



Bangladesh Forest Department
Ministry of Environment, Forest and Climate Change

Mid-term Scoping Report

Prepared for the
Strategic Environmental Assessment
of South West Region of Bangladesh for Conserving
the Outstanding Universal Value of the Sundarbans



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MID-TERM SCREENING AND SCOPING REPORT

Volume 2: Mid-Term Scoping Report

**Prepared for the
Strategic Environmental Assessment
of South West Region of Bangladesh for Conserving
the Outstanding Universal Value of the Sundarbans**

Dedication

The SEA Team dedicates this report to our colleague and friend, Dr Jean Jean-Roger Mercier, who passed away on 5th July 2020 after a short illness. He gave us sage advice, guidance, wit and inspiration. We shall miss him.

Acknowledgements

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Transparency Statement

This Mid-Term Scoping Report is a product of the strategic environmental assessment of the South West Region and Sundarbans, It is intended to provide information on the scoping phase of the SEA and progress to date, and is produced in support policy-making, planning and decision-taking by the government of Bangladesh. It is intended as an open access document for sharing with all stakeholders, all those who have participated in the SEA process to date, and any other interested individuals or organisations.

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Note on Mid-Term Screening and Scoping Report

The Mid-Term Screening and Scoping Report is presented in two volumes. This is because the two reports have substantially different aims and content, and because both are lengthy.

Volume 1: Mid-Term Screening Report

Volume 2: Mid-Term Scoping Report

Availability of documents

Both documents and other materials relevant to the SEA can be downloaded from the dedicated SEA website: www.seasw-sundarbansbd.org.

Abbreviations and Acronyms

ABS	Access and benefit sharing
ADB	Asian Development Bank
ADM	Adaptive delta modulation
AIDS	Acquired immune deficiency syndrome
ADP	Annual Development Programme
ASFR	Age specific fertility rate
BAPEX	Bangladesh Petroleum Exploration Co. Ltd
BBS	Bangladesh Bureau of Statistics
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BCCT	Bangladesh Climate Change Trust
BDP	Bangladesh Delta Plan
BELA	Bangladesh Environmental Lawyers Association
BIFPCL	Bangladesh-India Friendship Power Company Limited
BIGPCL	Bangladesh-India Power Company Ltd
BIWTA	Bangladesh Inland Water Transport Authority
BMET	Bureau of Manpower, Employment and Training
BOD	Biological oxygen demand
BPC	Bangladesh Petroleum Corporation
BRAC	Bangladesh Rural Advancement Committee
BRDB	Bangladesh Rural Development Board
BWDB	Bangladesh Water Development Board
CANSA	Climate Action Network-South Asia
CEGIS	Centre for Environmental and Geographic Information Services
BFD	Bangladesh Forest Department
BLC	Boat Licence Certificate
CBT	Community-based tourism
CF	Conservator of Forests
CC	Climate change
CCF	Chief Conservator of Forests
CEP	Coastal Embankment Project
Cl ⁻	Chloride

COD	Chemical oxygen demand
COPD	Chronic obstructive pulmonary disease
CO ₂	Carbon dioxide
CS	Cyclonic storm
CSO	Civil society organisation
dB	Decibel
DC	Direct current
DCF	Deputy Conservator of Forests
DEM	Digital elevation model
DoE	Department of Environment
DP	Delta Plan
DPHE	Department of Public Health Engineering
DSS	Decision support system
DTL	Deputy Team Leader
DWT	Dead weight tonnage
EC	Electrical conductivity
ECA	Ecologically critical area
	Environmental Conservation Act 1995 (amended 2000, 2002, 2007 and 2010)
ECC	Environmental Clearance Certificate
ECR	Environmental Conservation Rules (1997)
EIA	Environmental impact assessment
EMP	Environmental management plan
ERL	Eastern Refinery Limited
ESP	Electrostatic precipitator
ETP	Effluent treatment plant
FAO	Food and Agriculture Organisation of the UN
FAP	Flood Action Plan
FD	Forest Department
FEJB	Forum of Environmental Journalists of Bangladesh
FGD	Flue gas de-sulphurization
FPP	First Perspective Plan (2010-2021)
FSSAP	Female Secondary School Assistance Project
FY	Financial year

FYP	Five year plan
GAINS	Greenhouse Gas and Air Pollution Interactions and Synergies
GBM	Ganga-Brahmaputra-Meghna
GDP	Gross domestic product
GHG	Greenhouse gas emission
GIS	Geographical information system
GMB	Ganges-Brahmaputra-Meghna
GoB	Government of Bangladesh
GRRPO	Gorai River Restoration Project
GSMP	Gas Sector Management Plan
GWh	Gigawatt hour
Ha	Hectare
HFO	Heavy fuel oil
HIV	Human immunodeficiency virus
HSD	High speed diesel
HYV	High yielding variety
IA	Invasive alien species
ICTP	International conventions, treaties and protocols
ICU	Intensive care unit
ICZMP	Integrated Coastal Zone Management Plan
IDB	Islamic Development Bank
IEE	Initial environmental examination
IIASA	International Institute for Applied Systems Analysis
IMED	Implementation Monitoring and Evaluation Division
IMF	International Monetary Fund
IMSBc	International maritime solid bulk cargo
INGO	International non-governmental organisation
IPCC	Inter-governmental Panel on Climate Change
IT	Information technology
IUCN	International Union for Conservation of Nature
IWRM	Integrated Water Resources Management
JICA	Japan International Cooperation Agency
JWG	India-Bangladesh Joint Working Group

KCC	Khulna City Corporation
KJA	Khanjan Ali bridge
Km	Kilometre
KWASA	Khulna Water Supply and Sewage Authority
LGED	Local Government Engineering Department
LGI	Local government institution
LPG	Liquid petroleum gas
M&E	Monitoring and evaluation
MEA	Multilateral environmental agreements
mg	Milligram
Mg	Magnesium
mg O ₂ /L	Milligrams of oxygen per litre
m-mhos/cm	Millimhos per centimetre
MoA	Ministry of Agriculture
MoCAT	Ministry of Civil Aviation and Tourism
MoEFCC	Ministry of Environment, Forestry and Climate Change
MoF	Ministry of Finance
MoFL	Ministry of Fisheries and Livestock
MoI	Ministry of Industry
MoL	Ministry of Land
MoWR	Ministry of Water Resources
MPA	Mongla Port Authority
	Marine protected area
MoE	Ministry of Education
MoPEMR	Ministry of Power, Energy and Mineral Resources
MoP	Ministry of Planning
MoPME	Ministry of Primary and Mass Education
MoRTB	Ministry of Road Transport and Bridges
MoS	Ministry of Shipping
MoU	Memorandum of understanding
MoWCA	Ministry of Women and Children Affairs
MPEMR	Ministry of Power, Energy and Mineral Resources
MSWS	Maximum sustainable wind speed

MT	Million tons
MTBF	Medium term budgetary framework
MW	Megawatt
Na ⁺	Sodium
NAP	National Agriculture Policy
NAPA	National Adaptation Programme of Action (for Climate Change)
NAWG	National Assessment Working Group
NBSAPB	National Biodiversity Strategy and Action Plan for Bangladesh
NCD	Non-communicable diseases
NCS	National Conservation Strategy
NEC	National Economic Council
NEMAP	National Environment Management Action Plan
NEP	National Environmental Policy
NGO	Non-governmental organisation
NNR	Net reproductive rate
NO _x	Nitrogen oxides
NSDS	National Sustainable Development Strategy
NTFP	Non-timber forest products
NWDP	National Women Development Policy
NWMP	National Water Management Plan
N ₂ O	Nitrous oxide
OECD	Organisation for Economic Cooperation and Development
OECD-DAC	OECD Development Assistance Committee
ORP	Oxidation reduction potential
OUV	Outstanding Universal Value
PAP	Project affected person
PESSP	Power and Energy Sector Strategy Paper
PM	Particulate matter
PM ₁₀	Particulate matter 10 micrometres or less in diameter
PM _{2.5}	Particulate matter 10 micrometres or less in diameter
PMS	Performance Management System
PPCR	Pilot Programme for Climate Resilience
PPP	Policy, plan, programme

PSC	Project Steering Committee
PSMP	Power System Master Plan
RAB	Rapid Action Battalion
REB	Rural Electrification Board
RHD	Roads and Highways Department
RIMS	Resource Information Management System
RoW	Right of way
RMM	Reactive monitoring mission
RMMRU	Refugee and Migratory Movements Research Unit
RMSL	Relative mean sea level
RS	Remote sensing
RSW	Recyclable solid waste
SCS	Severe cyclonic storm
SDG	Sustainable Development Goal
SDS	Secondary disposal site (for solid waste)
SEA	Strategic Environmental Assessment
SEMP	Strategic Environmental Management Plan
SGGP	Sundarban Gas Company Limited
SLR	Sea level rise
SMART	Spatial monitoring and report tool
SME	Small- and medium-sized enterprise
SO ₂	Sulphur dioxide
SO ₄	Sulphate
SPP	Second Perspective Plan for Bangladesh (2021-2041)
SRF	Sundarbans Reserve Forest
STD	Sexually transmitted disease
STI	Sexually transmitted infection
SW	South West
SWM	Solid waste management
SWR	South West Region
TB	Tuberculosis
TCF/tcf	Trillion cubic feet
TFR	Total fertility rate

TL	Team Leader
TSP	Total suspended particles
UMIC	Upper Middle Income Country
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNFCCC	United Nations Framework Convention on Climate Change
UNFPA	United Nations Fund for Population Activities – now UN Population Fund
UP	Union Parishad
USD	United States Dollar
$\mu\text{g}/\text{m}^3$	Micrograms per cubic metre of air
$\mu\text{S}/\text{cm}$	Microsiemens per centimetre
VGD	Vulnerable group development
WARPO	Water Resources Planning Organisation
WCS	Wildlife Conservation Society
WHO	World Health Organisation
WHS	World Heritage Site
WR	Water resources

Bengali Terms

Baor	Oxbow lake
Beel	A large wetland depression
Chatal	A low lying area with some permanent water – smaller than a beel
Chingri	Shrimp
Haor	A bowl- or saucer-shaped shallow wetland depression. During monsoon, haors receive surface runoff water from rivers and canals to become vast stretches of turbulent water. They turn into a vast inland seas within which the villages appear as islands.
Jalmahal	Physically defined state-owned waterbodies for which the fishing rights are auctioned out by government
Khas	Government-owned fallow land
Upazila	Sub-district

Executive Summary

This Strategic Environmental Assessment (SEA) aims to assess the impacts of development in the South West Region of Bangladesh (Figure E.1) to ensure the sustainable development of the region and conservation of the Sundarbans, and to uphold its Outstanding Universal Value (OUV).

The Mid-Term Screening and Scoping Report is presented in two volumes since the two reports have substantially different aims and content, and because both are lengthy:

Volume 1: Mid-Term Screening Report; and

Volume 2: Mid-Term Scoping Report (this volume) containing nine chapters with appendices.

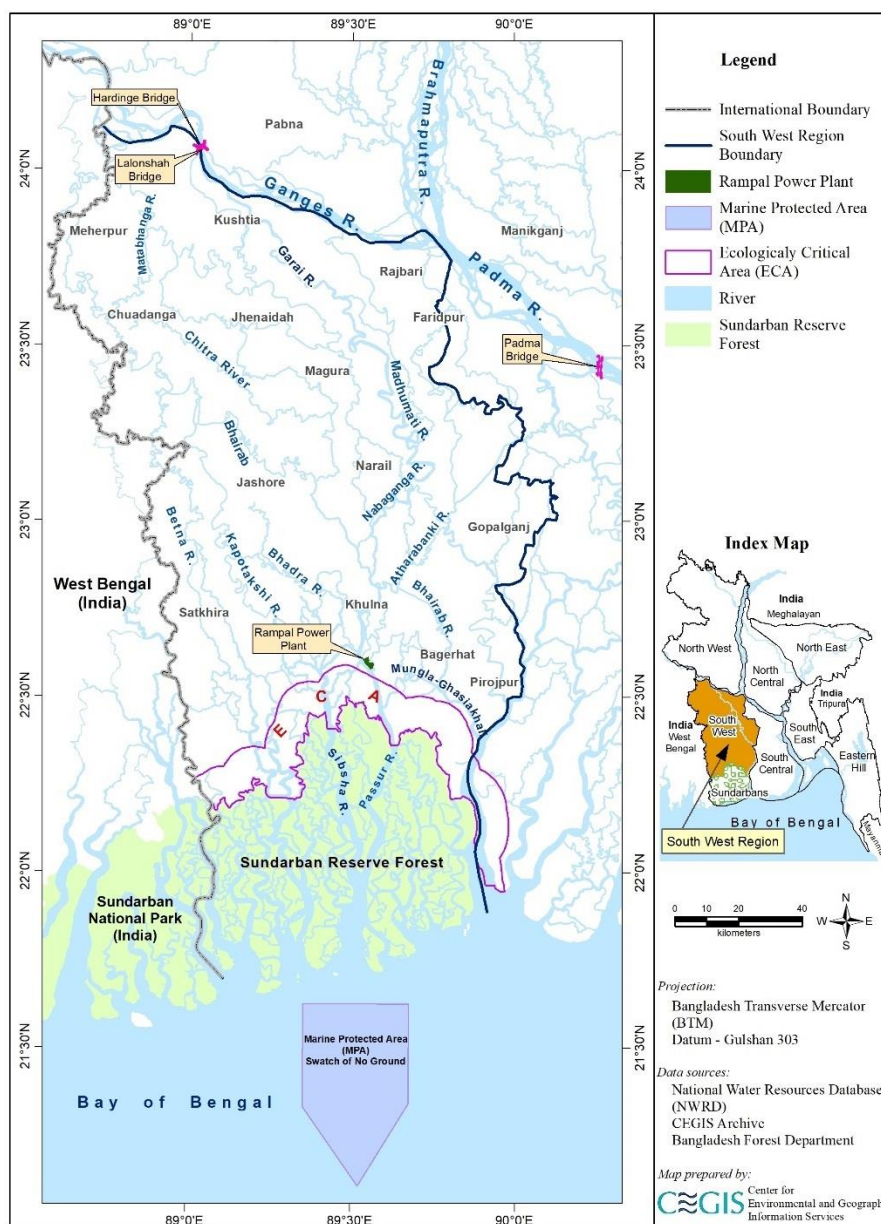


Figure E.1: The SEA Area of Focus, World Heritage Sites and Protected Areas

Chapter 1 is an introduction which describes the objectives of the SEA, outlines the role of SEA and the main steps involved.

Chapter 2 sets out the aims of the scoping phase (the focus of this report) and explains how the COVID-19 pandemic has interrupted the work, particularly stakeholder consultations. The main components of scoping have included:

- undertaking stakeholder analysis;
- preparing 13 thematic baseline papers and identifying the key environmental, social and economic issues and concerns on which the SEA will focus;
- reviewing the legal and regulatory framework of Bangladesh;
- surveying institutional capacities (postponed due to COVID-19);
- setting environmental and socio-economic objectives for key issues – to be used during the main assessment phase;
- establishing a dedicated website for the SEA and producing a Prospectus that summarises the aims and approach of the SEA for stakeholders.

Chapter 3 describes the baseline conditions and key environmental and socio-economic issues in the South West Region which are summarised in Table E.1. It also describes several important transboundary issues that are likely to influence the South West Region and Sundarbans (including upstream dams and irrigation in the Ganges basin, and industries in neighbouring West Bengal); and mega projects in the South West Region, particularly the Rampal coal-fired power station and the Padma bridge.

Chapter 4 examines the institutional framework, at national level and within the South West Region, describing the mandates and roles of the main institutions involved in the development and implementation of plans and policies, and with a role in environmental management. These include the Planning Commission, Ministry of Finance, Ministry of Environment, Forest and Climate Change and sector ministries, as well as NGOs and private sector organisations

Chapter 5 describes the legal and regulatory framework, focusing on laws and associated instruments concerned with managing the environment and natural resources. It also describes the environmental and social safeguards framework in place in Bangladesh, particularly the environmental impact assessment system. Whilst a growing number of countries in the region that have introduced formal requirements for SEA, Bangladesh currently has no legal or institutional framework for SEA, although the National Environment Policy 2018 sets an objective to establish SEA in Bangladesh. However, some SEAs have been conducted with donor assistance and several SEA-related initiatives have been undertaken or are underway. This chapter also summarises the international conventions, agreements and protocols that have been ratified by Bangladesh.

Chapter 6 provides an overview of the key policies, plans and mega projects affecting the South West Region, highlighting those relevant to the environment and various key sectors. A summary is provided of all of the almost 90 policies, plans and programmes screened (and dealt with in detail in the companion Mid-Term Screening Report) including matrices indicating their potential environmental and socio-economic impacts (both positive and negative).

Chapter 7 identifies a set of environmental and socio-economic objectives related to the key environmental and socio-economic issues that the SEA will need to address (Table E.2). The objectives are designed either to (a) avoid, reduce/minimise the scale of the issue (mainly for

environmental concerns), or (b) to enhance/promote measures to address the issue (mainly for socio-economic issues). These objectives will provide a basis against which to assess the impacts of developments likely to arise when implementing policies, plans and programmes (PPPs). The assessment will involve professional expert judgement (based on experience and evidence from implementing similar PPPs) on whether implementing PPPs - in order to pursue different macro-economic growth strategies (described in chapter 8) - will impede or enhance achieving each of the agreed objectives, and to what extent (e.g. to a high, medium or low extent/level).

Table E.1: List of priority environment, social and economic issues

Environmental issues and concerns	Comment / examples of potential impacts
<i>Pollution and waste (solid and liquid):</i> • Surface water pollution. Brackish and sea water • Groundwater pollution • Air pollution • Oil • Waste treatment and disposal • Plastics	Pollution & waste management is a major concern for the ecological integrity of the SWR of Bangladesh and the Sundarbans due to different developmental initiatives.
<i>Water flow dynamics in rivers</i>	Reduction of water flow in rivers of SWR may change the region's economic sustainability/integrity as well as livelihood patterns and crop production
<i>Sedimentation and siltation</i> (fluvial and tidal) • Dredging and disposal	Sedimentation and siltation management is a challenge to maintain river flows. Disposed dredged materials can affect the regeneration of trees & survival of existing forests as well as benthic aquatic biodiversity.
<i>Salinity:</i> • Groundwater • Soil	Due to reduced flow of upstream fresh water and channel siltation, and resultant sea water intrusion/inundation, soil and groundwater salinity has increased and soil productivity has decreased as well as livelihood diversity
<i>Noise</i> - particularly due to shipping in Sundarbans	Noise from the regular movement of ships (notably along major rivers of Sundarbans) can disrupt wildlife movement, cause localisation of populations and result in inbreeding.
<i>Habitat isolation</i>	Several large tracts of the Sundarbans are separated by wide rivers which tigers and other fauna tend not to cross. This may lead to genetic isolation. Increased numbers of vessels passing along the navigable channels, the noise they cause and use of lights at night may also disrupt the dispersal of fauna. These factors tend to disturb animal behaviour (eg feeding, breeding) and may lead to genetic isolation and also threaten effective biodiversity conservation.
<i>Loss of biodiversity</i>	Some environmental as well as regional & local activities may affect biodiversity (particularly in the Sundarbans), with loss of keystone species and their prey base due to poaching and habitat degradation as a result anthropogenic activities. Biodiversity losses may also occur due to climate change and natural dynamic changes in the ecosystem

Environmental issues and concerns	Comment / examples of potential impacts
<i>Invasive alien species</i>	Water hyacinth has become a major problem, clogging baors and ponds, and some water channels. <i>Prosopis juliflora</i> is also spreading on embankments although it is used as a fuelwood by local people. At present, there are no major issues with IAS within the Sundarbans. However, forest managers are concerned about their potential future spread and impacts,
<i>River bank erosion</i> – due to port expansion and boats	River bank erosion is a particular concern in the Sundarbans due to bow-waves from the increased numbers of fast-moving ships and due to river bed siltation, formation of new islands and changed river courses, as well as increasing sea water inflow in SWR.
<i>Climate change</i> • Sea level rise • Salt water intrusion • Erratic rainfall & distribution • Increased average temperatures • Cyclones & storm surges • Greenhouse gas emissions	• Sea level rise is a global threat that will impact on the region. • Many factors have reduced river flow in the region, decreasing flushing time, with increased periods of saltwater exposure. • Shifting of monsoon with erratic rainfall has impacted on the cropping season and pattern • There is no evidence of significant increased temperatures yet, but climate models predict a significant increase in the future. • Cyclones making landfall impact on livelihoods (killing people and causing damage). Cyclone frequency has decreased but may rise in the future. • Rapid industrialisation and urbanisation is likely to lead to increased carbon dioxide emissions from power and energy sector (including transport). Expansion of flood-irrigated paddy rice has increased methane emissions.
<i>Exceptional floods</i> (with potentially damaging water levels): • Freshwater floods (due to rain) upstream • Tidal • Poor drainage infrastructure	Freshwater flooding may occur due to: heavy rain in the upstream/catchment areas of SWR, lack of drainage infrastructure and high tidal flow.
<i>Industrialisation:</i> • Power generation – oil, gas, coal • Pipelines • Petroleum • Cement • Special economic zones	Industrialization of the inland parts of SWR can create air & water pollution as well as other potential impacts on biodiversity & livelihoods of the region.
<i>Urbanisation</i>	Rapid urbanization in the 14 districts of SWR as well as in the environmentally critical area around The Sundarbans

Environmental issues and concerns	Comment / examples of potential impacts
	can affect the extent of air & water pollution and agricultural productivity etc.
Land use changes	Land use changes north of The Sundarbans are arising due to population & economic growth of SWR, e.g. shrimp cultivation, infrastructures & urbanization, etc. Impacts of this include loss of biodiversity, reduced soil productivity and loss of livelihood opportunities
Protected areas and hotspots	- Many highly sensitive & important biodiversity areas have been declared by law as protected areas. However, laws are not always strictly enforced and people lack adequate knowledge and awareness about the need for nature conservation in such areas. - Due to lack of periodic maintenance and management, parts of the polder system have become water-logged in Khulna and Satkhira Districts; - Peat soil in areas around Gopalganj and Khulna are used as fuel and may increase GHG emission.
Socio-economic issue	Comment
Livelihoods: - Conflicts between economic sectors - Access to resources (e.g. in Sundarbans) - Salinity	- Salinity intrusion causes conflicts, e.g.: shrimp cultivators vs crop producers; powerful/rich land controller's vs the powerless, smallholder and marginalized people, etc. - Access by forest-dependent people to forest resources (to support their livelihood options) is limited so as to prevent exploitation and to maintain a sustainable flow of resources – as prescribed in the Sundarbans Management Plan. - Causes health problems (e.g. skin conditions), reduces drinking water quality – impairing people's ability to work, and affects crop production, etc.
Out-migration	Both involuntary and economic out-migration (mainly poor people) is common in SWR, especially from coastal areas. Much is driven by disasters, indebtedness, dispossession/land grabbing, lack of livelihood options, etc. Poor people move to unhealthy urban slums and become further marginalised in an uneven job market. Some educated people move to urban areas /overseas for employment. Migrant remittances can supplement family incomes and contribute national economy.
Health & sanitation: Water-borne, respiratory & salinity-related diseases	Local people, especially children and elderly people, are particularly susceptible to water-borne, respiratory and salinity-related skin diseases
Diet	Poor diet causes malnutrition.

Environmental issues and concerns	Comment / examples of potential impacts
Negative health impacts of air pollution (mainly pollution by particulate matter)	The dominant way of cooking causes indoor air pollution which has a serious impact on human health.
- Inadequate health facilities and access - Arsenic contamination (of drinking water & irrigated rice)	- Health service providers are based in city/urban and peri-urban areas. They are not easily accessible by people and/or emergency patients living in remote areas, due to poor communication networks. - Lack of public toilets in urban and semi urban areas. As a result, local people, especially women face problems during public gatherings and at local markets. - This is a serious issue in parts of the Ganges River floodplain and the northern part of the tidal floodplain.
Gender-related issues	Women face socio-political exclusion in decision-making processes - both in the home and society. They also bear a heavy burden for collecting potable water, fuelwood (from the Sundarbans and adjacent areas), etc. Women often encounter security problem while travelling alone to/from remote areas.
Education: - Low environmental awareness - High male dropout	- Males from poor households need to support family income, resulting in high drop out and/or lower attendance at school. - Poor communication network in the rural area often discourages school attendance.
Loss of traditional knowledge	Technological advancement & other development activities may be causing loss of traditional knowledge.
Loss of cultural heritage	Lack of proper maintenance & negligence due to low revenue return, inadequate budget allocation, etc.
Security – kidnapping of resource extractors	Kidnapping of forest produce extractors for ransom is an important issue for the management of the Sundarbans
Seasonal tourism	Uncontrolled tourism causes loss of biodiversity, disruptive noise and water pollution etc.
Illegal activities: - Poaching and hunting - Poison fishing - Illegal tree cutting - Trafficking of wildlife products - Corruption	These issue are of major concern in the Sundarbans, causing loss of habitat and biodiversity (terrestrial & aquatic) & economic loss for communities.
Institutional issues	Lack of manpower, capacity development & logistics are major institutional issues – impeding environmental management (In general) and overall management of the Sundarbans.

Table E.2: Proposed SEA objectives and related sustainable development goals

Theme		Objective	Related SDGs
Environmental			
Protected areas and biodiversity	1	Reduce over-exploitation/degradation/fragmentation of forests & habitats, loss of biodiversity and ecosystem(s) integrity and services	6, 14,15
	2	Reduce illegal activities in PAs and forest areas	15
	3	Reduce introduction and spread of invasive alien species	15
Waste and pollution	4	Reduce poor management and unsafe disposal of solid and liquid waste (urban & industrial)	3,6,14
	5	Reduce all forms of pollution (air, land, water, plastics, noise, etc)	3,6,14,15
	6	Minimise emissions of greenhouse gases	13
	7	Minimise noise from boats/ships	15
Climate change and disasters	8	Reduce vulnerability to climate change and natural disasters (floods, storm surges, etc)	1,13
Land degradation	9	Minimise the footprint of transport services (rail, road, air, water-borne)	15
	10	Minimise erosion of river banks/water channels	15
Land use change	11	Minimise loss of agricultural land (e.g. to shrimp ponds)	15
Water	12	Reduce the decline in freshwater flow rates in rivers	6,15
Sediment	13	Reduce improper disposal of dredged sediments	15
Socio-economic			
Economic growth	14	Ensure significant economic development and diversification, & increase in economic growth	8,9
Employment	15	Enhance opportunities for employment and new/improved livelihoods (particularly for fisheries, agriculture, eco-tourism)	8,9
Power and energy	16	Increase energy efficiency and uptake of renewable energy	7,9
Health and sanitation	17	Improve health services and health of society (e.g. by reducing vulnerability to diseases)	3
	18	Improve and extend sanitation services	3,6
Climate change and disasters	19	Minimise loss of life, damage to property and infrastructure	13
Women and children	20	Improve gender equality and empowerment of women	4,5
	21	Improve and enforce controls on employing children	5,8,16
Education, skills and training	22	Improve access to education for all, increase attendance (by reducing drop-out rates), and improve skills development and training	4
Food	23	Increase food production	2
Migration	24	Reduce migration from rural (including disaster-prone and risk-prone) areas to urban areas	10

Theme		Objective	Related SDGs
Conflicts and security	25	Reduce conflicts over use of land, forests and water	15
	26	Improve security for fishermen (eliminate kidnappings)	16
Cultural heritage	27	Preserve heritage sites (historic buildings, archaeological and cultural sites and enhance cultural diversity (e.g. language, arts, etc.).	11
Connectivity, access and mobility	28	Connect communities, and improve access to infrastructure, services and facilities.	11
Agriculture	29	Increase agricultural production	2
Tourism	30	Increase volume of tourism, particularly eco-tourism.	8
List of Sustainable Development Goals 1. No poverty: End poverty in all its forms everywhere 2. Zero hunger: End hunger, achieve food security and improved nutrition and promote sustainable agriculture 3. Good health and well-being: Ensure healthy lives and promote well-being for all at all ages 4. Quality education: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all 5. Gender equality: Achieve gender equality and empower all women and girls 6. Clean water and sanitation: Ensure availability and sustainable management of water and sanitation for all 7. Affordable and clean energy: Ensure access to affordable, reliable, sustainable and modern energy for all 8. Decent work and economic growth: Promote sustained and inclusive and sustainable economic growth, full and productive employment and decent work for all 9. Industry, innovation and infrastructure: Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation 10. Reduced inequalities: Reduce inequality within and among countries 11. Sustainable cities and communities: Make cities and human settlements inclusive, safe, resilient and sustainable 12. Responsible consumption and production: Ensure sustainable production and consumption patterns 13. Climate action: Take urgent action to combat climate change and its impacts 14. Life below water: Conserve and sustainably use the oceans, seas and marine resources for sustainable development 15. Life on the Land: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss 16. Peace, justice and strong institutions: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels 17. Partnerships for the goals: Strengthen the means of implementation and revitalise the global partnership for sustainable development			

Chapter 8 describes work that will continue during August and September 2020 to develop scenarios of plausible future development in the South West Region over the next 20 years – as influenced by a range of interacting driving forces (drivers of change). Subsequently, informed by

these scenarios, projections will be made of the developments that will be likely to arise over the next 20 years in the South West Region under three proposed alternative macro-economic growth strategies: high economic growth; green(sustainable) growth; and business-as-usual. Developments might include, for example, the extent of new/upgraded infrastructure (e.g. kilometres of new railways and roads, numbers of new ports and airports), new industrial facilities (e.g. types/numbers of new plants and sites), changed environmental and social management regimes, changes to agricultural and fisheries activities (e.g. altered cropping patterns, expansion of shrimp farms).

Finally, **chapter 9** summarises the next steps, following scoping, in the SEA process. These include:

- Stakeholder engagement during August to mid-October, based on video conferencing and emails;
- Institutional capacity survey – if the COVID-19 pandemic allows;
- Scenario development and projections for macro-economic growth strategies;
- Further development and completion of the thematic baseline papers;
- The main assessment phase (starting in mid-October).

A full set of references for all works cited in the text is included.

1. Introduction

1.1 Background

Bangladesh is on a trajectory to become a developed economy by 2041. In contributing to achieving this goal, the South West Region has significant prospects for development. The government is committed that such development should be sustainable and should not adversely affect the Outstanding Universal Value (see Box 1.1) of the Sundarbans.

The South West Region is one of the hydrological regions of Bangladesh. It is largely under tidal influence and dependent on sweet water supplies from upstream, many parts having a unique brackish water ecosystem. The region has vast low-lying *areas* enclosed by man-made polders and is considered to be highly vulnerable to climate change induced hazards. The current population is projected to be in excess of 22 million. The region comprises the six districts of Khulna Division and Faridpur District of Dhaka Division. There are 50 municipalities, including Khulna City Corporation and six major cities: Faridpur, Chuandanga, Jessore, Jhenaidah, Kuhstia and Satkhira.

The Sundarbans covers 10,000 km² of land and water in the Ganges delta. It contains the world's largest area of natural mangrove forests. 60 % of these forests occur in Bangladesh; the remainder in India. The area has both local and global significance due to its diversity, uniqueness, biological productivity and rich ecosystems, with a number of rare or endangered species living in the forest, including tigers, aquatic mammals, birds and reptiles. The area provides essential ecological services such as nursery grounds for many fish species, and coastal erosion protection against storms, tidal surges and cyclones.

Some parts of the Sundarbans were proposed by the Government of Bangladesh and subsequently designated by UNESCO as World Heritage Sites in 1997 (Figure 1.1). But, recently, concerns have been raised about the potential impacts on the Sundarbans of existing and planned developments in the SW Region. In this regard, UNESCO suggested to the Government of Bangladesh (GoB) to undertake a Strategic Environmental Assessment (SEA) to assess the impacts of development at a landscape and regional scale to help Bangladesh uphold the Outstanding Universal Value (OUV) of the Sundarbans (Box 1). The overall aim is to ensure the sustainable development of the SW Region whilst also ensuring the conservation of the Sundarbans.

Box 1.1: Outstanding Universal Value of the Sundarbans

The three wildlife sanctuaries in the south of the Sundarbans (Figure 1.1) cover an area of 139,700 ha and are considered core breeding areas for a number of endangered species. Situated in a unique bioclimatic zone within a typical geographical situation in the coastal region of the Bay of Bengal, it is a landmark of ancient heritage of mythological and historical events. Bestowed with magnificent scenic beauty and natural resources, it is internationally recognized for its high biodiversity of mangrove flora and fauna both on land and water.

The immense tidal mangrove forests of Bangladesh's Sundarbans Forest Reserve, is in reality a mosaic of islands of different shapes and sizes, perennially washed by brackish water shrilling in and around the endless labyrinths of water channels. The site supports exceptional biodiversity in its terrestrial, aquatic and marine habitats; ranging from micro to macro flora

and fauna. The Sundarbans is of universal importance for globally endangered species including the Royal Bengal Tiger, Ganges and Irrawaddy dolphins, estuarine crocodiles and the critically endangered endemic river terrapin (*Batagur baska*). It is the only mangrove habitat in the world for *Panthera tigris* species.

According to UNESCO, “**Outstanding Universal Value**” means cultural and/or natural significance which is so exceptional as to transcend national boundaries and to be of common importance for present and future generations of all humanity. To be included on the World Heritage List, sites must be of outstanding universal value and meet at least one out of ten selection criteria. The Sundarbans has been accorded World Heritage Site status on the basis of meeting two criteria:

Criterion (ix): The Sundarbans provides a significant example of on-going ecological processes as it represents the process of delta formation and the subsequent colonization of the newly formed deltaic islands and associated mangrove communities. These processes include monsoon rains, flooding, delta formation, tidal influence and plant colonization. As part of the world’s largest delta, formed from sediments deposited by three great rivers; the Ganges, Brahmaputra and Meghna, and covering the Bengal Basin, the land has been moulded by tidal action, resulting in a distinctive physiology.

Criterion (x): One of the largest remaining areas of mangroves in the world, the Sundarbans supports an exceptional level of biodiversity in both the terrestrial and marine environments, including significant populations of globally endangered cat species, such as the Royal Bengal Tiger. Population censuses of Royal Bengal Tigers estimate a population of between 400 to 450 individuals, a higher density than any other population of tigers in the world.



The Sundarbans mangrove forests

The property is the only remaining habitat in the lower Bengal Basin for a wide variety of faunal species. Its exceptional biodiversity is expressed in a wide range of flora; 334 plant species belonging to 245 genera and 75 families, 165 algae and 13 orchid species. It is also rich in fauna with 693 species of wildlife which includes; 49 mammals, 59 reptiles, 8 amphibians, 210 white fishes, 24 shrimps, 14 crabs and 43 molluscs species. The varied and colourful bird-life found along the waterways of the property is one of its greatest attractions, including 315 species of waterfowl, raptors and forest birds including nine species of kingfisher and the magnificent white-bellied sea eagle.

Source:

[file:///C:/Users/bdala/AppData/Local/Packages/Microsoft.MicrosoftEdge_8wekyb3d8bbwe/TempState/Downloads/The%20Sundarbans%20-%20UNESCO%20World%20%20Heritage%20Centre%20\(1\).html](file:///C:/Users/bdala/AppData/Local/Packages/Microsoft.MicrosoftEdge_8wekyb3d8bbwe/TempState/Downloads/The%20Sundarbans%20-%20UNESCO%20World%20%20Heritage%20Centre%20(1).html)

In response, following an open tender process, the Department of Forestry has commissioned CEGIS and Integra Consulting to undertake the SEA over 18 months, from January 2020 to June 2021. The overall aim is to ensure the sustainable development of the SW region (Figure 1.1) whilst also ensuring the conservation of the Sundarbans.

The SEA will analyse the environmental and socio-economic impacts, existing and likely, of current and future policies, plans and development programmes (PPPs) and of mega projects in the South West. In particular, the SEA will address PPPs covering all relevant sectors including, but not limited to, the following: forestry, fisheries, transportation and communication, industry, power and energy, water resources, shipping, urbanisation and tourism.

The SEA will identify the positive and negative, direct and indirect, transboundary, cumulative, synergistic and antagonistic impacts of development in the region and address how these are impacting on, or are likely to impact on (in the case of future PPPs) the region as a whole (and including the Sundarbans). It will also highlight the potential for enhancing positive impacts and for trade-offs. The SEA will result in a Strategic Environmental Management Plan (SEMP) for the region that sets out a framework for monitoring the implementation of policies, plans and programmes and individual mega development activities, providing a valuable tool to help transition to sustainable development in the region and to support sustainable forest management.

A key objective is to engage widely with all relevant stakeholders to ensure that key concerns about development and environmental management in SW region are able to be raised and taken into account. There are constraints to stakeholder engagement as a result of the current Covid-19 pandemic which is affecting all countries in the world including Bangladesh. As a result, during the scoping phase, it has not been possible to convene stakeholder meetings, for safety reasons, and it has been necessary to rely on email and video-conferencing to solicit and discuss stakeholders' views.



1.2 Objectives of the SEA

The specific objectives of the SEA as set out in the Revised Terms of Reference (Annex 1) are:

- Consideration of **environmental and socio-economic consequences** of existing policies, plans and programmes (PPPs) (national PPPs and those specific to SW region) and promoting that these issues be addressed when formulating and implementing future, as well as existing, PPPs with a view to promoting sustainable development in the region and conservation of the Sundarbans and its Outstanding Universal Value;
- [*Note: some mega-projects have such potential for impacts the SW division that they will be included with the PPPs for review*];
- Simultaneous assessment of the **impacts of development initiatives** on existing bio-physical settings and socio-economic conditions to facilitate informed decision-making regarding transitioning towards a sustainable, resilient and resource efficient economy;
- Identification **of key stakeholders** relevant to selected sectors and organising consultation meetings to obtain knowledge on existing bio-physical settings and socio-economic conditions, impacts of current and proposed developments, and potential strategies for future development of the SW region;
- Development of **alternative strategies** to minimize the direct/indirect, domestic/transboundary and cumulative impacts of development on the Sundarbans and more widely in the South West Region;
- Make **recommendations to improve environmental performance management** in both the public and private sectors as regards future development activities; and
- Formulation of a comprehensive framework in the form of a **Strategic Environmental Management Plan (SEMP)** for the SW region to support decision making and monitoring of the implementation of policies, plans and programs that are likely to affect the environment and socio-economic conditions of the region and in particular the Sundarbans.

1.3 Steps in the overall SEA process

Environmental impact assessment (EIA) practice is relatively standardised across the world with common steps and procedures. In contrast, there is no single approach to SEA; no right or wrong way. “A good SEA is adapted and tailor-made to the context in which it is applied” (OECD-DAC 2006). However various sets of SEA principles have been produced (some through international processes) (e.g. IAIA 2002, OECD-DAC 2006, UNECE 2012, IUCN World Heritage Programme 2013).

In accordance with the TORs, this SEA has been designed according to principles for good practice in SEA as contained in the SEA Guidance of the Development Assistance Committee of the Organisation for Economic Cooperation and Development (OECD-DAC 2006). It is also being undertaken in accordance with the eight UNESCO World Heritage Impact Assessment Principles.

Despite the lack of a standardised approach to SEA, there are a number of generic stages that are common to most SEAs and are also reflected in EIA procedures (e.g. screening, scoping, main assessment, report preparation, monitoring and evaluating). In this regard, the SEA is being

conducted through a sequence of such phases as shown in Table 1.1 and summarised in Figure 1.2.

In June, the team sought approval from the Forest Department, to revise the timetabling of the phases from that set out in the Inception Report due to lock-down delays during March-May as a result of the Covid-19 pandemic (the proposed revised schedule is shown in Table 1.1 and Figure 1.2). Depending on how the pattern and consequences of the pandemic continues, further adjustments may be inevitable.

Table 1.1: Schedule for SEA work: (A) Schedule in Inception Report and (B) proposed revised schedule

	(A): SCHEDULE AS PER INCEPTION REPORT		(B): PROPOSED REVISED SCHEDULE	
Phase	Activity	Work Dates	Activity	Work Dates
1	<i>Inception</i>	Jan-Feb 2020	<i>Inception</i>	Jan-March 2020
			Inception report	March 2020
2	<i>Screening</i>	Mid Feb – mid March 2020	<i>Screening</i>	March-April 2020
	Identify those PPPs likely to have significant environmental and socio-economic impacts to be included in the SEA		Identify those PPPs likely to have significant environmental and socio-economic impacts to be included in the SEA	
			Draft Screening Report	April 2020
3	<i>Scoping</i>	March – mid August 2020	<i>Scoping</i>	April-August 2020
	Gather baseline information and data	March-April 2020	Prepare thematic baseline papers	May-June 2020
	Prepare baseline environmental and socio-economic profile (current status of key themes/factors, trends, etc.).	June 2020	Prepare environmental and socio-economic profile through 13 rolling baseline papers (addressing key environmental and socio-economic themes)	May-June 2020 (first drafts)
	Stakeholder analysis and start stakeholder engagement (consultations at national, regional and local levels.	April-May 2020	Stakeholder analysis	April 2020
			Review of legal and regulatory framework	June 2020
	Review PPPs & identify environmental/social objectives.	May 2020	Review PPPs & identify environmental/social objectives	June 2020

	(A): SCHEDULE AS PER INCEPTION REPORT		(B): PROPOSED REVISED SCHEDULE	
Phase	Activity	Work Dates	Activity	Work Dates
			Internal review of provisional screening scores in Inception Report	June 2020
			Setting environmental and socio-economic objectives for key issues – for use in SEA assessment	June 2020
			Survey of institutional capacities	Depends on Covid-19
			Prepare Prospectus	April 2020
			Establish SEA Website	May 2020
			Liaison with IUCN & UNESCO	May 2020
			Identify transboundary issues (particularly with India/Nepal), PPPs, developments, etc. that may affect SW region	May-June 2020
			Model pollution flows	June -July 2020
			Develop scenarios	May-June 2020
			Prepare projections for macro-economic growth strategies	July 2020
	Draft Scoping Report	End June 2020	Mid-Term Screening and Scoping Report [in practice, this will be 2 documents due to size: (a) Mid-Term Screening Report (incorporating comments from Technical Committee); and (b) Mid-Term Scoping Report] Submitted to government and public (on website) in parallel (at same time) for review/consultation	End July 2020
	Public comment on Draft Scoping Report	End July 2020	Stakeholder consultations (national, regional, local levels) on Mid-Term Screening and Scoping Report and key issues	August – mid October 2020
			Revision of list of key environmental and socio-economic issues	October 2020
	Final scoping report	Mid August 2020	Final Screening and Scoping Report	End October 2020

	(A): SCHEDULE AS PER INCEPTION REPORT		(B): PROPOSED REVISED SCHEDULE	
Phase	Activity	Work Dates	Activity	Work Dates
4	Main assessment	Mid August 2020 – mid Feb 2021	Main assessment	November - February 2021
	Development of future scenarios – to inform assessment process	September 2020	<i>Moved to scoping</i>	
	Initial assessment impacts of alternatives (e.g. high, medium & low economic growth trajectories)	Mid-August to September 2020	Initial assessment impacts of alternative macro-economic growth strategies (e.g. high, green & business-as-usual)	November 2020
	Interim SEA report	End September 2020	Interim SEA report	Mid December 2020
	Circulate interim SEA report for open comment	Comments by end October	Stakeholder consultations and government review of interim SEA report and confirmation of preferred economic growth strategy (possible workshop for ministries to review report)	Review/decision by mid January 2021
	Deeper assessment (of impacts) of preferred alternative	November 2020 to mid-February 2021	Deeper assessment (of impacts by sector) of preferred economic growth strategy	February-March 2021
			Consultation with key ministries on SEMP (contents, targets, indicators, capacities to assume roles & responsibilities, consensus-building)	April 2021
5	Draft SEA report and draft SEMP	By end February 2021	Draft SEA report and draft SEMP	May 2021
6	Review – of draft SEA and SEMP		Review – of draft SEA and SEMP	June 2021
	National multi-stakeholder review workshop	Mid March 2021	Regional and national multi-stakeholder review workshops	June 2021
			Regional multi-stakeholder workshop ??	June 2021
7	Finalisation of SEA Report and SEMP	End May 2021	Finalisation of SEA Report and SEMP	August 2021
8	Implementation of SEMP (monitoring and evaluation of PPPs)	Ongoing	Implementation of SEMP) monitoring and evaluation of PPPs	Ongoing

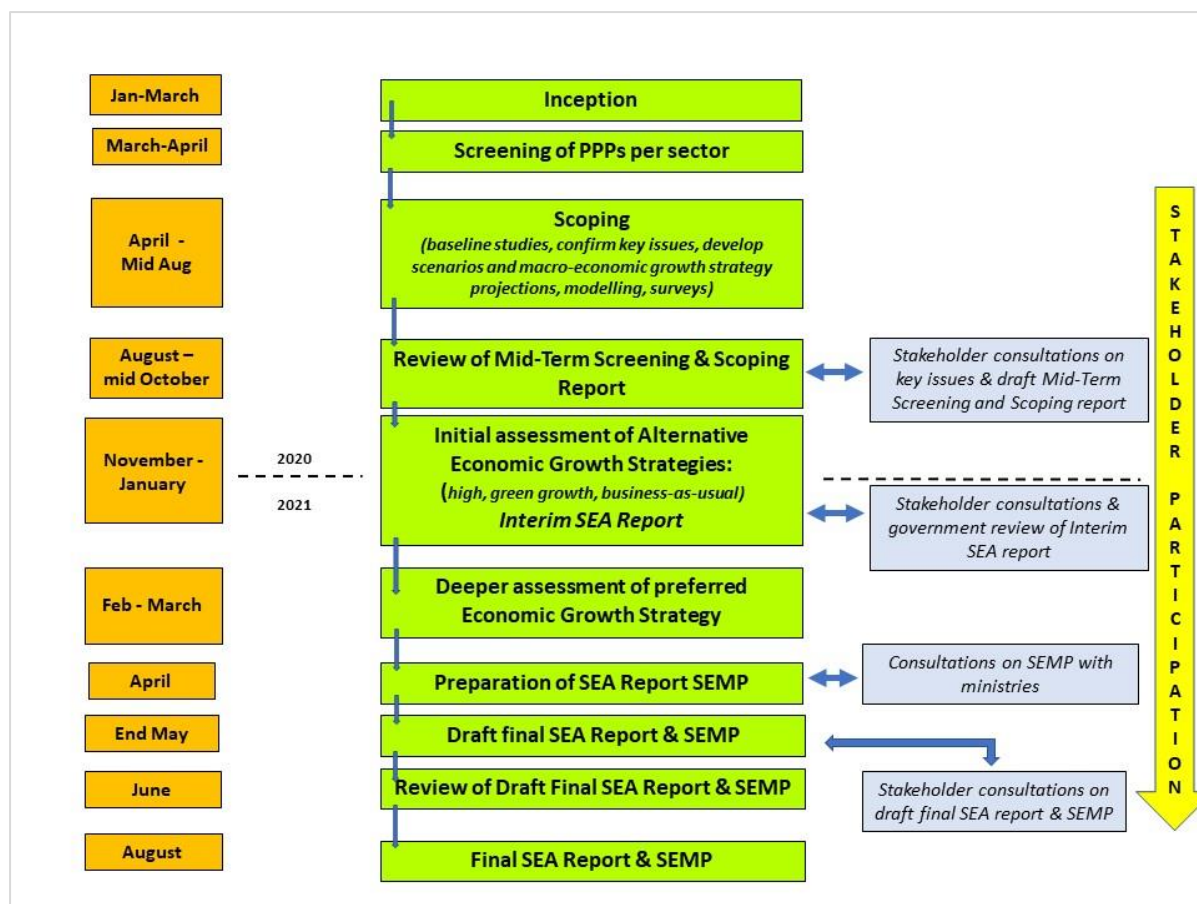


Figure 1.2: Steps in the SEA process and proposed revised timetable

1.4 What is Strategic Environmental Assessment

There is a hierarchy of levels in decision-making comprising policies, plans, programmes and then individual projects (Figure 1.3).

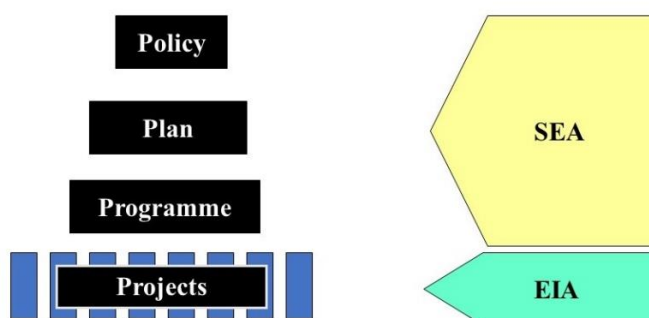


Figure 1.3: SEA, EIA and the decision-making hierarchy

Policies shape the subsequent plans, programmes and projects that put those policies into practice. Policies are thus top of the decision-making hierarchy. Policies, plans, and programmes (PPPs are more 'strategic' than projects as they determine the general direction or approach to

be followed towards broad goals. SEA is applied to these more strategic levels and deals with assessing broadly-defined proposals with a wide range of options usually available for assessment. As one moves down the hierarchy from policies to projects, the nature of decision-making changes, as does the nature of environmental and socio-economic assessment needed. Table 1.2 indicates how SEA differs from Environmental Impact Assessment (EIA) which is used to assess the impacts of individual projects. But as Table 1.2 shows, it differs considerably from SEA.

The experience gained from undertaking EIAs and SEAs of plans and programmes feeds into the design of policy SEAs. There is two-way flow between the four levels in Figure 1.2. Some major public instruments (e.g. White Papers) do not fit easily into the simplified hierarchy shown in Figure 1.2.

The uptake of SEA has grown since first introduced in the 1980s and it is now used in countries all over the world to support PPP preparation and implementation and over 60 countries now have formal legal and regulatory requirements for SEA. But there has been very little experience of its application in Bangladesh. So this SEA is playing a pilot role. It will help to raise awareness of the role, methods and value of the process, and hopefully will stimulate its wider uptake in the country.

In a nutshell, SEA involves analytical and participatory approaches for the environmental evaluation of proposed PPPs, also for evaluating the inter linkages with economic and social considerations. It is a planning tool that aims to improve strategic decision-making. It complements planning by (a) generating information on environmental and socio-economic issues, (b) providing a platform for stakeholder dialogue on these issues with well-structured debate involving government, the private sector and civil society; and (c) offering a mechanism to take the results of the assessment and debate into account in institutions and governance.

SEA uses a variety of tools in a flexible and adaptive way, rather than a single, fixed, prescriptive approach as is usually the case with EIA. SEA can complement and strengthen EIA at the project level by: (a) identifying prior information needs and potential impacts, providing the context and parameters for subsequent EIAs of projects designed to implement a PPP; and (b) making EIA and the project review process more streamlined and efficient by addressing many issues at a more strategic level - including concerns that may relate to project justification so that EIAs can be more effective by being designed to focus on local and site- or project-specific concerns

Table 1.2: SEA and EIA compared

	SEA	EIA
Level of application	Policies, plans and programmes	Specific projects
Alternatives	Broad range considered (e.g. to PPPs, scenarios, economic growth trajectories, etc).	Considers limited range
Who does it?	Commissioned by government.	Usually prepared and/or funded by project proponents.
Focus	Decision on policy, plan and programme implications for future lower-level decisions.	Obtaining project permission, and rarely with feedback to policy, plan or programme consideration.

	SEA	EIA
Process	Multi-stage & iterative, with feedback loops.	Well-defined & linear, with clear beginning and end (e.g. from feasibility to project approval).
Emphasis	Meeting balanced environmental, social and economic objectives in policies, plans and programmes. Includes identifying macro-level development outcomes.	Mitigating impacts (environmental and social) of a specific project, but with identification of some project opportunities, off-sets, etc.
Consideration of cumulative impacts	Key component of assessment	Limited consideration

1.5 Kinds of impacts to be assessed by the SEA

The SEA will look at all the developments (projects, infrastructure, industrial plants, etc.) likely to arise over the next 20 years in the SW Region as a result of implementing current and proposed policies, plans and programmes across all relevant sectors (e.g. particularly forestry, fisheries, agriculture, water, power and energy, tourism, urbanization, industry, transportation/communication and shipping, and others). The environmental and socio-economic impacts of developments arising under these sectors will be assessed in relation to three macro-economic growth strategies: high economic growth, greening the economy, and business-as-usual. A range of impact types will be considered including those which are positive/negative, direct/indirect, domestic/transboundary, cumulative, and synergistic/antagonistic. Impacts arising across the SW region will be assessed as well as those that impact upon the Outstanding Universal Value (OUV) of the Sundarbans (Box 1.1), including those that are transboundary in nature (i.e. arising across regional boundaries within Bangladesh and across international boundaries) – as illustrated in Figure 1.4.

1.6 The SEA team

The SEA is being conducted by a team from two partner organisations: CEGIS and Integra Consulting (see Appendix 5).

