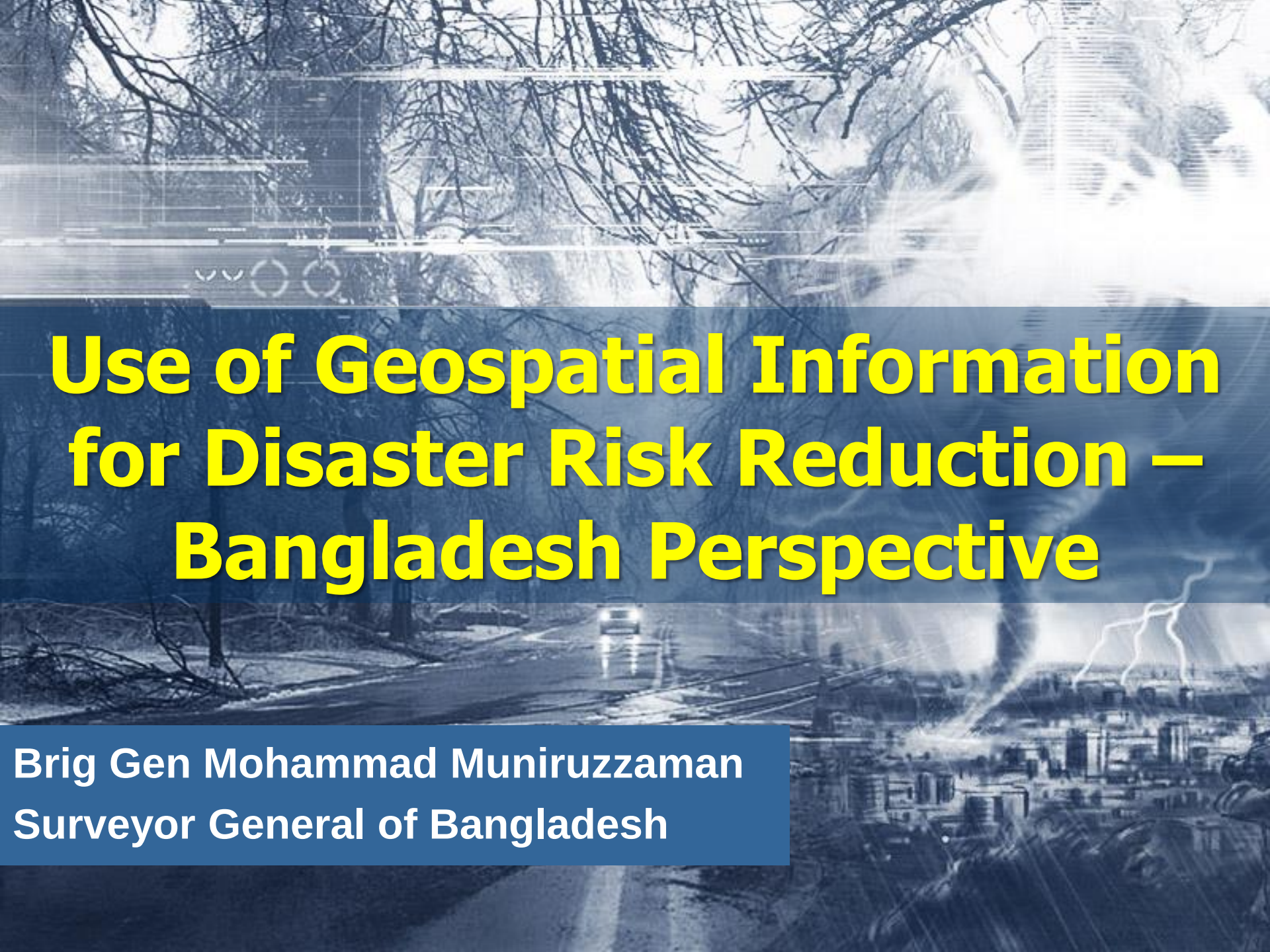


Use of Geospatial Information for Disaster Risk Reduction – Bangladesh Perspective

Brig Gen Mohammad Muniruzzaman
Surveyor General of Bangladesh

Introduction

- Use of space technology and geospatial data for disaster monitoring started in Bangladesh in the early seventies.
- Nowadays, Bangladesh has become a role model for space technology based early warning system in the country for cyclone.
- Bangladesh switched to digital arena of satellite image processing for disaster information retrieval after the big nation-wide flood in 1988.

Introduction

- Since then, flood map and relevant statistical information have been supplied to the relevant ministries and organizations in the country based on remotely sensed images.
- Information on river morphological changes and water logging are also being supplied based on satellite images.
- Presently, Bangladesh has a big community of geospatial data users. Bangladesh is building the National Spatial Data Infrastructure (NSDI) for the coordination and management of geospatial data /information at national level.

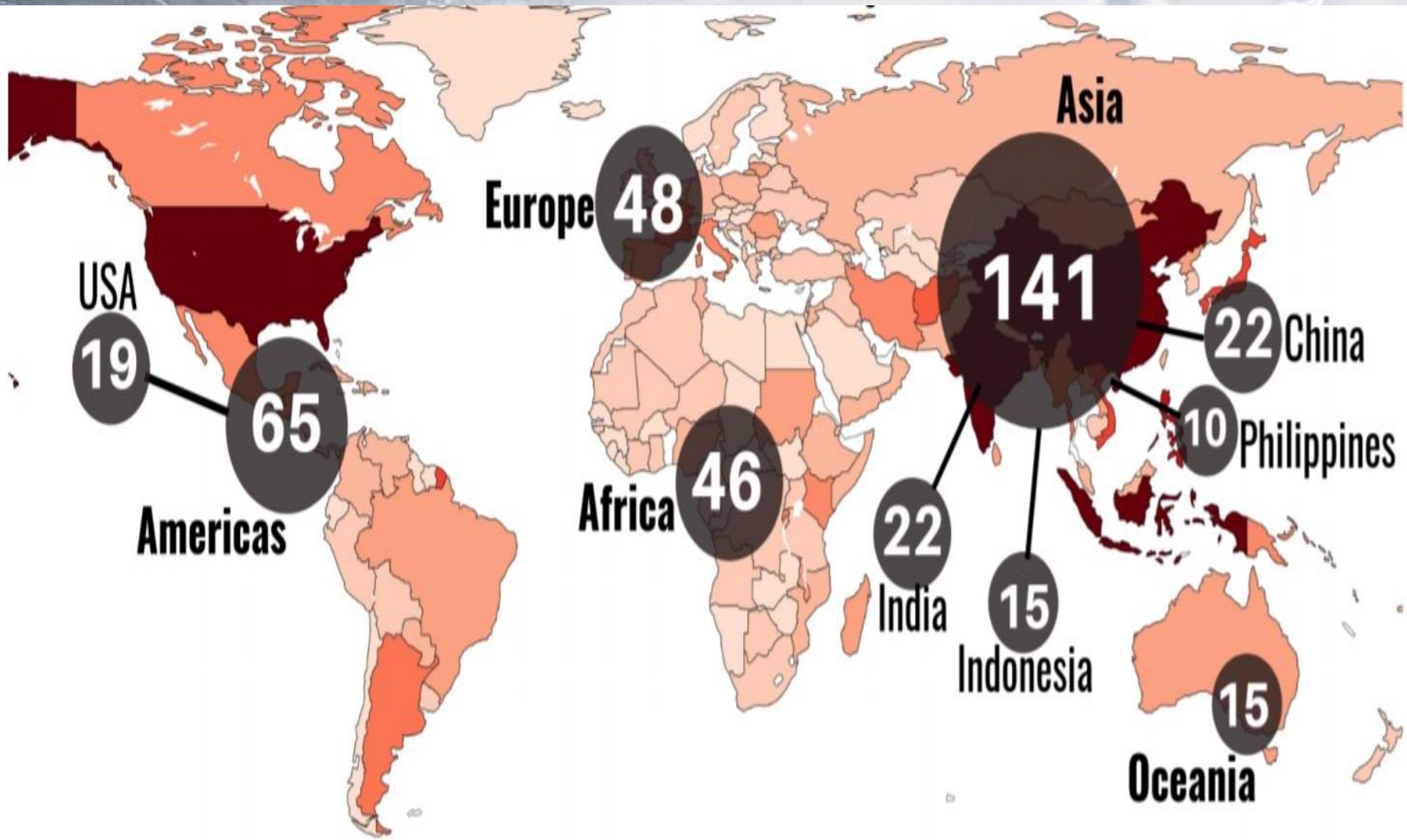
Aim

To orient you with how Bangladesh is preparing to utilize geospatial information for disaster risk reduction and mitigation

Sequence

- Global Trend of Disasters
- Common Disasters in Bangladesh
- Vulnerability of Dhaka City
- Disaster from Effect of Climate Change
- Use of Geospatial Information in Bangladesh
- Challenges
- Way Forward

World Trend of Disasters 1900-2018



Common Disasters in Bangladesh

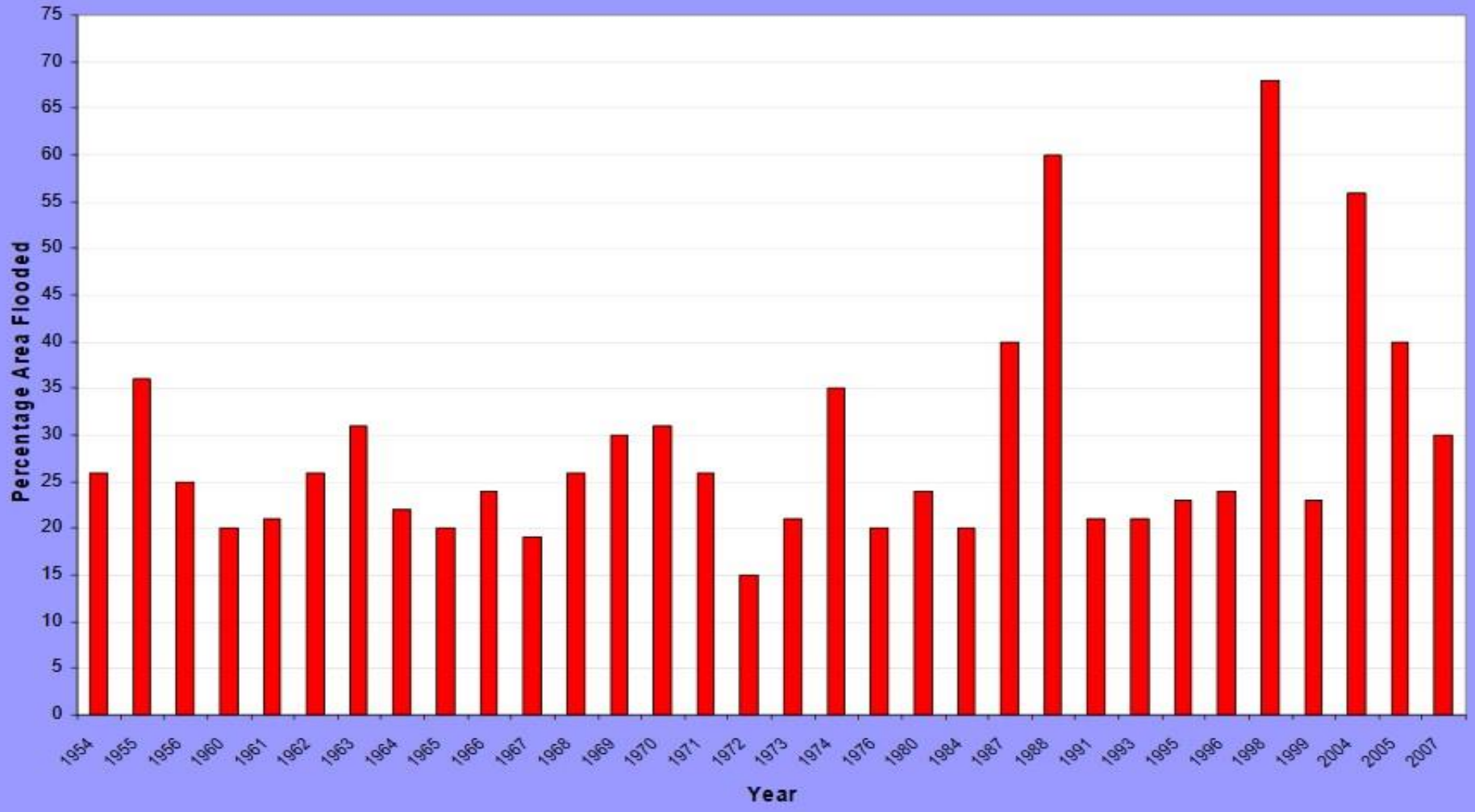
- **Floods/Flash Floods**
- **Cyclones/Tornadoes**
- **Droughts**
- **Land slides**
- **Heat waves/Cold waves**
- **River erosion**
- **Water logging**

Bangladesh is also on high risks of Earthquakes and Tsunami.

Floods in Bangladesh

- Prolonged floods
- Flash floods
- Coastal Floods

Yearly Floods in Bangladesh



Year wise Flooded Area in Bangladesh

Damage due to Flood in Bangladesh

- ✓ In case of most severe floods, 60%or more land area of the country is affected.
- ✓ Flood brings huge sufferings, loss of lives and damage of crops and infrastructures amounting to the tune of billion dollars.
- ✓ Recovery from flood damage takes long time.

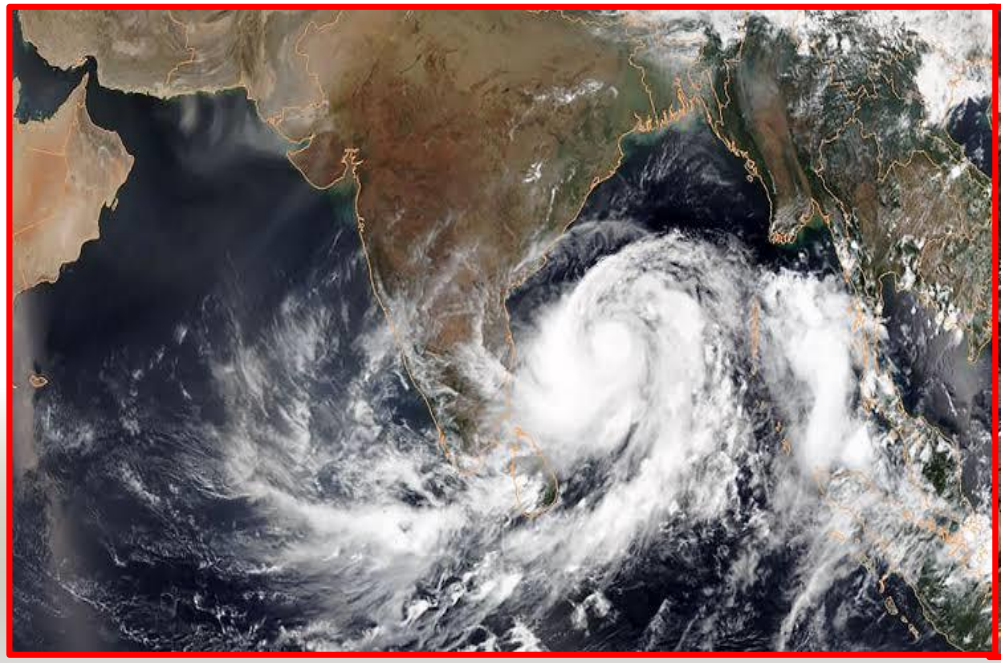
Damage due to Flood in Bangladesh

- ✓ The 1988 flood resulted in a total damage to the national economy of approximately US$2 billion.
- ✓ The cost of direct damage for 1998 flood was US$ 2.8 billions(World Bank, 2002).
- ✓ In 2004, the flood damage was estimated to be US$ 2 billion (Hye, 2007).

