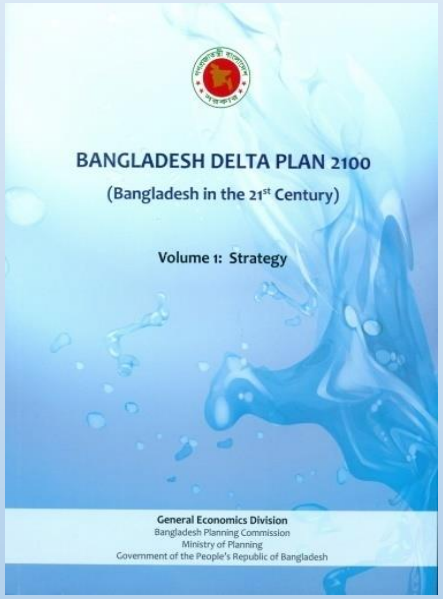
Training on

BDP 2100 Strategies/Measures: Environment, Agriculture and Food Security



Presented By

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Climate Change, Environment and Ecological Issues

Opportunities: Diversified Eco-system

Land Types-

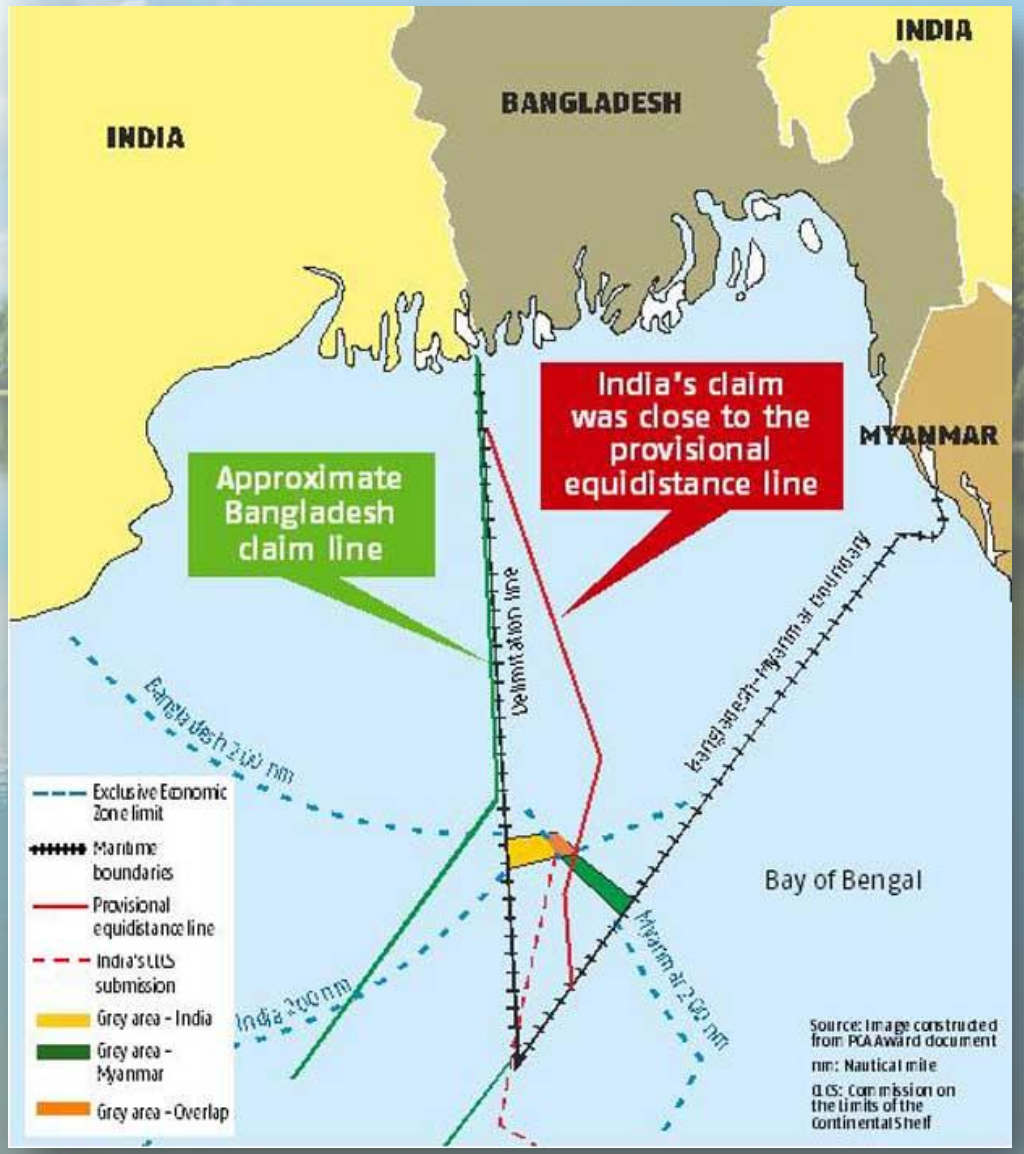
- Agricultural land: 65%
- Forest lands: 17%
- Urban areas: 8%
- Water and wetlands: 10%.

Plentiful Rivers-
(around 700 nos.)

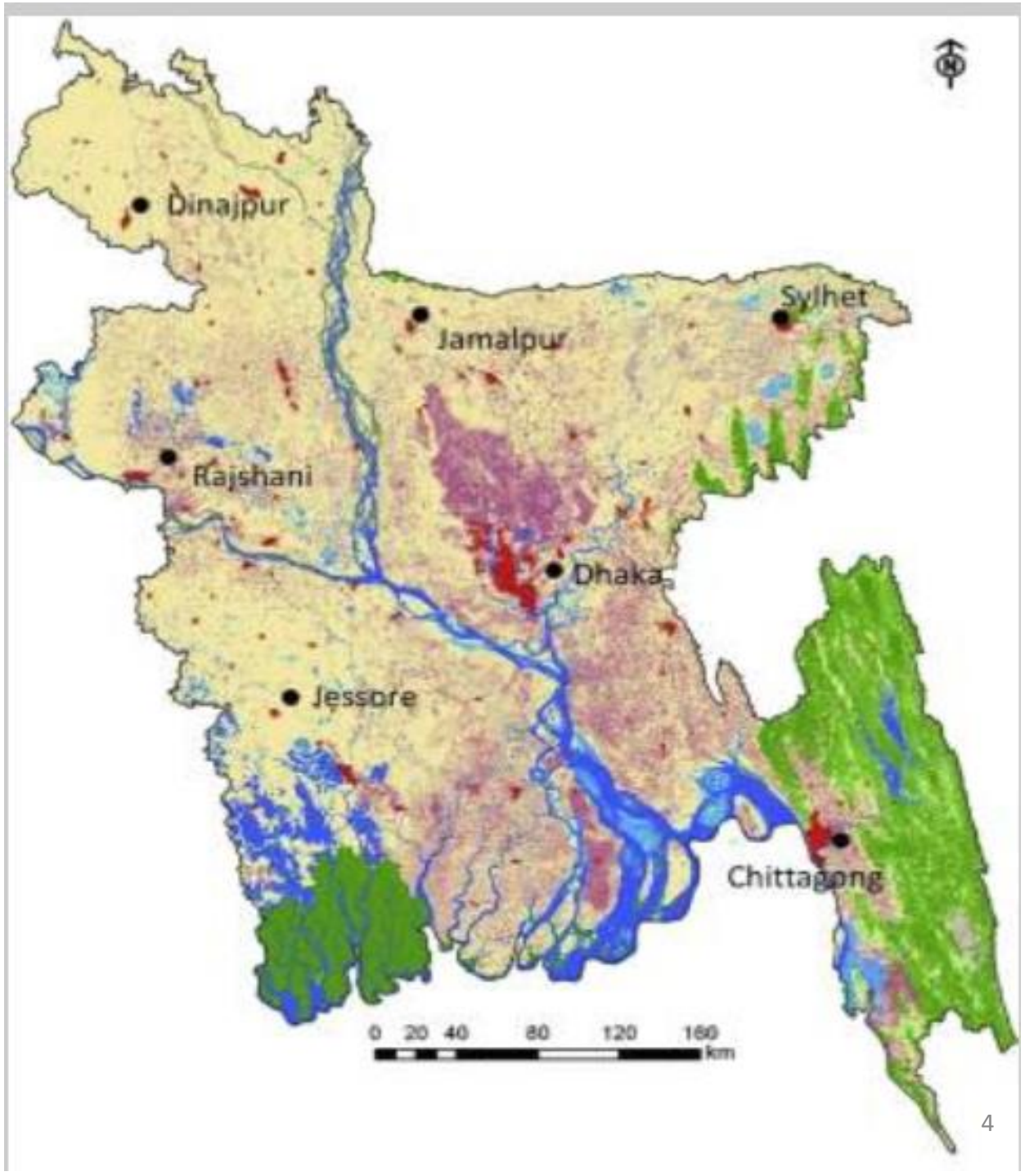
- Water bodies about 4.70 million ha;
- Access to the Bay of Bengal up to 1.125 million sq. km.