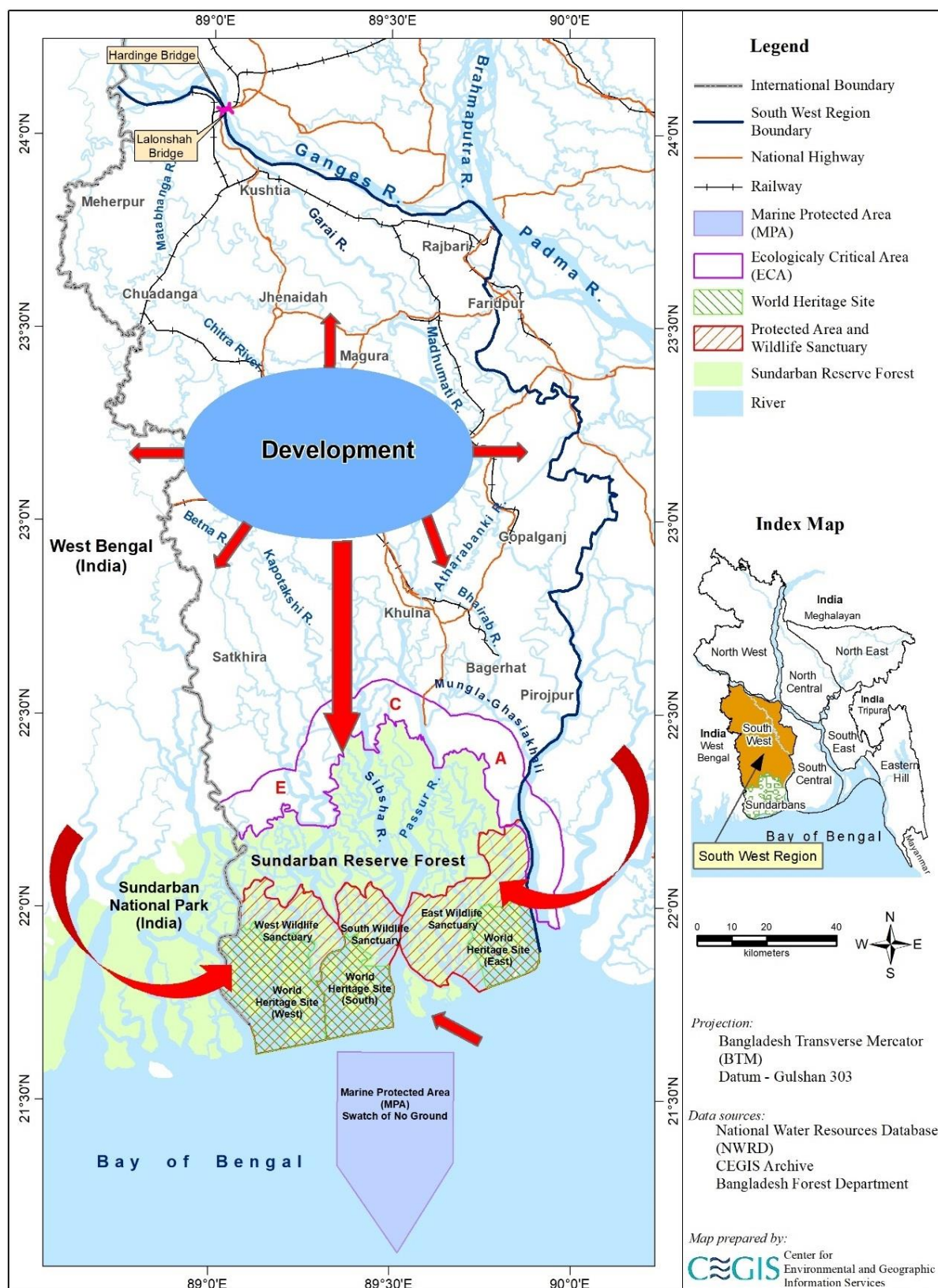


Figure 1.4: Schematic flow of impacts of development affecting the SW region

2. The Scoping Phase of the SEA

2.1 Aims of scoping and approach

The OECD SEA Guidance (2006) sets out the aims of scoping in SEA – it should:

- Establish the content of the SEA, i.e.. the key issues that the SEA should focus on;
- Identify the relevant criteria for assessment, e.g. goals and objectives set out in national policies and strategies, preferably those that focus on sustainable development;
- Take a pragmatic view on how much can be achieved given the time-scale, available resources, and existing knowledge about key issues;
- Follow an open and systematic process;
- Actively engage key stakeholders to identify significant issues;
- Set objectives based on the identified key issues. Such objectives should represent goals to achieve such as reducing loss of biodiversity or improving employment opportunities. These objectives will be used later to assess the impacts likely to arise when implementing PPPs;
- Identify decision criteria and suitable ‘indicators’ of desired outcomes.
- Recommend alternatives to be considered, suitable methods for analyses of key issues and sources of relevant data.

This is the approach that has been followed. It has provided an opportunity to focus the SEA on the important issues to maximise its usefulness to the authorities, decision-makers and public. It does not preclude changes in the scope of the SEA if the need for them becomes apparent at a later stage. To the extent possible, determined by the Covid-19 pandemic (see section 2.2), the scoping process has been open and iterative, involving key stakeholders.

2.2 Consequences of the COVID-19 pandemic for the SEA

The COVID-19 outbreak began to spread around the world during February and was declared a pandemic by WHO on 16th March. There were several immediate consequences for the SEA:

- It became impossible for the international members of the SEA team to travel to Bangladesh for scheduled activities. All have been in lock-down in their respective home countries (UK, France, Czech Republic).
- International airline travel has contracted and become very difficult. Many routes have been suspended. Plus, even where routes are still operational, quarantine restrictions for foreign nationals have been imposed.
- A total lock-down in Bangladesh was imposed by the government on 25 March 2020 and extended until the end of May. All government offices were closed, and all organisations (including CEGIS) were closed with all staff working from home, where possible. No fieldwork visits or public meetings have been possible. Subsequently, in June, further lockdowns and restrictions were imposed in particular designated zones (red – highly affected, yellow and green). CEGIS is located in a red zone and remains closed.

- It has been possible for the team to continue with desk-based activities, although these have taken longer than scheduled due to individuals and family members contracting Covid-19 and other factors.
- Face-to-face orientation and discussion meetings for the team were not possible, although some sessions were conducted by video conferencing;
- A major casualty has been that it has not been possible to conduct stakeholder engagement as planned – with multi-stakeholder workshops at national and regional/local levels (see section 2.3). However, the situation is under constant review and it is hoped to be able to conduct some of the planned stakeholder events and interactions at a later stage during the SEA process. In the meantime, it has been agreed with the Forest Department to conduct stakeholder consultations during August to mid-October 2020 by video conferencing to the extent possible.

2.3 Scoping activities conducted

2.3.1 *Stakeholder analysis*

An analysis of stakeholders was undertaken. This was organised by sector and covered government entities (at all levels), private sector organisations, NGOs, civil society organisations, resource user groups, etc. (see Appendix 2).

2.3.2 *Thematic baseline papers*

Work was initiated to prepare 13 thematic baseline papers listed in Table 3.1. Each paper is the responsibility of a dedicated core team (see Appendix 6). But other members of the overall SEA team have expertise and experience relevant to several theme papers and have made their contributions, where appropriate. In addition, each team has consulted outside experts to comment on the content of papers and to provide information and inputs.

Task teams have been able to work on preparing draft theme papers accessing information via the internet and email contacts. These papers are rolling documents and will be continuously revised/updated, as needed, during the SEA process. Early (zero) drafts of these theme papers have been prepared, but remain works-in-progress. Based on the drafts, the provisional list of key environmental, social and economic issues (included in the Inception Report, March 2020) has been reviewed and some additional issues and sub-issues included. The list of key will be further revised on the basis of stakeholder consultations when the latter become possible.

The thematic baseline papers will provide the substrate from which to derive a baseline environmental and socio-economic profile of SW Region to be included in the SEA Report. The profile will cover all relevant factors and including the current status of all relevant sectors and the Sundarbans. To aid this process, necessary information and baseline data is being collected from available sources. Field surveys and research will not be undertaken to collect primary data for the theme papers. Rather the SEA will use existing published data presented in peer-reviewed and credible publications. Wherever possible, status in relation to internationally recognized indicators will be noted.

2.3.3 *Review of legal and regulatory framework*

This review summarises the main legal and regulatory instruments for each of the key line sectors as well as for cross-sector or over-arching matters (those for which there are PPPs that are

included in the SEA – see Screening Report, April 2020). Descriptions cover the main elements of the instrument relevant to environmental or social management or regulation (see section 6).

2.3.4 *Survey of institutional capacities*

One of the thematic baseline papers covers institutional governance and discusses the mandates, roles of the main government agencies at national, regional and local levels, as well as NGOs/CSOs and private sector organisations, as regards the management and control of environmental, social and economic concerns.

This paper will also address institutional capacities – an issue that will be important for implementing the strategic environmental management plan for SW Region. It is planned to undertake a survey of institutions (particularly those that are likely to have a role in implementing the strategic environmental management plan for the South West Region) to assess such capacities (see section 10). However, due to the Covid-19, this has not yet been possible. It will be conducted when the situation allows and this information will then be added to the theme paper.

2.3.5 *Setting environmental and socio-economic objectives*

A review has been conducted of all 87 PPPs summarised in Appendix 1 of the Screening Report (April 2020) to identify the environmental, social and economic objectives which they contained (see Appendix 3 of this report). The aim was to determine whether existing PPPs contained objectives that related to the key environmental, social and economic issues identified during scoping.

Based on this review and team brainstorming, a provisional list of critical objectives have been distilled (see section 8) that respond to the main challenges posed by the identified key issues (see section 4). These objectives will provide a basis against which to assess the impact of developments likely to arise under different economic growth strategies (see section 2.3.9), as well as targets, indicators and decision criteria to use during the subsequent stages to select a preferred alternative.

2.3.6 *Dedicated SEA website*

A website dedicated to the SEA has been established (www.seasw-sundarbansbd.org). This provides summary details of the aims of the SEA and background information and will be updated periodically, as required. All SEA reports will be placed on the website to ensure open access.

2.3.7 *SEA Prospectus*

A Prospectus for the SEA was placed on the website of the Forest Department at the end of February. Its aim is to provide all stakeholders - from government, the private sector and civil society, and all interested organisations and individuals - with some basic information about the SEA. It sets out the reasons for the SEA, its aims, scope and steps, and gives a brief introduction to its role, function and benefits.

Due to the outbreak of COVID-19, which required some changes to the SEA methodology, a revised prospectus was published at the end of April. This was been circulated by email to all stakeholders and those requesting information about the SEA. It is available on the dedicated SEA website (www.seasw-sundarbansbd.org).

Due to the continuing COVID-19 pandemic, a further revision of the prospectus was made in July 2020, to reflect the proposed changes to the work schedule (available on the SEA website: www.seasw-sundarbansbd.org).

2.3.8 *Stakeholder consultations*

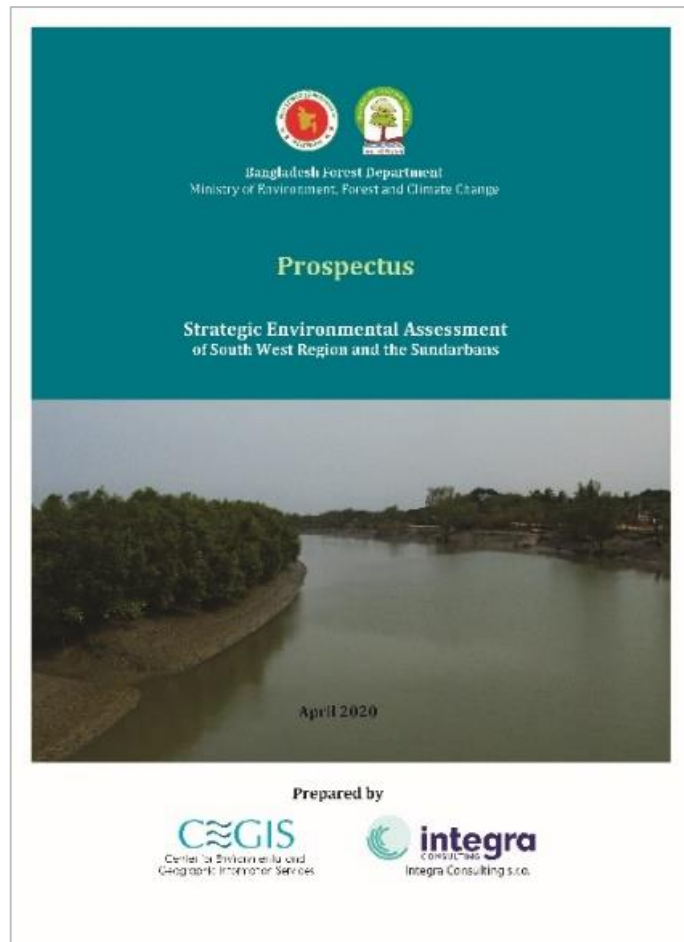
The Inception Report set out how it was proposed to conduct stakeholder engagement during the scoping phase. It was planned to organise multi-stakeholder workshops at national and regional levels at key stages of the SEA process. In addition, it was planned to carry out semi-structured interviews with key informants and undertake random informal interviews in the field, and organise consultative workshops in all districts and in selected upazilas. Focus sessions were to be arranged for particular occupational groups (e.g. fisherfolk, farmers, urban dwellers, marginalised groups). Finally, special meetings were to be arranged for women, where appropriate.

As a result of the Covid-19 pandemic, it was not possible to undertake any of these activities during April-May. As a substitute, emails were sent to all stakeholders listed in appendix 2 during early May requesting comments on the preliminary list of key issues set out in the SEA prospectus, and comments on any issues to do with the SEA process (see appendix 4). Discussions by video conferencing were also organised with selected NGOs, UNESCO and IUCN (regional).

Under the proposed revised work schedule (Table 1.1), the programme of national, regional and local stakeholder consultations would take place during August to mid October and based on the Mid-Term Screening and Scoping Report. However, at the time of writing (mid July) the COVID-19 situation has not improved. It has been agreed with the SEA Project Director at the Forest Department to proceed with stakeholder consultations on the basis of video conferencing to the extent possible.

2.3.9 *Revision of list of key environmental, social and economic issues*

Following email- and video call-based stakeholder consultations (see section 2.3.8), the provisional list of key environmental, social and economic issues (presented in appendix 3 of the approved Inception Report, April 2020) has been revised to include additional issues and sub-



issues (see section 4.2). This list will be further updated based on the stakeholder consultations planned for August to mid-October 2020.

Appendix 4 of this report provides a list of issues concerns and comments raised by stakeholders to date and indicates how they have been addressed.

2.3.10 Development of scenarios and consideration of alternatives

SEA aims to identify the impacts of a PPP. But a key principle is that the impacts of alternatives to the PPP in focus (or alternatives to elements of the PPP) should also be addressed. This should then lead to determining which alternatives should be assessed in the next stage of the SEA.

However, in this case, as set out in the Screening Report (April 2020), the SEA is dealing with almost 90 PPPs covering 30 sectors and key issue areas. Thus, it will not be possible to assess every PPP or alternatives to it. Therefore, the SEA needs to be 'strategic' itself. Thus, it will consider three meta-level alternatives in the form of macro-economic growth strategies (e.g. high, green growth, and business-as-usual). The likely scope and projected outcomes of such strategies are discussed in section 9.

To help identify the projected strategy outcomes, various scenarios are first being developed (discussed in section 9).

It is important to distinguish between (a) *scenarios* – which are plausible futures based on selected drivers of change, but which will not actually arise as envisaged due to uncertainties and unknown factors which will actually mould how things unfold; and (b) *strategies* which set determined end goals and the means by which they will be achieved.

3. Baseline Conditions and Key Environmental and Socio-economic Issues in SW Region

3.1 Baseline theme papers

Preparation of a suite of 13 baseline theme papers has been initiated (Table 3.1). First drafts (works-in-progress) have been completed and, in due course, will be made available on the SEA website (www.seasw-sunarbansbd.org). The papers are rolling documents that will be further elaborated and updated throughout the SEA process as more information is accessed.

All papers cover a similar format with some common sections:

- Introductory section;
- Administration/competent authorities – key agencies (government, private sector, NGOs) responsible for managing resources/issues covered by the paper, and their roles, mandates and performance;
- Relevant legislation and regulations;
- Brief description of main relevant PPPs and discussion of consequent environmental, social or economic impacts and why they arise, and mega projects;
- Drivers of change;
- Main issues concerned with the theme;
- References;
- Annexes

The theme papers present information and trends at a national and SW Region scale.

Table 3.1: Scope of baseline theme papers:

SL	Topics of thematic baseline papers	Scope of paper (beyond the common sections mentioned above)
1.	Climate and climate change	• Baseline climate of SW region and related issues; • Review of evidence for climate change, trends and projections; • Climate change scenarios; • Potential climate change impacts; • Adaptation and mitigation measures.
2.	Pollution and waste	• GHG emissions; • Pollution: air, water, soil, noise – impacts and futures scenarios; • Waste and waste management – municipal, rural, industrial, agricultural, e-waste, wrecked, cars, waste oil, plastics, hazardous waste (e.g. obsolete pesticides) and recycling.
3.	Delta morphology, river dynamics, floods and water management	• Hydrological setting: river system, freshwater, water levels, tidal and drainage characteristics, future projections; • Morphological setting: river planform analysis, coast line changes, sedimentation, projections for erosion/accretion; • Natural disaster: floods, cyclones, tidal surges; • Development of water infrastructure;

SL	Topics of thematic baseline papers	Scope of paper (beyond the common sections mentioned above)
		• Present and future risks; • Future plans to mitigate potential risks.
4.	Land resources	• Physical conditions: geography, physiography, land types, geology, hydro-meteorology; • Agro- and bio-ecological regions and land cover; • Soils; • Land resources management practices: agriculture, fisheries, forestry; • Major challenges and issues; • Coastal polders.
5.	The Sundarbans, other ecosystems and wildlife conservation	• Landscapes; • Protected areas and sanctuaries; • UNESCO World Heritage Site & its Outstanding Universal value; • Flora and fauna; • Management of the Sundarbans and other ecosystems; • Extraction of resources; • Contribution of the Sundarbans in the national and regional economy • Challenges and issues.
6.	Tourism in SW Region and Sundarbans	• Status of tourism industry: major attractions and spots; facilities; limitations of sector development; visitor numbers and capacity; community involvement, culture tourism; • Development potential/future prospects for tourism: ecotourism, cultural tourism, archaeological & historical tourism, riverine & rural tourism; • Caring capacity and tourism in the Sundarbans • Impacts of COVID-19 on tourism.
7.	Fisheries, agriculture and other land uses	• Land use data; • Determinants of land use; • Land use policy; • Agriculture; • Forestry; • Fisheries; • Cities, towns and settlements; • Land use change and its impacts.
8.	Infrastructure	• History & background information on infrastructure and communications; • Current infrastructure estate and trends (2011-2020); • Road transport; • Water transport: inland water ways, navigation and shipping; • Communications; • Other infrastructure; • Summary of five-year and two-year plans; • Projections for transport sub-sectors; • Mega projects.

SL	Topics of thematic baseline papers	Scope of paper (beyond the common sections mentioned above)
9.	Power and energy	• Basic information: energy sources, consumption, production, infrastructure (power plants and networks), indicators, impacts, accidents, etc; • Outlook: projections of energy production and consumption; intended new power plants, networks, pipelines etc; • Air pollution (current status and outlook); • GHG emissions (current status and outlook).
10.	Urbanization	• Background; • Cities and towns, functions and services: locations; land uses; • Trends and challenges: area & population; urbanization and land use changes; urbanization trends; key issues; waste management; air quality; transport; • Impact of urbanization; • Ongoing and proposed projects related to urbanization.
11.	Economic and industrial development in SW region	• State of the economy: employment; food security; exports/imports; prices; incentives; • Taxation and subsidy policies; • Economic activities: industries, SMEs; transport; agriculture; forestry; fishing; services; tourism; mining; shipping; etc. – and impacts; marketing • Development of Special Economic Zones; • Labour and employment opportunities and co-operatives; • Challenges in economic and industrial development; • Impacts of COVID-19.
12.	Social issues and challenges	• Population; • Education; • Livelihoods; • Health; • Gender perspectives and children; • Culture, heritage and traditional knowledge; • Conflict, contestations, power structure; • Security, law and order situation; • Impacts of COVID-19.
13.	Institutional governance	• Background to institutional governance; • Central, regional and local government institutional hierarchy; • Governance of environmental assessment; • Major governance issues; • Relations between government and other organisations; • Trans boundary cooperation, treaties and MOUs; • Institutional capacities <i>[this section will be added when the COVID-19 situation allows an institutional survey to be conducted]</i>

The papers will provide the substrate material for the preparation of a baseline chapter for the main SEA Report. The following sections are derived from these papers.

3.2 List of key environmental and socio-economic issues and concerns

Appendix 4 provides a list of all issues and concern raised by stakeholders by email responses and during video conferences, and indicates how they have been addressed. Based on stakeholder feedback, a revised list of priority environmental, social and economic issues and concerns has been developed (Table 3.2).

Table 3.2: List of priority environment, social and economic issues and concerns

Environmental issues and concerns	Comment / examples of potential impacts
<i>Pollution and waste (solid and liquid):</i> • Surface water pollution. Brackish and sea water • Groundwater pollution • Air pollution • Oil • Waste treatment and disposal • Plastics	Pollution & waste management is a major concern for the ecological integrity of the SWR of Bangladesh and the Sundarbans due to different developmental initiatives.
<i>Water flow dynamics in rivers</i>	Reduction of water flow in rivers of SWR may change the region's economic sustainability/integrity as well as livelihood patterns and crop production
<i>Sedimentation and siltation</i> (fluvial and tidal) • Dredging and disposal	Sedimentation and siltation management is a challenge to maintain river flows. Disposed dredged materials can affect the regeneration of trees & survival of existing forests as well as benthic aquatic biodiversity.
<i>Salinity:</i> • Groundwater • Soil	Due to reduced flow of upstream fresh water and channel siltation, and resultant sea water intrusion/inundation, soil and groundwater salinity has increased and soil productivity has decreased as well as livelihood diversity
<i>Noise</i> - particularly due to shipping in Sundarbans	Noise from the regular movement of ships (notably along major rivers of Sundarbans) can disrupt wildlife movement, cause localisation of populations and result in inbreeding.
<i>Habitat isolation</i>	Several large tracts of the Sundarbans are separated by wide rivers which tigers and other fauna tend not to cross. This may lead to genetic isolation. Increased numbers of vessels passing along the navigable channels, the noise they cause and use of lights at night may also disrupt the dispersal of fauna. These factors tend to disturb animal behaviour (eg feeding, breeding) and may lead to genetic isolation and also threaten effective biodiversity conservation.
<i>Loss of biodiversity</i>	Some environmental as well as regional & local activities may affect biodiversity (particularly in the Sundarbans), with loss of keystone species and their prey base due to poaching and habitat degradation as a result anthropogenic activities. Biodiversity losses may also occur due to climate change and natural dynamic changes in the ecosystem
<i>Invasive alien species</i>	Water hyacinth has become a major problem, clogging baors and ponds, and some water channels. <i>Prosopis juliflora</i> is also spreading on embankments although it is used as a fuelwood by local people. At

Environmental issues and concerns	Comment / examples of potential impacts
	present, there are no major issues with IAS within the Sundarbans. However, forest managers are concerned about their potential future spread and impacts,
River bank erosion – due to port expansion and boats	River bank erosion is a particular concern in the Sundarbans due to bow-waves from the increased numbers of fast-moving ships and due to river bed siltation, formation of new islands and changed river courses, as well as increasing sea water inflow in SWR.
Climate change • Sea level rise • Salt water intrusion • Erratic rainfall & distribution • Increased average temperatures • Cyclones & storm surges • Greenhouse gas emissions	• Sea level rise is a global threat that will impact on the region. • Many factors have reduced river flow in the region, decreasing flushing time, with increased periods of saltwater exposure. • Shifting of monsoon with erratic rainfall has impacted on the cropping season and pattern • There is no evidence of significant increased temperatures yet, but climate models predict a significant increase in the future. • Cyclones making landfall impact on livelihoods (killing people and causing damage). Cyclone frequency has decreased but may rise in the future. • Rapid industrialisation and urbanisation is likely to lead to increased carbon dioxide emissions from power and energy sector (including transport). Expansion of flood-irrigated paddy rice has increased methane emissions.
Exceptional floods (with potentially damaging water levels): • Freshwater floods (due to rain) upstream • Tidal • Poor drainage infrastructure	Freshwater flooding may occur due to: heavy rain in the upstream/catchment areas of SWR, lack of drainage infrastructure and high tidal flow.
Industrialisation: • Power generation – oil, gas, coal • Pipelines • Petroleum • Cement • Special economic zones	Industrialization of the inland parts of SWR can create air & water pollution as well as other potential impacts on biodiversity & livelihoods of the region.
Urbanisation	Rapid urbanization in the 14 districts of SWR as well as in the environmentally critical area around The Sundarbans can affect the extent of air & water pollution and agricultural productivity etc.
Land use changes	Land use changes north of The Sundarbans are arising due to population & economic growth of SWR, e.g. shrimp cultivation, infrastructures & urbanization, etc. Impacts of this include loss of biodiversity, reduced soil productivity and loss of livelihood opportunities

Environmental issues and concerns	Comment / examples of potential impacts
Protected areas and hotspots	- Many highly sensitive & important biodiversity areas have been declared by law as protected areas. However, laws are not always strictly enforced and people lack adequate knowledge and awareness about the need for nature conservation in such areas. - Due to lack of periodic maintenance and management, parts of the polder system have become water-logged in Khulna and Satkhira Districts; - Peat soil in areas around Gopalganj and Khulna are used as fuel and may increase GHG emission.
Socio-economic issue	Comment
Livelihoods: - Conflicts between economic sectors - Access to resources (e.g. in Sundarbans) - Salinity	- Salinity intrusion causes conflicts, e.g.: shrimp cultivators vs crop producers; powerful/rich land controller's vs the powerless, smallholder and marginalized people, etc. - Access by forest-dependent people to forest resources (to support their livelihood options) is limited so as to prevent exploitation and to maintain a sustainable flow of resources – as prescribed in the Sundarbans Management Plan. - Causes health problems (e.g. skin conditions), reduces drinking water quality – impairing people's ability to work, and affects crop production, etc.
Out-migration	Both involuntary and economic out-migration (mainly poor people) is common in SWR, especially from coastal areas. Much is driven by disasters, indebtedness, dispossession/land grabbing, lack of livelihood options, etc. Poor people move to unhealthy urban slums and become further marginalised in an uneven job market. Some educated people move to urban areas /overseas for employment. Migrant remittances can supplement family incomes and contribute national economy.
Health & sanitation: - Water-borne, respiratory & salinity-related diseases - Diet - Negative health impacts of air pollution (mainly pollution by particulate matter)	- Local people, especially children and elderly people, are particularly susceptible to water-borne, respiratory and salinity-related skin diseases - Poor diet causes malnutrition. - The dominant way of cooking causes indoor air pollution which has a serious impact on human health.
Inadequate health facilities and access	- Health service providers are based in city/urban and peri-urban areas. They are not easily accessible by people and/or emergency patients living in remote areas, due to poor communication networks. - Lack of public toilets in urban and semi urban areas. As a result, local people, especially women face problems during public gatherings and at local markets.

Environmental issues and concerns	Comment / examples of potential impacts
Arsenic contamination (of drinking water & irrigated rice)	This is a serious issue in parts of the Ganges River floodplain and the northern part of the tidal floodplain.
Gender-related issues	Women face socio-political exclusion in decision-making processes - both in the home and society. They also bear a heavy burden for collecting potable water, fuelwood (from the Sundarbans and adjacent areas), etc. Women often encounter security problem while travelling alone to/from remote areas.
Education: - Low environmental awareness - High male dropout	- Males from poor households need to support family income, resulting in high drop out and/or lower attendance at school. - Poor communication network in the rural area often discourages school attendance.
Loss of traditional knowledge	Technological advancement & other development activities may be causing loss of traditional knowledge.
Loss of cultural heritage	Lack of proper maintenance & negligence due to low revenue return, inadequate budget allocation, etc.
Security – kidnapping of resource extractors	Kidnapping of forest produce extractors for ransom is an important issue for the management of the Sundarbans
Seasonal tourism	Uncontrolled tourism causes loss of biodiversity, disruptive noise and water pollution etc.
Illegal activities: - Poaching and hunting - Poison fishing - Illegal tree cutting - Trafficking of wildlife products - Corruption	These issue are of major concern in the Sundarbans, causing loss of habitat and biodiversity (terrestrial & aquatic) & economic loss for communities.
Institutional issues	Lack of manpower, capacity development & logistics are major institutional issues – impeding environmental management (In general) and overall management of the Sundarbans.

Note: This table is a revised version of the list of key issues and concerns contained in the SEA prospectus which was based on an provisional list contained in Appendix 3 of the approved Inception Report (April 2020). The table has been updated following further brainstorming by the SEA team and through consultations with stakeholders. Issues and impacts in the Sundarbans will often be different to those affecting the inland parts of the South West Region.

3.3 Key environmental issues

3.3.1 Pollution and waste

The South West Region is characterised by increasing industrialisation, rapid but unplanned urbanisation (especially in Khulna, Bagerhat and Satkhira districts), port activities – particularly at Mongla - and navigation in water channels, intensive farming, shrimp cultivation and growing tourism. Each of these activities have impacts in the region, placing pressure on the rivers and wetlands, and potentially on the Sundarbans mangrove forest (Rahman *et al.*, 2009).

3.3.1.1 Air pollution

(a) National context - emissions of air pollutants in Bangladesh

Projection of national emissions of particulate matter (TSP, PM₁₀ and PM_{2.5}) and the main gaseous air pollutants (SO₂, NO_x) were developed by IIASA¹ using the GAINS² Asia model for the period 2015–2030³. Total emissions of TSP, PM₁₀ and PM_{2.5} are expected to grow by 17% and 15%, respectively, by 2030. Residential combustion will remain the main source of emissions of particulate matter in 2030 (33% TSP, 41% PM₁₀ and 48% PM_{2.5}), followed by agriculture (30% TSP, 27% PM₁₀ and 23% PM_{2.5}) and industrial processes (14% TSP, 9% PM₁₀ and 6% PM_{2.5}).

Total emissions of SO₂ are expected to grow almost 2.5 times by 2030, driven by the power and heating plants sector. The latter will become a dominant source of SO₂ emissions (almost 59% in 2030) followed by industrial combustion (more than 27% in 2030). Total emissions of NO_x are expected to grow by 59% by 2030, driven by the heavy duty diesel vehicle and power and heating plant sectors. Heavy duty diesel vehicles will become the most important source of NO_x emissions by 2030 (almost 27%) followed by power and heating plants (more than 10%) and agriculture (more than 16%). A considerable increase in particulate matter (dust), SO₂ and NO_x emissions from power and heating plants is likely due to newly built coal-fired power plants.

(b) National context - air quality in Bangladesh⁴

Air quality in Bangladesh is poor, mainly in terms of suspended particulate matter. The country is the most polluted country for PM_{2.5} exposure (83.3 µg/m³). Diseases caused by environmental pollution were responsible for 16% of all deaths worldwide in 2015, but, in Bangladesh, this proportion was nearly 28%. Air pollution by PM_{2.5}, (both ambient and indoor) is by far the most significant environmental risk, causing about 21% of all deaths in Bangladesh.

(c) Air quality in the SW region⁵

Monitoring of air pollution in Khulna City between 2013 and 2015 found that, usually, air quality did not exceed standards for carbon monoxide, sulphur dioxide and nitrogen dioxide. But air quality in the city in terms of particulate matter (PM₁₀ and especially PM_{2.5}) is high, especially during winter period (December-January) followed by February, March and November. The

¹ International Institute for Applied Systems Analysis

² Greenhouse Gas and Air Pollution Interactions and Synergies

³ Source: GAINS Asia https://gains.iiasa.ac.at/gains/ASN/index.login?accept_disclaimer=checked

⁴ Source: <https://www.igair.com/blog/report-over-90-percent-of-global-population-breathes-dangerously-polluted-air>

⁵ Source. Ministry of Environment and Forests. Clean Air and Sustainable Environment Project. http://case.doe.gov.bd/index.php?option=com_content&view=article&id=5&Itemid=9

average concentrations of PM₁₀ and PM_{2.5} during these months in Khulna were 148.2 and 87.2 µg/m³, respectively, exceeding both national and international standards dramatically⁶.

It has been found that an increase in estimated annual mean PM concentration is strongly associated with increased risk of respiratory and coronary diseases (e.g. chronic obstructive pulmonary disease (COPD), heart attacks and strokes) and lung cancer. In Khulna district, the most common illnesses are pneumonia, bronchial asthma, chronic obstructive pulmonary disease, and whooping cough⁷. Around 11% of the sick population suffer from respiratory-related diseases and about 8% patients from heart attacks and strokes⁸.

(d) Ambient air around the Sundarbans

Since 2014, the Bangladesh-India Power Company Ltd. (BIFPCL) has been undertaking quarterly air quarterly monitoring in three areas (Khanjan Ali bridge, Chalna-Mongla and the Passur river in the Sundarbans) that are influenced by the Rampal coal-fired power station (CEGIS, 2020⁹). The maximum concentrations of particulate matter were found to be highest in the winter months at all locations (Figure 3.1). Gaseous pollutants (SO₂ and NO_x) were higher during the monsoon, especially at Khanjan Ali bridge area and Chalna-Mongla areas. The Sundarbans area always showed the lowest pollution concentrations. The highest average concentration of PM_{2.5} in the KJA Bridge area was 42.2 µg/m³ and the highest average concentration of PM₁₀ was 129.4 µg/m³. Concentrations were lower in Chalna-Mongla area and lower still in the Sundarbans area, except during the monsoon period in the Chalna-Mongla area. The highest average concentrations of SO_x and NO_x were 29.4 µg/m³ during monsoon in Chalna-Mongla area and 29.0 µg/m³ in the monsoon in KJA bridge area. High concentrations of PM could be attributed to road transport (both emissions from vehicles and fugitive emissions from roads), emissions from crop fields, industries and cooking.

Figure 3.1 indicates that neither SO₂ nor NO_x represent a problem in the South West Region as the highest concentrations are up to 30 µg/m³ which is below international standards¹⁰. However, concentrations of PM_{2.5} and PM₁₀ are exceeding international standards which causes increased negative impact on the health of population.

⁶ The WHO ambient air quality guideline value for annual mean concentration of fine particulate matter PM_{2.5} is 10 µg/m³, EU air quality standard/limit value is 20 µg/m³ and the US national air quality primary standard is 12 µg/m³

⁷ NWPGL (2018)

⁸ NWPGL (2019)

⁹ CEGIS (2020)

¹⁰ WHO Air Quality Guidelines https://www.who.int/phe/health_topics/outdoorair/outdoorair_agq/en/

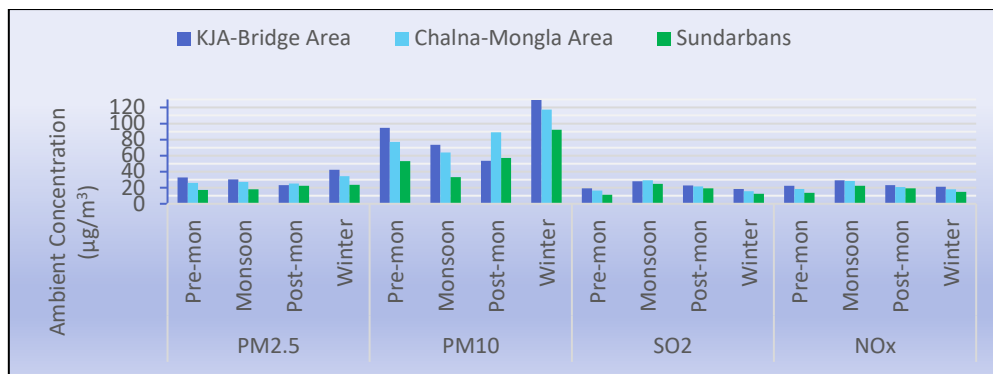


Figure 3.1: Seasonal distribution of average pollution concentration at different locations in SW region

(e) Transboundary air pollution

The north-western regions of India, neighbouring West Bengal and Nepal are the most probable transboundary sources of particulate matter pollution likely to affect the South West Region of Bangladesh. Prevailing wind direction in November to January suggests that this period is likely to be when the highest concentration of fine particles from these sources will reach Bangladesh.

3.3.1.2 Greenhouse gas emissions in Bangladesh

(a) Present situation

According to the latest official reports to the Secretariat of the UNFCCC¹¹, total national emissions of carbon dioxide (CO₂) in Bangladesh increased by 71% between 2006 and 2012. The share of CO₂ in total greenhouse gas (GHG) emissions increased from almost 26% in 2006 to more than 43% in 2012, while the share of methane (CH₄) decreased from 43% to 35%. Fuel combustion is the dominant source of CO₂ emissions (87% in 2012). Emissions of CO₂ from fuel combustion are driven by electricity generation (42% in 2012) and industrial combustion (29% in 2012). Emissions of CO₂ per capita have increased but are still very low (0.53t), and are almost 10 times lower than the world average (5t), while emissions of CO₂ per unit of GDP were 0.61t/1000 USD in 2012 which was higher than the world average (0.49t/1000 USD).

(b) Outlook

Projections of national emissions of GHG were developed by IIASA using the GAINS Asia model for the period 2015–2030¹². They showed that total national emissions of carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O) could increase by 70%, 189%, 27% and 40%, respectively. Very sharp increase in CO₂ would arise due to the introduction of newly built coal-fired power plants. The share of CO₂ in total GHG emissions could increase from almost 26% in 2005 to more than 43% in 2030, while the share of CH₄ could decrease from almost 58% to almost 43%. Fuel combustion in stationary installations is expected to be the dominant source of CO₂ emissions (66% in 2020, 73% in 2030). Emissions of CO₂ from fuel combustion are expected to be driven by electricity generation (40% in 2030) and industrial combustion (20% in 2030).

¹¹ Bangladesh. National Communication (NC). NC 3: <https://unfccc.int/documents/192278>

¹² Source: GAINS Asia https://gains.iiasa.ac.at/gains/ASN/index.login?accept_disclaimer=checked

Emissions of CO₂ per capita are expected to increase, but still be very low (0.61t in 2030), almost 10 times lower than the world average (5t).

It can be expected that newly-built fossil fuel-fired power plants will increase emissions of carbon dioxide significantly. The Rampal Thermal Power Plant could lead to 8 million tons of carbon dioxide emissions per year¹³. Moreover, the newly constructed Rupsha 800MW gas-based combined cycle power plant will emit around 1.7 million tons of GHG to the atmosphere and the upcoming Goalpara 300MW dual fuel combined cycle power plant will emit 0.63 million ton of GHG.

3.3.1.3 Pollution of surface waters, brackish water and sea water

Waste and pollution (including heavy metals) from industries in the South West Region (see section 3.3.7) puts pressure on both the lacustrine (standing) water bodies and river systems of the region (Khan, 2010).

There are 11 navigable waterways (total 838 km) in the region used by a large number of vessels (Bangladeshi and international) throughout the year – all with the potential to pollute the riverine ecosystem, e.g. from the discharge of ballast and bilge water, oil spills and waste thrown overboard. In the period 2017-2019, 2400 ships called at Mongla Port and 2396 sailed (Mongla Port Authority, 2019). The number of container ships handled at Mongla Port per year has varied between 33 and 72 over the last 15 years (Mongla Port Authority, 2019). During 2015-‘16, some 5000 lighter vessels were passed through Mongla Port along with 684 boats and other crafts.



Mongla Port

Livestock, shrimp/crab farming and the shrimp processing industry also pose a serious threat to the environment. Waste from livestock, especially poultry (particularly broiler excrement containing organic and inorganic nutrients and pathogens), pollutes the wetlands and other

¹³ BPDB (2013)

lowland water bodies in the region. There are 4,952 broiler and layer farms, both registered and unregistered, in the Khulna district itself.

The land area under shrimp farming in Bangladesh has increased from 70,331 ha in 1986 to 275,509 ha by 2016 (Hossain and Hasan 2017). Shrimp farming is increasingly accompanied by excessive feeding, the presence of high biomass due to high stocking density, the application of drugs, antibiotics and chemicals, and the production of effluents, all of which pollute the polders and adjacent rivers and canals - especially in Satkhira, Bagerhat and Khulna Districts. In 2008, the South West Region had 84,903 Bagda (black tiger) shrimp farms with an average size of 1.5ha and 94,391 Golda (giant) shrimp farms with an average size of 0.7ha.¹⁴ In addition, there were some 50 shrimp processing plants in the region.

Agro-chemicals (fertilisers, pesticides and herbicides) are also a source of pollution in surface water bodies. These are applied in the cultivation of paddy rice and mixed vegetables which are cultivated throughout the region to varying extents depending on the particular practice systems of the polders.

Surface, brackish and sea waters receive large amounts of pollutants from the above sources that may pose a threat to the riverine ecosystems and biodiversity. Khan (2010) studied water quality in 2007 in the pre-monsoon and monsoon periods in selected rivers (Gorai, Rupsha, Passur and Kapothakho) in the southern region of Bangladesh and found no pressure on the physical quality of the riverine ecosystem, especially as regards river water temperature, pH and dissolved oxygen level and total suspended solids.

Biochemical oxygen demand (BOD) and chemical oxygen demand (COD) concentrations were found to vary along the courses of the rivers. BOD in the upstream river segments of the Gorai, Bhairab and Rupsha rivers was found to be 1.25, 2.5 and 3.4 mg/L, respectively. These levels are much lower than the recommended inland water quality standard (10 mgO₂/L). This low BOD was due to the dumping of industrial effluents, municipal wastes, and surface runoff from cities and fields. Downstream, BOD concentration was also found low (1.2, 1.2 and 1.5 mg/L, in the Gorai, Bahirab and Rupsha Rivers, respectively). In contrast, COD was found to be higher than the recommended level (25 mgO₂/L) - mean monsoon COD was 1197 mg/L for the Kapothakho River and 27 mg/L for the Passur River at both upstream and downstream locations. In another study conducted by Rahaman (2015), average COD levels in the Rupsha-Passur, Kholpetua-Arpangasia and Baleswar-Bhola river systems were found to be four times higher in winter than the recommended value of 25 mgO₂/L (ECR'1997; Amendment 2017) .

Concentrations of chemicals and metals in the Passur River system have been evaluated since 2014 as part of compliance monitoring (for various environmental and social parameters) for the Rampal coal-fired power plant in Bagerhat District. The overall concentration of total dissolved solids (TDS) was higher in the more downstream areas due to the tidal influence that brings huge amounts of saline mixed nutrients towards the upstream sections of the river system. Nitrates were within the range 2.0 - 5.0 Mg/L which is within the recommended quality limit of 5 mg/L for inland waters. Phosphate levels were in the range 0.5 - 2.5 mg/L, a bit higher than the recommended standard (0.5 mg/L). As regards metals, no significant pollution in river water by

¹⁴ Department of Fisheries, 2008, Government of the People's Republic of Bangladesh

arsenic, lead or mercury was found. The same study also found that oil and grease in surface water was less than 2.0 mg/L in all seasons, except for accidental cases – much lower than the ECR 1997 standard of 10.0 mg/L for inland surface water.

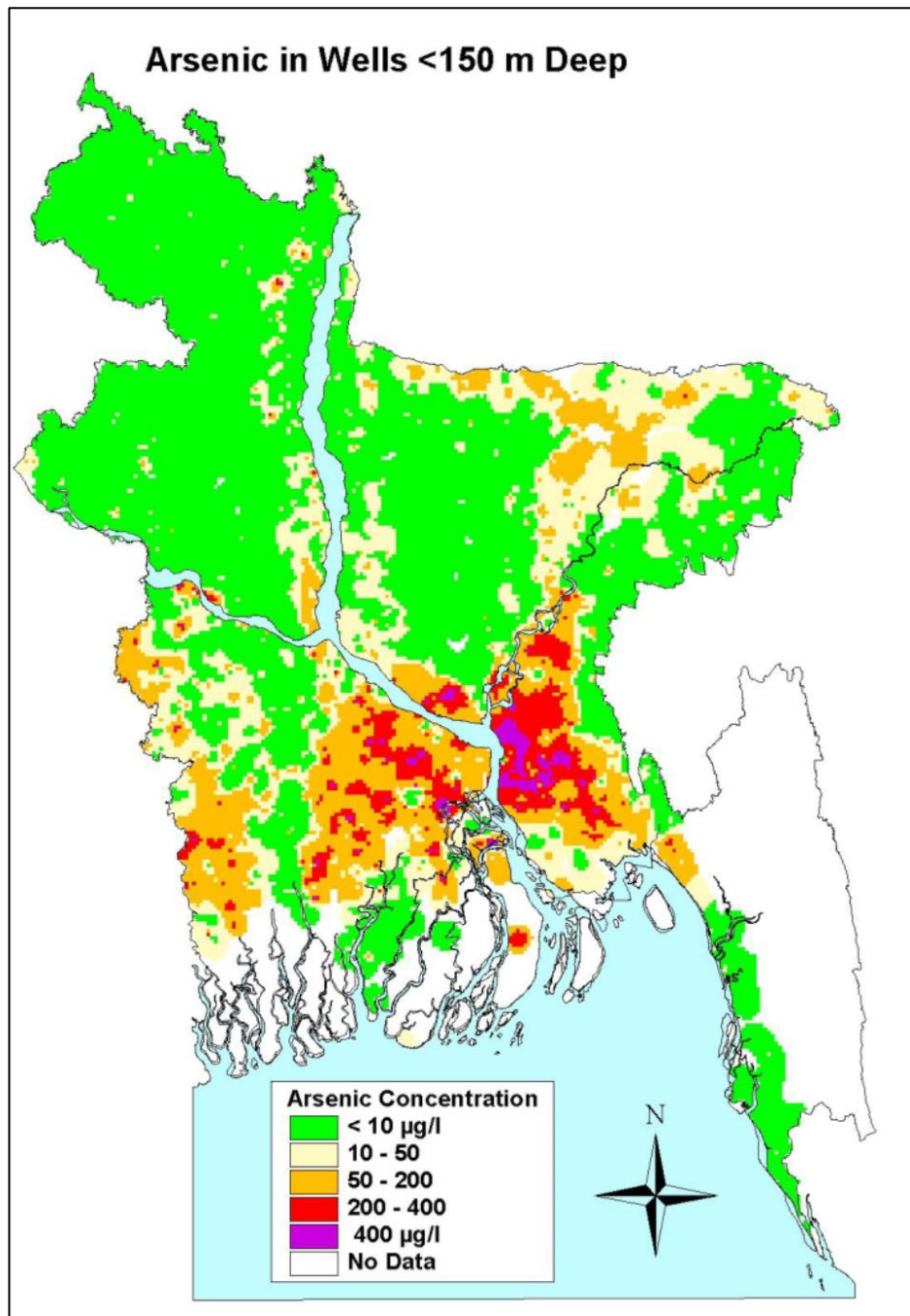
Numerous beels and baors are also found in South-West Region (e.g. Beel Dakatia, Jhapa baor, Fatehpur baor, Marjad baor, Chandbill and Joydea baor). The quality of the water in these bodies almost meets the ECR 1997 standards except for some physical characteristics such as alkalinity, turbidity and total suspended matter. However, some of these lacustrine water bodies are polluted by industrial effluents and urban runoff and have a distinct odour, slightly dark colour and high BOD and COD values.

3.3.1.4 Pollution of groundwater

Coastal groundwater, when fresh, is an important resource because it is used for drinking, agriculture and in industrial processes. Groundwater, used as drinking water, is contaminated with arsenic (Rikta *et al.*, 2016; Kibria *et al.*, 2016; Frisbie *et al.*, 2016). On average, arsenic concentration in the entire South West Region is in the range of <50 µg/L to 200 µg/L. (Abedin and Rajib, 2013). This exceeds the recommended WHO allowable limit (≤ 10 µg/L) and the Bangladesh standard for drinking water quality (≤ 50 µg/L¹⁵). Frisbie *et al.* (2016) suggests that about 49% of the water is likely contaminated with concentrations above the WHO guidelines.

Arsenic contamination of shallow groundwater is a natural occurring problem in some parts of the South West Region.

Since the 1970s, the government has promoted the use of shallow tube wells due to the shortage of surface water, which is often contaminated with various bacteria. These tube wells, however, reached the arsenic-contaminated groundwater in many parts of Bangladesh including the South West Region. This issue is more prevalent in inland areas and for rural areas, where most of the population uses tube wells. Figure 3.2 shows a map of arsenic concentration in wells across the country. Large areas of the South West Region are shown to have significant levels of contamination. A revised map with updated information on arsenic contamination in the South West Region will be developed during the SEA.



Source: Ravenscroft et al. 2005, based on raw data in DPHE (2001)¹⁶

Figure 3.2: Arsenic in wells in Bangladesh

¹⁶ The map based on data collected in 1998-99 over two phases of a study for the Department of Public Health Engineering¹⁶, with map modification generated from more recent representing changes in well construction and water use much more than changes in the aquifer. This map is probably the closest possible representation of groundwater quality.

In coastal areas, the heavy metal contamination has also had an effect on marine life and the local ecology. This, in turn, affects the economic output of the region that relies partly on aquaculture. For instance, high levels of metals may affect reproductive capabilities of fauna or contaminate fish making them unfit for human consumption (posing risks of developing cancer, suffering kidney failure or various forms of metal poisoning). There is also a possibility that fish will migrate away from toxic areas and threaten the livelihood of fishermen.

There has been some effort by the government to provide deeper tube wells that are clearly marked as arsenic free, as well as by various NGOs to provide filters to remove the heavy metal contaminants.

Environmental monitoring at three sites in the Sundarbans Reserve Forest undertaken by CEGIS (2014-2020) for the Rampal coal-fired power station has shown that, apart from arsenic, the physical characteristics of groundwater and its chemical and metal concentrations are acceptable for drinking purposes. Observations indicate there is slight salinity in groundwater during winter season only. This is partly due to saline water infiltration as a result of excessive withdrawal of groundwater by the surrounding communities during the dry season, and also due to evaporation. Chemical characteristics of the groundwater have also been found to be permissible limit as per the Bangladesh drinking water quality requirements (ECR'1997). COD, nitrate and phosphate levels comply the water quality standards for drinking purposes (4mg/L, 10mg/L and 6mg/L respectively). Also, groundwater has been found to be completely free from lead and mercury pollution, but arsenic is a problem (CEGIS, 2014-2020)¹⁷.

3.3.1.5 Oil pollution

The Rupsha, Passur and Bhairab rivers are adjacent to the Sundarbans and play an important role in the development and industrialization of the South-West Region. Different types of industries have been established along these rivers (e.g. fish/shrimp processing, rice mills, jute mills, cement, LPG, poultry, small boat and ship repairing), especially in the lower part of the Bhairab river near Khulna city and in the Mongla area (Adhikary *et al.*, 2012). Numerous types of vessels currently pass along the Passur and Ghoshiakhali rivers transporting goods to Mongla port and the Khulna area. But very few studies have focused on this issue (Sunny, 2017). Oil spills sometimes occur in the Bay of Bengal as well as along the river navigation route (Hoq *et al.*, 2011) - one of the main sources of river water pollution (Arefin *et al.*, 2017).

The total quantity of operational oil spills from ships and land sources in Bangladesh probably does not exceed 2,500 t/yr (Alam, 2004). At Mongla port, there is a risk of collision between vessels and of grounding due to engine breakdowns, navigational error or dragging of anchors. Other sources of marine pollution include illegal disposal from ships, waste water from industries, farming and domestic waste water (Hoq *et al.*, 2011). In 1990, a huge oil spill from an undefined source was detected near the Sundarbans and, in 1994, an oil spill caused by a vessel flying a Panamanian flag capsized near the Sundarbans (Ghosh, 2003). Concern about oil pollution increased considerably following an oil tanker accident on the Shela River on 9th

¹⁷ Environmental Compliance Monitoring of 1320 megawatt coal-fired power station at Rampal Upazila of Bagerhat District in Khulna from 2014 to 2020, Bangladesh India Friendship Power Company Limited (BIFPCL).

December, 2014¹⁸ (Sunny, 2017). The oil spread over 350 km², covering other rivers, channels and creeks in the Sundarbans Reserve Forest (Dasgupta, 2015).

Despite these incidents, Environmental monitoring conducted by CEGIS during 2014-2020 for the Rampal coal-fired power station found that oil and grease concentrations were <2.0 mg/L in the Sundarbans Reserve Forest areas. During the post-monsoon, the oil concentration of the Sundarbans Rivers were within the inland water quality standard of Bangladesh (10 mg/L). In the other seasons (pre-monsoon, post monsoon and winter), the concentration were higher - averaging 5 mg/L (but still less than the standard) - due to the lack of upstream freshwater flow. In addition, increasing number of regulated and non-regulated mechanized vessels used for different purposes (e.g. transporting cargo and people – for tourism and attending the annual Rash Mela festival) could also contribute to the increased concentrations of oil and grease inside the Sundarbans every year during these seasons. Moreover, indiscriminate discharging of bilge water (oil and grease mixed water) by non-regulated mechanized boats (particularly during seasonal fishing at sea) contributes to river water contamination. Generally, vessels certified by the International Maritime Organization (IMO) observe the regulations applicable to them.

Oil contamination changes river water quality and leads to decreased productivity and decreased abundance of phytoplankton and zooplankton (Zaman, 2001 and 2002),

After the oil spill in the Shela River in 2014, a number of studies were carried out (e.g. Amin *et al.*, 2017; Chowdhury *et al.*, 2014). They found a slight decrease in alkalinity, dissolved oxygen (DO), hardness, electrical conductivity (EC), oxidation reduction potential (ORP), nitrite and chloride content of river water during high tides and in downstream reaches; but there was a large decrease in salinity. The iron and zinc content in fruits and pneumatophores of *Heritiera fomes* increased significantly but the copper, cadmium, lead and nickel contents remained constant (Amin *et al.*, 2017). Signs of oil were found on plants in December 2014, especially on shoreline golpata (*Nypa fruticans*) (UNEP, 2015).

Oil spills from ships have also caused the depletion of fisheries resources. When interviewed, community fishermen reported a decrease in their catches and an adverse impact on their livelihoods within two weeks of the 2014 spill. This could be related to internal damage to blood and kidneys of aquatic organisms that was also observed about two weeks after the spill (Chowdhury *et al.*, 2014). A large majority of interviewees reported damage to fishing gear (90%) and clothes (80%), 20% reported the loss of domestic ducks and 10% reported that their drinking water supply and other sanitary facilities had been affected (Sunny, 2017). However, Kingston (2002) observed that oil contamination in mangroves has long-term impacts which can be measurable decades later. But, to date, there have been no published reports of such long-term effects resulting from the 2014 oil spillage.

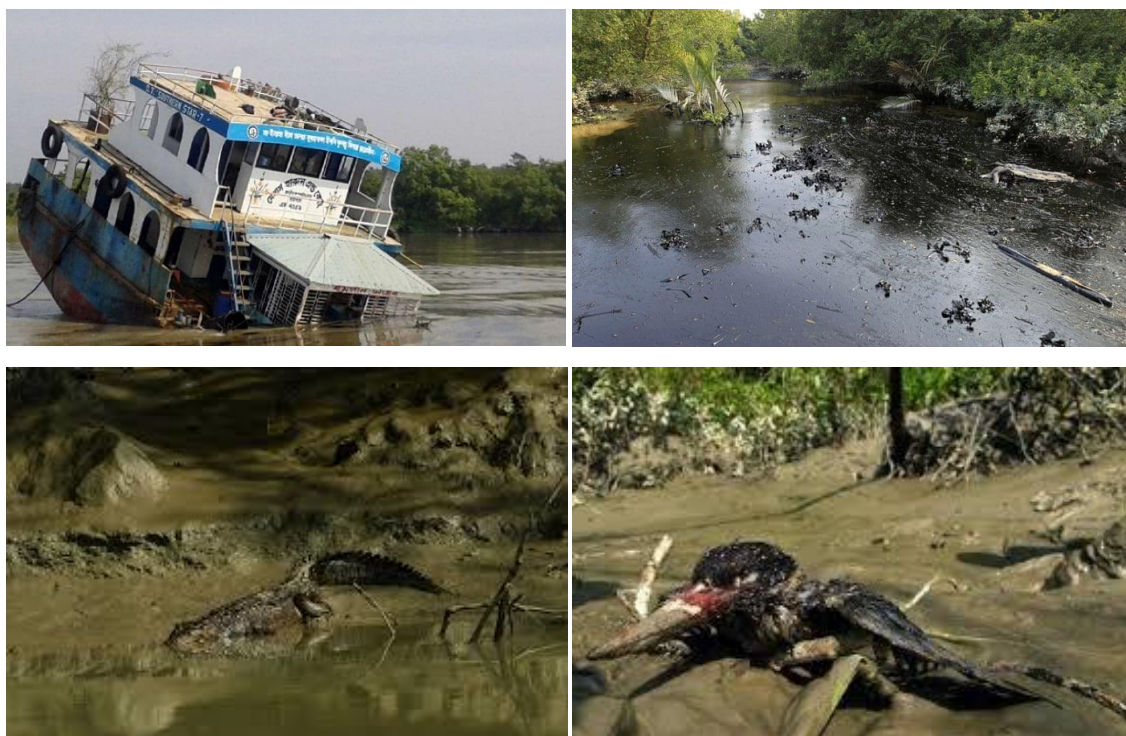
In support of sustainable development, in 2016, the Ministry of Environment, Forests and Climate Change (MoEFCC) finalised a National Oil Spill and Chemical Contingency Plan (NOSCP) with technical support from the International Maritime Organisation (IMO). It is based on the Marine Pollution Preparedness and Response section of the Marine Environment Protection Act. The plan

¹⁸ The Shela River is no longer used for transporting materials and goods as Ghoasiakhali channel has now been re-activated following dredging by BIWTA.

applies to oil spills which cause or could cause damage to the environment and the sea, in waters which are under the jurisdiction of Bangladesh for pollution prevention purposes, including the Exclusive Economic Zone (EEZ) and territorial sea.