Cyclones in Bangladesh

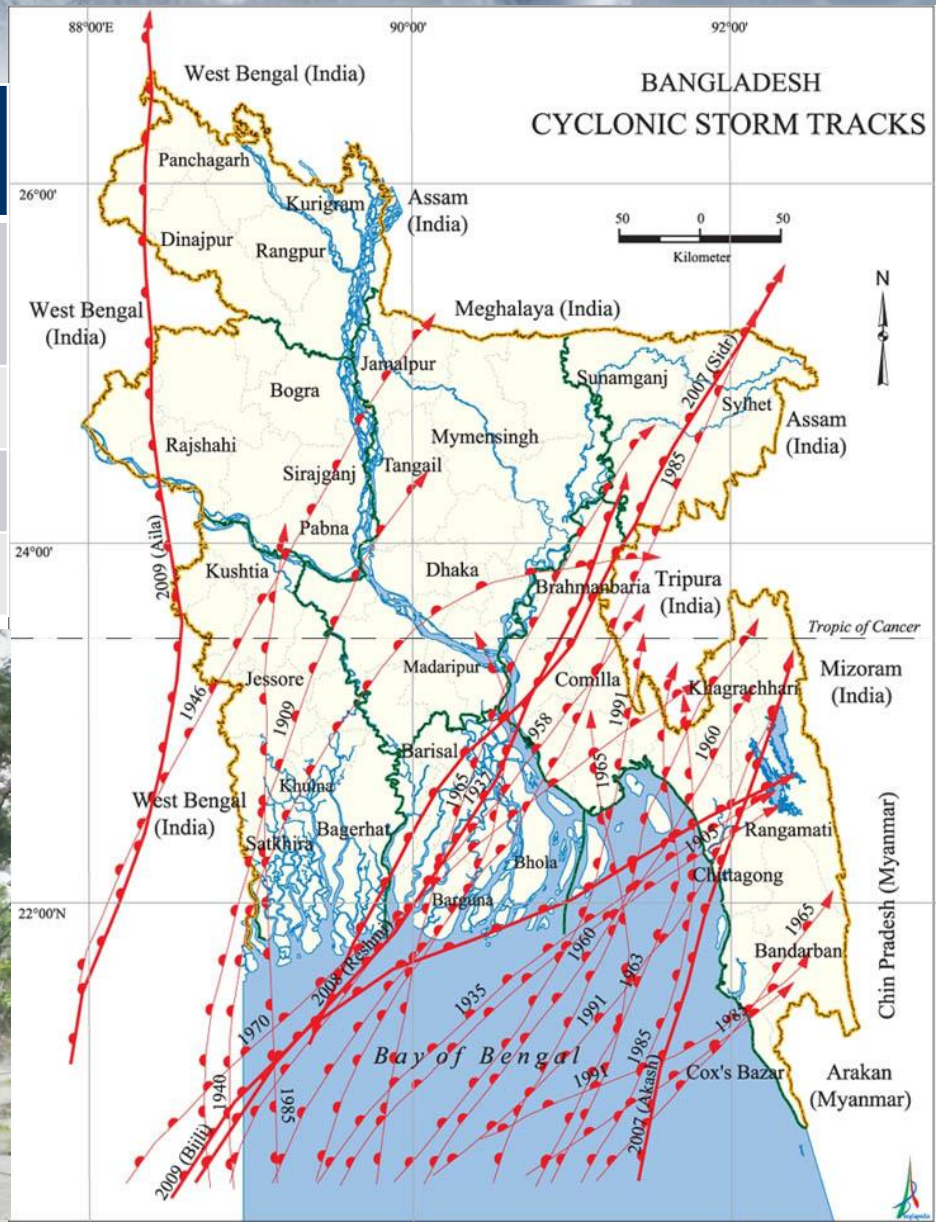
- Bangladesh is prone to severe cyclonic storms periodically due to its unique location along the Bay of Bengal.

- In last one decade, there were 3 cyclones hitting Bangladesh on an average.



Major Cyclones in Bangladesh

Year	Name of Storm	Human Casualty
1970	Bhola Cyclone	500,000
1991	Urir Char	138,000
2007	Sidr	3,400
2009	Aila	17

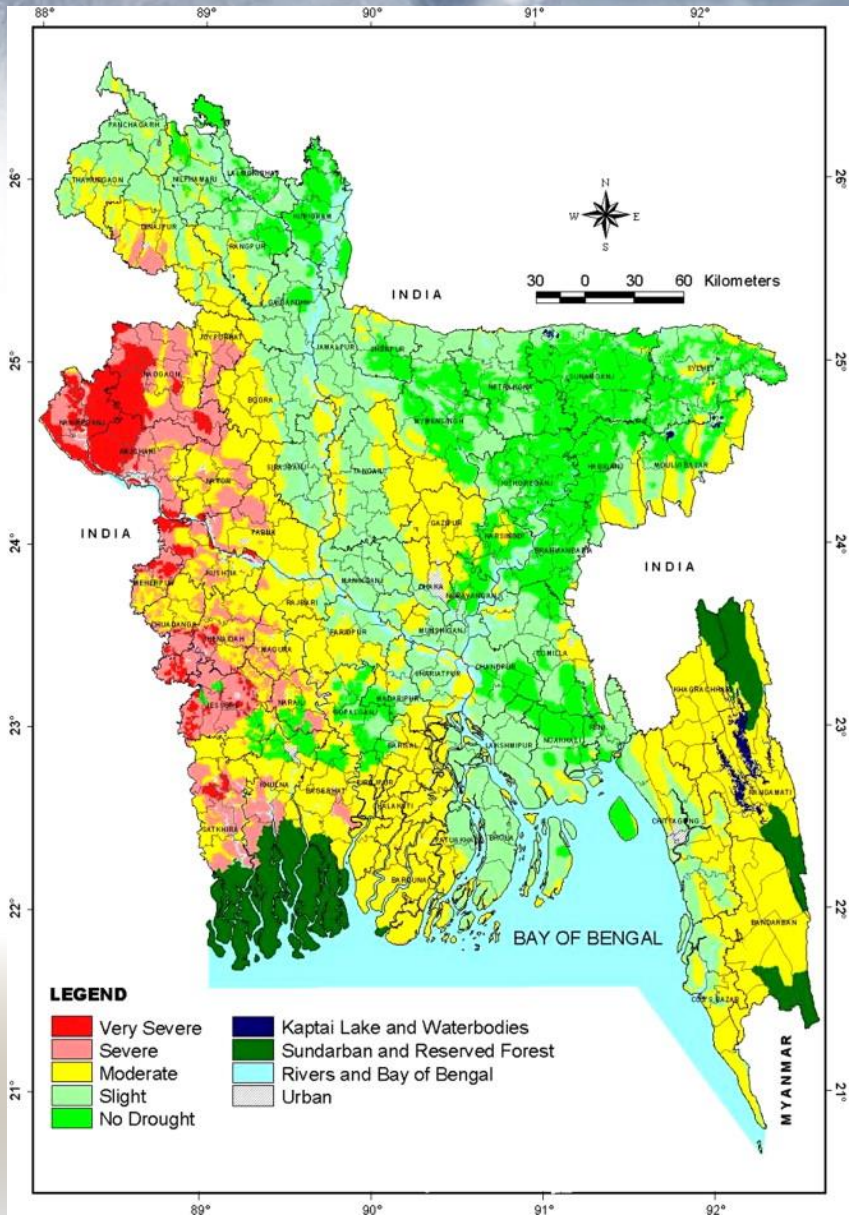


Droughts in Bangladesh

- Average rainfall has declined in the recent past and drought is not uncommon in Bangladesh.
- Bangladesh suffered around 20 drought conditions in last 50 years.
- There are strong evidences that climate change causing change in rainfall pattern and consequently more frequent droughts are happened.

Droughts in Bangladesh

- ‘Barind Tract’ of north western region suffers badly
- Crop damage may be cut down by 10% to 70%
- In 1990, there was a short fall of rice production of 3.5 million tons



Landslides

This is a very news type of disaster that Bangladesh is facing very frequently in the recent past.

Unplanned settlement on the slopes of hills is the root cause of landslide in Bangladesh.

In 2017, landslides in three districts claimed 152 lives and a loss of property of 223 million US Dollars.

Land Erosion
(Coastal)

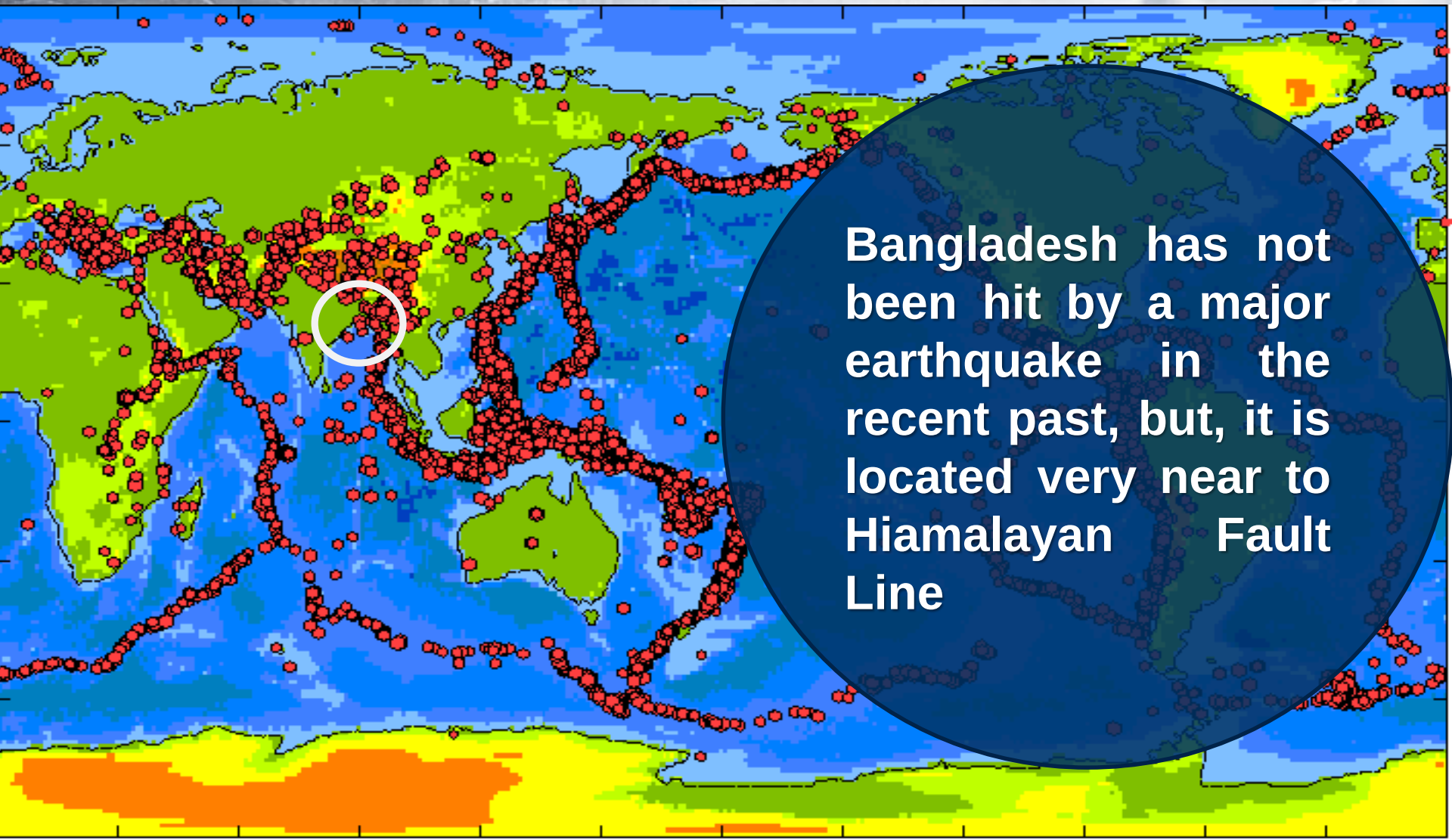
- **Refraction current for submarine canyon and swatch of no ground results in high tidal waves for erosion.**

- **About 5,800 hectares of land by 2030 and 11,200 hectares of land by 2075 would be lost coastal erosion.**

