Bangladesh Experiences and Innovations in Water Sector – Scopes for Strengthening Partnership

Water for People
Advancing South-South Cooperation

7th Karachi International Water Conference

28-29 Oct 2025

Karachi School of Business Leadership (KSBL), Pakistan

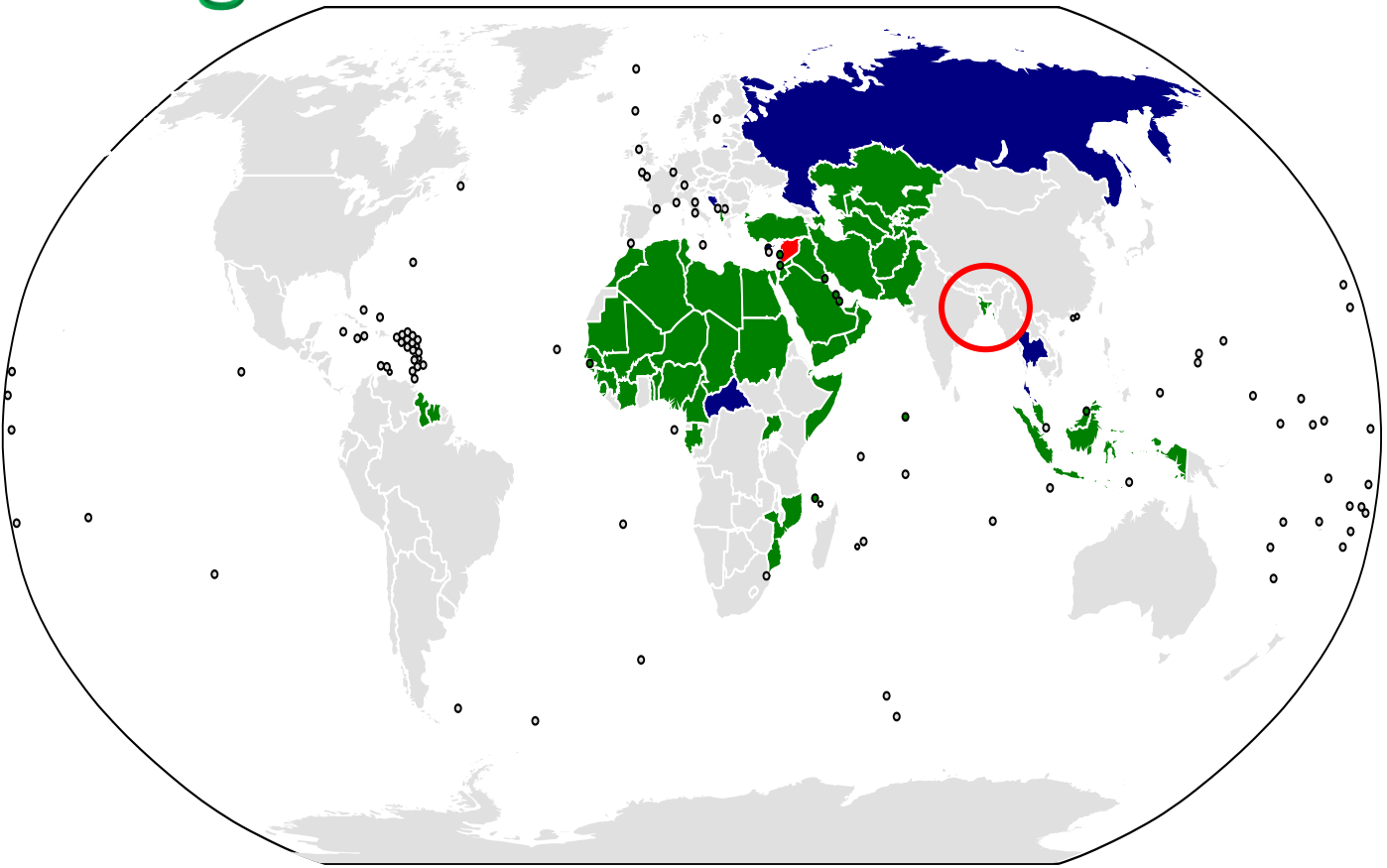
Hisaar Foundation

a foundation for water, food and livelihood security

Dr. Mollah Md Awlad Hossain

Director, ICT, IWM
Ministry of Water Resources, Bangladesh

Bangladesh



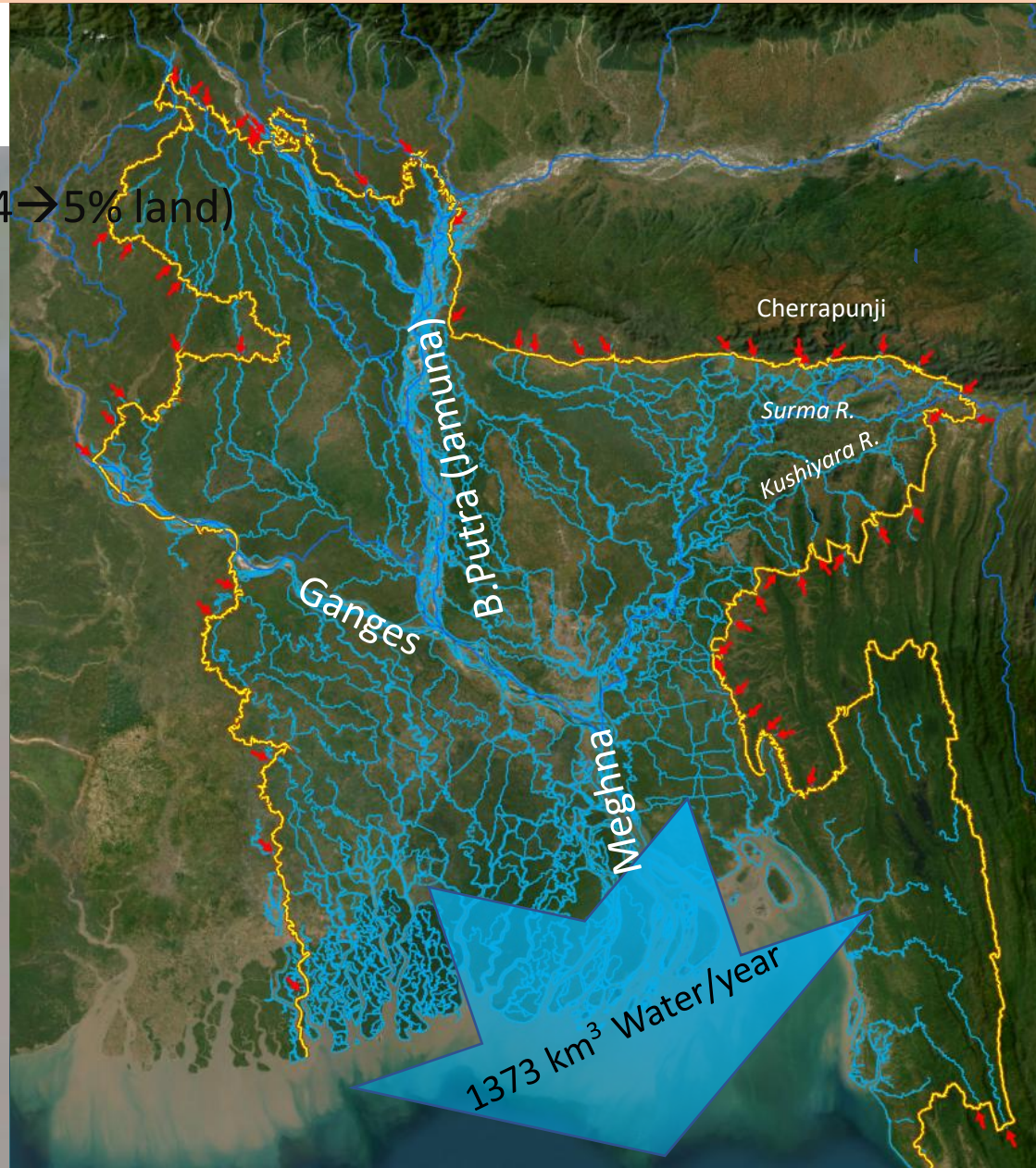
- Population: 2.1% of World, density 1350/km2
- Number 1 Most Flood affected in the World

Bangladesh – economy is governed by Water

Area: 1,47,570 km2

Population: ± 180 million

- Rivers: About 1100 nos. / 24, 000 km/ 6400 km2→7700 km2 (4→5% land)
- Major rivers: 405 rivers; Transboundary 57;
- Canals 6,536 Nos/27,083 km
- Navigable route 6000→38,00 km;
- Other wetlands: 4200 → 10,000 km2 (3→7% land)
- Sediment Load: 1.2 B.ton/yr
- Most ferocious reiver: Jamuna – Widen 12 km
- Flooding area : 20% (avg.) → 70% of BD area
- Rainfall (avg): 2700 mm

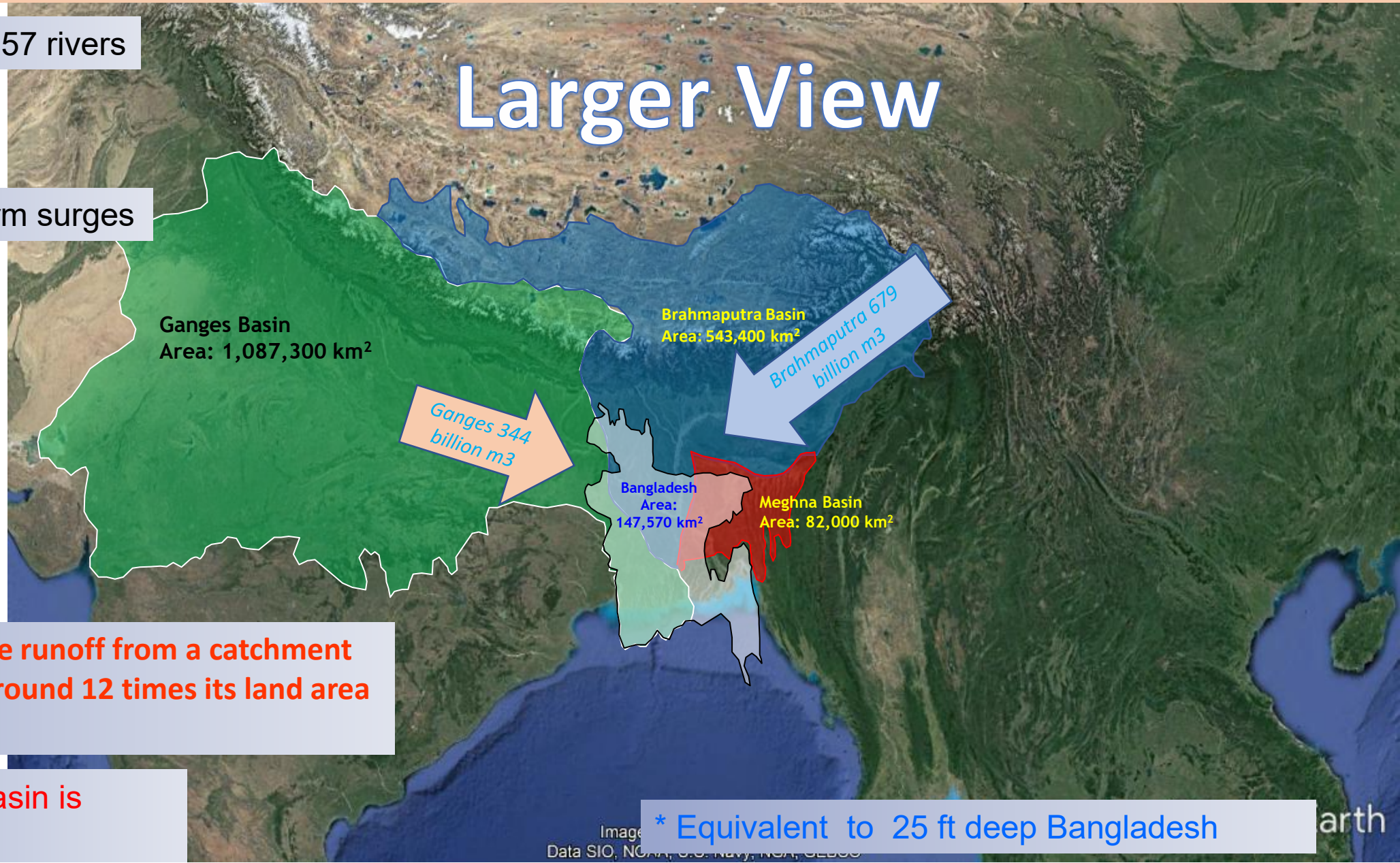


Water Flow in Regional Context

Transboundary Flow 57 rivers

Local Rainfall

Cyclone induced storm surges

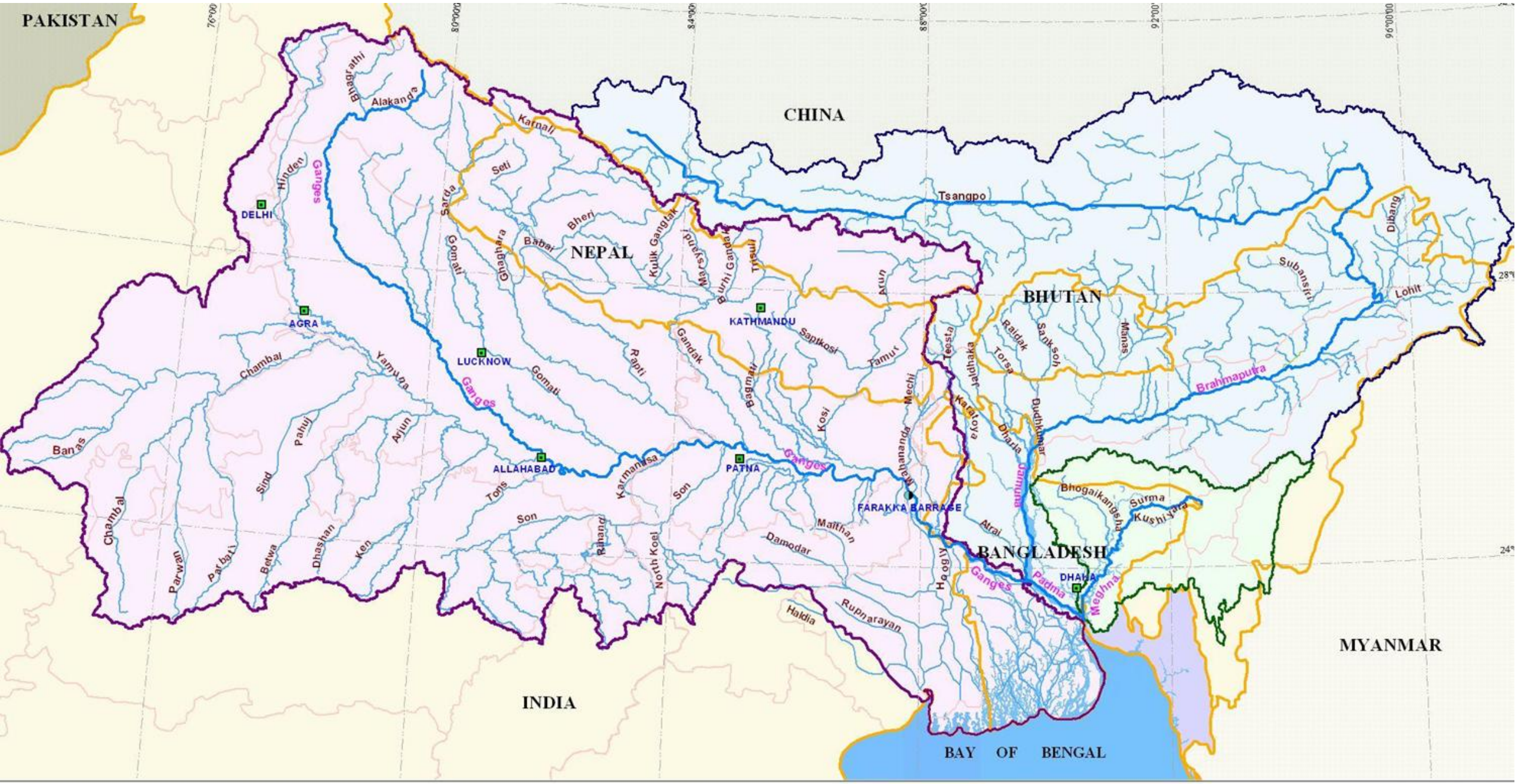


Bangladesh rivers receive runoff from a catchment of 1.72 million sq. km, around 12 times its land area

Only 8% of GBM basin is within Bangladesh

* Equivalent to 25 ft deep Bangladesh

Ganges Brahmaputra Meghna River Basins



Major Water related Hazards & Measures

Flood

Drought

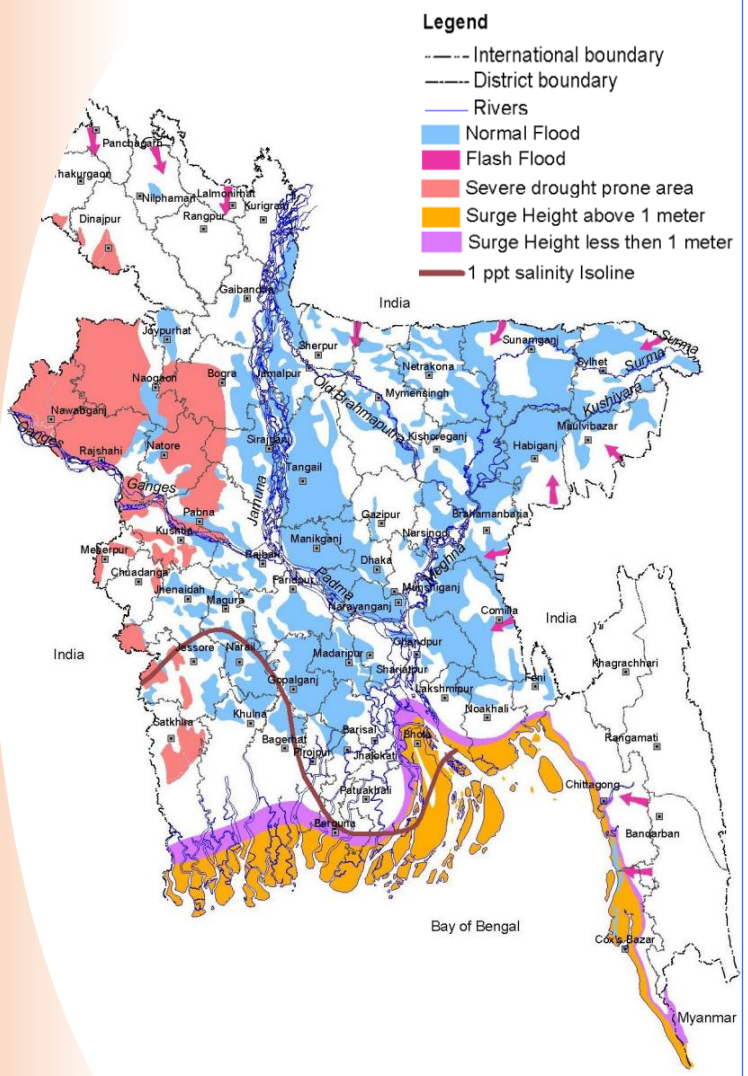
Erosion

Cyclone

Salinity

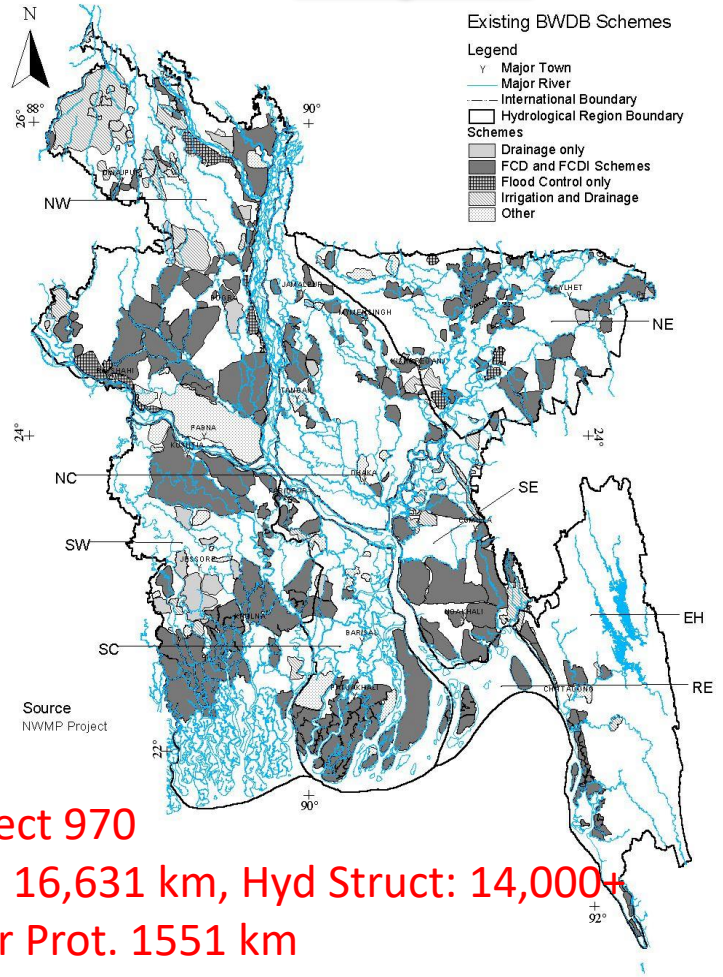
Pollution

Climate Change



Structural Measures

- Flood Protection and
- Flood Management



Project 970

Emb 16,631 km, Hyd Struct: 14,000+

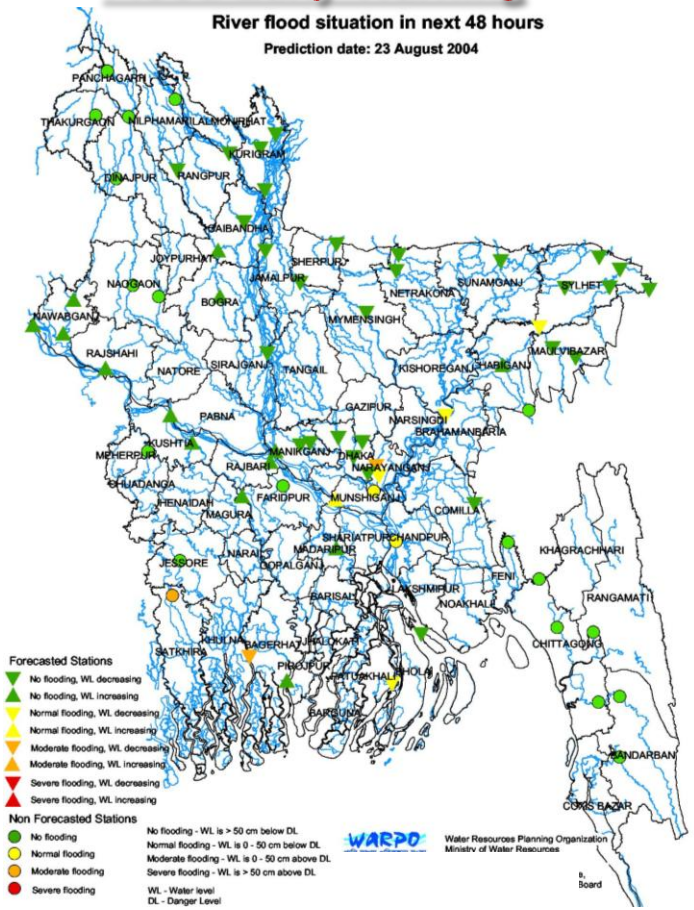
River Prot. 1551 km

Dredging 5050 km

Irrig. Proj 180 Nos.