According to the International Tanker Owners Pollution Federation (ITOPF) Ltd.¹⁹:

- The Director General of the Department of Shipping would have overall responsibility for coordinating the response to an oil spill but may delegate these powers to the Coastguard, port authorities and local authorities;
- In a major incident a National Emergency Response Centre (NERC) would be established within the Coastguard to direct and coordinate the response;
- Shoreline cleaning outside port limits falls to the local authorities;
- A Divisional Environment Authority may be formed between affected authorities and designate the responsibility to coordinate the clean-up;
- Limited specialised equipment is available in Bangladesh. The Chittagong Port Authority (CPA) received a specialised vessel intended for use as an oily waste reception vessel in January 2010 which can also be used for oil spill combat within the port limits and adjacent waters. A limited stock of dispersant and other equipment is also held by the CPA. Patrol vessels are available from the Navy with aerial surveillance and ground-to-air communications provided by the Air force. The Bangladesh Petroleum Corporation will provide vessels for the storage of collected oil.



Effects of oil spills in the Sundarbans reserve forest

¹⁹ <https://www.itopf.org/knowledge-resources/countries-territories-regions/countries/bangladesh/>

3.3.1.6 *Plastics pollution*

Plastic-derived products are convenient and readily available, and have become an essential part of daily life due to their durability, light weight and low price. As huge amount of used plastic has become a major contributor to municipal solid waste and its management is challenge. An estimated 0.8 million tons of plastic waste is generated in Bangladesh annually (Waste Concern, 2019). About 36% of the total plastic waste generated is recycled, while 39% is landfilled, and the rest 25% is considered leakage or discarded and finds its way into the marine environment (Waste Concern, 2019). The urban areas of Bangladesh generate 633,129 tons/year of plastic waste. Of this, 3,23,000 tons/year (51%) is recycled. Khulna city produces about 140 ton of plastic waste yearly (c. 3% of the total municipal solid waste generated). Except for polythene, there is no restriction on the production of plastic derivatives in Bangladesh.

In Khulna City, 8% of total per capita waste generation (0.346 kg/day) is plastic (Jambeck *et al.*, 2015). In the South West Region, plastic wastes are mainly found in the form of plastic bottle, jars, buckets, nets, boundary rope, polyethylene paper, plastic sheets and bags. Some of this waste (e.g. polythene bags, unused bottles, ropes, etc.) is mixed with other household waste and directly disposed to community waste bins or nearby household-level open dump sites. It is collected by Khulna City Corporation, municipal or paurashava authorities for disposal. Households also sell recyclable solid waste (RSW) (recyclable paper, plastic and glass) to hawkers or primary dealers. This recyclable waste is taken for sorting, cutting, moulding, drying, washing and further processing.

Most of the districts of in the region have a small-scale plastic recycling plants. In Khulna city there are four such plants which process about 3,100 kg of plastic waste every day. Nevertheless, overall, plastic waste management in the region is poor, largely due to lack of facilities and infrastructure, and insufficient budget for waste management. The situation could be improved by introducing proper grading and separation of plastic waste but there remain challenges to extracting dyes, fillers and other additives.

3.3.1.7 *Noise pollution*

Noise results from many human activities such as transportation by motor vehicles, trains and ships (engines and horns), construction works, industrial operations and recreational activities, etc. In some areas of the Sundarbans, noise is an increasing problem, mainly due to the light and heavy vessels used to transport goods (imports/exports and domestic). In addition, noise is generated by local motorised trawlers and small boats used for fishing and for transporting materials and people from deep in the Sundarbans to Khulna and its other cities. Furthermore, numerous tourist launches use the Sundarbans' waterways, particularly during the winter period, and these and their passengers also generate noise that can disturb wildlife (engines, music, shouting) and community residing along the riverine system.

Noise levels in the Sundarbans have been recorded by CEGIS since 2014 at four sites as part of environmental monitoring for the Rampal coal-fired power station (at Mongla ghat, Harbaria, Akram point and Hiron point):

- Mongla ghat has considerable industrial establishments and, during the day, the average noise level was 61.06 dB (A) – lower than the Bangladesh standard value for industrial areas (75 dB (A)). The sources of noise was mostly road traffic (heavy and light vehicles.), port activities (cranes, ships, etc.) and people in the ghat area.

- The Harbaria area is considered as a hotspot for biodiversity and an important anchoring site for most of the large ships. Most of the sea going vessels used to anchor at this site for transshipment of goods and commodities. The area is declared as a silent zone with a standard limit of ambient daytime noise set at 50 dB (Noise pollution control rules, 2006). Noise was measured at 100 m inside the forest area from the river bank and found to average 43.94dB (A) during this monitoring period - lower than that of standard limit. The main sources of noise at this site were from the movement of ships, engines of anchored ships and barges, transshipment activities, bird's chirping, wave breaking and wind action on tree leaves.
- Akram Point is another biodiversity hotspot. The average day time ambient noise level during this monitoring season was 36.59dB (A) – again lower than that of Bangladesh standard value (50 dB). The main sources were birds' chirping, stormy wind, waves breaking and falling of leaves.
- Hiron point falls within the World Heritage Site. This location is where mother vessels enter the Passur River - roughly 5-6 km wide. Noise level on the western bank of Passur river mouth and eastern side of the Sundarbans South Sanctuary averaged 40.34 dB (A) during the monitoring season – also lower than the standard value.

The government is now undertaking maintenance dredging activities to expand the facility of Mongla port so that ships with a bigger draft can navigate to the port (CEGIS, 2018). There are also plans to expand industrial activities near the Sundarbans including in the Mongla Economic Zone which will increase noise levels. However, the level of noise pollution from the industries may not be particularly significant due to their predominantly small scale as well as the adoption of noise reduction measures. But, it can be anticipated that there will be an increase in shipping traffic in the navigable channels through the Sundarbans which will impact on wildlife, although to different extents depending on the exposure period.

Bangladesh's Noise Pollution Control Rules define five classes of areas and permissible levels of noise for each area. They also state that no traffic (both on land and by water) is allowed to make noise more than 85 dB (A) (GoB, 2006). However, there is no specific guideline regarding the management of noise level in the Sundarbans. Also, there is no monitoring protocol to control noise pollution from shipping. Such monitoring is vital and could be initiated by the port authorities. The Department of Environment is mandated to monitor pollution including noise, but lacks manpower and technology. .

It is generally accepted that noise pollution disturbs the ecosystem which can lead to loss of biodiversity (Sordello *et al.*, 2019; Kight and Swaddle, 2011). Various studies in other parts of the world indicate how noise pollution can affect wildlife, particularly the physiology and behaviour of animals (Newport *et al.*, 2014). Animals use, hear and emit sounds (Romer & Bailey, 1990). Man-made noise can mask and inhibit animal sound (Sordello *et al.* 2019) and affect the communication among the animals (Sun and Narins, 2005), use of habitats (Drolet *et al.*, 2016) and the reproduction capacity (Bernath-Plaisted and Koper, 2016). Sufficient exposure to noise can cause physiological changes to animals such as raising blood glucose level (Wysocki *et al.*, 2007), disruption of hormone level (Smith *et al.*, 2004; Romano *et al.*, 2004) and can lead to damage at a cellular level (Pellegrini *et al.*, 1997). Noise stress can change reproduction rates and responses in different species (Kight and Swaddle, 2011) and alter their population sex ratio (Sobrian *et al.*, 1997). There is also evidence (Henderson *et al.*, 2011) that shows that noise can lead to hearing disorders, a decreased immune system as well as alteration of gene expressions

Most studies in the literature reviewed noise effects within limited noise ranges (65 to 130 dB) and on limited taxonomical traits.

Any increase in shipping will increase the ocean ambient noise level (Leaper and Renilson, 2012), which can affect marine mammals (Southall *et al.*, 2007; Andrew, Howe, & Mercer, 2002) as well as the fish by causing avoiding behaviour (Mitson and Knudsen, 2003; De Robertis and Wilson, 2010), stress (Wysocki *et al.*, 2006) and masking communication (Vasconcelos *et al.*, 2007). Kuşku *et al.* (2018) reviewed literature on the sources of noise pollution in marine ecosystems and their potential impacts on marine biology. But there have been no specific studies on the effects of noise pollution caused by shipping in the Sundarbans.

3.3.1.8 Waste disposal

Solid waste management (SWM) is an essential service in any society. Its primary goal is to reduce and eliminate the adverse impacts of waste materials on human health and the environment. In the South West Region, solid waste is generated mainly in residential and industrial areas (i.e., from houses, street sweeping, commercial, industrial and other sources). Waste disposal in the region faces many challenges due to the limited management facilities and rapidly growing population. However, there have been some recent improvement in urban areas such as the expansion of waste management services from municipalities, Khulna City Corporation (KCC) and Paurashava, and waste sorting and management facilities.

Khulna is the third largest metropolitan, industrial and port city in Bangladesh. It is one of the fast-growing commercial cities in the South West Region with a population of 1.5 million which produces about 520 tons of municipal solid waste per day (0.346 kg per capita per day) (KCC, 2017; Alamgir and Aminul, 2007). Of this daily generated waste, 53% is left discarded (Ahsan *et al.*, 2009). As a public authority, KCC is responsible for managing municipal waste in its area. Here, waste is generally deposited in community bins and secondary disposal sites (SDS) by citizens themselves, community-based organizations or NGOs through their door to door collection systems. KCC arranges the collection of waste from SDS. According to Islam and Moniruzzaman (2019), KCC sorts waste for recycling (9.1%), composting (4.4%) and landfilling (86.5%). Waste destined for landfilling is transported to the final disposal site in Rajbandh, about 7 km away from the main Khulna city (Moniruzzaman *et al.*, 2011).

In other municipal areas of the region, there are mixed approaches to solid waste management. Some municipal or paurashava authorities collect waste through door-to-door collection systems and transport it to dustbins/containers by rickshaw vans. Also, members of households voluntarily take home-produced waste to municipality dustbins (temporary storage places). The municipal or paurashava authority collects waste from dustbins and containers and transports it by truck to selected dump sites. In November 2019, Jessore District started the country's first integrated landfill and resource recovery centre (IL and RRC)²⁰ under the City Region Development Project funded by the Asian Development Bank, German Development Bank and Swedish Development Co-operation Agency. This facility recycles daily waste into biogas (capacity 720 m³), electricity (capacity 430 KW) and fertilizers (capacity 8 tons). This facility has become a role model for garbage recycling.

²⁰ <http://www.khulnacity.org/Content/index.php?page=Services&bWpt&pid=43>

There is no systematic waste management system in the rural areas of the South West Region. Rural inhabitants and villagers usually dump waste indiscriminately in the open, and/or burn it, or discard it into water bodies or landfills, and also dispose it directly onto agricultural land. However, a significant amount of waste generated from domestic animals, especially cow dung, is used as manure and for fuel. In addition, household kitchen waste and feedstuff waste is used to generate biogas and produce electricity.

The unsustainable management and disposal of waste in the region can cause problems with pollution in rivers, beels and lowland areas – a problem that is worsening with population growth. Landfills and dumping waste on open ground are the cause of land degradation, impaired soil quality and reduced agricultural production. Such waste is of many kinds: construction materials (bricks, sand, ash and cement); plastic bottles and polythene; debris from engineering workshops; market and household wastes. Open dumping of these wastes reduces the transformation and filtering capacity of soil.

3.3.2 *Water flow dynamics in rivers, river bank erosion, sedimentation and salinity*

3.3.2.1 *River Morphology*

The South West Region is criss-crossed by numerous south-flowing rivers (Figure 3.3) that form part of the dendritic distributary system of the Ganges river which is supplied annually by rainfall throughout its vast 1,087,300 km² catchment (Islam & Gnauck, 2008).

The Ganges along with the inter-connected distributary rivers in India and Bangladesh (Table 3.3) play a vital role in the supply of fresh water into the Sundarbans. The river Hoogly in the extreme west is the only river carrying freshwater from upstream of the lower Gangetic delta in the Indian Sundarbans. Due to upstream diversion and narrowing of the distributaries of the Bhagirathi-Hoogly in the Sundarbans, presently freshwater discharge in these rivers of Sundarbans are negligible or mostly absent except during monsoon months when downpour in the southern parts of Sundarbans occur (Banerjee, 1999).

Table 3.3 Major river system of the Sundarbans

Eastern (Bangladesh) side	Western (Indian) side
Mathabhanga	Hoogly
Gorai	Muriganga
Bhairab	Shaptamukhi
Madhumati	Bidyadhari
Kapotaksha	Thakuran
Raimangal	Matla
Arpangaisa	Gosaba
Sibsa	Harinbhanga
Passur	
Baleshwar	

Within the South West Region of Bangladesh, the distributary rivers fall into two zones: (a) upstream, dynamic, fluvial, freshwater channels, and (b) downstream tidal rivers.

The upstream fluvial channels are dominantly freshwater with dynamic processes (i.e. active bank erosion and changing courses), e.g. the Gorai-Madhumati, Gorai-Nabaganga and

Mathabhanga-Bhairab-Kobadak river systems. The off-take of the Mathabhanga River has become closed and currently no supply of fresh water flow to the Sundarbans through this system. On the other hand, Gorai River dries up during low-flow dry season periods but receives freshwater from Ganges River during the monsoon period and provides the only supply of freshwater flow in the region to the Sundarbans.

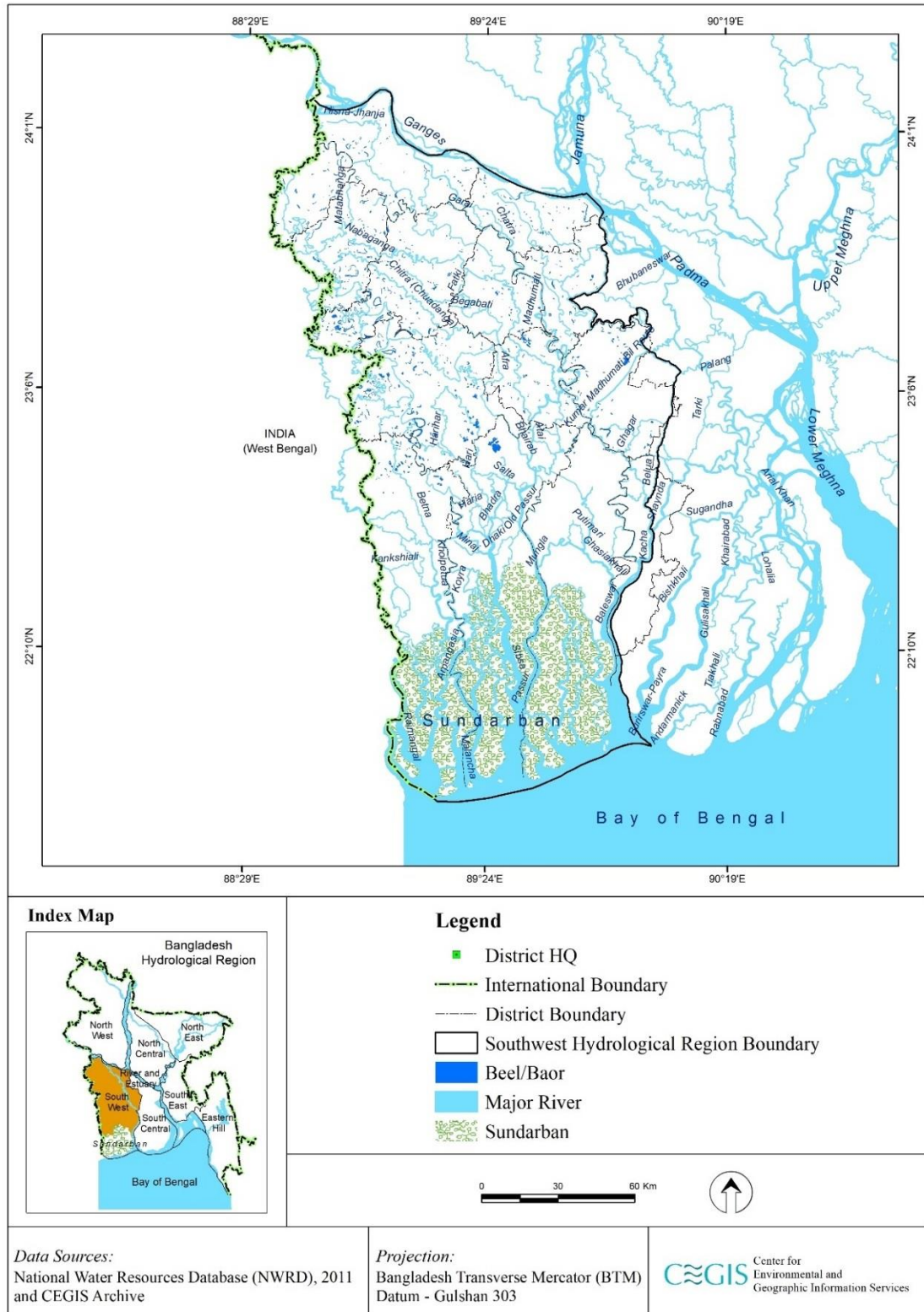


Figure 3.3: Rivers in the South West Region



Figure 3.4: Satellite image of South West part of Bangladesh and adjacent West Bengal

Tide and wave dominated rivers are found closer to the Bay of Bengal, e.g. Baleshwar, Passur, Shibsa and Arphangasia rivers. Compared to the upstream rivers, the tidal rivers carry much less sediment and are relatively stable with far less short-term bank erosion and course shifting, or river widening. However, even slight changes in river morphology may alter the environment of the Sundarbans ecosystem

Human interventions and morphological changes have played a significant role in changing the river system. The Heliflex cut (1910) diverted almost the entire flow of the Madhumati river to the Nabaganga river. The 23 km Madaripur Beel Route was excavated during 1910-12, diverting flow from the Arial Khan River to the Madhumati River. Furthermore, much infrastructure (particularly embankments to create polders and shrimp farms) was built between 1960 and 1970 in the coastal region of Bangladesh, resulting in many rivers drying up or silting-up. The embankments restricted the natural river flow, cut off numerous inter-connected branches and

creeks, prevented sediment being deposited on adjacent land and caused it build up the river beds.

(a) Erosion and river widening

There are hundreds of rivers in the region, but only few rivers are prone to erosion. It can be due to a range of factors, e.g. stream bed lowering or infilling, flooding of bank soils followed by rapid drops in flow, redirection and acceleration of flow within channels, poor soil drainage, wave action, excessive sand/gravel extraction, and intense rain and flood waters.

The Madhumati River is the most at risk of erosion. But it also occurs in the Shibsa, Passur, Baeshwar, Bhairab, Garai, Kholpetua, Kapotaksha (downstream), and Nabaganga (downstream) rivers. The width of these rivers has increased a little due to the continuous erosion. But none of the rivers has widened significantly since erosion has been balanced due to accretion.

For this SEA, the team calculated the average width of the Baleshwar, Passur and Shibsa rivers for five years between 1990 and 2019 (Table 3.4). Satellite image for the selected years were analysed using Arc-GIS and river width measured along different sections of each river and the arithmetic mean calculated. The average width of the Baleshwar River increased from 3730m in 1990 to 4065m in 2019. The main increase occurred during 1990-2003. Over this same period, the average width of the Passur River increased 1700m to 2100m whilst the Shibsa River increased from 2110 to 2320m.

Table 3.4: Average width of the Baleshwar, Passur and Shibsa Rivers over time

Year	Width of river (m)		
	<i>Baleshwar</i>	<i>Passur</i>	<i>Shibsa</i>
1990	3730	1700	2010
2003	4100	2030	2235
2010	4050	2050	2280
2015	4040	2060	2290
2019	4065	2100	2320

Erosion is a natural hazard which destroys the socio-economic life of affected people, e.g. through loss of homes, croplands and infrastructure. Important structures like schools, colleges, markets, hospitals and banks need to be replaced. The homeless and jobless suffer greatly. Erosion also adversely affects biodiversity in the Sundarbans, e.g. by washing away ancient trees and the species living on them.

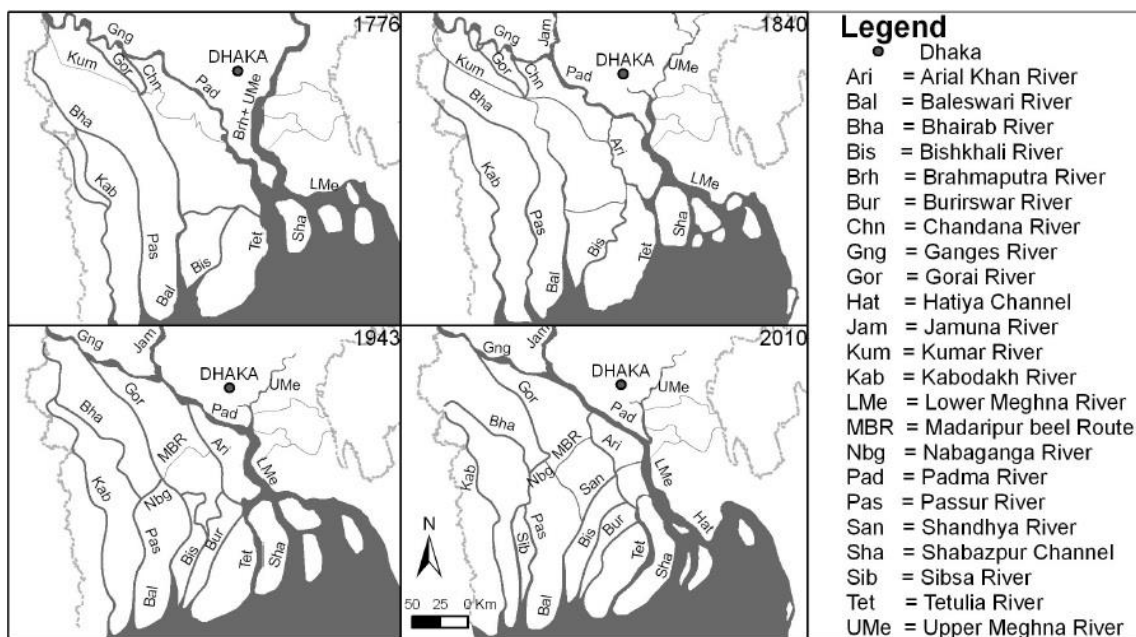
(b) Changing river courses

At the end of the 18th century, the Ganges was the main source of freshwater for the region. The Brahmaputra flowed to the east of the Madhupur Tract (Figure 3.5). The Ganges flow via Aricha and through the course of the present Arial Khan River to the Bay of Bengal to the west of Bhola. At the time, Jalengi and the Chandana were the major right bank distributaries of the then Ganges, and the Gorai and Mathabhanga Rivers were much less prominent (BWDB, 2011; Sarker *et al.*, 2013). But by the early 19th century, a significant portion of the Brahmaputra had shifted course to flow as the Jamuna into the Ganges. It is believed that the combined flow of the Ganges and the Jamuna had raised the water level in the Ganges/Padma River (Fergusson, 1863). At the same

time, flow in the Mathabhanga River had increased and this, in turn, increased flow in the downstream Kumar River.

By the early 20th century, the Chandana River had become much smaller, whilst the Gorai and the Arial Khan, as the distributaries of the Ganges and the Padma, had become quite large. At present, the Gorai-Madhumati is the main distributary of the Ganges, flowing through Kushtia Magura and Faridpur districts. Previously, a portion of the Madhumati River joined with the Rupsa River near Khulna as the Atharobanki River. However, following the diversion of the Madhumati flow through the Nabaganga into the Rupsa, the Atharobanki slowly dried up (BWDB, 2011; Sarker *et al.*, 2013).

The Mathabhanga diverges from the Ganges and unites with another border river, the Bhairab-Kapotaksha, in Chuadanga District. The Bhairab flows through Chuadanga and Jessore Districts and outfalls into the



Source: Sarker *et al.* (2013)

Figure 3.5: Development of rivers in the South West Region over time

Rupsa at Khulna. The Kumar River has left abandoned courses in Faridpur and Gopalganj Districts at many places. The Chandana had declined previously and the Gorai is currently declining significantly. Tidal rivers like the Passur and Shibsa are wide and still active. At present, most of the rivers of this zone are relatively stable but major changes in main rivers and massive man-made infrastructure may lead change of river courses.

When river courses changes, the area along the old course is left with insufficient water for irrigation and fisheries, and to sustain the aquatic environment and permit navigation, etc. Areas along the new course has may face new natural hazards such as floods and erosion.

(c) Atrophying rivers

Rivers of the northern part of the region (i.e. Meherpur, Kushtia, Chuadanga, Rajbari, Jhenaidah and Magura Districts) are morphologically inactive and atrophying steadily. Some rivers have

dried up significantly (e.g. Mathabhanga, Bhairab-Kapotaksha, Chitra and Nabaganga rivers), and have elevated bed levels which hinder upward tidal flow.

Atrophying rivers cannot supply enough water for agricultural use, not support navigation. If alternative water source cannot be found, it may be necessary to change cropping patterns. River ecosystems change and there is especially a reduction in the availability of fish. Many boatmen and fishermen are forced to change occupation.

(d) Shifting banklines

Shifting of banklines is a feature of dynamic rivers. The Gorai, Madhumati and Nabaganga (downstream) rivers show significant bankline changes. Such shifts are common in tidal rivers like the Passur, Shibsa and Baleshwar rivers and in adjoining rivers.

Shifting of banklines are a threat to the people living along the river banks. Infrastructure such as roads and bridges are highly vulnerable to bankline shifting, and mangroves are lost.

3.3.2.2 Sedimentation and salinity

The Ganges is a dynamic and erosion-prone river. Riverbank erosion adds a lot of sediment that is deposited downstream along its course and distributaries or carried into the Bay of Bengal. Many of the distributaries have narrowed due to siltation and their flow has reduced significantly, e.g. the Hishna-Jhanja, Mathabhanga, Kumar, Atharobanki, and Nabaganga rivers. Some river courses have become disconnected from their sources. Following the construction of the Farakka barrage (see also section 3.5.1.1), the dry season flow of the Ganges and its distributaries reduced and, as a consequence rivers have silted up. The off-take of the Gorai River – the main source of freshwater for the South West Region - has become silted up, restricting the inflow from the Ganges River. Char lands of Gorai are now used for residential projects and crop cultivation. Cropland of nearby areas, which was dependent on water of Gorai, suffers most for water. Navigation has become impossible. Many boatmen and fishermen left their jobs and started sand mining.

A low-lying wetland zone (beel) once occupied a vast area covering several districts (Jessore, Narail, Khulna, Bagerhat, Madaripur and Gopalganj) as marked in Rennel's map of Bihar and Bengal (Rennel, 1776). It has now been divided into small areas due to deposition of calcareous silty sediment by the Kapotakhsha, Bhairab and Gorai-Madhumati rivers which cross the area. As the vast wetland became smaller, the water storing capacity of the beel reduced. Many aquatic ecosystems became terrestrial.

The southern part of the South West Region is part Ganges tidal floodplain where river banks generally stand about a meter or less above the level of adjoining basins. It is characterized by a close network of interconnected, tidal rivers (e.g. Shibsa, Passur and Baleshwar) and creeks. Incoming tides bring seawater into the tidal rivers and creeks, and flood tides carry saline sediments into the rivers and creeks, which is then washed out again on the ebb tide. The speed of flood and ebb tides can vary. Usually, the flood tide is faster, although it can be reversed (tidal asymmetry) with the ebb tide having greater velocity. On balance, over a prolonged period, sediment gets deposited in the rivers instead of returning to the sea.

There has been much investment in water control infrastructure such as embankments (soil and turf) (Figure 3.6) and sluice gates. Whilst embankments prevent incoming tides from spreading onto the adjacent floodplain (unless damaged – Box 3.1), they have also prevented sediment deposition in the low-lying floodplains and led to increased sedimentation in the river channels.

Box 3.1: Embankments in the South West Region

During the 1950s and 1960s, embankments were constructed in the coastal area (improving embankments along tidal rivers that had been built by landowners since the 17th century), creating polders between the tidal rivers and extending 150 km inland in the west, and constraining flood dynamics (van Staveren et al., 2017). The embankments were built around continuous river banks, but they cut off the minor creeks which let water into and out of the enclosed areas under natural conditions. Under natural conditions, the rivers had levees on their banks surrounding lower basins behind them.

The purpose was to prevent salt-water flooding of the floodplain areas inland and provide increased security for monsoon-season rice production. Sluices in the embankments prevented inflow of salt-water at high tide and allowed ponded rainwater to drain away at low tide. There have been problems in the allocating of government funds for regular and adequate embankment and sluice maintenance. Land owners have also deliberately breached embankments to allow brackish water to flood polders for shrimp farming (which provides higher economic returns per ha than rice cultivation). However, this also displaced many small tenant farmers and reduced labour demand. Storm surges in 2007 and 2009 associated with cyclones breached some embankments (subsequently repaired) causing salt-water flooding. Cyclone Amphan in May 2020 again breached many embankments causing salt-water flooding within polders.

The Sundarbans forest ecosystem is dependent on the complex tidal and fluvial flows in the rivers and creeks. Any disturbance to this natural system may hamper the biological environment of this forest. For example, dredging is carried out to increase river depth and water availability as well as navigability. But dredging in tidal rivers is very challenging as dredged channels soon become re-silted. Besides, dumping of dredged materials even away from the riverbank may affect the regeneration of trees and the survival of existing forests, especially inside Sundarbans.



Figure 3.6: River embankments in the South West and Southern Region of Bangladesh²¹

A huge amount of dredging will be required in the near future to restore and maintain navigability in rivers in the Khulna and Barishal Divisions of Bangladesh. The management of dredged materials in the Sundarbans area and the operation of embankments and sluice gates will need to be properly controlled to ensure that there is minimal damage to the Sundarbans ecosystem. Dredged material should not be disposed in rivers or on riverbanks. Fallow lands or lowlands far away from the rivers can be used for disposal. Where dredging is undertaken inside deep forest, dredged material can be stored in dredger and disposed later at an appropriate site. Flow controlling structures should be maintained carefully so they do not restrict tidal movement in rivers and adjacent canals. If tides cannot disperse sediments in canals and creeks, the main rivers will become silted up quickly.

The freshwater supply from the Ganges/Padma River, passing through the northern part of the South West region, helps to flush out the saline silts from the river beds. However, in the dry season, water flow in the Gorai River (the main freshwater flow through the region) is much reduced due to it having become silted up and to lower flows in the Ganges/Padma Rivers. As a result, inflowing saline tidal water can reach the Gorai. Such issues will need to be considered when the Farakka treaty (which determines water flow releases from the barrage) comes up for renewal in 2026. Otherwise, there is a risk that there will be insufficient dry season flow for the Gorai. The Farakka barrage is often blamed for the reduced dry season flow in the Gorai River. However, the reduction of freshwater flow is a trend that has been happening for centuries and

²¹ Source: https://www.google.co.uk/search?q=embankments+in+bangladesh&source=lnms&tbm=isch&sa=X&ved=2ahUKEwino6Xi96HqAhX0uXEKHYthDzYQAUoAXoECAsQAw&biw=1280&bih=610&dpr=1.5#imgsrc=0H_UlZ-wbjj0YM

is not just due to the barrage. Historical evidence cited by Brammer (2014b) records that flow varied in the past due to natural causes (Brammer 2014b), including:

- changes in the flow of the Brahmaputra river into the Jamuna river (causing back-up in the Ganges above their confluence and increasing flow down the Gorai river);
- the meandering nature of the Ganges river;
- abstraction of river water and groundwater by the rapid expansion of irrigation in the districts through which these rivers cross.

In the monsoon, when flows through the Gorai are higher and there is significant run-off from rainfall, salinity levels in the tidal rivers is reduced.

In all coastal regions of Bangladesh, the extent of saline water entry into the delta varies daily, fortnightly and seasonally. The first two rhythms are determined by diurnal and spring-neap tidal cycles, whilst the third is a response to the huge seasonal variation in fresh water flows reaching the estuaries. There is a zone of continuous transition between fresh water and open-sea salt water. The ecology and land use pattern of the coastal areas is adapted to the normal movement of the saline front, and along most of the coast, there is an equilibrium regime. However, the regime has been affected significantly in the South West Region by the reduction in flows into the Ganges distributaries, especially the Gorai River. The effect has been particularly severe in the greater Khulna area. Sea level rise due to future climate change is predicted to aggravate the problem (Pethick and Orford; 2013). Salinity is a major concern for paddy rice production.

River flow dynamics in the South West Region affects agriculture, forests and industries. Due to the increase of salinity, the agricultural yields have been reduced significantly. The salt-tolerant paddy rice variety can tolerate up to 2,000 m-mhos/cm of EC. The yield falls by 50% when the EC increases to 6,000 m-mhos/cm and decreases to near zero when the EC reaches 16,000 m-mhos/cm.

There has been a significant increase in salinity in the aquifers of the country's coastal districts (see Box 3.2), mainly due to a large increase in unplanned use of groundwater for irrigation. It is also said that there has been subsurface intrusion of seawater due to sea-level rise caused by global warming, although there is no reliable data to support this claim. Reliable trend data is also needed for salinity levels in both rivers and soils (which, varies from year to year and also increases through the dry season)²².²³ IPCC (2013) predicts global mean sea level rise between 0.2 to 1m for low to high emission scenarios by 2100 for the Bay of Bengal. For the future, the IPCC projections for very high emissions (red, RCP 8.5) and very low emissions (indigo, RCP 4.5) are shown (IPCC, 2013) in Figure 3.14.

²² Sampling to determine trends will need to be undertaken on the same date over a period of years (e.g. 10 or more) in the same way that trends in annual rainfall is based on multi-year data.

²³ Sampling to determine trends will need to be undertaken on the same date over a period of years (eg 10 or more) in the same way that trends in annual rainfall is based on multi-year data.

Box 3.2: Aquifers, boreholes and salinity in the South West Region

Coastal aquifers occur in different subsurface layers which are heterogenous, even over short distances (Zahid *et al.*, 2014). The second aquifer below the surface is considered to be the main aquifer (Zahid *et al.*, 2014) and extends from 250 to 350 metres from the surface. It is composed mainly of fine to very fine sand and water and is estimated to be about 3,000 years old (Aggarwal *et al.*, 2000).

The depth of the groundwater table in coastal Bangladesh fluctuates (Zahid *et al.*, 2014) depending on physiography, geological characteristics, tidal fluctuations, abstraction (for irrigation) and recharge by rainfall and floodwaters, although variations in vertical movement at local scale may be significant (Zahid *et al.*, 2014) and this regulates the impact of salinity. Zahid *et al.* (2009, 2012) also observed hydraulic connectivity among the aquifers. The production wells supplying water to the municipalities are affected by the falling water table caused by over-abstraction (SDP, 2011).

Water in the coastal aquifers of Bangladesh is of two general types: (a) sodium-chloride; and (b) sodium-calcium-magnesium-bicarbonate. The widespread contamination of aquifers by salinity is represented by higher total dissolved solids (TDS) such as chloride (Cl^-), sodium (Na^+), magnesium (Mg^{2+}) and sulphate (SO_4^{2-}) (Zahid *et al.*, 2014). The potable water along the coastal Bangladesh is restricted either within the first 25m or to below about 150 to 200m depth (Ravenscroft *et al.*, 2005). However, the locations of such potable water aquifers do not follow any pre-defined pattern. Zahid *et al.* (2014) noticed that, in general, the shallow aquifer in Satkhira, Jessore and Narail contains water with electrical conductivity (EC) $<100 \mu\text{S}/\text{cm}$. Water from the main aquifers of Satkhira, Jessore and Narail districts are also fresh. However, the deep aquifers of Khulna are mostly saline. Seasonal variation in water chemistry also has been noticed where higher EC is observed in the dry season relative to the wet season. Tidal activity also influences aquifer chemistry.

The depth of boreholes varies from 12m to 150m in the shallow aquifer in Bagerhat, Faridpur, Jhenaidah, Paikgacha and Satkhira municipalities; however borehole depth in the main aquifer in the Khulna City Corporation (KCC) area varies from 300 m to 330 m. Datta and Ghosh (2015) studies the groundwater hydro-chemistry in these six municipalities. Samples were collected during winter, monsoon and post-monsoon. Water quality for potable purpose was assessed with respect to the standards defined in Bangladesh (Huq, 2002) and by the World Health Organization (WHO, 1993). The study found that total dissolved solids (TDS) in groundwater in most municipalities did not meet these standards. In KCC, Faridpur and Paikgacha, almost 100% of the samples taken exceeded the desirable limit for safe drinking water. Chowdhury (2010) suggests that such elevated TDS levels may be the result from over-exploitation due to increase in population density and growth. He also opines that it may be the consequence of rapid climate change (although, as indicated in section 3.3.6.2, there is no reliable evidence of such rapid climate change to date) and on changed water flows in the rivers due to Farakka Barrage.

It has been estimated that annual water availability per capita will decrease from $12,162\text{m}^3$ in 1991 $7,670\text{m}^3$ in 2020 due to the increased water demand of the growing population (Chowdhury, 2010). This would further exacerbate over-exploitation of groundwater for potable purposes and would increase the possibility of upwelling, particularly in the vulnerable coastal area. Over-exploitation of groundwater influences arsenic contamination.

In the coastal region, groundwater is mainly used for domestic and agricultural purposes, but salinisation of many groundwater resources limits its suitability for human consumption and practical use. The subsurface consists of a sequence of deltaic sediments with alternating sandy and clayey layers in which there are several aquifers. Salinity is a main problem in the shallow aquifer systems, where chlorine concentrations rise to nearly 8,000 mg/l and the groundwater is mostly brackish.

The different aquifers are connected with the sea. Thus, when water is pumped from groundwater, mainly for irrigation, the natural equilibrium is disrupted and the fresh/saltwater interface migrates inland (Van Camp *et al.* 2014; Walraevens *et al.* 2015). Thus, the rate of migration can be rapid in response to increased pumping (MPO 1987). The salinization of groundwater can also be geogenic, in which remnants of marine deposits remain at depth usually in the inland aquifers (Walraevens *et al.* 2007). The presence of mineral salt also poses a threat of salinisation (Grube *et al.* 1999; Al Farrah *et al.* 2011). The rainfall and river discharge has a direct impact on the salinity control in the South West Region (Nazim and Anisul 2010). Studies by Michael and Voss (2009) and Faneca Sanchez *et al.* (2015) showed that lateral



Sundari trees in the Sundarbans

seawater intrusion is slow (in the order of only 1 m per year) compared to downward infiltration of saline water in the Bengal basin.

In the Sundarbans, increased salinity has had an adverse effect the dominant mangrove species (Sundari) - a valuable timber species - which requires both freshwater and saline water for regeneration and growth.

The power supply industry has also faced problems due to increased salinity, with increased costs as a result of having to import fresh water for cooling.

Summary of issues and challenges:

- Salt intake by the people in the coastal parts of the South West Region exceeds the recommended limit (1500 milligram/day), increasing risk of (pre)-eclampsia and gestational hypertension²⁴;
- The construction and development of a commercial water supply system is very difficult due to inaccessibility of fresh water bearing aquifers at reasonable depths (200–300m);
- The population of the region face a persistent deficiency in freshwater supply for their daily use due to the expanding population and irrigation. Therefore, sustainable development of the groundwater resources and their protection from saltwater intrusion is critical;
- Where surface water and soils have become saline, cultivation and domestic use of water depends on the availability of groundwater. The quality of groundwater in the coastal aquifer is poor and salinity levels are often above potable limits. Most tube wells are found to be saline in this area.
- Natural and anthropogenic factors influence the quantity and quality of potable water; these changes need to be over time and spatially to assess the sustainability of development activities (Dávila Pórcel et al. 2011). The people in the South West Region face a potable water crisis due to increased contamination, seawater intrusion and arsenic pollution of groundwater (Harun and Kabir 2013).

3.3.3 Floods

Large parts of the country, and particularly the South West Region, are subjected to flooding every year (Figure 3.7). Soil surveys conducted in the 1960s and 1970s found that 62% of the country is prone to annual flooding (Brammer 2016b). In an average flood, 18% of the country is inundated²⁵. In 1998, 75% of the country was flooded. Though the flood is a problem for the whole country, it can be disastrous in the coastal region. Here, there are three main types of floods: rainfed floods, river floods and tidal floods.

²⁴ <https://www.hsph.harvard.edu/nutritionsource/>

²⁵ Reference: https://en.wikipedia.org/wiki/Floods_in_Bangladesh

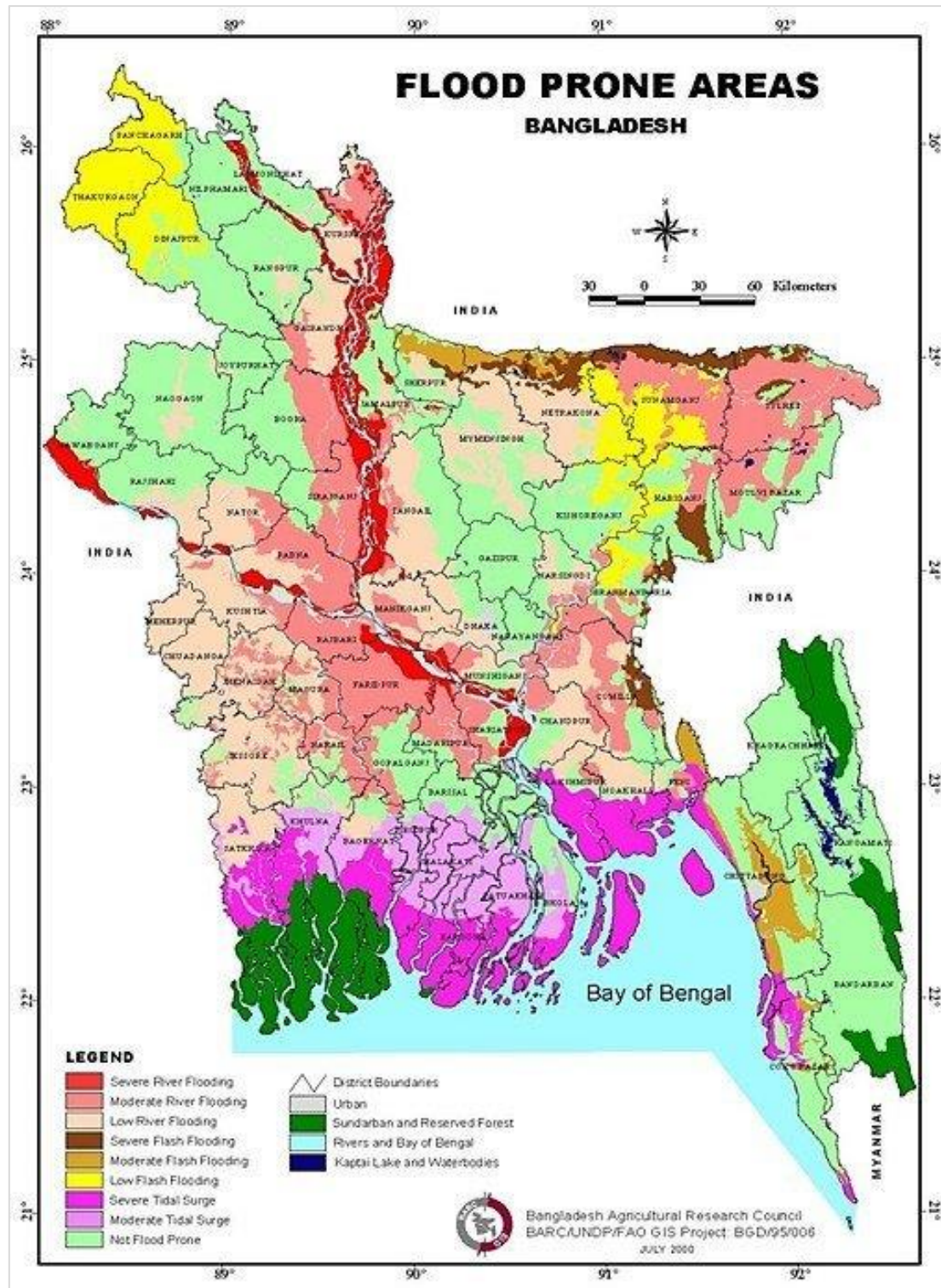


Figure 3.7: Flood prone areas in SW Bangladesh²⁶

²⁶Source:

<https://www.google.co.uk/search?q=bANGLADESH+FLOOD+PRONE+AREAS+MAP&tbm=isch&source=iu&ictx=1&fir=NK5ka7ZG9gIRgM%252CGk4jvnV-CINH3M%252C &vet=1&usg=AI4 ->

Bangladeshi farmers recognise different categories of flooding: Medium Highland (flooded up to 90 cm deep); Medium Lowland (flooded 90–190 cm deep); Lowland (flooded 180–300 cm deep); and Very Lowland (flooded > 300 cm deep). In considering flooding and risks associated with it, it is important to distinguish between what is normal (*barsha*) ‘flooding’ and abnormal (*bonna*) ‘floods’. Brammer (*op cit.*), describes these as follows:

- **Normal flooding** occurs every year, as reflected in the depth-of-flooding land types described above, to which rural people have adapted their traditional settlements and agricultural practices. The different land types occur within floodplain villages, linked to the landscape of former levees and back swamps (now ridges and basins) created over time by meandering rivers. Farmers’ crop choice and cropping patterns are finely adapted to these micro-differences in elevation and associated flooding characteristics.
- **Abnormal floods** - those which damage or destroy crops and property - occur at intervals of several years, and they vary in frequency with location in the country. They are more common alongside rivers that are subject to flash floods in the country’s high-rainfall eastern Districts than they are on the floodplains adjoining the country’s two major rivers, the Brahmaputra and Ganges).

Brammer also comments on the periodicity of damaging abnormal floods. Those that can be termed ‘serious’ and cause extensive crop damage, occur, on average, about once in 3–5 years. More damaging ‘catastrophic’ floods which displace many thousands of people, cause extensive damage to property and crops, and sometimes cause many human and livestock casualties, occur at intervals of ca 5–10 years or longer – examples are the floods of 1974, 1987, 1988, 1998, 2004 and 2009.

Flooding and waterlogging (natural and man-made) are common in the South-West Region and can occur due to a variety of factors including siltation, excessive precipitation and tidal surges. They can also be caused due to unplanned and/or poorly constructed infrastructure such as embankments, sluice gates/regulars as well as the malfunctioning of such structures which can affect the drainage system and eventually lead to waterlogging.

A combination of heavy rainfall in the region and freshwater carried by rivers from upstream (due to rain elsewhere in the catchment) can cause particularly heavy flooding. In July 2020, Bangladesh suffered the longest monsoon flood in 22 years. By 30th July, it had engulfed more than 35% of the country (mainly in the northern, north-eastern and south-eastern parts) with the possibility of it extending further²⁷. In the South West Region, the main areas affected have been around and to the north east of Khulna. Despite the damage and distress caused, this 2020 flood (by the end of July) was less extensive than floods in 1988 (61%), 1998 (38% and 2007 (42%). However, as the population of the country has increased, there are probably now more people living in vulnerable places such as the char areas in the major river channels; and with increased economic development too, there is more infrastructure (houses, roads and factories) likely to

[kQeS6Wu8ILBlb1VfsSGi2GPWibm_Q&sa=X&ved=2ahUKEwjmuNGblOjqAhXNQxUIHWrlDxcQ9QEwAnoEC_AoQIg&biw=1280&bih=610&dpr=1.5#imgsrc=NK5ka7ZG9gIRgM](https://www.newagebd.net/Q&sa=X&ved=2ahUKEwjmuNGblOjqAhXNQxUIHWrlDxcQ9QEwAnoEC_AoQIg&biw=1280&bih=610&dpr=1.5#imgsrc=NK5ka7ZG9gIRgM)

²⁷ <https://www.newagebd.net/article/112438/bangladesh-faces-longest-flooding-in-2-decades>

damaged, and the losses of affected farmers and rural people can be greater because of their greater investments in crop production.

The freshwater flood problem is exacerbated in the coastal areas when further combined tidal floods. Every high tide can create a tidal flooding in the lowlands. If the tidal flood merges with a cyclone, catastrophic flooding can occur. Since May 2019, Bangladesh has been hit by three big cyclones (Fani, Bulbul and Amphan) and suffered extensive flooding, causing extensive damage, loss of properties and economic costs.

The downstream part of the South West Region is extensively covered by embankments around polders. Some have no or limited openings and often block the natural drainage system. The embankments constrict the rivers and has reduced their conveyance capacity. As a result, many of the rivers have become increasingly silted up (e.g. Hamkura and Kapotaksha rivers) which leads to flooding. Sediment has been prevented from being distributed into surrounding areas. Water control structures (e.g. sluices) in the embankments prevent tidal water entering the polders. Due to poor maintenance, much of the drainage infrastructure is not working properly. As a result, there is drainage congestion in the polder areas which means that many become waterlogged, even after small amounts of rain.

Following the severe floods in 1987 and 1988, international concern led to a range of separate flood studies funded by international development partners and conducted by commercial consultants. In July 1989, major donors called for effective, coordinated action by the international community to understanding of the complexity of the water cycle in Bangladesh and support the Bangladesh government in finding solutions to major floods. The World Bank accepted to coordinate these efforts and subsequently presented a five-year (1990-1995) Action Plan for Flood Control (FAP) (World Bank, 1989). The guiding principles of the FAP specified that embankments were to be an integral part of the outcome of the FAP. It contained over 30 components (Hughes *et al.*, 1994), each supported by different donor agencies, individually or in partnership). The main components included, for example, strengthening embankments, various regional and estuarine studies, South West Area Management Study, cyclone and city/town protection projects, flood forecasting and early warning. The other components included reviews, studies, mapping, pilot projects modelling and institutional development and guidelines

The FAP aimed to provide a foundation for a long-term programme to address flooding problems. But it did not address climate change or sea-level rise issues. Subsequent advances in climate change modelling and scenarios need to be addressed in future long-term planning.

3.3.4 Ecological issues

3.3.4.1 Isolation of Sundarbans forest habitat

In some areas of the Sundarbans, forest habitats are becoming increasingly isolated due to the width of the rivers and human activities, particularly shipping which prevents terrestrial fauna such as the Royal Bengal Tiger and its prey species from crossing river channels and dispersing. Some of the major rivers in the Sundarbans have been used as cargo channels/Protocol route as well as for other human activities for centuries (Aziz *et al.* 2018).

A recent genetic study by Aziz (2017) has revealed a significant relationship between genetic clusters among the tiger population and the width of major rivers. However, disturbance along the major rivers due to the frequency of ships, noise and light – particularly at night - might also be a factor. The effect of wide rivers has been to separate the Sundarbans along north-south axes

into several large isolated forest habitats. The major wide rivers are the Arpangassia (width: 1.2 - 2.8 km), the Sibsa (width: 1.3 - 3.4 km) and the Passur (width: 1.4 - 3.1 km). In addition, the Raimangal River (width: 1.5 - 2.8 km) and Hariabhanga river (width: 2.9 - 4.4 km) mark the international boundary with India and bisect the entire Sundarbans into Bangladesh and Indian parts.

Aziz *et al.* (2018) argue that river width is a major barrier to east-west and west-east animal dispersal. This conclusion is supported by two radio-collaring studies which showed that tigers rarely cross the rivers wider than 400m in the Indian Sundarbans (Naha *et al.* 2016) and 600m in the Bangladesh Sundarbans (Barlow 2009).

Other observations show that many segments of narrow creeks have experienced severe bank erosion due to regular cargo movements between India and Bangladesh: e.g. between Kachikata (from the Kachikata Border Guard camp on the Raimongal river in Bangladesh) and Dobeki FD Camp on the Arpangassia river (Satkhira Range) – being used as ‘River Protocol Route’ between India and Bangladesh.

The government is committed to tiger conservation in the Sundarbans. But if it is to be ensured in the future, it will be vital to ensure connectivity across the wide rivers between populations of terrestrial fauna. This is critical to facilitate the normal dispersal of tigers and other species and prevent further genetic differentiation (Aziz *et al.* 2018). It will be necessary to limit the intensity and impact of human activities on wide rivers, e.g. by regulating cargo movement at night and controlling the use of loud whistles and lights by vessels.

3.3.4.2 Loss of biodiversity

There is considerable concern about the depletion of resources in the Sundarbans and loss of biodiversity. A range of factors contribute to these losses including, for example, over-extraction of non-timber forest products (NTFP), poaching, poison fishing, diseases, pollution, salinity changes and other edaphic factors. These and other factors are discussed below.

The very rich floral and faunal diversity of the Sundarbans mangrove forests has long been recognised. In 1875, the then Director General of Statistics of India, Sir William Wilson Hunter, noted in his statistical account of Bengal. Volume 1, that:

- “The other jungle products of the Sundarbans consist of cane, reeds, thatching leaf, honey and shell-lime” and
- Tiger, leopards, rhinoceros, wild buffaloes, wild hogs, wild cats, bara singh or large deer, spotted deer, hog deer, barking deer, porcupine, otters and monkeys, are the principal varieties of wild animals found in the Sundarbans. Tigers are very numerous, and their ravages from one of the obstacles to the extension of cultivation.” (Hunter 1875).