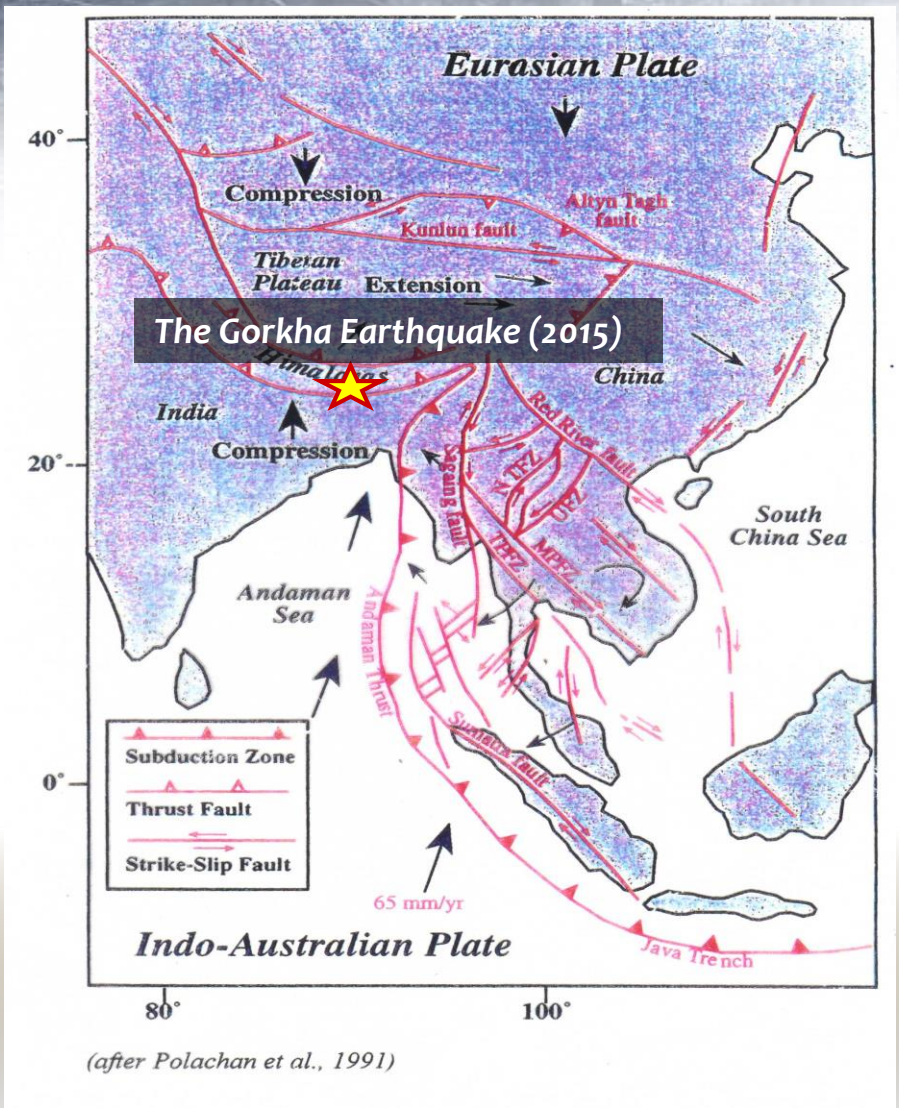
Land Erosion
(River)

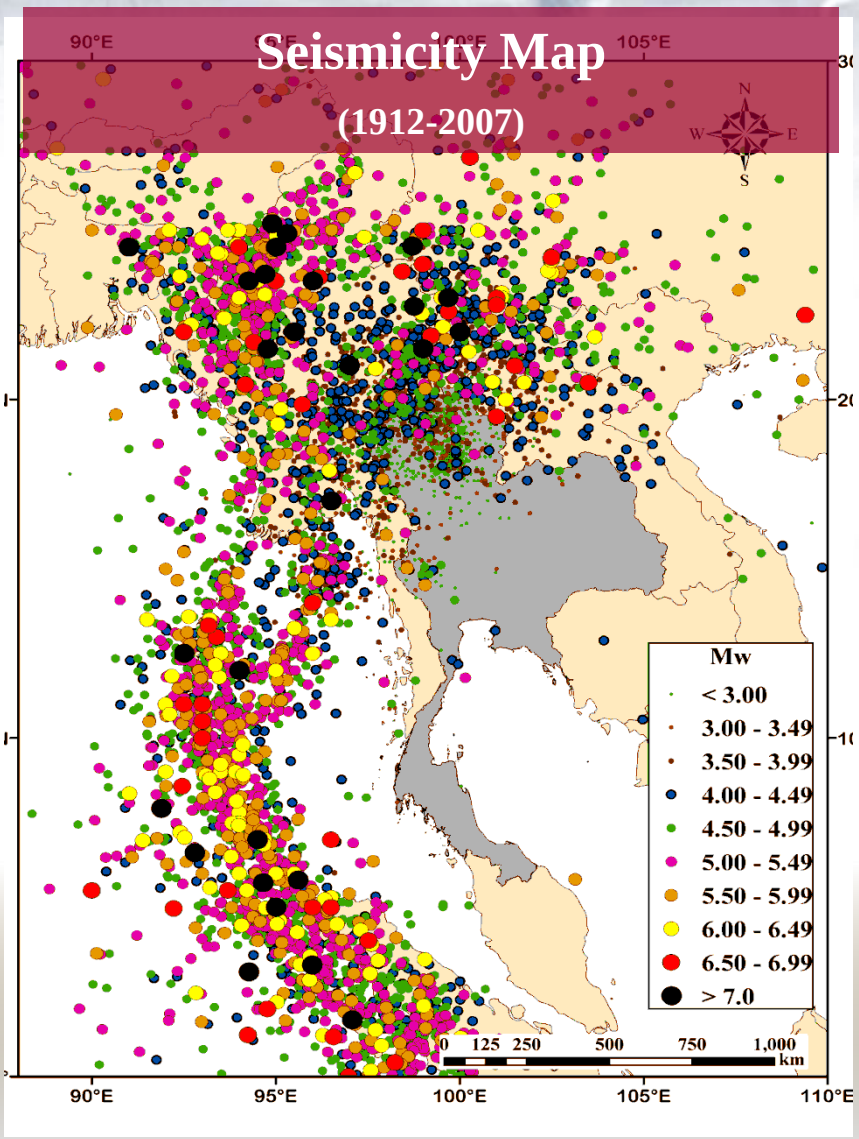
- 10,000 hectares of land is lost every year for river erosion.
- About 13,750 and 252,000 tons of food grains production would be lost by the year 2030 and 2075 respectively.
- People shift their dwellings for 02 to 04 times in 20 to 30 years causing internal migration.

Earthquakes

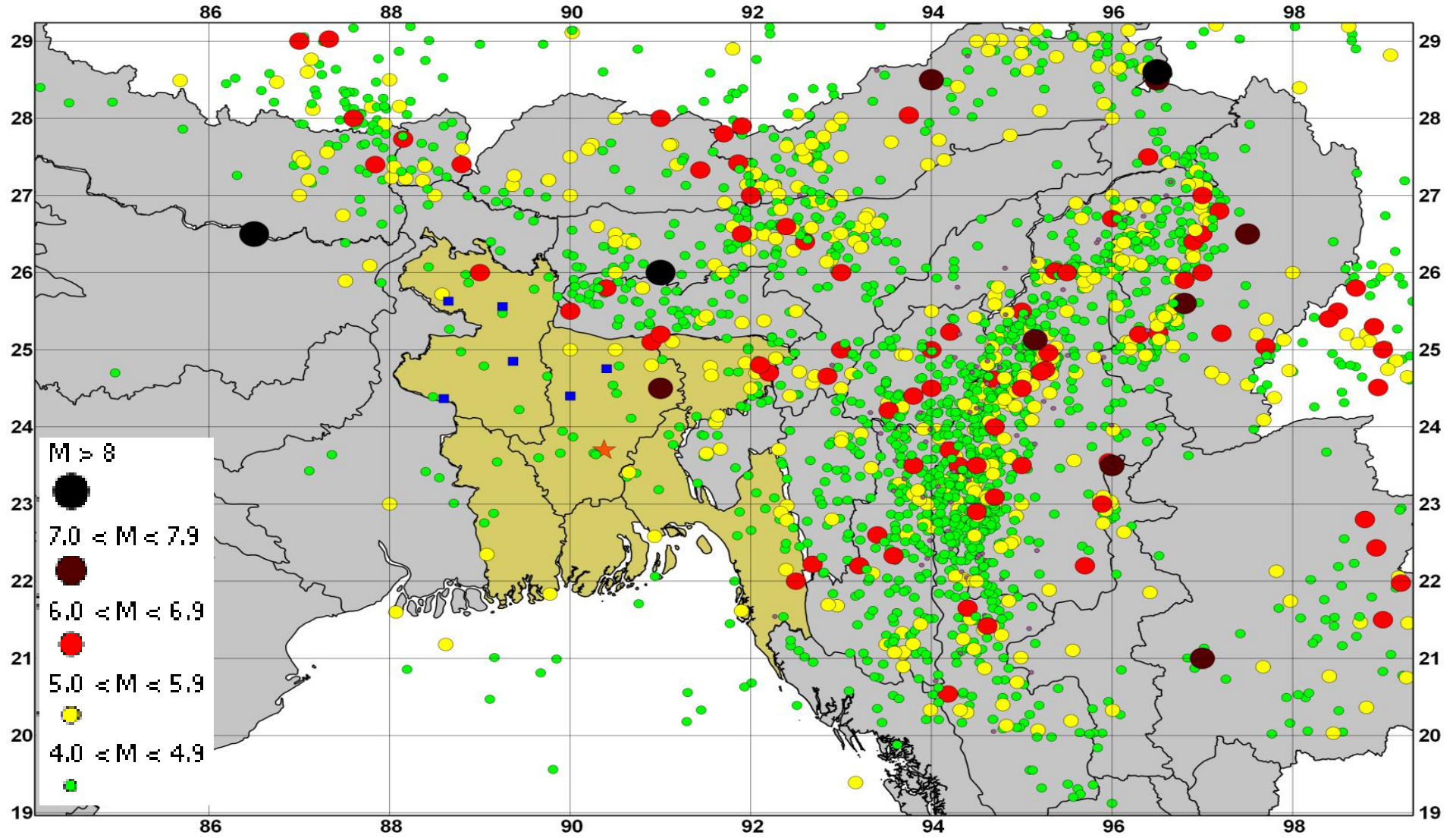


Tectonic and seismic map of Asia-Pacific Region

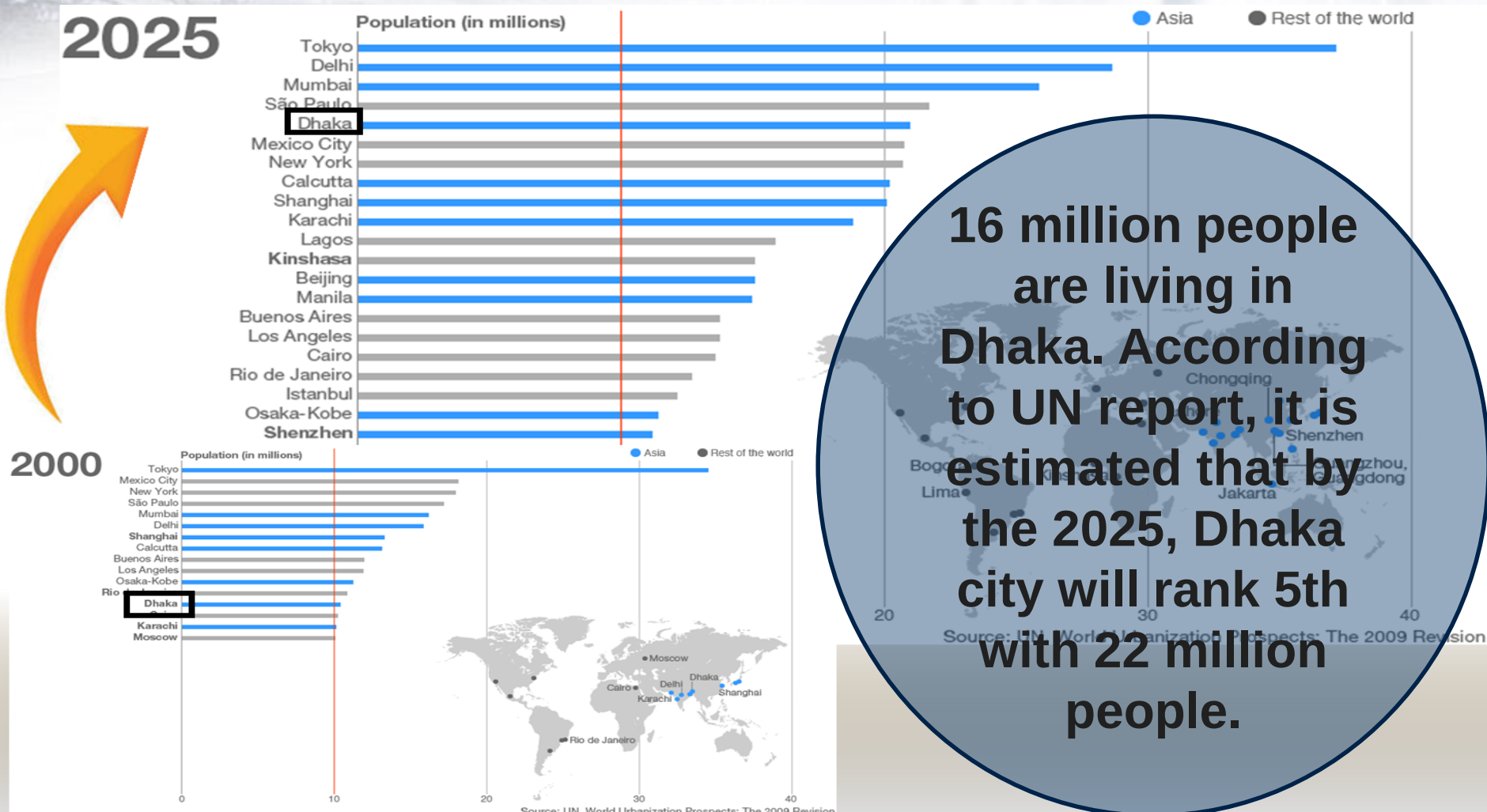




Earthquakes in Bangladesh (1897-2012)



Dhaka – The Capital City
(at increased risk of disaster)



16 million people are living in Dhaka. According to UN report, it is estimated that by the 2025, Dhaka city will rank 5th with 22 million people.

Dhaka – Vulnerable to disaster

6 story building collapsed- died 21, 25/02/2006

Nine-story garment factory collapsed near Dhaka on April 12, 2005. 73 people died.

Vulnerable People

16 May. 2012, fire at Shamoli Tong Slum

Dhaka – Vulnerable to disaster

26 February, 2007, fire in a 11 storied building, died 2

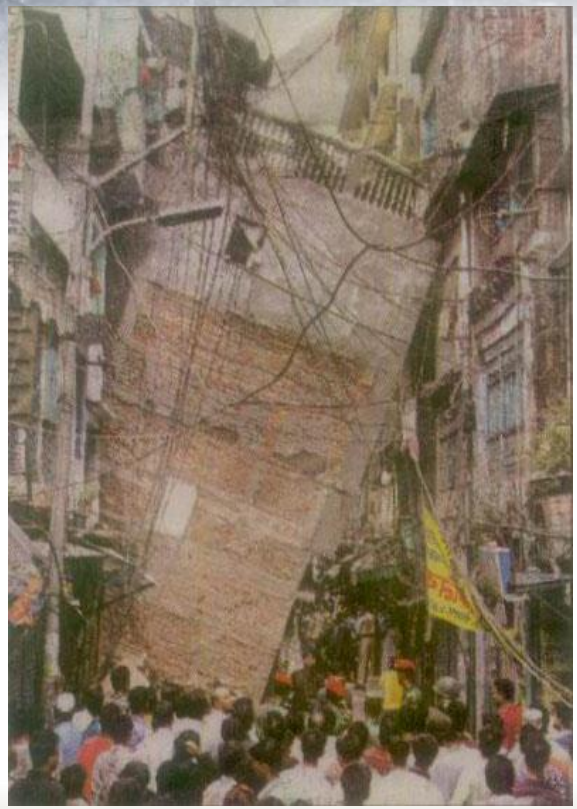
13 march. 2009, fire in a high rise comme[illegible] building, died 5

Feb. 2, 2006. thousands of people homeless

December 15, 2007, slum – south of Dhaka

November 21, 2008, Begunbari slum.