Open Access To Sea Is A Huge Advantage -

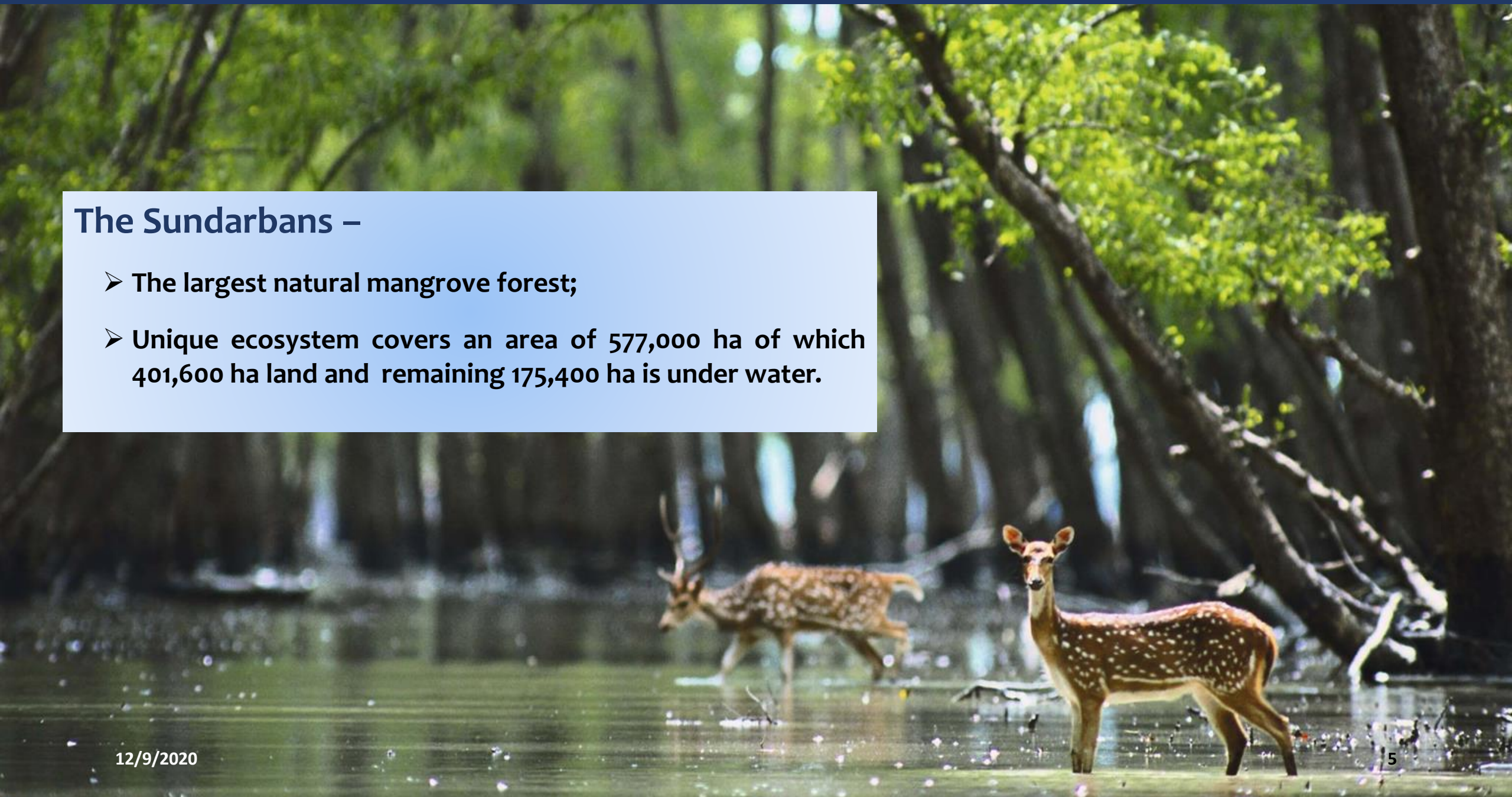
- It could serve the needs of growing internal trade and commerce;
- Could become a regional hub for international sea transportation.



Land usage of Bangladesh (Reddy et al., 2016)



Opportunities: Diversified Eco-system (Cont'd)



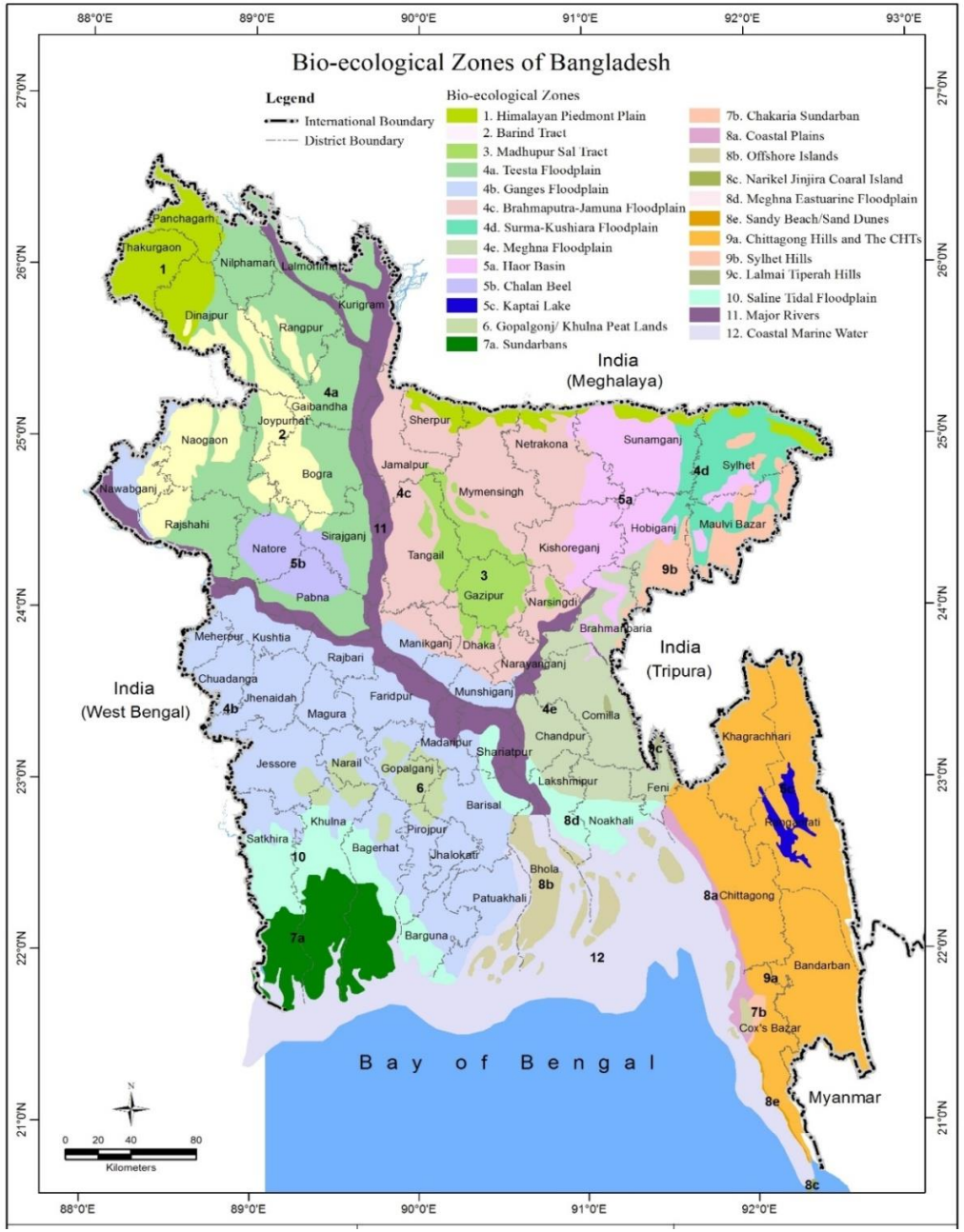
The Sundarbans –

- The largest natural mangrove forest;
- Unique ecosystem covers an area of 577,000 ha of which 401,600 ha land and remaining 175,400 ha is under water.

Opportunities: Diversified Eco-system (Cont'd)

On the basis of physiographical, hydrological, meteorological, and ecological features, the **IUCN (2002) has delineated**

25 Bio-ecological Zones of Bangladesh



Source: CEGIS, 2014

For **Analytical Purposes,** the **ecosystem** of the country can broadly be **divided into 2 categories**:

I. **Aquatic Ecosystem**
II. **Terrestrial Ecosystem**

I. Aquatic Ecosystem

The aquatic ecosystem of the country is derived from river hydrology and water characteristics (freshwater and saline water). Hence, the **Aquatic Ecosystem** can be divided as **fresh water and saline water ecosystems**.