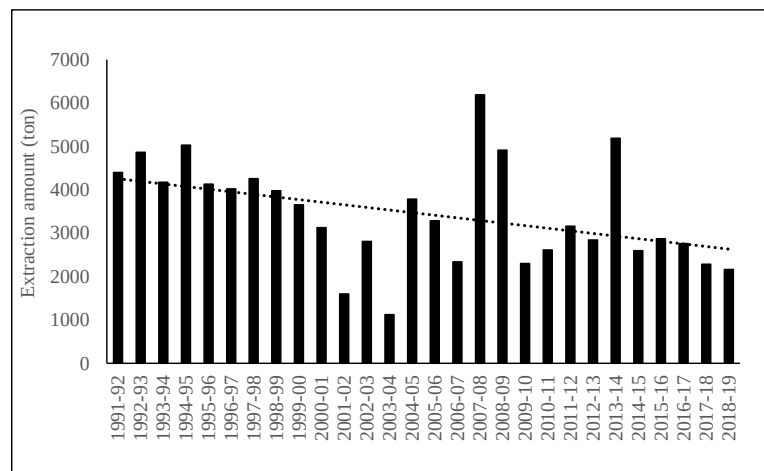
Among these wildlife, Javan rhinoceros (*Rhinoceros sondaicus*), wild water buffalo (*Bubalus arnee*), swamp deer (*Cervus duvaucelii*) and hog deer (*Hyelaphus porcinus*) have become extinct since the beginning of the 20th century. During these years, biodiversity was of much lower concern than its immense stock of valuable resources in the Sundarbans that was useful for construction, industrialization and for people’s livelihoods. Although there have been centuries of extraction, the Sundarbans has been only slightly depleted due to control measures. The livelihoods of people living adjacent to the Sundarbans are still dependent on the forests for timber, fuel wood, fish, honey, tannin, medicine and others forest products.

Several studies have noted the loss of some species from the Sundarbans and the reduced abundance of many important flora and fauna. An inventory by Chaffey *et al.* (1985) reported that the volume stock of *Heritiera fomes* and *Excoecaria agallocha* had been reduced by 40 and 45%, respectively, since an inventory conducted by Forestal (1960). The loss of biodiversity is believed to relate to the over-exploitation of both plant and aquatic resources, wildlife killing, poaching and trafficking, wildlife-human conflicts, habitat degradation and, extreme weather events (Curtis, 1933; BF, 2010; Bhattacharya, 2011; IUCN, 2012; BFD, 2020).

Considering the importance of maintaining the sustainable flow of the Sundarbans resources and ensuring its continued existence as the largest mangrove forest in the world, the Bangladesh Forest Department banned the extraction of trees from Sundarbans in 1989. It also implemented initiatives to protect the Sundarbans through enhanced conservation, protection and monitoring activities (BFD, 2010). As a result, compared to the inventory of 1960, there has been a significant increase in the density of *Heritiera fomes* and *Excoecaria agallocha* - to 331 and 228 stem/ha, respectively (Forestry Department, 2019).

About 2.5 million people living around the Sundarbans are directly and indirectly dependent on its fisheries. There has been an increasing trend of fish harvesting that is evident from research reports. The fish harvest averaged 4700 MT/yr (white fish, shrimp and crabs, but excluding Dubla fish which are collected outside the Sundarbans) during 2001-02 to 2018-19 (BFD, 2020).

The Sundarbans contributes 2-5% of the total capture fishes of the country (Shah *et al.*, 2010). Forest Department records for the last 28 years show fluctuations in the yearly harvested amount of fish in the range 1,127 - 6,192 tons (mean: 3,445 $\pm$ 221 tons) (Figure 3.8). Studies conducted during 2009-10 reveal that fisheries production has been reduced by 56% in the last four decades. (BFD, 2010). A wide range of factors may have influenced this trend: long-term data on fish harvests; outbreaks of disease in fish; management and monitoring initiatives at different time period; expansion of the sanctuary areas; yearly number of permit issued; increases in the royalty rate; the number of precautionary weather signals and cyclonic events during the fishing seasons; and safety and security condition (the activities of pirates) during the fishing seasons.. The over-exploitation and loss of aquatic biodiversity in the Sundarbans is also linked to the use of destructive or prohibited fishing gears, fishing during the ban season, fishing in sanctuaries and breeding canals, illegal collection of post larvae and poison fishing (IUCN, 2012).



Source: BFD (2020)

Figure 3.8: Yearly extraction of fish from the Sundarbans: 1991-92 to 2018-19

In response to the over-exploitation of fisheries resources, the Forest Department has started to adopt a set of activities to sustainably manage the fisheries resources as prescribed by the Integrated Resources Management Plans for the Sundarbans (2010-2020) (BFD, 2010):

- Strict control of poison fishing;
- A fishing ban in the core zone comprising the three wildlife sanctuaries and the 18 identified canals in the buffer zone;
- Ban on collection of post-larvae since 2002;
- A fishing ban in all canals during July and August and in the beels/chatals during February-May;
- A ban on the use of Ilish jal/Fash jal during September and October;
- A ban on complete gear:
 - i. Bhendi/bebdi/bendi (set bag net);
 - ii. No fishing by de-watering, particularly in the beels/chatals;
 - iii. Net jal and current jal for post larvae collection of Golda and Bagda
- A ban on the fishing nets having mesh below 15 mm (knot to knot at the stretch condition);
- Size limits for certain species of fishes;
- Limit of 20,000 Boat License Certificates (BLC)

Wildlife losses are mainly caused by poachers hunting tigers, deer, snakes, birds, monitor lizards, etc. to supply both local and international markets. Tiger and deer are most vulnerable to poaching. Tiger parts (skin, teeth, bones, meat, tongue, genital organs, claws, furs, and whiskers) are in high demand in the international market for medicinal and personal social status (Samia, 2016). This is a high demand for deer meat amongst the local elites - often supplied to order by poachers. Poachers and pirates use guns, traps and bait. Deer poaching reduces the prey stock for tigers which may influence the population dynamics of the tiger in the Sundarbans and will also increase human-tiger conflicts as tigers are forced to find prey outside the forest. There are also other reasons why tiger stray beyond the forests and for human tiger conflict, e.g. territorial conflict, depletion of prey base or sickness.

The Forest Department has initiated various initiatives to control poaching and combat human-tiger conflict:

- The Management Plan for the three wildlife Sanctuaries;
- Habitat protection and wildlife sanctuaries management under the Integrated Resources Management Plan (IRMP);
- Expansion of wildlife sanctuary areas;
- Involvement of communities in the conservation and management of the Sundarbans through Co-management, structuring of village conservation forums (VCFs) and community patrol groups (CPG);
- Implementation of the Tiger Action Plan (BTAP) for 2018-27;
- National Tiger Recovery Programme (NTRP) for 2017-2022;
- Establishment of the Wildlife Crime Control Unit;
- Formation of the Tiger Co-ordination Committee at national and regional level;
- Structuring 49 Village Tiger Response Teams (VTRT);
- Compensation Policy for wildlife victims (2012);

- Communication with the regional and international organizations and consortiums for the protection of smuggling of wildlife and body parts.

Biodiversity loss also occurs as a result of habitat degradation. There are many depressed, waterlogged and raised areas in the Sundarbans where there is low natural regeneration of mangrove species. Habitat quality is an important factor that determines the diversity of flora and fauna and is determined by soil and water salinity, both of which range more widely in the Sundarbans (Siddiqi, 2001). The salinity intrusion due to reduced flows of freshwater from upstream is another important factor for biodiversity loss. Mahmood *et al.* (2014) demonstrated that seed germination of less salt-tolerant mangrove species (e.g. *Amoora cuculata* and *Heritiera fome*) is drastically reduced at higher salinity levels (15 ppt). From this, it can be speculated that higher salinity due to saltwater intrusion and lower flows of freshwater in the Sundarbans ecosystem may significantly reduce the diversity and abundance of less salt-tolerant species in the future.

Other important factors concerning the loss of biodiversity in the Sundarbans are pollution from domestic and urban areas, rapid industrialization around the Sundarbans, increased use of agrochemicals in the nearby fields, large scale aquaculture, mass tourism, increased movement of sea-going vessels, oil spills, bilge and ballast water (Rahman *et al.*, 2009; Begum *et al.*, 2015). Pollution from tourism (e.g. oil and fuel spills from boats and noise) has increased during the last two decades as the Sundarbans has become a more popular destination. The number of tourists increased from 49,000 in 2001-2002 to 220,000 in 2018-2019 (BFD, 2020). However, to address these concerns, the government has initiated initiatives such as preparing tourism guidelines for the Sundarbans and commissioning this SEA.

The loss of biodiversity for the SW region outside Sundarbans is mainly occurring in the fisheries and agricultural sector. The introduction of high-yielding rice varieties and GM/introduced crops has been responsible for the loss of some native crop varieties and biodiversity as well. The government has introduced many initiatives for biodiversity conservation (e.g. species conservation, SMART protection). There is a clear and urgent need to address how to quickly reduce and eliminate the anthropogenic threats to biodiversity in the Sundarbans, especially if Bangladesh is to maintain the area's beauty and unique universal value.

3.3.4.3 Invasive species – including alien species

For a long time, alien species of animals and plants have been introduced into Bangladesh from different parts of the world like South America, Asia, Africa and Australia. Some of these species were introduced to meet demand of food and timber and to provide certain environmental benefits and some occurred naturally. Gradually, these alien species have become a threat to the native species, displacing them in their natural habitats - literally as 'invaders'.

Invasive alien species (IAS) can be categorised as highly invasive, invasive and potentially invasive according to their severity of damage and magnitude of spread. Based on a literature review, Mukul *et al.* (2020) have noted 69 IAS in Bangladesh: 46 plants, 16 fish and 5 insects.

In the South West Region, there is also a pool of such alien invasive species - the most significant are *Echhornia crassipes* (water hyacinth), *Mimosa pudica* (Lajjabati), *Cuscuta reflexa* (Shornolata), *Lantana camara* (Lantana), *Mikania cordata* (Assam/German lata) and *Ipomoea fistulosa* (Dholkalmi) (Ndimele *et al.*, 2011). Among these, the water hyacinth is the most widespread and destructive invasive species in the fresh water ecosystem, but it cannot survive in the Sundarbans due the saline conditions. It is found in almost all fresh water bodies, spreading over the surface

and preventing sunlight and oxygen from reaching below, particularly where it is not regular cleared. It also hampers fishing and water transport system.

There are no known reports of invasive the alien species occurring in the Sundarbans. However, 14 invasive domestic (not alien) species are found in the Sundarbans that are a threat to the ecosystem. Most of these are light demanding. So, site modification/disturbances (i.e. canopy opening) can accelerate their spread. Three of these domestic invasive species are highly invasive (*Derris trifoliata*, *Eichhonia crassipes* and *Eupetorium odoratum*); six moderately invasive and the rest are potentially invasive. However, these invasive species are not particularly harmful to the major species of the Sundarbans in terms of impeding their establishment and growth (Biswas *et al.*, 2007).



*Water hyacinth*²⁸



*Prosopis juliflora*²⁹

Prosopis juliflora is found at the embankments near Munshiganj (Shatkhiral district) close to the Sundarbans. It is hard and expensive to remove as the plant can regenerate from the roots/copies. This versatile, medium-sized alien tree species is native to Mexico, South America and the Caribbean (ILDIS, 2018; CABI, 2020), and is fast-growing and can adopt in different habitats - from dry to saline. The species was introduced in dry areas of India and Sri Lanka for the production of fuel wood. Unfortunately, it then invaded the mangroves of south India (Walter, 2011; Gunawardena, 2013). *P. juliflora* is well adapted to warm and dry tropical climates. It grows well in areas receiving 250-600 mm annual rainfall. It is a fast growing tree and has a deep to very deep, well-meshed root system. It is capable of growing in inhospitable habitats such as rocky and saline soils, under adverse climatic conditions³⁰. Though there is no official record regarding its origin in Bangladesh, locally it is reported that this species was collected from India by individuals and planted unintentionally. Nowadays, local peoples plant this species on the embankment for

²⁸ Source: <https://www.google.co.uk/search?q=water+hyacinth+bangladesh&source=lnms&tbn=isch&sa=X&ved=2ahUKEwiY5Zqrma7qAhUHUBUIHe8BCloQAUoAnoECA8QBA&biw=1280&bih=610#imgsrc=UJYM5K6ZInPRmM>

²⁹ Source: <https://www.google.co.uk/search?q=water+hyacinth+bangladesh&source=lnms&tbn=isch&sa=X&ved=2ahUKEwiY5Zqrma7qAhUHUBUIHe8BCloQAUoAnoECA8QBA&biw=1280&bih=610#imgsrc=UJYM5K6ZInPRmM>

³⁰ Source: <http://www.fao.org/3/ad321e/ad321e04.htm>

its rapid growth and for fuel wood. There is no report yet of this species occurring inside the Sundarbans.

Several alien fish (mostly carps) and bird species (*Columba livia*) are also found. The most problematic invasive alien fish species in the country are *Clarias gariepinus*, *Pangasius sutchi*, *Pangasius giganticus*, *Tilapia mossambica* and *Oreochromis niloticus* (Rahman 1997). In recent years, some fish species have been introduced primarily to increase productivity to support the nutrients needs of a huge population (Galib and Mohsin 2010; Hossain 2009) and some were introduced for decorative or ornamental purposes. These fish species have been found all over Bangladesh including the South West Region.

The location and climate of Bangladesh are favourable to the IAS mentioned above. IAS have been identified as one of the greatest threats to native ecosystems, habitats and species (Guido and Pillar 2017; Mukul *et al.* 2006). Increasing globalization facilitates the arrival of IAS in new regions; and environmental changes, including global warming, facilitate their establishment worldwide (Early *et al.* 2016). The Forest Department is working on a comprehensive assessment and framework to identify and manage IAS in Bangladesh. To protect native species and ecosystems, government authorities should be more cautious about allowing the import or introduction of any new species in the country

3.3.5 **Protected areas and hotspots**

The Sundarbans, the largest mangrove forest in the world, is a unique ecosystem harbouring a large number of rare and globally threatened and flagship species such as the Royal Bengal Tiger, the critically endangered Northern River Terrapin, the endangered Irrawaddy Dolphin, the vulnerable fishing cat and saltwater crocodile along with numerous terrestrial and aquatic plants and wildlife. The entire Sundarbans (6,000 km²) was declared as a Ramsar Site in 1992 under the UN Convention on Wetlands, while its three wildlife sanctuaries covering 139,699 ha (23% of the Sundarbans) were declared as a World Heritage Site (WHS) in 1997 by UNESCO. This declaration committed Bangladesh to the international community to protect the biodiversity and outstanding universal value of the Sundarbans' ecosystem.

Both the WHS and Ramsar site in the Sundarbans have been afforded protection as reserved forest since 1875 under the Forest Act 1865 (Rahman, 2016; Bhattacharya, 2011; IUCN, 19978; Banglapedia, 2015). Later replaced as the Forest Act 1927, this restricts any entry, trespassing and attempt to cause damage to any resources such as trees, wildlife, water and soil within the Sundarbans. The act is strictly enforced and violation of most of its provisions are non-bailable punishable offence. The WHS enjoys additional protection under the Wildlife Act 2012. This provides for seven years imprisonment for killing a tiger, and makes any attempt to drive, damage or injure wildlife a punishable offence. The Wildlife Act also restricts industrialisation within 2 km from the boundary of a wildlife sanctuary – which includes the WHS.

Activities harmful to nature are restricted (under the Environmental Rules 1997) in the 10 km wide Ecologically Critical Area (ECA) adjacent to the Sundarbans. The rules prevents building infrastructure within the ECA without prior permission from the Department of Environment.

In Bangladesh, there are many areas rich in biodiversity and sensitive to changes, particularly to the impacts of anthropogenic factors such as land fragmentation, degradation, logging of trees, wildlife poaching, pollution, infrastructure development and industrialisation. The government

has taken initiatives to safeguard these biodiverse areas by declaring them a protected areas (Box 3.3) or ecologically critical areas.

Box 3.3: Definitions of protected areas

As defined by IUCN (2008) a protected area is:

“a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long term conservation of nature with associated ecosystem services and cultural values”³¹.

As defined by the Wildlife (Conservation and Security) Act 2010:

“protected area means all sanctuaries, national parks, community conservation areas, safari parks, eco-parks, botanical gardens declared by the Government under sections 13, 17, 18 and 19 of Chapter IV and special biodiversity conservation area established under section 22 of Chapter V and national heritage and kunjavana declared under section 23”³².

The South Western Region has many areas that are rich in biodiversity. Several have received special attention. The Sundarbans contains nine wildlife sanctuaries. Three terrestrial sanctuaries were declared in 1977 and six sanctuaries for dolphin conservation were declared in 2012. Outside the Sundarbans, two ecologically critical areas (ECA) were declared in 1999. One of these lies adjacent to the Sundarbans on its inland side; the other, the Marjat Baor, is in the Jhenaidah District. This 325 ha baor is an oxbow lake and supports wide range of flora and fauna. Its unique ecosystem is known for hosting many species of fish and aquatic bird species. It possesses a high density of diverse aquatic vegetation including free floating, attached floating and submerged plants. It is an extremely productive ecosystem with habitats that are crucial as feeding and breeding grounds for many fauna and faunal species. It is the only single baor to have ECA status.

In addition to above, a 1738 km² area was declared as a marine protected area (MPA) in 2014. It lies about 40 km south of the Sundarbans in the Bay of Bengal and includes a submarine canyon (>900m deep) (IUCN 2014). The MPA contains supports an diverse range of dolphins, porpoises and whales including species in need of immediate protection, e.g. Irrawaddy dolphin, finless porpoises, Indo-Pacific humpback dolphins, Pantropical spotted dolphin, spinner dolphin and also Bryde’s whale.

Whilst the protected areas and ECAs have been designated to conserve bio-diversity and restrict harmful activities, millions people in the surrounding areas are high dependent on the ecosystem services provided by these areas for their livelihoods. This sometimes obstructs the strict enforcement of laws. The areas are under pressure due to the high population density and demand for residential and agricultural expansion, infrastructural development and

³¹ <http://www.bforest.gov.bd/site/page/5430ce33-561e-44f6-9827-ea1ebaa2c00d/->

³² <http://www.bforest.gov.bd/site/page/5430ce33-561e-44f6-9827-ea1ebaa2c00d/->

industrialisation. Moreover, the people lack awareness of the need to conserve wildlife and natural resources. Therefore, there is a critical need for widespread consultation with stakeholders regarding (i) how local biodiversity concerns can be integrated with local area development plans and programs, and (ii) how effectively to engage local stakeholders in the governance system of these sensitive and protected areas.

In this regard, the Protected Area Rule 2017 introduced co-management in the Sundarbans. Four Co-management Committees have been established to strengthen conservation efforts with the active involvement of stakeholders. Hundreds of local residents are now official actors in protecting the Sundarbans as members of the Village Conservation Forum (VCF). A number of Community Patrol Groups (CPG) have been established comprising members of local communities, and have started guarding the Sundarbans together with forest officials (Sundarbans East and West Division report 2020). The Co-management Committees are due to receive a share of the revenue earned in the Sundarbans, which will hopefully contribute more to the effective protection of the area.

3.3.6 *Climate and climate change*

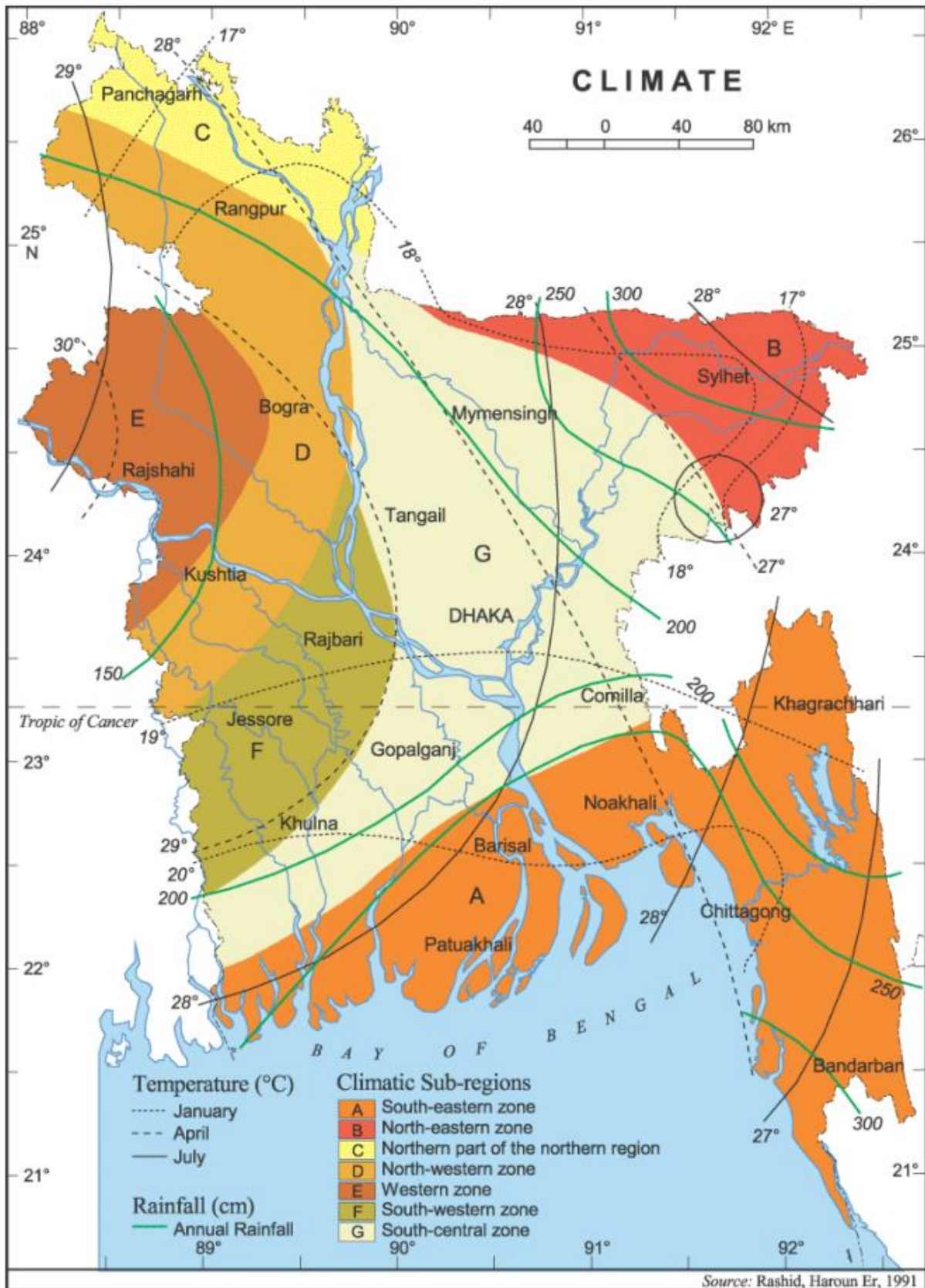
3.3.6.1 *Climate of Bangladesh*

Although located in the sub-tropics, Bangladesh has a tropical monsoon climate characterized by wide seasonal rainfall variations, moderate warm temperatures and high humidity. There are four distinct seasons (Shahid, Wang, & Harun, 2016; Ludwig *et al.* 2018; MoEFCC, 2018):

- winter (December-February) - cool and dry;
- pre-monsoon (March-May) - hot summer
- monsoon (June-September) – hot and humid with high rainfall;
- post-monsoon (October-November) – hot and humid, but drier autumn

The mean annual temperature in the country is about 25°C. The mean monthly temperature ranges between 18°C in January and 30°C from April to May. The highest temperatures throughout the year range between 38°C and 41°C. The average annual rainfall in the country is about 2,200 mm. About 80% of the total rainfall occurs from May to September (MoEFCC, 2018). During the winter, relative humidity remains below 60% and cloud cover is the lowest (about 10% country-wide) due to the cold dry winds from the north-western part of India. In contrast, during the monsoon, humidity is more than 80% with 80 – 90% cloud cover.

In general, climatic conditions in Bangladesh are characterised by seasonality, variability in arrival and departure of monsoon and variability between the climatic regions /sub-regions identified by Rashid (1991). All but two of the seven climatic regions are represented in the South West Region (Figure 3.9).



(Source: Rashid, 1991)

Figure 3.9: Climatic sub-regions of Bangladesh

3.3.6.2 Climate pattern, trends and evidence of climate change in the South West Region

a) Temperature

According to Shahid *et al.* (2012) average maximum temperature in the South West Region ranges from 30.1°C in the east to 31.3°C in the west and minimum temperature ranges from 20.1°C towards the north to 22.0°C towards the south. April is the warmest month while January is the coldest month.

Various workers have analysed official temperature records for weather station covering different time periods – some for weather trends across Bangladesh (e.g. Nishat and Mukherjee, 2013; Rahman *et al.*, 2016, for 1971-2010) and others focused on the South West Region (e.g. Shahid, 2010, for 1958-2003; Mondal *et al.*, 2013, for 1980-2010 and 1983-2010; Brammer, 2014 and 2016, for 1959-2008; Roy *et al.*, 2017 for 1948-2014; Rahaman, 2019. for 1971-2000; and CEGIS for 1951-2020

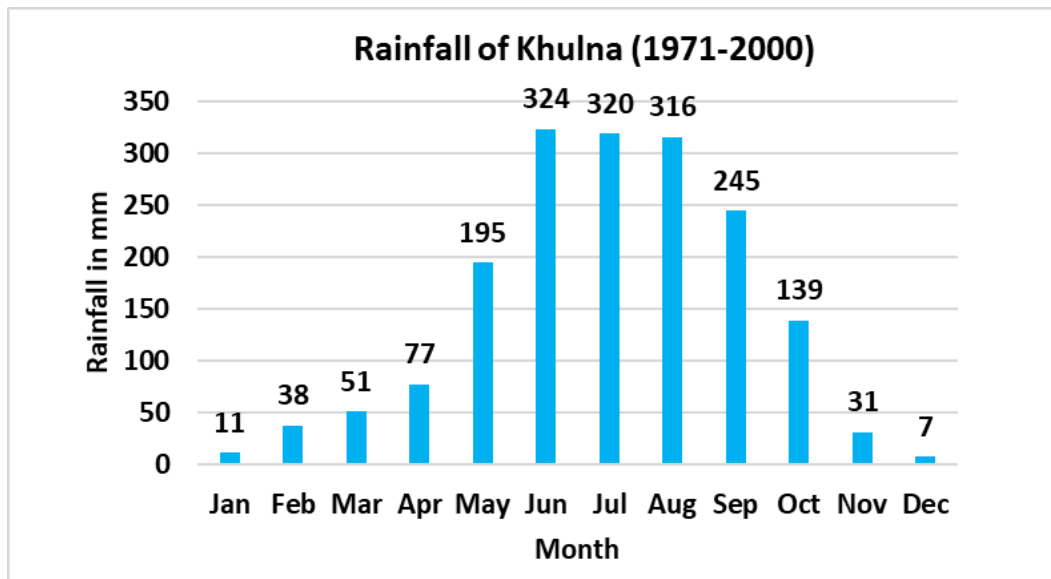
These studies (see appendix 7 for details) show varying, sometimes conflicting, results, but they generally suggest that there has been some rise in temperature over the particular periods studied. They variously report:

- A gradual increase in maximum temperatures - particularly in the monsoon and post-monsoon seasons (CEGIS);
- A gradual warming of the monsoon season over the last 70 years (by 0.4 - 0.7°C at different stations), but no significant increase in minimum temperature;
- Warmer winters with a prominent increase in minimum temperature (Nishat and Mukherjee, 2013);
- An upward trend in annual mean, minimum and maximum temperatures (Rahman *et al.* 2016);
- No trend in annual average minimum temperature (Mondal *et al.*, 2013);
- Annual mean temperature trend varies spatially and average annual temperature had increased significantly (Roy *et al.*, 2017);
- Irregular changes in maximum, mean and minimum temperatures (Brammer, 2014, page 219);
- Varying annual trends in mean temperatures (per decade) - some increasing, others decreasing for selected weather stations³³ (Shahid, 2010).

b) Rainfall

Heavy rainfall is characteristic of Bangladesh. Mean annual rainfall in the South West Region ranges from 1562 mm at Kushtia in the north to 1923 mm at Khulna in the centre to 1880mm at Mongla (Sundarbans) in the south. More than 70% of rainfall occurs in the monsoon season in this region (See Figure 3.10 which shows data for Khulna, representing the centre of the region).

³³ Faridpur, Khulna, Barishal, Satkhira and Jessore



(Source: CEGIS Analysis based on BMD data)³⁴

Figure 3.10: Rainfall at Khulna: 1971-2000

Various studies have examined rainfall records for different periods for Bangladesh (Brammer, 2014, for 1959-2008; Rahman *et al.*, 2016, for 1971-2010) and for stations in the South West Region (Shahid, 2010, for 1948-2007; Mondal *et al.*, 2013, for 1948-2010; Roy *et al.*, 2017 for 1948-2007; CEGIS for 1951-2020).

These studies show varying results -some indicating increases in rainfall, others indicating either no change or downtrends over the particular periods studied (see appendix 7 for details). They variously report:

- Increasing trend of annual rainfall in the South West Region – in the range 135-215 mm (1991-2010 bi-decade compared to 1951-1970) (CEGIS);
- Overall increase in the mean seasonal rainfall in all seasons (Nishat and Mukherjee, 2013);
- Increase at a rate of 8.4 mm/year (Roy *et al.*, 2017);
- A significant increase in winter rainfall in each decade, and increasing number of rainy days (Mondal *et al.*, 2013);
- Annual increases for each station (Shahid, 2010);
- Downward trends in pre-monsoon and post-monsoon rainfall (Rahman *et al.*, 2016);
- No evidence that rainfall amounts had changed (Brammer, 2014).

³⁴ WMO (2017) has defined the climate normal periods as the 30-year periods 1961-1990, 1971-2000, and 1981-2010. The period ending 2020 is not yet completed, so the 1971-2000 is used here to represent the baseline climate for the South West Region.

c) *Sunshine hours*

According to Mondal *et al.* (2013), there was a decrease³⁵ in sunshine duration during the winter and post-monsoon seasons over the period of 1984-2010 (27 years) (decrease of 0.6 hours a day per decade in winter and 0.4 hours a day per decade in post monsoon).

d) *Cyclone and storm surges*

Bangladesh is periodically hit by tropical cyclones (storms equivalent to hurricanes or typhoons) that form in the pre-monsoon and post-monsoon seasons in the Bay of Bengal (around latitudes 8–10° N). They generally strike the country in two seasons: March to July and September to December, with the majority of storms arriving in May and October. The cyclones strengthen as they initially move northward in the Bay of Bengal towards the coast of Bangladesh, although some weaken before they reach the coast. Such cyclones often pass inland.

Two categories of storms are recognized: tropical cyclones with wind speeds of >117 km/hr near their centre (tropical cyclones); and severe cyclonic storms with wind speeds of 87–117 km/hr. Both categories can cause substantial damage to property and crops by strong wind, heavy rainfall and storm surges (up to c. 9 m above normal sea-level) – the latter causing most of the human and livestock casualties, depending on whether they make landfall near high tide or low tide.

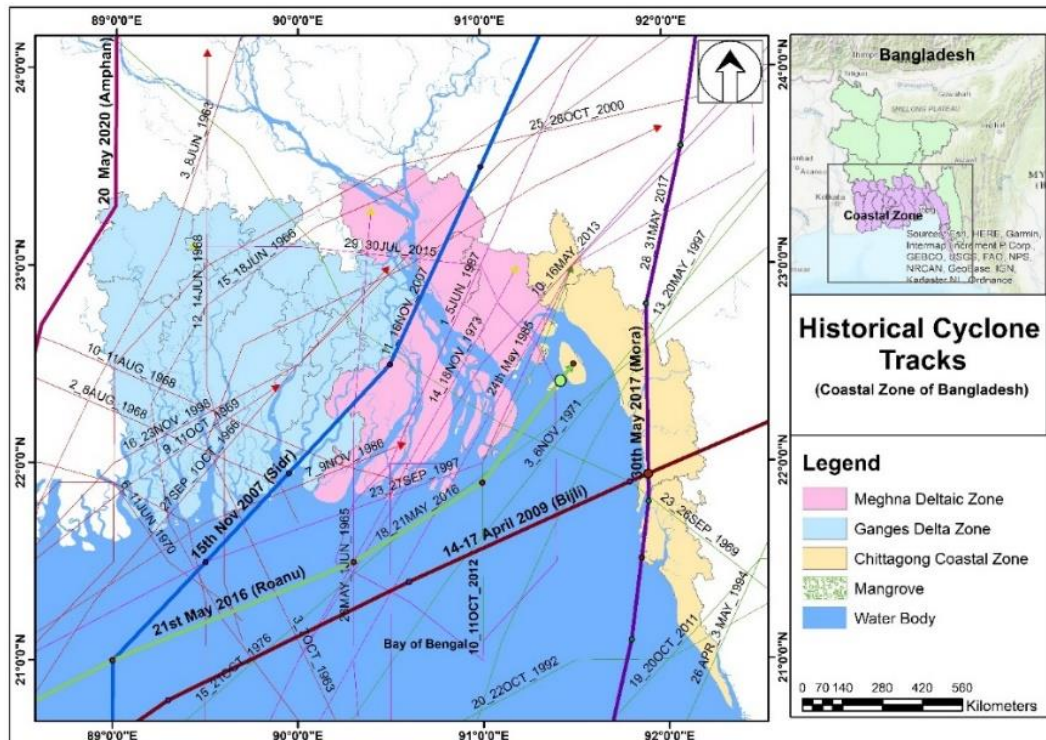
According to the Bangladesh Bureau of Statistics Yearbook (2014), 21 cyclones and severe cyclonic storms hit the Bangladesh coast in the period of 1960-2010. Two thirds of these occurred in the post-monsoon season (MoEFCC, 2018).

As with temperature and rainfall, there is mixed evidence about whether the frequency of cyclones and tropical depressions affecting Bangladesh has increased or decreased since global warming resumed 60 years ago³⁶.

CEGIS has analysed records held by the Bangladesh Meteorological Department on cyclonic storm events for the 1960-2020 period. According to CEGIS, the data indicate that the number of different cyclones types hitting Bangladesh has decreased over this period – from 24 in the 1960s to 13 in 2020s. However, the formation of deep depressions and occurrence of super cyclones (> 222 km/hr) increased in the period 1990-2020 by 6% compared to the previous 30 years. Figure 3.11 shows the distribution of high intensity cyclone along the Bangladesh coastline since 1963.

³⁵ The trend is statistically significant at 99% and 95% level of confidence, respectively, in the winter and post-monsoon seasons (Mondal *et al.*, 2013).

³⁶ During the period 1940 to 1970, there was worldwide cooling of 0.2°C. (Marshall, 2006)



(Source: CEGIS)

Figure 3.11: Reported cyclone tracks over Bangladesh coastline from 1960-2020

In 2007, the southwestern coastal zone of Bangladesh was hit by a category 5 cyclone (Sidr), followed by a category 1 cyclone (Aila) in 2009 (Jahan, 2012). Sidr is considered as one of the worst natural disasters in Bangladesh. It struck the southwest coast with winds up to 240 km per hour, accompanied by tidal waves up to 5 meters high and surges up to 6 m in some areas (Mallick, 2017). Embankments constructed to provide protection against storm surge flooding failed during Sidr and resulted in inundation of 35% of the affected area (without breaching of polder embankments, inundation would have been only 18% of the affected area) (Adnan, 2019). The most recent cyclone, Amphan, hit the South West Region in 20 May 2020 (Box 3.4).

Box 3.4: Cyclone Amphan

Cyclone Amphan was the first super cyclone, classed as severe, to form in the Bay of Bengal since 1999. After hitting the coast, it moved north across the country with a 15-17 ft high storm surge damaging more than 150 km of embankments in 13 districts, breaching embankments at 84 points and inundating large areas. With winds up to 185 km/hr, the cyclone caused devastating damage, particularly in the coastal zone: uprooting trees; flooding forest and adjacent land, and salinising freshwater ponds in the Sundarbans and surrounding areas - creating a scarcity of fresh drinking water for both people and wildlife in and around the forest; bringing down electricity and telephone lines; and flattening hundreds of homes. Covid-19 and social distancing made mass evacuations more difficult, with shelters unable to be used to full capacity. The worst affected district was Satkhira, where large areas were flooded as embankments collapsed in several places, areas became flooded and roads blocked. The authorities in the South West Region have been focused on recovery activities following the cyclone.

The total cost of damages caused by the cyclone in Bangladesh has been estimated at about BDT 11 billion³⁷.



Cyclone Amphan strikes the coast of Bangladesh, 20 May 2020

Table 3.5 lists the 10 cyclonic storms that have hit the south west coast during the period 1960-2020. Of these, eight severe to super cyclonic storms.

According to Roy *et al.* (2017), 123 cyclones and tropical depressions (TD) hit Bangladesh over the period of 1877–2014, 60% of them making landfall in the southwest coastal region. They report that, over this period, the record shows no clear trend, but conclude that severe cyclonic storms with hurricane intensity have increased over the Khulna coast since 1990. This result is consistent with Ali (1996) who examined the cyclone records over the period of 1181-1990. 50-year timeseries data for cyclones (1960-2010) compiled by Saha and Khan (2014) suggest that while cyclone severity has increased, the percent of cyclones making landfall on the southwestern and central coast has also increased. Vissa *et al.* (2013) suggest that intensification of severe cyclones is likely to be linked with the increasing sea surface temperature and high enthalpy flux exchange and with available moisture content during post-monsoon over the Bay of Bengal.

e) Sea level rise

There is evidence for recent changes in relative sea-level change (how the height of the sea rises or falls relative to the land at a particular location) along the southwest coast. The coastal areas of Bangladesh are generally divided into three categories: (a) the Ganges tidal plain or South-Western coastal region; (b) the Meghna deltaic plain or central coastal region; and (c) the Chittagong coastal plain or eastern coastal region.

³⁷ <https://tbsnews.net/environment/cyclone-amphan/cyclone-amphan-causes-damage-worth-tk1100cr-84139>

Analysis by Sen's slope³⁸ of tidal water levels using data over 30 years (1981-2013) from the Bangladesh Water Development Board, Chittagong Port Authority and Bangladesh Inland Water Transport Authority, reveals an increase in water levels in the south west Ganges tidal floodplain at a rate of 7-8 mm/year (CCC, 2016). By comparison, the rate of increase is 6-10 mm/year in the Meghna estuarine flood plain and 11-21 mm/year in the Chittagong coastal plain areas (CCC, 2016).

In another study, SMRC (2003) analysed the tidal gauge record for the period 1977-1998. This study showed water level increases of 4.0, 6.0 and 7.8 mm/year at Hiron Point, Char Changa and Cox's Bazar, respectively. However, local factors may affect meaningful determination of relative sea level rise, e.g. subsidence, sedimentation and tectonic movement, impact of wind circulation, anthropogenic effects such as the impact of fresh water flows or polderisation in the coastal region. These require further investigation.

Table 3.5: Cyclonic storms hitting south-west coast of Bangladesh (1960-2020)

Date	Nature of event	Category as Per IMD Scale	Landfall Area	Wind Speed in km/hr.	Tidal Surge Height in ft.	Central Pressure (mbs)
23.10.70	Severe cyclonic storm of hurricane intensity	Very severe cyclonic storm	Khulna-Barisal	163	-	-
10.12.81	Cyclonic storm	Very severe cyclonic storm	Khulna	120	7-15	989
29.11.88	Severe cyclonic storm with a core of hurricane wind	Very severe cyclonic storm	Khulna	160	2-14.5	983
28.10.00	Cyclonic storm	Cyclonic storm	Sundarban coast near Mongla	83	-	-
12.11.02	Cyclonic storm	Cyclonic storm	Sundarban coast near Raimangal River	65-85	5-7	998
15.11.07	Severe cyclonic storm with core of hurricane winds (SIDR)	Very severe cyclonic storm	Khulna-Barisal coast near Baleshwar River	215	15-20	942
25.05.09	Cyclonic storm (AILA)	Severe cyclonic storm	West Bengal-Khulna Coast near Sagar Island	110	4-6	987
21.05.16	Cyclonic storm (ROANU)	Very severe cyclonic storm	Barisal-Chittagong	128	4-5	992

³⁸ Sen's slope estimator is a statistical method for robustly fitting a line to sample points in the plane (simple linear regression) by choosing the median of the slopes of all lines through pairs of points (https://en.wikipedia.org/wiki/Theil%E2%80%93Sen_estimator).

Date	Nature of event	Category as Per IMD Scale	Landfall Area	Wind Speed in km/hr.	Tidal Surge Height in ft.	Central Pressure (mbs)
			coast near Patenga			
9.11.2019	Very severe cyclonic storm (Bulbul)	Very severe cyclonic storm	Kolkata-Khulna	140	5-7	976
20.5.2020	Super cyclonic storm (Amphan)	Super cyclonic storm	Kolkata-Khulna	240	15-17	920

(Source: BMD³⁹)

Pethick and Orford (2013) present evidence of relative sea level rise for the period 1930-2010 from three estuarine tide gauges located in the coastal area⁴⁰. This indicates a rise substantially in excess of generally accepted estuarine rates based on altimetry, as well as previous analyses of tide-gauges. The data showed rates of increase in relative mean sea level (RMSL) ranging from 2.8mma⁻¹ to 8.8mma⁻¹. However, they argued that these trends in RMSL disguise the fact that high water levels in the polder zone have been increasing at an average rate of 15.9mma⁻¹ and a maximum of 17.2mma⁻¹. They adopted 'effective sea level rise' (ESLR) as a more strategic parameter. This combines deltaic subsidence, including sediment compaction, and eustatic sea level rise, and particularly the increased tidal range in estuary channels that have now been constricted by embankments. Pethick and Orford (2013) conclude that ESLR in the South West Region is 14.1mm/year: ranging from 10.7mm/year at Hiron Point (a relatively undisturbed area) to 17.2mm/year at Khulna (mostly disturbed by anthropogenic activities)

Brown and Nicholls (2015) analysed data extracted from Holgate *et al.* (2013) and the Permanent Service for Mean Sea Level⁴¹ (2014) and concluded that relative sea level rise varied from 4 mm/yr (Hiron Point) to 19 mm/yr (Khepupara) over 1976-2003.

Bangladesh Delta Plan 2100 (GED, 2018) states that sea level rise is likely to cause significant changes in river salinity in the southwest coastal zone of Bangladesh during the dry season (October to May) by 2050, which will likely to lead significant shortages of drinking water in the coastal urban area, scarcity of water for irrigation for dry season agriculture and significant changes in the coastal aquatic ecosystems. Sea level rise along with drying up of upstream fresh water flows in rivers in the southwest is causing problems for agriculture and fresh water supply.

³⁹ <http://live3.bmd.gov.bd/p/Historical-Cyclones/>

⁴⁰ One located in the uninhabited mangrove forested area (Sundarbans), the others in the densely populated polder zone to the north of the Sundarbans.

⁴¹ A repository for tide gauge data used in the measurement of long-term sea level change - based at the National Oceanography Centre in Liverpool, England.

3.3.6.3 Future scenarios of climate change in the South West Region

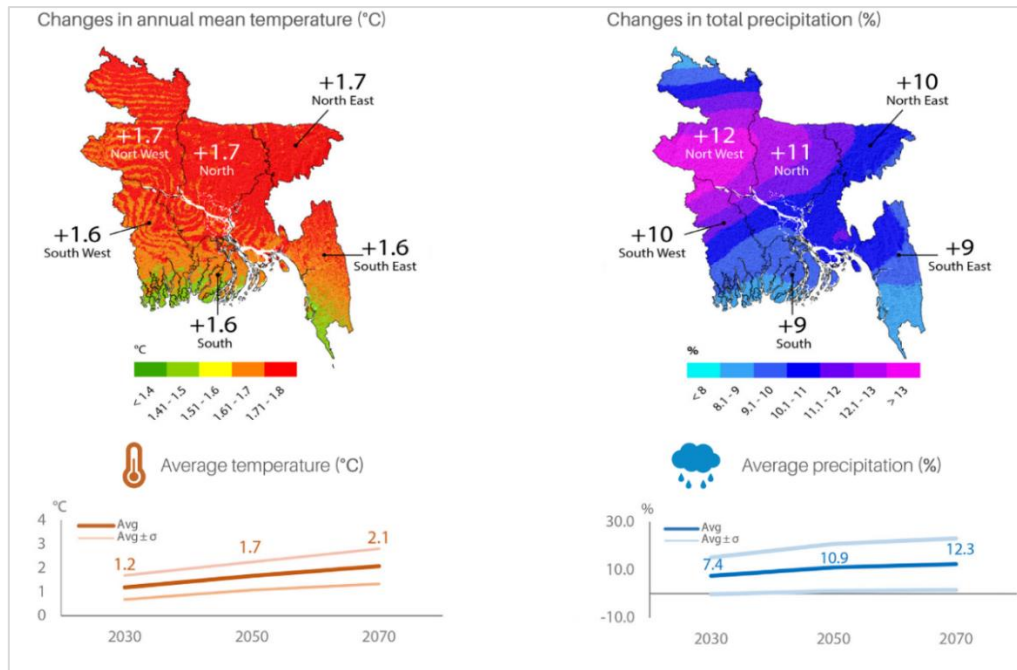
(a) Temperature and rainfall

CEGIS (2020) has updated the future climate change scenarios for the second phase of the Bangladesh Delta Plan 2100 (GED, 2018). These scenarios suggest a rise of 1.4 – 2.3°C in maximum temperature and a rise of 2.1 - 3.6°C in minimum temperature by the 2080s in the South West Region.

The Third National Communication of Bangladesh to the UNFCCC stated that, on the basis of integrated assessment models for the South Asia region prepared by ADB (2014), the average temperature in Bangladesh could rise by 2°C by 2050 and by around 4°C under the business-as-usual scenario. Such a rise in temperature would cause significant damage and losses to the economy. The expected annual GDP loss would be around 2% by 2050 (MoEFCC, 2018). Rahaman (2019) predicts 11% and 15% increase in annual rainfall, 1.3°C and 2.5°C increase in maximum temperature and 1.6°C and 3.1°C increase in minimum temperature by the end of century under RCP4.5 and RCP8.5 scenarios, respectively. These predications are based on statistical downscaling model using data from all 34 meteorological stations across Bangladesh.

A number of other modelling exercises have been conducted on future climate change in Bangladesh, e.g. Dastagir (2015), Basak *et al.* (2010), Fahad (2017), Islam (2008), Islam (2014) and CIAT (2017). The models predict different ranges of anomalies with a wide range of uncertainties. But they indicate high chances of a rise in temperature and increased rainfall variability, their predictions include:

- Bangladesh will become warmer and rainfall intensity will increase;
- Average rainfall is likely to increase but dry spells will become longer;
- Both maximum and minimum temperatures will continue to increase during the coming century;
- Minimum temperatures will increase between 2° and 5°C. depending on the time periods and emission scenarios;
- By mid-century, temperatures will increase between 2° and 3°C.;
- At the end of the century, with high emissions, temperatures could be 4°C degrees higher compared to the baseline period 1970-1999;
- The scenarios show a broad scale increase in total annual rainfall for Bangladesh;
- Rainfall will increase the most in the North East and the least in the South West - around 10-15%;
- In the North East, rainfall increases up to 800 mm/year, but in the South West the increase is less than 200 mm per year;
- In the South West, average temperature will increase by 1.6°C and average annual rainfall will increase by 10% (Figure 3.12) (CIAT, 2017).



(figure reproduced from CIAT 2017)

Figure 3.12: Temperature and rainfall projections over Bangladesh

(b) Sea Level rise

IPCC (2013) predicts global mean sea level rise between 0.2 and 1m for low to high emission scenarios by 2100 for the Bay of Bengal. For the future, the IPCC projections for very high emissions (red, RCP 8.5) and very low emissions (indigo, RCP 4.5) are shown in Figure 3.13 (IPCC, 2013).

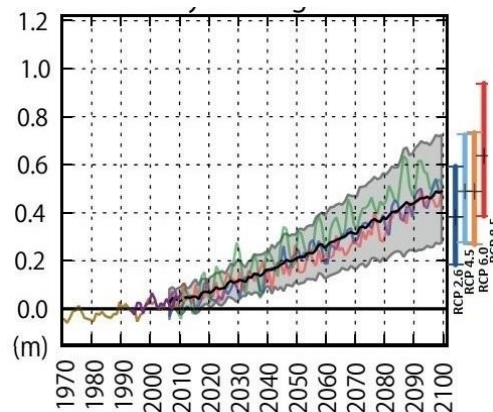


Figure 3.13: Sea level rise predictions for different RCPs in Bay of Bengal (IPCC, 2013)

3.3.6.4 Implications of climate change

(a) Flooded areas

Climate change due to anthropogenic activities will put the country at risk of recurrent and intensive natural disasters such as riverine floods, recurrent and flash floods, tropical cyclones and storm surges, droughts, salinity intrusion, sea level rise, and riverbank and coastal erosion (GED 2018; MOEFCC, 2018). According to Dasgupta *et al.* (2013), the areas vulnerable to inundation depths more than 1m and 3m would be flooded 14 and 69% higher, respectively, in

an extreme scenario than under the baseline scenario. 10-year-return period cyclones in the extreme scenario will be more intense by 2050 and will cover 43% of the vulnerable area – a 17% increase on the current coverage. However, most of the South West Region lies in the moribund delta which is less flooded than the current floodplain areas.

(b) *Salinity*

A report by IWM & CEGIS (2007) indicates that about 10% of the land area of the coastal belt of Bangladesh currently has salinity of 1 ppt, whilst 16% has 5 ppt salinity. By 2050, salinity levels are predicted to increase by up to 17.5% in the former areas and by up to 24% in the latter areas under extreme climate change scenarios.

(c) *Morphology and land formation*

Brammer (2014) suggests that the direct impacts of a rising sea-level will be to aggravate or accelerate some of the adverse effects of natural and human-induced environmental changes. For example, it will draw further inland the salt-water front in the western parts of the Ganges tidal floodplain. It will also further impede drainage from the interior areas to the east of the Lower Meghna River and from individual basins within regions to the west of that river. A rising sea-level could also increase rates of erosion of relatively older land on the major islands in the Meghna estuary, but this would be offset by continuing new land formation and reclamation elsewhere in the estuary.

(d) *Agricultural production and food security*

There has been no specific research on agricultural production and food security under climate change in the South West Region. Rahman *et al.* (2017) examined the poor yield potential and crop failure in Bangladesh under the threat of a change of climate. They found that, if rainfall increases during the post-monsoon season but remains unchanged during other seasons, rice production, especially rainfed rice, will be at risk due to frequent droughts and decreasing diurnal temperature range. They suggest that stress-tolerant rice varieties requiring less irrigation water and able to survive at high temperatures should be introduced. Research on rescheduling crop calendar and cropping pattern is necessary to mitigate the adverse climatic conditions.

(e) *Shrimp farming*

The production of tiger shrimp (*Penaeus monodon*) (also called “white gold”) under alternating shrimp-rice and shrimp-only farming systems in the region might be affected by projected climate change (Ahmed and Diana, 2015):

- Coastal flooding due to elevated tide level and sea level rise might inundate shrimp farms and create prolonged waterlogging and pose an economic threat;
- Future intensified cyclones may increase the associated short-term decline in abundance of post larvae and stocking rate, especially in the Mongla region where there is a lack of general awareness of cyclone forecasts. This may shrimp harvests and cause economic loss;
- Increased salinity may lead to crop failure.

(f) *Water quality*

Deterioration of water quality in the South West Region is related to excess groundwater abstraction and salinity intrusion (Roy *et al.* 2017) and local stratigraphy. Future sea level rise may increase salinity levels in the far SW aquifer. Hossain *et al.* (2016) report that rice production

has reduced poverty alleviation and increased gross domestic product (GDP) growth in the region, whilst the deterioration in water quality has had a negative impact on economic growth. Climate change can be expected to affect river and soil salinity in the coastal area, particularly due to sea-level rise and therefore increased ingress, and also due to increased upstream withdrawal of freshwater flow.

(g) *Power generation*

Shahid (2012) reviewed the vulnerability of the power sector of Bangladesh due to possible climate change. He concluded that rising temperature:

“will elevate total power consumption and peak power demand, especially during the pre-monsoon hot summer season, reduce power plant efficiency and transformer lifetime, and increase the transmission loss. More frequent and severe extreme weather events may cause more disruption in power generation and distribution, and more damage to power infrastructure. Lower river flow in the dry season may cause water scarcity in power plants and hamper generation. Increased salinity in river water due to sea level rise may lead to corrosion and leakages in power plants located in the coastal region. A diversified, decentralized, and climate resilient power system can reduce negative impacts of climate change on power sector of Bangladesh. Adaptation and mitigation strategies must be incorporated in the planning and development of new power systems and the reformation of existing power systems of Bangladesh.”

(h) *Livelihoods*

Hossain *et al.* (2012) conclude that:

“adverse impacts of climate change are likely to reduce availability and deteriorate quality of water for domestic use. Moreover, climate change is likely to increase the prevalence and infection of vector- and water-borne diseases such as malaria and dengue fever, cholera and dysentery, etc. Degradation of biodiversity will reduce the availability of many traditional medicines which may affect poor and rural people who depend more on natural resources for medicine as well as income and food. Sea level rise will drastically affect the poor people who are in coastal area and flood plain zone in Bangladesh. However, many actions undertaken to address the baseline or contextual risks in Bangladesh are also synergistic with the so-called adaptations that might be required as climate change impacts manifest themselves.”

Estimates suggest that sea level rise (SLR) could affect at least 1 million people in the Bangladesh part of the GBM basin by 2050 (Ericson *et al.*, 2006; Cruz *et al.*, 2007 in Rabbani *et al.*, 2015). The people of the exposed coast especially in Satkhira, Khulna, Bagerhat, Barguna, Patuakhali, Jhalkhati, Pirojpur and Barisal are very vulnerable to SLR and surge flooding. It is estimated that nearly 7 million and 13 million of people will be at risk in coastal zones alone (25,504 km²) by 2025 and 2050, respectively if the population growth continues at a rate of 1.4% and climate remains unchanged (Karim and Mimura, 2008). In the long term, if no action is taken to adapt to or mitigate global climate change, the average total economic losses are projected to be 9.4% by 2100 (MoEFCC, 2018).

A World Bank Study (World Bank, 2009) estimates that under the baseline scenario, the damages and losses stand at \$4.6 billion from a single cyclone/storm surge of a ten-year return period. With climate change, the damages and losses would increase to \$9.16 billion, including \$4.5 billion attributable to climate change. Damages and losses due to tropical cyclones and storm surges that accounted for 0.3% of the GDP under the baseline scenario would rise to 0.06% of GDP in 2050.

Over the last three decades, the GoB has invested over \$10 billion (at 2007 constant price) to make the country more climate resilient and less vulnerable to natural disaster. The BCCTF received a total allocation of a total of 450 million USD from the fiscal year 2009-10 to 2018-2019 to implement the climate change agenda of both public and private sectors. A total of 625 projects with an estimated cost of 404 million USD have been undertaken within this period, of which some 282 of such projects have already been completed. Yet, the government will need to raise US\$ 37 billion by 2030 to implement the delta plan (GED, 2018) over three phases: a short-term plan by 2030, a medium-term plan by 2050, and a long-term plan by 2100 for ensuring food and water security and fighting disasters.