Dhaka – Vulnerable to disaster



Shakhari Bazar-
June 2004, died 19

Begun Bari-
1 June 2010, died 25

June 3, 2010, Nimtoli, Dhaka, died 123.

Dhaka – Vulnerable to disaster

24 April, 2013, Savar – 8 storied building collapse, 1130 people died, At least 2,500 people were rescued from the building alive

Dhaka – Vulnerable to disaster

20 February, 2019, Chakbazar – Fire, 71 people died

28 March, 2019, FR Tower – Fire, 25 people died

Statistics of Fire Incidents in Bangladesh

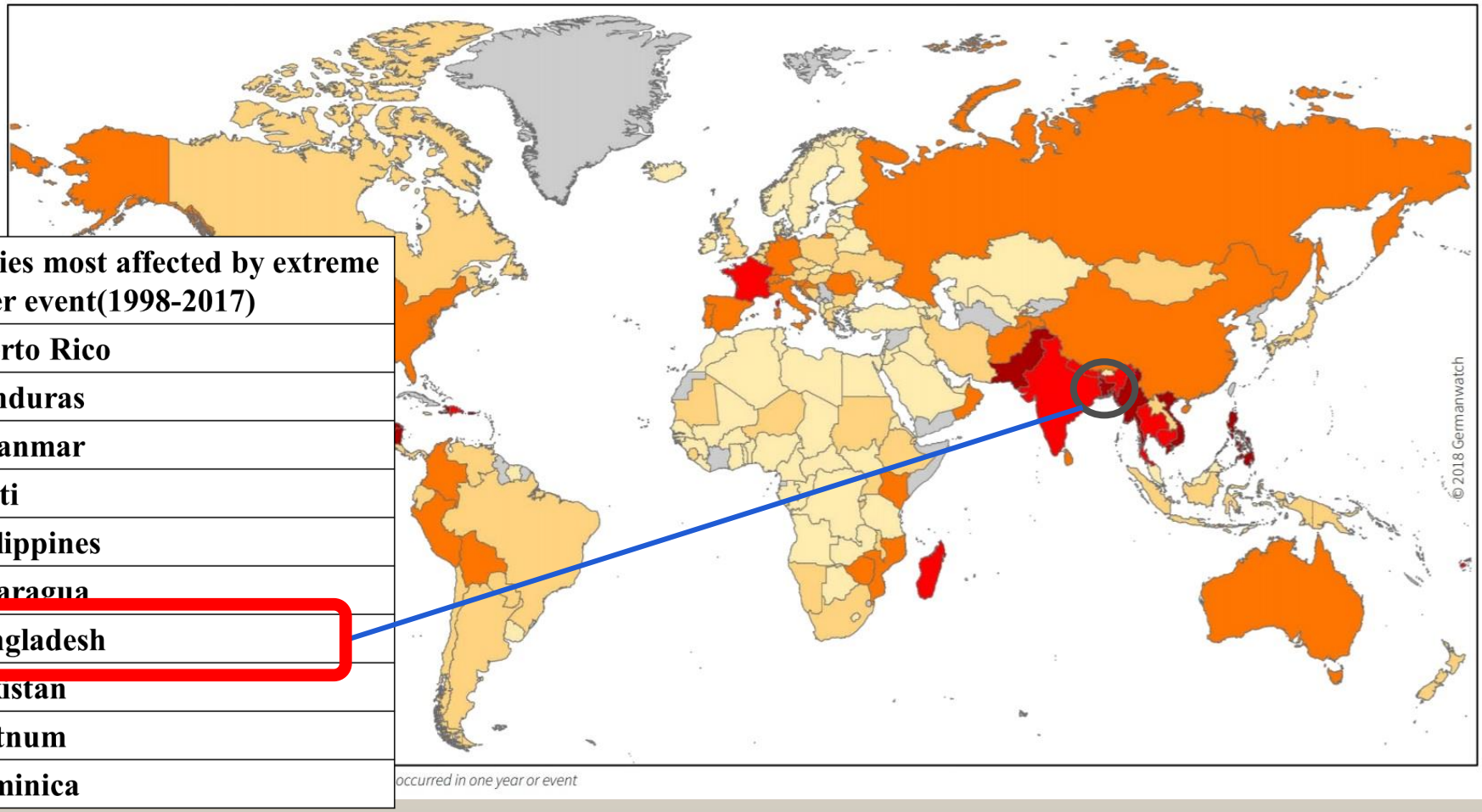
Year	No of Fire Incidents	Approx amount of loss (in million BDT)	Approx number of people rescued
2015	17,488	8570	1831
2016	16,858	2400	1157
2017	18,105	2570	1348
2018	19,642	3850	1862
2019 (June)	15,239	1370	1231

Vulnerability of Bangladesh from Different Disasters

Vulnerability	Hazard Type				
	Flood	Flash Flood	Cyclone & Storm Surge	Drought	Earthquake
	%	%	%	%	%
Land Area	61	23	32	46	73
Population	71	24	27	46	80

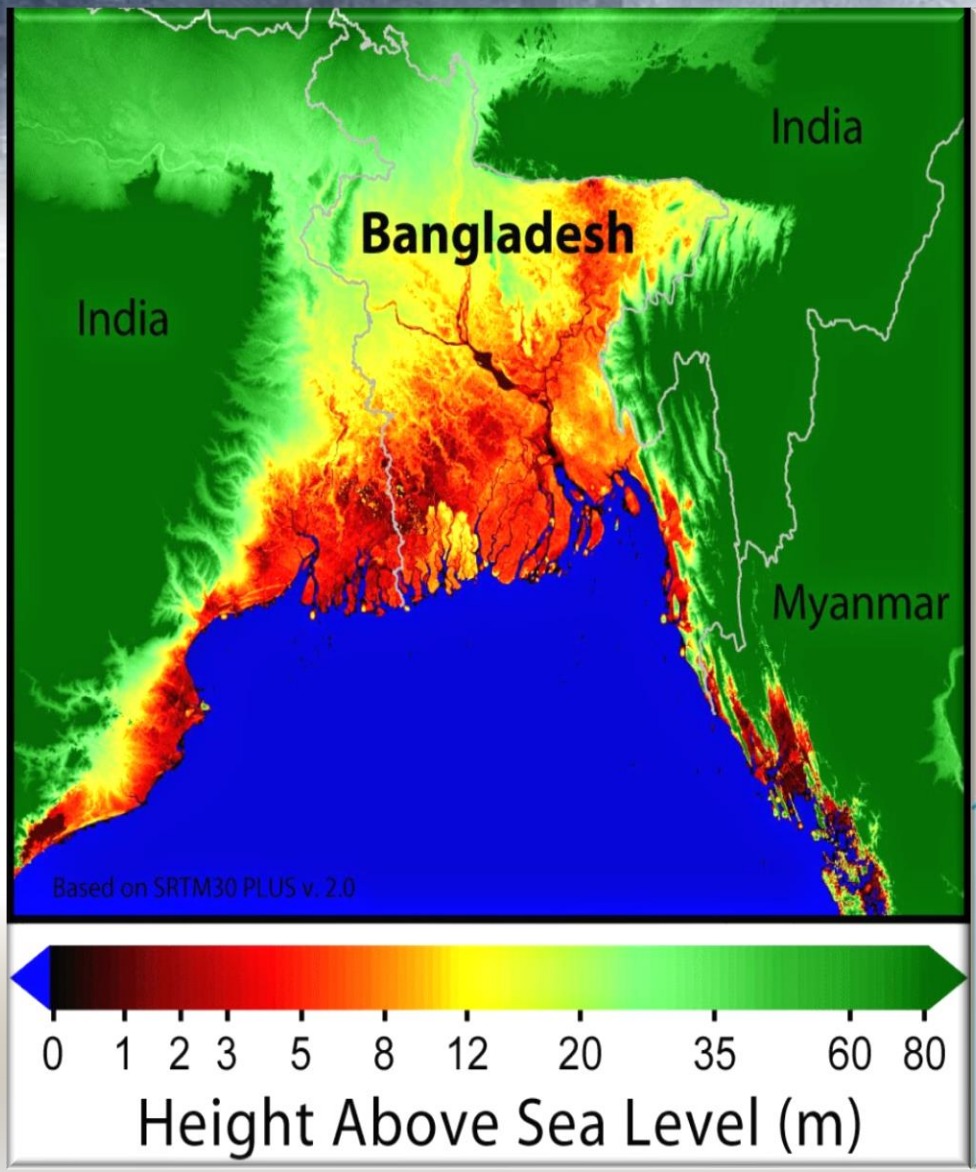
Climate Risk Index Ranking (1998-2017)

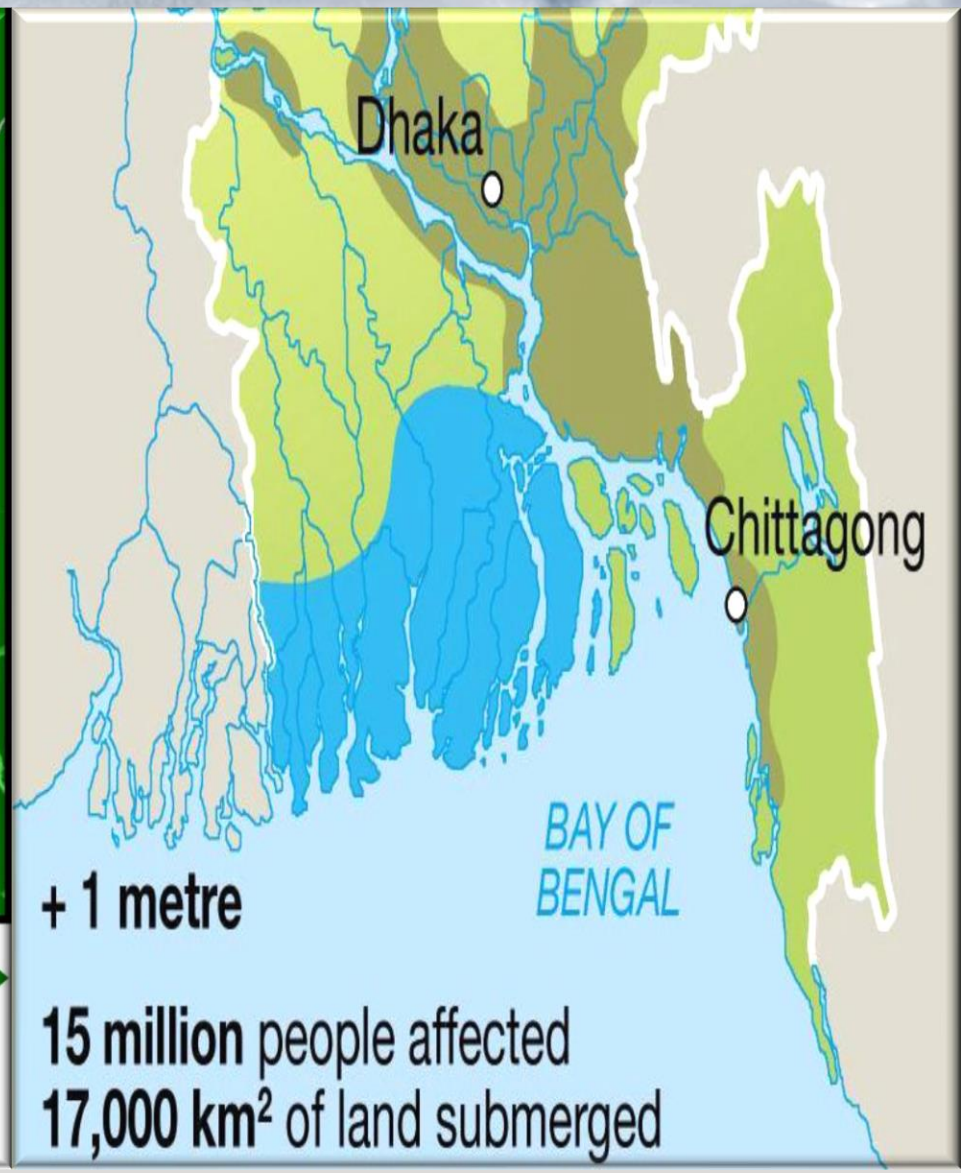
Countries most affected by extreme Weather event(1998-2017)	
1	Puerto Rico
2	Honduras
3	Myanmar
4	Haiti
4	Philippines
6	Nicaragua
7	Bangladesh
8	Pakistan
9	Vietnum
10	Dominica