Table: Types of Wetlands and their Estimated Area during the Wet Season

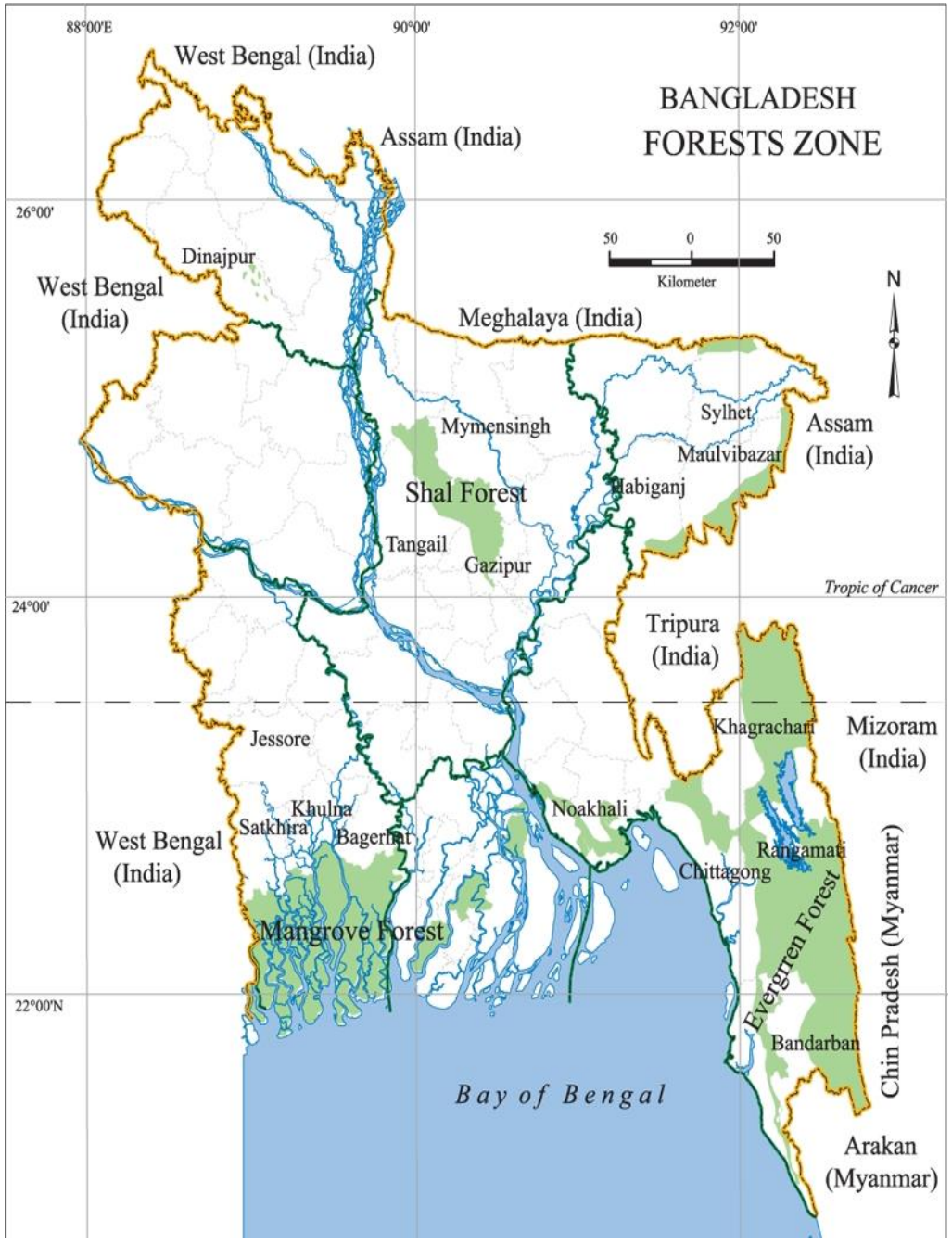
Wetland types	Area ('000 ha)
Permanent rivers and streams	480
Estuarine and mangrove swamps	610
Shallow lakes and marshes	120-290
Large water storage reservoirs	90
Small tanks and fish ponds	150-180
Shrimp ponds	90-115
Seasonally-flooded flood plains	5,770

Source: A directory of Asian Wetlands, 1989

II. Terrestrial Ecosystem

Ecologically, Bangladesh delta is represented by **Five Broad Natural Forest Types**:

a. Tropical wet evergreen on eastern and northeastern hills
b. Tropical semi-evergreen on eastern hills,
c. Tropical moist deciduous/ sal forests on central and north western terraces,
d. Mangrove forests facing the sea and
e. Freshwater swamp forests in low lying areas of Sylhet.



Map: Forest Zones of Bangladesh

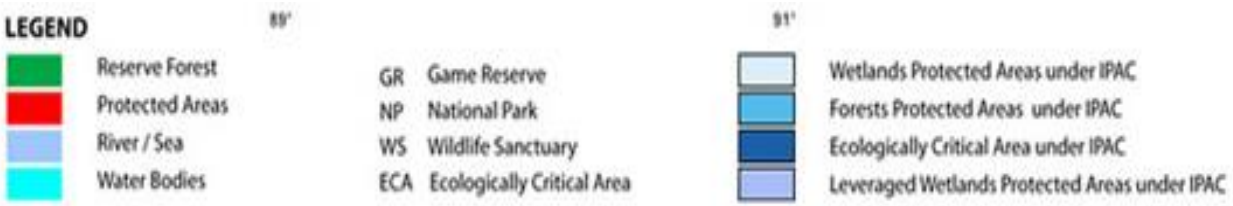
Source: Banglapeida, 2015

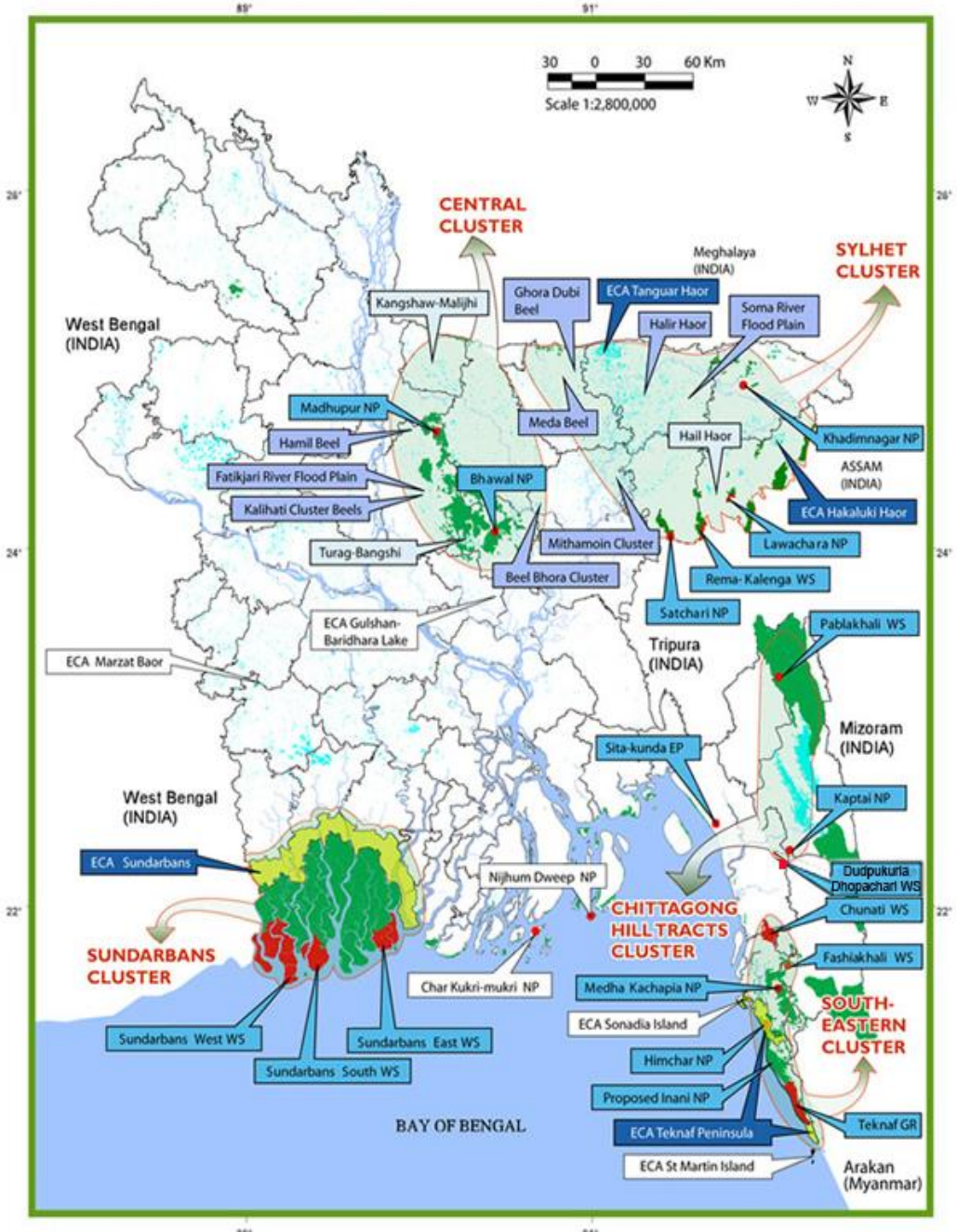
Present Status of Eco-system Balance

In order to preserve ecosystem balance in the country, several types of **Protected Areas** have been established. For example,
there are:

- **-- 2 RAMSAR sites (Sundarban and Tanguar Haor)**
- **-- 13 Ecologically Critically Areas (ECA),**
- **-- 17 National Parks,**
- **-- 20 Wildlife Sanctuaries,**
- **-- 8 Eco Parks and**
- **-- 2 Botanical Gardens in Bangladesh).**

- **Important five ECAs are as below:**
  - ✓ **Hakaluki Haor (18,382 ha),**
  - ✓ **Tanguar Haor (9727 ha),**
  - ✓ **Sonadia Island (4,916 ha),**
  - ✓ **St Martin's Island (590 ha),**
  - ✓ **Teknaf Peninsula (10,465 ha);**
- **Over 800 species of wildlife identified in ECAs.**





Present Status of Eco-system Balance (Cont'd)

Alarming Animal Bio-diversity

Table : National Status of Inland and Resident Vertebrates of Bangladesh

Group	Species	Extinct in Bangladesh	Threat category (National)				Data Deficient (DD)
			Critically Endangered (CR)	Endangered (EN)	Vulnerable (VU)	Total	
Fishes	653	0	12	28	14	54	66
Amphibians	34	0	0	3	5	8	7
Reptiles	154	1	12	24	22	58	39
Birds	650	30	19	18	4	41	158
Mammals	120	10	21	13	6	40	53
Total (2000)	***1611***	***41***	***64***	***86***	***51***	***201***	***323***
Total (2015)	***1619***	***31***	***56***	***181***	***153***	***390***	***278***

Source: International Union for Conservation of Nature (IUCN), Bangladesh, 2000& 2015

➢ Knowledge Gaps

There is substantial knowledge gap in the area of biodiversity. Regarding biological resources and its conservation, following gaps have been identified in Bangladesh:

- Lack of a complete inventory of species.
- Lack of institutional arrangement for regular environmental monitoring
- Little knowledge for causes of extinction of wild species
- There is no data available for the harvest quantity of mollusks and turtles.