3.3.7 Industrialisation

The Jute industry, once highly prioritised and a major export, is now in decline. There remain nine jute companies in the region and 48 associated spinning mills⁴². All the mills are established on the banks of the Bhairab River and discharge processing wastes directly into the river without treatment. The rivers provide good transport opportunities. LPG bottling is expanding to meet the increased demand as the population grows. There are 11 such bottling plants in the environmentally critical area (within 10km of Sundarbans Reserve Forest). There are also seven big cement and bag processing businesses in the region. In addition, within the Environmentally Critical Area, there are more than 70 rice mills and 80 food processing operations.

3.3.7.1 Petroleum products and pipelines

(a) Responsibilities for exploration, production, refining and marketing

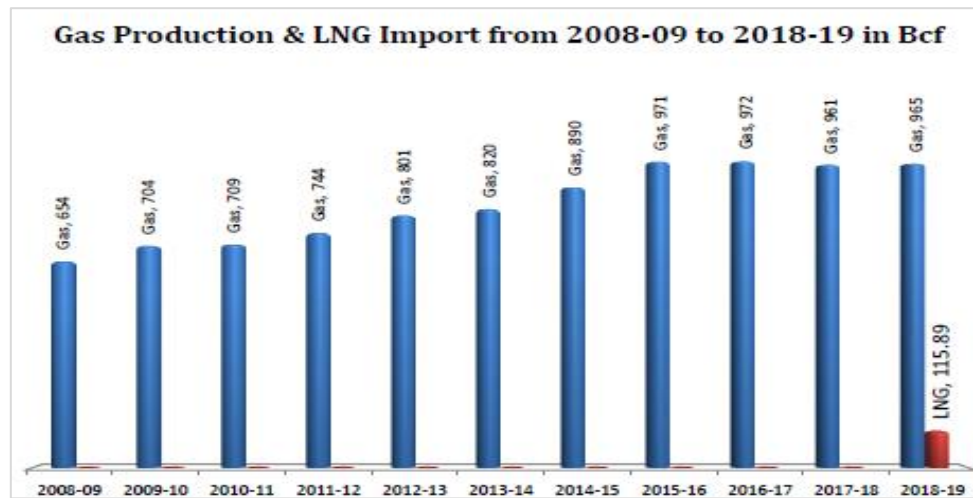
Petroleum and mineral resources plays a vital role in implementing Vision-2121 and Vision-2041 and in achieving Sustainable Development Goals 2030. The Bangladesh Oil, Gas, and Mineral Corporation (Petrobangla) was formed in 1972, under the Energy and Mineral Resources Division of the Ministry of Power, Energy and Mineral Resources. It was given responsibility for oil and gas exploration as well as production, transmission and marketing of natural gas in the country. Petrobangla operates through ten companies. In 1989 a new company, the Bangladesh Petroleum Exploration Co. Ltd. (BAPEX) took over responsibilities for exploration and production of hydrocarbons in selected areas of Bangladesh. The Bangladesh Petroleum Corporation (BPC) was created in 1976 to oversee the downstream portion of the oil and gas industry, i.e. importation, refining, and marketing of petroleum products.

(b) Gas trends

In last 10 years, gas production and consumption in Bangladesh has doubled to 2,750 million cubic feet per day (MMCFD). Natural gas accounts for 63% of energy demand. Since the first discovery in 1955, 20 of the 27 discovered gas are in production. As of June 2019, the estimated proven plus probable recoverable reserves were 28.69 trillion cubic feet (TCF). Of this, 16.93 TCF gas has already been extracted leaving 11.76 TCF recoverable proven plus probable reserves still available. Since the natural gas reserves are not sufficient for the country's production and

⁴² <http://textilefashionstudy.com/jute-mills-in-bangladesh-government-and-private-sector/>

consumption needs, the additional energy demand is being met through imported oil and liquid petroleum gas (LPG). Gas production and import status for natural gas is shown in Figure 3.14.



Source: Hydrocarbon Unit, 2020

Figure 3.14: Gas production in Bangladesh and imports: 2008-2019

(c) Imports and use

The Government has also focused on biomass energy production, support to renewable energy and importing electricity from India. The Gas Sector Management Plan (GSMP), 2017, recommends rigorous exploration and development programmes for the unexplored land and offshore areas of Bangladesh. The country is an oil importing country with the government controlling oil production, imports and domestic oil distribution. Oil prices are heavily regulated and controlled. The Bangladesh Petroleum Corporation (BPC) controls imports, production and supply of petroleum products throughout the country, with the involvement of the publicly-owned Eastern Refinery Limited (ERL) and public distribution companies in the supply chain. A number of LPG bottling plants, condensate storing facilities and refineries have been established in Mongla and Khulna region.

Several energy products are considered as sensitive and are subsidized under the government's pricing policy. These include:

- Diesel and kerosene: these are used mainly in transportation, irrigation and rural household lighting. Their direct prices are critical factors for communities at remote areas, irrigation and transportation of goods in the South West Region;
- Furnace oil: mainly used for power generation by private producers and in the manufacturing sector.

Octane and petrol are used for motor cars which are mainly owned by richer people. They are not considered sensitive and are therefore subject to tax.

There has been an increase in the use of LPG for cooking by people in urban areas in the South West Region due to government promotional initiatives and a shortage of biomass. Vehicles and vessels use petrol or diesel for transporting goods and commuters. The use of heavy fuel in transportation, industries and power plants is an important source of air pollution (SO₂ and particulate matter). The transportation and handling/storage of petrochemicals require high levels of precaution, but accidents still happen. A major oil spill occurred in 2014 in the Shela

River in the Sundarbans. Moreover, scattered oil spills from ships and unregulated vessels, cargo and lances have been found in the Mongla Port area. Recently, there have been a number of incidents when handling LPG bottle in kitchens.

(d) Pipelines and distribution

To assure access to natural gas by industries and commerce in the South West Region, a gas pipe line was established connecting Jessore, Khulna, Barishal and Shabajpur (Figure 3.15). The public-owned Sundarban Gas Company Limited (SGCL), established in 2009, supplies natural gas in the region. Since 2011, under the South West Region Gas Distribution Network Project, a gas distribution network has been constructed in five districts: Kushtia, Jhenaidah, Jessore, Khulna and Bagerhat. It is estimated that SGCL handled 11% of the total national gas distribution in 2016-2017. Three MOUs have been signed between SGCL and concerned authorities to supply gas to power companies in the region:

- Khulna 225 MW power plant (required gas load: 35 million cubic feet per day);
- Khulna 800 MW power plant (required gas load 125 million cubic feet per day).

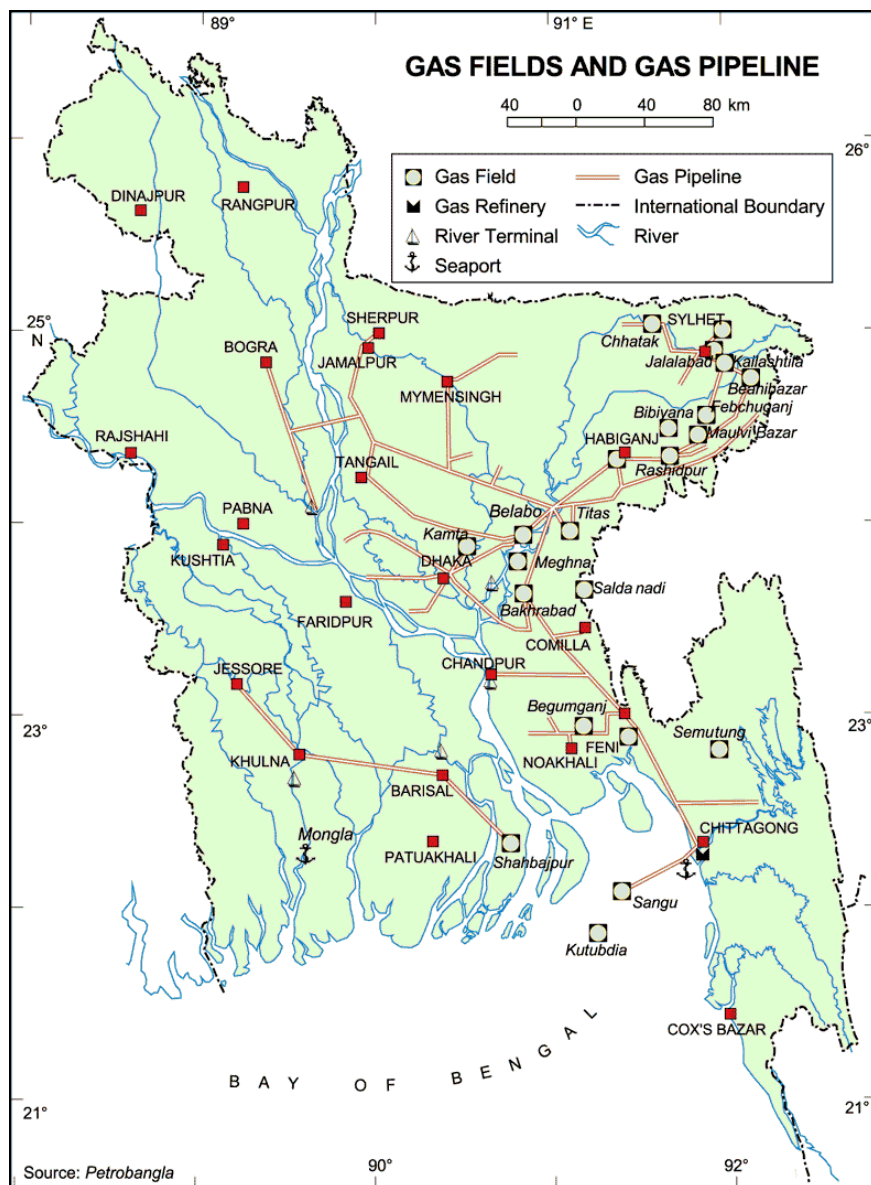


Figure 3.15: Location of the gas field and gas pipelines

According to the Gas Sector Master Plan, 2017, a 135 km transboundary gas pipeline is proposed from Ishwaripur in Satkhira District to Haldia in West Bengal, providing a link with the Indian gas transmission grid.

Construction of such a transboundary pipeline may have environmental and socio-economic impacts. Key issues could include: resettlement, political frictions, associated infrastructure, habitat fragmentation and pollution (see section 3.6.3.1).

(e) Future policy choices

Government decisions on incentives, choice of technology and investment in the petrochemical sector may also have potential impacts on the environment and climate change in the highly sensitive South West Region. This requires careful consideration of the use of subsidies, and appropriate policies and regulations. A recent study of 20 countries, including Bangladesh, found that the phasing out of the fossil fuel subsidy by 2020 led to a reduction in average national carbon emissions of 8.7% for Bangladesh (PRI, 2016). Additionally, if some of the fiscal savings are used to improve energy efficiency and to support renewable energy, the estimate for CO₂ reduction would increase to 13.6%.

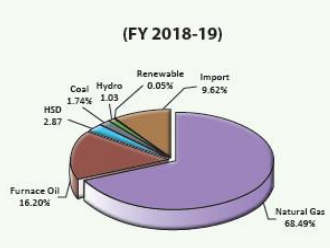
3.3.7.2 Power generation from oil, gas and coal

(a) Power generation

The power and energy sector is prioritized by government and is one of the fastest growing in terms of capacity. The maximum peak generation was 12,893 MW in 2018-2019, 17.66% higher than that in the previous year (BPDB, 2019). The Power System Master Plan (PSMP), 2016, expects to generate 24 GW of electricity by 2021, 40 GW by 2030, and 60 GW by 2041. It sets out an extensive energy and power development plan up to the year 2041 covering energy balance, power balance, and tariff strategies. The PSMP and Power and Energy Sector Strategy Paper, 2018, both recommend fuel diversification.

Total net energy generation in FY 2019 was 70,533 GWh, 12.53% higher than previous year's net generation of 62,678 GWh (BPDB, 2019). Net energy generation in the public sector was 35,107 GWh and 28,640 GWh in the private sector (including the Rural Electrification Board, REB). Another 6,786 GWh was imported from India via the interconnections between Baharampur and Bheramara and between Tripura and Cumilla. Net energy generated in public and private sector power plants from different fuel types is shown in Table 3.6.

Table 3.6: Power generation status in 2019

Fuel Type	Net Energy (GWh)	Fuel Contribution in Percentage
Natural Gas/LNG	48306	 (FY 2018-19) Total Net Generation : 70,533 MkWh
Furnace Oil	11426	
Diesel	2022	
Coal	1230	
Hydro	725	
Renewable Energy	39	
Power Import	6786	
Total	70533	

Source: BPDB Annual Report, 2019

The power plants in different zones in Bangladesh are usually constructed considering the power demand of those zones, availability of fuel and power evacuation facilities, etc. Electricity generated by power plants is supplied to the national grid which then distributes it according to zonal demand. At present, most of the power plants in the South West Region are using either heavy fuel oil (HFO) or high speed diesel (HSD). HFO and HSD is transported to the power plants by river. The construction and operation of gas or coal-based power plants in the region requires a combination of associated infrastructure: ports, river routes, roads, railways, pipelines and power transmission lines.

The planned energy mix in the South West Region includes natural gas, coal and renewables, taking into account the need to cover the growing future demand. Demand in Khulna region, as projected in the Revised Power System Master Plan, 2018, is shown in Figure 3.16. Power generation is expected to rise from 2575MW in 2018 to 9593MW in 2035, and then to decline to 9338MW in 2041.

At present, five new fossil fuel-fired power plants, with a total installed capacity 2655 MW, are being constructed: one is a coal-fired plant (1320 MW), two are heavy fuel oil-fired plants (105 MW, 100 MW), and two are natural gas/high-speed diesel-fired plants (330 MW, 800 MW) in association with renewable projects.

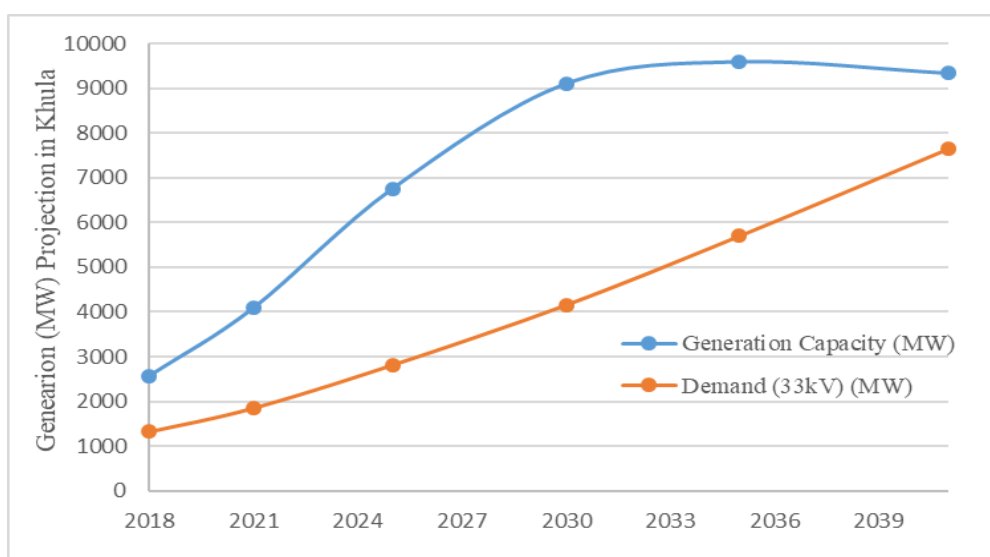


Figure 3.16: Power generation and transmission projection for Khulna region

(b) Impacts of energy production

In the South West Region, the energy and power system structure is more complex due to a number of issues: socio-economic challenges, industrial development, demand-supply imbalances, infrastructure and power transmission challenges, environmental stress, presence of the World Heritage Site (WHS), land use, cross-boundary issues, etc. This region is highly environmentally sensitive due to presence of Sundarbans Reserve forest.

The supply of electricity may help to revive the industrial zone of Khalishpur in Khulna, Mongla export processing zone and new industrial zones such as Khustia, Jessore, Bagerhat and Noapara. Apart from future power plants, there are also 24 highly polluting industries in the Sundarbans Environmentally Critical Area, including six cement factories and one petroleum refinery.

The increased air and water pollution associated with power and energy production and other industrialization in the South West Region is likely to have a considerable impact on sensitive ecosystems and people (particularly health).

The revised Power Sector Master Plan, 2018, proposes a range of energy developments including large-scale power generation facilities in Khulna region as well as a DC electricity interconnection with India from Bheramara, power transmission from adjacent nuclear power stations, a coal-fired power station at Payra in the adjacent South Region. There will be an excess of power production over demand. The locations for such new developments will need to be carefully evaluated after individual project environmental impact assessments, and possibly a strategic environmental assessment for the power sector, have been conducted to determine their potential individual and cumulative pollution risks, effects on the fragile Sundarbans ecosystem and cultural integrity.

3.3.8 Urbanisation

In recent years, the South West region has seen a decline of its major industries (jute, pulp, paper and matches). Nevertheless there has still been an influx of people to the cities, including from the rural areas as well as an expansion of development. Between 1998 and 2011, the total urban area in the region increased from 708 km² to 808 km² and urban population increased from 2.4 million to 2.7 million. In this region, there are in total 50 municipalities (pourashavas), including Khulna City Corporation and six major cities of Bangladesh (BBS 2011) (Table 3.7).

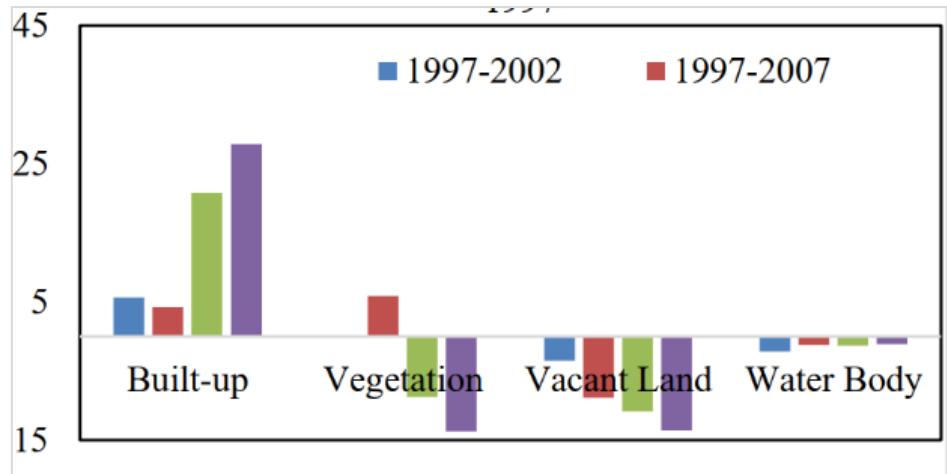
Table 3.7: Major cities/pourashavas of South West Region

Division	District	Major city	Area km ²	Population	
			2011	2011 census	projection for 2020*
Dhaka	Faridpur	Faridpur	19.02	1.91	2.24
Khulna	Chuadanga	Chuadanga	37.37	1.13	1.32
	Jessore	Jessore	14.71	2.76	3.24
	Jhenaidah	Jhenaidah	44.33	1.77	2.08
	Khulna	Khulna City Corporation	50.61	2.32	2.71
	Kushtia	Kushtia	13.32	1.95	2.28
	Satkhira	Satkhira	32.39	1.99	2.32

Source (Bangladesh Bureau of Statistics, 2014, Projections by BIDS (2014))

3.3.8.1 Changes in land use land cover

According to a study by Moniruzzaman *et al.* (2018), the amount of vacant land in the Khulna City Corporation area declined between 1997 and 2017 by 13.55%, whilst the built-up area increased by 6522 ha (27.92%) (Figure 3.17), indicating significant urban growth. Vegetation cover increased between 2002 and 2007 by 1,343 ha (5.85%).



(Source: Moniruzzaman *et al.*, 2018)

Figure 3.17: Progressive changes in land use land cover in Khulna city with respect to the year 1997

If the trend of converting water bodies and vacant land to built-up area continues in its unplanned way, then there will be a serious threat to the environment and ‘urban lung’ space.

3.3.8.2 Encroachment of water bodies

Urbanization and industrial expansion are encroaching upon the surface water bodies of the region. For example, in Khulna City Corporation area, between 1998 and 2018, the extent of surface water bodies decreased from 74,502 km² to 59,598 km² (some converted to built-up area, some replaced by vegetation or bare soil), whilst the built-up area increased from 20,214 km² to 25,068 km². (Marufuzzaman *et al.*, 2019).

Surface water body areas have important functions as habitats for fauna and flora, and also as soaks for excessive rainfall. Without proper management of surface water body areas, Khulna city may face more frequent urban flood during rainy seasons (Marufuzzaman *et al.*, 2019).

3.3.8.3 Air pollution

The Khulna Water Supply and Sewage Authority (KWASA) monitored air quality at various locations in Khulna City in 2016 to determine compliance with the standards prescribed by the Environmental Conservation Rules (ECR). The results showed that all parameters (CO, SO₂, NO₂, suspended particulate matter) are in compliance with the standards, except for one location in Mathavanga area where the SO₂ value was extremely high due the presence of brick kilns in the area (LGED 2019).

See also section 3.3.1.1.

3.3.8.4 Water pollution

Urbanization may trigger water pollution unless there is proper waste management (solid and liquid). In Khulna city, currently there are two systems of solid waste collection (LGED 2019):

- Households carry their solid wastes to the nearest roadside bins or similar facilities provided by Khulna City Corporation (KCC). KCC then collects the deposited wastes and transfers them to the final disposal (landfill) site at regular intervals.

- For a monthly fee paid by each household, private collectors gather solid wastes from houses every day by rickshaw vans, and then take them to nearby transfer points. The wastes are then transported on to the final disposal site by KCC trucks.

About 8% of the total generated waste in the city is recycled informally by scavengers and waste pickers. It is estimated that 40 tons of solid waste is recycled and recovered by households themselves or by scavengers. Khulna City Corporation operates two landfill sites. Nearly 80% of the waste is organic material. Initiatives to undertake composting would obviously help to reduce the dumping of such wastes. For several years, various NGOs have been running composting initiatives in KCC. However, these schemes are small scale with limited coverage. In Satkhira Municipality, 50% of solid waste is collected (Satkhira Municipality, 2020). There is no sewerage system in Khulna city. Most people use septic tanks or prehistoric storage pits. As a result of these deficiencies, there is significant air and water contamination in the municipal areas of the South West Region and thus people suffer from water-borne diseases (Zakaria, 2020).

3.3.8.5 Urban population density

Urban population density is below the national urban average (3785 persons/km²) in all the districts of the South West Region except Khulna District (3762 persons per km²) (Bangladesh Bureau of Statistics, 2014). However, population density is increasing in all districts except Bagerhat and Chuadanga, and this will increase the demand for jobs and housing and put increased pressure on social services.

3.3.8.6 Migration

There is an increasing trend of migrants moving to the urban centres, driven by the consequences of frequent natural disasters (particularly cyclones, tidal surges and floods), salinization and loss of livelihood opportunities. Almost all are poor and many are landless and are forced to live in urban slums and squatter settlements, particularly in the Khulna City area. Here, they do not have access to urban amenities such as clean drinking water, hygiene services and health facilities. They are at increased risk of health issues from unhygienic and overcrowded living conditions and from water and sanitation problems. They often suffer from different waterborne diseases, under-nutrition and micronutrient deficiencies (Rahaman *et al.*, 2018).

See also section 3.4.2.

3.3.9 Land use

3.3.9.1 Introduction

The major land uses of the South West Region are agriculture, shrimp and fish farming, forestry, urban development and other settlement needs. Over the years, changes in land use, especially in the fisheries sector, have resulted in environmental degradation. The region is increasingly becoming a focus for development to realise its economic potential. This, together with population growth, is driving expansion of all current forms of land use and unplanned land use practices. The changes and increasing anthropogenic pressures are causing environmental challenges: increasing salinity in soil and water, drinking water scarcity, decreased land fertility, increased health hazards, destruction of mangrove forests and agricultural land loss. These problems are acute due to lack of proper regulatory enforcement and ineffective monitoring mechanisms as a result of weak legislation.

3.3.9.2 Major land uses and changes

Land use in Bangladesh is generally determined by physiography, climate and land levels (Brammer, 2002). However, land in the coastal areas of the South West Region is mainly mangrove forest or is used for agriculture, rural settlement with homestead vegetation, shrimp cultivation and fish farming or is urban (Table 3.8 and Figure 3.18).

Livelihoods in the South West Region are largely dependent on agriculture, mainly rice production. 39.8% of the land is used for crop cultivation. Flooding, physiography, soil salinity, drainage congestion and irrigation facilities are the important factors affecting the land use for agriculture in the South West region. Agricultural cultivation in the coastal area is limited to the wet season because soil salinity is high in the dry season.

The other major economic activity in the region is shrimp farming and aquaculture. A vast network of rivers, beels (natural depressions), baors (oxbow lakes), flood lands and ponds provide opportunities for both capture and culture fisheries. About 11% area of the region is used for shrimp farming and pond aquaculture. Brackish water shrimp farms are mostly concentrated in the southwestern districts of Khulna, Satkhira and Bagerhat. They are mainly located within polders and most alternate between shrimp and rice production.

In recent years, freshwater shrimp farming has been increasing rapidly. It is concentrated in the Mollahat, Fakirhat, Chitalmari and Kochua upazilas of Bagerhat District; Dumuria, Phultala and Terokhada upazilas of Khulna District; and Monirampur and Abhoynagar upazilas of Jessore District.

There is 808 km² of urban area in the South West Region, mostly in Khulna Division. The major centres include Khulna City Corporation, Faridpur, Chuadanga, Jhenaidah, Jessore, Kushtia and Satkhira.

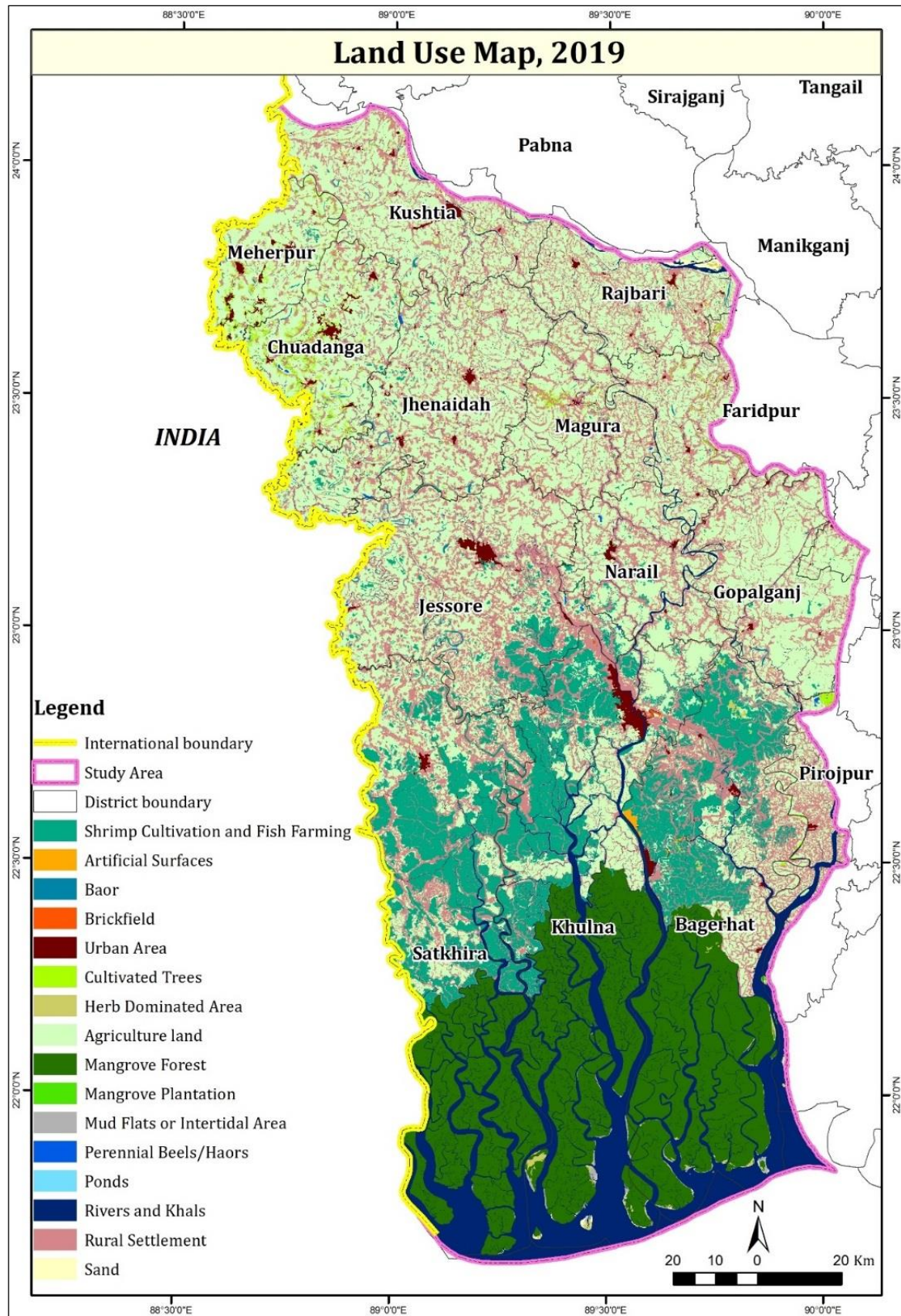
A change analysis of major land uses was carried out using LANDSAT satellite images of 2000 and 2019.

CEGIS (2020) analysed changes in the main land uses between 2000 and 2019 (Table 3.9). Agricultural crop land reduced by 7.5% whilst shrimp cultivation and fish farming increased by 6.8%. The analysis showed no change in the extent of homestead forests. However, another study by Parvin *et al.* (2017) showed significant increase of rural settlements with homestead forests over the last half century.

Table 3.8: Major land uses in the SW Region

Land use type	Area (km ²)	Area (%)
Agricultural crop land	10,531	39.8
Rural settlement with homestead vegetation	5,441	20.5
Mangrove natural forest (canopy cover)	3,957	14.9
Shrimp cultivation and fish farming	2,994	11.1

(Source: CEGIS, Analysis of LANDSAT Satellite Image, 2020)



(derived from LANDSAT8 satellite images, 2019)

Figure 3.18: Land use map, 2019

Table 3.9: Changes in extent of land under different uses: 2000-2019

Land Use	2000		2019		Change	
	Area (km ²)	Area (%)	Area (km ²)	Area (%)	Area (km ²)	Area (%)
Agricultural Crop Land	12,525	47.3	10,531	39.8	-1,994	-7.5
Rural Settlement with Homestead Vegetation	5,429	20.5	5,441	20.5	12	0.0
Mangrove Natural Forest (Canopy Cover)	3,986	15.1	3,957	14.9	-29	-0.1
Shrimp Cultivation and Fish Farming	1,141	4.3	2,944	11.1	1,802	6.8

Source: CEGIS (2020)

3.3.9.3 Causes of land use changes

Traditionally, paddy cultivation, especially using low-yielding, locally-adapted varieties, was the dominant agricultural land use in the South West Region. Shrimp culture was practiced in very limited areas. Salt intrusion and tidal surges routinely caused crop damage. In 1967, with the support of the World Bank, the Coastal Embankment Project (CEP) was initiated to increase agricultural production. Though the dominant land use was still traditional local varieties, modern paddy varieties and technologies were introduced. Between 1970s and 1980s, there was intensification of paddy cultivation with attempts to expand the use of modern rice varieties, and conversion of agricultural land to non-agricultural use. During this time, coastal afforestation began with the objective of protecting the coast from cyclones and foreshore erosion. There was also an expansion of industrial belts.

However, the polders of the southwestern coast experienced severe internal drainage congestion and heavy external siltation in the river channels. The areas became unsuitable for agriculture and even for human habitation. This “man-made disaster” (Rahman, 1995) resulted in increased poverty and out-migration from the area. At the same time, the polders provided new opportunities for expanding shrimp farming using the control structures (sluices) in the embankments to allow salt water into ponds. Subsequently, the land devoted to shrimp farming expanded and encroached on agricultural and forest lands.

Apart from the emergence of commercial shrimp farming, population pressure and land degradation are also driving land use change:

In the coastal zone alone, the population is expected to increase from 36.8 million in 2001, to 43.9 million in 2015, and to 60.8 million by 2050 (Ahmad, 2005). The extent of agricultural land per capita is predicted to decrease from 0.056 ha to 0.025 ha by 2050 (Islam *et al.*, 2006). With increasing population, land is being converted from productive purposes, such as crop cultivation, to other uses. Bangladesh is losing approximately 80 000 ha of good quality agricultural land annually to urbanization, building of new infrastructure (such as roads) and implementation of other development projects (World Bank, 2005).

Land is being continuously degraded or lost owing to erosion, salinity, inundation, etc.. According to Rahman and Ahsan (2001), 70% of the land of Barisal and Khulna Divisions is affected by different degrees of salinity, which reduces agricultural productivity, and 50% of coastal lands are subject to inundation of varying degrees and frequency that limits their effective use. This situation is expected to worsen due to climate change impacts (Islam 2006).

3.3.9.4 Impacts of land use changes

The conversion of agricultural land and mangroves, often forcibly and driven by commercial interests, to shrimp farming (Haque, 2004) resulted in wide-scale pollution and land-use conflicts (Karim and Stellwagen, 1998; Deb, 1998) as well as social unrest (Firoze, 2003).

Attracted by prospects of high incomes and economic prosperity, farmers have brought hundreds of acres of lands under shrimp production, mostly in an unplanned, haphazard and uncoordinated manner. As a consequence, there has been serious ecological and socio-economic damage (Karim, 2003):

- saline water from rivers and channels has been introduced to shrimp ponds, contaminating soil and groundwater and affecting agricultural yields - salinity has been dubbed a 'silent poison' (Kabir and Iva, 2014);
- local water has been polluted;
- local hydrology has changed with loss of fresh water (Kabir and Iva, 2014);
- biodiversity has reduced (World Bank, 2002) with a decrease in the variety of fish and shellfish;
- traditional, and not always efficient, systems of shrimp farming and processing have been used; and
- there has been indiscriminate use of chemicals that are damaging to the very sensitive environment; the gradual increase in toxic elements is contaminating soil and water and creating health hazards;
- conflict associated with the control of the large shrimp farms is one of the important causes of social imbalance and deteriorating law and order in the coastal areas in Bangladesh (Alauddin and Hamid, 1996). Firoze (2003) and Majid and Gupta (1997) have reported the social impacts of industrial shrimp culture. As agricultural lands were converted into shrimp farms, sharecroppers and landless wage labourer's lost their livelihoods. They began movements to resist the introduction of shrimp into their areas. This often resulted in violence. During the last two decades, more than 150 people have been killed and thousands injured in shrimp related violence (Firoze, 2003). Influential and rich shrimp farmers also initiated thousands of court cases. Many of these cases are still pending
- The Land Use Policy (2006) emphasises:
- Minimizing loss of cropland, stopping indiscriminate use of land; preparing guidelines for and use for different regions, rationalizing land acquisition, and synchronization of land use with natural environment;
- Protecting agricultural land to meet the additional food requirement for increased population;
- Ensuring best utilization of land through "land zoning" for agriculture, fisheries, forestry, rural and urban settlement, industry, infrastructure etc through modern technology;
- Implementing the Land Use Policy, 2001 and enforcing laws to prevent encroachment;
- Revision and updating of the Land Use Policy, 2001, to make it relevant to the present land resources management context;
- Improving coordination and harmonization among different agencies active in the coastal zone;

- Reserving government khas land for future development projects;
- Making land use environmentally friendly.

3.4 Key socio-economic issues

3.4.1 Population dynamics

Bangladesh is one of most densely populated countries in the world with an estimated 164.5 million people in 2020 (World Population Review, 2020). According to the Population and Housing Census, 2011, the population of the South West Region in that year (the base year) was 18.95 million. Projections by BIDS (2014) estimate that it would reach 22.19 million by 2020, 24.89 million by 2030 and 26.89 million by 2040 (Table 3.10). The overall growth rate in the census year 2011 was 1.37 (1.9 urban; 2.2 rural) (BBS, 2012; BIDS, 2014). The average population density was 951 persons/km² (BBS, 2012).

Table 3.10: Population in the South West Region with projection up to 2040

Districts	Population (in million)			
	Base year-2011*	Projection-2020	Projection-2030	Projection-2040
Pirojpur	1.11	1.30	1.46	1.58
Faridpur	1.91	2.24	2.51	2.72
Gopalganj	1.17	1.37	1.54	1.66
Rajbari	1.05	1.23	1.38	1.49
Bagerhat	1.48	1.72	1.93	2.09
Chuadanga	1.13	1.32	1.49	1.61
Jashore	2.76	3.24	3.64	3.93
Jhenaidah	1.77	2.08	2.33	2.52
Khulna	2.32	2.71	3.04	3.28
Kushtia	1.95	2.28	2.56	2.77
Magura	0.92	1.08	1.21	1.30
Meherpur	0.66	0.77	0.86	0.93
Narail	0.72	0.84	0.95	1.02
Satkhira	1.99	2.32	2.61	2.82
Total Population	18.95	22.19	24.89	26.89
National Population	150.70	169.12	189.70	205.00

Note: * Data for census year 2011 (BBS, 2012); Projections are based on this base year

Bangladesh is now experiencing a demographic transition with projections by BDHS (2014) indicating a decline in natural population growth rate nationally as well as for the South West Region, and the population expected to reach 205 million by 2050. By comparison, the United Nations projects it will be slightly lower (202 million) by that year (UN, 2015).

In 1976, the government declared the then rapid growth of the population to be the country's number one problem and adopted a broad-based, multisectoral family planning programme along with an official population policy (GOB, 1994). Population planning was seen as an integral part of the total development process and was incorporated into the successive five-year plans. Policy guidelines and strategies for the population programme are formulated by the National Population Council. However, population growth was identified as one of the major national problems in the first Five Year Plan (1973–1978). The main objective of the Bangladesh

Population Policy 2004 was to achieve net reproductive rate (NRR) of 1 by 2010 in order to have a stable population by 2060. But it did not prove possible to achieve this rate by 2010. So a revised population policy (2012) aimed to lower the total fertility rate (TFR) to 2.1 by increasing the rate of contraceptive user to 72%, and achieve NRR=1 by 2015. Other important objectives of the 2012 policy were to ensure the availability of family planning methods to eligible couples (by providing easy access to reproduction health services), to reduce infant and maternal mortality and to ensure gender and women's empowerment (BBS, 2015b).

TFR dropped from 6.36 in 1950–1955 to 2.23 in 2010–2015 and is projected to fall to 1.67 in 2050–2055 (SVRS, 2018). In the South West Region, the TFR in 2019 was 1.95, with Khulna having the highest rate (2.12) (BBS, 2019). However, the highest age specific fertility rate (ASFR) (0.125) is for the 20-24 years age range. In its population projections, BIDS (2014) used a low variant with NRR=1 by 2021 which corresponds to TFR 2.1 in 2021 ($NRR \sim 0.488 * TFR$) with an initial value 2.3 in 2011. By comparison, the UNFPA assumed three total fertility rate variants: low, medium and high (BBS, 2015). The high scenario assumes that TFR would remain constant at 2.3 (current level) for the entire projection period. The medium scenario assumes that TFR first drops to 2.1 (replacement level) in the 2011-2016 period, then to 1.9 (below replacement level) by 2016-21, and remains there until 2061. The low scenario is similar to the medium scenario except that it drops to 2.0 (below replacement) instead of 2.1 in the period 2011-2016, and 1.6 instead of 1.9 in the period 2016-2021 (BBS, 2015b).

Crude birth rate (the number of live births per 1000 mid-year population during a calendar year) in the South West Region was 17.43 in 2018 whilst the national rate was lower (18.3). By comparison, crude death rate (CDR) in the South West Region was 4.93, with Barisal and Khulna Divisions having similar rates (Barisal 5.8, Khulna 5.3) whilst in Dhaka Division it was lower (3.7) (BBS, 2019). Rural areas had a higher CDR (5.4) than urban areas (4.4). Child mortality has been decreasing proportionately in Bangladesh from 6.3% in 2006 to 3.4% in 2016 (Ramisa, 2019).

Apart from fertility rate, birth rate and child mortality are also factors that have led there being more people of working age than children – the so-called “demographic dividend” (Ramisa, 2019). The demographic may boost the economy with increased number of people in work and having proper health provisions, and improved infrastructure, etc. Low child mortality, birth and fertility rates, could support achieving sustainable economic growth. However, a large number of the younger working population lack employment and job opportunities. The unemployment rate in Bangladesh is still high (10.6%). 29.8% of all youths are neither in education, nor in employment or training (NEET) (Ramia, 2019). Similarly, there is rising income inequality. The poorest 5% earned 0.78% of the national income in 2010, but only 0.23% in 2019 (Ramisa, 2019). Life expectancy has improved from 70.7 in 2014 to 72.3 in 2018. It is higher for females (73.8) than males (70.8) - the latter are more prone to accidents and chronic vulnerability to fatal diseases. The mortality rate for children is decreasing.

According to SVRS (2018), the proportion of the population below 15 years of age fell from 37.6% in 2005 to 28.8% in 2018. Over the same period the proportion aged over 60 years increased from 4.2% to 5.0%. The censuses also showed a similar trend, with the proportion of the population over 60 years increasing from 4.0 in 2001 to in 2011. In the South West Region, 41.1% of the total population is dependent on the economically active population age group (5-60 years old) and 58.9% of the population of the South West Region is economically active (World Bank, 2020).

Age composition in the South West Region in 2011 (last census year) supplements the dependency ratio. In compounded percentages, the larger population in the mid-range group reflects a historically high-fertility regime that has recently started to stabilise or decline. In the South West Region, in 2011, children and adolescents (age range 0-19 years) accounted for 40.9% of the population whilst young adults (age range 20-49) made up 43.5% (BBS, 2012). 15.6% of the population were aged 50 years and over (BBS, 2012).

Bangladesh is considered to be one of the countries most vulnerable climate change due to a combination of factors: dense population in the coastal zone; 'feeble' economic conditions (IPCC, 2007); geographical location and low topographic relief, associated with tropical climate conditions. These challenges potentially exacerbate the risks of human and material losses, including impacts on agriculture production (Haque, 2018). People are very vulnerable to frequent disasters like tropical storms, cyclones and storm surges. It has been estimated that, by 2050, one in every seven people in Bangladesh will be displaced by climate change (The Humanitarian, 2015). About 28% of the population of Bangladesh live on the coast and are vulnerable to sea level rise and tidal flooding. The Environmental Justice Foundation (2018) suggests that up to 18 million people may have to move because of sea level rise alone in Bangladesh. Apart from regular storms, cyclones Sidr (2007), Aila (2009), Komen (2015), Bulbul (2019) and Amphan (2020) caused a huge losses (lives and livelihoods) amongst the coastal people. These events trigger affected people to migrate to the cities. Where they are forced to live in squalor in slums. On average, about 700,000 Bangladeshis are displaced each year by natural disasters (Mcdonnell, 2019).

3.4.2 Livelihoods

3.4.2.1 Livelihood strategies and patterns

The Bangladesh Bureau of Statistics (BBS) categorises livelihoods within three broad groups: agriculture (including fishing), industry and service (including salaried jobs). According to BBS (2012), 40% of those aged over seven years, but not attending school, are employed. Of these, 75% are employed in the agriculture sector, 20% in service sectors and 5% in industry. Throughout the 14 districts of the South West Region, agriculture is the dominant livelihood option. However, involvement in both the industry and service sectors is comparatively higher in Khulna District, the regional hub for industry. Other than this general pattern, four dominant livelihood strategies are evident around the Sundarbans area: agriculture, fisheries and aquaculture, forestry, and tourism.

Agriculture: Farming is practised in three seasons: Kharif-I (March – June), Kharif-II (July-October) and Rabi (November-February). Aman rice is the major crop grown in the South West Region, cultivated in Kharif-II in 51% of the total cultivated areas. Boro rice is cultivated in the Rabi season in 40% of the cultivated area. Boro accounts for 53% total of production, Aman 39%, and Aus only 8%. Almost 90% Aman production is from high yielding varieties (HYV), 7% is from local transplanted varieties, and 3% from broadcast rice.

Other than rice, different varieties of crops and vegetable are also produced in the South West Region. According to BBS (2018), annual total production of wheat, maize and potato was 1,255,852 MT per year; whilst cotton, sugarcane and tobacco totalled 628,008 MT. Kharif and winter vegetable production provide 1,000,761 MT. whilst production of fruits produced both in and outside of gardens was 913,289 MT per year

Although crop production is dominant in the entire region, it has been replaced around the Sundarbans, fully or partially, by fisheries (aquaculture). In slightly higher areas, where salt water cannot be perennially entrapped, rice is the principal crop. In those areas away from rivers and canals, people often cultivate crops and brackish water shrimps in rotation - following seasonal variability. In areas where salinity is low, crop production is higher; whilst in areas with higher salinity, rice, vegetables and fruits are not cultivated at all (Kabir, 2019; Faruque *et al.* 2017).

Fisheries and aquaculture: In the South West Region, peoples' involvement in the fishery sector can be of two broad types: capture and culture. Capture fishery in and around Sundarabans is a historically important livelihood and has expanded from a subsistence and artisanal form to a commercial basis (Kabir *et al.* 2019). Both forms are widely practised in the Sundarbans and adjacent waterbodies. The mangroves are rich in diverse fish and satisfy local, regional and national demand (Sen & Ghorai, 2019). A study by the DoE (2018) shows that 18.31 million subsistence or artisanal households in the region depend on capture fishery. The total annual catch of this type is 98,385 MT, whilst the average annual catch per household is 48.25 kilogram (DoF, 2018). Commercial fishing in the Bay of Bengal and adjoining rivers is increasing rapidly. A study by CEGIS (2020) revealed that each commercial operator fished in about a 15ha area during February, April, July and November, with an estimated average catch of 202.679 MT per operator.

The entire region, and especially areas around the Sundarbans, have witnessed a boom in commercial polyculture with fresh, marine and brackish water fish species (Azad *et al.* 2009). Almost all the land (300,000 ha) in the area surrounding the Sundarbans under has now been transformed into aquaculture ponds (Kabir *et al.*, 2019). People either cultivate by themselves or lease out land to others for cultivation. Jahan *et al.* (2015) assessed five major aquaculture practices in the southwest region: (i) homestead pond; (ii) gher; (ii) beel; (iii) commercial pond; (iv) rice-fish plot. The study found that culture fishery is the dominant mode of fishery practice in the South West Region, yielding an estimated 582,378 MT annually and accounting for 78% of total fish production. According to FoF (2018), the largest proportion of total fish production is from shrimp farms (30%), followed by semi-intensive fish ponds (16%), intensive fish ponds (14%), seasonal culture water bodies (8%), extensive fish ponds (2%), crab farms (1%), baors (1%), pen culture (0.48%), highly intensive fish ponds (0.3%) and cage culture (0.2%).

Fish drying is also an important livelihood. The second largest site for fish drying in the country (based on catch) is found on Dubla Island (char) in the East Sundarbans. This island included five small chars (Alorkol, Majher Kella, Meher Ali, Narikelbaria and Shelarchar) where fish are dried after catching from the Bay of Bengal (The Independent, 1 November, 2017). This seasonal activity provides employment for thousands of people during the dry season (Kabir *et al.*, 2019). Usually, the season starts in the second week of October and continues till March. During this fish period, fishermen and traders stay on Dubla Island permission from the Forest Department. According to a report in The Independent newspaper (1 November, 2017), in 2017, fishermen with official passes built in 870 makeshift houses and 38 fish storage depots. 11 wholesale fish traders (*bahaddars*) were also permitted to stay. Such traders usually lend money (*dadon*) to fishermen, which commits those fishermen to sell their fish and work for the lenders. The same report also stated that many fishermen have been involved in this activity for a long period (at least 40 years), and usually stay for four months consecutively in that catching and drying season. The conditions are difficult (saline and muddy) causing various waterborne and skin diseases. Trained village doctors and temporary medicine shops are established on Dubla Island during fishing period. Civil surgeons and doctors from Bagherhat monitor the health issues.

Use of forest resources: The Sundarbans provides various non-timber forest products that underpin livelihood opportunities. About 2.5 million people depend on extracting forest resources, mainly on a subsistence basis (Sen & Ghorai, 2019). In a study in Sharankhola subdistrict (upazila) of Bagerhat District, Chowdhury and Ashrafi (2008) showed that 49% of households depend on forest resources to varying degrees. These include food (various types of fish, honey, crabs, etc.), fuel wood (trees and tree parts) and materials for building shelters (e.g. *Golpata* – nipa palm; and *Goran* – a mangrove species). About 60% of households collected forest resources as their 'primary' occupation, with agriculture and trade as alternatives. In another study of 200 sampled households in the south western part of the Sundarbans, Getzner and Islam (2013) calculated that 90% of cash income is derived from the harvesting and sale of forest products, and only 10% from other sources. Another study showed that about 740,000 people, including collectors and traders, are directly involved in forest resources extraction, of which 80% are 'collectors'. 95% of the collectors work for others (Islam, 2010). Although collection times vary according to the type of resource, the maximum extraction takes place during December to March months (Islam, 2010).

Tourism: There is a significant opportunity for community-based tourism (CBT) in the Sundarbans, but relatively few local people are involved in such activities (Islam *et al.*, 2011). Most people have adopted it only as a secondary occupation during the tourist (winter) season (Siddiqui, 2003). The slow uptake of this opportunity is mainly due to the lack of proper concentration and management of this sector by the government (Alauddin *et al.* 2014; Islam *et al.* 2013). Community-based tourism activities are now growing around the Sundarbans providing alternative livelihood opportunities. Capacity development, training and also small incentives are provided to both men and women who are interested in this activity. In Khulna, Satkhira and Bagherhat areas, near to the Sundarbans, a number of community-based eco-tourism ventures have been started.

3.4.2.2 Marginal livelihood groups

A study by Mutahara *et al.* (2016) revealed six different marginal livelihood groups: (i) farmers, (ii) fisherman, (iii) dry fishers, (iv) fry collectors, (v) forest extractors (bawals, mouals), and (vi) wage labourers. These groups mostly work for others and do not have work all year round. In most cases, they do not have cultivable land other than homesteads and many are landless. A study by Mahmud *et al.* (2020) found that 35.73% were non-farm holders/landless in Rampal upazila in 2008, compared to 19.27% in 1983-84 (data retrieved from BBS, 2011). This increasing landlessness and lack of round the year jobs has caused increased marginalisation.

3.4.2.3 Livelihood-related issues and concerns

(a) Increased salinity

Increasing soil and water salinity are the main factors driving changes in livelihood strategies, particularly due to the replacement of cropland by aquaculture ponds. Rahman *et al.* (2013) reported the increase of soil salinity level up to 500% in non-saline areas in the South West Region as a result of shrimping. Kabir *et al.* (2019) show that crops are not produced in high saline areas; and where salinity level increases in non-saline or low saline areas, crop production is hampered. Although shrimping generates thousands of job opportunities and has improved the economy of south-west Bangladesh (Keus *et al.* 2017; Ahmed 2013b; Ahmed and Flaherty 2013; Bunting *et al.* 2017), it has brought contestations/conflicts regarding land control, and has limited farmers' choice regarding their own cropping pattern (Paul and Vogl 2011; Paul and Vogl 2013;

Afroz and Alam 2013). Many local people want to get rid of salinity and return to earlier crop-based production, but are facing increasing salinity. It is predicted that climate-induced inundation (as a result of sea level rise) will lead to the submerging under saline water of about 6,300 km² of the southwest delta by 2050 (IWM & CEGIS, 2007), which will push many people to abandon their present livelihoods.

(b) *Unregulated shrimping and negative externalities*

From its inception, shrimping in the South West Region expanded without regulation, with extreme negative consequences for the ecosystem (Islam and Braden, 2006). It has led to the decline of both crops and natural vegetation. Because of high economic return from shrimp farming, policy-makers are often compelled to ignore the negative environmental and social impacts it causes (Rosenberry 1993; Bundell and Maybin 1996). This unregulated shrimping has also led to severe land use conflict between rich shrimp cultivators and poor farmers (Paul and Vogl 2011; Azad *et al.* 2009), mainly because poorer people wish to continue to grow rice (Islam 2006; Kabir *et al.*, 2019). Despite significant conflict resolution over the last decade, the problem persists in areas with medium to low salinity where rice and other crop cultivation still competes with aquaculture (especially shrimp farming) (Maniruzzaman, 2012). This, in turn, continues to negatively affect local livelihoods (Adeel and Pomeroy 2002).

(c) *Influence of politics & local elites*

Since shrimp cultivation requires relatively high capital investment and provides a significant economic return, the majority of cultivated land has been exploited by rich and powerful actors (Sen & Ghorai, 2019). Because of the high profitability, powerful urban residents, including political leaders, relatives of bureaucrats, bankers and businessmen, have been able to lease-in coastal lands from the government, even though such were mandated to be allocated to the poor landless people of the region (Deb, 1998; Mahmud *et al.*, 2020). Thus, the processes of land grabbing, forceful land transaction, lease-in of most of the state-owned khas land by local-political elites, have forced the poor and powerless to become landless and to migrate elsewhere in search of livelihoods.

(d) *Natural calamities and livelihoods*

Due to its unique geophysical setting, the southwest delta had been hit severely by various cyclones and storm surges, notably in recent years: Sidr (2007), Aila (2009) and Amphan (2020). Cyclone Sidr devastated the Khulna region, with Bagerhat District severely hit. It is estimated that this cyclone caused severe damage: BDT 81.53.19 million to agriculture, BDT 620.19 million to industry, and BDT 339.66 million to trade services (Afsana & Jahan, 2016). A large number of people lost employment (FAO, 2007). Cyclone Aila affected the entire coastal area of the South West Region with an estimated 100,000 livestock killed, nearly 142,000 ha of crop land damaged and 38,900 ha of fish ponds damaged. Alongside, 190 people were killed or reported missing and 7,100 were injured (Islam *et al.* 2012). Cyclone Amphan affected about 2.6 million people in different ways. More than 200,000 houses were fully or partially damaged and more than 176,000 ha of productive land with standing crops and fish/shrimp farms were washed away. A large

number of people lost their last form of livelihood (NAWG, 2020). OXFAM Bangladesh⁴³ reports that, as a consequence, many people were forced to adopt negative coping mechanisms risking a potential increase in gender-based violence, child labour, child marriage and human trafficking. The current Covid-19 pandemic initially led to the unemployment of people, especially migrants working in cities. Most such migrants had to return to their villages. Rural people, especially businessman and fishers, faced a severe loss of income loss and livelihood crisis due to shutdowns. However, after some months, life returned to a more normal situation.

(e) Problems with fishery-dependent livelihoods

Disease infestation in shrimp farms is very common, In the 1990s it led to significant economic losses and unemployment in many places (Paul and Vogl 2011). Capture fishers encounter many problems in trading. Since they lack capital to invest, they turn to borrowing from traders, which obliges them to sell fish to those traders at lowered prices. Sometimes creditors take too much interest from the fishermen and this creates an extra financial burden. Over-fishing and fishing using poison are increasing problems in the Sundarbans.