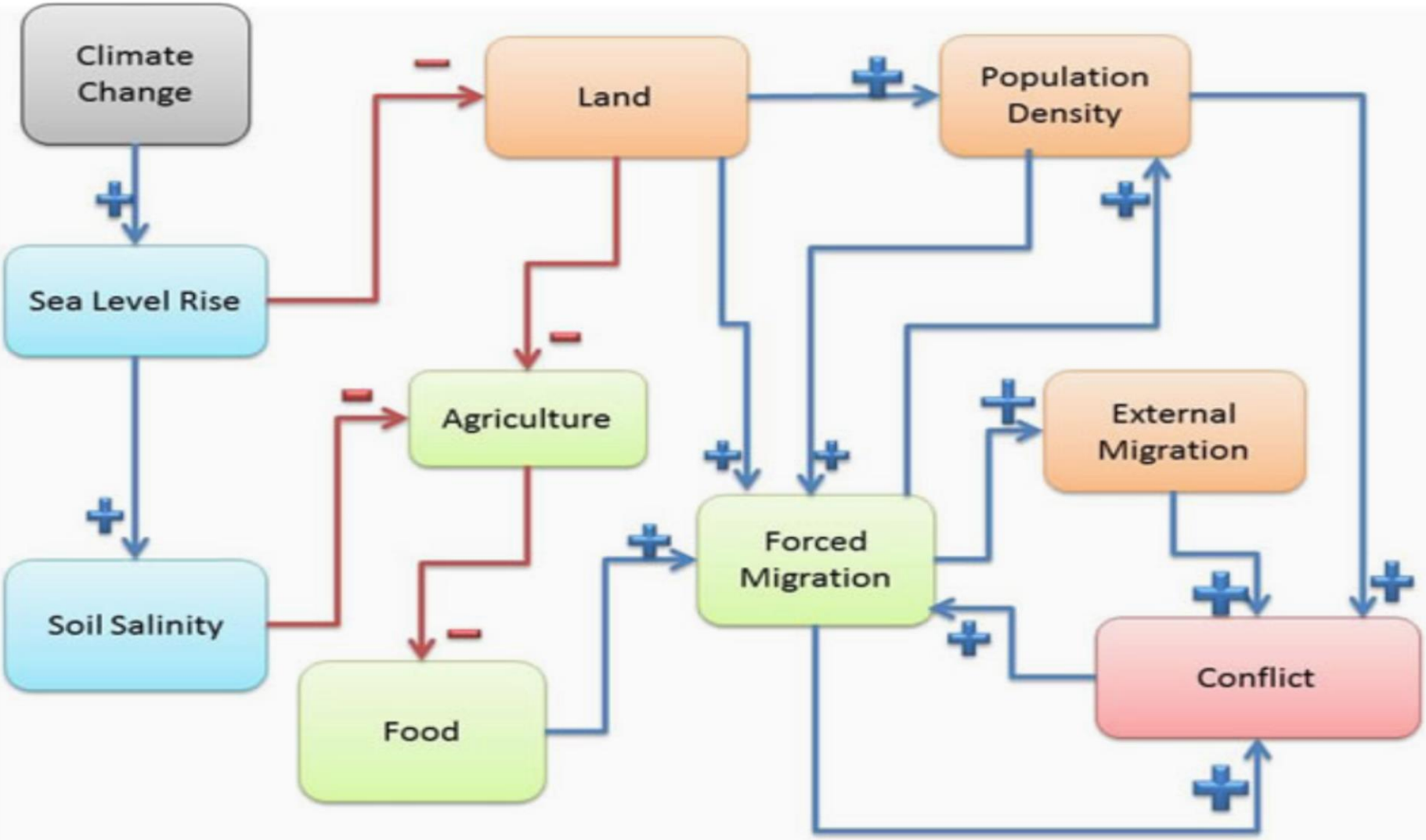
Source : Germanwatch “Global Climate Risk Index (2019)”

Climate Risk – Sea Level Rise





Climate Risk – Sea Level Rise – Soil Salinity



Effect of Salinity, Coastal Surges and River Erosion

SALINITY-TRIGGERED INTERNAL MIGRATION TREND

IMPACT OF SALINITY ON AGRICULTURE

District	Total affected agro-land (hectares)	Totally barren land (hectares)
Patuakhali	155,000	62,000
Satkhira	153,000	99,000
Khulna	148,000	79,000
Bagerhat	131,000	62,000
Barguna	95,000	38,000

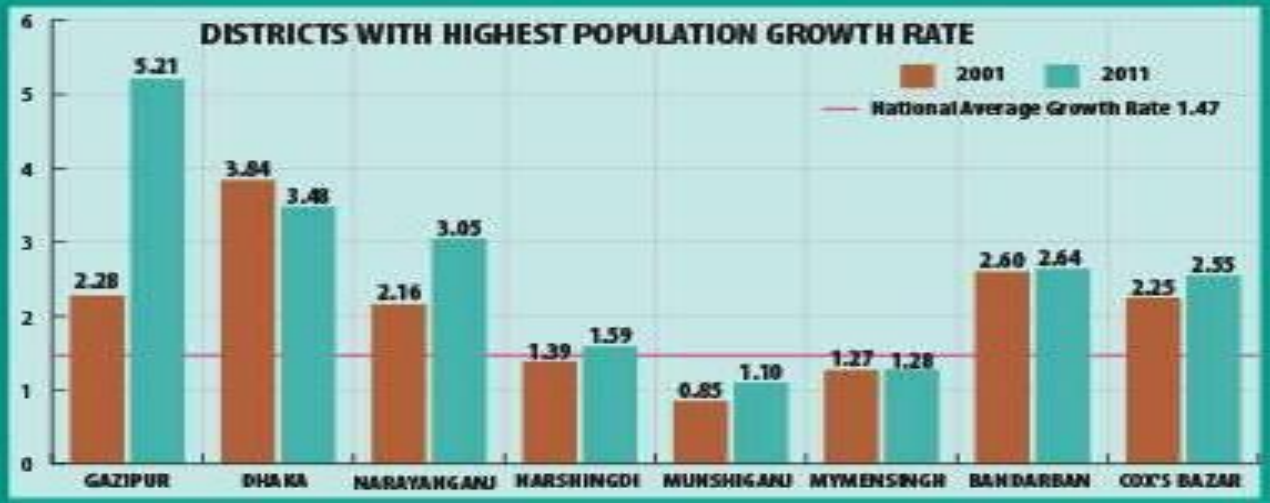
Source: Bangladesh Soil Resource Development Institute

URBAN SLUM GROWTH

From 1997 to 2014

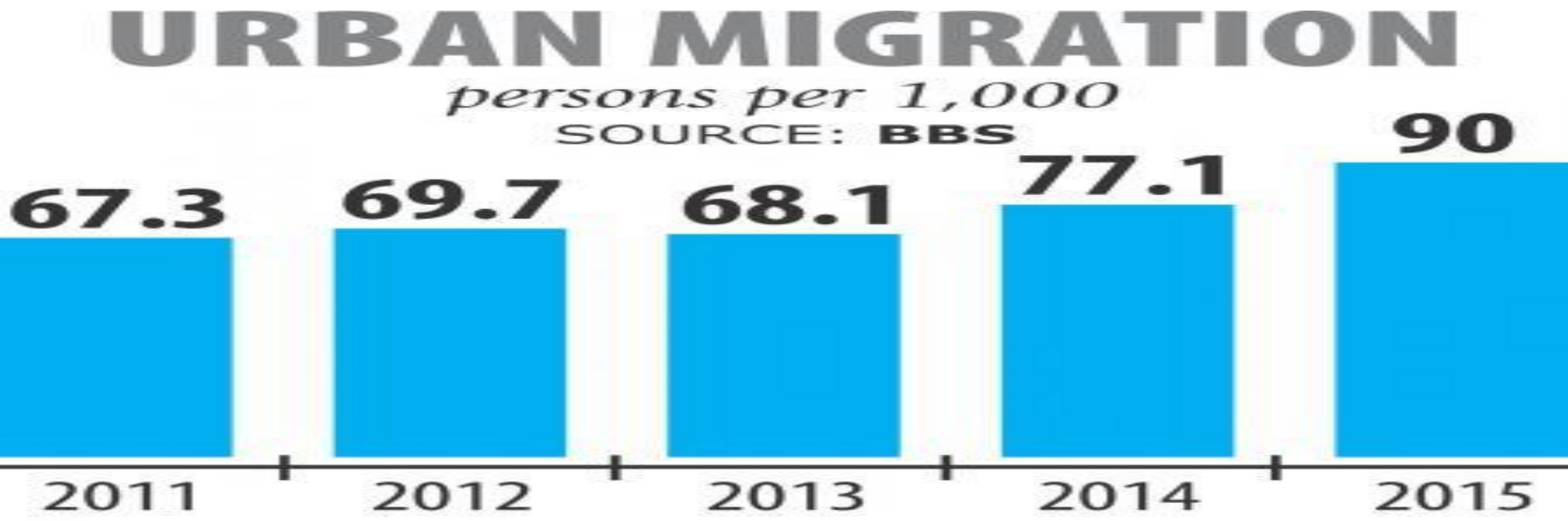
Slum Growth
366%

Slum Household Growth
77%



Effect of Salinity, Coastal Surges and River Erosion

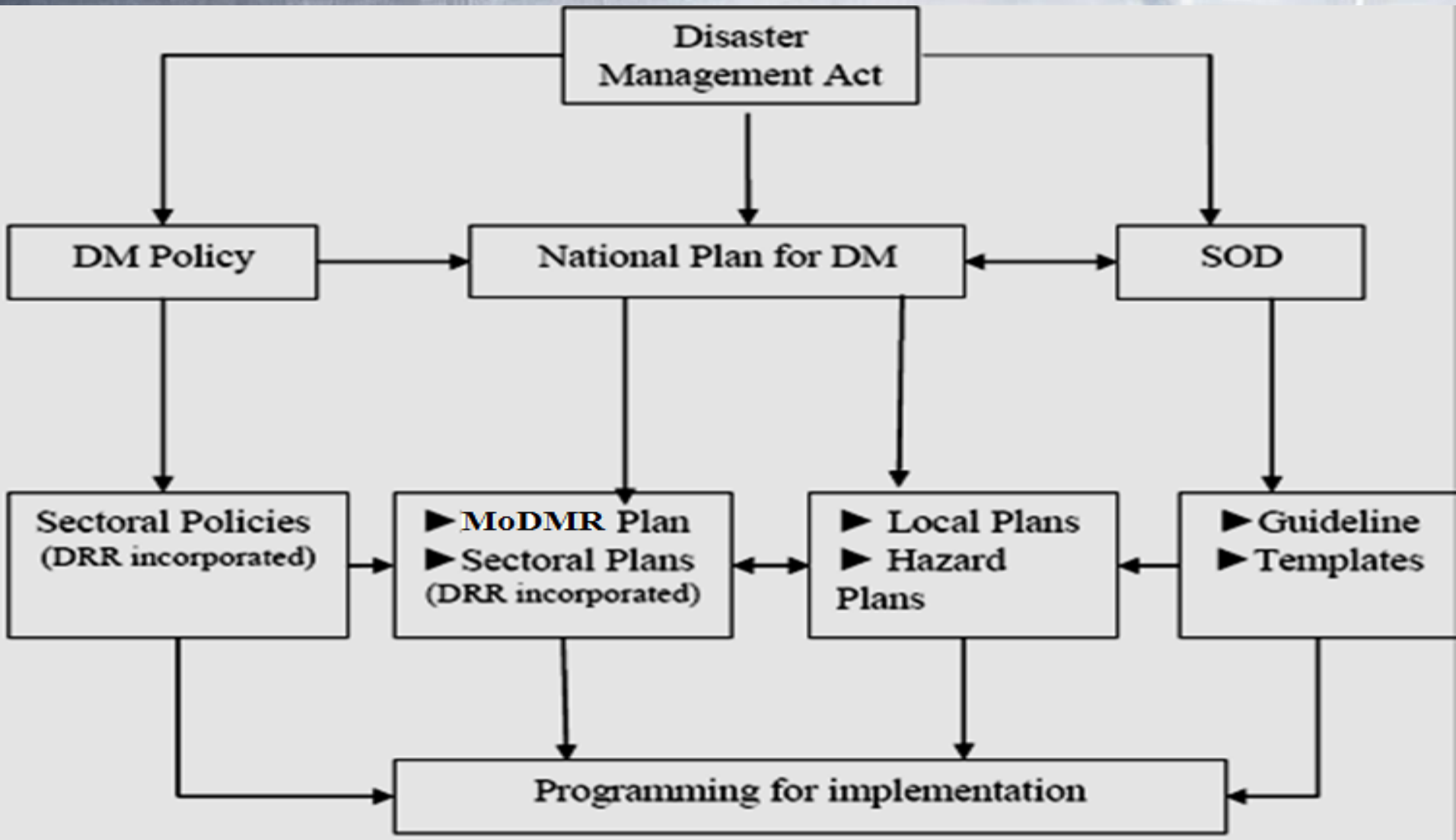
Some 90 out of every 1,000 persons moved to urban areas in 2015, up 17 percent year-on-year, according to Bangladesh Sample Vital Statistics (BSVS) 2015, published by BBS recently.



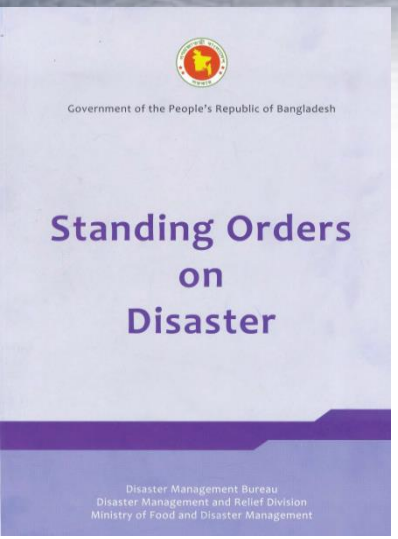
Use of Geospatial Information for Disaster Management in Bangladesh

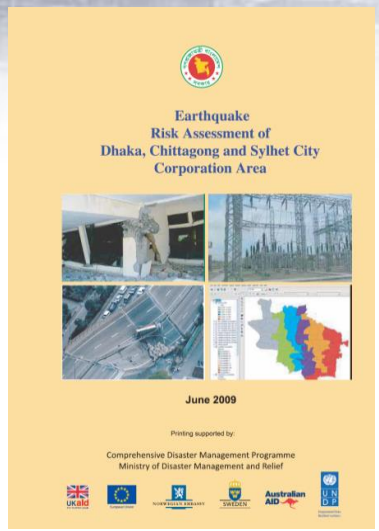
- ✓ With limited resources and capability, Bangladesh is striving hard to take advantage of latest technology for disaster risk reduction by integrating space technology and geospatial information.
- ✓ Bangladesh has developed well coordinated system for monitoring natural disaster and provide timely early warning to minimize damage.
- ✓ Bangladesh is slowly building her capability both in terms of infrastructure and human capital to generate, analyze and manage spatial data for disaster risk reduction.