Non-Structural Measures

Flood Early Warning



Flood EW : 3 – 5 days

Bangladesh Flood prone area

Flood Impacts

Flooded 20-25% of land area, in extreme it →70%

Annual Impact: Floods affect 5-10 million people annually, extreme years it may exceed 30 million

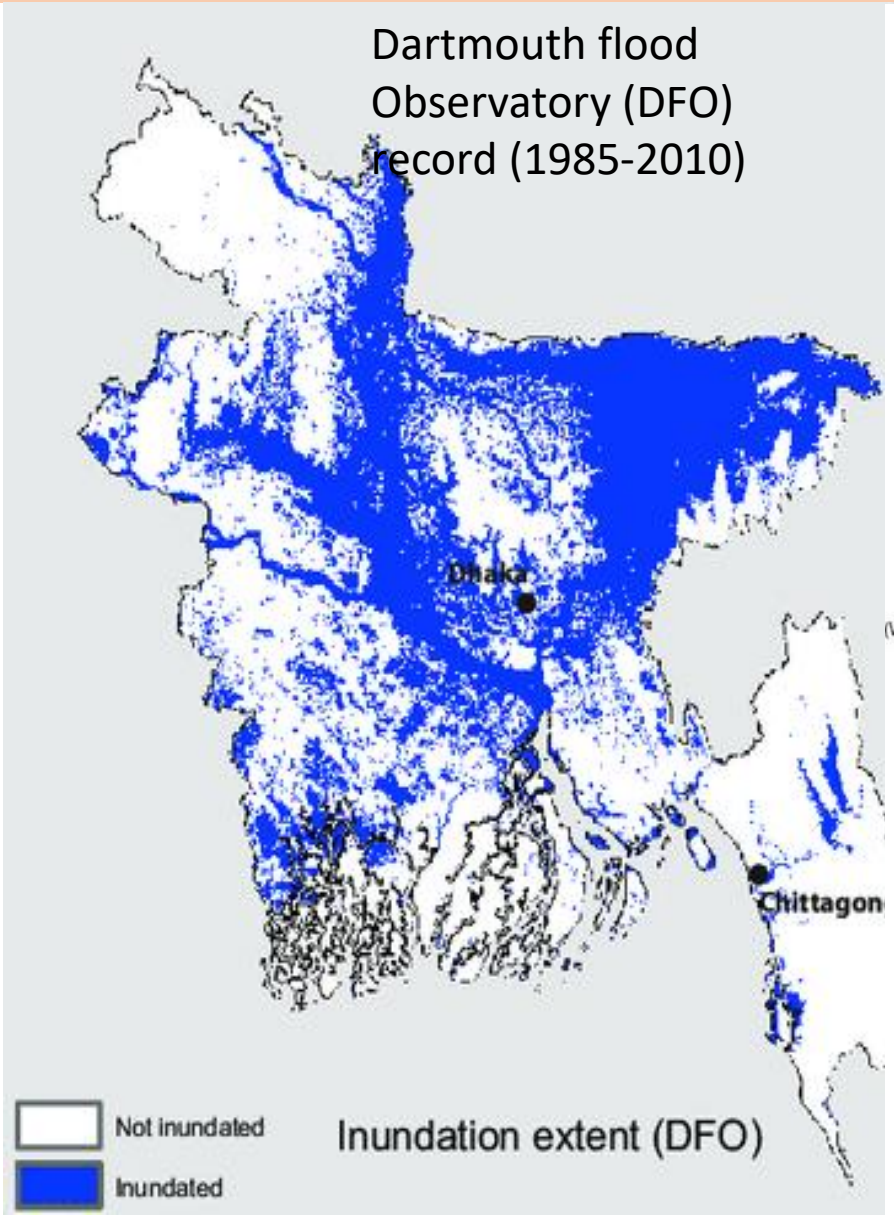
Floods cause economic losses of **USD 1-2 billion**

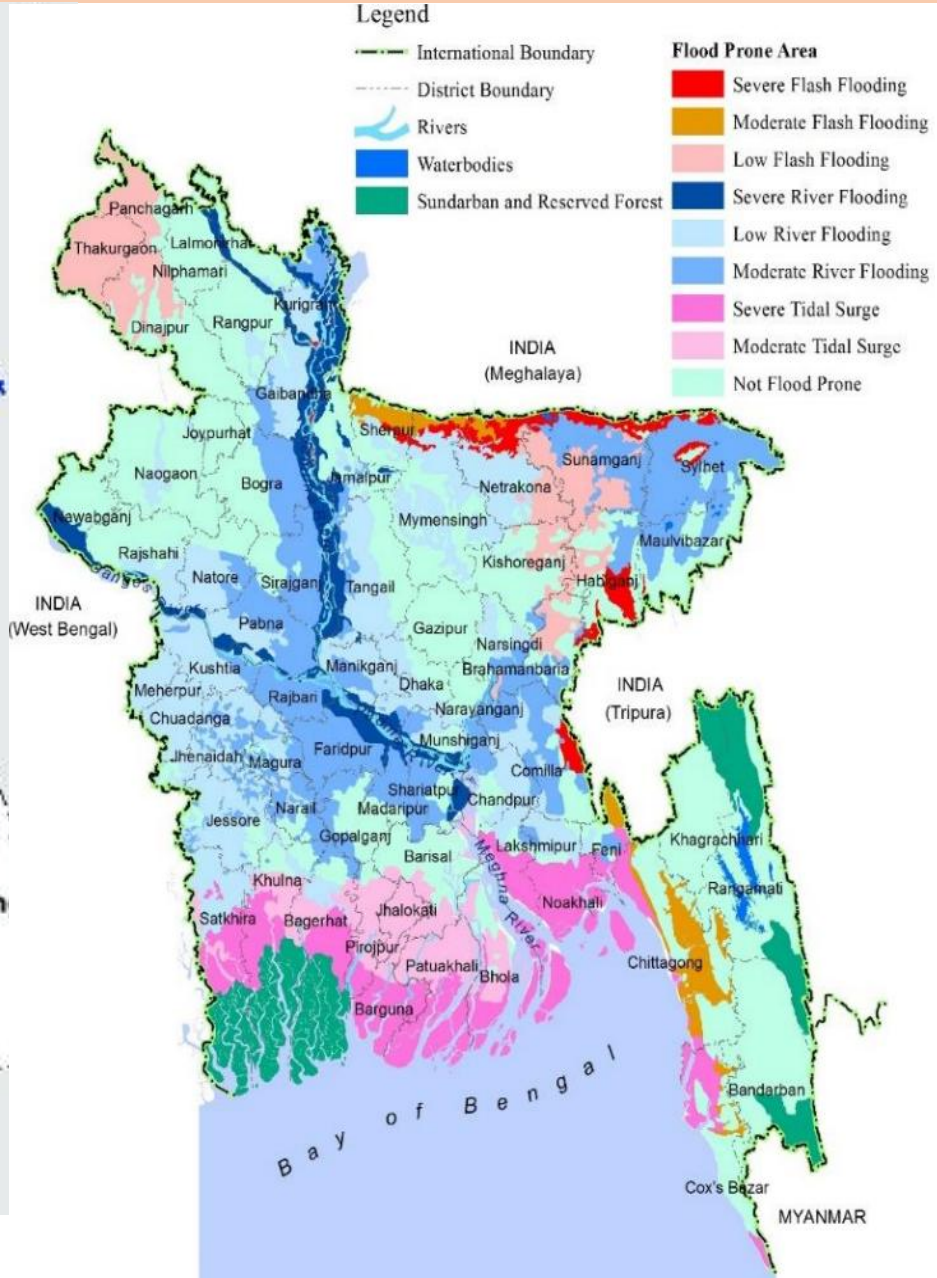
Yr 2020 floods damaged **over 400,000 homes**

2020 floods displaced **over 1.5 million people**.

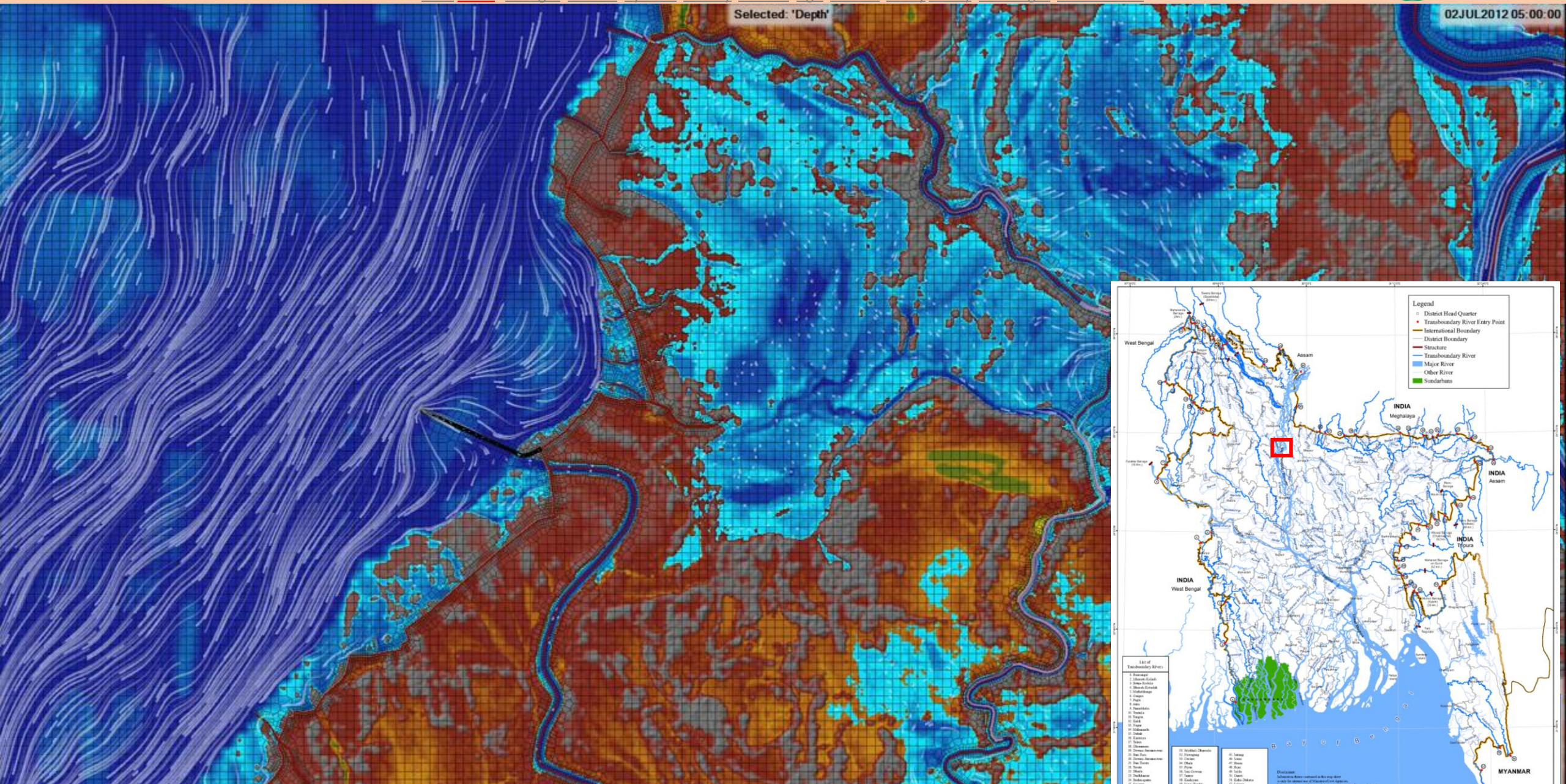
Climate Change is expected to increase flood-prone areas by **25-30%**

Dartmouth flood Observatory (DFO) record (1985-2010)





2d Model -Flood Simulation on Jamuna Right Bank



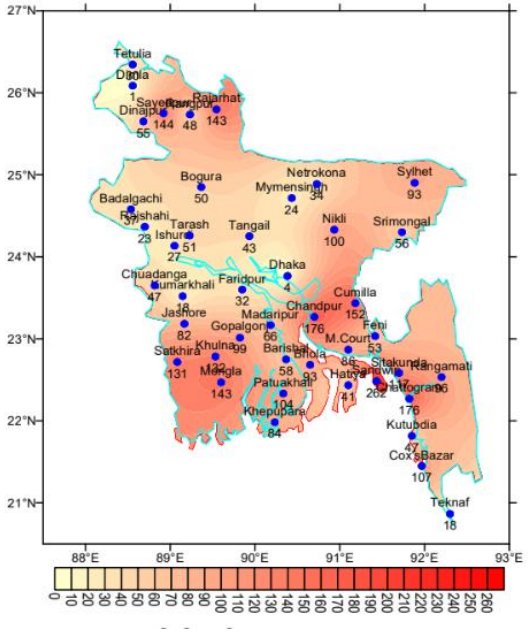
Meteorological Forecasting

Government of the People's Republic of Bangladesh
Bangladesh Meteorological Department
(Agro-meteorology Division)
Meteorological Complex, E-24, Agargaon, Dhaka-1207.
www.bmd.gov.bd

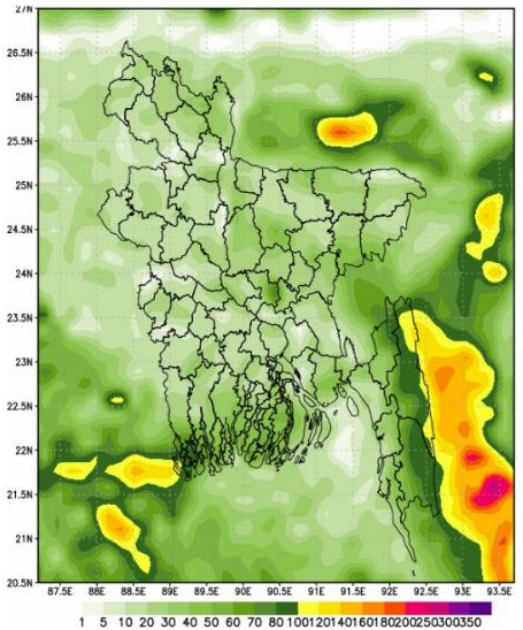
Agm-23.09.0000.035.51.011.21.36 **Issue date: 22-09-2021**

Forecast for the period: 22.09.2021 to 30.09.2021

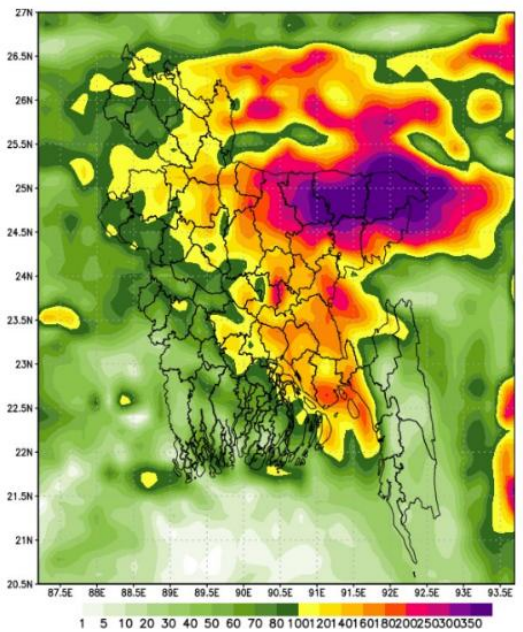
Spatial distribution of Rainfall (mm)
Period (15-09-2021 to 21-09-2021)



Simulated Rainfall (mm) (WRF model)
Period (22-09-2021 to 30-09-2021)



Extended outlook for accumulative rainfall(mm)
Period 01-10-2021 to 07-10-2021)



Flood Forecasting by FFWC

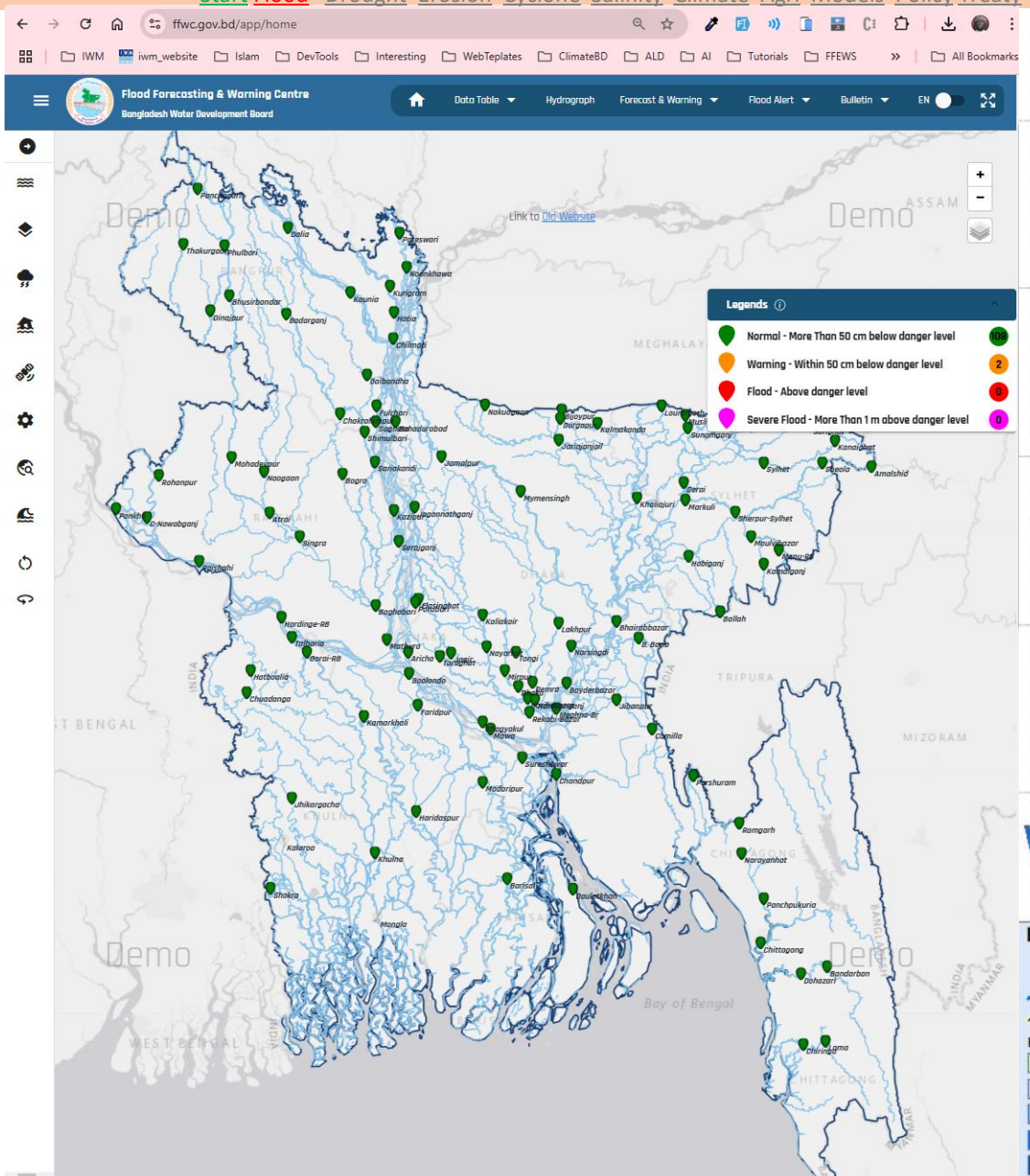
Flood Forecasting and Warning Center (FFWC), BWDB