(f) Livelihood insecurity amongst marginal groups

Local people, especially smallholders and marginal groups engaged in crop production, fishing and aquaculture do not have secure livelihoods. Many work as labourers with minor wages, and need to adopt secondary livelihoods to survive. Women and school children also contribute to household incomes. Some work temporarily as forest resource collectors in the Sundarbans. However, due to increasing restrictions on accessing the forest imposed by the Forest Department, their livelihood options have become limited (Hoq, 2014). The government seems reluctant to distribute state-owned khas land to the landless although this is prescribed in a land reform law (Presidential Order 135) (see Siddiqui, 1981; Mahmud *et al.* 2020). The government has introduced a number of Social Safety Net Programmes (SSNP) such as the Vulnerable Group Feeding (VGF) and Amar Bari Amar Khamar. However, in practice, most of the benefits from these programmes are exploited by ruling party actors and/or politically connected actors (Alam and Hossain, 2016). Many NGOs operate micro-credit programmes, but, due to high interest rates, many people lack year-round income and many fail to repay installments on loans (Dhaka Tribune, 22 August 2017). These combined issues are a livelihood tragedy for the marginal groups.

3.4.3 Migration

3.4.3.1 Introduction

In the southwest region, rural to urban migration is common, mainly for economic reasons, to find employment and a chance to remit money back home. Village-to-city migration accounts for nearly two-thirds of all migration, with overseas migration less than a quarter (24%) and village-to-village migration 10% (Afsar 2005, cited by Martin, *et al.*, 2013).

Women tend to move for family reasons, e.g. to marry or join a spouse (DECCMA, 2018). The implications of migration depend on whether it is voluntary or involuntary (i.e. the absence of

⁴³ <https://www.facebook.com/watch/?v=749966575764617>

options in home location). Involuntary migrants often face risks and poverty in urban centres (DECCMA, 2018). The majority of migrants are men.

Internal migration is a major policy concern and the subject of heated public debate in Bangladesh. It has been identified as both the *saviour and villain* of national development - a driver of economic and industrial expansion and modernization, whilst also the cause of severe urban deprivation and a destroyer of traditional rural life (Marshal and Rahman, n.d).

According to Akhter (2016), the main causes of migration in the South West Region are unemployment (65%) and poverty and food insecurity (23%). The rate of temporary/seasonal migration (67%) is higher than permanent migration (20%) and most migrants move to cities (77%). Lower economic groups (extremely poor, poor and lower middle class) are the main migrants in the South West Region.

Rural-urban migration is resulting in urban resources becoming scarcer. Overcrowding in urban areas, particularly in city slums, and the absence of sanitation and sewerage systems, has increased the prevalence of waterborne and airborne diseases. The lack of job opportunities and the high risk of disease drives slum dwellers even further into poverty. High population density within urban centres is also a key issue (Alam *et al.*, 2018).

3.4.3.2 Strategies to facilitate migration adopted in national plans

The Perspective Plan of Bangladesh 2010-2021 (2012) aims to alleviate poverty by facilitating migration from poor areas, particularly out-migration of labour to take up overseas employment and generate remittances as the Bangladesh economy becomes increasingly integrated with the global market. The Seventh Five Year Plan (2015) prioritises migration to exploit the demographic dividend⁴⁴. There is evidence that countries that have experienced growth for long periods have also undergone structural transformation of their economies and societies. For centuries, rural-urban migration has been recognised as a factor in structural transformation. The Seventh FYP includes strategies to create opportunities for international migration. The flow of remittance earnings is emerging as a crucial source of resources to improve local economy. This flow is still low in lagging districts and is contributing to their continued under-development. Thus, the Seventh FYP contains the following provisions for lagging districts:

- To increase the number of migrants working abroad from such district which receive meagre share of foreign remittances;
- To establish technical and vocational training institutions to create opportunities for the people to be semi-skilled and get employment by internal migration to industrial districts of Bangladesh;
- To establish a special financing scheme for prospective migrants from lagging districts.

⁴⁴ The demographic dividend means the economic growth potential that can result from shifts in a population's age structure, mainly when the share of the working-age population (15 to 64) is larger than the non-working-age share of the population (14 and younger, and 65 and older).

3.4.3.3 Risk of population migration

Drivers of migration include factors such as socio-economic vulnerability, scarcity of potable water, health threats caused by salinity and increased treatment costs, and poverty due to frequent cyclone hits. Rakib, *et.al.*, (2019) found a high migration risk in the unions of Gabura, Munshigonj, Atulia, Burigoaliny, and Padmapukur (from highest risk to lowest) in Satkhira District in South West Region. Climate change, sea level rise, and the associated impacts of these trends may soon lead to further migration. However, some studies suggest that migration is an effective climate adaptation strategy (Barnett and Webber 2009, Tacoli 2009, Foresight 2011, Black *et al.* 2011a, ADB 2012, Banerjee *et al.* 2012; cited by Martin, *et al.*, 2013).

Internal migration to urban areas is increasing sharply (Planning Commission 2010b). An estimated half a million people move to cities every year, mainly from coastal and rural areas (Islam 2012) and mainly driven by income diversification and changing farming patterns. The contribution of agriculture to rural household incomes dropped from 59% to 44% between 1987-1988 and 1999-2000. Over the same period, the share of services and remittances in their incomes grew from 35% to 49% (Afsar, 2005, cited by Martin *et al.*, 2013). In effect, countryside has become a labour source for the cities (Toufique and Turton 2002, cited by Martin *et al.*, 2013).

Martin *et al.* (2018) cite work showing that five key factors drive migration in Bangladesh: economic (dominant), environmental, social, demographic and political, probably influenced by climate change and variability. Migration/mobility is critically important for the rural poor during lean farming seasons and is an important livelihood strategy (Afsar 2005, cited by Martin *et al.*, 2013).

International migration is also increasing, although it is still too costly for most Bangladeshi families (Black *et al.* 2011b, cited by Martin *et al.*, 2013). It could become a risky option for those with insufficient capital and institutional or social support (Martin *et al.*, 2013).

About 11% (see Table 3.11) of total international migrants from the South West Region move to countries in the Gulf and South East Asia. Table 3.10 shows the numbers of people from the South West Region employed overseas during 2005-2018. The website of the Bureau of Manpower, Employment and Training (BMET) (www.bmet.gov.bd) states that the highest number of Bangladeshis employed in overseas countries during the period 1976-2020 was in 2017 (1,008,525). But numbers have been falling since. Total emigration from Bangladesh in 2018 and 2019 decreased respectively by 27% and 40% compared to 2017. In 2020, up to May, 181,218 emigrants were employed in overseas countries, 82% lower than 2017.

Table 3.11: People from the South West Region employed overseas: 2005-2018

District	Male	Female	Total
Bagerhat	31,482	5,793	37,275
Chuadanga	37,008	3,206	40,214
Faridpur	130,505	46,193	176,698
Gopalganj	44,184	5,262	49,446
Jashore	83,731	12,975	96,706
Jhenaidah	68,966	7,787	76,753
Khulna	27,519	8,491	36,010
Kushtia	80,189	6,122	86,311

District	Male	Female	Total
Magura	34,277	3,280	37,557
Meherpur	57,266	1,331	58,597
Narail	29,341	3,066	32,407
Pirojpur	41,715	6,527	48,242
Rajbari	54,620	9,036	63,656
Satkhira	29,854	7,418	37,272
Total in SW Region (%)	750,657 (85.58)	126,487 (14.42)	877,144 (100)
Total in Bangladesh	7,350,508	768,829	8,119,337

Source: Bureau of Manpower, Employment and Training; Ministry of Expatriates' Welfare and Overseas Employment.

3.4.3.4 Remittances

Remittances by Bangladeshis employed overseas have become an integral part of the economy, contributing significantly to alleviating poverty in the country. According to Bangladesh Bank, migrants remitted US\$15.54 billion in 2018, 15% higher than in 2017 (US\$13.53 billion). Generally, migrants cannot remit money in the year they migrate. They start doing so from the second year of migration. The increased flow of remittance in 2018 is due to the massive increased outflow of migrants in 2017 (Siddiqui et al., 2019).

3.4.4 Health and sanitation

3.4.4.1 Prevalent diseases

The pattern of disease prevalence and death rates is almost similar across the country and varies very little between urban and rural areas: death rates due to communicable and non-communicable diseases (NCD) are 26% and 67%, respectively (DGHS, 2018).

Among the communicable diseases, tuberculosis and diarrhea are the most prevalent. Others include filariasis, malaria, nipa virus, anthrax, HIV/AIDS and avian influenza. In the South West Region, the prevalence of diarrhea is much higher in Barisal Division than in Khulna and Dhaka Divisions. Cases of acute respiratory diseases are highest in Khulna Division followed by Barisal Division. The Bangladesh Multiple Indicator Cluster Survey (2012-2013) showed that there are more cases among the poor than those who are richer (BBS & UNICEF, 2014).

Recently, a significant number of cases of diseases transmitted by the Aedes mosquito (i.e. dengue fever and chikungunya) have been detected, including in the South West Region (DGHS 2017 and 2018). Currently, Covid-19 is the main concern in Bangladesh. Up to 26th June, 2020, 0.13 million people had been affected by this diseases in the country. In the South West Region, there had been 5090 confirmed cases - the highest numbers in Faridpur (1479) and Khulna District (1120)⁴⁵.

Diabetes is the most prevalent non-communicable disease in the country, followed by heart diseases and chronic obstructive pulmonary diseases (COPD) (DGHS, 2018). The prevalence of these diseases is similar across the country, although it is a little less in rural areas, and depends mostly on factors such as physical/mental stress, food habit and immunity.

⁴⁵ <https://www.iedcr.gov.bd/index.php/surveillance/212-nipahreport>

3.4.4.2 Impacts of diseases

The above mentioned diseases have a significant impact on lives and livelihoods, especially for poor and lower middle class families:

- While people are recovering from communicable diseases, or are hospitalized, they lose their regular income;
- Some communicable diseases transmit rapidly through communities and affect many families;
- People may be forced to take early retirement as a result of non-communicable diseases, depriving them of income/livelihood;
- Treatment of some diseases is costly and cannot be borne by poor and lower middle class families without taking on the burden of loans; and
- The death of the only or main earning member of a family due to diseases represents a disaster.

3.4.4.3 Health care facilities

All of the 14 districts of the South West Region have district/general hospitals with 100-500 beds and most upazilas have health complexes containing 10-50 beds and associated common medical and general treatment facilities (DGHS, 2018). There are three government medical colleges located in Khulna, Barisal and Faridpur Divisions. In addition, there are some private medical facilities (i.e. hospitals, clinics, diagnostic centres, authorized dispensaries) in the Division/District/Upazila head-quarters in the region. Plus there are also some alternative medical treatment facilities in both urban and rural areas, i.e. homeopathic, unani-ayurvedic.

The Covid-19 crisis has exposed that health care facilities are poorly managed, fragile and function poorly in emergencies⁴⁶. Across Bangladesh, nursing care and treatment facilities in hospitals is poor and insufficient. Only 340 intensive care units (ICU) are available for 160 million people⁴⁷, with very few apparently in the South West Region (general observation from reports on local television news). Only 23 government hospital have been able to set up a central oxygen supply system. As a result, about 80% of Covid-19 patients have been treated at home. People have been advised not to go to hospitals unless they face a critical and emergency situation.

3.4.4.4 Access to health facilities

In the South West Region, both roads and waterways are used for transportation. But during the monsoon period (April–August), connectivity between some villages and upazila/district headquarters becomes difficult. Cost and availability of transport are the main constraint during this period. Some of the Upazila health complexes have no ambulance facilities – a major concern

⁴⁶ <https://asiatimes.com/2020/06/bangladesh-and-covid-19-disaster-within-a-disaster/>

⁴⁷ https://www.bbc.com/bengali/news-53188922?at_medium=custom7&at_custom1=%5Bpost+type%5D&at_custom4=8361C4BA-B798-11EA-B562-9E9C96E8478F&at_custom2=facebook_page&at_campaign=64&at_custom3=BBC+Bangla&fbclid=IwAR2M8P_ge6DcuCalf6ijXc9txaPlrUh3bvHc7vtM-QRUBm9SM8y9lsgS7d0

for moving critical patients in the region. Also, government health care centres find it difficult to meet the high demand for services due to insufficient staff and treatment facilities.

3.4.5 *Gender*

Women constitute about half of the total population of the country. The government has adopted various policies, plans and programmes⁴⁸ to eliminate discrimination against women and girls in all spheres and to promote women's equality. Women play a pivotal role in the economy and their increasing involvement in economic activities over time can be attributed owing to (i) the implementation of government family planning policies in the late 1970s, (ii) the microcredit revolution in the mid-1970s, (iii) industrial policy in the early 1980s, and (iv) the Food for Education Programme piloted in 1980, which helped in reducing the total fertility rate (TFR) of women, creating jobs for women, increasing their involvement in agricultural and industrial production and encouraging children to attend school.

3.4.5.1 *Womens' participation in economic activities*

The majority of women in Bangladesh engage in home management activities while men usually work outside the home in agriculture, trading, marketing, etc. (Khan and Rahman, 2016). The absence of women's participation indicated in official agricultural statistics is primarily due to deeply embedded social and cultural norms: (a) patriarchy - a set of social relations with a material base that enables men to dominate women; and (b) purdah - a practice that proscribes the seclusion of women including severe restrictions on their movement and engagement in economic activities outside of their homes (Paris *et al.*, 2004; Asadullah and Wahhaj, 2012, cited by Khan and Rahman, 2016). Nevertheless, many women do perform economic activities such as raising cattle and poultry, vegetable production, gardening, post-harvest activities, agro-forestry and, importantly, income-raising and expenditure-saving activities (Kabeer, 2001, cited by Khan and Rahman, 2016). Furthermore, women from poor households are increasingly involved in micro-credit programmes and are attaining co-breadwinner status within the family through helping their male counterparts with post-harvest agricultural activities (Karim and Law, 2013, cited by Khan and Rahman, 2016).

In Bangladesh, the participation of women in the labour force has been increasing faster than that of men. In 1974, only 4% of women aged 10 years and above were employed in the labour force. This rose by 4.5 times by 1983-84 and reached 36% in 2010. Since the 1980s, women have accounted for about two-thirds of the total number employed in the garment industry. It has played an important role in changing employment opportunities for women with little or no education (Rahman and Islam, 2013, cited by Khan and Rahman, 2016).

However, although the gender pay gap has been reduced significantly in many industries in Bangladesh, in general, women still tend to be paid less than men (Hossain and Tisdell, 2005, cited by Khan and Rahman, 2016).

⁴⁸ National Women Development Policy 2011; National Children Policy 2011; National Action Plan on Women, Peace and Security: 2019-2022; Vulnerable Group Development (VGD) Programme, 2011; and Vulnerable Group Feeding (VGF) programme.

3.4.5.2 Social exclusion and gender inequality in the South West Region

The lives of women and girls in the South West Region are constrained by unequal power relations and deeply rooted attitudes about gender roles and potentials. Women and girls are disadvantaged by multiple gender-based inequalities, including: wage discrimination; limited mobility; limited decision-making authority within the household; risks of exploitation; abuse and violence; limited access to basic services and social and legal protections; and limited visibility in society. The widespread trend of male out-migration from the region offers opportunities for women to take on new roles; but it also results in increased vulnerabilities in terms of women's workload, risk of abandonment, insecurity and exploitation (CARE Bangladesh, 2016).

3.4.5.3 Women in education

Bangladesh stands as a model for its progress in improving girls' education. Such progress is the result of several incentives, especially the Female Secondary School Assistance Project (FSSAP) which provides stipends and tuition waivers. The latter started in the early 1990s as a pilot and then became a nationwide program (Sosale *et al.*, 2019). The Bangladesh Bureau of Educational Information and Statistics (2017) released education statistics for 2016 which showed that the proportions of boys and girls enrolled in primary education were almost identical: 49.6% boys and 50.4% girls. The proportion of girl students in secondary level of education was a little higher (53.6%) but was lower in higher secondary and tertiary levels.

3.4.5.4 Womens' security and safety

The government has undertaken social safety net programmes under different ministries to reduce poverty and improve gender outcomes. It has introduced income- and employment-generating programmes/projects as well as direct transfers towards the poor to address income poverty; and education, health, nutrition, and water and sanitation projects/programmes for human development and mitigating human-poverty. These measures include various allowances/stipends (for the elderly; widows, deserted and destitute women; maternity; urban low-income lactating mothers, disabled students) and the Programme for the Poor, Vulnerable Group Development (VGD), etc. The government has allocated 16.83% of total national budget and 3.01% of GDP in FY 2020-21 for the social safety net programmes. The number of recipients/beneficiaries of these projects/programmes (only those mentioned here) is increased in the FY2019-20 from 6.44 to 7.25 million. At present, nearly 25% of all families in the country are served by social safety net programmes.

3.4.5.5 Violence against women

Violence against women and girls can include physical, sexual, psychological and economic abuse. It cuts across age, race, culture, wealth and geographic boundaries. Such violence is the most obvious gender specific violation of human rights and is a form of discrimination against women. It enforces women's subordination to men and patriarchal structures throughout all levels of Bangladesh society (Khan *et al.*, 2017). A study by BBS & UNFPA (2011) (cited by ucanews.com reporters, n.d) found that about 87% of married women in Bangladesh were victims of various forms of domestic violence in their lifetime, 65% were physically tortured by their husbands, 36% were victims of sexual violence, 82% faced psychological abuse and 53% were victims of mental anguish. In rural Bangladesh, 55% of married women face sexual violence compared to 37% in urban areas (ucanews.com reporters, n.d). Bangladesh is claimed by the media to rank as one of the worst offenders amongst the world's nations with respect to violence against women: second

according to the Independent (12 June 2002) and fourth according to the Daily Star (14 Aug. 2003) as cited by IRB (2004).

The government has introduced the Prevention of Women and Child Repression Act (2000) and the Domestic Violence Act (2010), and the Ministry of Women and Children Affairs (MoWCA) has developed other initiatives to protect women from violence. The Acts make provision for the punishment of sexual abuse, sexual harassment and grievous injuries. Yet, domestic abuse cases still go largely unreported. Unreported cases of violence are often attributed to negligence by the police and local authorities (ucanews.com reporters, n.d). The World Bank and Australian Government/AusAID (2007) recommended the adoption of various policies and programmes to reduce violence against women and increase safety and security of women:

- Stepping up poverty reduction efforts;
- Designing region-specific interventions;
- Designing more prevention programmes that focus on men;
- Sending tough messages to law enforcement agencies;
- Increasing access to secondary education;
- Increasing options for women to report and seek help in violent situations.

3.4.6 **Education**

3.4.6.1 *Educational facilities*

- *Educational institutions:* Since primary education is mandatory for all, primary schools predominate and are found even in remote villages in the South West Region. Each district has secondary schools, colleges, alia madrasahs and tertiary vocational education facilities. In addition, most districts (except Meherpur, Rajbari, Magura, Narail, Bagerhat and Pirojpur) have universities or medical colleges. *Non-government/private sector involvement:* More than 700 NGOs are active in non-formal education. Some also organize and manage formal primary schools including for non-enrolled, dropouts and illiterate youths and adults. Many NGOs work at the union level in the South West Region, providing education materials such as pens, computers, tiffin etc. aimed at encouraging children to go to school.
- *Accessibility:* Though access to education has improved during the last decade, children still face problems when they attend schools. The average student completes the five years of primary education in eight or nine years, but only 55% of students complete the full five years. Bangladesh also suffers from a severe lack of qualified teachers. The current teacher-to-student ratio is one to 49.
- *Transportation and communication facilities:* The average distance between households and nearby schools (primary or secondary) in the South West Region is 0.86 km. There is one primary school in every 1.5 - 2.0 km² and secondary schools in every 2 - 3.5 km². Roads are the main means of communication. In the rainy season, the roads become submerged and very muddy which makes it hazardous for students to travel to school. As a result, a significant percentage of students (40%) stay away from school, repeat years and eventually drop out.

3.4.6.2 Quality of educational facilities

CEGIS (2012)⁴⁹ carried out for the World Bank amongst communities dependent on the Sundarbans. It looked at the condition of educational and water and sanitation facilities:

- *Condition of educational infrastructure:* The study found that most of the primary schools (88%) were concrete buildings, with some semi concrete (9%). However, most of the primary schools were constructed with materials of poor quality, and most schools most of all types] did not have electricity facilities. Registered primary schools had hardly any furniture (e.g. chairs, tables, blackboards, laboratory instruments).
- *Water and sanitation facilities:* The study found that many schools had no drinking water facilities: 60% of government primary schools, 64% of registered government schools and 81% of the non-registered government schools. The situation was similarly very bad for *Ebtedayee* (primary) madrasah and primary schools. 91% of government primary schools and 88% of registered government schools had sanitation facilities within the school compounds. But all these facilities were dirty and unhygienic. By comparison, about 90% of kindergarten schools had sanitation facilities in good condition, mainly due to having proper maintenance.

3.4.6.3 Dropout rate

Statistical evidence shows that, in the South West Region, the overall drop-out rate from secondary education for boys tends to be slightly higher than for girls. In the first two grades of secondary school, boys are more likely to drop out, However, in the last three grades, the pattern is reversed with more girls dropping out. The last grade of secondary school has the highest drop-out rate for both sexes. For the poorest families, the opportunity cost of sending a relatively young child to school creates a significant barrier to increasing the number of years of school participation. The government's response to the high dropout and low daily attendance rates at primary schools has been to supply free textbooks and tuition waivers, and it has introduced a conditional stipend and a school feeding programme.

3.4.6.4 Environment in the school curriculum

The government has increased the emphasis on environmental study at different education levels, making it one of the objectives in the National Education Policy 2010. The aim is to provide students with the skills to fight the challenges of a world threatened by climate change and other natural disasters and to raise awareness about the environment. The government also included environmental issues in the new school curriculum introduced in 2012. In addition, eight public universities offer environment-related courses and 10 private universities provide departmental environmental education programmes (Ross and Khan, 1995).

⁴⁹ Socio-Economic Sustainable Development in the Sundarbans Area of Bangladesh. Unpublished Study by CEGIS

3.4.7 Culture, heritage and traditional knowledge

The South West Region of Bangladesh has a diversity of ethnic and cultural groups with distinctive religions, traditions, rituals, customs and beliefs. According to the Bangladesh Population and Housing Census 2011, about 86% are Muslims, 13.5% Hindus and 0.26% Christian. The main Islamic festivals are Eid-ul-Fitr (end of the fasting month of Ramadhan), Eid-ul-Azha, Muharram and Miladunnabi (birth day of the Prophet). The biggest Hindu festival is the Durga Puja whilst Christians celebrate Christmas. There are also several important national public holidays.

The guardian spirit *Banabibi* (the lady of the forest) is popularly worshipped in the Sundarbans as the saviour of the natives. Local people in the Sundarbans area believe that Banabibi has omnipotent power that looks after the welfare of the dwellers of the forest. Banabibi is very popular among both the Hindu and Muslim communities, and is often worshipped by honey-collectors and woodcutters before entering the forest for protection against attack from tigers.

Several places in the region have been declared as World Heritage Sites by UNESCO. Three sanctuaries within the Sundarbans have been designated due to their natural and ecological significance, acknowledging both their natural and ecological significance; and the Mazar (tomb) of Khan Jahan Ali in Bagerhat District has been designated as an archaeological site representing 'ancient heritage of mythological and historical events' (UNESCO, 1997).



Mazar Khan Jahan Ali, Bagerhat District

Traditional Knowledge includes technological values, scientific thought and ideas. It helps to solve day-to-day problems, and challenges in practical work, daily life and livelihood practices. It is derived from local or regional cultures and ecology, their social context and economics (Antweiler, 1988). Farmers' traditional knowledge derived from local culture and long experiences is used by fisherman during pond preparation, feeding and fertilising, and fry stocking during shrimp farming (Chowdhury and Khairun, 2014). In the Sundarbans, honey collectors (*mawali*) use traditional knowledge that has been preserved for generations (Ray, 2014).

According to the 2011 census, the most numerous tribal group is Munda (population 3271), followed by Barmon (2701), Tripura (884) and Swantal (703). The indigenous Munda have their

own language, religion, and culture, but their own unwritten language has been lost and most now speak Bengali.

The value of diversified cultural patterns and practices is declining because of lack of preservation and failure to address in policies. Cultural hybridisation and loss of traditional heritage and practices, due in large part to conflict between indigenous methods and scientific knowledge, is increasing due to modernization and the influences of social media and satellite television.

The National Cultural Policy (2006) aims to preserve local heritage, culture and tradition of all people. In reality, small ethnic and cultural groups are not benefitting due to a failure to effectively implement this policy. There is an inadequate cultural management system with few local archives or institutes, and little promotion of cultural heritage. The expansion of the market economy and changing consumer behaviour promote branded products and makes it difficult to popularise local cultural artifacts and traditional livelihood opportunities.

Lack of technical and financial support traditional practices and use of traditional objects has also been a factor. Very limited budget is allocated to preserve, monitor and maintain archaeological and heritage sites, contributing to a decline in their aesthetic, historical and cultural value.

Inadequate management system, local archive, local institutes (e.g. local cultural centres to identify and promote local culture) are issues requiring to be addressed.

3.4.8 Conflicts, power and security

Rural power structure is not stand-alone, rather it is highly influenced by the national political power structure. If the national ruling party changes, the rural power regime and actors are overtaken by local supporters of the same ruling party. The main political decisions in the rural area are thus shaped by the intention of the ruling party, which result in the exclusion of opposition party supporters from political decision-making (Mahmud *et al.* 2020, Alam and Teicher, 2012).

The rural power structure in the South West Region is connected with land relations: people who control more land have a greater control over rural power; conversely, those with high political power control more land (Mahmud *et al.*, 2020). Historically, the South West Region was dominated by crop production prior to the introduction of brackish water shrimp cultivation in the 1950s and 1960s (Rahman *et al.*, 2006; Pokrant, 2014). At that time, shrimps were cultivated along the shoreline. In the 1970s, having identified a business opportunity, a group of outsider investors, including politically-backed thugs, introduced new shrimp cultivation techniques and began to extend shrimp cultivation to inland areas and encroach into forest areas. Their tactics included leasing private land and 'grabbing' land - both state-owned khas land (government-owned fallow land) and private land of poor/powerless people (Alauddin and Tisdell, 1998). Gradually, local elites, especially the large and absentee landholders, started shrimp cultivation on a commercial basis (Mahmud *et al.*, 2020). This expanding cultivation of shrimps led to allowing water brackish in rivers/canals to inundate surrounding cropland. The shrimp cultivators had both money and political power and their practices eventually pushed farmers to transform cropland into embanked aquaculture ponds (Mahmud *et al.*, 2020). However, although large and medium-sized crop producers maintained their control over land in this transformation process, many small landholders – especially the poor and powerless - had to either lease out of land under arbitrary rents (decided by the lease takers) and/or become victims of land grabbing (Mahmud *et al.*, 2020).

Since the 1980s, commercial shrimp cultivation has boomed with state involvement (Sobhan, 2007; Ali, 2006; Afroz *et al.*, 2017). Through the Structural Adjustment Programme, sponsored by the World Bank and the International Monetary Fund (IMF), effected on December, 1980 (Anisuzzaman, 1994), the government tried to boost production by aligning the earlier unplanned cultivation with policy prescriptions and financial incentives (loan facilities) (Sobhan, 2007). It also encouraged the establishment of linked processing industries which led to shrimp exporting. With this strong support, there followed an increase in efforts by large landholders to control land. The per capita amount of land controlled by small-scale owners and landless people has decreased further. Much of the land under shrimp cultivation in the area is now controlled by absentee landlords, notably national and local political leaders, often in cooperation with each other. As a result, the number of landless people is increasing day-by-day (Adnan, 2013; Pokrant, 2014; Rahman *et al.*, 2006).

Land control in Bangladesh is operated under 3D principles: *Dalil*, *Dakhila*, and *Dakhal*.

- *Dalil* refers to legal document approved by the country's legal system;
- *Dakhila* refers to receipt paid as land tax; and
- *Dakhal* refers to physical occupation of land or access.

Both *Dalil* and *Dakhila* are maintained by land offices, but neither ensure the third and the most important one - *Dakhal* (Mahmud *et al.*, 2020). In many cases, especially in the South West Region where land has become heavily contested with the booming of shrimp cultivation, poor and powerless people often do not have access to their land in spite of having *Dalil* and *Dakhila*, since *Dakhal* requires power. Originally, Presidential Order 135 (promulgated in 1972) prioritised agricultural khas land distribution to the landless poor people (Siddiqui, 1981). However, the Act was modified in 1974 to enable rich people to acquire leases on khas land, leading eventually to a wide disparity between large landowners and landless poor. As a result, preference in khas land distribution was given to large landholders by the state (Adnan, 2013). For example, in Rampal sub-district, only 0.18 acres of an available 1578.03 acres of khas land was distributed to landless households, and only to 48 out of 4552 such households (Mahmud *et al.*, 2020).

This type of land control and land transformation has led to conflicts, contestations, court cases, and demonstrations by anti-shrimp dissidents – recorded in numerous reports, newspapers and articles (Nijera Kori, 2006; see Paprocki and Cons, 2014). Shrimp expansion has had various consequences for the poor and landless: displacement and land dispossession, loss of livelihoods for many local people, health hazards, unemployment, marginalization of landless and smallholders, etc. Many villages have sought to return to the earlier crop-based practices (there is a notable success case in Pankhali UP) (Haider & Akhtar, 2018), but more often it has led to violent conflict.

The recent development of the Rampal coal-fired power plant project has led to another dynamic in the rural power structure. In the area around the plant, people have divided into two factions: pro and anti the power station project. The pro-Rampal faction comprises ruling party supporters who tend to dominate people. Furthermore, many outside investors are purchasing local land (often forcing people to sell land) or are leasing state-owned khas land. This is leading to the tensions between different parties over land control (Mahmud *et al.*, 2020; EJ Atlas, 2020).

The Rampal power development has created many jobs, particularly for local labourers to do manual work, such as earth work and construction. However, the recruitment of local labourers has faced political interference. People aligned to the ruling party and familiar to the recruiters

have been favoured. In such manual work, there is no written agreement to safeguard the workers. As a result, recruiters can suspend the workers verbally at any time without prior notice or compensation. This situation has also generated tensions between local people/workers, recruiters and their political allies (Mahmud *et al.*, 2020).

3.4.9 Law and order

It has not been possible to secure data about security and law enforcement from the relevant agencies as it is treated as confidential. The discussion below is based on information from secondary sources.

3.4.9.1 Forest-centred crimes

Forest-centred crimes can be divided into three main categories; illegal poaching of animals, illegal logging, and ransoms demanded by bandits.

(a) *Illegal poaching of animals*

For decades poachers have targeted a range of valuable animals found in the Sundarbans, particularly deer, and also the rare Royal Bengal Tiger, crocodiles, birds and snakes (Rahman, 2015). The Bangladesh Tiger Action Plan (2018-2027) (Khan *et al.*, 2018) notes that the tiger population in the Bangladesh part of the Sundarbans has been estimated at different times by different methods (some not scientifically valid) (Table 3.12).

Table 3.12: Estimates of the tiger population in the Bangladesh part of the Sundarbans

Tiger Population	Method	Sources*
362	Pug-mark study	Tamang (1993)
440	Pug-mark study	BFD (2004)
200	Camera-trap survey and carrying capacity (prey density)	Khan (2007)
335-500	Telemetry of two females	Barlow (2009)
106	Camera-trap survey	BFD (2015)
114	Camera-trap survey	BFD (2019)

* Cited in Khan *et al.* 2018)

According to the latest tiger status report produced by the Bangladesh Forest Department, based on a camera-trap survey (BFD, 2018), the number of tigers remaining in the Bangladesh part of Sundarbans is only 114. The main factors affecting the tiger population are poaching by local forest users, professional poachers and pirates (Mallik, 2018), tiger-human conflict, prey depletion, habitat loss and degradation (Khan *et al.*, 2018).

A report published in the Financial Express on December 30, 2019, states that, in November 2019, the Bangladesh Rapid Action Battalion (RAB) conducted 246 successful drives and arrested 586 criminals of various gangs in the Sundarbans. The RAB seized 780 firearms and 41,955 bullets while 163 pirates were killed in gunfights. In addition, the RAB recovered nine Royal Bengal Tiger cubs, 23 tiger hides, 29 deer, 129 deer hides and various wild animals during the drives.

(b) *Illegal logging*

A ban was introduced in 1989 on the felling of trees from natural forests including Sundarbans. From August 2008, the government imposed a ban on the use and sale of Sundari and Passur timber from the Sundarbans in order to prevent their felling. However, illegal wood cutters tried to avoid the ban by hiding Sundari and Passur timber within Goran firewood. So the government

also banned the extraction of Goran from the Sundarbans after cyclone Aila in 2009. Since then, illegal logging incidences reduced substantially. However, whilst illegal logging is no longer common, there are still attempts to remove and transport logs to saw mills in adjacent districts. The Forest Department works with local law enforcers in operations against sawmills close to the Sundarbans to stop illegal practices. UNB (2016) claim that suspected criminals frequently enter the forest illegally and log Sundari trees, hunt tigers and deer through trapping and setting fires – allow the criminals to catch fish during monsoon using pesticides. However, now that the forest is guarded by local residence/people with BFD (using the spatial monitoring and reporting tool – SMART), such activities are more effective and challenging.

(c) *Bandits and ransoms*

A few groups of terrorists/pirates operate in the Sundarbans, looting resources (e.g. valuable trees) from local people and selling them on the black market (IUCN, 2017).

It is difficult for forest officials to monitor the legal collection of forest resources. During the extraction season for non-timber forest products, a huge number of resources extractors disperse into the forests in search of suitable resources, and sometimes they go beyond the designated area. Sometimes the officials encounter bandits (dacoits) and there have been incidences of such bandits even overpower foresters with modernized fire arms. There is a security vacuum in the forests and pirates are able to abduct resources collectors, demand ransoms from victims' families or kill them (Uddin, 2019).

3.4.9.2 *Crime management/control procedure*

According to the Financial Express published on December 30, 2019, a taskforce (led by the Director General of RAB) was established in 2012 involving RAB, Police, Coast Guard, Border Guard Bangladesh (BGB) and the Forest Department. Roy (2018) cites a statement of the Bangladesh Rapid Action Battalion (RAB)-6 that 264 pirates of 26 different groups have already surrendered their arms. Every month, 20 to 25 pirates have surrendered their arms and last date of surrender was November 1, 2018. To rehabilitate the increasing number of former bandits, RAB has introduced *Shundarbaner Hashi* - a rehabilitation initiative. However, at least five groups of bandits and poachers (*Tayebur Bahini, Anowerul, Alamin, Sattar, and Siddique Bahini* (gang) are still operating in different parts of the Sundarbans (Roy, 2018).

Information and data are not available from relevant government departments about the nature and levels of urban and rural crime.

3.4.10 *Seasonal tourism*

Bangladesh is rich in natural beauty flora and fauna, rivers, beaches, archaeological sites, religious places, hills, forests, waterfalls and tea gardens which attract both domestic and foreign tourists, including to its many festivals. The busiest month for tourism is July, followed by December (with its warm sunny days and cooler nights) and October. Tourists also visit the country during the rainy season. In 2012, Bangladesh received about 600,000 tourists. In 2013, tourism accounted 4.4% of GDP, compared 3.8% from employment and 1.5% from investment (Roy, 2015).

The Bangladesh Parjatan Corporation (BPC) under the Ministry of Aviation and Tourism, is responsible for the tourism sector. The country faces challenges to attract tourists including because of the poor maintenance and management of tourist sites. Other issues limiting tourism development include tourists' perceptions about poor law and order situation, communication

(road, air and water) accommodation and restaurants (Hafiz Uddin 2015). Uncontrolled tourism causes disturbance of local ecosystems, biodiversity and habitats.

3.4.10.1 Waste and pollution

Tourism development puts great pressure on water, land, air and ecosystems. Increasing tourism leads to an increased demand for fresh water - for personal use and to maintain facilities. For example, large volumes of water are consumed by tourists, hotels, swimming pools, golf courses, etc., decreasing the amount of water available to local people (Lan, 2019). Tourism can also increase the generation of sewage and waste, and cause increased pollution.

The construction of tourist facilities (e.g. hotels, lodges, recreation venues) can have a negative impacts on land and water, e.g. converting land from agricultural use and depleting wetlands. Untreated sewage and solid waste disposal at tourist facilities is a serious problem causing pollution of the rivers, lakes and the marine environment. This can lead to the death of riverine and marine animals (Lan, 2019). For example, sewage runoff causes serious damage to coral reefs because it stimulates the growth of algae, which then cover the filter-feeding corals and hindering their ability to survive. Irresponsible tourists often litter tourist spots. Some cruise operators recognise the problem and are actively working to reduce waste-related impacts.

3.4.10.2 Disturbance of ecosystems and biodiversity

The construction of tourism infrastructure (hotels, lodges, port facilities, marinas, etc.) and the transport of tourists (e.g. by boat both inside and outside in the Sundarbans) can significantly affect habitats (e.g. due to land clearing and fuelwood collection) and disturb wildlife (e.g. noise such as loud music and the physical presence of visitors can distress and interrupt the natural behaviour of wildlife, disturbing feeding, hunting, feeding and breeding).

See also section 3.3.4.

3.4.10.3 Other problems

Tourism can be a vector for the spread of infectious diseases (including COVID-19). The deliberate and ignorant behaviour of visitors (especially from other countries) can have a detrimental effect on host communities and culture, e.g. not respecting local cultural norms, beliefs and values, introducing foreign practices, problems with drugs and alcohol.

3.4.11 Institutional issues

The institutional framework in Bangladesh and the South West Region is discussed in Chapter 4.

3.4.11.1 Major institutional governance issues

Citizen participation is a key component of a good governance framework. Recently, the government formulated acts to ensure public engagement in decision-making. The Union Parishad Act 2009 makes community consultation a requirement in preparing the UP's plans and budget (Annual Development Plan). Yet, at the national level, policies and programmes are formulated and implemented without an appropriate process of citizen consultation.

Local government institutions (LGI) lack capacity – particularly local government units such as Union Parishads (UPs) - to prepare proposals and prepare/implement frameworks for monitoring and evaluation of environmental programme. Although laws, policies, rules, regulations and action plans have been adopted to enable/support local governance, in reality, local government

agencies are rarely fully aware of all of these existing instruments and their accompanying documentation.

There is always lack of horizontal and vertical coordination among INGOs and national and local level NGOs. The flow of information on environmental projects among non-state actors is not adequate due to a lack of a non-functioning platform.

Following the introduction of the Medium Term Budgetary framework (MTBF), there has been some improvement in ensuring accountability of the Annual Development Programme (ADP) funds, Non-ADP funds or Pilot Programme for Climate Resilience (PPCR) funds. However, despite the MTBF, there are weaknesses in the other parts of the process. The lack of parliamentary oversight with respect to public expenditure is affecting accountability. There is little analysis of the budget on environmental and climate change spending. Parliamentary committees are set up usually after a delay. The opposition party members mostly do not attend meetings or parliamentary sessions.

The ADP projects are monitored by the Implementation Monitoring and Evaluation Division (IMED) on a quarterly basis - mainly with a focus on financial progress and, to some extent, physical performance. There is no system of results-based monitoring or benefit monitoring. The lack of such an M&E system has made it very difficult to make officials accountable for performance. However, recently, the government has introduced a Performance Management System (PMS)⁵⁰ in public sector organisations with Annual Performance Assessments.

Allocating funds for environmental and climate change projects need to meet the requirements of transparency and accountability. Currently, fund flows (BCCTF and BCCRF) to selected projects lacks adequate transparency due to the lack of ICT-based infrastructure. Right to Information Act (2009) provides rights to citizens' with a right of access to information. But information disclosure on the flow of environment and climate funds is required both at locational and type of intervention.

3.4.11.2 Areas requiring capacity-building

A number of areas require capacity-building to tackle environmental, socio-economic and institutional development in Bangladesh:

- Training is required on the assessment of environmental risks and vulnerability, and on address the adaptation;
- Technology to provide information on environment, climate change and adaptation can be made available at all levels from policy/decision makers to the grassroots level (e.g. farmers). Recognising the immense potential of information and communication technology (ICT), the government developed "Digital Bangladesh" – an initiative to

⁵⁰ The Prime Minister's Office (PMO) has pioneered this process by signing Performance Contracts (in the form of a Memorandum of Understanding) with each of the organizations working under the purview of the PMO.(see: [https://cabinet.portal.gov.bd/sites/default/files/files/cabinet.portal.gov.bd/page/089de62d_b4d1_4aa7_a879_bc9d483d9b2c/APA%20GUIDELINES%202014-15%20\(1\).pdf](https://cabinet.portal.gov.bd/sites/default/files/files/cabinet.portal.gov.bd/page/089de62d_b4d1_4aa7_a879_bc9d483d9b2c/APA%20GUIDELINES%202014-15%20(1).pdf))

implement ICT in every sphere including in combating the effects of climate change and environmental disasters;

- It is important for the developing country like Bangladesh to build its capacity to negotiate on environment and climate change effectively in international forums;
- Environmental change can have different effects according to region, generation, age, class and gender. Gender-based vulnerability does not derive from a single factor, but reflects historically- and culturally-specific patterns of relations in social institutions and personal lives. A gender focus needs to be an integral part of environment change policies and programmes so as to move towards the goal of achieving more equitable and sustainable development in the face of environmental and socio-economic disruptions. Gender needs to be a more central and continuous process in all policy development. Training in this regard is needed. It can provide an opportunity for organizations already engaged in environmental change activities to build capacity to address gender and environmental change.

3.5 Transboundary issues

A number of issues are of concern due to policies, plans, developments and activities occurring beyond the international border of Bangladesh, notably in India and Nepal. These main concerns are:

- Water management in the upstream parts of Ganges basin in India and Nepal (hydropower dams, irrigation schemes, water abstraction for urban and industrial use, etc.).
- Pollution from industries and developments in West Bengal,
- Cross-boundary transport and infrastructure – road, rail and gas transmission pipelines (e.g. between West Bengal & SW Region of Bangladesh).

3.5.1 *Water management in the Ganges basin*

Bangladesh shares 54 trans-boundary rivers with India all of which are part of the drainage system of the Ganga-Brahmaputra-Meghna (GBM) basin. The most important as far as feeding the waterways of the SW Region is concerned is the River Ganges (known locally as the Padma within Bangladesh). The source of the Ganges is considered to be at Gaumukh, about 21 km southeast of Gangotri in the Indian state of Uttarakhand. The total length of the Ganges is 2510 km from its origin to the outfall in the Brahmaputra. The main tributaries in India are the Yamuna, Ton, Son, Ramganga, Gomati and Ghaghara while the important tributaries joining the Ganges from Nepal are the Karnali, Mahakali, Narayani and Koshi. The Mahananda River joins the Ganges in Bangladesh. Figure 3.19 shows the 1,087,300 km² drainage basin of the Ganges basin. Snow and ice melt in the Himalayas contribute about 9% (2/3 from snow) of annual flows in the Ganges (much more in some tributaries), whilst glaciers contribute about 2% of the total flow (most glacier melt occurs in early monsoon when river flow is already heavy)⁵¹. Glaciers and snow

⁵¹ Sharan Jain - <https://www.ceh.ac.uk/sites/default/files/Future%20Ganga%20Workshop%20-%20Sharad%20Jain%20-%20NIH.pdf>

storage ensures perennial flow of Himalayan tributaries and enhances dry season flows. Snow and ice melt contribution ranges between 12 and 38% of low flows (March-May) at Farakka.

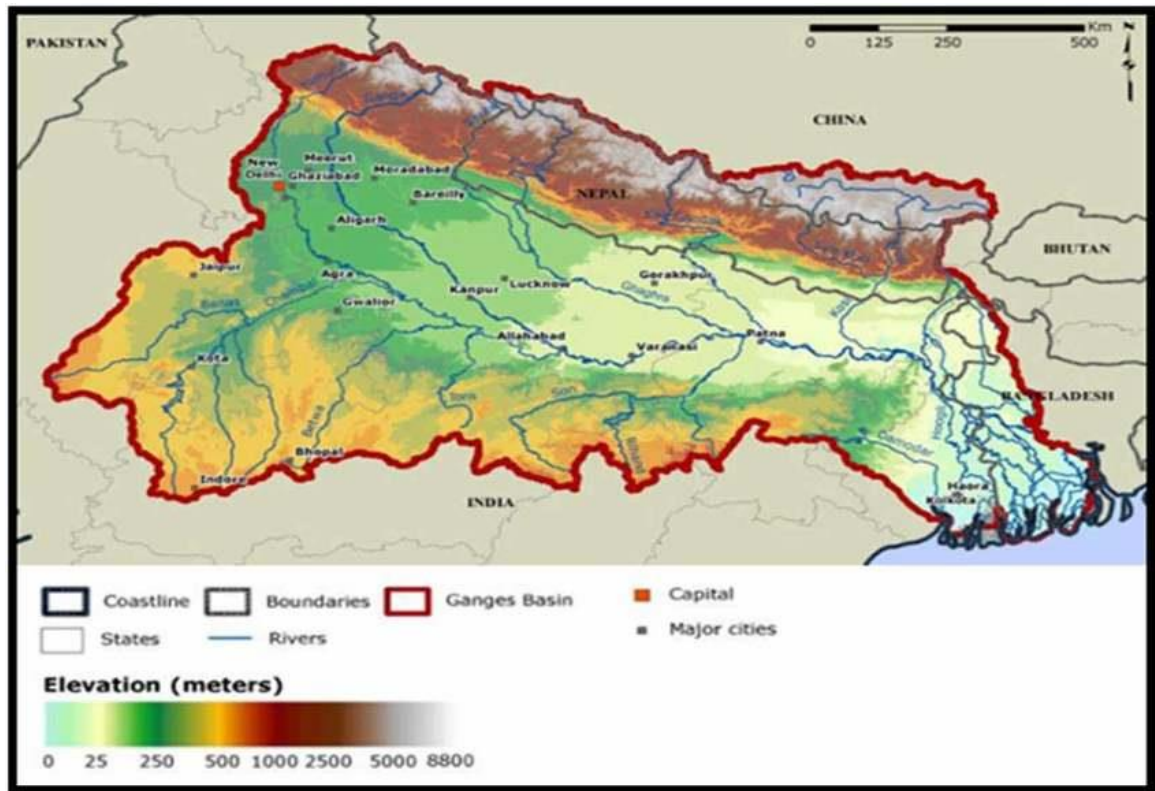


Figure 3.19: The Ganges Basin

The Ganges has many distributaries. The main distributary in India is the Bhagirathi-Hooghly which branches off nearly 40 km below Farakka barrage (Figure 3.19), although the vast majority of its flow is provided by the Farraka feeder canal. Within Bangladesh the main distributaries are the Mathabhanga, Gorai and Baral.

The SW Region is heavily dependent on water delivered via distributaries of the Ganges, particularly the Gorai River. But it has no control and little influence over the water shed management policies of India and Nepal. Bangladesh regularly faces both floods and water scarcity which reduces crop yields and fish productivity, causes an ecological imbalance in estuarine areas, allows saline water intrusion in the southwestern part of Bangladesh and reduces navigation.

3.5.1.1 Farakka barrage

The primary conflicts between Bangladesh and India started in 1951 (Crow 1995) concerning the planned building of Farakka barrage on the Ganges River 18 km upstream of the Bangladesh-India border (Figure 3.20). Construction started in 1964 with completion in 1970. The aim of the barrage was to ensure water flow to the Bhagirathi-Hooghly River so as to maintain the navigability of Calcutta port. Indian newspaper reports on the barrage project prompted a protest from the then Pakistan government. A Joint River Commission was formed between India and Bangladesh in 1972. In a joint declaration issued on 16 May 1974, the prime ministers of both countries acknowledged the need for the flow augmentation of the Ganges in the lean season to meet the requirements of both countries. Subsequently, India and Bangladesh held nearly a hundred meetings regarding water-sharing (Thakur 2020). A five-year agreement was signed on

5 November 1977. Thereafter, two Memoranda of Understanding were signed; in 1982 (for two years: 1983-1984) and in 1985 (for three years: 1986-88). In this period, however, no long-term treaty was put in place regarding water sharing of the Ganges. Negotiations resumed in 1996, which would lead to the signing in December 1996 of a 30-year Ganges Water Treaty on sharing of the Ganges water (Box 3.5).

Box 3.5: The Ganges Water Treaty 1996 and water availability

Article-II (i) of the treaty states that “The sharing between India and Bangladesh of the Ganga/Ganges waters at Farakka by ten day periods from the 1st January to the 31st May every year will be with reference to the formula at Annexure I, and an indicative schedule giving the implications of the sharing arrangement under Annexure I is at Annexure II”.

Article-II (ii) states that “The indicative schedule at Annexure II, as referred to in Article-II (i), is based on 40 years (1949-1988) 10-day period average availability of water at Farakka”.

Annexure-I of the treaty describes water availability at Farakka and the shares of India and Bangladesh, based on availability at Farakka, as per the agreement as: ‘Subject to the condition that India and Bangladesh each [would] receive guaranteed 35,000 cusecs of water in alternative three 10-day periods during the period March 1 to May 10’. During the most critical months of March and April, Bangladesh thus gets a guaranteed flow of 35,000 cusecs in the second ten days of March and in the first and last ten days of April. If the flow at Farakka falls below 50,000 cusecs in any 10-day period, the two sides enter into immediate consultations to make adjustments on an emergency basis. The treaty has an indicative schedule based on 40-year average flow data (1949–88) at Farakka.

The two parties to the agreement are to meet every five years to review the treaty and make adjustments if required. In absence of a mutual agreement, India will release water to Bangladesh at a rate not less than 90% of Bangladesh’s share as enjoined in the treaty.

Table 3.13: Annexure-I of the 1996 treaty: Water availability at Farakka and the shares of the two countries⁵²

Availability at Farakka	Indian share	Bangladeshi share
70,000 cusecs or less	50%	50%
70,000 – 75,000 cusecs	Balance of flow	35,000 cusecs
75,000 cusecs or more	40,000 cusecs	Balance of flow

⁵² Source: Treaty between the governments of India and Bangladesh on Sharing of the Ganges/Ganga Waters at Farakka, signed in 1996 (Appendix 6).

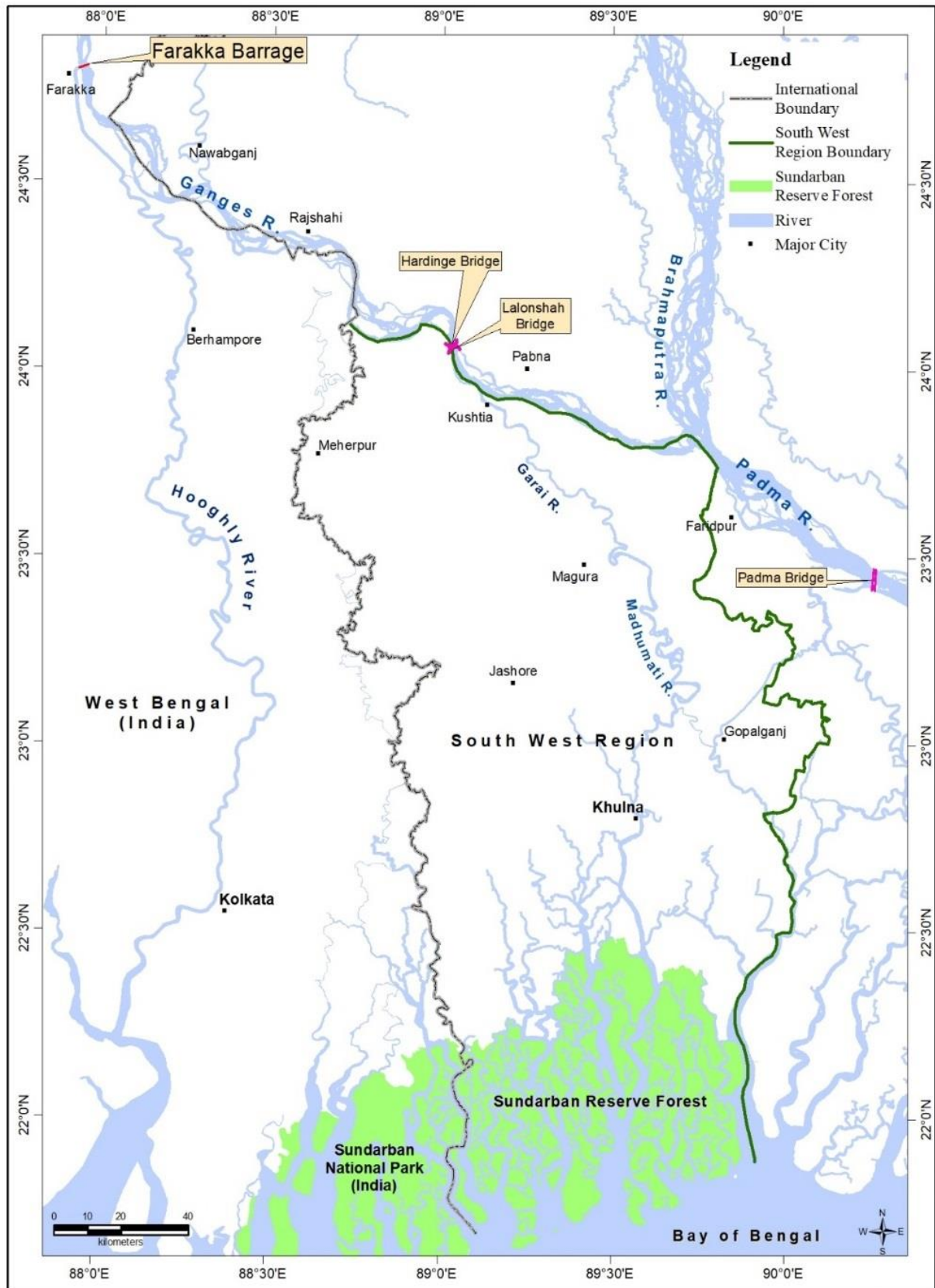


Figure 3.20: Location of Farakka barrage

This long-term treaty relaxed the tensions between India and Bangladesh regarding the management of trans-boundary Ganges. The treaty assumes equitable sharing of river waters, subject to an impact review by either party.

Since the treaty was signed, Bangladesh and India have been sharing the flows available at Farakka as per the formula given in Annexure-I. In addition, both sides receive a guaranteed 35,000 cusecs of water in alternative three 10-day periods during the period March 11 to May 10.