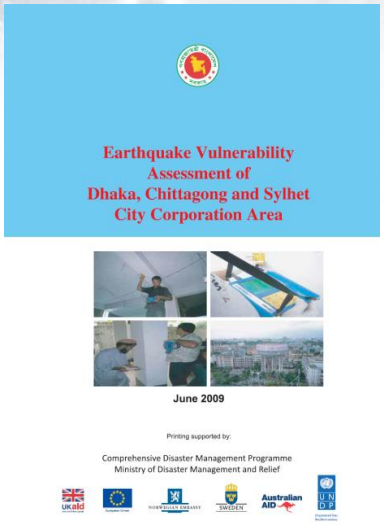
Legal Framework for Disaster Management in Bangladesh

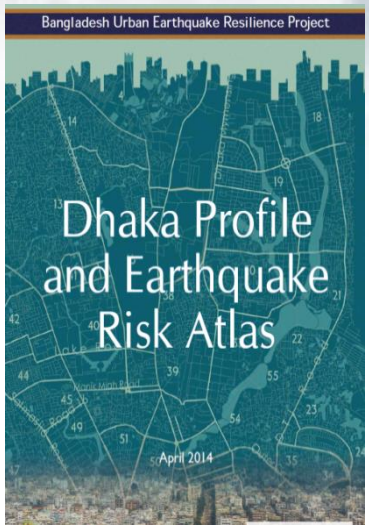


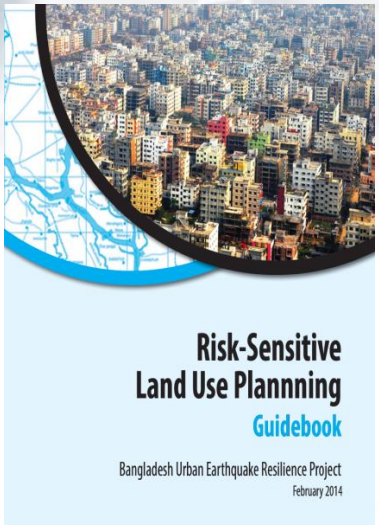
Legal Framework for Disaster Management in Bangladesh

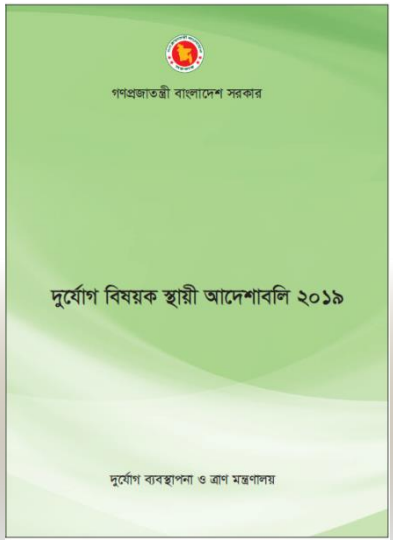


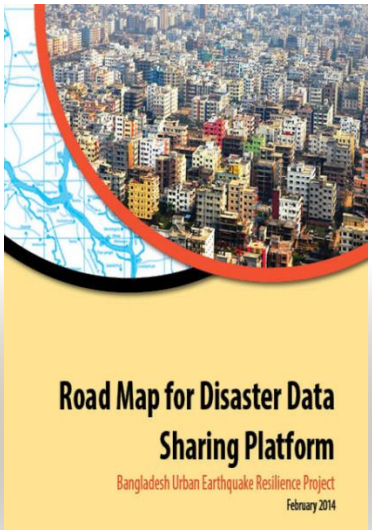


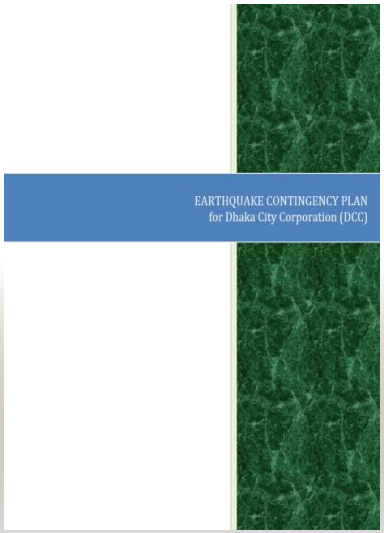


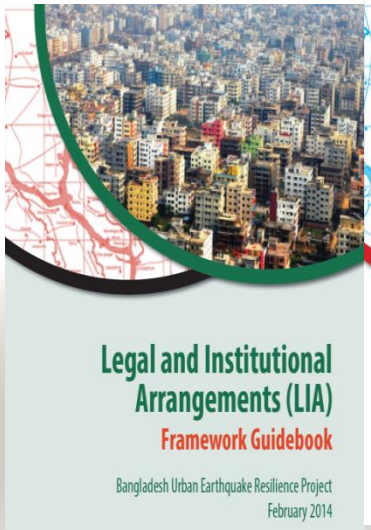


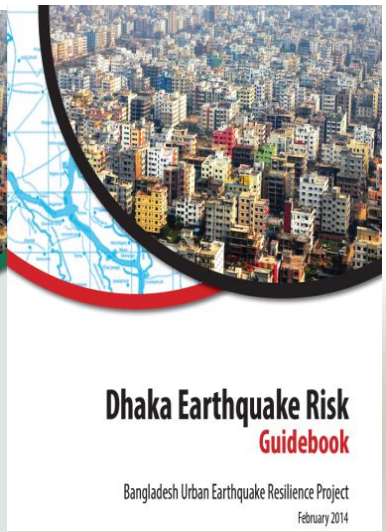










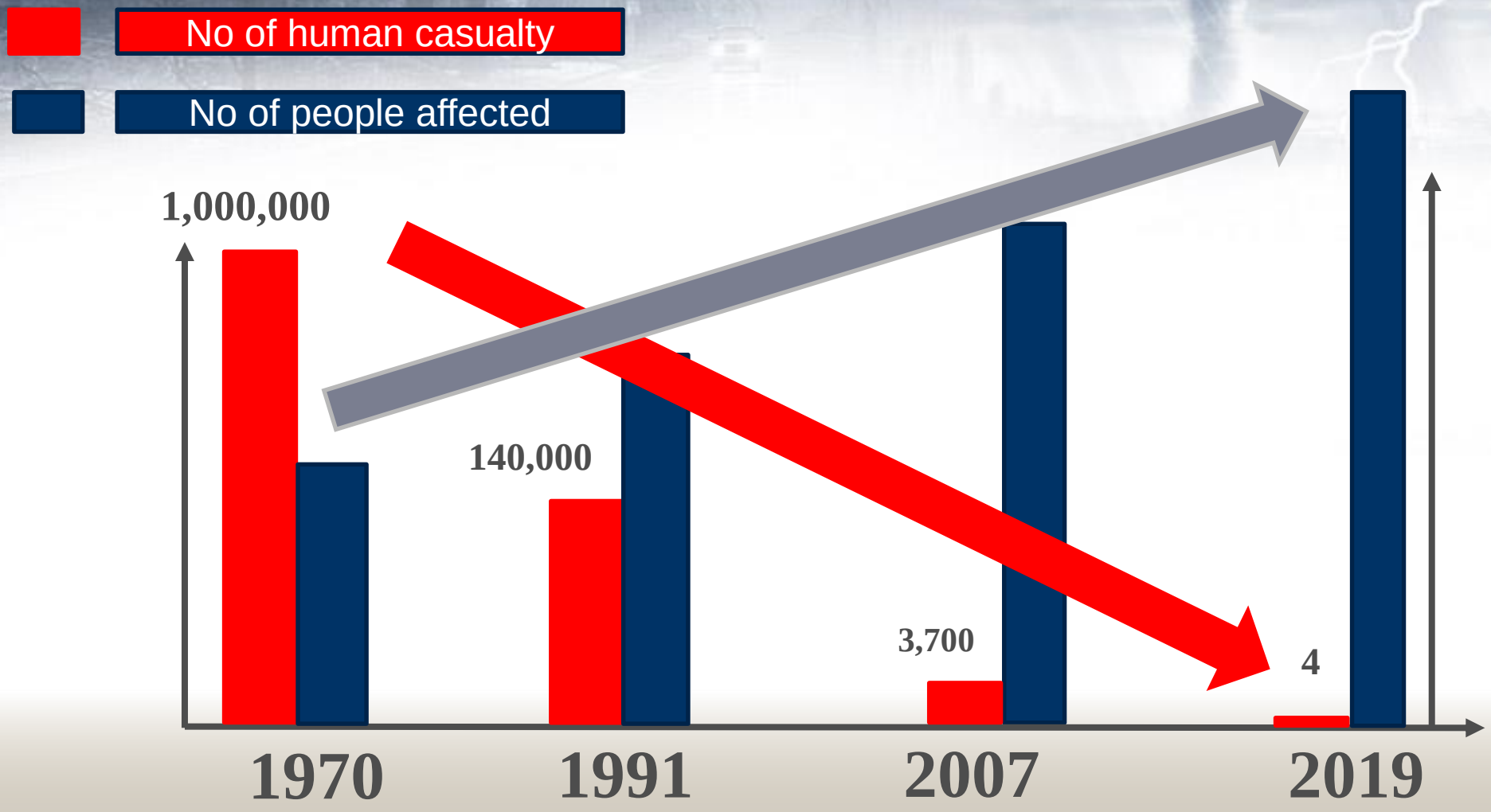


Disaster Early Warning Systems in Bangladesh

Cyclone:

- ✓ **Bangladesh is a role model for space technology based early warning system in the country for cyclone.**
- ✓ **The performance of the Space Research and Remote Sensing Organization (SPARRSO) of Bangladesh is well recognized an authentic source of early warning system for cyclones in Bangladesh.**

Causality Trend in Bangladesh Cyclones



Early Warning Systems for Flood

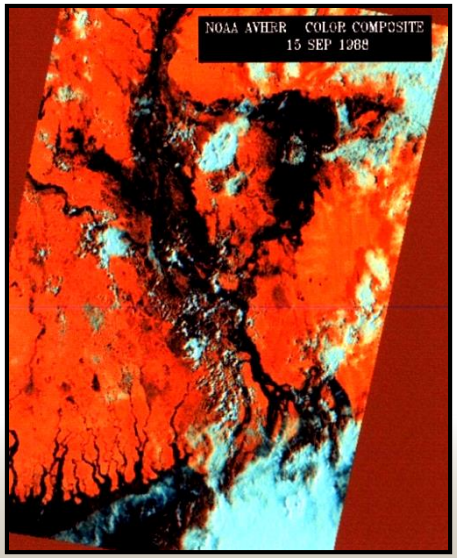
- Bangladesh Water Development Board has established an organization named “Flood Forecasting and Warning Center (FFWC)” for providing early warning of flood in the country.

- FFWC is using Numerical Models and GIS tools for generating flood early warning and is capable of providing early warning with 72 hour lead time.

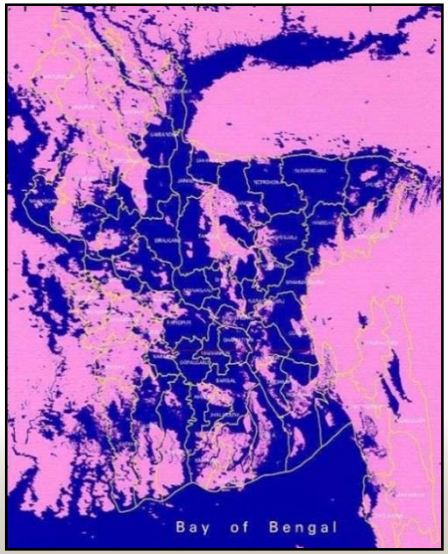
- The early warning information are disseminated using website, internet, fax and mobile telephone from national level to local level.

Early Warning Systems for Flood

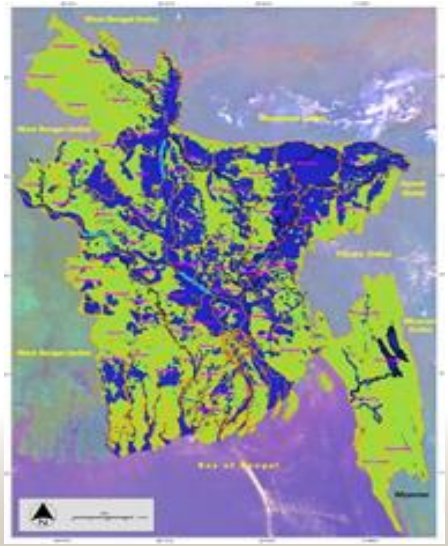
Bangladesh started to apply remote sensing technology for flood monitoring since 1988 for preparation of flood map, generation of statistics for flood area and damage.