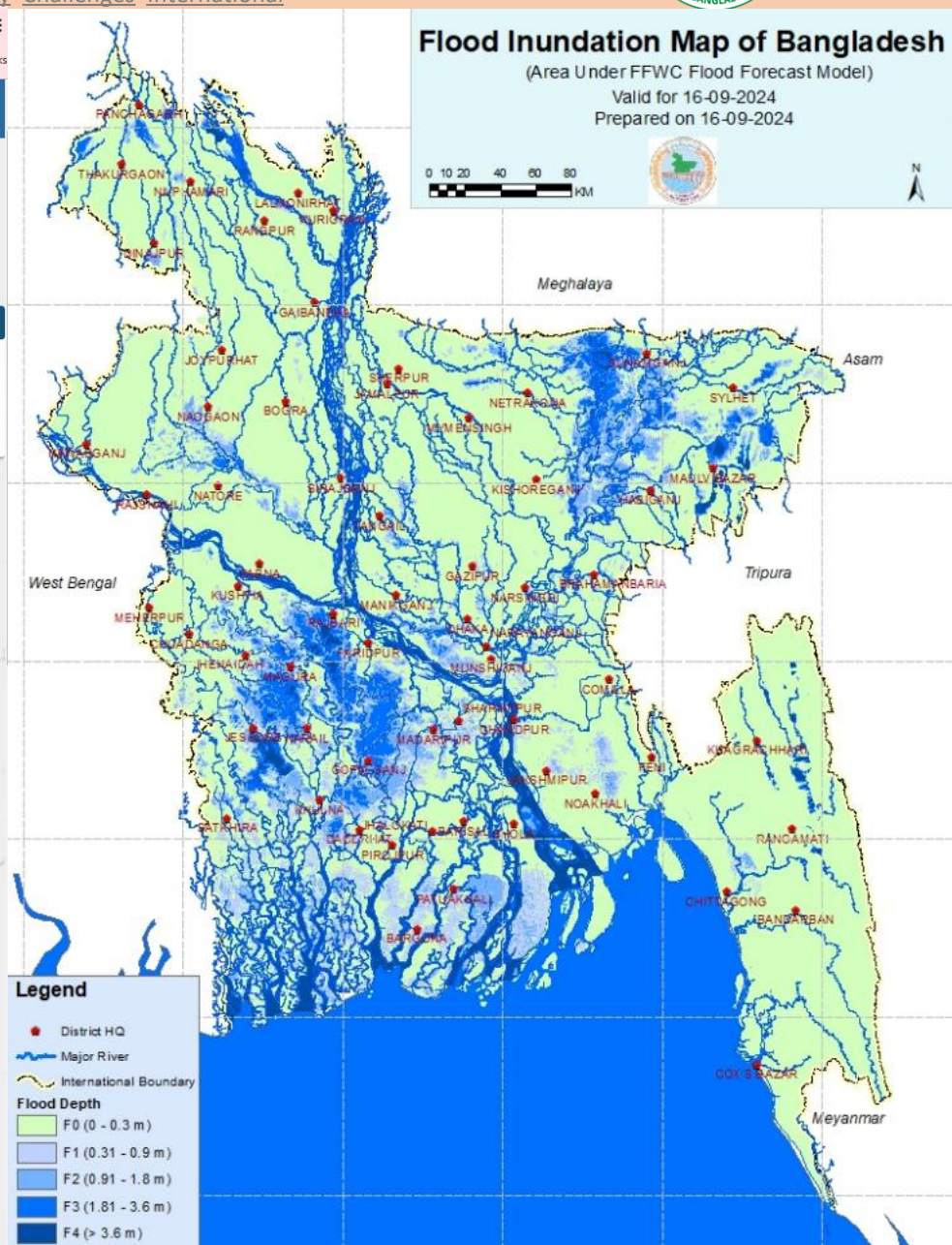
5–day deterministic

10–day probabilistic

Flood Bulletin

Flood Alerts

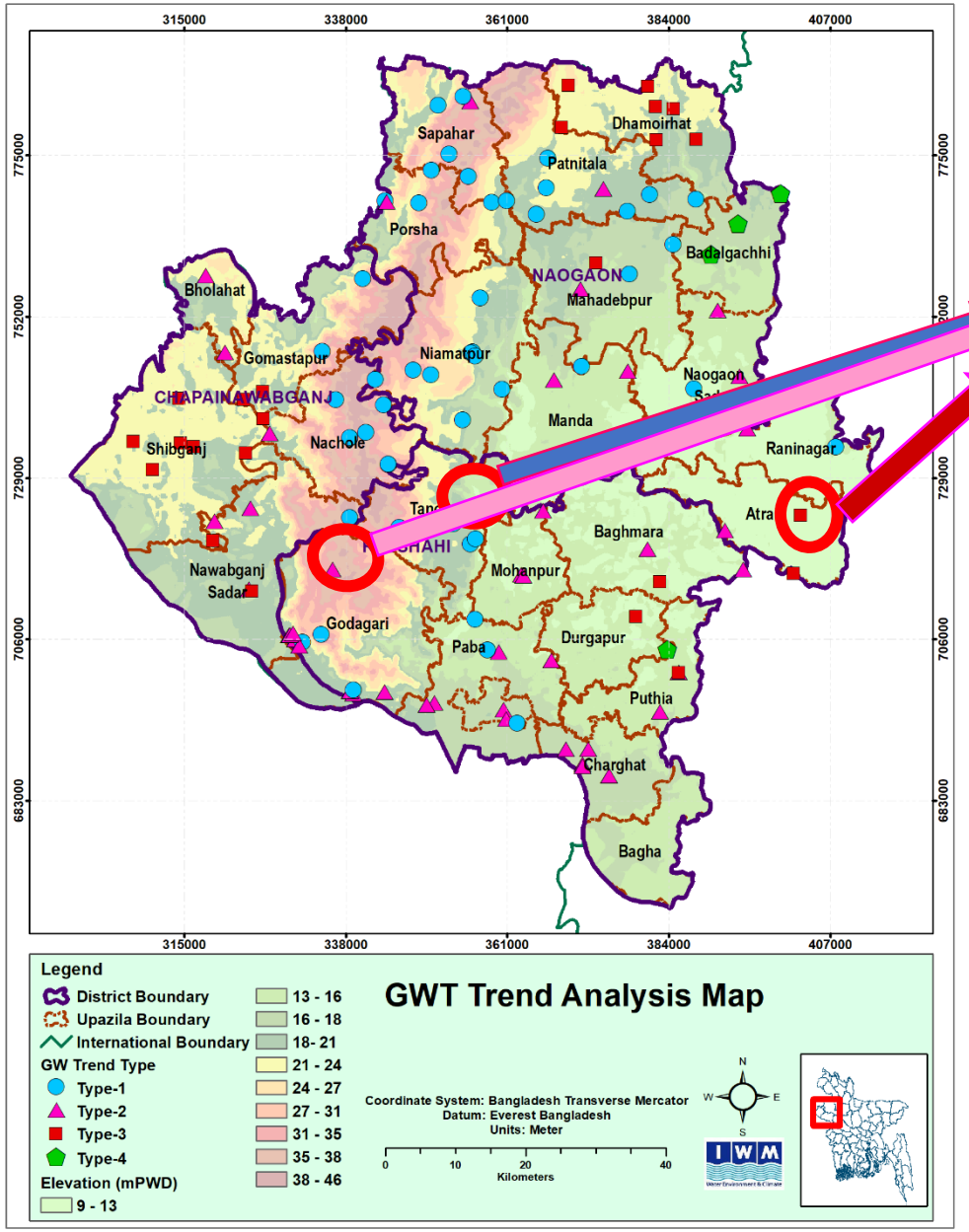


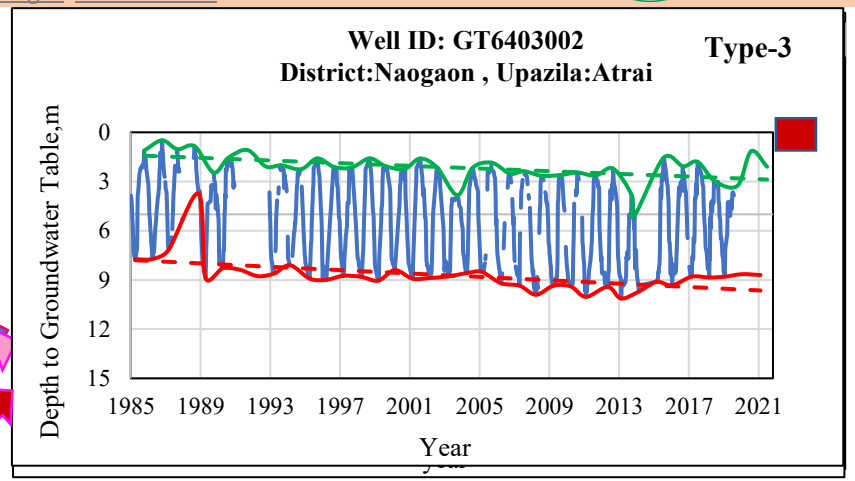


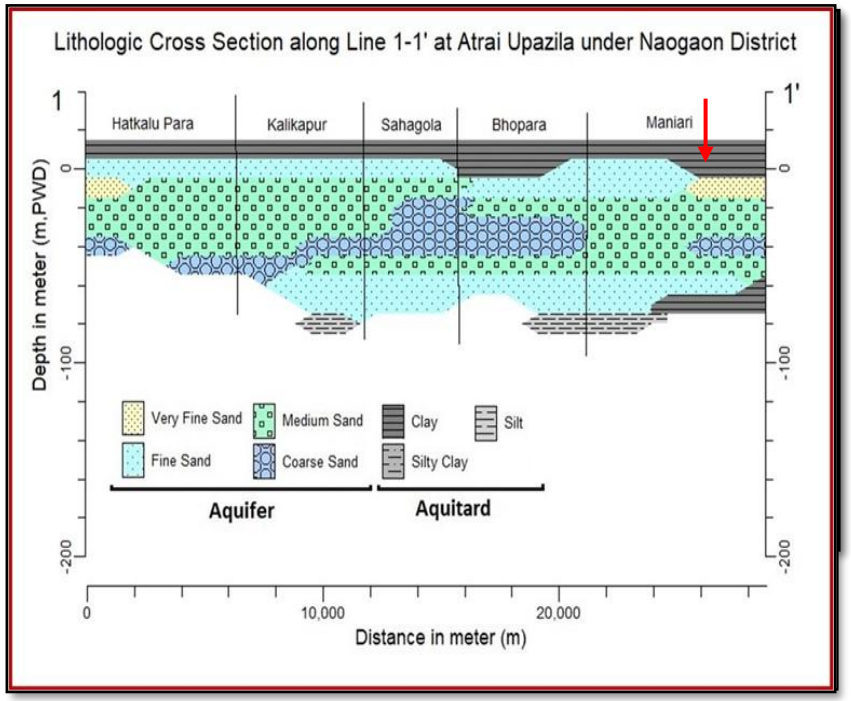
Ground Water Modelling

Ground Water is going down

- Alternate source (SW storage) required
- AWD for optimal use of water
- Change of cropping to less water req







Drought

IMPACTS

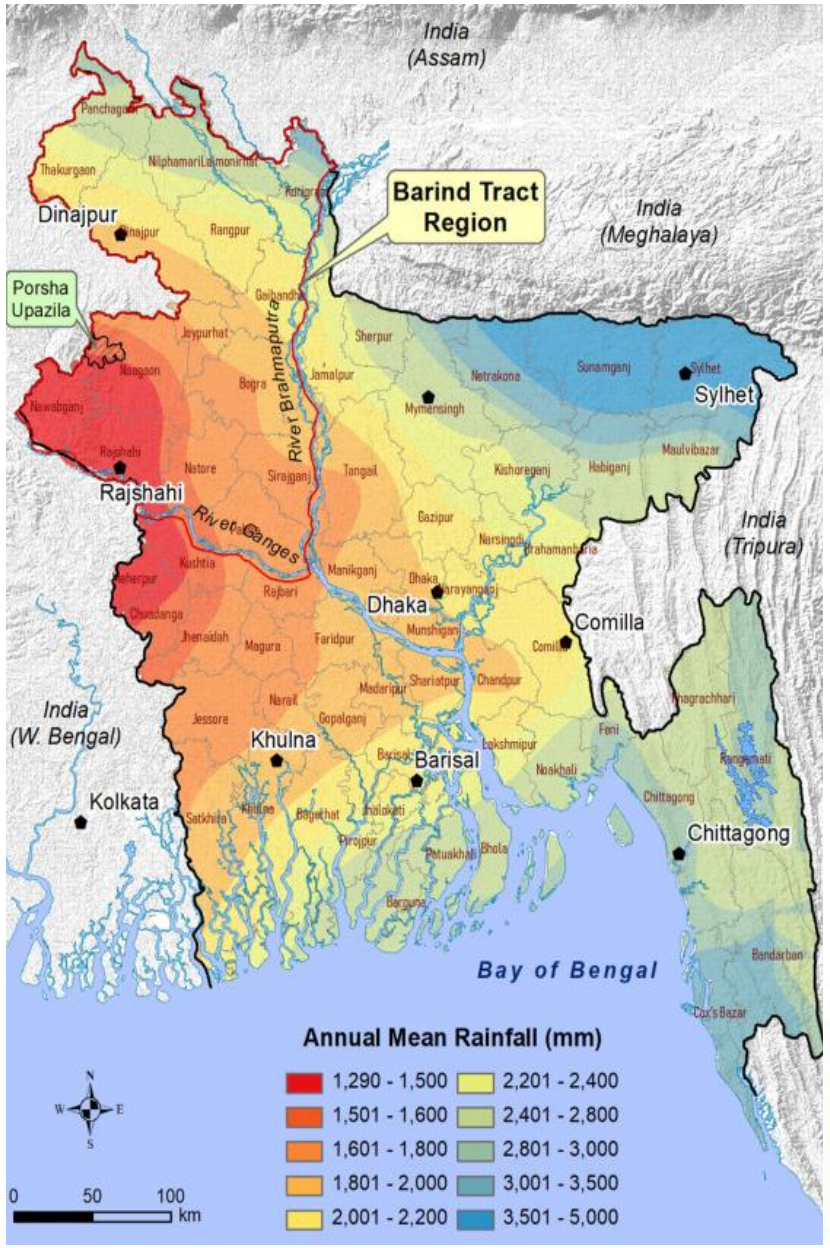
Agriculture and Food Security:
20-40% less production

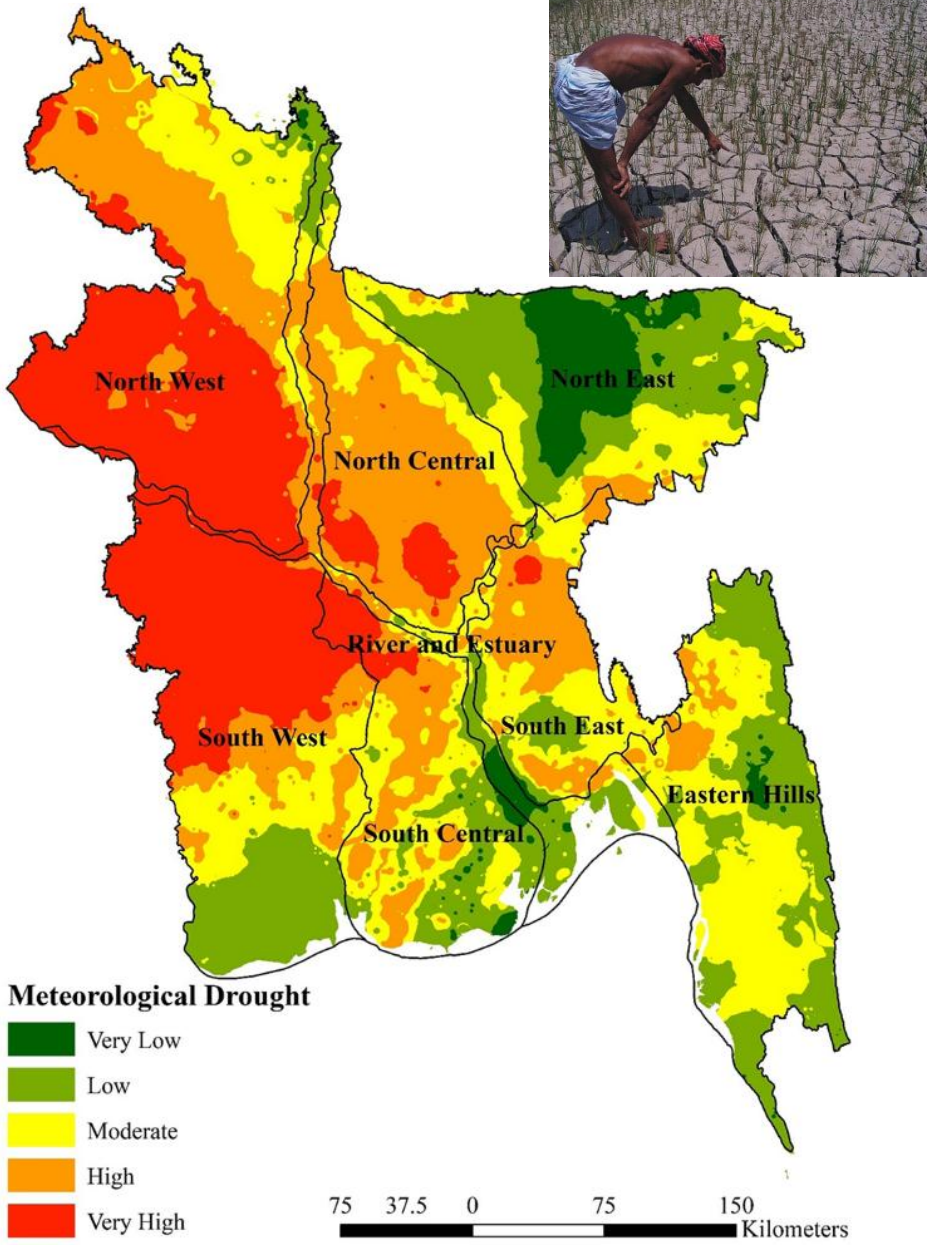
Water Resources:
Depleted Groundwater (1-2m), Reduced River Flow, Water Scarcity (20million people suffers from availability drinking water)