Annexure-2 of the treaty shows the average water availability (1949-88) at Farakka and the share of Bangladesh and India, if the actual flow at Farakka corresponds to 40 years' average flows. The treaty also provides that "Every effort would be made by the upper riparian country to protect flows of water at Farakka as in the 40-years average availability as mentioned above." However, the flow at Farakka was less than the 40 years' average flow in many ten day periods and Bangladesh received less share than the quantum shown in Annexure-2. Bangladesh raised this issue in meetings with India, seeking to protect the 40 years' average flow so that Bangladesh receives its share as per the figure indicated in Annexure-2.

While India also agreed that flows had reduced at Farakka, this was attributed to 'normal' hydrological cycles, or that the ice in the Himalayas was not melting enough to raise the water levels. The treaty has a provision for review, but, to date, neither of the sides has called for this. The treaty remains in place and is a working agreement.

Views on the impacts of Farakka barrage vary. Parven and Hassan 2018 claim that water flow in the Padma River in Bangladesh and its distributaries is considerably lower since the Farakka barrage started its operation in 1975 with the amount of water flow in the dry season 50% lower since pre-Farakka times.

There is considerably less silt from the Ganges river system being deposited in the south west part of the delta. It is being held back by multiple dams, weirs and barrages that divert much of the water upstream in India and Nepal (to a lesser extent). The entire delta is also sinking and is not being rebuilt by fresh silt to the same extent as previously, adding to the effect of sea level rise.

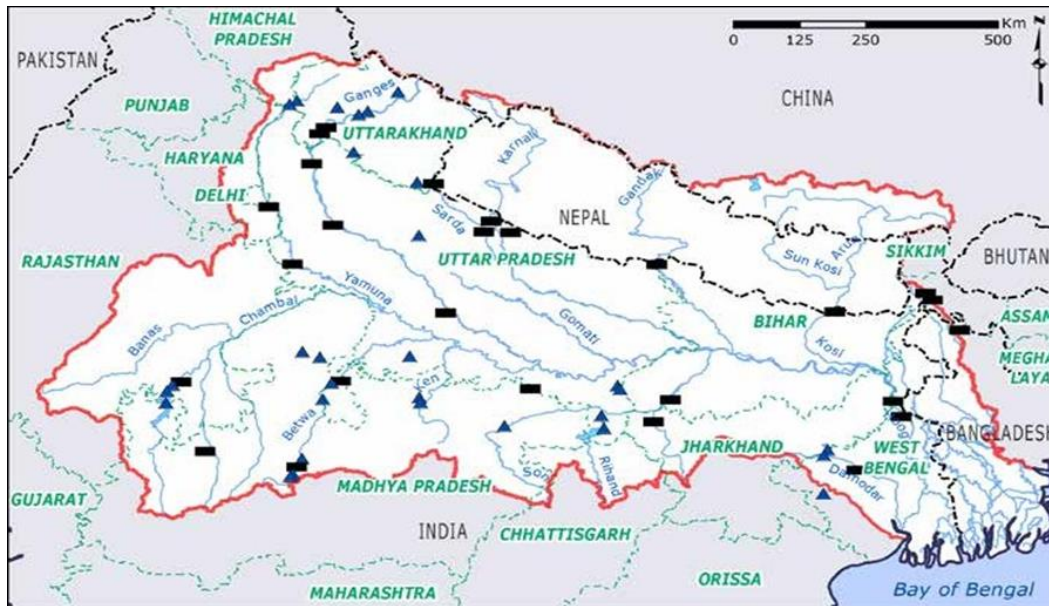
The flow of the Ganges depends on several variables – some natural, some human-induced. A primary contributor of surface run-off generation is the spatial and temporal distribution of rainfall in addition to the area's topography, glacier/snow melt contributions in the Himalayas and groundwater retention capacity, which again depend on geomorphology, soil properties and vegetative evapotranspiration in the catchment area (Kolas *et al.*, 2013)

The temporal and spatial concentrations of monsoonal rains largely dictate the agro-ecological landscape of Bangladesh, as the monsoon contributes 80% of annual rainfall in Bangladesh over a four-month period spanning from June until the end of September.

3.5.1.2 Dams and irrigation schemes in the Ganges basin

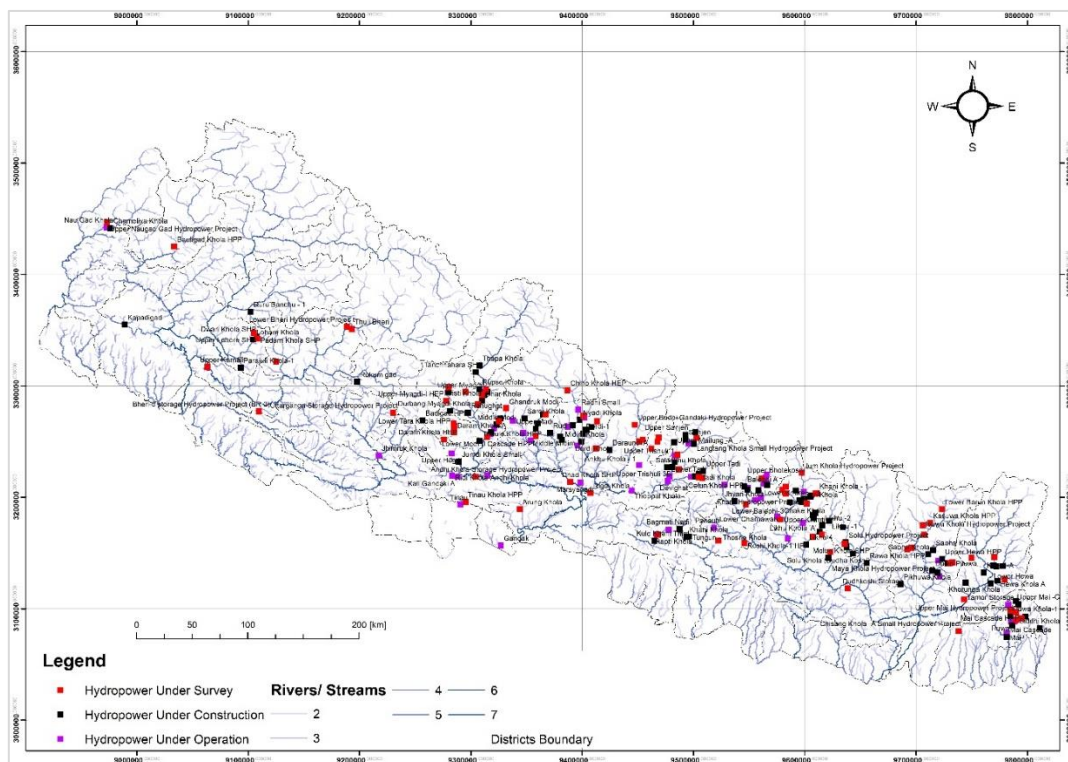
There are more than 1,000 dams and reservoirs on rivers in the Ganges basin, with heights varying from 10 to 260m (Only five more than 100m tall) (World Bank, 2014), particularly in the Himalaya Mountain in India and a few in Nepal (Figures 3.21, 3.22 and 3.23). These Himalayan reservoirs are expected to release water stored during the wet season for use in the dry season. The releases from the Indian dams are utilized in India mostly for irrigation. A joint Nepal-Bangladesh study was conducted (after devastating floods in Bangladesh in 1987 and 1988) on flood mitigation measures and multipurpose use of water resources (BNJST, 1989). It identified

30 potential reservoir sites in Nepal for moderating floods, augmenting dry season flows and generating hydropower. Of these, 20 sites were considered to be more effective for flow regulation and, if built, could augment dry season flows at Farakka by 4950 cumec and generate 36,600 MW of hydropower.



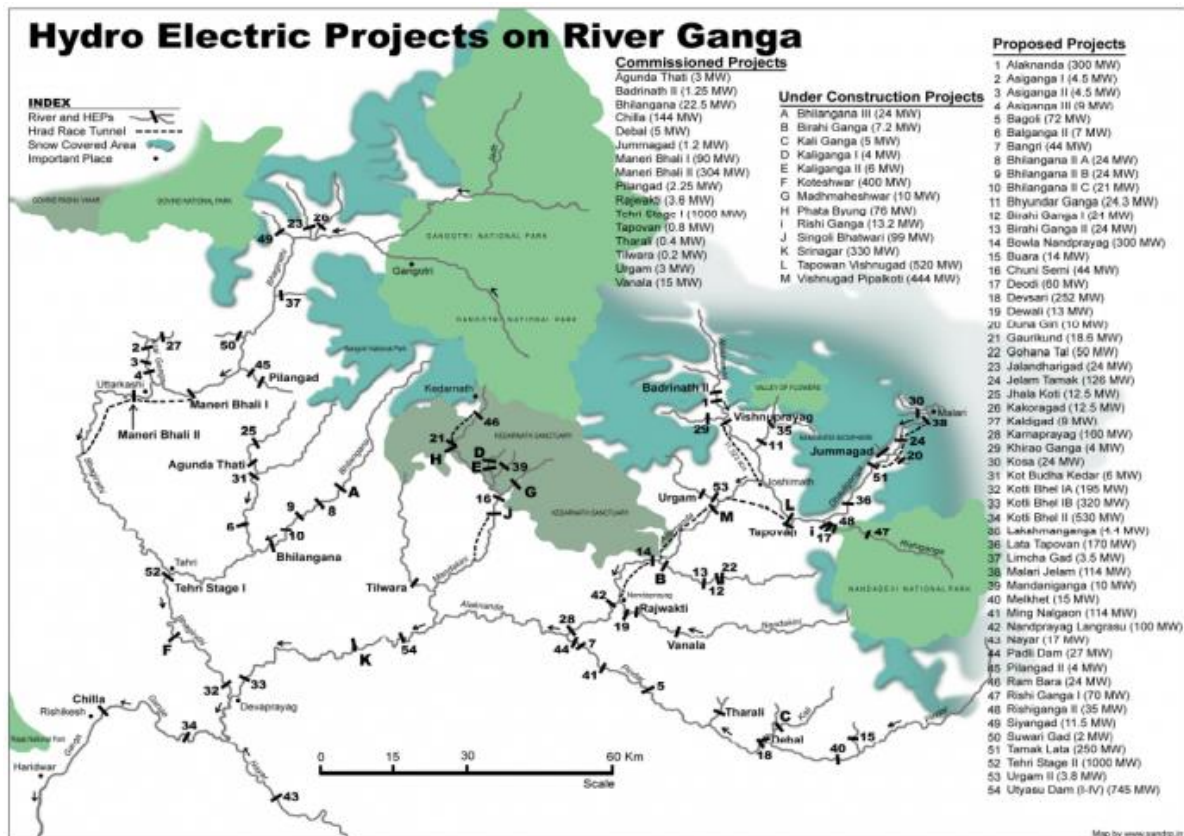
Source: World Bank (2014)

Figure 3.21: Major dams and barrages in the Ganges basin



(Source: Ajay Mathema (pers.com), School of Environmental Science and Management, Kathmandu, Nepal. Map based on data from Department of Irrigation, Nepal)

Figure 3.22: Map showing location of dams in Nepal



(Source: <https://www.internationalrivers.org/resources/hydro-electric-projects-on-river-ganga-7575>)

Figure 3.23: Hydro-electric projects on the River Ganges in India

Nepal has more than 6,000 rivers with a combined run-off of about 200 billion cubic metres. All the river systems in the country end in the Ganges – these rivers contributing 46% of the flow in the Ganges, but in the lean season increasing to 71% (Dhungel 2009). The country has huge hydropower potential, as much as 83,000 MW (BUP-CPR-IIDS, 2000), but it remains largely untapped. It only generates around 847 MW from its hydro resources. There are over 100 micro (run-of-river) hydropower plants - not connected with the grid - that generate around 5 MW in total. Only four schemes have reservoirs:

- *Kulekhani I*: reservoir type with 60 MW capacity, 114 m tall rock-fill dam with a reservoir storage capacity of 85,300,000 cub m. Located in Makwanpur District. Kulekhani II uses tailrace water from Kulekhani I.
- *Kaligandaki A HEP*: peaking plant run-of-river project with 144 MW capacity, a reservoir of 3.1 mill cub m but its water is flushed out to generate electricity, and then again filled to generate electricity for the next day. Location - Syangja District.
- *Middle Marsyandi HEP*: a peaking plant run-of-river project with 70 MW capacity and a live storage of 1.65 mill cub m. Located in Lamjung District.
- *Marsyangdi HEP*: a peaking plant run-of-river project with 69 MW capacity and live storage of 1.5 mill cub m. Located in Tanahu District.

12 major hydropower projects are under construction and nine more are proposed (Alam *et al.* 2017). Figure 3.22 shows the distribution of hydropower schemes that are operating, under construction or being surveyed in Nepal.

Several countries led by India and China have been negotiating with Nepal for possible investment in large-scale hydropower projects in Nepal.

The hydroelectric potential of the Ganges basin has also been exploited in India, including projects located on headwater tributaries of the Ganges in Uttarakhand (e.g., the Bhagirathi and Alaknanda rivers), on the upper Yamuna River and its tributaries in Himachal Pradesh, and, farther downstream in the Ganges basin along the Ghambal (a right-bank tributary of the Yamuna) and Rihand rivers. Figure 3.22 indicates the location of some of these projects. However, it has not been possible yet to identify which of these projects are run-of-river and which involve reservoirs, nor to acquire data on the projects.

There are five barrages on the Ganges itself. The Bhimgoda barrage at Haridwar diverts much of the flow into the Upper Ganges Canal, built by the British (completed in 1854). The Madhya Ganga barrage at Bijnor diverts water to the Madhya Ganga canal during the monsoon. Another barrage at Narora diverts water to the Lower Ganga canal to irrigate the surrounding land. Three barrages (at Haridwar, Narora and Farakka) divert a huge amount of water in the dry season and is the cause of decay of the Ganges as an inland waterway. The Farakka barrage (see section 3.6.1.1) diverts a large volume of water to flush the Bhagirathi-Hooghly River. The major polluting industries on the Ganges are the leather industries, especially near Kanpur, which use large amounts of chromium and other chemicals, much of which find their way into the river.

In 2019, the Indian government adopted a new Hydroelectric Policy which, among other things, included large hydro projects within the ambit of renewable energy. Previously, only small hydro projects of a capacity of less than 25 MW were treated as renewable energy. Large hydro projects were treated as a separate source of energy. According to the Indian Ministry of New and Renewable Energy, the government is committed to promoting hydropower and aims to reach 70,000 MW installed capacity by 2030 (currently, it stands at 45,700 MW)⁵³.

An article in the Hindustan Times (Nandi 2019) cites a citizen's report. "Rejuvenating Ganga" which states that there are at least a thousand dams in the Ganga basin that are "obstructing the flows of its various tributaries". The report was prepared by the Natural Heritage Division of the Indian National Trust for Art and Cultural Heritage (INTACH). It mapped the dams, barrages and hydroelectric projects in the Ganges basin based on data from Water Resources Information System of the Central Water Commission, the Uttarakhand Renewable Energy Development Agency, and the Uttarakhand Jal Vidyut Nigam. The report also noted other reasons for the reduced flow including are ruthless sand and boulder mining, indiscriminate extraction of groundwater and loss of flood plains. The report states that certain stretches of the rivers linked to the Ganges - such as Betwa, Chambal, lower Yamuna, Sone, Kiul, Damodar and Ganga Sagar - have recorded more than 50% decline in annual and seasonal flow over a 31-year period between 1975 and 2005.

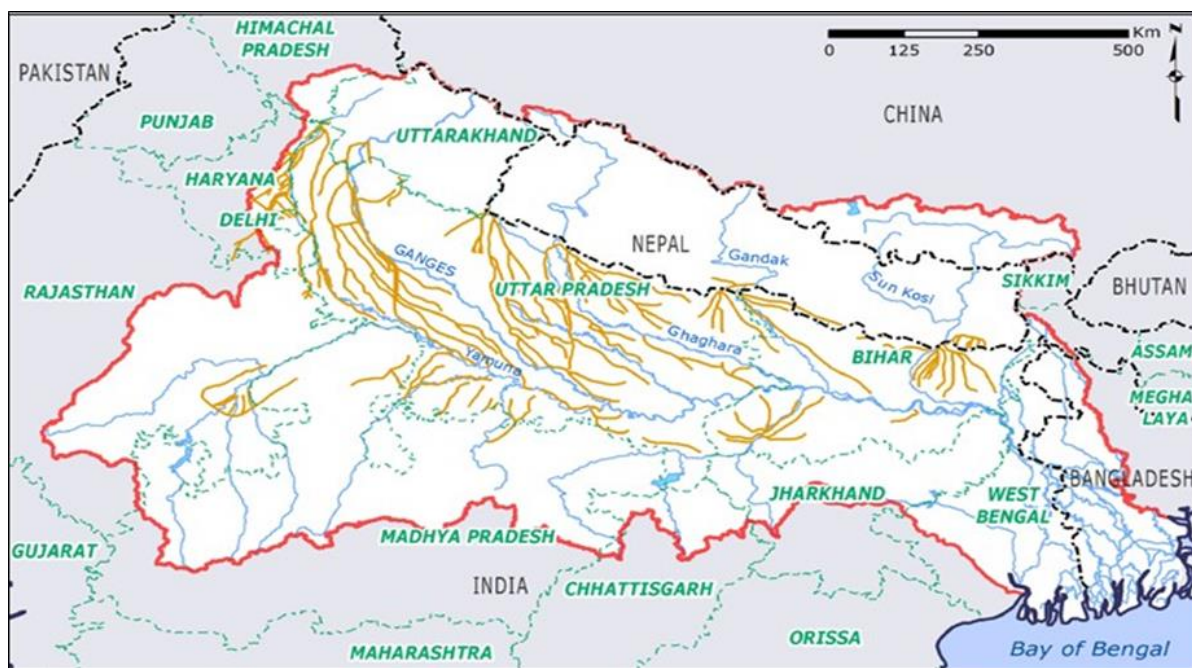
In October 2018, India's National Mission for Clean Ganga (NMCG) - the implementation wing of National Ganga River Basin Authority (NGRBA) - published a notification specifying the minimum environmental flow for the Ganges main stem (which has only five dams or barrages

⁵³ ETEnergyWorld, May 21, 2020: <https://energy.economictimes.indiatimes.com/news/power/india-to-have-70000-mw-of-hydropower-capacity-by-2030-official/75859241>

including Farakka) in the dry, lean and high flow seasons. The notification was to comply with by all hydroelectric projects and large dams by 2021. The NMCG then advanced this deadline to December 15, 2019.

A comprehensive River Basin Management Plan for the Ganges is currently being prepared by a consortium of seven Indian Institutes of Technology (IITs) (Kanpur, Delhi, Madras, Bombay, Kharagpur, Guwahati and Roorkee)⁵⁴. Its objectives are to take comprehensive measures for the “restoration of the wholesomeness of the Ganga ecosystem and improvement of its ecological health, with due regard to the issue of competing water uses in the river basin”.

There is an extensive network of irrigation canals in the Ganges basin in India (Figure 3.24). But there is also significant conjunctive use of groundwater, much unplanned - using deep (electric) tube wells, in the western part of the basin, and shallow (diesel) tube wells in the east. This buffers against erratic surface water supply.



Source: World Bank (2014)

Figure 3.24: Irrigation canals in the Ganges basin

Overall, given population growth, expanding urbanisation and increasing demand for energy in India and Nepal, the likelihood is that the number of dams and hydropower installations on rivers in the Ganges basin will increase in the coming years. In addition, there is likely to be increased diversions and sand mining in the river courses, as well as groundwater withdrawals for irrigation (currently, about 90% of water demand in the Ganges basin is for irrigation with some of the lowest productivity levels in the world⁵⁵). Consumption (drinking, cooking, bathing, etc.)

⁵⁴ <https://nmcg.nic.in/grbmp.aspx>

⁵⁵ Sharan Jain - <https://www.ceh.ac.uk/sites/default/files/Future%20Ganga%20Workshop%20-%20Sharad%20Jain%20-%20NIH.pdf>

and industrial use of water will also increase. It is estimated that water demand in India will increase by 30% by 2050⁵⁶. Together, these demands are bound to have cumulative impacts on river flow and characteristics in the Ganges and Padma and their distributaries. In addition, climate changes may lead to changes in rates of warming and snow/glacier melt, and increased extreme events in the mountains, which may also affect flows. The Indian River Interlinking project⁵⁷ would also have an impact on the availability of the Ganges. Whilst much data is reputed to be collected in the Indian parts of the Ganges basin on water-related matters, it is largely inaccessible. This makes it very difficult to make deductions or predictions concerning the downstream impacts of changes and trends in upstream water use and offtake and the amount and quality of water entering the South West Region of Bangladesh.

3.5.2 *Industries in West Bengal*

Kolkata is the largest city in West Bengal lying about 150 west of Khulna. It is home to many industrial units operated by large public- and private-sector corporations. The major sectors include steel, heavy engineering, mining, minerals, cement, pharmaceuticals, food processing, agriculture, electronics, textiles, and jute. The State Government is planning to establish a modern 1000 acre complex outside the city of Kolkata to produce footwear, leather goods and garments. An Export Processing Zone is already operational in the district of 24-Parganas (South) on the left bank of the Hoogly river.

In the immediate vicinity of the Indian Sundarbans, there are no large- or medium-scale industries. Based on mostly traditional skills, there are only small industrial units such as pottery, wooden furniture, fishnet making, bidi (hand-rolled cigarettes) making, jorri (snacks), blacksmiths, jute rope making, village bakeries, brick and tile making.

Most of the brick kilns are coal-fired and often use low grade, high sulphur coals. They emit fly ash, particulate matter and high concentrations of CO and SO_x.

Since about 2010, an increasing number of remote villages in the Indian Sundarbans have been connected to the interior highways by brick roads (replacing existing mud paths), mainly constructed by women and supported by World Vision⁵⁸.

Tables 3.14 and 3.15 provide details of the coal-based and gas-based power stations in West Bengal.

⁵⁶ Sharan Jain - <https://www.ceh.ac.uk/sites/default/files/Future%20Ganga%20Workshop%20-%20Sharad%20Jain%20-%20NIH.pdf>

⁵⁷ A proposed large-scale civil engineering project that aims to effectively manage water resources in India by linking Indian rivers by a network of reservoirs and canals to enhance irrigation and groundwater recharge, reduce persistent floods in some parts and water shortages in other parts of India (https://en.wikipedia.org/wiki/Indian_Rivers_Interlink#:~:text=The%20Indian%20Rivers%20Inter%20link,and%20water%20shortages%20in%20other)

⁵⁸ <http://theindianminority.org/inroads-into-dense-sundarbans-through-women-laid-brick-lanes/>

Table 3.14: Coal-based power stations in West Bengal

Name	Operator	Location	District	Sector	Region	Units	Capacity (MW)	Coordinates
Mejia Thermal Power Station	DVC	Durlavpur	Bankura	Central	Eastern	4 x 210, 2 x 250, 2 x 500	2,340	 23°27'47"N 87°07'51"E
Farakka Super Thermal Power Station	NTPC	Farakka	Murshidabad	Central	Eastern	3 x 200, 2 x 500, 1 x 500	2,100	 24°46'23"N 87°53'43"E
Bakreshwar Thermal Power Station	WBPDC ^[1]	Suri	Birbhum	State	Eastern	5 x 210	1,050 ^[2]	 23°49'43"N 87°27'06"E
Durgapur Steel Thermal Power Station	DVC	Durgapur	Bardhaman	Central	Eastern	2 x 500	1,000	 23°27'47"N 87°07'51"E
Kolaghat Thermal Power Station	WBPDC	Mecheda	Purba Medinipur district	Private	Eastern	6 x 210	1,260 ^[3]	 22°24'56"N 87°52'12"E
Budge Budge Thermal Power Plant	CESC	Budge Budge	South 24 Paraganas	Private	Eastern	3 x 250	750	 22°28'09"N 88°08'23"E
Santaldih Thermal Power Station	WBPDC CESC	Santaldih	Purulia	State	Eastern	2 x 250	500	 23°36'08"N 86°28'06"E
Durgapur Projects Limited	WBSEDCL	Durgapur	Bardhaman	State	Eastern	2 x 30, 1 x 70, 2 x 75, 1 x 110, 1 x 300	690	 23°31'09"N 87°18'05"E
Sagardighi Thermal Power Station	WBPDC	Monigram	Murshidabad	State	Eastern	2 x 300, 2 x 500 ^[4] ^[5]	1,600	 24°22'44"N 88°05'44"E
Bandel Thermal Power Station	WBPDC	Bandel	Hooghly	State	Eastern	4 x 60, 1 x 210	450	 22°59'44"N 88°24'13"E
Durgapur Thermal Power Station	DVC	Durgapur	Bardhaman	Central	Eastern	1 x 140, 1 x 210	350	 23°31'59"N 87°15'00"E

Name	Operator	Location	District	Sector	Region	Units	Capacity (MW)	Coordinates
CESC Southern Generating Station	CESC	Kolkata	Kolkata	Private	Eastern	3 x 67.5	135	 22°32'58"N 88°17'29"E
New Cossipore Generating Station	CESC	Cossipore	Kolkata	Private	Eastern	1 x 100	100	
Titagarh Thermal Power Station	CESC	Titagarh	North 24 Paraganas	State	Eastern	4x60	240	
Raghunathpur Thermal Power Station	DVC	Raghunathpur	Purulia	State	Eastern	2 x 600	1,200	

(Source: https://en.wikipedia.org/wiki/List_of_power_stations_in_West_Bengal)

Table 3.15: Gas-based power stations in West Bengal

Power station	Operator	Location	District	Sector	Region	Unit wise Capacity	Installed Capacity (MW)
Maithan GT	DVC	Maithan		State	Eastern	1 x 90	90
Haldia GT		Haldia		State	Eastern	1 x 40	40
Kasba Peak Load Power Generating Station	CESC	Kasba	Kolkata	Private	Eastern	2 x 20	40

(Source: https://en.wikipedia.org/wiki/List_of_power_stations_in_West_Bengal)

3.5.3 Cross-boundary transport and infrastructure

3.5.3.1 Transboundary gas pipeline

There are plans to integrate the currently isolated Bangladesh gas network with those of neighbouring countries. In India, the Jagdishpur-Haldia Pipeline (JHPL) network runs from Jagdishpur in Uttar Pradesh to Haldia to the southwest of Kolkata. A 135 km pipeline connection between Haldia and Ishwaripur in Satkhira District, Bangladesh, is being considered (Ramboll, 2018). A receiving terminal is to be constructed at Khulna.

No information has been gathered about the possible route for this pipeline, or whether any preparatory studies have been conducted. But, in general terms, apart from the pipeline itself, various associated facilities may be required including, access or maintenance roads, the receiving, dispatch and control station, and the compressor station or pump stations. Pipeline installation activities may include surveying, acquiring rights-of-way (ROW), clearing land, ditching, pipe stringing, bending, welding, wrapping, coating and installing cathodic protection for corrosion control, placement in ditches (for buried pipelines), backfilling and clean-up. In wetland areas, dredging and spoil disposal will be necessary for placement of the pipeline. In completely water-logged soils and open-water areas, pipeline-laying barges are usually used for dredging, pipeline fabrication and placement. The World Bank (1991a) identifies a number of impacts that may arise from gas pipelines (Box 3.6) which will need to be addressed in an environmental impact assessment (EIA) conducted for such a transboundary pipeline.

Box 3.6: Possible direct impacts of gas pipelines

- Installation of pipelines and maintenance roads can lead to alteration of drainage patterns, including blocking water flow and raising the water table on the upslope side of the pipeline, and can lead to the killing and reduction of vegetation, such as trees. If a pipeline cuts through a large forested area, this impact could be significant. Water supply to wetlands can be altered.
- Creation of rights-of-way (ROW) can lead to the invasion of exotic plants which may out-compete native vegetation. If uncontrolled, this can have a significant impact over time. In addition, pipeline installation can result in habitat fragmentation of natural areas (e.g., wildlands), resulting in the loss of species and lowering of biodiversity.
- In developed areas, pipelines can result in the loss of land use and displacement of inhabitants due to the placement of pipeline and substations. Some types of agricultural activities may only be affected in the short-term during construction.
- Above-ground pipelines can create barriers for humans and migratory wildlife. This could be significant depending upon the length and location of the pipeline.
- Archaeological sites are vulnerable to damage or loss during pipeline construction.
- Pipeline construction can cause temporary interruption of traffic. This could be significant in developed areas, if the pipeline crosses major transportation routes.
- Ruptures and leaks, as well as wastes generated at the pump and transfer stations, can result in potential contamination of soils, surface water and groundwater. The significance of this contamination is dependent on the type and size of the leak, on the type and volume of wastes generated, and on the degree to which the natural resource is affected. Ruptures of oil pipelines crossing rivers and other water bodies or wetlands can result in significant environmental damage.
- Gas pipeline leakage or rupture can cause explosions or fires. In developed areas, such accidents pose significant human health risk.

Source: World Bank (1991a).

3.5.3.2 Cross-border traffic

The government is undertaking a project to expand the capacity and facilities at Mongla⁵⁹, enabling it to handle 15 million tons of cargo and 4 lakh shipping containers of a standard 20 ft size⁶⁰. This is likely to lead to a significant increase in vessels using the port and also in road and rail traffic transporting goods to and from the port – not only from destinations within Bangladesh but also from India, Nepal and Bhutan.

A Joint Communiqué signed on January 12, 2010 between Bangladesh and India set the stage for offering multi-modal transit access to India, and port access to Nepal and Bhutan, using road and rail as well as river transit (with Ashuganj in Bangladesh and Silghat in India serving as ‘ports of call’). India and Bangladesh subsequently signed a MoU on the use of Chattogram and Mongla ports in 2015. The MoU envisages transit of goods from Mongla Port to north eastern states of India through waterways, roads and railways⁶¹. Missing links in the rail network have been identified and actions are being taken to address these, including ‘gauge conversion’ where necessary. In May 2018, the Executive Committee of the National Economic Council (ECNEC) approved a project to build a 217 kilometre double rail line, alongside the existing single line, from Khulna to Darshana with an aim of boosting trade activities with Nepal and Bhutan using the Mongla port⁶². At present, a 43 km new rail line is being built from Khulna to Mongla port. The Dhaka-Mawa-Mongla road is also being upgraded to a four-lane highway.

Northeast India’s access to seaports in Bangladesh is expected to give momentum to Bangladesh-Bhutan-India-Nepal (BBIN) quadrilateral cooperation, and may influence Bhutan to ratify the BBIN Motor Vehicles Agreement (MVA) that aims at enhanced regional connectivity through facilitation of regional cross-border road transport.

Vehicle movements through the international check post at Petrapole, on the Indian side of the border from Benapole in the South West Region, were recorded as 163,555 in 2018-19⁶³ (average 448 per day). According to an article in 2006 in *Hindustanbusinessline.com*⁶⁴, total traffic passing through the land border at Benapole in 2029-30 was projected to reach 2938 trucks per day and the passenger traffic 3,924 people per day.

Undoubtedly, when the Padma Bridge is completed and operational, this will lead to an increase in cross-border road traffic (particularly lorries) through Benapole. Padma Bridge will provide direct links between two major seaports (Mongla and Chittagong) and provide a connecting link

⁵⁹ The Executive Committee of the National Economic Council has approved a \$710 million project for construction of two container terminals, one container handling yard, one container delivery yard, and extension of a service jetty, yard and sheds, among others. The target date for completion of the modernization project is by 2021.

⁶⁰ <http://www.newsonair.com/News?title=Bangladesh-to-enhance-Mongla-Port-Capacity&id=381596>

⁶¹ <http://www.maritimegateway.com/mongla-port-adds-muscle/>

⁶² <https://www.thedailystar.net/city/double-rail-line-boost-trade-nepal-and-bhutan-1573570>

⁶³ <http://lpai.gov.in/content/innerpage/icp-petrapole.php>

⁶⁴ *Hindustanbusinessline.com*, 18 June, 2006: <https://www.thehindubusinessline.com/todays-paper/tp-economy/Petrapole-infrastructure-to-be-beefed-up/article20211599.ece>

for the Tamabil-Sylhet-Sorail-Kanchpur-Dhaka-Mawa-Bhatiapara-Norail-Jessore-Benapole highway. It will be an integral part of the Asian Highway No 1 and Trans-Asian railway network systems. (Source: <https://www.adb.org/sites/default/files/linked-documents/35049-01-ban-eiaab.pdf>).

The infrastructure improvements and increased rail, road and water transport may have consequential negative impacts often associated with such activities including, for example, noise, disturbance to habitats and wildlife, oil and fuel spills, accidents, land acquisition and displacement of people.

Direct road and highway use impacts may include: increased demand for motor fuels; accidents with and/or displacement of non-motorized methods of transport; increased air pollution, noise, roadside litter; injury or death to animals and people attempting to cross roadways; health risk and environmental damage from accidents involving hazardous materials in transit; and water pollution from spills or accumulated contaminants on road surface (World Bank, 1991b; BBA, 2010b). Transboundary roads can also be a significant conduit for the transmission of sexually transmissible diseases (e.g. AIDS).

3.6 Mega projects

Two particular mega projects – Rampal coal-fired power station in the power sector and Padma Bridge in the infrastructure sector - have been the focus of discussion for development in the South West Region. Both pose considerable challenges in terms of their ultimate potential environmental and socio-economic impacts. The sections below discuss their main physical elements. It is not the role of SEA to assess the impacts of individual projects. But given the importance of these two particular projects, a summary of their key impacts, identified by their respective EIAs, is provided in sections 3.5.1 and 3.5.2.

3.6.1 Rampal coal-fired power station

3.6.1.1 Power plants

The Governments of Bangladesh and India have formed a joint venture company - Bangladesh-India Friendship Power Company Limited (BIFPCL) - to build and operate the Maitree coal-based thermal power plant with two units at Rampal, Khulna.

An EIA was conducted for two alternative sites (BDPB 2013): one at Sapmari Katakhal, Rampal; the other at Labanchara, Khulna. The Rampal site was preferred. It is located 23 km to the south of Khulna City in an area dominated by shrimp farms. It is 14 km north-east of Mongla port, 14 km north-west of the nearest point of the Sundarbans and 4km north west of the declared Ecologically Critical Area of the Sundarbans.

Construction on the Rampal power plant started in 2017 with commissioning expected by 2022. The proposed project will use modern technology for the plant with a capacity of 1320 MW (two units, each with a capacity of 660 MW).

The plant will be designed in such a way that it will ensure minimum environmental pollution and maintain all MoEFCC and IFC standards. Surface water (9,150 m³/hr) of the nearby Passur River will be used for meeting different demand including makeup of circulating water systems (cooling, boiler, etc), service water, domestic water, water for ash management, etc. The project rejected using water from domestics (i.e. waste water from different sources such as boiler blowdown, steam line, used domestic water, oily water from the machines, water treatment plant

etc.) except for the cooling tower blow down. Blowdown water (that intentionally wasted to avoid concentration of impurities) from equipment and machinery will be treated by an effluent treatment plant (ETP) and reused as much as possible. Blowdown from the cooling tower and ETP discharge will be discharged to the Passur River at a maximum rate of 6,150 m³/hr.

The plant will need 12,000 tonnes of coal daily. The heat generation capacity of the coal will be in the range of 5800 to 6100 Kcal/kg. The coal will be imported from Indonesia, Australia and South Africa. According to the EIA report, the coal would have 0.6% sulphur content (but may increase up to 1%) and maximum 15% ash content. The sulphur percentage may increase up to 1% because of using the Flue Gas De-sulphurisation (FGD) Plant. The coal will be imported through Mongla Port navigational facilities (not berthing facilities). The project's main components include (Figures 3.25 and 3.26):

- Two 660MW steam turbines;
- Two wet-type forced draft cooling tower stations;
- A riverside cooling water intake station including intake piping and a discharge channel;
- 275m high stacks;
- Residential and social area;
- Water treatment plant,
- Effluent treatment plant;
- Electrostatic precipitator;
- Flue gas de-sulphurisation plant;
- Advanced dry-Low NO_x burner;
- Sub-station;
- Coal terminal and Jetty;
- Coal handling and coal silo;
- High concentration slurry disposal system for ash;
- Greenbelt.

Measures to control pollution, fresh water removal, and manage ash are described in Box 3.7.

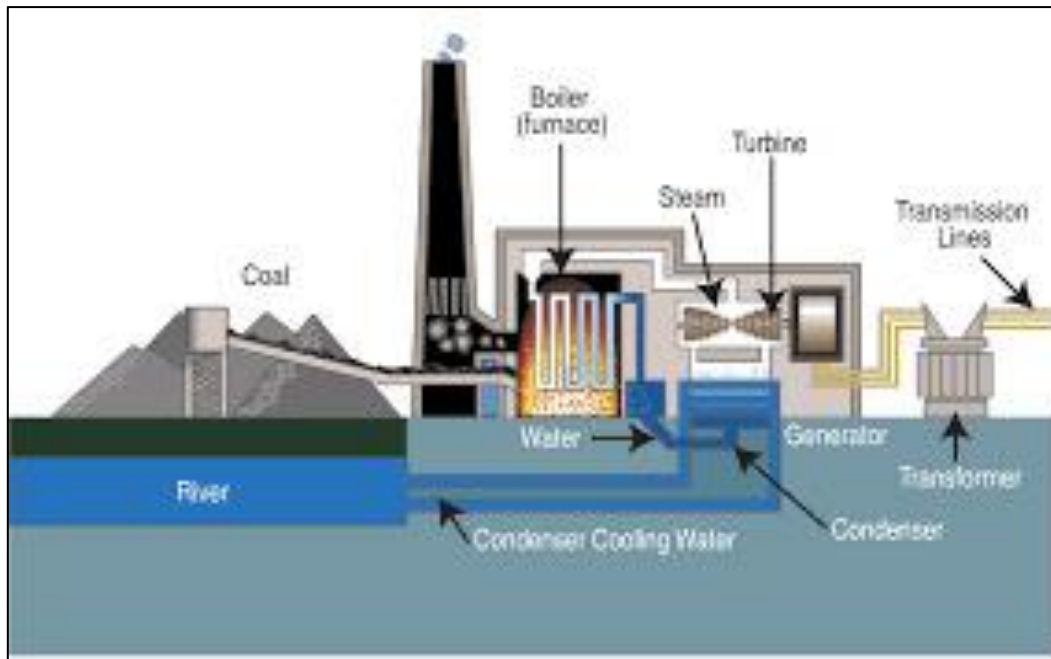


Figure 3.25: Rampal – plant components



Figure 3.26: Rampal – schematic layout

Source: (<https://www.youtube.com/watch?v=Cg3VozxZpsg>)

Box 3.7: Rampal coal-fired power station: measures to control pollution, fresh water removal, and manage ash

A. Air Pollution Control

- **Modern & efficient technology:** High steam temperature and pressure to increase plant efficiency, less quantity of coal burning per unit of electricity output which results in lesser fuel consumption and less greenhouse gas emission.
- **Imported coal of high calorific value,** low sulphur and low ash content will be used.
- Highly efficient wet limestone-based **flue gas de-sulphurisation system (FGD)** shall be used to capture and control SO₂ emissions, within the limit of 200 mg/Nm³ - the lower limit of the IFC standard for thermal power plants. Further, high quality coal with low sulphur content will be used – with an average content of 0.6% sulphur.

- **A wet limestone, forced oxidation type FGD system** shall be used to remove SO_x from flue gas.
- Modern Japanese technology-based **double flow contact scrubber** type FGD of high efficiency shall be used.
- To augment the cleaning of flue gas, **very high purity limestone** shall be used.
- The rate of **maximum SO₂ emission** from the chimney will be 200mg/Nm³.
- **Electrostatic Precipitator (ESP)** of efficiency above 99.9% shall be used to collect fly ash and to control emission of Particulate Matter (PM) within the limit of 50 mg/Nm³ as per WB/IFC guidelines. Some dust particles will be captured in the FGD during scrubbing process, before the flue gas exits the chimney.
- **Advanced low NO_x burner**: An effective and proven low NO_x burner technology will be used to reduce and control NO_x emissions within the limit of 510 mg/Nm³ as per WB/ IFC guidelines.
- Formation of NO_x in combustion is related to source of N₂ from combustion air and organic fuel.
- Combustion at near stoichiometric air fuel ratio and at low temperature will result in less NO_x generation.
- A low NO_x tangential firing system equipped with closed coupled over fire air (CCOFA) and separate over fire air (OFA) will be used. This system has been developed by Alstom Power Inc. (a pioneer in steam generator technology). Alstom has a technology transfer arrangement with BHEL (the engineering, procurement and construction contractor).
- With this technology the emission of NO_x will be maintained within the norms of international standards.
- **275m tall chimney** for wider dispersion of particulates leading to reduced ground level concentration.
- **Covered storage of coal and enclosed conveyors** for elimination of fugitive coal dust.
- **Dust extraction and suppression** system in coal handling plant.
- **Large scale afforestation** in and around the project which will improve overall environment/ ambience and also act as a carbon sink. The Rampal project will plant 200,000 saplings of different species (86,000 planted to date), e.g. mangrove species, golpata, fruit/medicinal trees, and coconut trees. Management care is being taken to ensure their growth.
- Coal to be transported in **completely covered barges** and coal trans-shipment/transfer to be done utilising modern environment-friendly technology and best practices to **ensure clean coal handling**.
- **Collection of mercury**. Mercury is only present in coal as a trace element. But a large part of whatever is present will be collected in the dry form in the dry ash handling system and almost almost all of the rest captured in the downstream FGD equipment

B. Removal of fresh water from River Passur and water pollution

- Provision of Modern **indirect dry cooling tower** (IDCT) for closed circuit cooling water system to reduce the overall water requirement.
- **Make-up water requirement** is only 0.05% of lean flow period in the lean season through the Passur River; discharge will be about half of this make up water

- **Dry bottom ash system** to reduce intake water requirement and facilitate utilization of dry bottom ash.
- **Effluent treatment plant and sewage treatment plants** will ensure that no effluents from the plant are discharged to the river without treatment.

C. Ash management

- **100% ash utilization** for this project is planned. The handling and management system will include: ash collection, loading to closed barges/closed tankers for transport to ash utility companies.
- Nearby cement companies have expressed interest to buy dry ash. The demand is 4-5 times more than the plant's maximum output.
- In the unlikely event of ash not being dispensed for a limited period, measures have been taken to collect and store the ash through a high concentration slurry disposal system (HCSD) to store in a 25 acre dyked ash pond.
- The HCSD system enables mineral transformation of settled dense ash slurry to produce, ash stone which has several benefits:
 - No water leakage to surface and ground water systems
 - No dissolution of ash components.
 - Hazardous components remain embedded
 - No dyke breeching, leaching and contamination
 - No dusting and ash/water run off.
- The high concentration slurry disposal (HCSD) system is supposed to have no excess water. However, a recirculation system is being installed with high capacity pumps to convey any excess decanted water from the ash pond to the plant area where it will be further used.
- The dyke will provide protection from river back water. Stone pitching with an inverted filter arrangement will be installed on the downstream slope of the dyke embankment - from ground level to highest flood level plus 1.0 m. The upstream slope of embankment will also be protected. A rock toe with toe drain will be constructed at the base of the embankment all around the ash pond dyke to prevent capillary rise on the downstream sloping surface. In addition, ash pond will have an impermeable liner in compliance with statutory guidelines to ensure no leaching of water to sub soil/ground water contamination.

3.6.1.2 Coal transportation

Depending on the weather condition, coal will be brought by sea in 'mother vessels' from sourced countries to trans-shipment points at Fairway Buoy, Akram Point and Mazhar Point (Harbaria) on the Passur River. It will then be brought to the power plant jetty by smaller covered barges (lighterage) of about 10,000 DWT with the draft of 5-5.5m. Unloading of coal will be done to the covered coal stackyard by covered conveyor belt. A separate EIA was undertaken for the coal transportation aspects (BIFPCL 2018).

Three routes were studied to assess for coal transportation from Fairway Buoy to the plant jetty.

- Option 1: Passur Channel: Fairway Buoy to Power Plant Jetty via Hiron Point-Akram Point-Harbaria-Mongla;

- Option 2: Sibsa River: Fairway Buoy to Power Plant Jetty via Hiron Point-Akram Point-Chalna and through Sibsa-Dhaki-Chunkuri;
- Option 3: Mongla-Ghasiakhali Canal (MG Canal): Fairway Buoy to Power Plant Jetty via Mongla Port through Baleswar-Ghasiakhali- Mongla Nulla-Passur.

The Passur Channel is the designated maritime route of the Mongla Port Authority (MPA) having routine bathymetry survey reports and maintaining the draft, signalling system of the channel to keep the port operational. The travel length (78 NM) of MPA designated route is relatively less with negligible bends and eroding tendency, and has suitable draft for the coal barges compared to other options. The anchorage points for coal transshipment will be Mazhar point during rough weather time - usually in the monsoon (6-7months) and Fairway point in the Bay of Bengal during the remaining months.

The areas adjacent to the studied channels are mostly mangrove forest except for the upper part which is surrounded by agricultural land and other land uses.

The main components for safe coal movement include:

- IMO class covered vessel;
- Methane detector in the hull;
- Tran-shipper having spillage prevention and dust suppression devices;
- Plant site jetty having covered conveyor belt, spillage prevention device, hopper (mobile), de-dusting device, etc,
- Maintain IMO convention rules during movement and berthing;
- Control of vessel speed, lighting/beaming, etc. as per Mongla Port Authority (MPA);
- Bilge and polluted water reception facilities in the MPA premises;
- Enforcement of IMSBC Code, IMO, MARPOL, MPA rules and regulations etc. in managing bilge, ballast & oily water, wastewater, leachate, etc.;
- Check seal of cargo space and re-sealing if required;
- Dust suppression system (wetting, dust cover plates, etc.);
- Covered barge to prevent fugitive dust;
- Port reception facilities for collecting dry residues and/or wash water;
- Conveyor belts with fire taps with valves at regular intervals;
- Fire resistant hydraulic fluids;

3.6.1.3 Public and international concerns

Concerns have been raised about the potential of the project to cause irreversible damage to the unique eco-system of the Sundarbans - particularly issues such as:

- the regular transportation and handling of coal on small barges through the Passur river;
- the risk of environmental disaster if such barges sink—as some petroleum carrying barges have sunk in the recent times;
- the possibility of coal dust spreading while loading and unloading coal;
- the releasing ash into the air;
- release of waste to the Passur River.

Many emotive articles have been written demanding that the project be stopped and claiming, for example, that: (a) the power plant threatens the livelihoods of over two million inhabitants that are dependent upon the Sundarbans forest's resources to fulfil their basic needs or as a means to

earn a living; (b) it threatens the rich biodiversity of the Sundarbans.; and (c) it will emit around 8 million tonnes of CO₂ each year, contributing massively to global warming.

In 2016, UNESCO urged the authorities to relocate the power station, saying it could threatened the unique Sundarbans ecosystem, and indicating that it could threaten the World Heritage Site status given to certain parts of the Sundarbans. In 2017, UNESCO gave an 18-month deadline to address certain environmental concerns such as those listed above and the potential. Cumulative impact of industrial and related development infrastructure on the forest. It requested that no large-scale industrial and/or infrastructure developments be allowed to proceed before a Strategic Environment Assessment (SEA) was submitted. The government confirmed this position in November 2019 (MoEFCC (2019) and that “all future projects/industries will depend on the results/recommendations of SEA”.

In 2019, during the 43rd session of the World Heritage Committee held in Baku (WHC/19/43.COM/18), the following decision was adopted on The Sundarbans (Bangladesh):

Decision: 43 COM 7B.3

“Expresses concern that 154 industrial projects upstream of the property are currently active, and reiterates the Committee’s request in Paragraph 4 of Decision 41 COM 7B.25 and welcomes the commitment of the State Party to continue the Strategic Environmental Assessment (SEA) requested by the same decision;” “ Requests that the State Party implement the relevant recommendations of the SEA to all current and future projects and recalls the obligation of the State Party to submit to the World Heritage Centre, for review by the Advisory Bodies, detailed information including environmental impact assessments for development projects, which have the potential to influence the OUV of the property before they commence in accordance with Paragraph 172 of the *Operational Guidelines* before work commences or any irretrievable decision is made.”

These issues and others were addressed by the two EIAs. The key potential impacts identified are listed in Box 3.8. Estimated emissions of air pollutants and main GHGs are presented in Table 3.16.

Box 3.8: Potential environmental and socio-economic impacts of Rampal coal-fired power station identified by EIAs

Potential environmental impacts

- Degradation of scenic and landscape beauty;
- Minor increase in suspended particulate matter around the site during construction;
- Gaseous emissions (CO₂, SO_x, NO_x, and fly ash) will be limited due to technology used and use of low-Sulphur coal;
- Limited noise outside the project boundary;
- Solid waste disposal (coal dust, bottom ash and domestic waste);
- All waste water will be treated (and the amount reduced by recycling) before discharge to the Passur river;
- Total discharge to Passur river would be 6150m³/hr which may pollute the Passur river through heat and other contamination;
- Impacts on ecosystem during pre-construction and construction phases;
- Emission of heavy metals, e.g. mercury;
- Impacts from coal transportation and handling (unless the EMP and regulations are fully enforced), e.g.:
 - noise (including unnecessary whistling and underwater noise) vibration), increased lighting and beaming of light, and disturbance to habitats of birds (resident and migratory) and mammals in Sundarbans, dolphins, crocodiles in Passur River and their migration;
 - shoreline erosion,
 - pollution by fuel and coal/coal dust, oil spills and toxic chemicals;
 - spontaneous combustion of coal;
 - generation of leachate responsible for corrosion of ship walls;
 - collisions and barges hitting ground or getting stuck with underwater roots/vegetation/mud/sand and colliding with other ships/barges;
 - contamination of water by food / sewage / household and ship waste, etc, at trans-shipment sites;
 - Spillage of coal especially at anchorage point and jetty areas;
 - increased maritime traffic – affecting fishing activities;

Potential socio-economic impacts

- Property loss (agricultural land, shrimp farming land and house) and loss of income generating activities for the Project Affected Persons (PAPs);
- Need for resettlement (120-140 temporary houses);
- Local loss of land - 905 ac (366.24 ha) for Plant A, and 929 ha (375.95 ha) for the future Plant B: total 1834 ac (742.2 ha) – formerly used for shrimp farming and one season rice cultivation – with loss of production;
- Loss of livelihoods for those who depended (directly or indirectly) on the acquired land – mainly used as a shrimp farm;

- Regional development, creation of employment and economic opportunities, and improved livelihoods;
- Infrastructural improvement, rural electrification and industrial development;
- risk of spreading HIV/AIDS, STD/STI and TB infection and diseases through interaction between migrant workers and community women during project construction

Sources: BDPB (2013), BIFPC (2018), MoEFCC (2019).

Table 3.16: Expected emissions of air pollutants and greenhouse gases from the Rampal Power Plant

Pollutant	Emissions (tons/year)		
	Coal Transport	Coal Power Plant	Total Project
Air pollutants			
NO _x	397	10 351	10 748
SO ₂	1 974	6 502	8 475
CO	105	855	961
PM ₁₀	7	1 386	1 393
PM _{2.5}	6	616	622
Greenhouse gases			
CO ₂	20 450	6 788 219	6 808 670
CH ₄	11	64	75

Source: EIA Report (BPDP 2013)

3.6.1.4 Conclusions of EIAs

Overall both EIAs concluded that the project will not have significant adverse impacts. The EIA of the power station (BPDB 2013) concluded that:

- “It is not very likely that the long term ground level concentration of the SO_x, NO_x, SPM will increase during operational phase of the thermal power plant as the pollutant concentration in emission is very low and depression and cyclone is very regular phenomenon in this region. Unstable atmosphere will dilute the possibility of acid rain.
- The proposed project will have certain adverse impact on the fish habitat in the project area due to the direct alteration of physical setup of habitats. Minor impact on fish might be noticed only during dredging activities. During plant operation, there may not be any major impact on fish of Passur River as the plants adopt ‘No Discharge of Thermal Plume and No Discharge of Waste Water without satisfying MoEFCC’s Standard Strategy’. Fish mortality may hardly be noticed at water intake structure due to installation of fish saving devices. In addition, EMP implementation and public awareness growing and declaration of fish sanctuary may conserve and protect the fishes.
- Impact on ecosystem will also be minimum due to adoption of different pollution abatement measures. No thermal plume shall be discharged to the river which is the major issue in case of any thermal power plant. Ash collection and management system comprise of Electrostatic Precipitator (ESP) that have 99.9% efficiency to arrest fly ash. Hence, ash deposition on the surrounding ecosystem habitat and

components may be minor. Nevertheless, there may be risk of accidental release of ash particles, chemical and fire explosion for which the safety measure and hazard management plan have been prescribed in the hazard and risk assessment sections.

- The risk of potential hazards includes mechanical, electrical, chemical, fire and explosion, and risk of failure mode.
- Impact of plant operation on Sundarbans Ecosystem may be minor as the forest is located 14 km south westwards of the plant. The world heritage site is 70 km south of the plant location. The prevailing wind mostly flows northward. Only, during November to February, wind flows south eastwards. Hence, emissions reach the Sundarbans will remain within the MoEF standard and likelihood of any negative impact on the forest is insignificant.

The EIA of coal transportation for the power station (BIFPCL 2018) concluded that:

- “the project is unlikely to cause any significant adverse impact in the study area which comprises part of Sundarbans Reserve Forest. Many of the impacts are localized and short term or temporary in nature. Most of the identified impacts have already been addressed by appropriate embedded control measures in the Feasibility and Design Phase of the Project as well as additional mitigation measures and environmental management plan (EMP)suggested in this EIA Study Report. Moreover, the Project will also have several benefits to the study (Project) area through supporting economic growth in this region by opening avenues for future development, direct and indirect employment opportunities and improving local infrastructure facilities.”
- In Notes compiled for a UNESCO Reactive Monitoring Mission (RMM) held in December 2019, the government stated its view that the Rampal coal power project posed no significant environmental threats to the Sundarbans (MoEFCC 2019). It reported that the project is being developed with all measures to safeguard the Sundarbans from potential hazards as recommended in the EIAs and RMM in 2016.
- The Notes also provide details of 24 Red Category industries in the Sundarbans ECA areas: six cement factories, seven LPG bottling plants, one cylinder manufacturing factory, one cigarette packaging factory, one petroleum refinery, two bulk petroleum storage facilities (currently closed), two ship-yards (currently closed), one jetty, one factory for assembling metal fencing, one artificial hair implant factory and one car-seat-heater assembling factory. The distance from the outer area of the Sundarbans Reserve Forest to the industries is from 5 to 10 km.

3.6.2 **Padma Bridge**

3.6.2.1 *Aims*

Padma bridge is intended to provide improved communication between the South West Region and other parts of the country and to stimulate socio-economic development and help propel Bangladesh towards becoming an upper middle income by 2031 and a development country 2041.

The Padma bridge project (see section 7.3.2 for project description of EIA report) will have considerable environmental and social impacts which are identified in the EIA report for the project (BBA 2010a,b). The project has entailed considerable land acquisition and resettlement effort. Planning efforts during the past decade assessed and developed impact mitigation and monitoring which are described in environmental and social action plans.