Addressing these knowledge gaps and establishing a proper monitoring and evaluation system for biodiversity and the environment are important agendas for BDP 2100.

Climate Change: Challenges, Opportunities and Response Actions

The **major challenges** of climate change are:

- **increasingly frequent and severe tropical cyclones,** with higher wind speeds and storm surges leading to more damage in the coastal region;
- **heavier and more erratic rainfall** in the Ganges-Brahmaputra-Meghna basins, including Bangladesh, during the monsoon season resulting in:
  - **higher river flows,** causing over-topping and breaching of embankments and widespread flooding in rural and urban areas as well as drainage congestion,
  - **river bank erosion** resulting in loss of homes and agricultural land to the rivers;
  - **increased sedimentation** in riverbeds leading to drainage congestion and water logging;

- **lower and more erratic rainfall,** resulting in increasing droughts, especially in drier northern and western regions of the country;

- **melting of the Himalayan glaciers,** leading to higher river flows in the warmer months of the year, followed by lower river flows and increased saline intrusion after the glaciers have shrunk or disappeared;
- **sea level rise** leading to submergence of low-lying coastal areas and saline water intrusion up coastal rivers and into groundwater aquifers, reducing freshwater availability; damage to the Sundarbans mangrove forest, a World Heritage site with rich biodiversity; and drainage congestion inside coastal polders, which will adversely affect agriculture.
- **warmer and more humid weather** leading to increased prevalence of disease and infections.

Possible Sectoral Impacts of Climate Change

Sector / Asset	Climate Change	Impact	Possible Consequences under BAU scenario
1. Agriculture	**Rise** in temperature of **1°C–2°C** in combination with lower solar radiation	sterility in the rice spikelet; reduces yields of high-yielding varieties of aus, aman, and boro rice; incidence of insect pests, diseases, and microorganisms	about 17% decline in overall rice production and as high as 61% decline in wheat production compared with the baseline; By 2050, a reduction in 4.5 million tonnes of rice output at the 2002 level of production.
	Temperature increase of 4°C	apparent fertilization effect due to doubling of atmospheric concentration of CO_2 may result in an overall 20% increase in rice production; however, a 60% moisture stress on top of other effects might cause a decline in boro yield as high as 32%.	decrease in production by some 28% for rice and 68% for wheat; decline in paddy production by 1.60% in 2050 and 5.05% in 2100; negative impact on real GDP by 0.67% in 2050 and 0.93% in 2100
	Salinity intrusion under moderate SLR	Crop loss	about 0.2 million tonnes or more
2. Health	Temperature and precipitation increase	Increasing dengue and malaria risk; water-borne diseases like diarrhea and dysentery; congestion in urban areas; increase in emissions	By 2090 increase in Dengue cases by 24,000 with fatalities 314; malaria cases by 440,000 and fatalities could reach over 2,500; respiratory illnesses; and increasing health costs

Possible Sectoral Impacts of Climate Change (Cont'd)

Sector / Asset	Climate Change	Impact	Possible Consequences under BAU scenario
3. Land	1 m sea level rise; Increased precipitation	Inundation permanent and seasonal	17-21% area loss (up to 30,000 km^2 inundated; additional 16% land inundated due to increased rainfall (5,500 km^2)
4. Infrastructure	Floods; cyclones; sea level rise	Permanent and reparable damage	capital stock depletion in the construction sector by 0.05% annually until 2100; sectors closely related to construction would experience larger falls in real GDP
5. Energy	Cyclones, floods, dry periods	Affecting hydropower and thermal generation; energy infrastructure damage; loss of energy in irrigation sub-sector	Increased load shedding; increase in energy demand-supply gap; fall of production; GDP losses in agriculture and industry
6. Forest and other ecosystems	Sea level rise; increase in temperatures; salt water intrusion	Impact on species composition and extinction	40% mangrove loss; 96% decline in tiger habitat
7. GDP	N/A	Deacrease in GDP	By 2050, annual GDP losses are projected to be 2.0% per annum

Environmental Challenges in Bangladesh

1. Surface Water Pollution

The pollution levels [acidic level of water (pH), Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), and Chemical Oxygen Demand (COD)]of the major rivers located besides the major cities of Bangladesh are shown in the following Table . By and large, the pollution level of the most of the rivers exceeds the safe levels (***pH: 7; DO: >3.5; BOD5: <1; COD: >200***) for many of the indicators

Parameters					
Sl. No.	**Rivers**	**pH**	**DO (mg/L)**	**BOD_5 (mg/L)**	**COD (mg/L)**
1	Buriganga	6.58-7.98	0-5.7	0.6-35	4.83-124.3
2	Shitalakhya	6.66-7.97	0-5.5	2-16	0.8-18
3	Turag	6.14-8.79	0-5.9	1.86	17-233
4	Meghna	6.5-7.47	4.7-8.1	1.0-7.0	3.8-58
5	Jamuna	6.5-7.84	5.0-7.6	0.3-5.2	11-15
6	Padma	7.25-7.69	5.8-8.5	2.1-3.3	163.5-1569.5
7	Kirtonkhola	7.1-7.5	6.5-7.1	1.1-2.5	2.0-4.75
8	Passur	7.54-8.2	5.0-6.8	0.8-1.2	<200
9	Rupsha	7.72-8.5	5.1-6.7	0.7-1.2	20-22
10	Moyuri	7.52-8.0	0.4-3.8	6-20	46-676
11	Karnaphuli	7.0-8.2	5.1-5.8	9.0-144.5	109-489
12	Halda	6.92-7.9	5.3-7.2	0.2-0.45	8.0-105
13	Surma	6.4-7.6	5.2-6.7	1.6-32	32-138

(Source: DoE, 2012 and 2013)

Note: Safe Reference values of pH, DO & BOD of inland surface water for fisheries according to Environmental Quality Standards (EQS) of Environmental Conservation Rules 1997. Environmental Quality Standards (EQS) of COD is for wastewater after treatment from industrial units)

2. Groundwater Quantity and Quality Issues

a) Ground Water Deplition

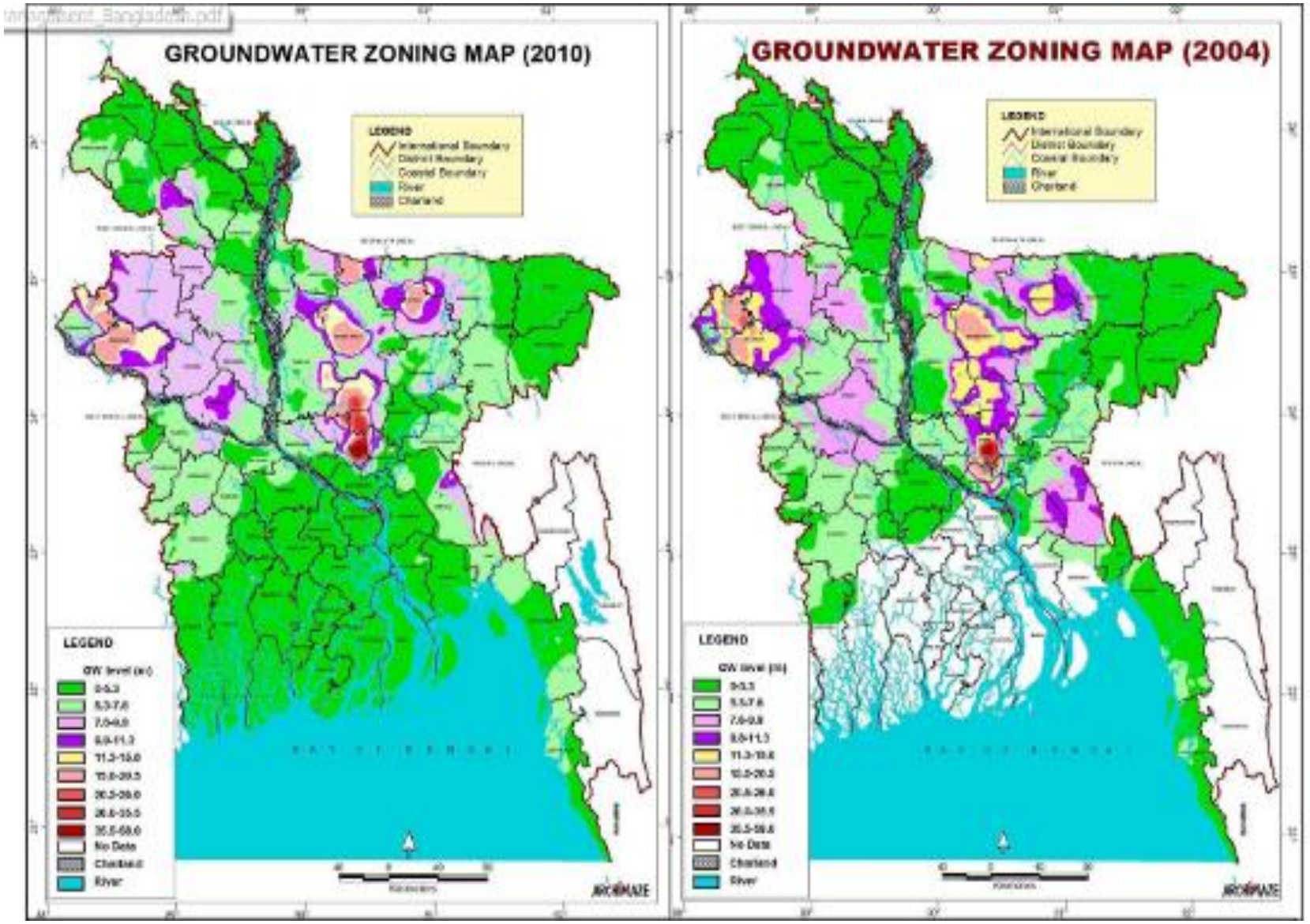
Table : Areawise Comparison of Groundwater Tables 2004-10