Environment: Soil Degradation, Loss of Biodiversity, loss of wetlands

Socioeconomic Impacts:
Poverty and Displacement, Health Issues, Economic Losses

Climate Change may increase frequency 20-30%

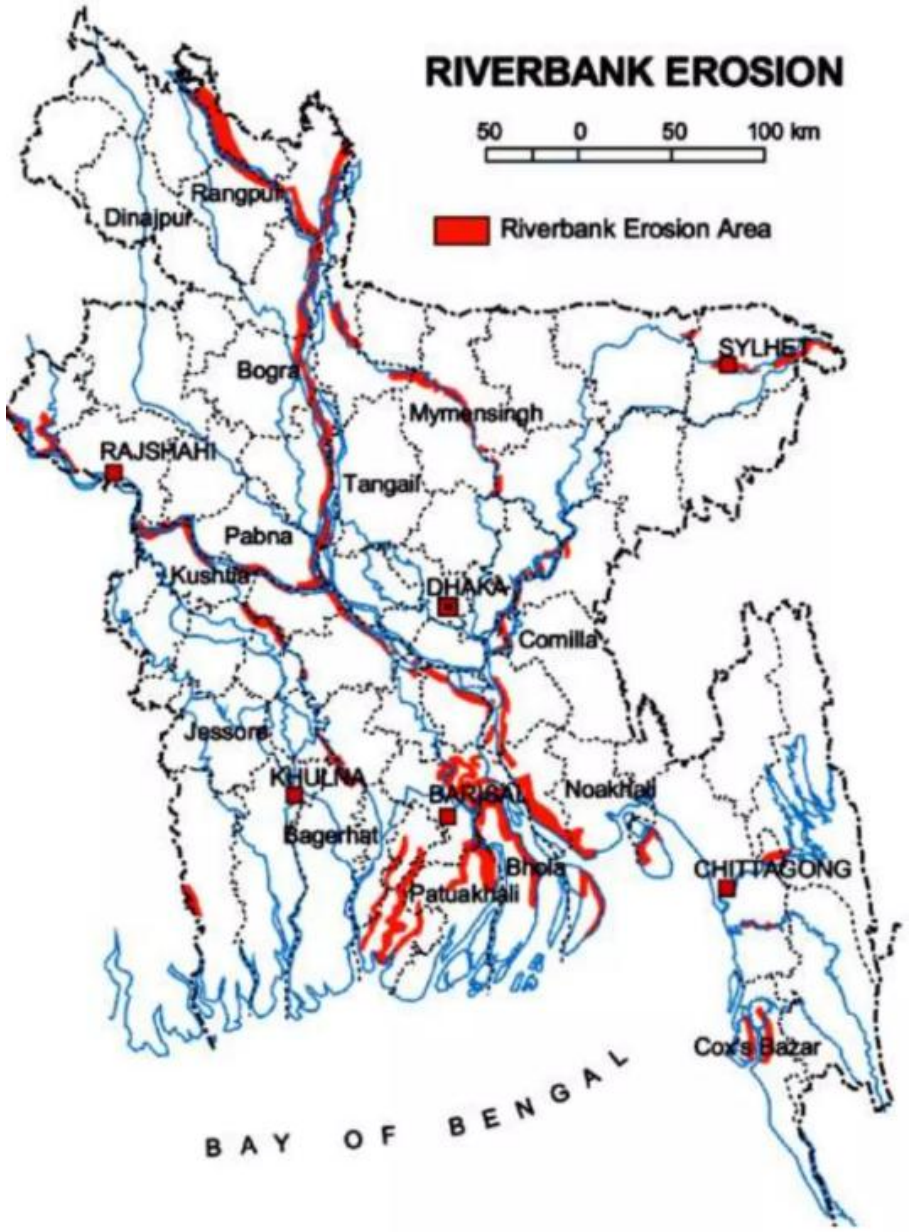




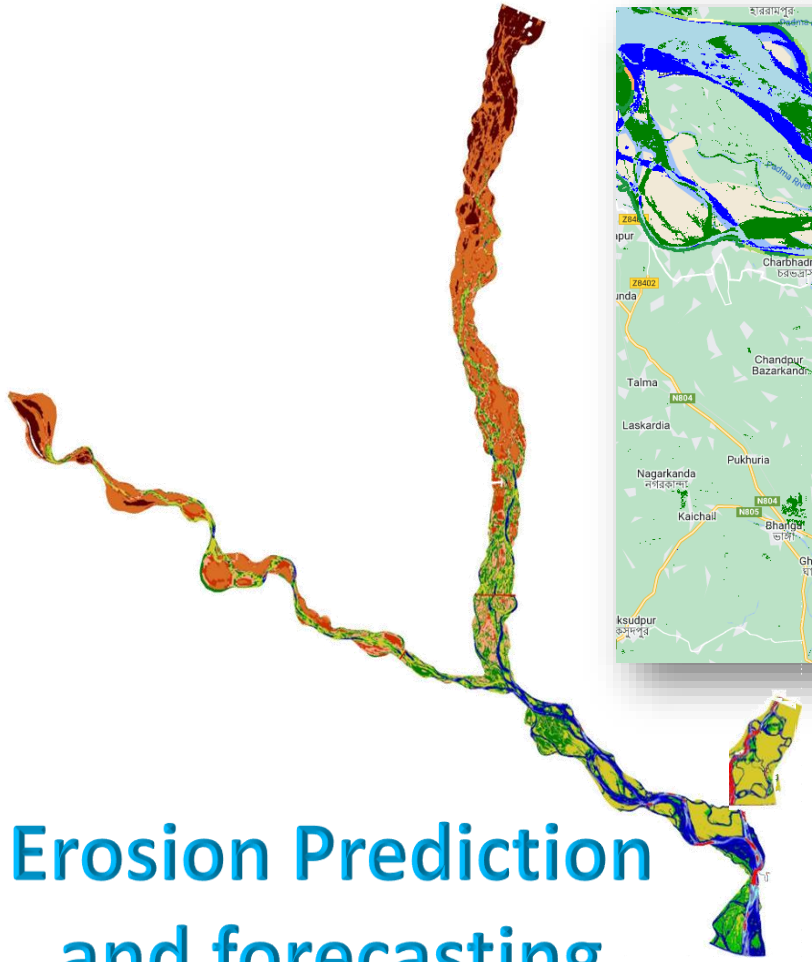
Erosion

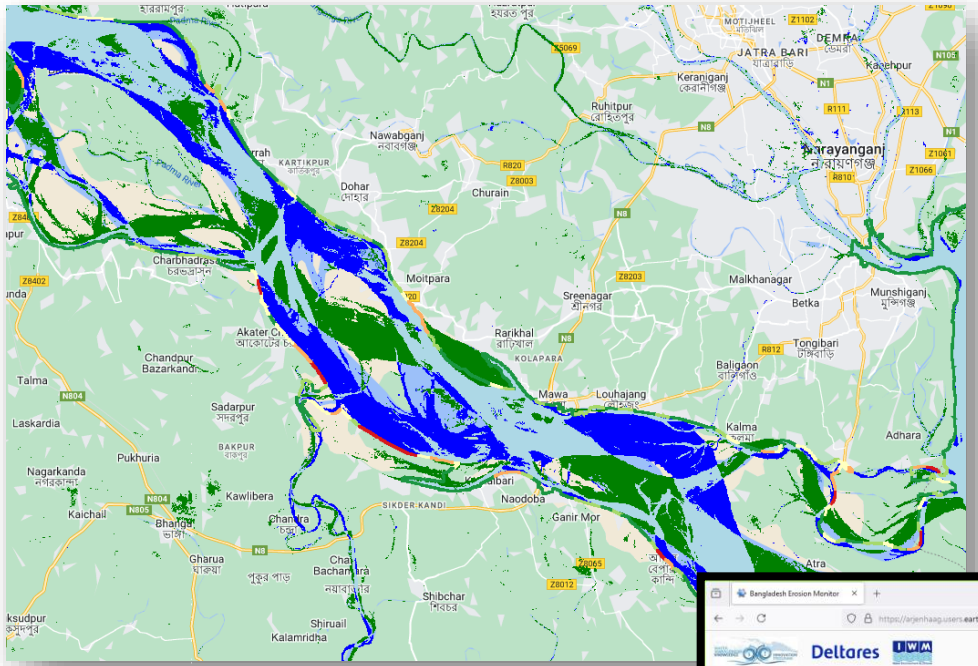
Erosion IMPACTS

- Annual Land Loss:8,000 to 10,000 ha
- Annual Displacement: 50 to 200K people
- Agricultural Losses: $500 mil – $1.0 bil
- Infrastructure Damage: $100 million
- Loss of Homes and Assets (20,000 families affected in 2020)
- Climate Change and Future Projections (20-30% increase by 2050)

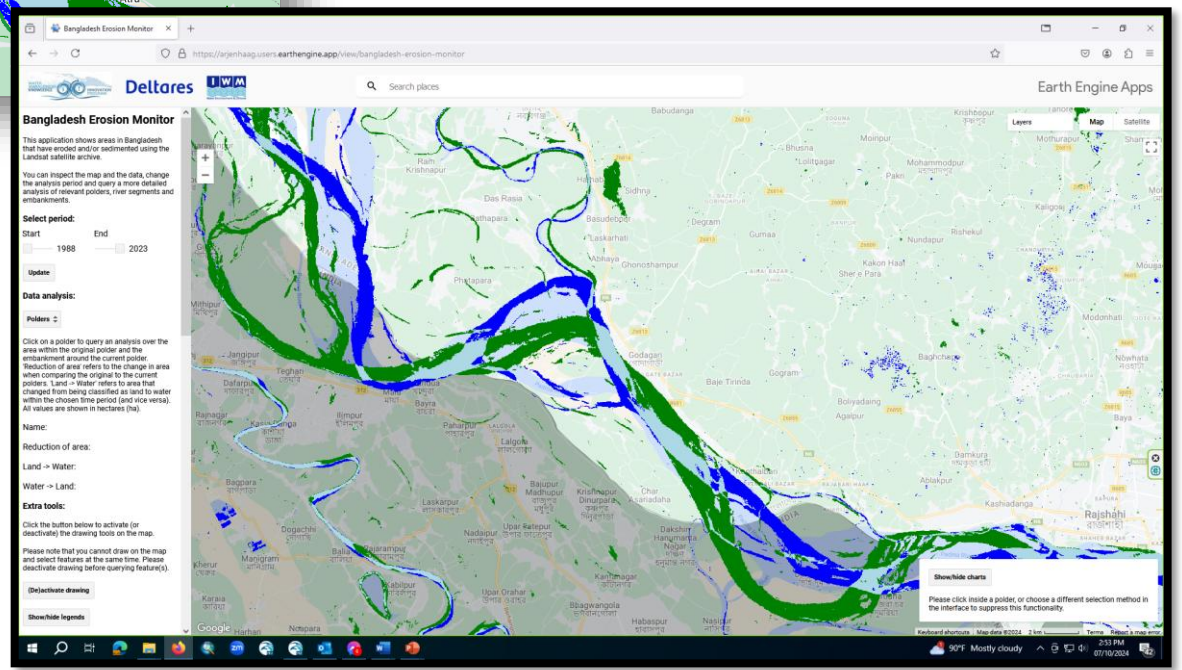


Bangladesh Erosion Monitor Tool





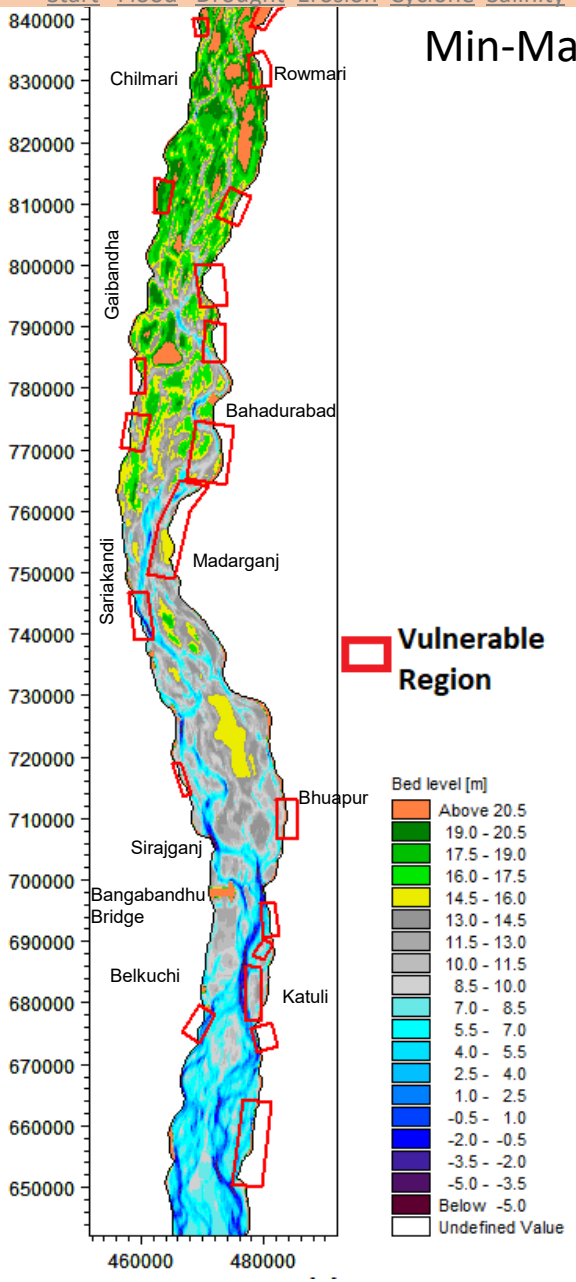
Since 1967, more than 66,000 hectares (256 square miles) have been lost—roughly the area of Chicago.



Erosion Prediction and forecasting

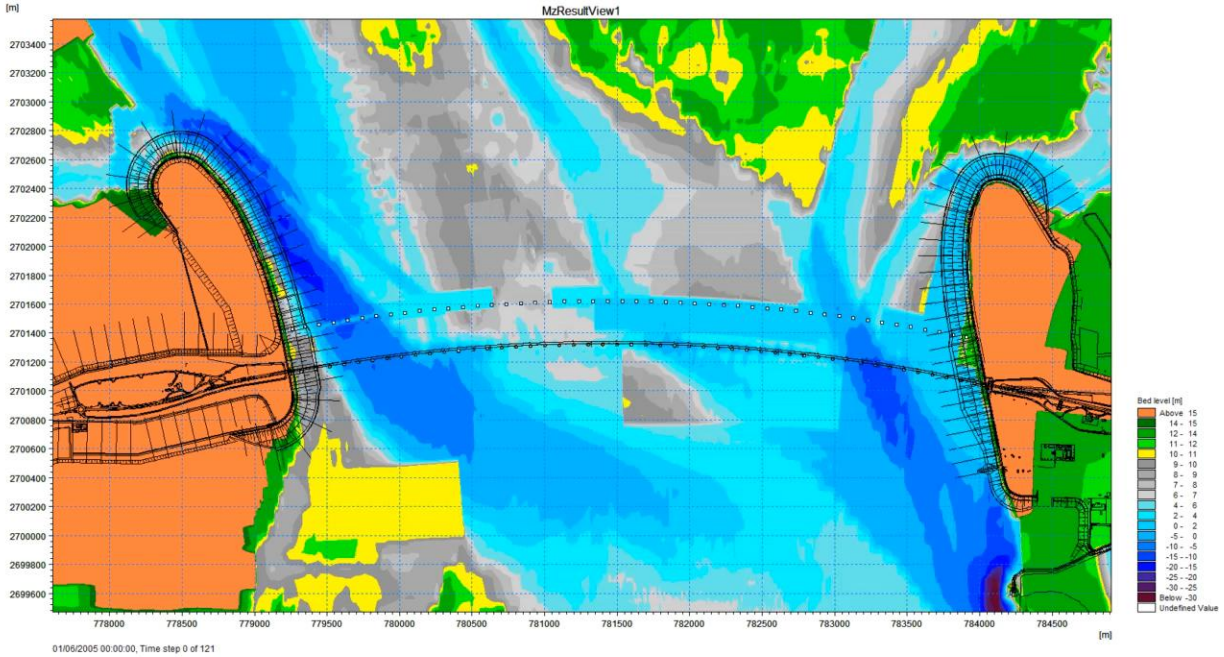
App Ink

Modelling of Jamuna R. for Bridge



Min-Max: 3140 m3/s →98,000m3/s

E-Flow: 6287 m3/s →42580 m3/s



Simulation for Extreme flood Event along incorporating with dredging

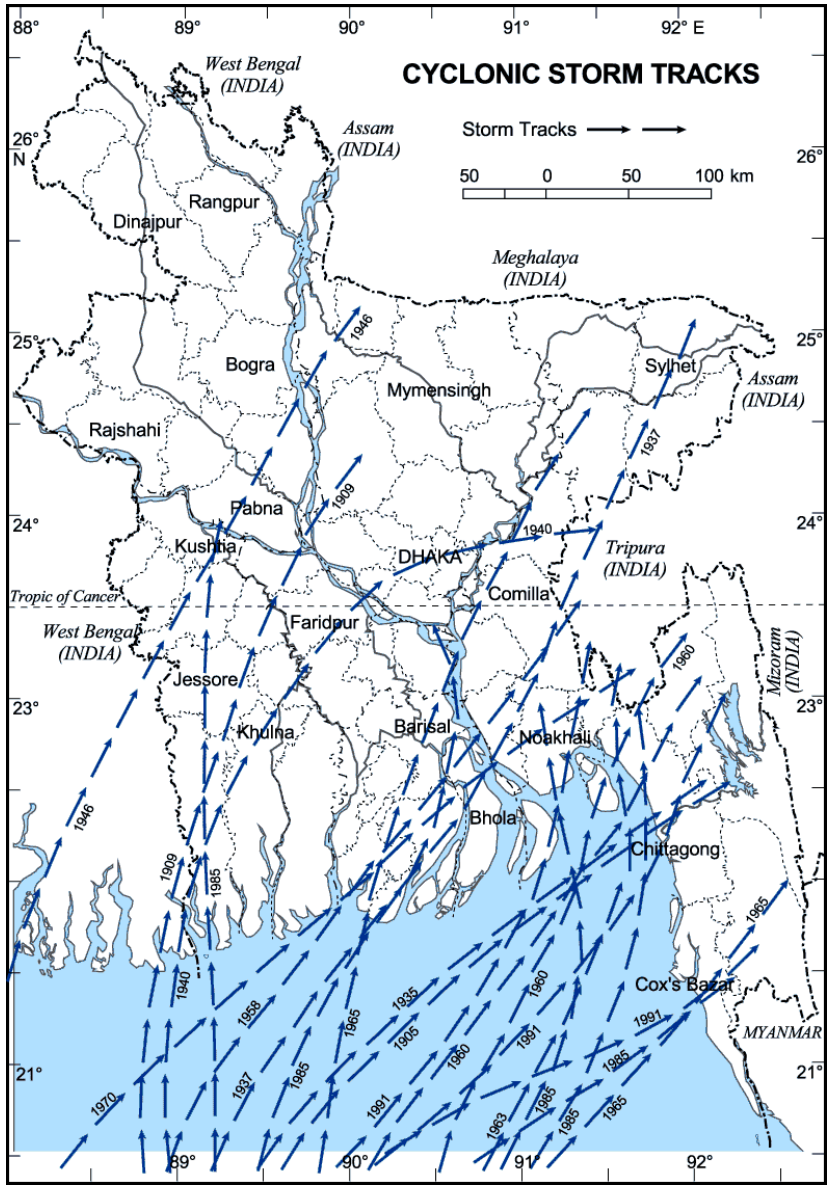
Monitoring & Modelling of risk mapping for Jamuna Bridge

West Guide Bund

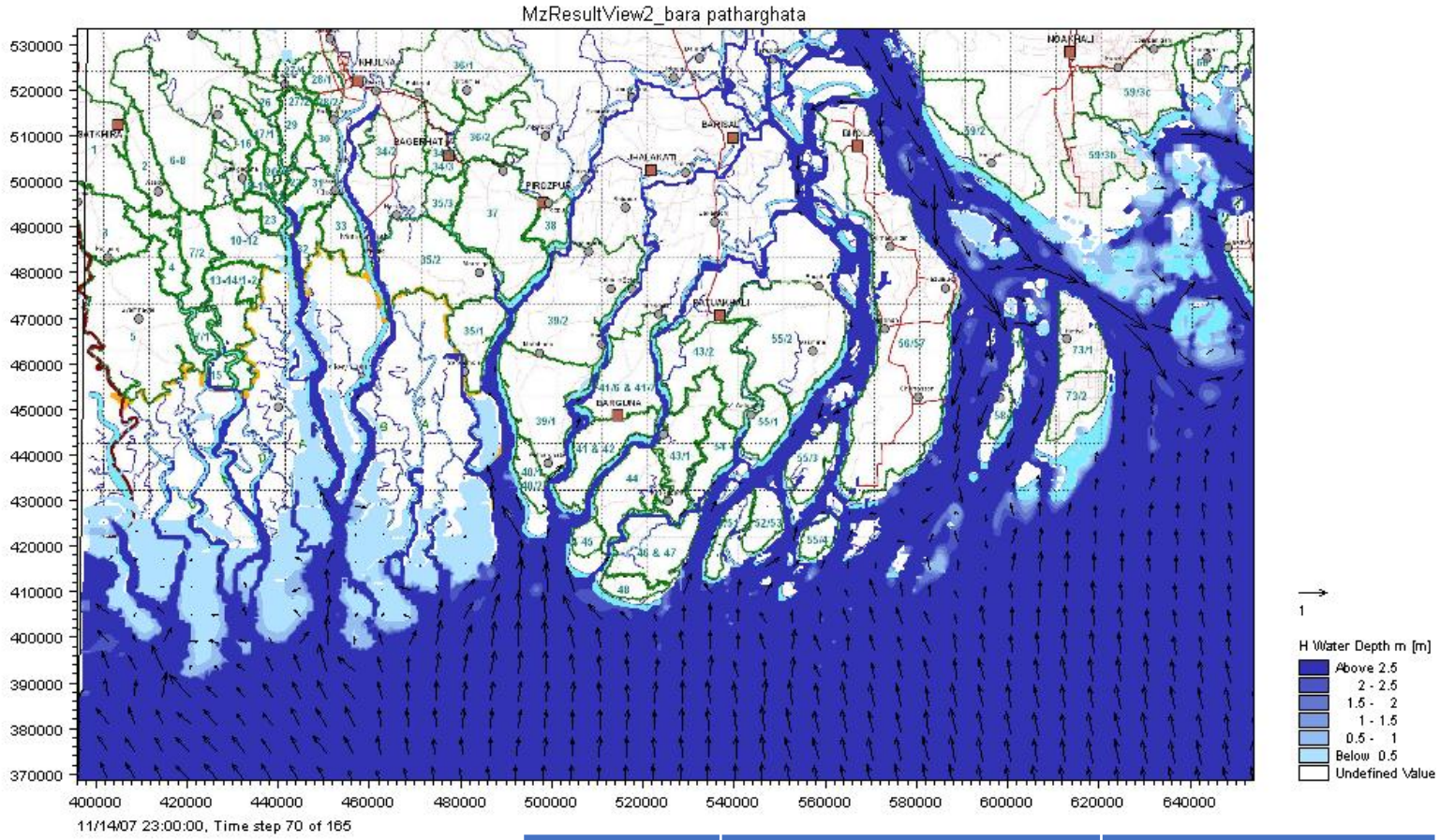
Bed level [m]

Above	15	2 -	4
14 -	15	0 -	2
12 -	14	-5 -	0
11 -	12	-10 -	-5
10 -	11	-15 -	-10
9 -	10	-20 -	-15
8 -	9	-25 -	-20
7 -	8	-30 -	-25
6 -	7	Below	-30
4 -	6		

Cyclone & Storm Surge Modelling



INUNDATION FOR SIDR, 2007



Cyclonic Event	Maximum Wind Speed (kph)	Maximum Surge Height (m)
1970	224	3-10
1991	225	6-7.6
2007	223	4.6-6.1

