood Induced Riverbank Erosion

Historically the rivers of Bangladesh are unstable and bank erosion is common during flood.

Major avulsion of the rivers of Bangladesh occurred during the late eighteenth century

The morphological changes of the river due to flood have been associated with

Shifting,
widening and
widespread bank erosion

Flood Induced Erosion is one of the major natural disasters of Bangladesh

Last moments on their own land!

National loses

An embankment

A road

Flood Damage
Jamuna River

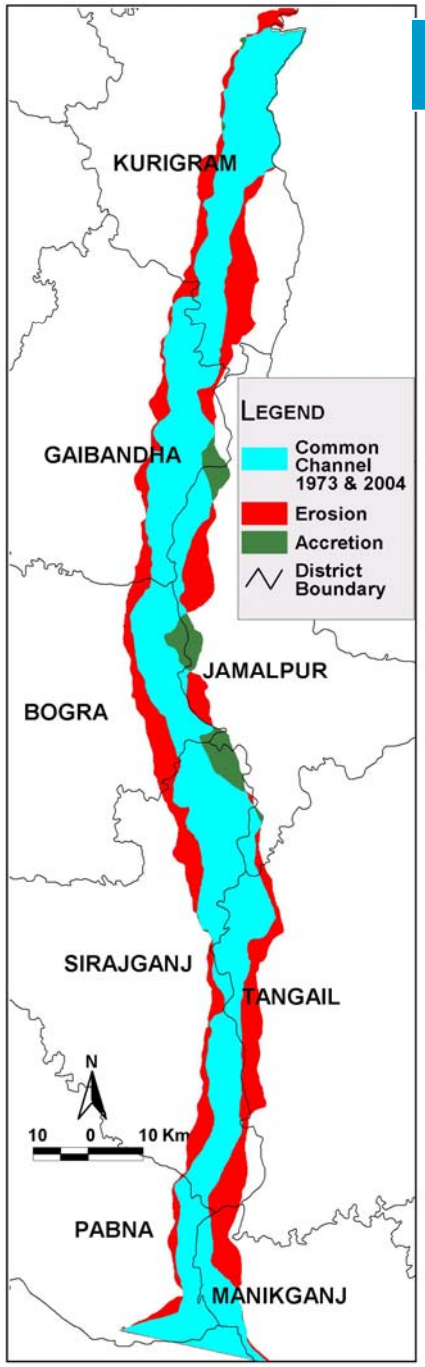
Flood Damage
Ganges River

Various estimates show that about 2000 km of river reaches in Bangladesh experience bank erosion each year mainly due to flood induced flow processes.

Studies have shown that erosion rate is the highest in the Jamuna River.

Very low erosion and width change occur in the Upper Meghna River which is the most stable among the large rivers.

Jamuna River



Erosion and accretion along the Jamuna River (1973-2004)

Total Erosion: 88,000 ha

Total Accretion: 12,500 ha

More than 9 lac people became homeless and landless

Erosion and accretion at different reaches along the Jamuna River are the most prominent in Bangladesh and is shown in the following table (1973-2004)

District	Eroded area (ha)	Accreted area (ha)
Kurigram	19,110	470
Gaibandha	8,870	1,370
Jamalpur	10,220	4,770
Bogra	9,940	2,440
Sirajganj	19,250	3,440
Tangail	11,540	0
Pabna	3,090	0
Manikganj	5,770	0
Total	**87,790**	**12,490**

Flood Control Measures

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.

Indigenous low cost solutions such as changing the housing structures and crop patterns can help reduce flood damage

Moreover, good governance, appropriate environmental laws, acts and ordinances will be necessary to achieve sustainable economic development and to reduce any environmental degradation.

In addition, implementation of an improved real-time flood and drought control warning system can reduce damage caused by floods (National Water Policy, 1999)

Therefore an integrated approach comprising

(i) structural and

(ii) non-structural measures

should be adopted

(i) Structural measures

A total of 5,695 km of embankments, including

3,433 km in the coastal areas,
1695 flood control/regulating structures, and
4,310 km of drainage canals have been constructed in Bangladesh

Embankments and polders have reduced floodplain storage capacity during floods, leading to an increase in water levels and discharges in many rivers

To reduce the losses from floods as well as to use the surplus water for irrigation, Bangladesh Water Development Board as part of structural measures for flood control, constructed a number of embankments and Barrages and dug canals.