GW Level (m)	Area in 2004 (km^2)	Area in 2010 (km^2)	Difference	Percentage %
0.1-5.3	41,958	35,769	6,189	14.75
5.3-7.6	31,778	34,671	2,893	9.10
7.6-9.8	14,441	13,691	750	-5.19
9.8-11.3	5,503	6,849	1,345	24.44
11.3-15.0	4,812	5,099	287	5.96
15.0-20.5	1,464	3,787	2,323	158.73
20.5-26.0	200	452	251	125.47
26.0-35.5	112	209	96	85.77
35.5-60+	76	91	15	19.80
River	10,856	10,856	0	0
RHF	31,836	31,836	0	0
Char Land	4,260	4,260	0	0

Source: BADC, 2011

Environmental Challenges in Bangladesh(Cont'd)

Source: Bangladesh Agricultural Development Corporation (BADC), 2011



Map: Groundwater Zoning Maps of Bangladesh, 2004 and 2010

Environmental Challenges in Bangladesh(Cont'd)

b) Arsenic Contamination

- ✓ The groundwater of Bangladesh is heavily contaminated with Arsenic. **Some 61 of 64 districts** in Bangladesh have **arsenic levels above 0.05 mg/L (NWMP, 2004).**

- ✓ The **people** in **59 out of 64** districts **comprising 126,134 km²** of Bangladesh are suffering due to the arsenic contamination in drinking water.

Environmental Challenges in Bangladesh(Cont'd)

3. Air Quality

- ✓ Air pollution in Bangladesh is mainly happening **due to emission of black carbon** from **vehicular emission, brick kilns and industries as well as dust pollution** due to constructions and vehicular movement.

- ✓ The **two major air quality parameters** are **PM (particulate matter)2.5 and PM10**. The national **ambient air quality standard** for these two parameters **are 65 and 150 µg/m³(24 hour average),respectively.**

- ✓ There are **11 continuous air quality measuring stations in 8 cities in Bangladesh**. All of them show that the **PM2.5 and PM 10 concentrations** are **higher than the standard value during dry season**, which is dangerous for the environment and public health.

- ✓ **Only Haor and Flash Flood Area is comparatively safer** than the other hotspots. However, **other air quality parameters like CO, SOx, NOx, O3** are within national standard almost round the year.

Impact of Climate Change on Environment and Ecology

Major issues regarding **Biological Environment** are as follows:

- ***Biological diversity and population of different species:*** Biological diversity and population size of different flora and faunal communities/species is changing in Bangladesh delta due to change **of landuse and land type (erosion and accretions**), **over harvesting**, illegal poaching and **lack of knowledge** regarding **biodiversity conservation**.

- ***Habitat suitability and their sustainability:*** Suitability of wildlife and plant habitats is changing with landuse, environmental pollutions, change of river hydrology, climate change, deforestation, urbanization etc. This issue needs to be given more importance in the context of Bangladesh as a highly populated country and consequential growth of land demand for agricultural extension, settlement expansion and other infrastructural developments.

- ***Habitat conversion:*** Biological habitats are frequently converted agricultural extension, human habitation and industrialization. Cumulative pressure on land and waterbodies caused by habitat conversion should be addressed on a priority basis.

- ***Utilization of ecosystem services:*** Proper utilization of ecosystem services is not ensured for monoculture, lack of knowledge, over exploration etc. Proper plan should be prepared for sustainable utilization of ecosystem services.

Major National Responses to Tackle Climate Change Risks

a. Constitutional Provision of Bangladesh

Article *18A :* *The State shall endeavour to protect and improve the environment and to preserve and safeguard the natural resources, biodiversity, wetlands, forests and wild lives for the present and future citizens.*

b. **Bangladesh Climate Change Strategy and Action Plan (BCCSAP), 2009**

The BCCSAP 2009 was built on six themes/pillars,

Theme 1: Food security, social protection and health;
Theme 2: Comprehensive disaster management;
Theme 3: Infrastructure;
Theme 4: Research and knowledge management;
Theme 5: Mitigation and low carbon development;
Theme 6: Capacity building and institutional strengthening

c. Bangladesh Climate Change Trust Fund, 2009-10

The following outputs have been achieved in the water resources sector:

- 16.4 kilometers of coastal sea dykes have been constructed;
- 352.12 kilometers of embankments have been constructed and 156.792 kilometers of river bank protective works completed;
- 872.19 kilometers of canals have been excavated/re-excavated and
- 65 water control infrastructures have been constructed.

Major National Responses to Tackle Climate Change Risks (Cont'd)

d. Nationally Determined Contributions (NDC)

Bangladesh NDC consists of 4 major elements;

- Mitigation Contribution
- Adaptation Component
- NDC Development and Implementation; and
- Support for NDC Implementation

Table: Bangladesh's Determined Contributions for Reducing GHG Emissions

Contribution Type	Reduction in GHG Emissions
Unconditional contribution *(assuming no additional international support)*	Bangladesh will reduce its GHG emissions in the power, transport, and industry sectors by 12 $MtCO_2e$ by 2030 or 5% below BAU emissions for those sectors.
Conditional contribution *(assuming additional international support)*	Bangladesh will reduce its GHG emissions in the power, transport, and industry sectors by 36 $MtCO_2e$ by 2030 or 15% below BAU emissions for those sectors.

e. Initiatives on Renewables

Target: upto 2041 **30%** of Total Energy

- **Solar Power**
- **Improved Cook Stoves**
- **Improved Rice Parboiling System**

Existing Strategies and Policies

- Bangladesh Wildlife (Preservation) (Amendment) Act, 1974
- Bangladesh Forest Act, 1927 and Subsequent Amendments
- Forest Policy and Forestry Sector Master Plan
- National Environment Management Action Plan (NEMAP), 1995
- National Conservation Strategy (NCS)
- The Bangladesh Environment Conservation Act, 1995 and Environment Conservation Rules 1997
- Sustainable Environment Management Program (SEMP)
- National Biodiversity Strategy and Action Plan (NBSAP), 2014
- Bangladesh Biological Diversity Act 2017
- Environmentally Critical Area Management Rules, 2016
- Bangladesh National Action Program for Combating Desertification, Land Degradation and Drought, 2015-2024
- Investment Plan on Environment, Climate Change and Forests(2016-2021)
- Integrated Coastal Zone Management (ICZM)

Strategies and Policies for Moving Forward

Strategies

- **Establishment of zoning** of the region on the basis of ecological attributes distribution of biological resources and the land use patterns.
- Implementation of **threatened species wild flora and fauna recovery programme**.
- Establishment of **wetland protected areas and assessment of degradation** of wetlands ecological values
- Establishment of **Sundarbans Research Centre** for research, education, conservation, awareness, networking, recreation, monitoring and evaluation.
- **Strengthening local institutions** for wetland and biodiversity management.
- Implementation of **biodiversity enhancement and sustainable management** programme.
- **Identification of ecologically important area** within the region to protect the biodiversity and mitigate conflicts over resource exploitation and providing legal arrangement.

Strategies and Policies for Moving Forward (Cont'd)

- Establishment of **a national monitoring programme** to recognize wetlands' changing ecology, i.e.
  - Changes of flora and fauna, hydrology or chemistry, in response to climate change, pollution and other long term impacts.
  - Habitat/land use studies on a national or regional scale should be initiated for evaluation of the success of direct conservation initiatives and allow to identify wetland loss still occurring or not and the reason behind it.

- Promotion of **effective wetland science**; **establishment of national priorities for scientific research on wetland** with regular review of comprehensive national inventory.