Salinity Intrusion Model

Salinity IMPACTS

Salinity affects 20-25% of Bangladesh's total land area

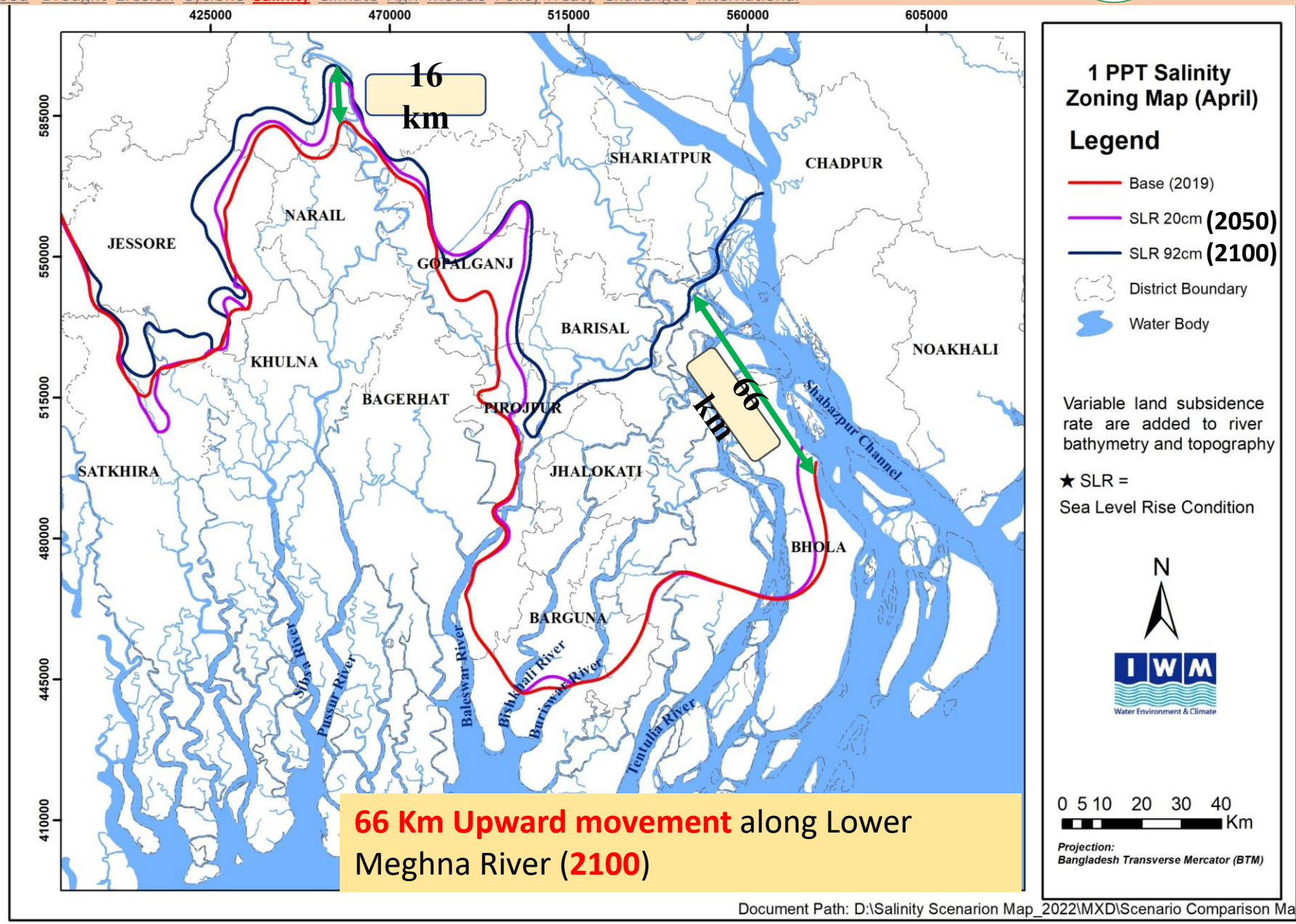
Reduces rice yields by 15-40%

Over 20 million people in coastal areas face **drinking water** shortages

Reduces **freshwater** fish production by 20-30%,

Salinity has caused 10-15% **loss of mangrove** cover in the last two decades

By 2050, **salinity intrusion** is projected to increase by 50-100%



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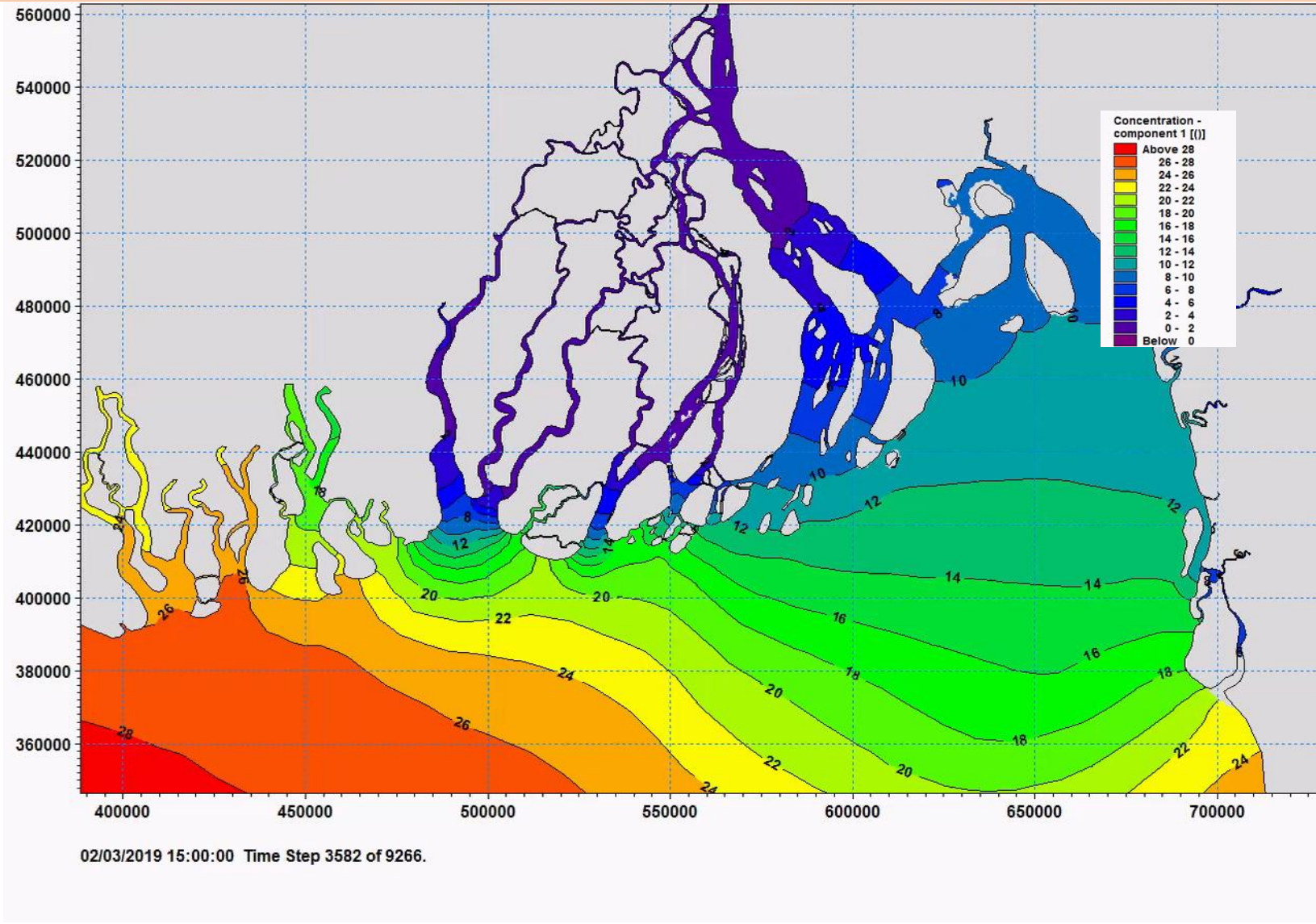
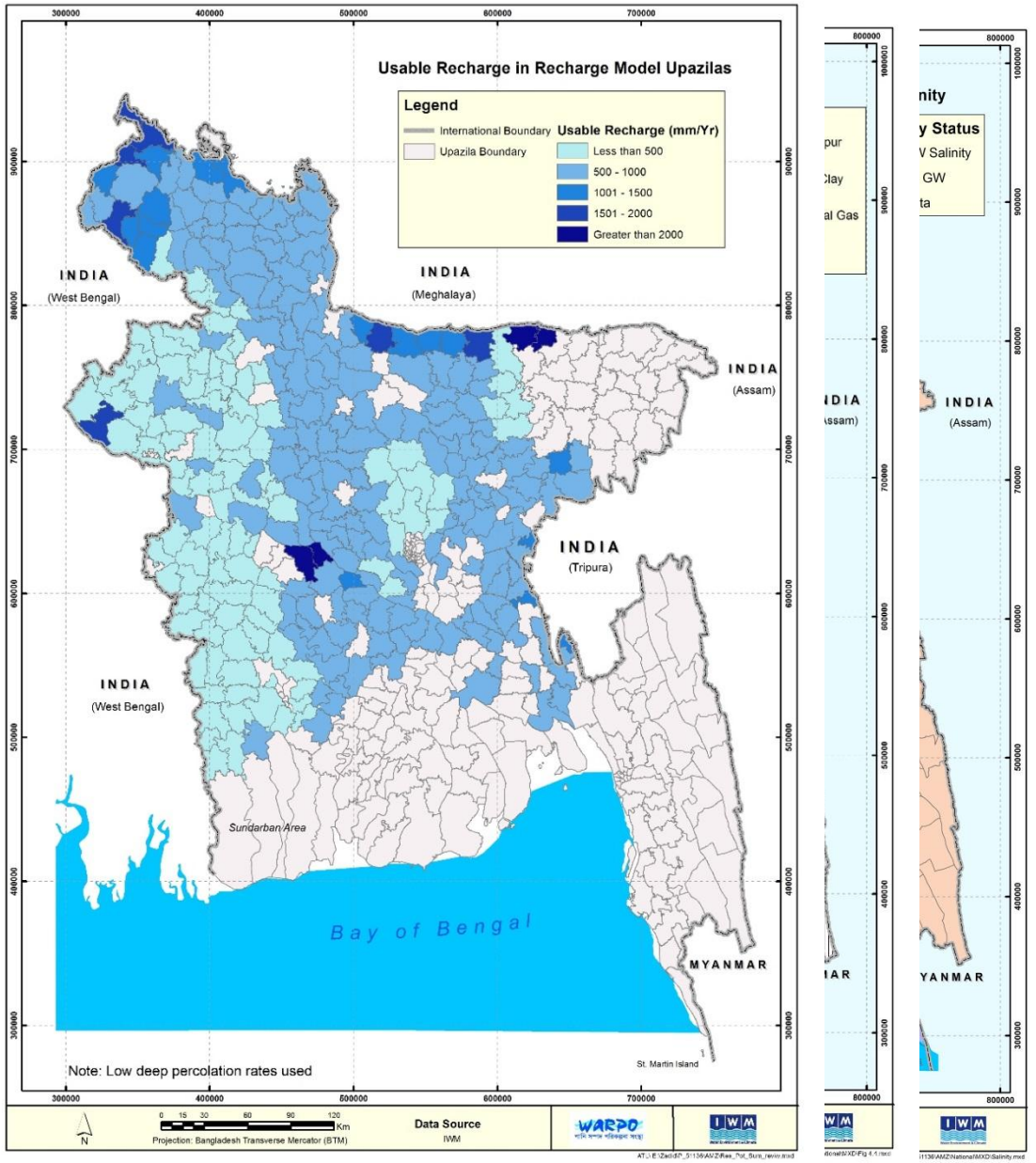
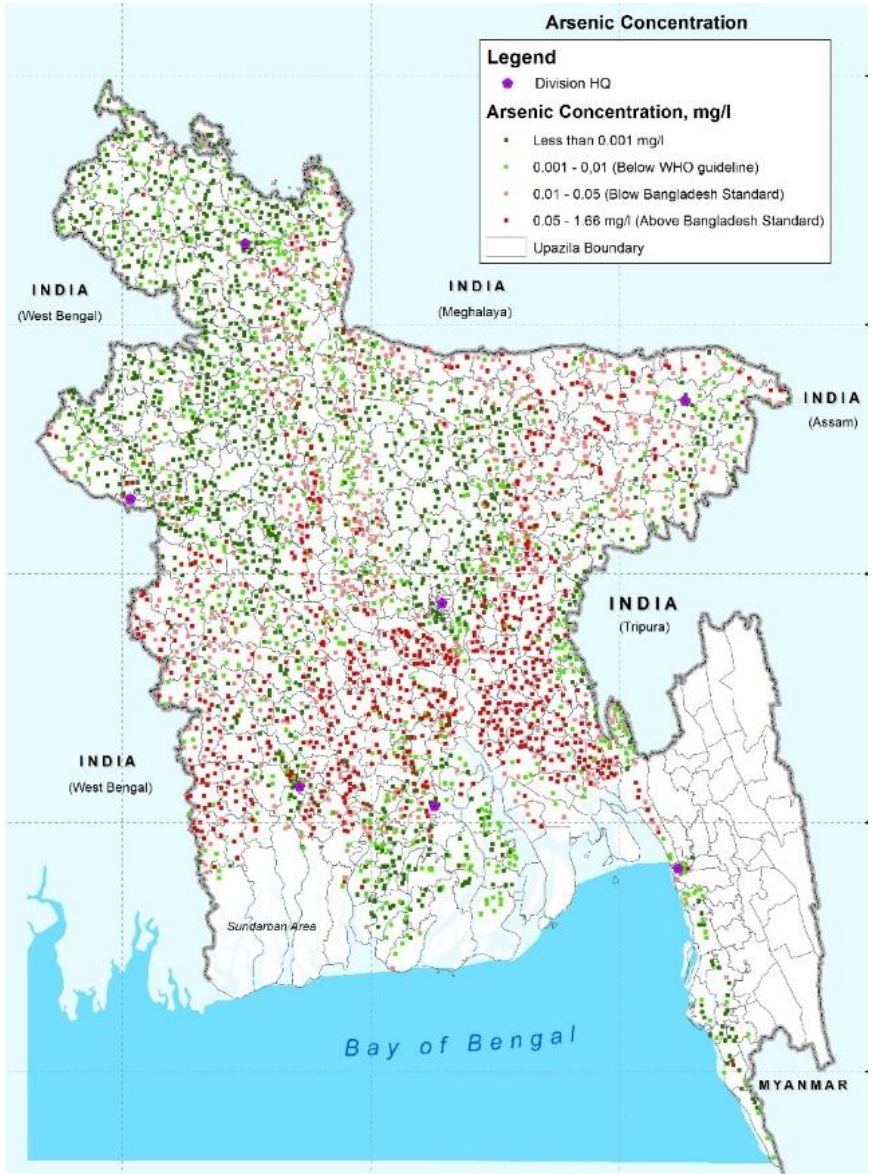


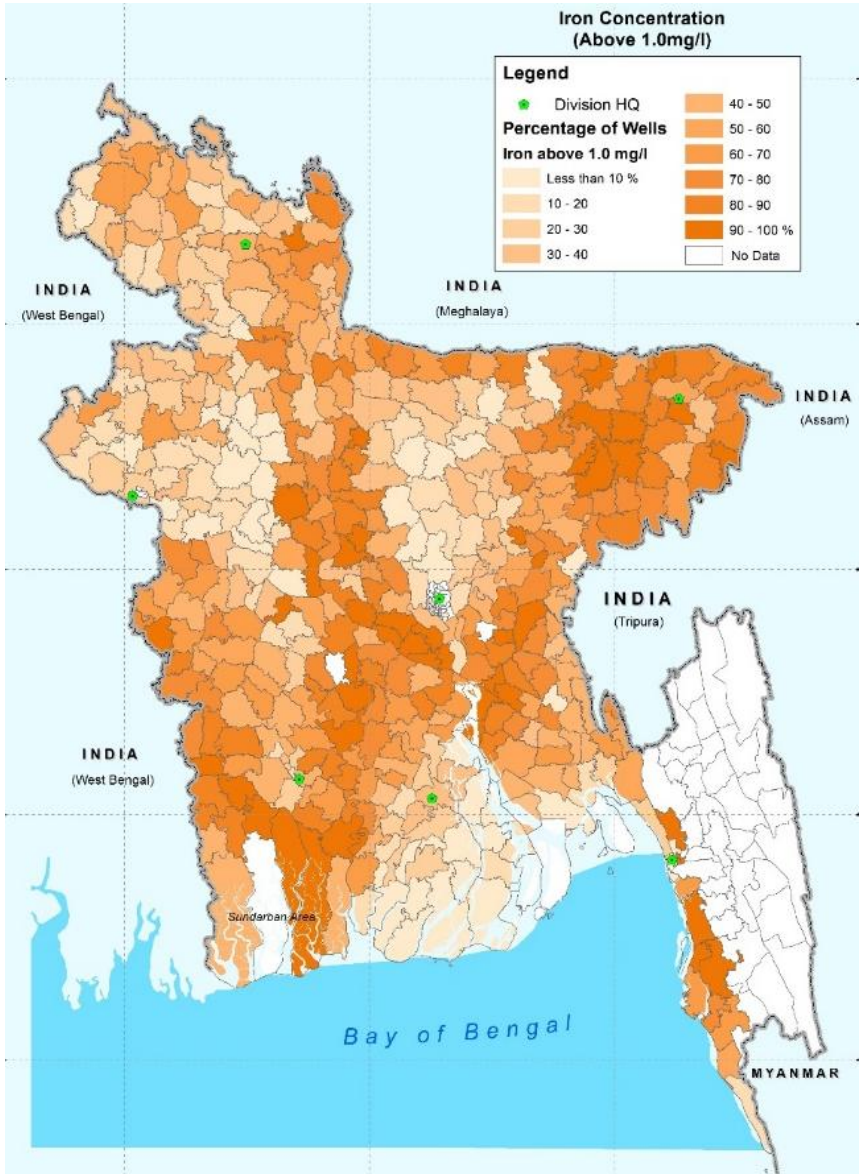
3 Groundwater constraints

- Groundwater is saline in 127 (26%) Upazilas
- Groundwater abstraction is constrained by rocky formation, thick clay, depleting groundwater level (mining), gas bearing formation, water quality etc

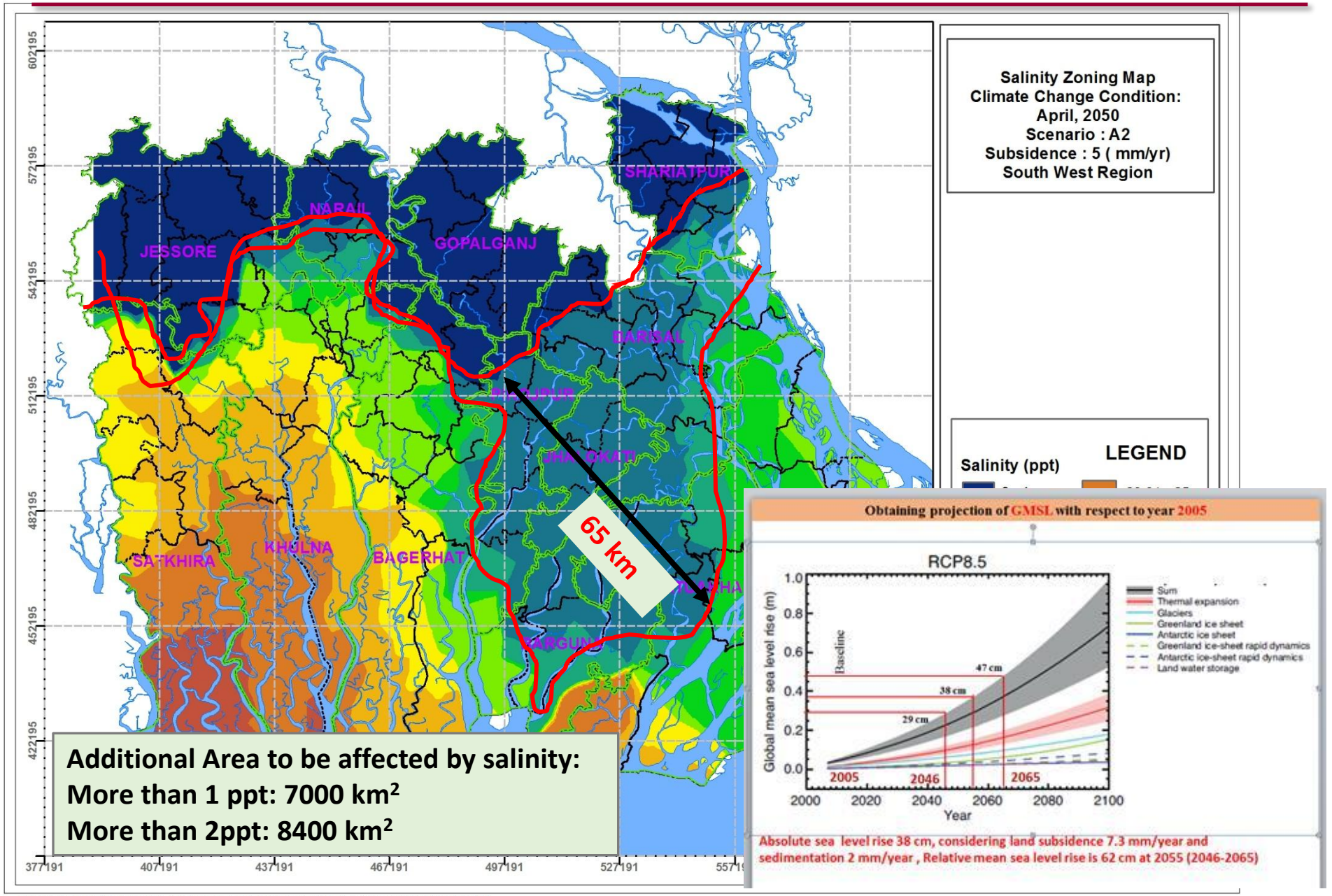


4 Groundwater Quality





Effect of SLR (62cm, RCP 8.5) on 2ppt Salinity contour at 2050's



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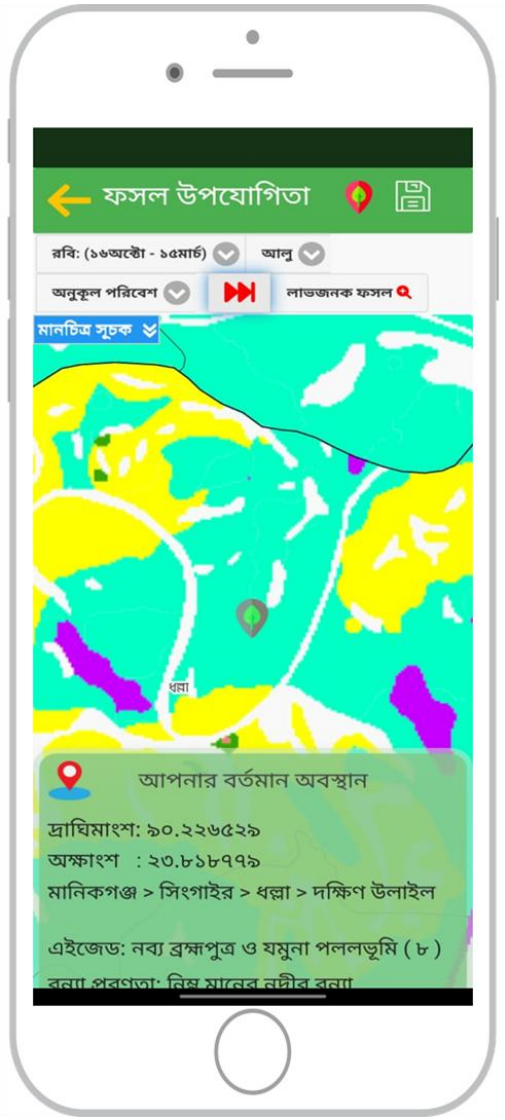
Agriculture – With Less Water & Less Fertilizer