Some major projects are

- G-K Project
- Dhaka-Narayanganj-Demra (DND) Project
- Karnafuli Multipurpose Project
- Coastal Embankment Project
- Brahmaputra Right Embankment Project

- Chandpur Irrigation Project
- Meghna-Dhonagoda Project
- Manu River Project
- Khowai River Project
- Pabna Irrigation Project
- Gumti Project
- Muhuri Irrigation Project
- Tista Barrage Project
- Dhaka Integrated Flood Protection Project
- System Rehabilitation Project
- Early Implementation Project.

(ii) Non-structural measures

An alternative strategy of Flood hazard mitigation, a concept of social adjustment known as non-structural measures.These include:

- dissemination of meteorological/flood forecasts to help speedy evacuation
- land management for reduction of runoff;
- landuse change and enactment of building codes, diversification of agricultural production;
- floodplain zoning involving landuse zoning to control development and restrictive development regulations;
- disaster relief during and post flood situation forms an important part of flood loss recovery.

Godagari Flood Embankment

Erosion protection works

Bank protection Meghai, Jamuna river

Coastal Embankment

Flood induced erosion control

Protection with sand -filled geobag

Protection with cement concrete blocks

Flood induced erosion protection

Protection with cement grout mattress

Protection with interlocking cement concrete blocks (tongue-grove type)

A new low cost concept: Bottom vanes

In Bangladesh for major rivers high cost bank protection measures are frequently exercised while for medium and minor rivers relatively low cost measures are being tried

Constructions of spurs, groynes and revetments using boulders and cement concrete blocks are very expensive.

A number of traditional and low cost measures are available, for example

bottom vanes, bandals, percupines, sills, floating screens, cut-offs, so-called intelligent dredging at critical locations, etc

A pilot project was undertaken to test the efficacy of bottom vanes on a medium sized river in Bangladesh located in the Dhaleswari basin in Tangail district. The river used to erode at an average rate of about 6 m per year in a bend due to flood.

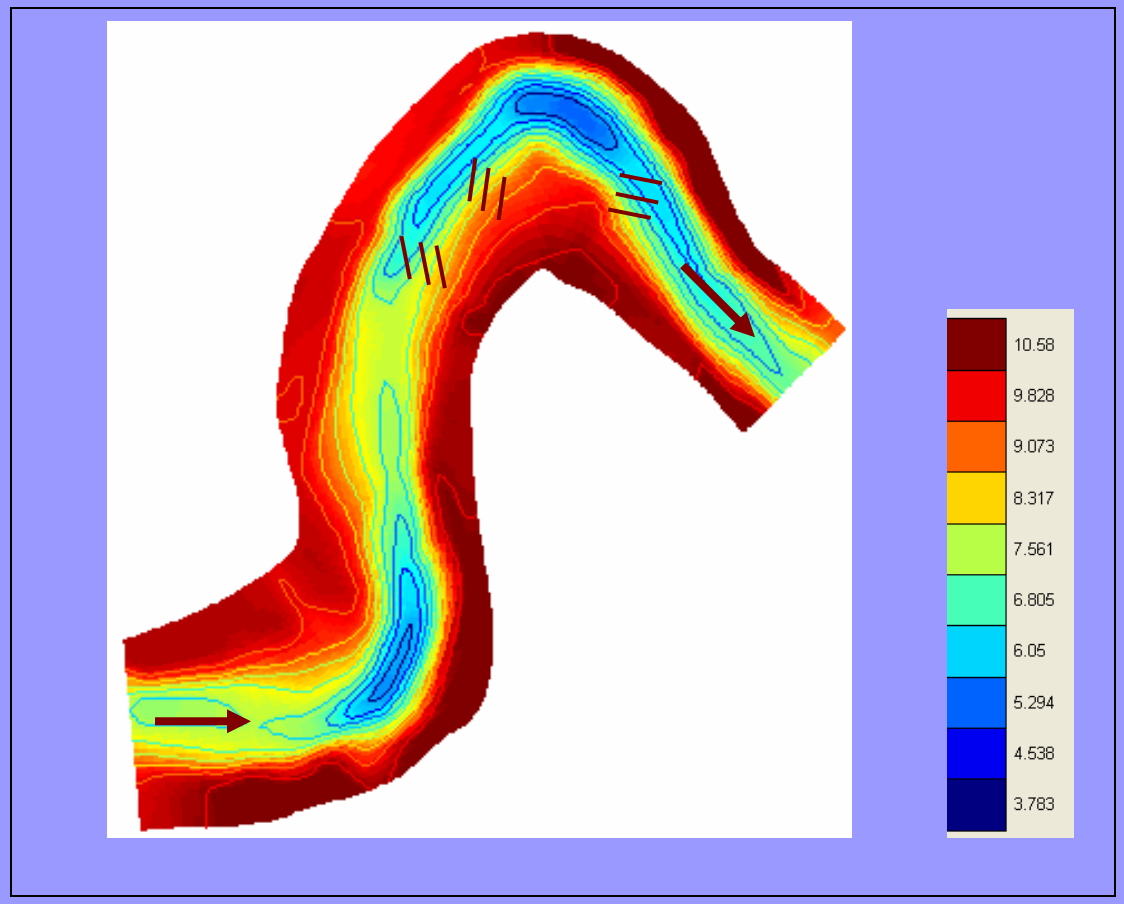
If no protection were provided in the selected river bend, the houses at the outer bend in the village Porabari could have been washed away by floods in few years.