- Creation of **wetland data management system** for comprehensive national inventory to achieving **the wise use of wetlands, documentation of wetland losses, and identification** of wetlands with potential for restoration.

- Coordination and rationalization of government development programmes to **minimize their adverse effects on wetlands and to encourage watershed conservation.** Create **incentives programme** that will encourage the landowner and conservation agencies **to maintain wetlands**.

- With frequent heat waves and intensifying thunderstorms, studies on climate change induced temperature rising and intensity of cyclones may be conducted.

Strategies and Policies for Moving Forward (Cont'd)

Measures

The above mentioned strategies can be implemented through the following activities:

- Strengthening **legal and policy provisions for ecosystem and biodiversity management through revising policies and rules related to ecosystem and biodiversity conservation**, especially for protection of endangered and threatened species.
- Setting up/updating standards for soil and water quality.
- Adopting habitat **preservation programmes for wildlife, fisheries and migratory birds through maintaining existing protected areas** and establishing **new protected areas for preserving habitat of wild plants and animal**s including **migratory species on the basis of life cycle analysis** of the species.
- Controlling and monitoring plant and animal population for food chain management within protected habitats.
- **Undertaking research and education** on
  - ✓evolution and life cycle of **key species** as well as **endangered and threatened species**;
  - ✓sustainable production of goods and services of ecosystems;
  - ✓impact of climate change on ecosystems, wetlands and biodiversity; and
  - ✓impact of pollution on wetland habitat and biodiversity.
- Establishment of **gene bank** of all plant and animal species.

Strategies and Policies for Moving Forward (Cont'd)

- **Sustainable management** of **commercially important species** and ecosystems.
- Promoting **eco-tourism** as alternative income source from ecosystems.
- Promoting plantation programmes, farming of medicinal plants and sustainable pearl farming.
- Undertaking **pollution control** and **prevention** from **agriculture, industry, infrastructure development and urban settlement.**
- Implementing **restrictions** over **solid waste and wastewater disposal** from industries, mechanized boats and urban settlements to wetland areas.
- Controlling use of chemical fertilizer, pesticides and promote use organic fertilizer in agriculture(e.g. Compost)
- Promoting integrated approach towards disaster and climate change resilience in national and sectoral planning.

Agriculture & Food Security

Structural Change and Economic Transformation

Table :Structural Change in the Economy During the 7th FYP

(% of GDP Constant Prices 2005-06)

Structure of the Economy	FY2015	FY2019
Agriculture	**15.36**	**12.69**
Share of non-crop agriculture	(44.90)	(48.13)
Industry	**29.19**	**34.57**
of which Manufacturing	(19.35)	(23.27)
Services	**55.45**	**52.74**

Source: National Accounts Statistics, Bangladesh Bureau of Statistics (BBS)

Table : Employment Progress in the 7th FYP

Sectors	FY2015 (million workers)	FY2019 (million Workers)	FY2015 (percent share)	FY2019 (percent share)
Agriculture	25.8	22.3	44.0	35.2
Industry	11.5	13.6	19.5	21.6
(Manufacturing)	(8.6)	(9.8)	14.7	15.5
Services	21.4	25.1	36.5	43.2
Total	58.7	64.3	100.0	100.0

Source: GED estimates based on LFS data and using sectoral employment elasticities between 2010 2017

Growth Performance of Agriculture Sub-Sectors

Table: Growth Performance of Agriculture Sub-Sectors

	2014-15	2015-16	2016-17	2017-18	2018-19
Growth (%)					
Agriculture	3.33	2.79	2.97	4.19	3.92
A. Agriculture and Forestry	2.45	1.79	1.96	3.47	3.15
i) Crops & horticulture	1.83	0.88	0.96	3.06	1.96
ii) Animal farming	3.08	3.19	3.31	3.4	3.54
iii) Forest and related services	5.08	5.12	5.6	5.51	8.34
B. Fishing	6.38	6.11	6.23	6.37	6.21
Percent of GDP (%)					
Agriculture (A+B)	16	15.35	14.74	14.23	13.65
A. Agriculture and Forestry	12.32	11.7	11.12	10.67	10.15
i) Crops & horticulture	8.87	8.35	7.86	7.51	7.06
ii) Animal farming	1.73	1.66	1.6	1.53	1.47
iii) Forest and related services	1.72	1.69	1.66	1.62	1.62
B. Fishing	3.69	3.65	3.61	3.56	3.49

Source: Bangladesh Bureau of Statistics (BBS).

Climate Change and Potential Impacts on Agriculture

Table : Climate Change and Potential Impacts on Agriculture

Key Vulnerabilities	Outcomes	Impacts on Agriculture
Climate change may increase rainfall variability, i.e. heavier and more erratic rainfall	Higher river flows, causing over-topping and breaching of embankments; widespread flooding. River bank erosion resulting in loss of homes and agricultural land; Increased sedimentation in riverbeds leading to drainage congestion and water logging.	Reduced crop yield affects diet and nutrition; IPCC estimates that, by 2050, rice production in Bangladesh could decline by 8% and wheat by 32%, compared to 1990; Existing crop mixes are not sustainable under climate change in some areas.
Lower and more erratic rainfall	Increasing droughts, especially in drier northern and western regions	Livelihood activities in drought-prone areas will suffer as a result of increased impact of droughts due to climate change
Melting of the Himalayan glaciers	Higher river flows in the warmer months of the year, followed by lower river flows and increasedsaline intrusion after the glaciers have shrunk	Lower agricultural yields due to decreased water availability
Sea level rise	Submergence of low- lying coastal areas and saline water intrusion up coastal rivers and into groundwater aquifers; reducing freshwater availability; damage to the Sundarbans mangrove forest; and drainage congestion inside coastal polders	Adverse effects on agriculture in the coastal zone.

Climate Change and Potential Impacts on Agriculture (Cont'd)

Key Vulnerabilities	Outcomes	Impacts on Agriculture
Increasingly frequent and severe tropical cyclones	Higher wind speeds and storm surges.	More damage to crops in the Coastal Zone
Higher temperature and evaporation lead to excessive water use and water scarcity	Decline in surface water and groundwater resources; over exploitation of groundwater causes heavy metal contamination	Rise in temperature of 1°C–2°C reduces yields of high-yielding varieties of rice; Increased incidence of insect pests, diseases, and microorganisms. Low yields due to high temperature stress and water scarcity; By 2050, a reduction in 4.5 million tonnes of rice output compared to production in 2002.
increases in carbon dioxide (CO_2)	Increased Photosynthesis	Higher future CO_2 levels could benefit forests with fertile soils in the Northeast. However, increased CO_2 may not be as effective in promoting growth in the West and Southeast, where water is limited.

Other Issues and Challenges Facing Bangladesh Agriculture

The **main challenges** to achieve and sustain food security over the longer term include:

- **Expanding urbanization and land use change threatens food security**

  The **total population** of Bangladesh is **set to increase from the present 160 million to a range of 209 to 224 million in 2061** (BBS, 2015). It is projected that by 2075 population will drop to 193 million and by 2100 population decrease to 170 million (UN, 2015). Bangladesh experienced faster urbanization than South Asia as a whole between 2000 and 2010.

- **Climate change and natural hazards will likely continue to worsen**
- **Loss of agricultural land**

  - Bangladesh is **losing agriculture land at a rate of 0.5% per year** due to
    - ✓Urban encroachment of agriculture land,
    - ✓Road infrastructure,
    - ✓Water logging,
    - ✓Depletion of groundwater and soil fertility,
    - ✓Erosion, and
    - ✓Salinity (Hasan, 2013).

Other Issues and Challenges Facing Bangladesh Agriculture (Cont'd)

➢In the last three decades about **170,000 ha** of agriculture land has been **degraded by increased salinity** (FAO, 2012).

➢ **Soil fertility degradation** results from
- ✓Imbalanced fertilizer use (overuse of subsidized nitrogen fertilizers),
- ✓Absence of micronutrient application,
- ✓mono culture of rice without rotation.

➢ **River bank erosion** accounts for about **40% of land loss** on about **1,200 km of riverbanks** (primarily the Ganges, Jamuna, and Padma Rivers) that are seriously affected as **topsoil is washed away and replaced by sand** (Hasan, 2013).

- **Uncertainty in water availability from upstream**

➢ Around **700 rivers** of which **57 Trans-boundary Rivers**
- ✓54 from India and
- ✓3 from Myanmar
- ✓93% catchment area of the Padma, Jamuna and Meghna is located outside Bangladesh

Strategic Approaches and Policy Priorities for Addressing Cliamate Change Impact

Strategic Approaches :

Four Strategic Approaches are associated with addressing climate change impacts in agriculture, food security and nutrition:

I. ***Coping with Uncertainty in Developing Responses*** *(modern science based and Adaptive)*
II. ***Sustainably Intensifying Agricultural Production Systems*** *(without bringing new lands)*
III. ***Increasing Resilience of Agricultural Production Systems*** *(drought and salt tolerant varieties)*
IV. ***Diversification in agricultural output and livelihoods***

The Policy Priorities for the Future

It is critical for policymakers to recognize that the future climate poses challenges outside historical experience. Building and improving adaptive capacity and taking technical and non-technical adaptation actions in key climate-sensitive sectors such as agriculture, water resources, forestry, coastal and marine resources must be of urgent priority for Bangladesh.