Empowering the Farmers for efficient cropping in Bangladesh

Boro + Aman = +1440 million USD/yr

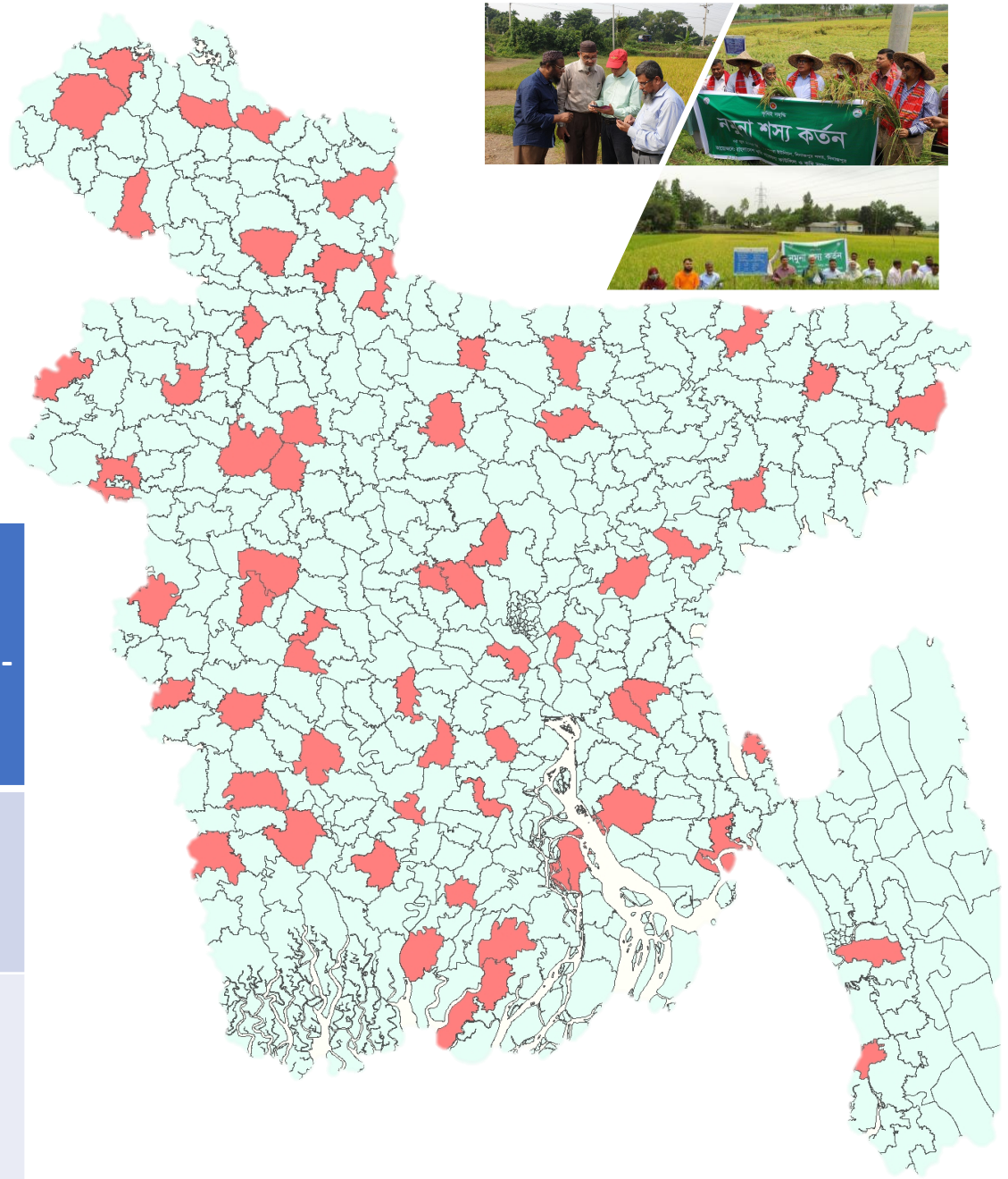


Field Assessment of Khamari Mobile App

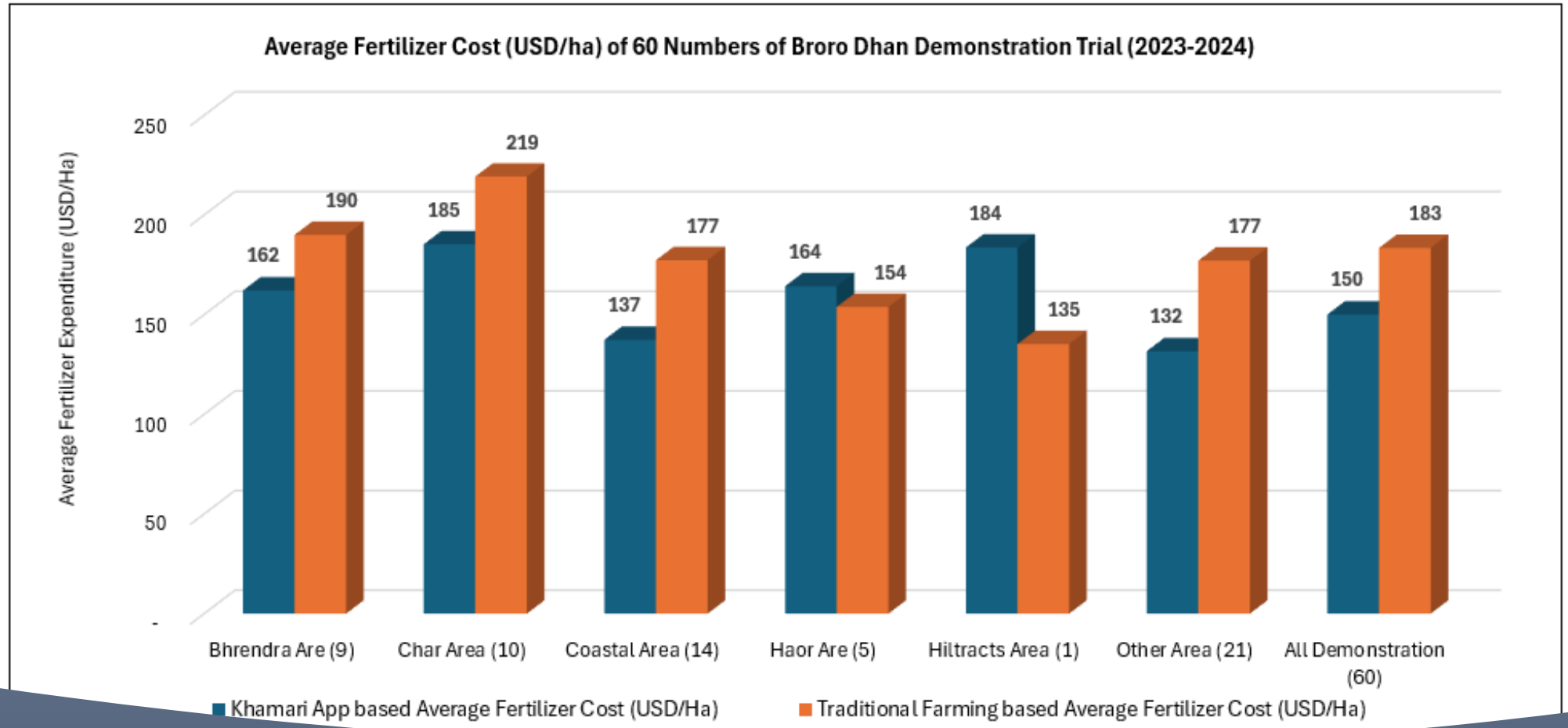
The BARC and DAE has conducted 60 Trials & demonstrations

Likely estimate

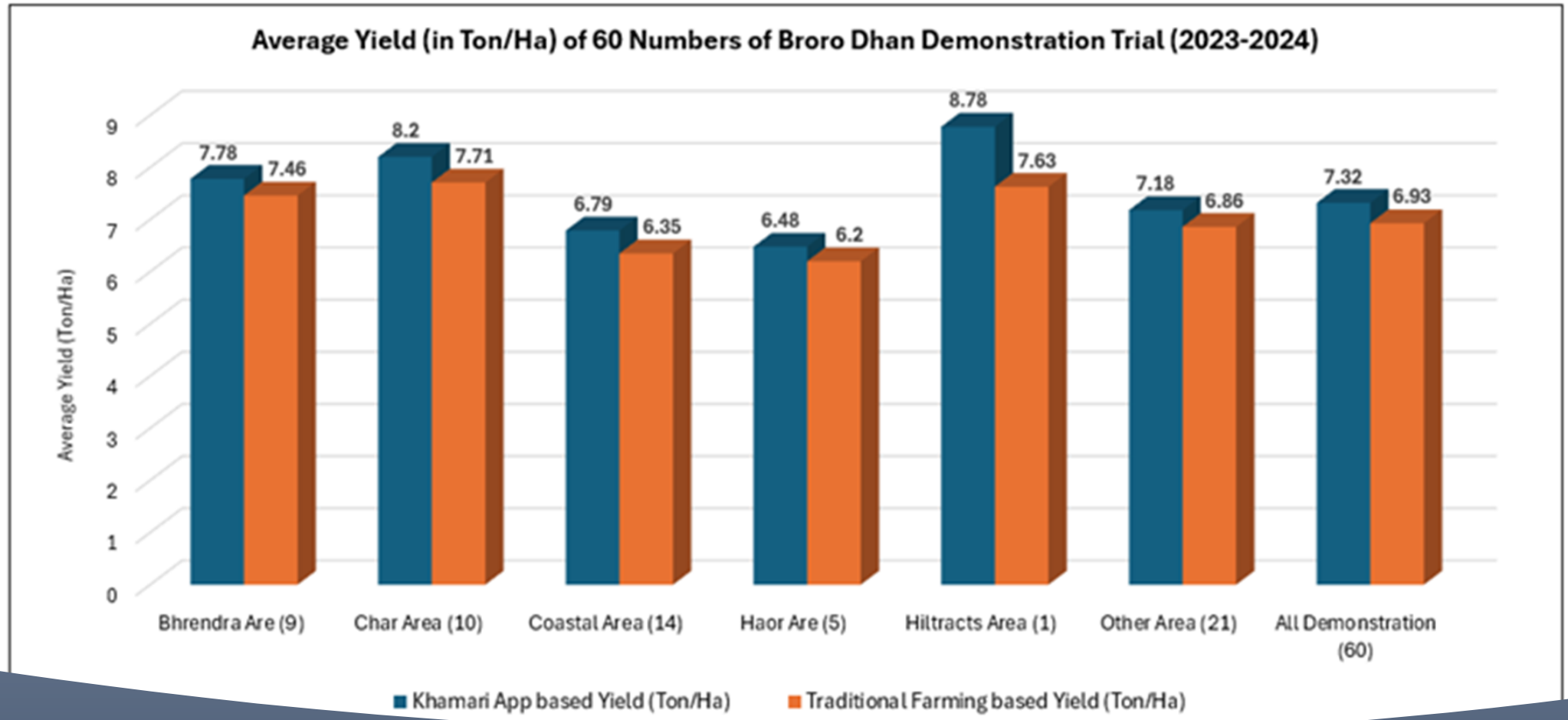
Impact Items	Rabi Season (Nov-Mar)	Kharif-1 Season (Mar-Jul)	Kharif-2 Season (Jul-Nov)
Fertilizer Use	-13.22%	-27.34%	-34.56%
Production Change	+10.43%	+10.04%	+6.77%



Harvesting from Field Trial Plots



Field Assessment of Khamari Mobile App



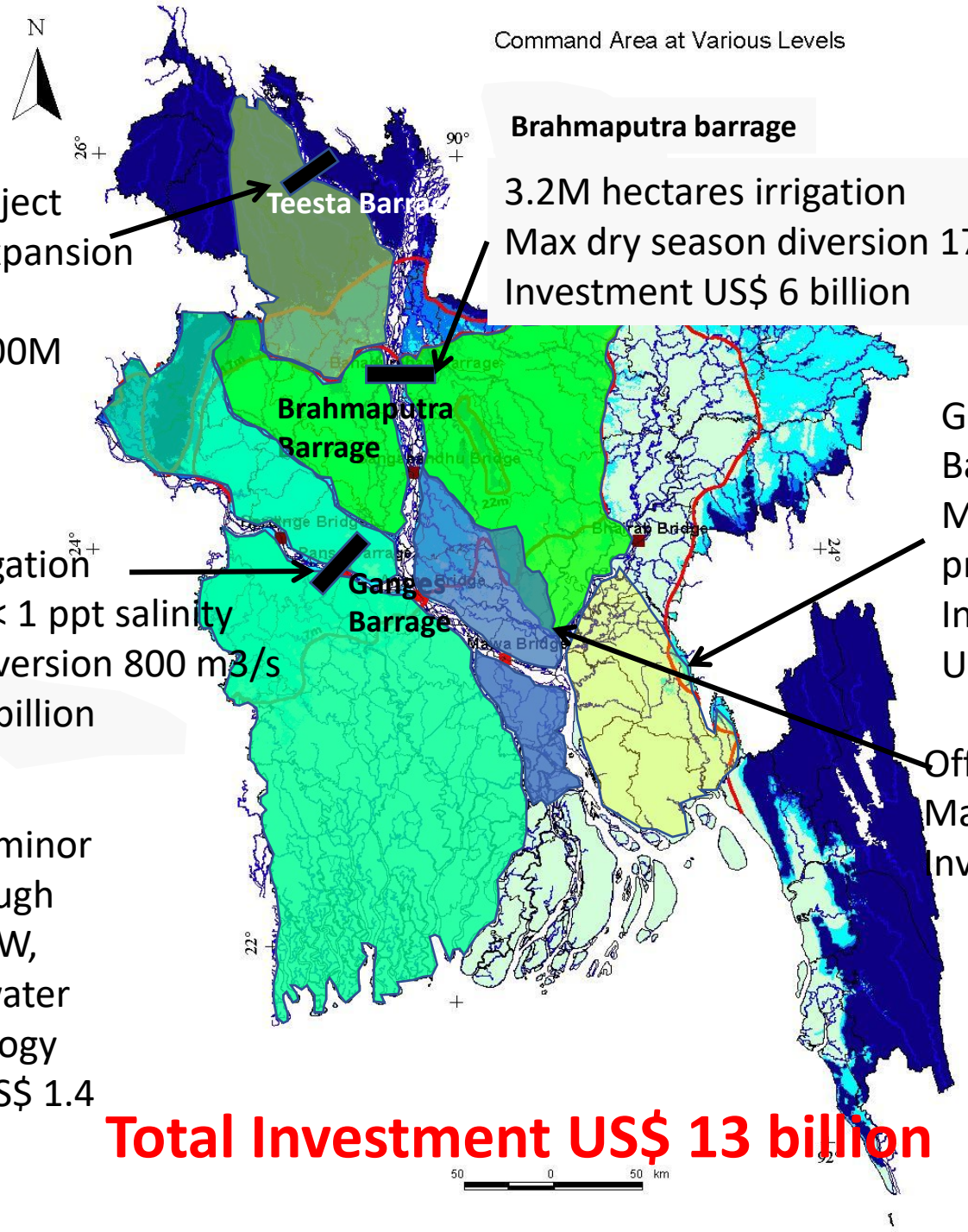
Field Assessment of Khamari Mobile App

Financial Benefits : Enhanced Food Security

Aman Crop (all 5.9 M.ha area with Khamari)	Savings from Fertilizer	Tk 27.64 billion
	Cost of increased production	Tk 62.02 billion
	Sub Total	**Tk BDT 89.66 billion → 752 M.Usd**
Boro Crop (all 4.8 M.ha area with Khamari)	Fertilizer Saving + increased production	**Tk 82.05 billion →(USD 688.0 million**
Aman+Boro	**Fertilizer Saving + increased production**	**Tk 171.71 billion → (USD 1440.0 million)**

Environmental Benefit:

Less Fertilizer means increase of soil and water health



Teesta Barrage Project
Improvement & expansion
750,000 hectares
Investment: US$500M

Brahmaputra barrage

3.2M hectares irrigation
Max dry season diversion 1700 m3/s
Investment US$ 6 billion

Ganges barrage

1.9M hectares irrigation
273,000 hectares < 1 ppt salinity
Max dry season diversion 800 m3/s
Investment US$ 4 billion

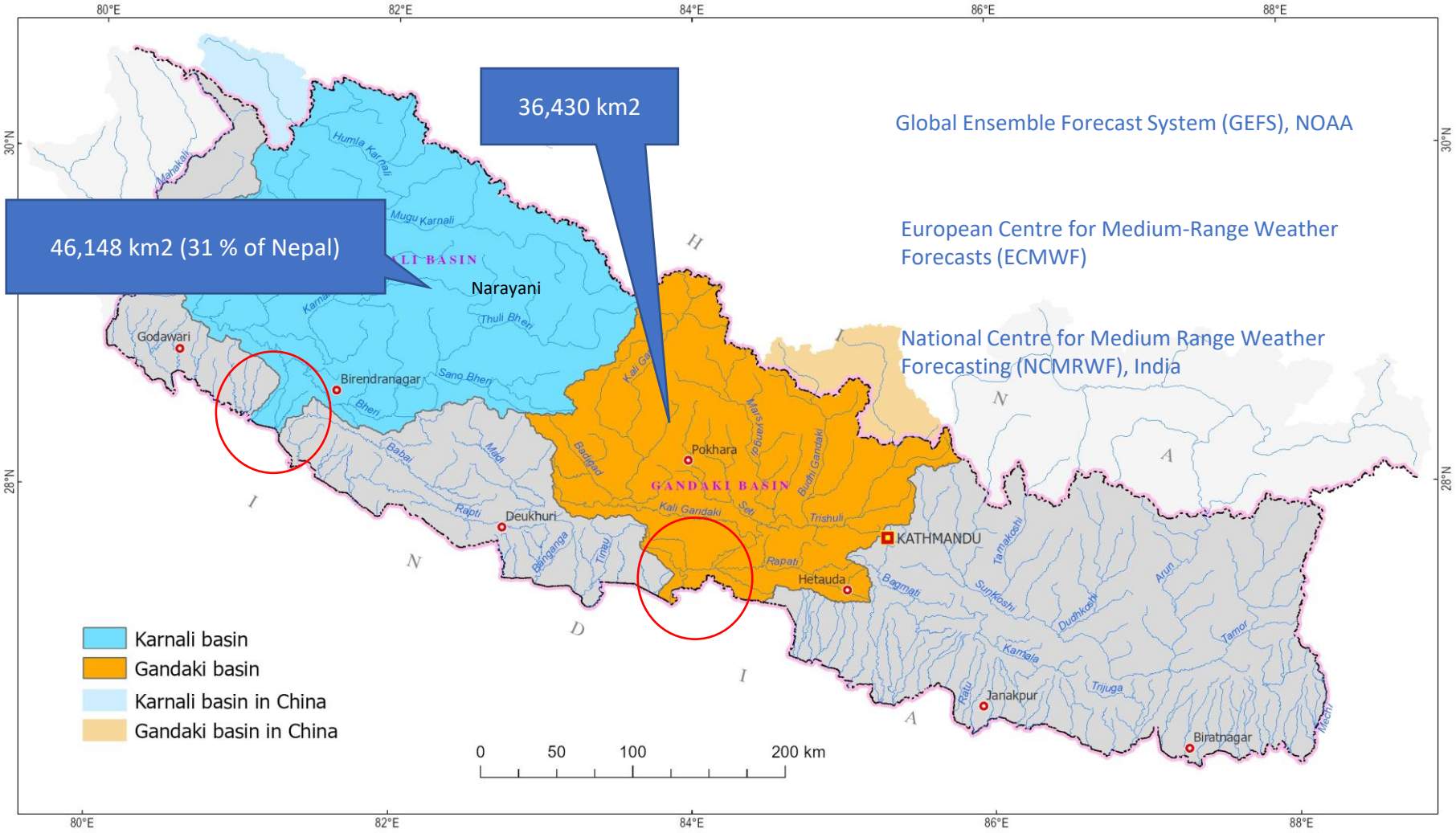
Gumti-Muhuri Basin water Management project
Investment: USD$ 1 billion