Field site description

- Outer bend at low flow with an erosion rate of about 20 ft every year (6 m)

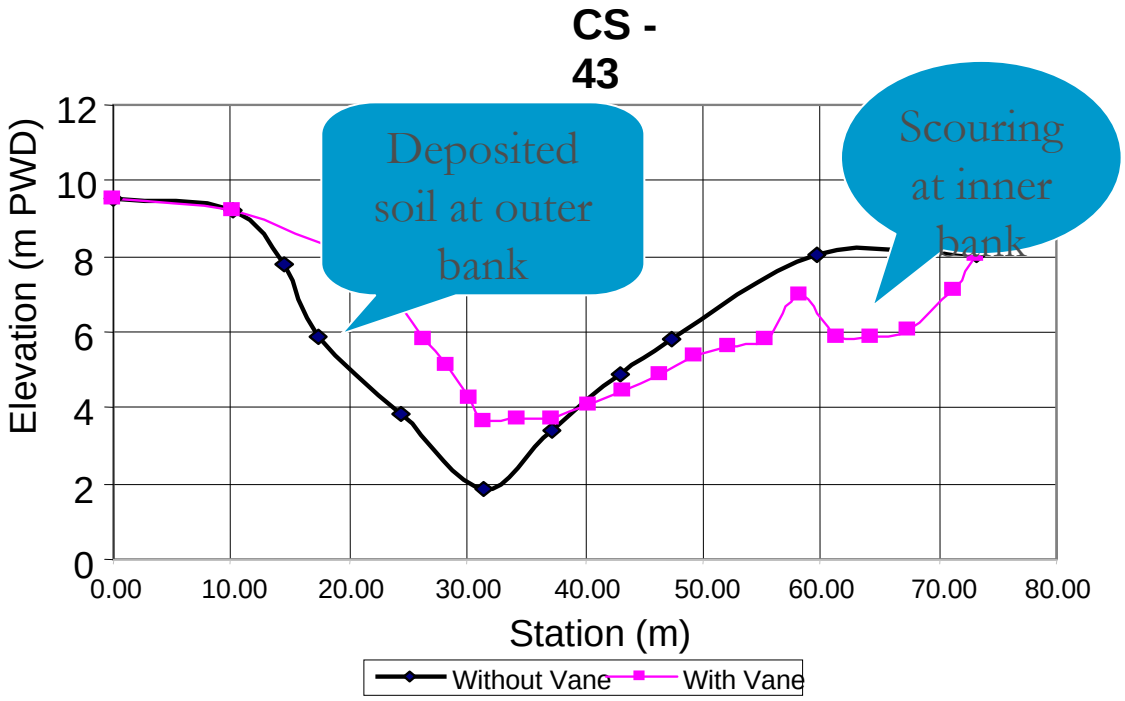
General layout

Layout of vanes and elevation contour lines of Elenjani River based on GPS data with Delft 3D modeling software



A view of a bottom vane constructed with low cost materials installed in the Elanjani River

Pilot study produced a remarkable result due to deposition of sediments in the eroding bend.



The cross-sectional view of bed topography where the deposited area and the scouring area are clearly visible

Conclusion

Structural solutions, such as embankments and revetments along the rivers, hard material protection and polders in coastal regions of Bangladesh are the conventional expensive structural measures against floods.

Nonstructural measures are equally important in reducing flood losses in a densely populated country like Bangladesh. A combination of structural and nonstructural solution is more desirable to avoid many adverse environmental, social and ecological consequences.

Low cost solution using cheap labour and materials for control of flood induced erosion may be tried in the minor rivers of Bangladesh

Since Bangladesh is a small part of a larger hydrodynamic system that comprises several countries in the region mutual understanding and cooperation among the co-riparian countries will be necessary to formulate long-term and sustainable solutions to the flooding and subsequent erosion problems in Bangladesh.

Thank You