Agriculture Sector: To strengthen local adaptive capacity by providing public goods and services

Water Resources: To scale up existing good practices of water conservation and management, and apply more widely integrated water management

Forestry Sector: To implement effective public-private partnerships for reforestation and afforestation.

Coastal And Marine Resources Sector: To implement integrated coastal zone management plans, including mangrove conservation and plantation.

Future Agricultural Policies and Measures for Sustaining Food Security and Nutrition

Future Agricultural Policies and Measures:

1. **Livelihood protection in ecologically fragile areas:** Climate smart livelihood in Chars, coastal areas and CHT
2. **Livelihood protection of vulnerable socio-economic groups** (agro-related groups in allover the country)
3. ***Monitoring of ecosystem and biodiversity changes and their impacts:*** *Effect of salinity, drought etc. on biodiversity*
4. ***Lowering emissions from agricultural land*** *(dev. Technology for Lowering CH4)*
5. **Devise longer term adaptation mechanism against impacts of climate change and particularly of sea level rise on food security**

Proposed measures :

- Implement climate smart agriculture, e.g. saline or drought tolerant verities
- Expand **cropped area** with **saline tolerant varieties** for coastal area;
- Investigate into **enhancement of productivity of traditional floating agriculture;**
- Prevent SLR from affecting agricultural land by constructing heightened sea dykes

Future Policies Agriculture Policies and Measures (Cont'd)

6. **Building institutional capacity towards climate resilient cultivars:**
    - Collection and preservation of local cultivar varieties and documentation of their characteristics;
    - Research to develop climate resilient varieties of rice (i.e. heat, drought, salinity and submergence-tolerant varieties);
    - Research to develop climate resilient cultivars of wheat and other food and non-food crops, including vegetables;
    - Field trials and dissemination to farmers of the local robust cultivars and the newly developed varieties, in partnership with the extension service and NGOs; and
    - Strengthening the capacity of key research institutes and scientists.

7. **Development of climate resilient cropping systems:**
    - Identify likely changes in agro-economic zones and probable climatic parameters;
    - Develop **climate resilient cropping patterns** suited to different regions of the country;
    - Field trials of climate resilient cropping patterns and associated water management systems; and
    - Develop seed supply and extension mechanisms

8. ***Adaptation-mitigation against drought:***
    - Preparation of GIS maps of areas vulnerable to droughts; and
    - Development and testing of adaptive measures in drought-prone areas by combining appropriate cultivars, cropping patterns and land and water management practices, and effective dissemination to farmers

Future Policies Agriculture Policies and Measures (Cont'd)

9. Improved Delta Management including conjunctive use of surface and groundwater
Proposed measures:

- Augmentation of surface water for irrigation through development of water reservoirs, recharge groundwater, and reduced use of groundwater.
- Use water saving technology **for improving efficiency of water and install facil**ities to reduce distribution losses. e.g. Drip irrigation, buried pipe irrigation etc. (*It is to mention that it takes 14 million litres of irrigation water to produce 6 tonnes of Boro rice on one hectare of typical farmland in Bangladesh. In other words, one needs* ***3,500 litres of water to*** *produce a kg. of rice*)
- Gradual shifting of high water consuming crops to low water volume high value crops specially in the Barind and Drought Prone Areas.
- Reduce impact of saline water intrusion in the south and enhance river water flow.

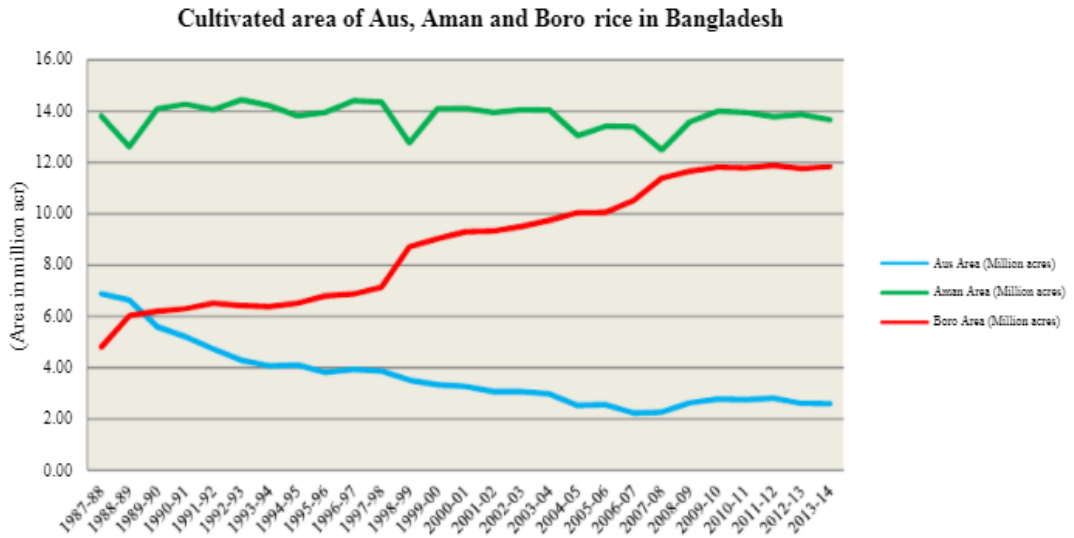


Figure 1: Cultivated area of Aus,Aman and Boro rice varieties in Bangladesh (1988-2014) (BARC 2015).

Future Policies Agriculture Policies and Measures (Cont'd)

- **10. Prevent encroachment of agricultural and forest lands from expanding urbanization**

Proposed measures:

Promote Compact Township to reduce substitution of agricultural land for non-agricultural purposes.

- Improvement of land information, land administration and management
- Land Zoning effort should be continued with strong law enforcement.

Climate Change Impact on Fisheries

- ✓ **Water temperatures** in **ponds and inland waterbodies** are likely to **increase;**

- ✓ **Saline water is likely to extend further towa**rds inland in the south of the country, which will change the aquatic ecosystem and production of fish in this zone; and

- ✓ Turbulent and rough weather along the coast may prevail for longer durations adversely impacting on the livelihoods of fishermen.
- ✓ Effect in reproduction and growth of fish
- ✓ **Changes in Species composition, abundance** and **distribution**
- ✓ Impacts on habitat **quality and migration** of fish
- ✓ Serious threat to indigenous fish, particularly small ones, as most of the water bodies are now dying specially in the Barind and Drought Prone Areas
- ✓ Scanty **rainfall** and **scorching heat** causing **habitat degradation** of native fish
- ✓.

Other Impact on Fisheries

- Overall fish production in inland open water declined due to-
  - ✓**Movement and migratory rout**e within river, from river to beel and floodplain and within floodplain, **have been blocked** which **caused reduction of fish production** in open water.
  - ✓Recruitment of new fishes are going down every year due to squeezing and/or destruction of habitats.
- Fish farmer are struggling with higher production cost
- Over-fishing and destructive fishing adding further fuel in depletion of fish resources and elimination of precious indigenous fish stock
- Hatcheries production also declined due to water scarcity, higher and lower temperature, day-night temperature fluctuation
- River's biodiversity and fish abundances due to apply illegal poison
- Adverse impacts on livelihood of root level stakeholders

Proposed Measures: Fisheries

Proposed measures for *ensuring sustainable fisheries management:*

- Identification of **new important breeding, spawning, nursery and grazing distribution** of fish and other aquatic fauna
- Restoration and maintenance of the **connectivity between the rivers, haors, beels and other wetlands** to ensure the environmental flow
- **Development and conservation of mother fishes and their migration routes** in Tanguar haor, Hakluki haor, kawadighi haor, Chalan beel and other important rivers, beels and wetlands
- Introduction of **fish passes** in existing and new FCD/I projects
- **Establish and maintain fish and wetland sanctuaries/protected areas** which include ban on fishing in certain eco-sensitive areas like the Sundarbans, parts of the Kaptai Lake, several sections of the Rriver Halda, selected Beel and Haor areas and certain sections of the Bay of Bengal and certain section of Padma and Meghna (Hilsha sanctuaries)
- Strengthening **Fish Act implementation** to conserve fish and fisheries resources.

Proposed Measures: Fisheries (Cont'd)

- Assessment of potential threats to following sectors:
  - ✓ fish spawning and growth of fish in the freshwater fisheries sector
  - ✓ fish spawning and growth of fish in the Coastal Zone and brackish water sector
  - ✓ marine fish sector
  - ✓ shrimp sector.