Offtake improvement Management
Investment: US$500 M

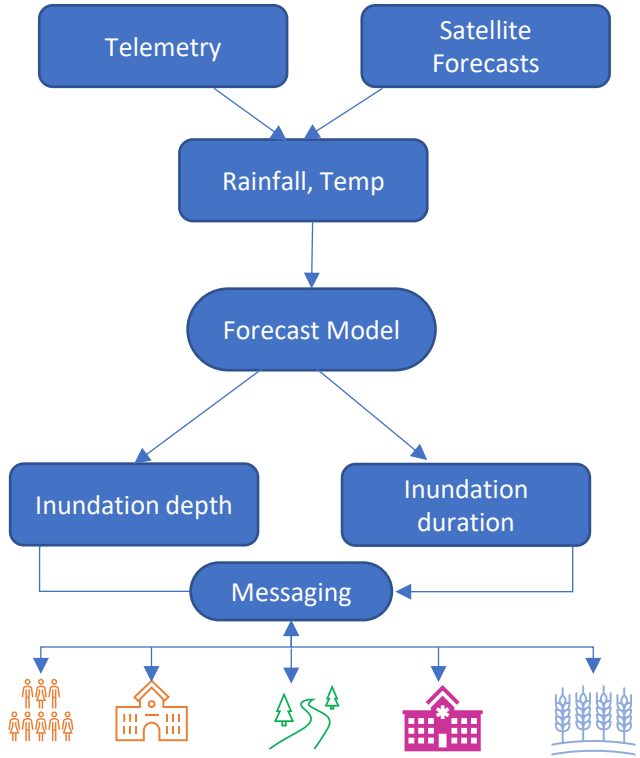
Country wide minor Irrigation through utilization of SW, extension of water saving technology
Investment: US$ 1.4 billion

Total Investment US$ 13 billion

Flood Forecasting and Early Warning System (FFEWS) in NEPAL



The Department of Hydrology and Meteorology (DHM) has decided to implement Impact based Flood Forecasting and Early Warning System for **Karnali and Narayani River Basin**

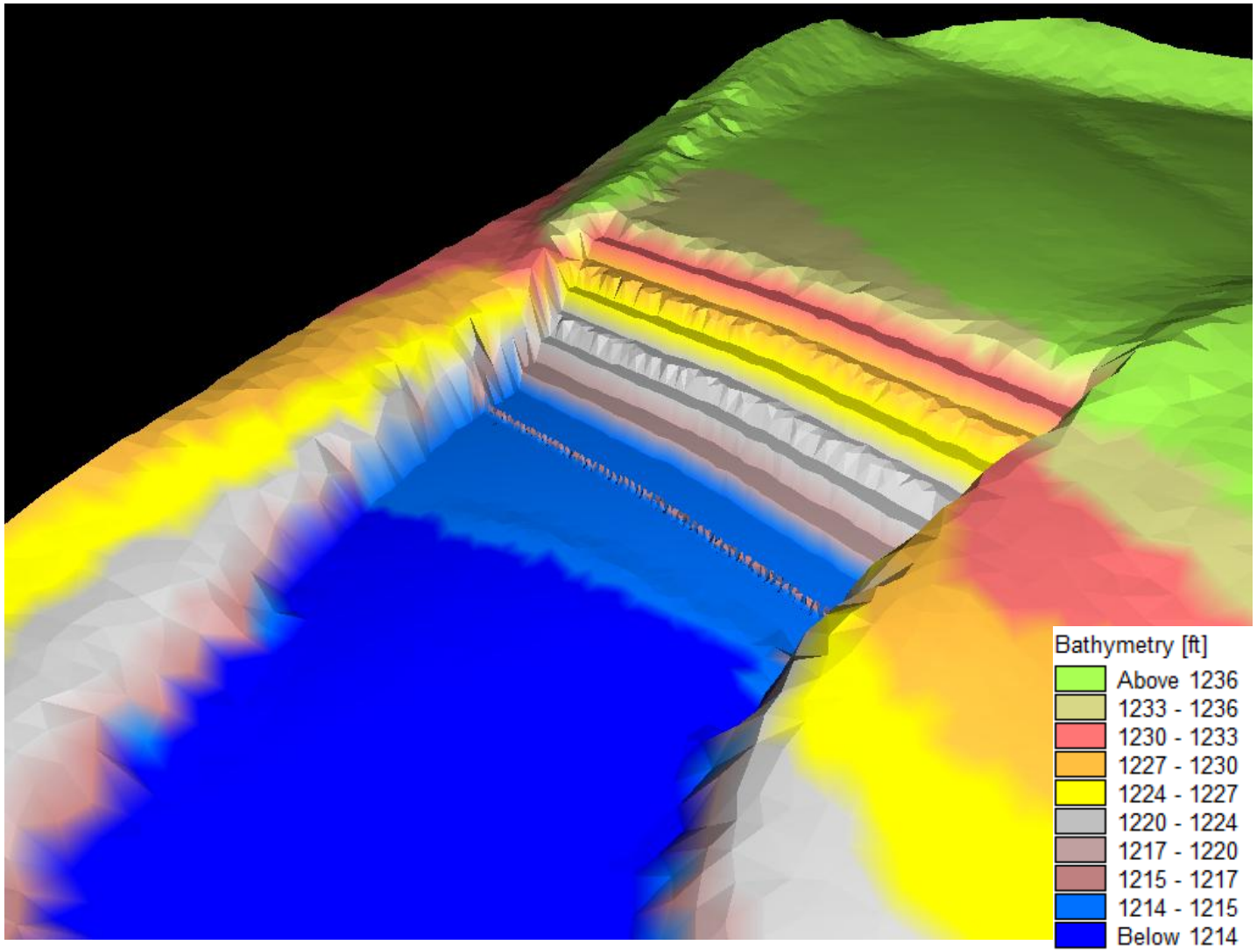


Hydro-Morphological Modelling of Lake Elmdale Spillway, Arkansas, USA

Options Considered

1) Stepped Spillway of different number of steps
   - 7 steps with 3 ft drops
   - 8 steps with 3 ft drops

2) Stepped Spillway with Baffle Piers
   - Baffle Piers with 13.5 inch Baffle Pier Height (Based on Design Calculations)
   - Baffle Piers with 18 inch Baffle Pier Height

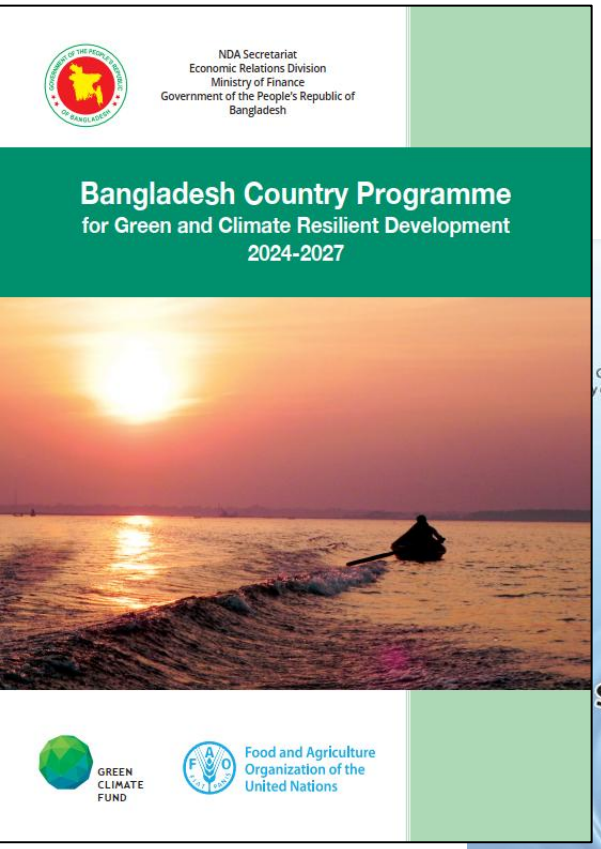


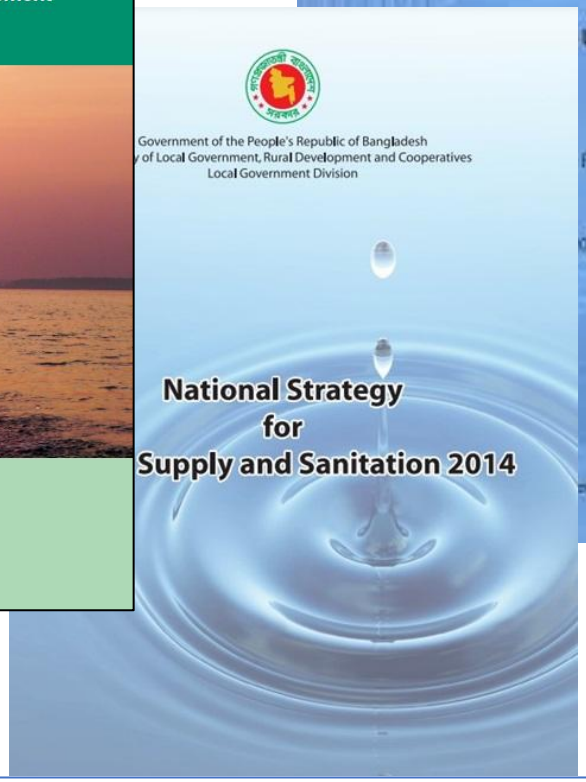
Models, Tools & Technology

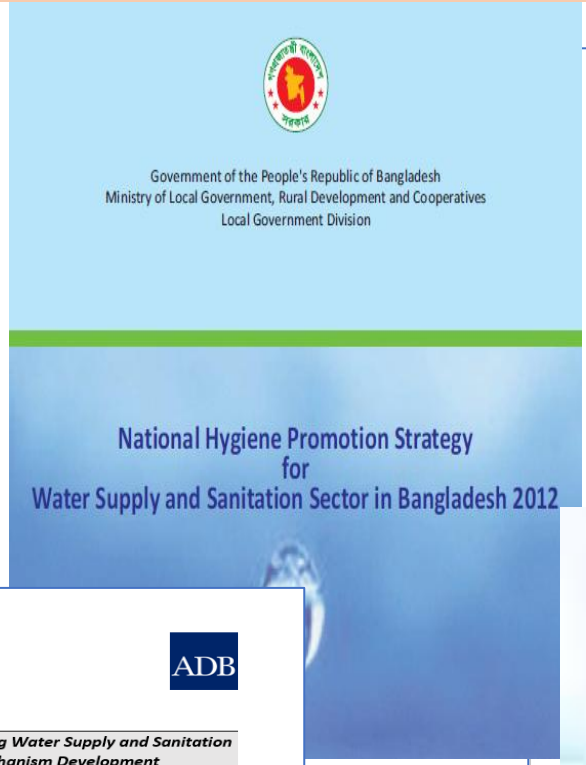
- INTEGRATED PLATFORM
  - MIKE+
- CITIES
  - WEST-– Modelling and simulation of wastewater treatment plants
- COAST AND SEA Model
  - MIKE 21- 2D modelling of coast and sea
  - MIKE 3 – 3D modelling of coast and sea
  - LITPACK – Littoral processes and coastline kinetics
  - MIKE ECO LAB – Ecological modelling
- WATER RESOURCES Models
  - MIKE 11 – One dimensional Mike Model
  - MIKE SHE – Integrated catchment modelling
  - MIKE HYDRO Basin– River basin management and planning
  - MIKE 21 C – River hydraulics and morphology
- GROUND WATER AND POROUS MEDIA Models
  - FEFLOW– All-in-one groundwater modelling solution

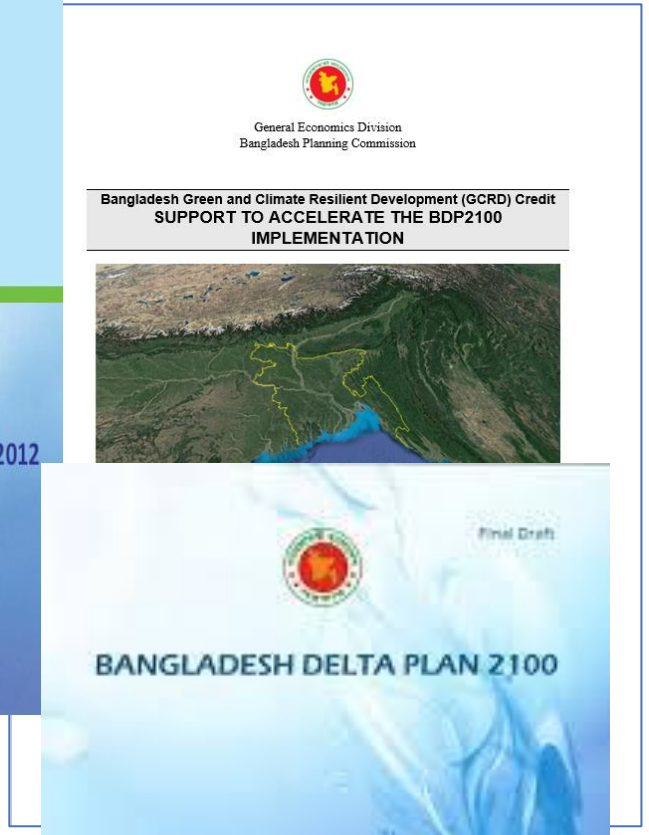
- HEC series
- SoundPLAN Essential – noise simulation software
- Argus ONE – Ground/Surface Water Modelling
- NeoroSolutions - graphical neural network development tool
- Hymos - an information system for storage, processing and presentation of hydrological and environmental data
- AIERMOD View - air dispersion modelling package
- ArcGIS System – for Geospatial Analysis