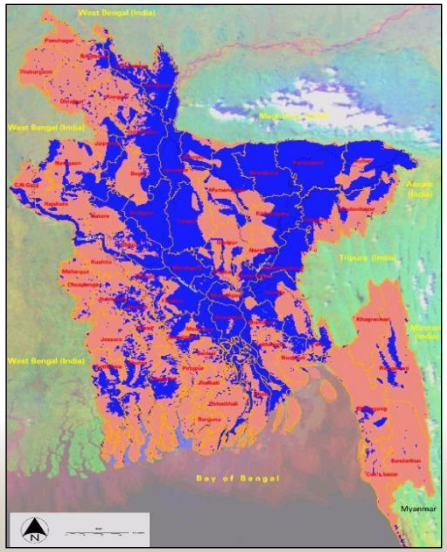
1988



1998



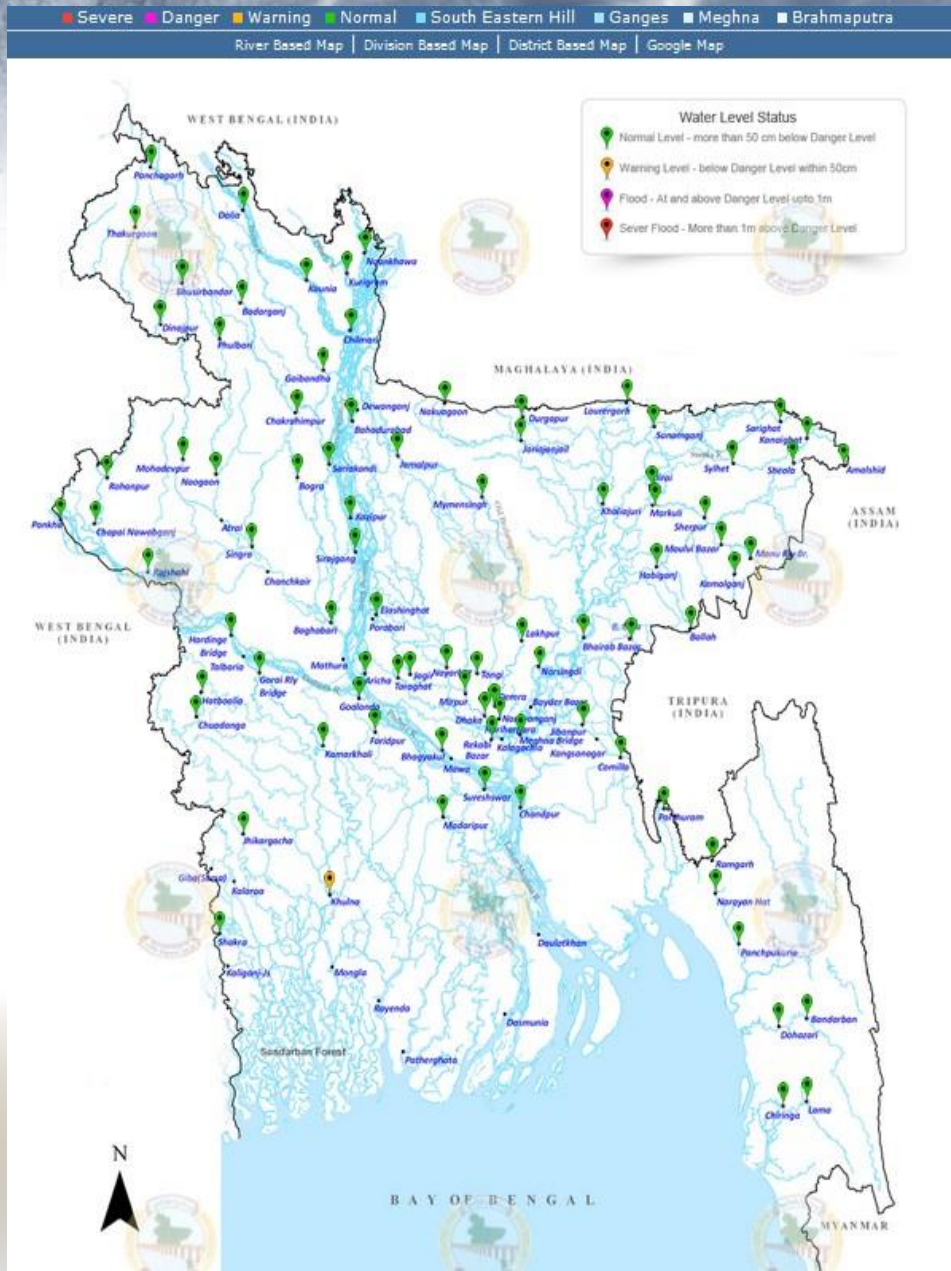
2004



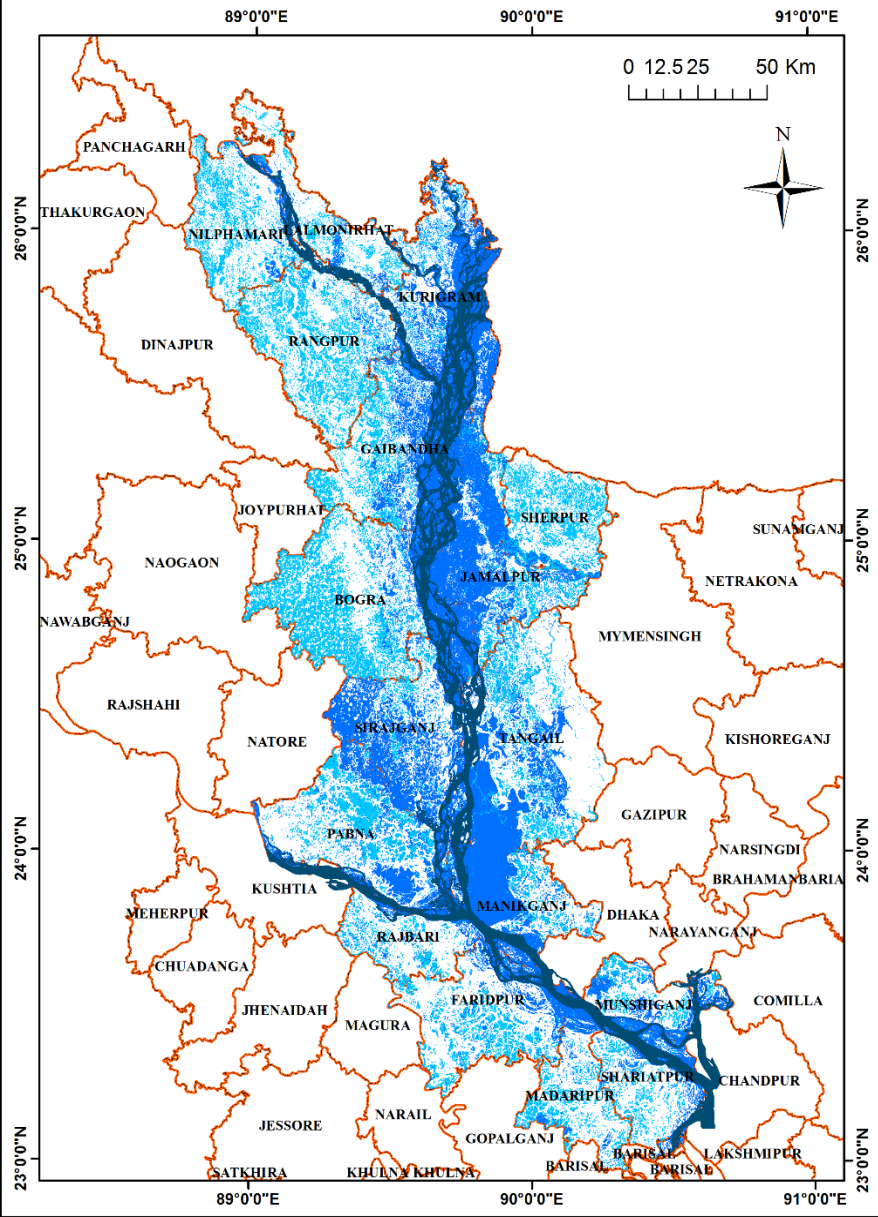
2007

Early Warning Systems for Flood

This map has been developed by Bangladesh Water Development Board for flood forecasting and warning. Most of the important rivers are monitored daily and forecast for flood is made for 72 hours time line.



Early Warning Systems for Flood



Map of Major Flood Affected Districts of Bangladesh

July - August, 2016

Perennial Flood Area:

Perennial flood areas are the areas which are inundated almost every year and Inundation does not create any damage. Perennial flood areas mainly include areas of Aman crop (rain-fed summer rice) and standing water bodies.

Extended Flood Area:

Extended flood areas are the areas which are inundated occasionally due to excess rainfall. These are the potential areas where flood damage occurs. Due to horizontal and vertical extension of flood water, perennial areas may be converted to extended areas.

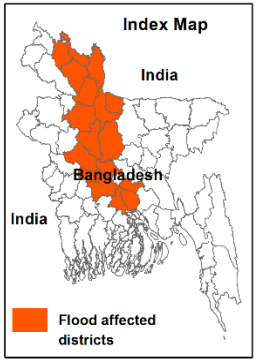
Flood Statistics:

Note:

(a) Map shows the peak flood condition.

(b) At the start of the flood, some areas of the flood affected cropland contained Aman crop (crop in planting stage and seed bed) which was damaged completely.

Extended flood water area
Perennial flood water area
River
District boundary



Sl. No.	Districts	Area of perennial flood, Hec.	Area of extended flood, Hec.	Area of flood affected settlement, Hec	Area of flood affected cropland, Hec
1	BOGRA	110400	30566	2806	9490
2	FARIDPUR	39101	31071	5566	7800
3	GAIBANDHA	43619	59591	2838	25874
4	JAMALPUR	27325	110488	14862	47268
5	KURIGRAM	14681	87761	8440	48592
6	LALMONIRHAT	19629	8819	16	2565
7	MADARIPUR	26779	12903	1762	2601
8	MANIKGANJ	15504	59735	12771	22272
9	MUNSHIGANJ	16792	24491	4344	8159
10	NILPHAMARI	47397	8072	1650	3006
11	PABNA	49390	58901	4286	9835
12	RAJBARI	19357	11769	5471	949
13	RANGPUR	82993	8723	1203	6042
14	SHARIATPUR	19051	19475	2960	3247
15	SHERPUR	48610	8067	2084	1194
16	SIRAJGANJ	15970	117120	8138	44028
17	TANGAIL	47524	90101	15075	26259
	Total	644122	747653	94272	269181

Data Sources:

ALOS-2 SAR Images: 03 August, 2016 obtained through Sentinel Asia initiatives. Copyright JAXA.

TerraSAR Images: 02 August, 2016 obtained through Sentinel Asia initiatives. Copyright DLR.

RADARSAT-2 Images: 04 August, 2016 obtained through International Disaster Charter initiatives. Copyright MacDONALD, DETTWILER AND ASSOCIATES LTD. (MDA).

RADARSAT-2: Aug./Sept., 2009-2013, obtained from SPARRSO archieve. Copyright SPARRSO.

Sentinel-1Images: 24 and 30 July, 2016 obtained through download. Copyright ESA.

Landsat OLI Image: 01 August, 2016 obtained from USGS archieve. Copyright USGS.

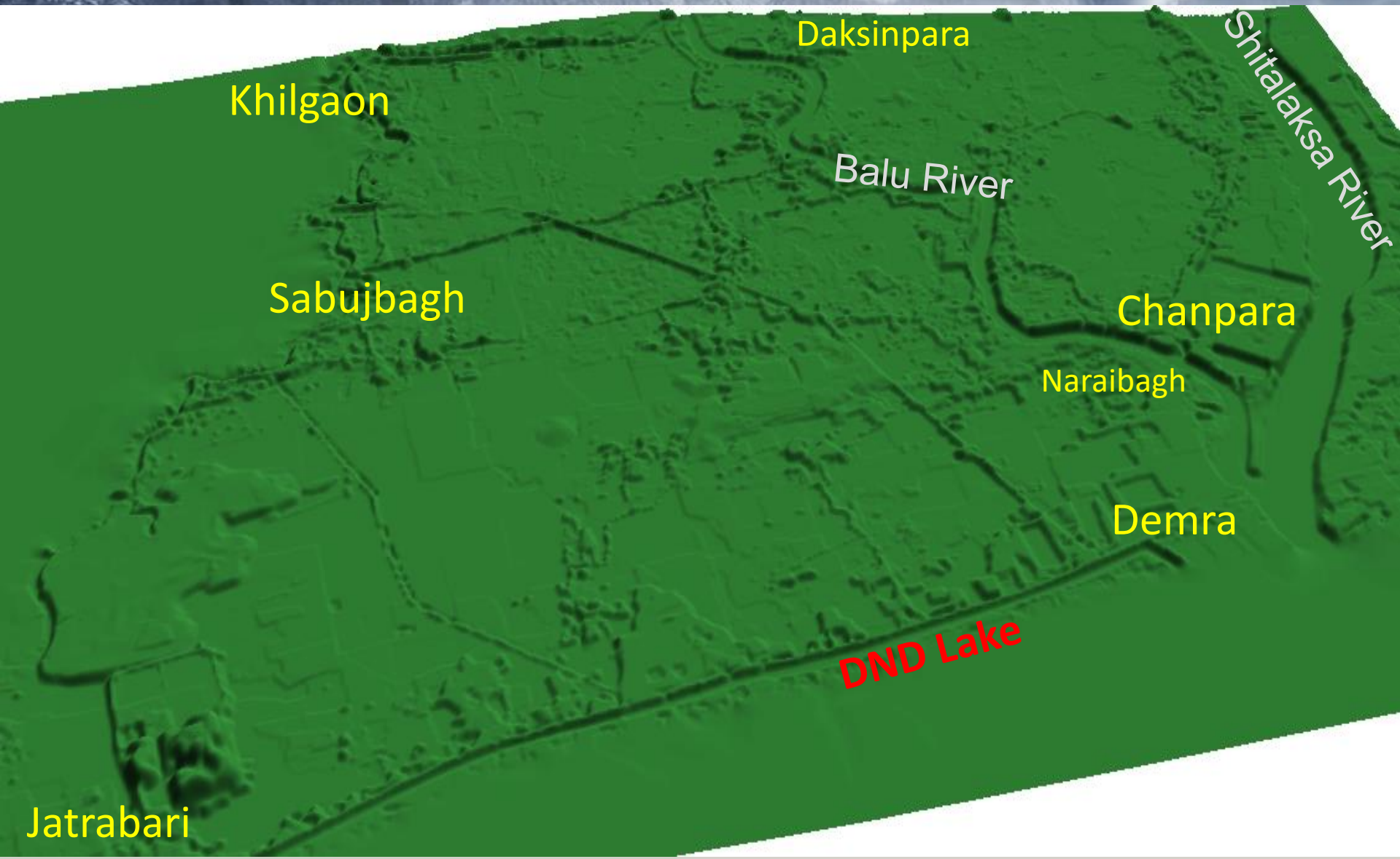
Grade 'G-1A' Flood Map

Remote Sensing and GIS based National Flood Monitoring System (NFMS)

Bangladesh Space Research and Remote Sensing Organization (SPARRSO)