  Development of **adaptive measures** based on the identified sectoral threats.
- **Introduction of Climate Smart Aquaculture Technology** in which saline tolerant and drought smart varieties/species will be introduced
- ***Continuation of further research and study***

Marine fisheries

- Procurement of modern survey vessels
- Capacity building in survey works (science and techniques)
- Regional collaboration (India, Myanmar)
- Assessment of stock and maximum sustainable yield (MSY)/total allowable catch (quota) must be determined thorough assessments on a regular basis of hilsa and other commercially important marine fishes
- Introduction of Digital Marine Fisheries Resource Mapping (DMFRM) for the marine waters using digital cartography of the marine fisheries resources which is an essential tool for efficient and sustainable harvesting of the marine resources.
- Further initiatives to take up sea wide culture on commercial scale

Proposed Measures: Fisheries (Cont'd)

Shallow and deep sea fishing

- Issue licenses for long line fisheries;
- Financial credit line to private sector, tax incentives;
- Introduction of Vessal Tracking and Monitoring System (VTMS);
- Capacity building in deep sea fisheries;
- Seek FDIs in building deep sea fisheries fleet;
- Simultaneous development of fish landing and processing facilities

Fisheries in international waters

- Joint collaboration with regional and international countries
- Creation of export oriented market mechanism

Coastal aquaculture and mariculture

- Local capacity building;
- Small scale investment support for shrimp, crab culture;

Climate Change Impact & Measures: Livestock

Resultant impacts and economic losses:

- Impact of climate change on quality and quantity of forage from grasslands
- Impact of climate change on animal production
- Effects of climate change on the spread and emergence of animal (and human) diseases
- Impact of climate change on breeding on poultry and other livestocks
- Other effects of climate change

Proposed measures are:

- Assess potential threats to poultry and livestock sector and develop adaptive measures and disseminate among farmers
- Enhanced and sustainable milk and meat production
- Develop climate smart brood stock for poultry and catle.
- Strengthen veterinary service system.
- Promote Climate Smart Live stock Production
- Support research and innovation

Climate Change Impact & Measures: forestry

Growth and Productivity Impact of Climate Change on Forestry

Many aspects of projected **climate change** will likely **affect forest growth and productivity**. Climate Change implies the possible occurrence of:

- ✓increases in carbon dioxide (CO2),
- ✓increases in temperature, and
- ✓changes in precipitation.

- Higher future CO_2 levels could benefit forests with fertile soils in the Northeast. However, increased CO_2 may not be as effective in promoting growth in the West and Southeast, where water is limited.

- Warming temperatures could increase the length of the growing season. However, warming could also shift the geographic ranges of some tree species. Other species may be at risk locally or regionally if conditions in their current geographic range are no longer suitable.

- Climate change will likely increase the risk of drought in some areas and the risk of extreme precipitation and flooding in others. Although many **trees are resilient to** some **degree of drought, increases in temperature** could make future droughts more damaging than those experienced in the past. In addition, drought increases **wildfire risk, since dry trees and shrubs provide fuel to fires**. Drought also reduces trees' ability to produce sap, which protects them from destructive insects such as pine beetles.

Climate Change Impact & Measures: forestry

- ***Afforestation and reforestation***
  (Green belt, social forestry, restoration of Sundarban and other forests)

Proposed measures are:

- Provide support to existing and new coastal afforestation programmes taking into account the future rise in salinity levels due to sea level rise
- Develop a wetland afforestation programme to protect settlements against wave erosion
- Study the scope for carbon credits under REDD and invest in reforestation of degraded forests
- Provide support to existing and new homestead and social forestry programmes.
- Research on the suitability of various tree species for their carbon-locking properties for designing various forestry programmes.

Innovation and research:

- Vertical and/or floating farms

- **Aquaponics**: Fish and plant farming together in one recycling system, vegetables and fish are grown together without chemicals and pesticides

Fig: Aquaponics

- **Nanotechnology:** especially for food processing

Haor and Flash Flood Areas Agriculture

Haor Hotspot area (1.657 mill ha) comprises a vital resource for fisheries, irrigation water, ecosystem functioning and navigation. A total of 1.31 million ha is under agricultural production, producing 4.35 million tonnes of rice per annum and an estimated 0.329 million tonne of fish from the Haor areas. In terms of national share, the Haor areas produce about 13% of the rice production and 15% of the fishing output.

Major Constraints in Haor and flash flood areas

- Degradation of natural resources and biodiversity
- Underdeveloped physical and social infrastructure
- Crop damage by flash floods
- Declining crop productivity
- Poor market linkage and value addition

Strategies for Development of Agriculture in the Haor and flash flood areas

In terms of priority, policy attention needs to be specifically focused on agriculture issues in Sylhet, Sunamganj and Habiganj Districts. For the Haor and flash flood areas as a whole, the main strategic priorities are:

- Protect Boro Crops from Flash Flood in Low Lying Areas
- Protect Aus and Aman Crops from Monsoon Floods in High Lands
- Mechanizing Crop harvesting g
- Protect the Post-Harvest Crop from Rotting
- Introduce short duration crop verities
- Providing irrigation facilities utilizing surface water
- Biodiversity enhancement and wetland management
- Social safety nets and improvement of living conditioin
- Specialized enterprise and technology development for alternative sources of livelihood

Coastal Zone Agriculture

Historically, the Government has responded by providing protection against sea water encroachment through polder based embankments. The polders of the Coastal Zone are badly in need of **maintenance and facing the following problems**:

- ***Siltation*:** Due to empoldering, natural inundation outside the polders has been obstructed by embankments resulting in higher elevation of land outside the polder and no siltation inside.
- ***Drainage*:** Because of siltation of outfall channels, channels within polders have significantly lost drainage capability resulting in water logging. The problem has been compounded by siltation of internal drainage channels.
- ***Water logging*:** Because of land accretion, particularly in the Meghna estuary, many rivers and *canals* (drainage canals) have been silted up. Onrush of upstream flow and prolonged rainfall often cause water logging. This problem has been aggravated by empoldering.
- ***Salinity*:** Though soil salinity declines in the long run because of empoldering, problem recurs because of erosion and embankment failure (breaches or overtopping by storm surge).
- ***Land use conflict:*** Shrimp Vs. Agriculture, Agriculture Vs. Salt Production.
- **Many polders** are in dilapidated condition in terms of breach and slip in the embankment, erosion, neglect in repair works, drainage congestion because of siltation and encroachment of canals and, above all, location in the risk zone.
- **Water control structures** in many places of polders are damaged or non-functional.

Strategy of Coastal Zone

1. **Supply management and additional irrigation:** Construction of the Padma barrage and ancillary works
2. **Demand management and efficient water use:** Increasing cropping intensity in the southern region of Bangladesh
3. **Introduction of salt tolerant crop verities**
4. **Increase drainage capacity and reduce flood risk at coastal zone**
5. **Diversification away from Agriculture towards other more sustainable and higher value added activities like:** Eco tourism, Marine Fisheries products deveopled **etc.**

Chattogram Hill Tracts (CHT)

Major Constraints of CHT

- Natural resource degradation – soil erosion and siltation of water bodies; reduced soil fertility; and biodiversity loss
- Weak provision of essential inputs and extension (seed, fertilizer, credit)
- Scarcity of adaptive research, on-farm trials and demonstrations, leading to low knowledge of CHT-specific conditions and absence of innovative practices.
- Limited access to markets, and opportunities for agro-processing
- Low productivity, and missed opportunities for diversification (and associated benefits to nutrition), due in part to poor access to improved inputs, and/or to new adapted technologies
- Poor technical capacity of stakeholders and a lack of technical coordination

Strategies for Chattogram Hill Tracts (CHT)

- Enhancing productivity
- More sustainable adapted and improved jum practices
- Up-scaling of technology and sustainable input supply
- Strengthen
- Marketing and value chain development

River Systems and Estuaries Hotspot

Problems:

- Lands degradation for river erosion: Loss of land, crops, cattle, home state and livelihood.
- Surrounding low-Lands/Char lands get inundated almost on a yearly basis during the monsoon season.
- Lack of adequate irrigation facilities for char lands
- Quality Seeds, Fertilizer are not readily available
- Slow Technology Transfer
- Absence of proper marketing linkage

Strategies:

- Provide adequate room for the river and infrastructure to reduce flood risk
- Strengthening river and estuaries management in the newly accreted Char areas
- Develop Flood resistant and climate resilient of verities of crops
- Introducing Low water consuming crop verities, vegetables
- Provide Quality Seeds, Fertilizers in time
- Improve extension service for Technology Transfer
- Marketing and value chain development

Key Impacts of the Barind and Drought Prone Areas Hotspot

Vulnerability from	Impacts
1. Increased Temperature	Reduced crops and livestockproduction; increase in disease and pest infestation; extinction of some flora and fauna.
2. Longer Dry periods / drought	Further reduction in groundwater table; water scarcity for irrigation and household consumption; up to 39 million people could be affected; landuse pattern, plan species composition in the Barind ecosystem may change and also increase in top soil erosion
3. Reduced groundwater levels	Crop failures, reduced agricultural output; water scarcity; increase in water, sanitation and hygiene problems and related diseases
4. Reduced wetlands	Reduce water availability for domestic and irrigation purpose, rise in temperature due to low evapo-transpiration, affect food security and nutrition, disease and pests outbreak, land degradation and loss of biodiversity.

Source: BDP 2100 Technical Team Analysis, GED, 2015

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Barind and Drought Prone Areas Strategy

Barind and Drought Prone (DP) Areas Strategies:

- **Strategy 1:** Balancing Supply and Demand for Sustainable and Inclusive Growth

  i. Augmentation of surface water for irrigation through development of water reservoirs, recharge groundwater, and reduced use of groundwater.
  ii. Supply management and additional irrigation
  iii. Demand management and efficient water use
  iv. Preserve and enhance valuable wetlands and ecosystems
  v. Use water saving technology for improving efficiency of water and install facilities to reduce distribution losses. e.g. Drip irrigation, buried pipe irrigation etc.
  vi. Gradual shifting of high water consuming crops to low water volume high value crops specially in the Barind and Drought Prone Areas.

- **Strategy 2 :** Minimising losses due to floods and drainage congestion

- **Strategy 3:** Management of cross-boundary water issues including river basin developments.

Thank You

Open Discussion
&
Question-Answer