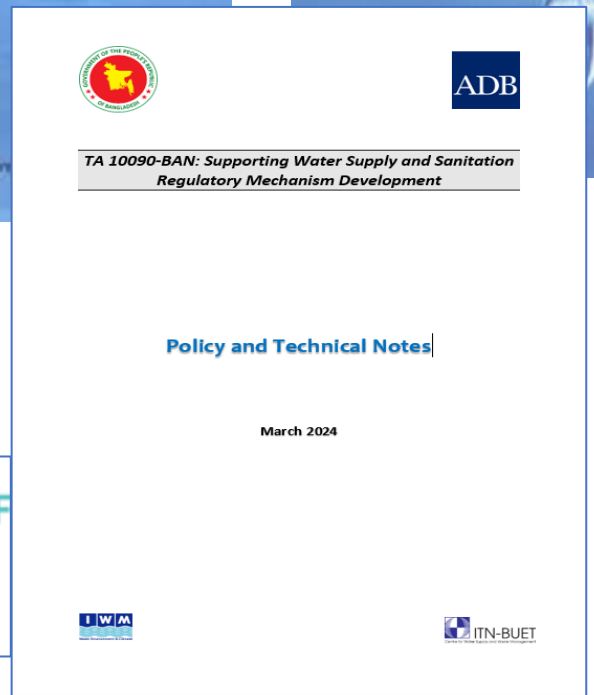
Policy and Plans

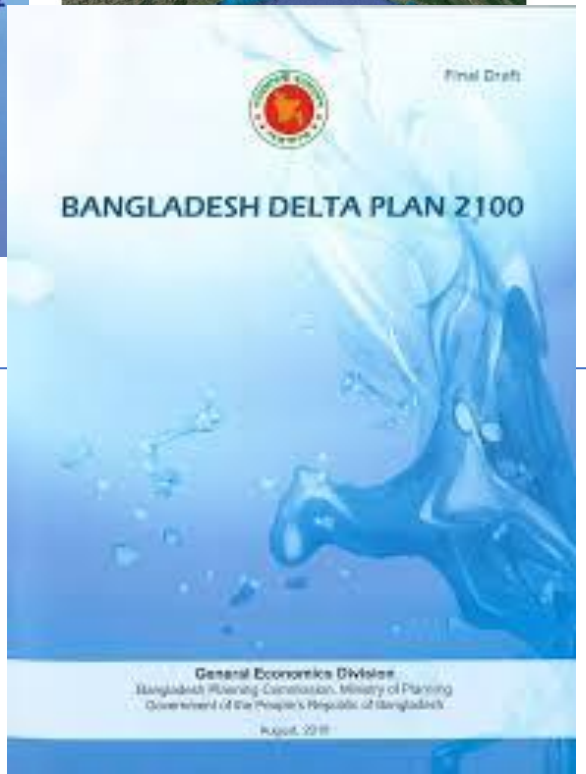




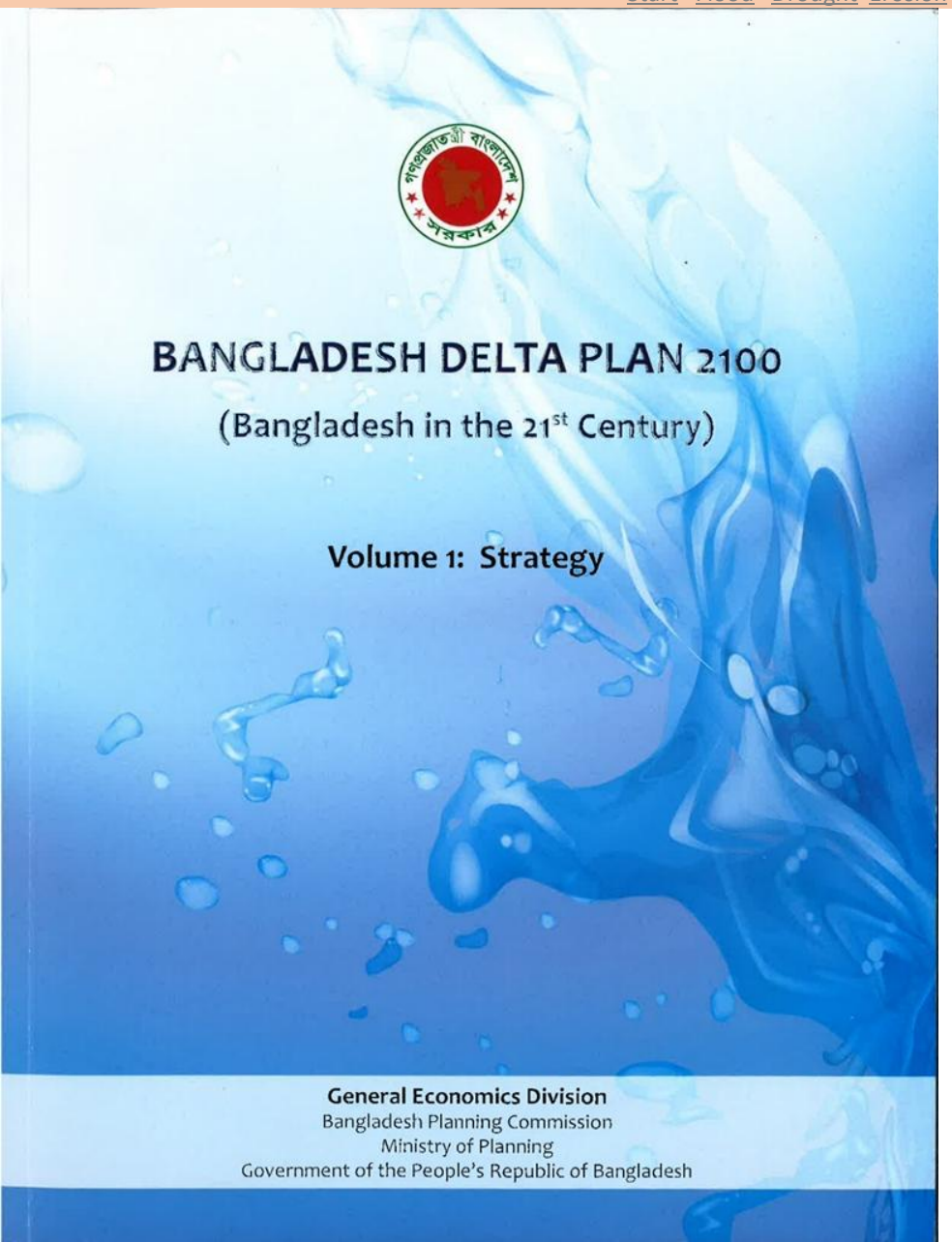


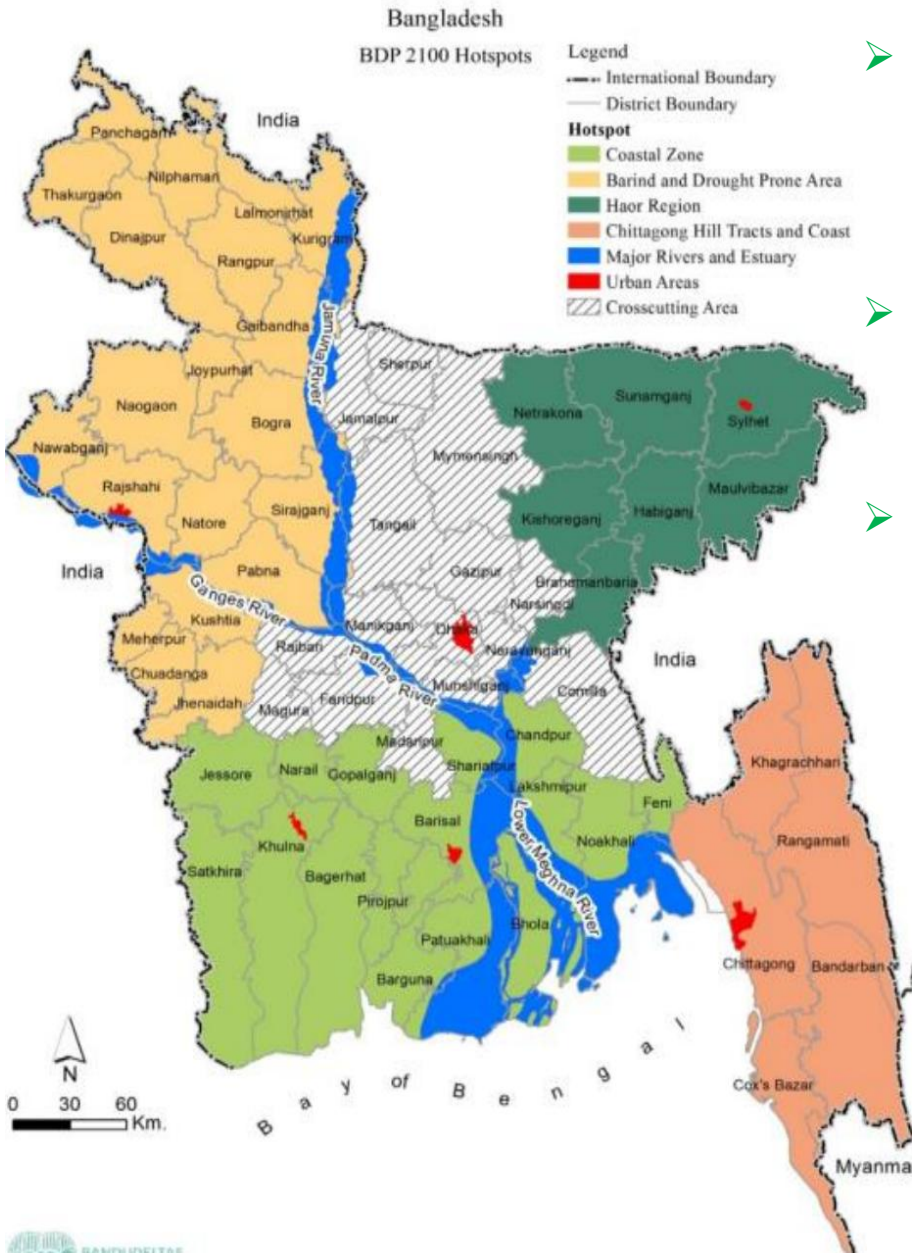






Bangladesh Delta Plan - BDP 2100

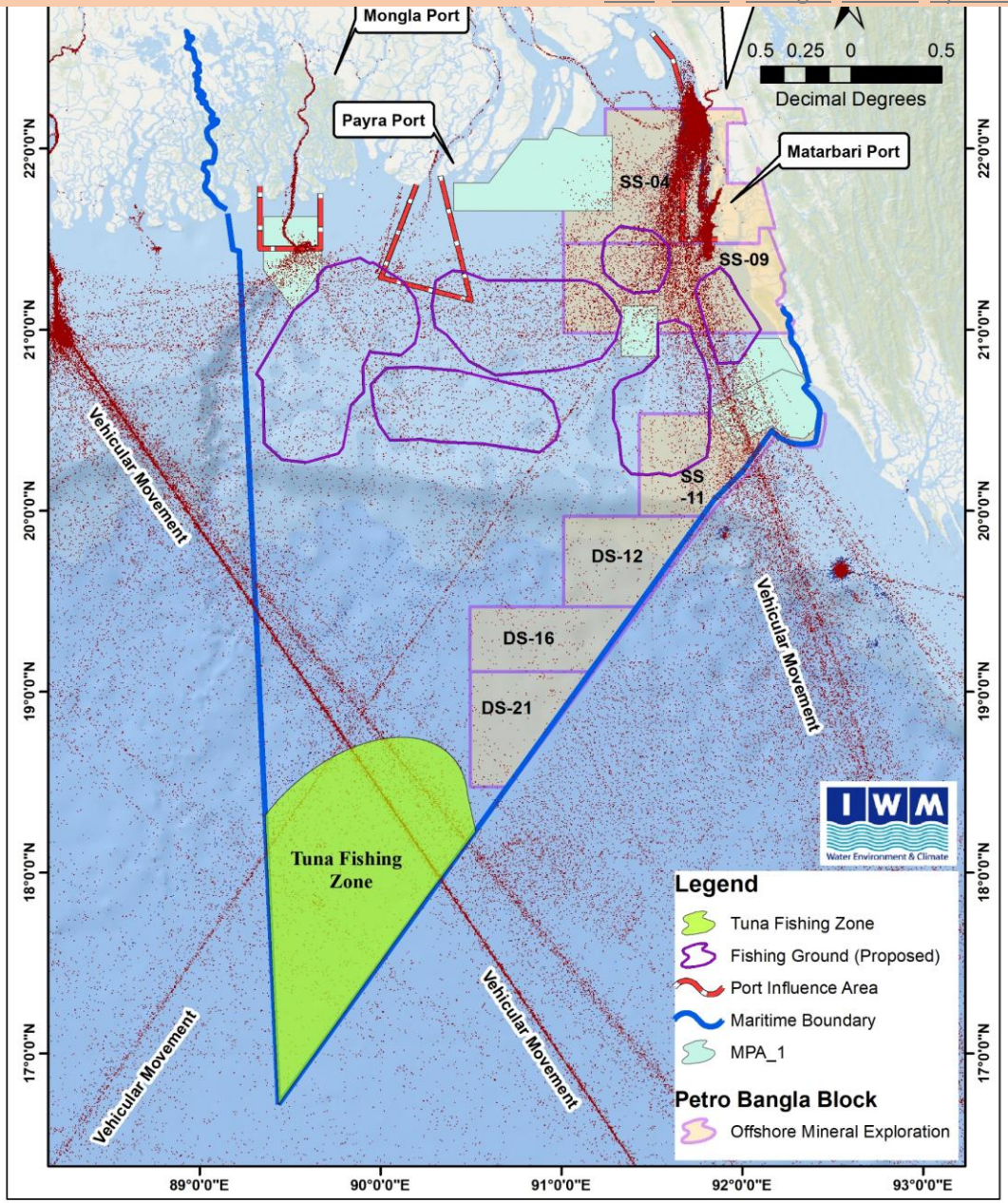




- BDP 2100 has been conceived as a techno-economic, long-term, holistic and water centric integrated plan.
- to achieve upper middle income (UMIC) status and eliminate extreme poverty by 2030
- a prosperous country beyond 2041
  - sustainable management of water for
    - Ecology
    - Environment
    - Land resources

  in the context of their interaction with natural disasters and climate change.

Marine Spatial Plan (MSP)



1. Tuna Fishing Zone

The tuna fish zone illustrated on the map represents the catch area identified from data collected by the M.V. SEAFDEC research vessel

2. Fishing Grounds

3. Port Influence Area

The Port Influence Area was identified using data collected from the Bangladesh Navy, focusing on Navigation & Marine Transportation.

4. Maritime Boundary

The Bangladesh Maritime Zone Act, 2018 defines the maritime boundary in the Bay of Bengal,

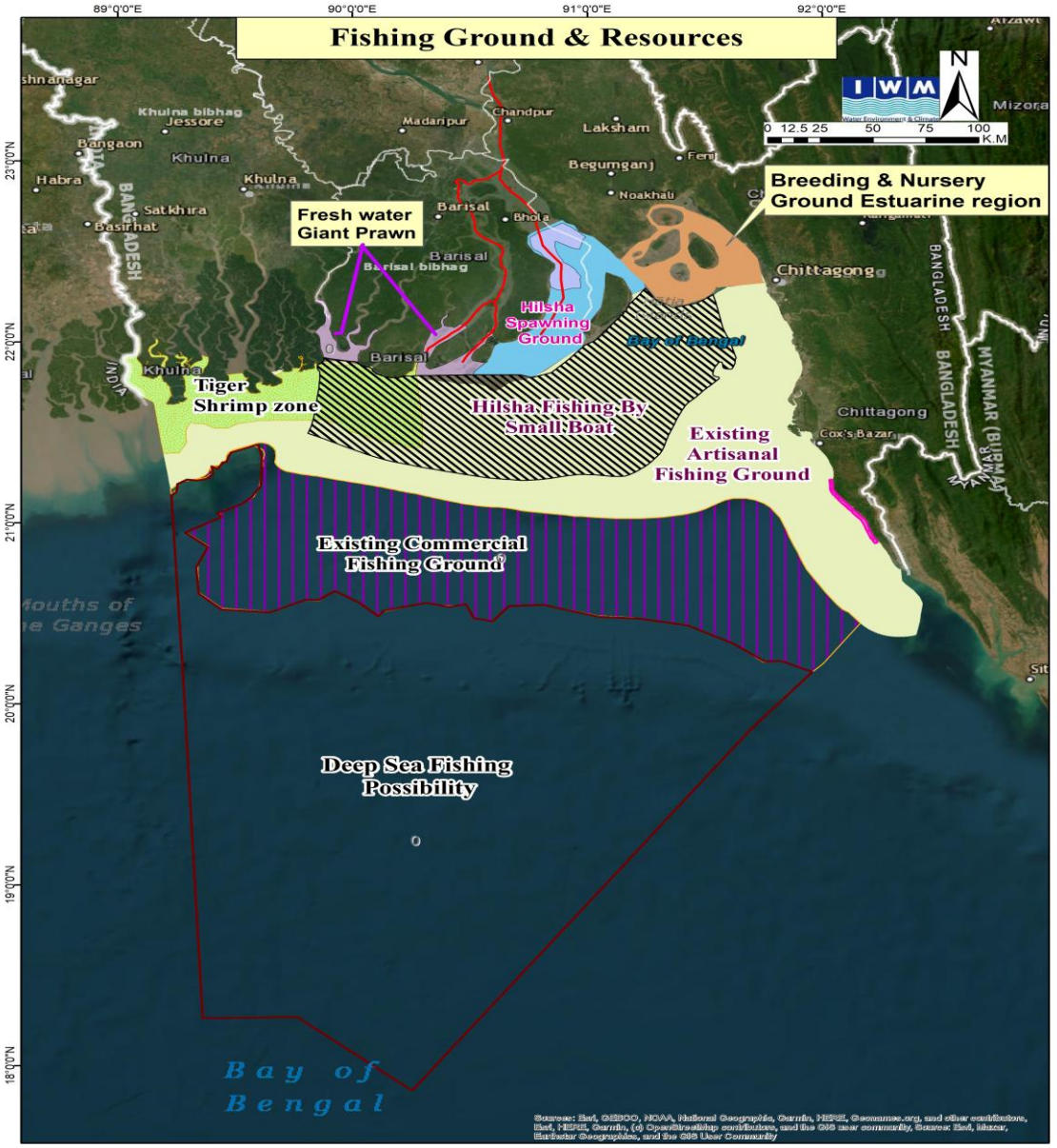
5. Marine Protected Area

Bangladesh has designated five Marine Protected Areas

6. Offshore Energy and Mineral Exploration

Bangladesh government opens the bid for mineral extraction from **six mineral blocks** out of **26 blocks**.

Marine Space Allocation



Marine Space Allocation

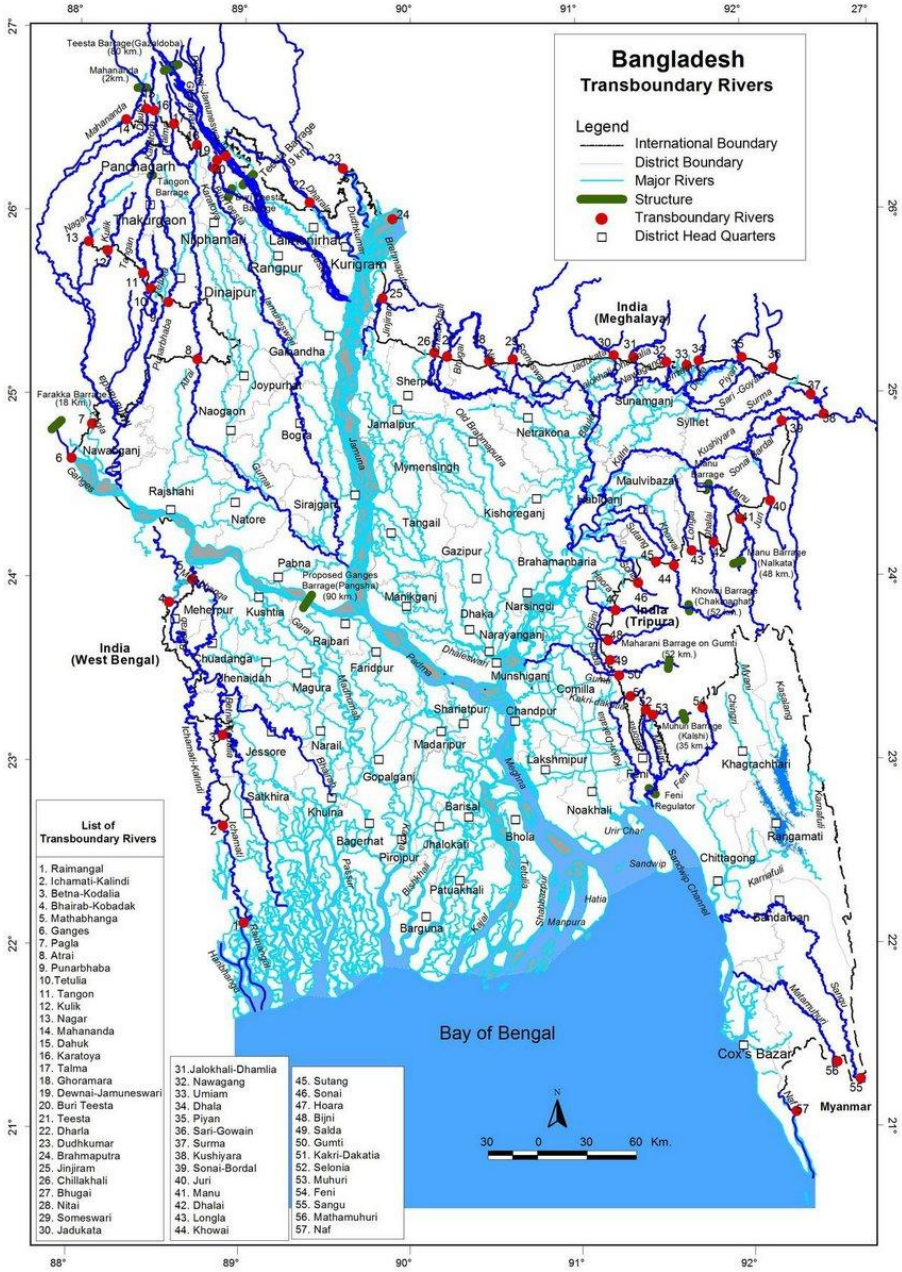
Legend

- Fishing Ground of small fish
- Hilsha migration route
- Hilsha fishing ground by small boat
- Freshwater Giantprawn
- Deep Sea
- Suitability of Hilsha Spawning Ground
- Commercial fishing ground (>40m)
- Tiger shrimp
- Breeding and Nursery Ground of Esturian shirmp and fish
- Artisanal fishing ground (<40m)

Regional Treaty on Water Sharing

54 transboundary rivers with India

- **Treaty signed in 1996 for Ganges River only** – fare share during Jan-May
- **Teesta River Treaty is hanging** – draft was prepared in 2011
- **Feni River – Limited agreement** (India is allowed to withdraw 1.82 cusecs of water from the Feni River for drinking water supply to Tripura)
- **MoU on Hydrological Data Sharing** -To share hydrological data during the monsoon season for flood forecasting and disaster management.



Current Challenges in Water Sector

Limited land and water resources to support its huge population in this region

Management of Water Pollution from in-country and transboundary

Bangladesh the water resources are not within the control of the country

Water related information sharing between dependent countries needs huge improvement

Climate change impacts adversely affecting water resources and thus Food and Livelihood

International

IWM is a Trust of Ministry of Water Resources, Bangladesh

IWM
Water Environment, Climate & ICT

ISO 9001:2015 CERTIFIED
INSTITUTION

- Nepal
- India
- Malaysia
- Philippines
- Cambodia
- Sri Lanka
- Turkey
- United States

Major Knowledge Partners of IWM

United Kingdom

JPZ Malaysia

Major Development Partners

Some of National Partners and Clients

Recommendations

- Create **Water Centric Innovation Center** where countries can contribute by their unique capacities to solve problems with best shared knowledge and experiences
- Create accessible **database of skills and professionals – including replicable models**
- Frequent **interactions and cooperations** for sharing skills and knowledge

IWM profile

Thank You

Start
Flood
Drought
Erosion
Cyclone
Salinity
Climate
Agri
Models
Policy Treaty
Challenges
International

Climate Change Impact Models – Urban Heat

1980 - 2023, the maximum temp increased by 1.1°C, with the "feels like" 4.5°C

Expected Temperature increase by 1.0°C → 1.5°C → 2.5°C by 2050.

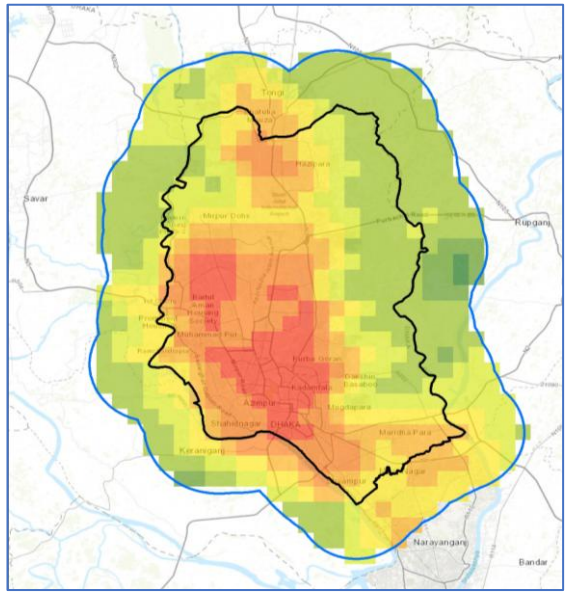
During the summer months from 2018 → 2022 (baseline 1986-2005)

- Global avg → 0.4 °C
- Bangladesh → 0.9°C rise

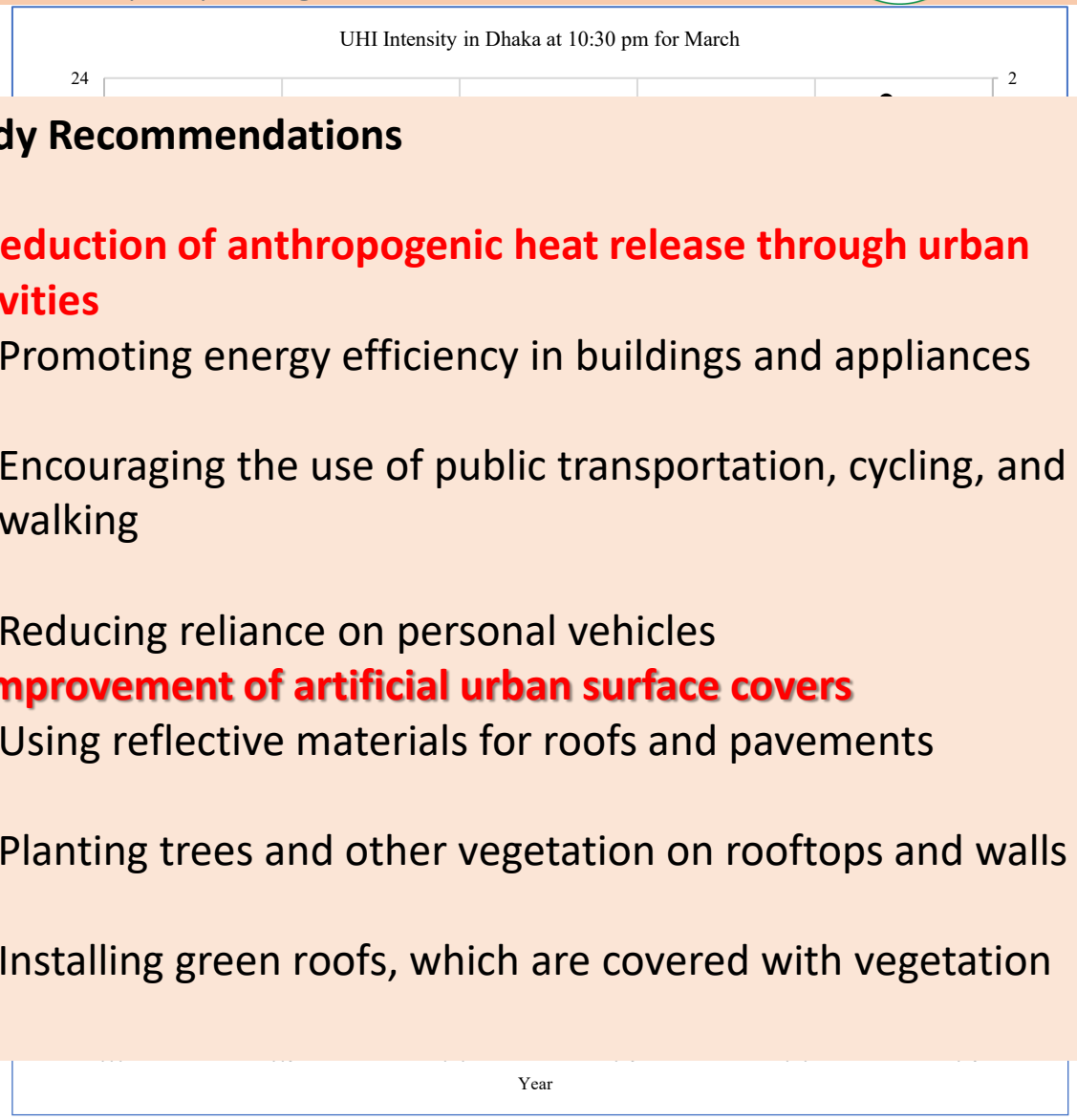
In 2024 (April) → 42°C (exceeded by 6 °C) → Nationwide school closures affecting approximately 33 million children. 15 person died.

Climate Change Impact Models – Urban Heat

Urban Heat Island Intensity



- Increased energy consumption
- Increased heat-related illnesses and deaths
- Loss of effective working hours, loss of livelihc
- Elevated emissions of air pollutants
- Generation of ground-level ozone
  (NOx+VOC+Heat & Sunlight = Ozone)
- Damage to ecosystems



Study Recommendations

1. Reduction of anthropogenic heat release through urban activities

- ❑ Promoting energy efficiency in buildings and appliances
- ❑ Encouraging the use of public transportation, cycling, and walking
- ❑ Reducing reliance on personal vehicles

2. Improvement of artificial urban surface covers

- ❑ Using reflective materials for roofs and pavements
- ❑ Planting trees and other vegetation on rooftops and walls
- ❑ Installing green roofs, which are covered with vegetation