August, 2016

DIGITAL ELEVATION MODEL (DEM): FLOOD FORECASTING



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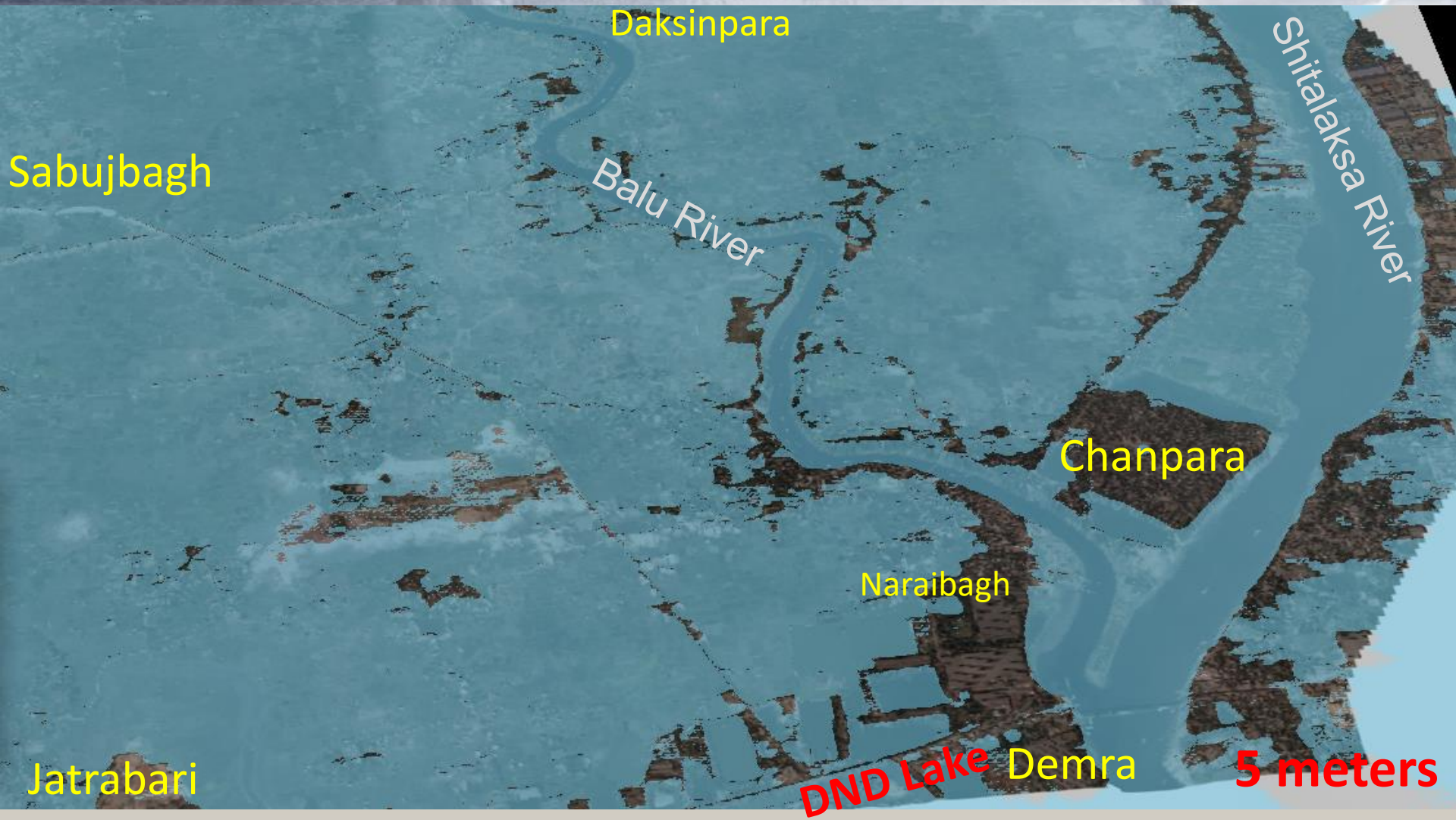
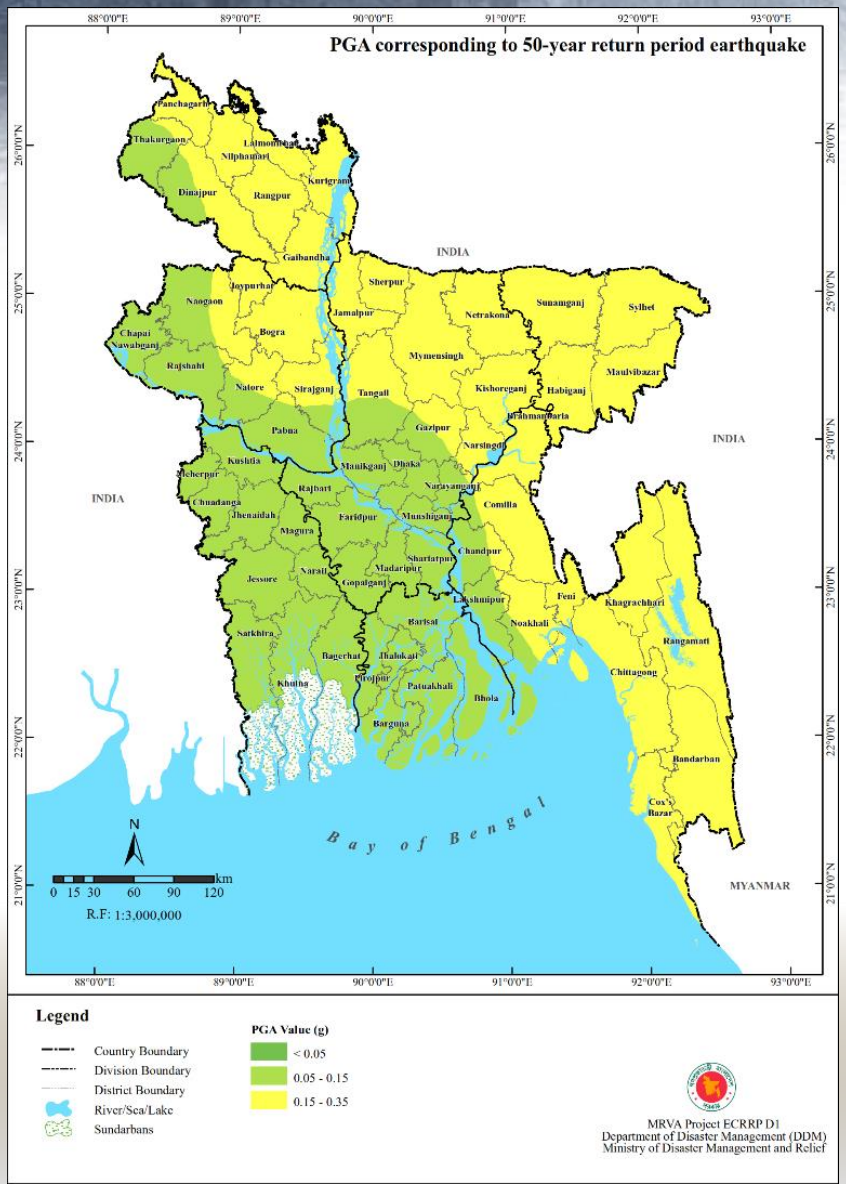
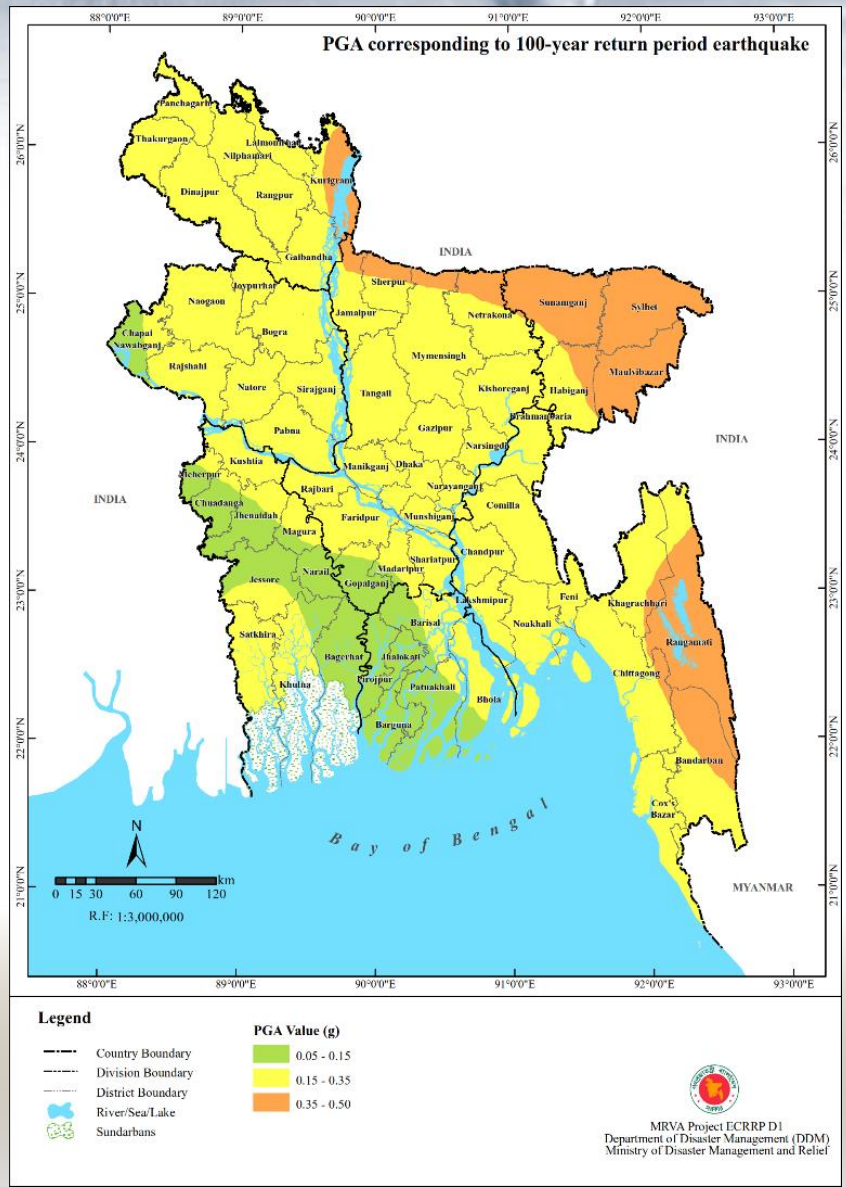


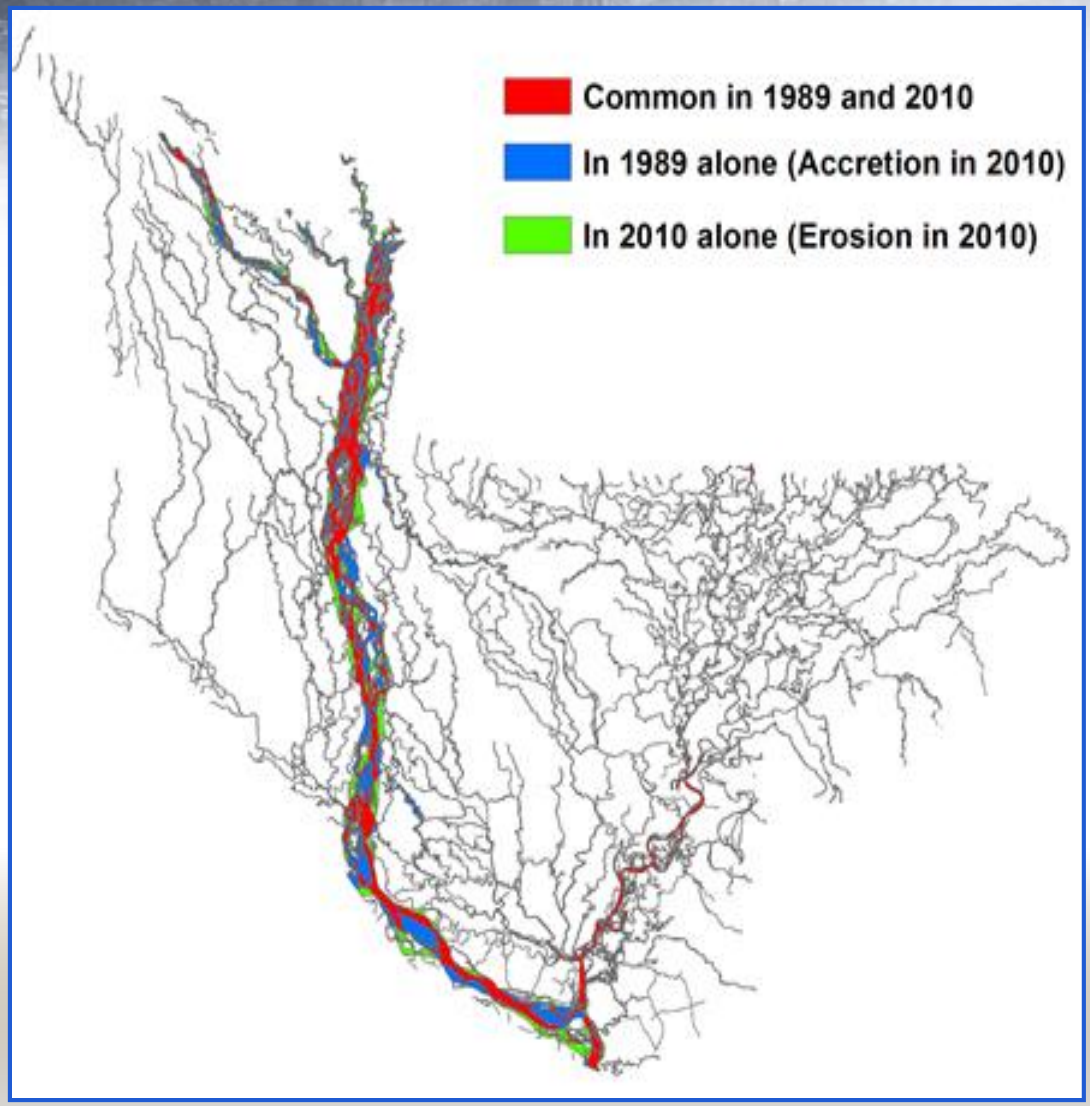
Earthquake Peak Ground Acceleration (PGA)

(Next 50 and 100 years return period)





River Monitoring System based on Remote Sensing and GIS Techniques



Years	Erosion	Accretion	Stable
	% of the total area	% of the total area	% of the total area
1973 - 1989	27.55	19.45	53.00
1989 - 2010	20.70	31.30	48.00

- Dominancy of morphological changes has been shifted from erosion to accretion.
- JBM river system in Bangladesh has become more unstable in the recent years.

Geospatial Information in Bangladesh

- Operational use of GIS first started in Bangladesh by SPARRSO in 1986 through ERIM (Environmental Research Institute of Michigan). GIS was installed in Microvax 3400 system.

- Since then SPARRSO has been playing pioneering role in the country for generation and use of geo-spatial data as well as capacity building in this field.

- Nowadays more than 50 organizations are using GIS in the country and generating geospatial data.

Use of Geo-spatial Data in Bangladesh

Applications covers many geo-discipline including:

- Disaster monitoring (flood, river erosion, cyclone, water logging, etc.)
- Water Resources
- Fisheries
- Cartography
- Forestry
- Land Inventories/Zoning
- Population Census
- Urban Planning
- Petroleum and Gas Exploration Industries
- Utilities
- Transportation Systems
- Agriculture
- Soil Resources
- Geological Survey
- Bathymetric survey

Geospatial Information in Bangladesh

- Survey of Bangladesh is going to establish National Spatial Data Infrastructure for Bangladesh.
- Country is going for densification of the existing CORS Network by establishing another 75 GNSS CORS.
- Large scale 2D and 3D maps are going to be prepared for major cities in order to create backbone for smart city management.

Challenges

- National level coordination for management of geospatial data/information is not present in Bangladesh. Each of the relevant organizations manages its Geospatial Data/ Information independently.
- Technology is developing very fast. The government organizations fail to acquire appropriate technology at the right time. Development of skilled human resource and data infrastructure need huge investment.
- Integrating statistical data with geospatial information is a major challenge.

HONOURABLE PRIME MINISTER REITERATES

"Bangladesh has not been sitting around waiting for the world to save us. We are fighting for our future, albeit with limited resources and technologies. The goal of combating disaster and climate change including its impacts is crucial, as we are at the frontline of this global threat"

Way Forward

There is a need for global partnership among technology giants, developed and developing countries for technology transfer and capacity building.

Any Question?


Thanks