Padma Bridge under construction

3.6.2.2 Project impacts

According to the EIA reports (BBA 2010a,b), the Padma bridge will result in a range of direct potential positive and negative impacts when operational (Box 3.9).

Box 3.9: Impacts of the Padma bridge project – operational phase

Positive impacts

- The distance from Dhaka to nearly all major cities in the southwest region will be reduced by 100 km or more, bringing considerable savings in fuel consumption, and reducing air emission;
- Reduced deaths due to overloaded ferry vessels (launches and speed boats) that frequently sink in the Ganges;
- Strengthened links between the southwest and north-central zones;
- Improved connectivity between the south-west and the rest of country, providing increased access to markets, ports and growth centres and opportunities to develop businesses (including in agriculture and fisheries), expand industry, develop communications and tourism, etc., all driving economic growth, jobs and improved livelihoods.
- A multipurpose bridge will enhance freight, passenger travel, railway transportation, and utility crossings (high pressure gas transmission, high voltage power transmission, and optical fibre telecommunication cable) between Dhaka and major points in the southwest zone and contribute substantially to the development of the southwest zone as well as to the national and regional economic growth.
- Elimination of traffic congestion and long waiting times for ferries;
- Creation of new employment opportunities (e.g. permanent jobs connected to the operation and maintenance of the bridge and in associated project components);

- Enhanced access to healthcare, educational and recreational facilities due to improved connectivity;

Negative impacts

- Unplanned urbanization, especially along road and railway corridors in the South West Region, triggering environmental and social issues at local and regional level - if not mitigated;
- Increased road accidents due to increased traffic;
- Increased pollution and GHG emissions) due to increased traffic;
- Loss of some livelihoods and incomes;

Sources: BBA (2010a,b)

3.6.2.3 Induced environmental impacts at regional level

Urbanization in Bangladesh is growing in rapid pace especially along the road and railway corridors. With the construction of the Padma Bridge, a rapid uncontrolled and unplanned urbanization may take place around the project area, Asian highway and railway corridor. Apart from such urbanization, induced development activities along these areas will occur in the southwest regions of the country; these development activities will trigger several environmental issues at local and regional level.

A network diagram showing the induced impacts from widening of national highway 8 (N8) and railway network is shown in Figure 3.26. It is expected that the connectivity of the south-western part of the region with the rest of country will provide increased accessibility to markets, ports and growth centres. This will lead to development of business (including agriculture and fisheries), industry, communication, tourism, urbanization, etc. The induced development has both negative and positive impacts.

The *positive impacts* are increase in the socio-economic conditions of the region through employment generation and poverty reduction.

The negative impacts are

- air and noise pollution due to construction activities, increase in traffic levels and industrial development;
- generation of wastes due to increased living standards;
- consequent health impacts due to pollution and waste generation;
- loss of biodiversity;
- land acquisition and resettlement.

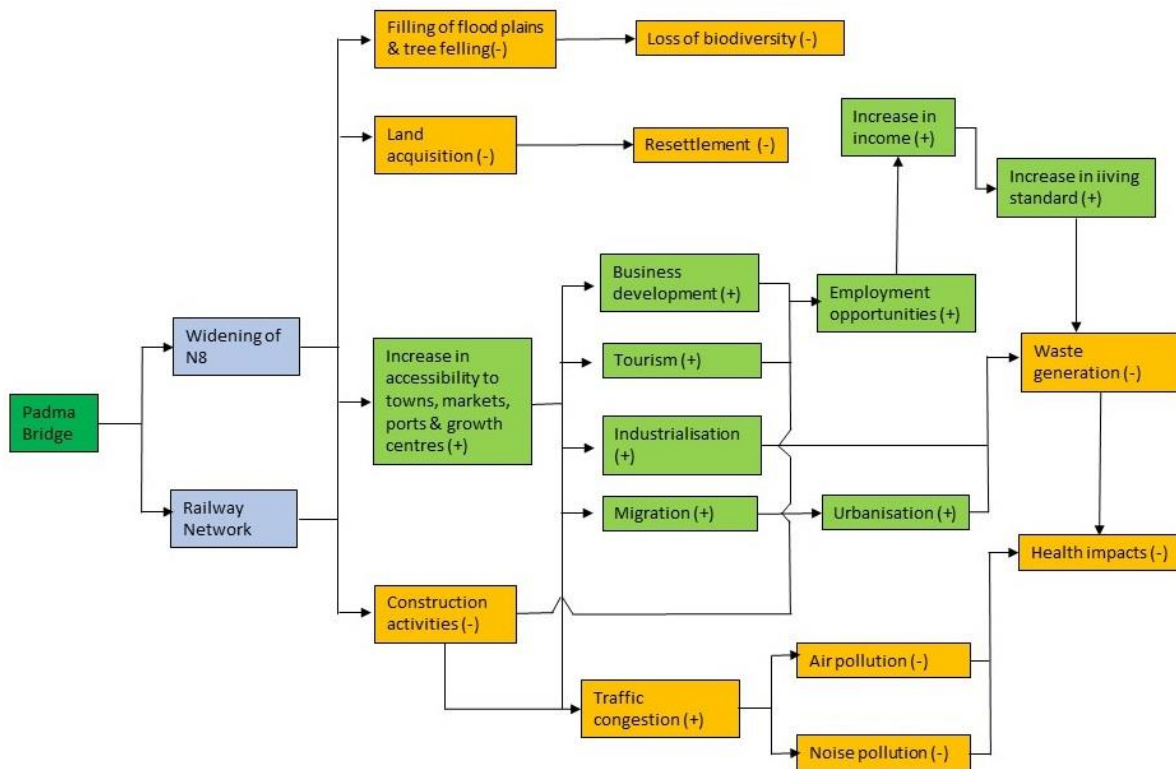
The long-term positive impacts and negative impacts are represented with +/- sign in Figure 3.27. An assessment of these positive and negative impacts in terms of degree and mitigability of impacts is shown in Table 3.3.

Whilst the EIA, Table 3.17 and Figure 3.27 identify certain potential regional environmental impacts (e.g. loss of biodiversity, pollution), there is no specific mention of how the Padma bridge might impact on the Sundarbans.

Table 3.17: Long-term induced regional impacts from widening of national highway 8 (N8) and railway network

Impact	Degree of negative impact	Degree of positive impact	Mitigability
Loss of biodiversity	High		Partly
Land acquisition & resettlement	High		Partly
Air & noise pollution	Medium		Partly
Waste generation	High		Fully
Health impacts	High		Fully
Business development		High	Enhancement
Industrialisation		High	Enhancement
Tourism		High	Enhancement
Employment opportunities	High positive		Enhancement

Source: BBA (2010B)



Source: BBA (2010b)

Figure 3.27: Network diagram for induced regional impacts from widening of national highway 8 (N8) and railway network

The EIA focused mainly on direct impacts and the mitigation measures set out in the Environmental Management and Monitoring Plan (EMMP) (Box 3.15) relate to such direct impacts arising during pre-construction, construction and the operational/management stages due to the implementation of various project activities and associated development (as stated in section 8.1.1 of the EIA report). Indirect impacts that could result from induced development are not discussed and are addressed only through recommendations on policy and planning measures. Others have raised concerns as regards such indirect impacts. For example, Mukul et

al. (2020) have recently expressed concerns that the bridge will affect the Sundarbans by facilitating greater access to and use of Mongla port and lead to accelerated forest clearing and land grabbing, and will increase various risks such as habitat degradation, land clearing, landfilling, waste disposal and wastewater discharge. Whilst these concerns are only assumptions, they cannot be ignored. Relevant government agencies, under their respective mandates and exercising controls prescribed by laws and regulations, will need to monitor development proposals and take appropriate safeguard actions.

4. Institutional Framework

4.1 National institutional arrangements

In Bangladesh, environmental, economic or social services are provided by a large number of public and private organizations as well as NGOs. Some are involved in the direct delivery of goods while others provide services, both tangible and intangible.

Institutions in the public sector play the most dominant role in policy formulation, implementation and evaluation. The sectoral ministries usually have a range of sections including departments, directorates, sub-ordinate offices, statutory organizations, local and regional offices of central government. These public organizations are governed in accordance to rules and regulations of the central government – with their mandated activities described in Rule of business by the government. On the other hand, statutory organizations, remaining within the overall control of the government, are governed in accordance with relevant laws or acts. Private sector organisations and NGOs are required to comply with the rules and regulations of different regulatory organizations

The main institutions involved in the development and implementation of plans and policies, and with a role in environmental management are:

- Planning Commission;
- Ministry of Environment, Forest and Climate Change (MoEFCC):
 - Department of Forest;
 - Department of Environment;
 - National Herbarium;
 - Botanical Garden, Zoo garden;
 - Bangladesh Forest Research Institute
 - Climate Change Trust
- Ministry of Agriculture:
 - Department of Agriculture Extension;
 - Agriculture Research Institute;
 - Barind Multipurpose Development Authority;
- Ministry of Fisheries and Livestock:
 - Department of Fisheries;
 - Department of Livestock;
 - Fisheries Research Institute;
 - Bangladesh Livestock Research Institute;
- Ministry of Water Resources:
 - Bangladesh Water Development Board (BWDB),
- Ministry of Power, Energy and Mineral Resources;
- Ministry of Health and Family Welfare;
- Ministry of Civil Aviation and Tourism;
- Ministry of Education;
- Ministry of Housing and Public Works.

- Ministry of Local Government, Rural Development and Cooperatives:
 - Local Government Engineering Department (LGED);
 - Department of Public Health Engineering (DPHE);
- Ministry of Road Transport and Bridges
 - Roads and Highways Department (RHD),
- Ministry of Shipping
 - Bangladesh Inland Water Transport Authority

4.2 Local government institutions

Local government institutions include Union Parishad, Upazila Parishad and Zila Parishad and have been vested with a wide range of development functions including planning for the provision of general physical infrastructure at the local level. Local Government Ordinances mandate Union Parishads and Upazila Parishads to coordinate development activity implemented by the government and NGOs within their territorial and functional jurisdiction.

4.3 Key institutions

4.3.1 Planning Commission

The Bangladesh Planning Commission acts as the central planning and investment organization of the country. The Prime Minister is the Chairman and the Minister for Planning is the Vice-Chairman. It determines the goals and strategies of short-, medium- and long-term plans, and formulates policy measures for the achievement of planned goals and targets. It also acts as advisor to the government in respect of, among others, projects and programmes relating to environment, disaster and other development issues.

The Planning Commission can not fully keep itself independent from other influential ministries and ministers and the pressures they may exert. As a result, sometimes, projects are taken up on non-economic considerations, leading to some inefficient usage of vital investment resources of the country. There is also scope for improving staff capacity and skills (e.g. new tools, techniques, methods and approaches). The Planning Commission needs to benefit from the continuous research and developments in appraisal and evaluation carried out in academic, research and training institutes, both within and outside the country. Also, the Commission staff lack exposure to actual conditions in the field which results in difficulties in comprehending project objectives and implementation modalities. This means that the voices of the stakeholders (who are likely to benefit from or be harmed by project interventions) are not properly heard.

4.3.2 Ministry of Finance

The Ministry of Finance has four Divisions: Finance Division, Economic Relations Division, Bank and Financial Institutions Division and Internal Resources Division. The Finance Division solicits budget proposals from all the ministries, departments, directorates and statutory organizations through 1st and 2nd call notices. A number of reform programmes have allowed the government to streamline the allocation procedure based on “value of money” of the previous fund allocation.

The Ministry of Finance is responsible for budgetary guidelines and the timely release of funds. Natural and man-made disasters lead to changes in budget allocation jeopardizing disbursements of normal time budgets. For example, ministries needing funds for roads and communication,

expansion of primary education and the social safety net programme may be deprived of funds leading to worsening performance of these organizations. There are also problems in ensuring accountability for meeting budgetary targets. There are no well-defined performance standards and performance rewards or requirements to implement evaluation procedures.

4.3.3 Ministry of Environment, Forest and Climate Change (MoEFCC)

The Ministry of Environment and Forest was renamed as the Ministry of Environment, Forests and Climate Change (MoEFCC) in 2018. It is responsible for planning, regulation and co-ordination of environmental, forestry and climate change programmes. It is a permanent member in the Executive Committee of the National Economic Council (ECNEC), with responsibility to ensure that the environmental interests are addressed while undertaking development actions.

The MoEFCC comprises various directorates: Department of Environment, Forest Department, Bangladesh Climate Change Trust, Bangladesh National Herbarium, Bangladesh Forest Research Institute, and Bangladesh Forest Industries Development Corporation.

The Department of Environment is headed by a Director General and is responsible for protecting the environment – particularly from the negative impacts of development activities. It is concerned with biodiversity conservation, pollution control (through monitoring), and processing environmental impact assessments (EIA).

The Ministry of Environment, Forest and Climate Change (MoEFCC) has overall responsibility for environmental matters. But, the National Environment Council (NEC) (chaired by the Prime Minister), and the Executive Committee of the NEC (chaired by the Minister for MoEFCC) provides guidance to the sectoral ministries/agencies on matters of national environmental concern. At the Divisional level, the Divisional Environment Committee (chaired by the Commissioner with representation from government agencies) is responsible for dealing with environmental issues at the local level. Environment Committees are also in place at district and sub-district (upazilla) level.

Sector Ministries have their own policy and programme frameworks for addressing environmental management in Bangladesh, but they lack adequate institutional capacity to effectively implement required actions and measures. The MoEFCC has responsibility for working with other ministries to ensure that environmental concerns are given due recognition when implementing their development program, and provides policy advice and coordination for action plans across all sectors. The MoEFCC is also responsible for reviewing and monitoring the impact of development initiatives on the environment across all sectors and nationally.

4.3.4 *Sector ministries***Table 4.1: Functions of key sector ministries**

Institution	Functions
Ministry of Agriculture	Comprises seven wings with responsibilities for policy formulation, planning, monitoring and administration. Sixteen agencies operate under the MoA, responsible for implementation of different projects and plans: • Agriculture Information Service (AIS) • Department of Agricultural Marketing • Department of Agricultural Extension • Central Extension Resources Development Institute • National Institute of Biotechnology • Cotton Development Board • Barind Multipurpose Development Authority • Bangladesh Agricultural Development Corporation • Bangladesh Agricultural Research Institute • Bangladesh Agricultural Research Council • Bangladesh Sugarcane Research Institute • Bangladesh Rice Research Institute • Bangladesh Institute of Nuclear Agriculture • Bangladesh Jute Research Institute (BJRI) • Bangladesh Applied Nutrition and Human Resources Development Board • Soil Resources Development Institute • SAARC Agricultural Information Centre (SAC) • Seed Certification Agency
Ministry of Fisheries and Livestock	It's role is to ensure the sustainable utilisation of fisheries and livestock. Its mission is to: • Meet the demand of animal protein by enhancing production, productivity and value addition of Fish and Livestock products; • Increase fishery resources and production; • Increase livestock and poultry production and productivity; • Enhancing export fish, fishery and livestock products; • Maintain ecological balance, conserve bio-diversity and improve public health; • Prevent and control diseases; • Generate employment towards poverty alleviation. It has six directorates: • Department of Livestock; • Bangladesh Fisheries Research Institute; • Department of Fisheries; • Bangladesh Livestock Research Institute (BLRI); • Bangladesh Fisheries Development Corporation; • Marine Fisheries Academy.
Ministry of Water Resources	The key elements of the mandate of the Ministry of Water Resources includes: • Regulation and development of rivers and river valleys; • General policy and technical assistance in the field of irrigation, flood control, anti-water-logging, drainage and anti-erosions;

Institution	Functions
	• All matters relating to irrigation, flood forecasting and warning, flood control, flood control works, causes off floods and damage caused by floods to irrigation projects, embankments, etc; • Basic, fundamental and applied research on river valley projects and flood control works; • International cooperation in the field of flood control and development of water resources; • International commissions and conferences relating to irrigation, flood control and water resource management; • Construction and maintenance of canals under W. D. B. Project; construction and maintenance of water control structures for the canals executed under the Canal Digging programme; • Soil conservation drainage and water-logging; • Storage of water and construction of reservoirs, embankment and barrages; • Land reclamation, estuary control; • Anti-salinity measures and anti-desertification; • Hydrological survey and data collection; • Matters relating to Joint Rivers Commission; Joint Committee, Standing Committee, etc and Common Border Rivers; It has seven directorates: • Institute of Water Modelling; • River Research Institute; • Water Resources Planning Organisation (WARPO); • Bangladesh Water Development Board; ◦ Flood Forecasting and Warning Centre; • Bangladesh Haor and Wetland Development Board; • Joint River Commission, Bangladesh; • Centre for Environmental and Geographic Information Services.
Ministry of Power, Energy and Mineral Resources	Mainly responsible for all policies and matters relating to electricity generation, transmission and distribution from conventional and non-conventional energy sources including hydro electricity. It also deals with the import, distribution, exploration, extraction, pricing and other policy related details related to primary fuels. The MPEMR has two Divisions headed by two secretaries: Power Division; and Energy and Mineral Resources Division: Power Division • Bangladesh Power Development Board • Dhaka Electric Supply Company Limited • Dhaka Power Distribution Company Limited • Ashuganj Power Station Company Limited. • Electricity Generation Company Limited. • West Zone Power Distribution Company Limited. • Bangladesh Rural Electrification Board • Rural Power Company Limited • Power Cell • Power Grid Company of Bangladesh • North West Power Generation Company Limited • Sustainable and Renewable Energy Development Authority (SREDA)

Institution	Functions
	Energy and Mineral Resources Division • Geological Survey of Bangladesh • Bakhraabad Gas Distribution Company Limited • Sylhet Gas Fields Limited • Mineral Resources Development Bureau • Titas Gas Transmission and Distribution Company • Bangladesh Energy Regulatory Commission • Bangladesh Oil, Gas and Mineral Corporation (Petrobangla) • Bangladesh Petroleum Institute • Geological Survey of Bangladesh • Bangladesh Hydrocarbon Unit • Department of Explosives • Rupantarita Prakritik Gas Company Limited
Ministry of Health and Family Welfare	Charged with health policy in Bangladesh and is responsible for all government programmes relating to family planning.
Ministry of Education	Responsible for secondary, vocational and tertiary education in Bangladesh. Primary education and mass literacy is the responsibility of the Ministry of Primary and Mass Education (MOPME). At the central level, there are three types of bodies under the MOE and MPME: directorates, professional organisations, and semi-autonomous bodies. The Ministry of Education is the apex body responsible for policy-making, planning, directing, and controlling the administration and management of secondary, higher and technical education in Bangladesh. But there are different implementing bodies for secondary education, higher education and technical education.
Ministry of Housing and Public Works	Provides housing and regulates the state construction activities in the country. Its directorates are: • Khulna Development Authority • Public Works Department • Chittagong Development Authority • National Housing Authority • Urban Development Directorate • Capital Development Authority (RAJUK) • Rajshahi Development Authority • Department of Architecture • Housing and Building Research Institute • Directorate of Government Accommodation
Ministry of Local Government, Rural Development and Cooperatives	Responsible for housing and building, regional and rural policy, municipal and cities administration and finances, and the conduct of elections. Local Government Division: • Local Government Engineering Department; • Khulna Water Supply and Sewerage Authority (WASA); • Khulna City Corporation; • Chittagong WASA; • Chittagong City Corporation; • Public Health Engineering Department; • National Institute of Local Government; • Dhaka North City Corporation;

Institution	Functions
	• Dhaka WASA; • Dhaka South City Corporation; • Narayanganj City Corporation; • Water Supply and Sewerage Authority; • Sylhet City Corporation. Rural Development and Co-operatives Division: • Department of Cooperatives; • Bangladesh Rural Development Board (BRDB); • Rural Poverty Alleviation Foundation (PDBF); • Small Farmer Development Foundation (SFDF); • Bangladesh Cooperative Bank; • Bangladesh dairy farmer co-operative Union Limited (Milk Vita); • Bangladesh Academy for Rural Development (BARD); • Rural Development Academy (RDA) Bogra; • Bangabandhu Poverty Alleviation and Rural Development (BAPARD).
Ministry of Road Transport and Bridges	The Ministry has two divisions: the Road Transport and Highways Division; and the Bridges Division - responsible for construction of all bridges which are longer than 1.5 km. In contrast to practices in other nations, Bangladesh has four ministries responsible for transportation within the country. They have specific responsibilities, such as: • Road safety: Ministry of Road Transport and Bridges • Civil aviation: Ministry of Civil Aviation and Tourism • Maritime transport: Ministry of Shipping • Rail transport: Ministry of Railways
Ministry of Shipping	This ministry is responsible for the modernization of sea ports, river ports and land ports, conservation of navigability of waterways, creation of efficient workforce in the maritime sector, safe and affordable transportation of passengers and goods. and facilitation of international trade. It has 10 subsidiary directorates: • Chittagong Port Authority; • Bangladesh Land Port Authority; • National Maritime Institute; • Bangladesh Inland Water Transport Authority; • Bangladesh Inland Water Transport Corporation (BIWTA) - responsible for the control, management, and development of inland water transport; • Bangladesh Marine Academy; • Bangladesh Shipping Corporation; • Mongla Port Authority; • Payra Port Authority; • Department of Shipping.

4.3.5 National and international academic and research organizations

(a) **BRAC University** carries out environment and climate related research through its Centre for Climate Change and Environmental Research (C3ER). It offers postgraduate programmes on disaster management leading to certificates, diplomas and master's degrees.

(b) **International Centre for Climate Change and Development (ICCCAD)** is a research and training centre based at the Independent University, Bangladesh (IUB) Dhaka. It has three

primary initiatives: climate change related training through short courses and workshops; a MSc in climate change and development in partnership with the School of Environmental Science and Management within IUB; and knowledge management that incorporates both cutting edge research and investigation. Past short courses and workshops have covered environmental challenges, disaster risk reduction and adaptation to climate change, community-based adaptation, and mainstreaming climate change into national planning systems, among others.

(c) **Dhaka University** has two institutes that are actively involved in disaster management and vulnerability studies:

- **Institute of Disaster Management and Vulnerability Studies (IDMVS)** - offers a two-year Master of Disaster Management (MDM) degree programme, with comprehensive and multi-disciplinary class teaching assignment, field based research, presentation and comprehensive assessment.
- **Department of Sociology and Centre for Disaster and Vulnerability Studies (CDVS)** offers a Master of Disaster Management programme - supported through a collaborative agreement involving the Ministry of Food and Disaster Management and several overseas universities and voluntary organizations

(d) **Consultative Group on International Agricultural Research (CGIAR)** has been conducting research on the impacts of climate change on agriculture through the National Agricultural Research System (NARS).

(e) **International Institute for Environment and Development (IIED)** as an independent, international research organization that works to convert the voices of the most vulnerable into policy. The institution has funded various research projects in Bangladesh on adaptation, community-based adaptation, ecological agriculture, mainstreaming adaptation and climate change, and economics of environment and climate change.

(f) **Bangladesh Institute of Development Studies (BIDS)** is a public, multi-disciplinary body that conducts research on policy-making in different sectors of development in Bangladesh, e.g on environmental pollution, climate change, fuel subsidies to the local poor, food insecurity, poultry supply chain, dynamics of dowries, engagement of religious leaders in development issues, gender and development, growth studies, sexual health and mother-child health.

(h) **Center for Environmental and Geographic Information Services (CEGIS)** is a public trust and not-for-profit centre of excellence established under the Ministry of Water Resources (MoWR). It focuses on resource management planning, system development, studies and research and capacity building.

(i) **Institute of Water Modelling (IWM)** is focuses on water resources and modelling covering issues such as: flood control, flood forecasting, irrigation and drainage, river morphology, salinity and sediment transport, coastal hydraulics, port, coast and estuary management, environmental impact assessment, bridge hydraulics and related infrastructure development. IWM undertakes statistical downscaling of the Global Circulation Models (GCMs) to develop climate scenarios.

(j) **Institute of Water and Flood Management (IWFM)** was established in 2002 as part of the Bangladesh University of Engineering and Technology (BUET). It undertakes research and capacity development in the field of water and flood management, and provides advisory and consultancy services to government and non-government organizations.

4.3.6 **Non-governmental and activities/advocacy organisations**

In Bangladesh, NGOs have a broad role in addressing many environmental and social issues and running/ strengthening associated projects and programmes. This is particularly important in rural areas which tend to receive much less development attention.

4.3.6.1 *Non-governmental organisations*

The role of some of the main NGOs is described below:

(a) **Action Aid, Bangladesh** supports projects that promote and strengthen livelihoods, provide protect from disasters, access to and control over natural resources, etc. It now emphasises raising awareness about environmental and climate change rights and access to justice. Action Aid's current projects aim to strengthen the capacity of local government institutions to formulate projects and carry out monitoring and evaluation of community-based adaptation activities.

(c) **Oxfam GB** has been an important development partner focusing on humanitarian, livelihoods, gender, river basin and indigenous people's development programmes in Bangladesh. All of the focal points face risks as a result of climate change. Oxfam works on disaster management in the Meghna, and Ganges- Brahmaputra basins to mitigate the effects of floods. Oxfam- Netherlands is actively involved with Climate Action Network-South Asia (CANSAs) and also provides financial resources for networking.

(c) **CARE Bangladesh** works on climate change adaptation and risk reduction with local government institutions. This work is based on the notion that communities do not need significant outside resources to overcome the challenges they face. CARE 's work includes:

- Empowering communities to address poverty and marginalisation in a more sustainable way;
- Supporting exercises to map vulnerabilities at the village, ward, and union levels.
- Working with UPs to make planning and budgeting process more transparent and participatory;
- Utilising the "Community Vulnerability and Capacity Analysis (CVCA)" tool to help groups create a Community Action Plan - prioritising all the problems that people face, not only those related to climate change and disasters.
- Organising consultation meetings to share such plans with UP members to influence the UP to integrate the ideas into the annual development plan.
- CARE does not directly provide substantial financial resources for the implementation of these plans, believing that empowered communities can address their problems collectively without significant external support;
- Working with communities and local government bodies to increase UP revenues through activities such as sensitising local elites to the importance of paying taxes.
- Helping to connect communities to other sources of funding, such as other agencies and partnerships with the private sector.

According to CARE's experience, social safety net programmes, especially if improved to reduce political bias, could be an important avenue for providing communities with additional resources to address the problems they face.

(d) **Climate Action Network South Asia (CANSAs)** is a network of 500 NGOs that encourages government and individual actions to limit human-induced climate change to ecologically sustainable levels. The network promotes a three-track approach involving mitigating, greening

and adapting, and encourages cooperation amongst individuals and organisations to follow the same approach.

(e) **Bangladesh Rural Advancement Committee** (BRAC) is the largest non-governmental development organization in the world. It is dedicated to reducing poverty by empowering the poor to bring about change in their own lives.

(b) **Caritas Bangladesh** works in integrated development, disaster management and human resource development, and also contribute to social justice and human rights, health and care.

(c) **Heed Bangladesh** works in 32 districts and is focused on relief and welfare programmes, particularly health, education and economic development.

(d) **International Union for Conservation of Nature** (IUCN) is part of the global IUCN – a leading authority on biodiversity conservation, environmental governance and nature-based solutions. Bangladesh joined IUCN as a State Member in 1972 with a country office established in 1992. IUCN in Bangladesh works in close collaboration with its Members comprising national non-government organizations, with key support from the Ministry of Environment and Forest. Throughout the Asia region, IUCN leads initiatives that address species loss and ecosystem degradation, help improve management of natural resources for the benefit of human communities, and promote natural infrastructure to reduce risks and impacts of disasters. IUCN's projects cut across themes such as species and biodiversity conservation, climate change and resilience, coastal and marine ecosystems, protected areas, water and wetlands, and nature-based disaster risk reduction.

(e) **Wildlife Conservation Society** (WCS) of Bangladesh was established in 2004 focusing on marine conservation with an emphasis on cetaceans and later sharks and rays. More recently WCS Bangladesh has engaged law enforcement agencies to conduct more effective wildlife patrols and support efforts to combat illegal wildlife trade. It engages political leaders and local communities through interactive outreach for creating an informed constituency for marine and terrestrial conservation. WCS Bangladesh focuses on wildlife science and shares new knowledge with local communities and government agencies through innovative outreach. It collaborates with the government and local communities to adopt management practices that balance the protection of wildlife with the needs of local communities. In addition, WCS Bangladesh provides technical support to law enforcement agencies to ensure wildlife conservation laws are enforced and maintains a growing network of trained and motivated citizen scientists to support science-based and community informed marine conservation.

4.3.6.2 Action and activist organisations

Action Research for Community Adaptation in Bangladesh (ARCAB) is a long-term programme to promote community-based adaptation (CBA) to climate change in five major livelihood zones that correspond to five major ecosystems, which are part of the Ganges-Brahmaputra River flood plains, coastal and hill systems. The programme is jointly managed by Bangladesh centre for Advanced Studies (BCAS) and International Institute for Environment and Development (IIED), ARCAB UK has organised national and international conferences on CBA to collect experiences and advocate policy formulation.

Bangladesh Paribesh Andolon (BAPA) is a forum of citizens and organizations concerned with the environment of Bangladesh. It works to promote public awareness and action for the

prevention of environmental degradation, mitigation of pollution and protection of safe environment in Bangladesh and influencing protection of the global environment.

Bangladesh Environmental Lawyers Association (BELA) is a non-profit legal organisation established in 1992 to assist efforts to protect the environment. It monitors compliance with Bangladesh's environmental laws and works to increase environmental awareness and ensure proper environmental jurisprudence. BELA is the leading Bangladeshi lawyer's advocacy group that supports people on environment issues. It has developed techniques and strategies to deal with the legal regimes to protect the environment and filed several public interest litigations. BELA has launched mass campaigns to raise peoples' awareness of their environmental rights and access to justice.

4.3.7 **Private sector organisations**

Private sector organisations in Bangladesh include a range of bodies including chambers of commerce, trade bodies and associations.

(a) **The Bangladesh Enterprise Institute** promotes and articulates issues of importance to the private sector and seeks to influence policy and to initiate measures crucial to the development of a market-oriented economy as well as sustainable growth of trade, commerce and industry.

(b) **Major private sector groups.** The economy is driven by a number of large company groups, including, for example:

- PRAN-RFL Group - one of the largest multinationals in Bangladesh established, in started with the establishment of Rangpur Foundry Ltd (RFL) in 1981, to provide affordable irrigation instruments across the country. In 1985, the Program for Rural Advancement Nationally (PRAN) was founded to produce agro-products. By 2016, PRAN started exporting its products to 118 different countries, reaching 10 billion taka value.
- Advance Chemical Industries (ACI) Group is another leading conglomerate involved in pharmaceuticals, agri-business and consumer brands. Formerly part of Imperial Chemical Industries (ICI) in Pakistan, the company was registered in Bangladesh in 1973. ACI employs over 7,275 employees.
- BEXIMCO Group is the largest private sector group in Bangladesh, founded in 1970, and is the most diversified industrial conglomerate. Its interests include: pharmaceuticals, textiles, information technology, jute, media, finance, real estate, and others. Its IT division (Bangladesh Online Limited, BOL) is the top internet service provider in Bangladesh. The group employs over 50,000 people.
- PARTEX Group started in 1959, initially as a trading business operating in tobacco. It now has over 40 subsidiaries with interests including foods and beverages, agri-business, real estate, steel, textiles, furniture, plastics, consumer goods, and IT.
- Ananda Group was established in 1983 as a real estate company. It now has other interests in textiles, shipbuilding, heavy engineering and shipping. Ananda Shipyard and Shipways Ltd is the first ship exporter from Bangladesh.
- Jamuna Group (JGI), established in 1974 as the Jamuna Electric Manufacturing Company. It now includes 24 enterprises with interests in electrical, engineering, motor cycles, chemical, leather, garments and textiles (including spinning, knitting and dyeing), cosmetics, toiletries, beverages, real estate, housing, print and electronic media sectors.

- Basundhara Group, established in 1987 as a real estate company, it now owns more than 20 companies with interests in cement, shipping, logistics, horticulture, chemicals, trading, employment services, electricity, infrastructure, exports, agriculture, oil and gas, airways, steel, technology, paper and pulp, tissue paper, LPG bottling and distribution and trading, among others.

4.4 India-Bangladesh Joint Working Group (JWG) On Conservation of the Sundarbans

The India-Bangladesh Joint Working Group (JWG) on the conservation of the Sundarbans was established to strengthen sustainable management and development of the shared Sundarbans ecosystem. The JWG also provides the institutional mechanism for improving interaction between two sides at the field level in their mutual interest. The first JWG meeting was held on 21 July 2016 in New Delhi. The agenda items included:

- Sharing of knowledge of flora and fauna in both parts of Sundarbans through biodiversity mapping and evaluation study;
- Water quality monitoring of important rivers terminating in the Sundarbans region and ultimately in the Bay of Bengal for both the countries through a standard methodology and standard parameters solely for the management of Sundarbans ecosystem;
- Siltation trend analysis of rivers in the Sundarbans region of both the countries and generation of timeline data for future studies and assessments solely for the management of Sundarbans ecosystem;
- Sharing of intelligence on smuggling of animals and wildlife products, inviting forest officials to regularly attend meetings on security issues held by forces; officials of India and Bangladesh holding periodic meetings on either side of the Sundarbans alternatively, to share management strategies and create common approaches as envisaged in the MoUs;
- Reserving seats for personnel from Bangladesh in the nine months diploma course at the Wildlife Institute of India, Dehradun;
- Illegal exploitation of marine biodiversity using harmful gear;
- Measuring the scale of dependency of adjacent communities on the Sundarbans ecosystem;
- Study of the Sundarbans-dependent communities and their alternative livelihoods;
- Joint identification of research needs, joint research and incorporation of research findings in the Sundarbans management practice for the whole Sundarbans ecosystem.

The two sides agreed on the need for a range of activities:

- Joint biodiversity mapping of the Sundarbans;
- Compilation of good practices;
- Developing a common approach towards monitoring of river pollution;
- Management of the marine ecosystem
- A study on indicators for the assessment of the health of the Sundarbans ecosystem.
- A joint study on the impact of climate change on the Sundarbans ecosystem.

Detailed modalities for these studies would be worked out after mutual consultation. Unfortunately, the second meeting of the JWG had to be postponed due to COVID-19. So the future plan of activities has yet to be prioritised and finalised.

5. Legal and Regulatory Framework, and International Conventions

5.1 Environmental and social laws and regulations

5.1.1 *Introduction*

The main environmental regulations in Bangladesh are the Environment Conservation Act (ECA) 1995 (amended 2000, 2002, 2007 and 2010) and Environment Conservation Rules (ECR) 1997. The ECA 1995 provides the requirements on environmental protection, improvement of environmental standards, and control and abatement of environmental pollution. Through the ECA 1995, the Department of Environment (DoE) is mandated to undertake any activity needed to conserve and enhance the quality of environment and to control, prevent and mitigate pollution.

The ECR, 1997, provide the parameters for: (a) the declaration of ecologically-critical areas and restrictions on operations and process which can or cannot be carried out/initiated in such areas, (b) securing an environmental clearance certificate, (c) environmental quality standards, (d) acceptable limits for discharges of waste, and (e) guidelines on pollution prevention. Overall, the ECA, (1995) and ECR, (1997) outline the regulatory mechanism to protect the environment in Bangladesh.

The Department of Environment (DOE) under the Ministry of Environment, Forest and Climate Change (MOEF) of Bangladesh is responsible for the environmental approval process for all kinds of development activities.

In addition, there are around 200 laws with direct relevance to environment (. In most of the cases, their primary objective does not concern natural resource management or addressing environmental pollution directly. However, they can be invoked with regard to sectoral environmental issues related to public services and practices concerning, for example, use of pesticides, land use, human health and urban facilities (Farooque and Hasan, 1996).

Laws relevant to natural resource management in Bangladesh can be broadly divided into the following categories (Farooque and Hassan 1996):

- *Non-sectoral laws*, e.g. Environmental Conservation Act (ECA), 1995; and the Environmental Conservation Rules (ECR), 1997;
- *Sectoral laws* – covering: land use, agriculture and irrigation, water resources, fisheries, forestry, wildlife, energy, health, food and consumer protection, transportation, local government, urban and rural development.

5.1.2 *National legislation*

Table 5.1 summarises the national environmental regulations and other relevant laws. Further details are provided in the following sections.

Table 5.1: National legislation relevant to sectoral development activities

Issue	Legislation or Regulation	Brief description of the legislation
Protection of Environment including protected areas and pollution management	Environment Conservation Act- 1995 (with amendments till 2010)	The ECA 1995, amended in 2010, covers environment conservation, standards development, pollution control and abatement, declaration of ecologically critical areas (ECAs) and imposing of restriction for operations within the jurisdiction of such areas, defining and conserving wetlands, hill cutting, ship breaking, and hazardous waste disposal. The 2010 amendment empowered the government to enforce more penalties than before. Moreover, affected persons were given provision for make objections or take legal actions against polluters or any entity creating a nuisance.
	Environment Conservation Rules- 1997 (including all amendments)	These rules, promulgated under the ECA 95, categorise industries and projects and identify the types of environmental assessments needed for the categories, and established national environmental quality standards.
	Environment Court Act 2010)	The objective of this act is to expedite trials concerning environmental crimes. Previously, environmental crimes were not usually considered as serious offences. The act allows government to take necessary legal action against any parties who create environmental hazards/ damage to environmentally sensitive areas as well as human society. According to this act, government can take legal actions if any environmental problem occurs due to interventions of the River Management Improvement Programme.
	The Forest Act, 1927 (amended in 1982, 1989 and 2000)	This Act aims to protect forest resources and provides for reserving forests over which the Government has an acquired property right. It enables the restriction of many activities that may cause damage to forests and wildlife resources within forest areas and the imposition of punishment for violation. Relevant people are bound to inform and assist Forest or Police Officers to prevent crime in the forests.
	The Protected Area Rule 2017	This rule provides for the formation of Co-management Committees for the management of Protected Areas. The Committees involve stakeholders including the resources users and especially ethnic people. It empowers the Committee to act as official actor for the protection of forests and collect revenue, and also provides for sharing of revenue to cover the recurrent costs of co-management. Recently introduced in Sundarbans.
	The Social Forestry Rule 2004	Provides regulation for plantation on marginal lands besides roads, canals, embankments and railways with the involvement of local residence as beneficiaries. The latter are given the majority of the harvested crops in return for their contribution to protect the seedlings planted. The rule

Issue	Legislation or Regulation	Brief description of the legislation
		allows tree firming funds from the sale proceeds of harvested plantation for replanting.
	Wildlife (Conservation and Security) Act- 2012-	Provides for the conservation and safety of biodiversity, forest and wildlife of the country by repealing the Bangladesh Wildlife (Preservation) Order 1973 relating to conservation and management of wildlife of Bangladesh. Under this Act, hunting, trapping, killing, driving or damaging of wildlife are strictly prohibited.
	Bangladesh Biodiversity Act 2017	As a dualist country, Bangladesh requires implementing domestic legislation to give legal effect to the provisions of international treaties. The act was introduced 25 years after Bangladesh signed the Convention on Biodiversity in order to fulfil the State's international obligations. The law introduces an access and benefit-sharing (ABS) mechanism and also promotes research related to biotechnology and documentation of traditional knowledge.
	Noise Pollution Control Rules- 2006	This Rules give a right to the respective authority to mark off the areas under their jurisdiction as silent, residential, mixed, commercial or industrial. Also describes the approved standard limit of sound for each area.
	Bangladesh Water Act- 2013	Makes provisions for integrated development, management, abstraction, distribution, use, protection and conservation of water resources.
	National River Protection Commission Act- 2013	This act created the National River Protection Commission. It establishes composition, duties and responsibilities of the Commission to manage and control pollution of rivers caused by industries and construction of illegal structures, to prevent irregularities and restore the normal flow of rivers, to control floods and drainage, and monitor hydrology and use of surface and ground water; and examine equipment.
	The National River Conservation Commission Act, 2013	Established the Commission to prevent illegal occupation of rivers, pollution of water and environment, pollution of rivers caused by industrial factories, illegal constructions and various irregularities and ensuring multidimensional use of rivers for socio-economic development including restoration of the normal flow of rivers, proper maintenance thereof and making them navigable.
	Natural Water Bodies Protection Act 2000	According to this Act, the character of water bodies, i.e. rivers, canals, tanks, or floodplains identified as water bodies in the master plans or in the master plans formulated under the laws establishing the municipalities in division and district towns, shall not be changed without approval of concerned ministry.

Issue	Legislation or Regulation	Brief description of the legislation
	The Ground Water Management Ordinance (1985)	Describes the management of ground water resources and licensing of tube wells.
	The Water Supply and Sanitation Act (1996)	Regulates the management and control of water supply and sanitation in urban areas.
	Bangladesh Climate Change Trust Act 2010	An Act to establish a trust to be called the Climate Change Trust to redress the adverse impact of climate change on Bangladesh and to take measures on other matters relating thereto. The objective of the Trust is to use funds beyond the revenue and development budget to address vulnerability to climate change issues.
	The Ship Breaking and Recycling Rules-2011	The Rules promulgated under the ECA of 1995 (amended) defines and classifies hazardous materials (hazmats) (including hazardous wastes) and provides for safe and environmentally sound ship recycling in Bangladesh.
	Embankment and Drainage Act 1952	An Act to consolidate the laws relating to embankment and drainage and to make better provision for the construction, maintenance, management, removal and control of embankments and water courses for the better drainage of lands and for their protection from floods, erosion or other damage by water.
Agriculture and Fisheries	The Protection and Conservation of Fish Act 1950 (amended 1973, 1982, 1995, 2002)	The act sets requirements to protect and conserve fish. Defines fish as “all cartilaginous, bony fishes, prawn, shrimp, amphibians, tortoise, turtles, crustacean animals, molluscs, echinoderms and frogs at all stages in their life history.”
	The Protection and Conservation of Fish Rules-1985	The Rules focus on the protection of fisheries/fishes and aim to prevent the destruction of fish in the natural waters and killing of fish by poisoning.
	Private Fisheries Protection Act 1889	Provides for the protection of private fishing rights.
	Irrigation Act 1876	Makes provision for the construction, maintenance and regulation of canals, for the supply of water therefrom, and for the levy of rates for water so supplied, in Bangladesh.
	Marine Fisheries ordinance 1983 and Marine Fisheries Rules-1983	Covers fisheries conservation and management.

Issue	Legislation or Regulation	Brief description of the legislation
	Biosafety Rules-2012	Provide regulations on the approval process for biotech products developed domestically or by a third country. Requires all GE products to be approved before they can be imported or sold domestically within Bangladesh.
Toxic and hazardous substances	Agricultural Pest Ordinance 1962	An Ordinance to provide for the prevention of the spread of agricultural pests in Bangladesh.
	Agriculture and Sanitary Improvement Act 1920	Act to consolidate and amend the law relating to the construction of drainage and other works for the improvement of the agricultural and sanitary conditions.
	Drug Act 1940	An Act to regulate the import, export, manufacture, distribution and sale of drugs.
	Drug Control Order 1982	An Ordinance to control manufacture, import, distribution and sale of drugs.
	Poison Act 1919	An Act to consolidate and amend the law regulating the importation, possession and sale of poisons.
	Agricultural Pest Ordinance 1962	An Ordinance to provide for the prevention of the spread of agricultural pests in Bangladesh
	Pesticide Act-2018 and Pesticide Rules, 1985 (Amendment) in 2010	Bans harmful toxic substance which were earlier imported and used for pest control.
Land, land use and cultural heritage	Antiquities Act 1968	The Act focuses on protection and preservation of archaeological and historical artefacts.
	Acquisition and Requisition of Immovable Property Act, 2017	Repealed the Acquisition and Requisition of Immovable Property Ordinance 1982 and provides certain safeguards for the owners and has provision for payment of “fair value” for the property acquired. Also gives the right to the land owner to appeal against land acquisition.
	Balumahal and Soil Management Act 2010	This Act has the provision for protection of uncontrolled mining of sand from water ways and prohibits sand quarrying within a kilometre of bridges, culverts, dams, barrages, embankments, highways, rail tracks, residential areas and other important structures, as well as sand lifting without permission.
	Non-Agricultural Tenancy Act 1949-for land use	Makes provisions relating to the certain non-agricultural tenancies in Bangladesh.
	State Acquisition and Tenancy Act 1950-land use	Introduced to eradicate flaws and gaps in the provisions for collection and receiving of rents for land. It also declares forests and waterbodies as non-retainable properties.
	Acquisition of Waste Land Act 1950	This Act authorizes the government to acquire private lands that have not been cultivated during last five years, for any public purposes including afforestation.

Issue	Legislation or Regulation	Brief description of the legislation
	Land Reforms Ordinance 1984 Land use	Reformed the law relating to land tenure, land holding and land transfer with a view to maximising production and ensuring a better relationship between land owners and bargadars (people who cultivate the land for others).
Water Transportation, handling and storage, pollution and coastal resources management,	Territorial Water and Marine Zone Act 1974 & Maritime Rules- 1977	Provide guidelines for transportation through marine and inland water ways and control of pollution in the surrounding waterways, and for the conservation, management and development of marine fisheries.
	Ports Act- 1908	The Act has guidelines for controlling pollutant discharges (oil, grease, oily water, bilge and ballast water, rubbish etc.), creation of fires, creation of obstacles for navigation and spread of infectious diseases in the surrounding environment or damage of shore/bank.
	Hazardous Wastes and Ship Breaking Waste Management Rules, 2011 (22 December, 2011; MoEF)	The legislation is premised on the Basel Convention. It bars the import of wastes if ships are not certified by authorized agents of exporting countries as not containing hazardous wastes; provides regulations for safe disposal of hazardous waste. Implementation through an emergency response plan Implementation is the responsibility of a National Technical Committee under MoEF.
	The removal of wrecks and obstructions in inland navigable water-ways Rules, 1973	The Rules has provision to take action against any obstruction created in the water ways. The wreck or obstruction can be required to be raised, removed or destroyed.
	Bangladesh Merchant Shipping Ordinance- 1983	The Act provides for the engagement of seaman during project activities.
	The inland shipping Ordinance-1976	The law makes provision for BIWTA to issue a permit for navigation.
	Coast Guard Act 2016	The Act makes provisions to control pollution discharges and protect the surrounding environment.
	Rules for Removal of Wrecks and Obstructions in inland Navigable Water Ways (1973)	The Rules apply to inland navigable waterways, including all rivers, canals, lakes, shores, inland river ports, piers and terminals (as per Section 2, clause I) and deal with any kind of obstruction and all wrecks (as per Section 2, clause IV) impeding navigation. The appointed Authority may dispose, remove or destroy obstructing items or even take possession of them and issue a public notice in this regard.
	Canals Act 1864	This old law in need of amendment and consolidation. It covers the collection of tolls on canals and lines of navigation.
	Inland shipping Ordinance 1976	An Ordinance to provide for the survey, registration and control of navigation of vessels plying on inland waters.

Issue	Legislation or Regulation	Brief description of the legislation
	Mongla Port Authority Ordinance- 1976	The legislation enables the controlling, anchorage and sailing of ships and provides guidelines for environmental pollution control in the surrounding sea and land environment.
Road transportation	The Vehicle Act (1927) and the Motor Vehicles Ordinance (1983)	This Act provided for the better control of horse-drawn vehicles in certain areas in Bangladesh. The Ordinance consolidated and amended the law relating to motor vehicles in Bangladesh. These laws regulate vehicular exhaust emissions, air and noise pollution including road safety.
Power generation, energy, mining, industry and utilities	Electricity Act, 2018	The Act repealed a 2010 law relating to the supply and use of electrical energy. The 2018 Act specifies conditions of distribution, sale and use of electricity, including related generation and transmission infrastructure, and obligations regarding the need for preservation of the environment, and associated protection and safety clauses.
	Bangladesh Energy Regulatory Commission Act- 2003	Makes provisions for the establishment of an independent and impartial regulatory commission for the energy sector.
	The Telegraph Act (Act XIII of 1885)-1885	Sections 10-19 specify parameters and obligations for government-built transmission lines throughout the country.
	NG Safety Rules 1991 (amended 2003)	Provides guidelines on the materials, design and construction of gas transmission and pipeline industry. This Safety Rules were based on the American National Standard Codes for Gas Transmission and Piping System.
	Bangladesh Petroleum Act 1974	Provides for the exploration, development, exploitation, production, processing, refining, and marketing of petroleum.
	Petroleum Act 2016	An Act to consolidate and amend the law relating to the import, transport, storage, production, refining, blending, or reclaiming by recycling of petroleum and other inflammable substances. This Act, consisting of six Chapters, regulates petroleum import, transport, storage, distribution, refining, blending, testing, licensing and all aspects related to petroleum exploitation.
	Bangladesh Gas Act 2010	Regulates the transmission, distribution, marketing, supply and storage of natural gas and liquid hydrocarbon.
	NG Safety Rules 1991 (amended 2003)	Provides guidelines on the materials, design and construction of gas transmission and pipeline industry. This Safety Rules were based on the American National Standard Codes for Gas Transmission and Piping System.
	Brick Manufacturing and Brick Kiln Establishment	The proposed law (passed by parliament in February 2019) is a modified version of the 2013 Act and will prohibit conventional technologies in the brick-making industry.

Issue	Legislation or Regulation	Brief description of the legislation
	(Amendment) Bill 2019	
	Speedy Increase of Electricity & Fuel (Special Provision) 2010	An Act to make special provisions for facilitating effective and urgent measures to enhance the generation, transmission, transportation and marketing of electricity and energy with a view to ensuring uninterrupted supply of electricity and energy keeping pace with the demands of agricultural, industrial, commercial and domestic activities, and for quick implementation of the plan to import electricity and energy from abroad, if necessary, and for implementation of the decisions on urgent extraction and utilization of minerals related to energy.
	SREDA Act 2012, Renewable energy Act-2012	Sustainable and Renewable Energy Development Authority (SREDA) has been formed under Sustainable and Renewable Energy Development Authority Act, 2012 as a nodal agency to promote, facilitate and disseminate sustainable energy (SE), i.e. covering both the areas of Renewable Energy (RE) and Energy Efficiency (EE) to ensure the energy security of the country.
	BEZA Act 2010	An act to make provisions for the establishment of economic zones in all potential areas including backward and underdeveloped regions and development, operation, management and control thereof including the matters ancillary thereto with a view to encouraging rapid economic development through increase and diversification of industry, employment, production and export.
	Bangladesh Electricity & Energy Research Council Act 2015	This Act created the Bangladesh Energy and Power Research Council. It prescribed the composition, duties and responsibilities of the Council regarding research and development of the country's power and energy sector. It specifies the authorized use of electricity and fuel diversification for the identification, conservation and conversion of energy to ensure the safety of the power and energy sector in the country with a view to long-term planning study of the sector.
	Mines Act 1927	The Act focuses on mineral resources development and management. It requires amending and consolidation regarding the regulation and inspection of mines.
Procurement in Bangladesh	The Public Procurement Regulations-2003 (and all amendments)	The regulation focuses on each of the project services and equipment which will be procured following the government rules.
	Import and Export Control Act-1950	The Act outlined guidelines on the export and import of goods. The Government may prohibit, restrict or otherwise control the import or export of goods of any specified description, or regulate generally all practices (including

Issue	Legislation or Regulation	Brief description of the legislation
		trade practices) and procedures connected with the import or export of such goods.
Health and Safety and labor management	The Penal Code 1860	The Code contains still valid provisions relating to pollution management, environment protection, and protection of health and safety.
	Dangerous Cargoes Act 1953	The Act provides for guidelines for cargos to avoid any discharges of hazardous materials in the surrounding water ways and adjacent land.
	Explosives Act 1884, Explosive Rules-2008.	An Act to regulate the manufacture, possession, use, sale, transport and importation of Explosives.
	Pressure Vessel Rules 1995 (amended 2004)	The Rules provide the safety requirements for units handling divergent types of hazardous materials.
	Explosive Substances Act 1908 and Explosive Substances (Amendment) Act, 1987.	This amendmet act imposed a penalty for causing an explosion with intent to commit an offense, and punishment for exploding, making or possessing explosives under suspicious circumstances.
	Fire Prevention and Extinguish Act, 2003	The Act has provisions for controlling and prevention of fire and accidental events.
	Bangladesh Labour Act 2006 and Bangladesh Labour (Amendment) Act, 2013.	The 2013 amendment makes a large number of changes to the 2006 Act. It provides regulations that aim to protect the interests and rights of the workers, provision for a comfortable working environment, reasonable working conditions, and to ensure workers' safety and wellbeing during project life cycles. In addition, it stipulates that children under 18 years are not allowed to be employed during project life cycle.
	Bangladesh Labour Rules 2015	The Rules require that any establishments which want to employ labour must have service rules and must get permission from the Chief Inspector of Labour. The Manpower Supply Agency is registered under the Labour Act. The Rules prescribed the process for investigating misconduct. They also cover festival bonuses, provident fund, holidays, health and fire safety, calculating wages, a form for use in labour court cases, and approval of factory plans and extensions.

5.1.3 **Key environmental and natural resource legislation**

5.1.3.1 *Environmental Conservation Act (1995 and amendments)*

The Bangladesh Environment Conservation Act of 1995 (ECA, 1995) is the key legislation in relation to environment protection in Bangladesh. It covers environment conservation, standards, development, pollution control, and abatement. The Act provides for:

- Declaration of ecologically critical areas and restriction of operations and processes which can or cannot be carried/initiated in such areas;
- Regulations of vehicles emitting smoke harmful for the environment;
- Environmental clearance;
- Regulation of discharge permits for industries and other development activities;
- Promulgation of standards for quality of air, water, noise and soil for different areas for different purposes;
- Promulgation of a standard limit for discharging and emitting waste; and
- Formulation and declaration of environmental guidelines.

The Act was amended in 2000, 2002, 2007 and 2010 (Box 5.1).

Box 5.1: Amendments to the Environmental Conservation Act

- **2000:** focuses on: (1) ascertaining responsibility for compensation in cases of damage to ecosystems, (2) increased provision of punitive measures both for fines and imprisonment and (3) fixing authority on cognizance of offences.
- **2002:** elaborates: (1) restriction on polluting automobiles, (2) restriction on the sale and production of environmentally harmful items like polythene bags, (3) assistance from law enforcement agencies for environmental actions, (4) break up of punitive measures and (5) authority to try environmental cases.
- **2007:** modified the Environmental Conservation Rules 1997 by abolishing the Orange-B category of projects.
- **2010:** introduces new rules and restrictions on: (a) ensuring proper management of hazardous wastes to prevent environmental pollution and health risk, (b) preventing the filling/changing of any water body, except in the case of national interest with clearance by the relevant department, (c) binding emitters those responsible for any activities/incidents to control the emission of environmental pollutants that exceeds the existing emission standards, and enables the government to (d) declare any ecosystem as “ecologically critical area” if it appears to be degraded or expected to be degraded and take all precaution measures to protect that ecosystem. In addition, government shall stop any ongoing activities and will not allow any new developments in the ecosystem after declaration as an “Ecologically Critical Area”.

5.1.3.2 Environment Conservation Rules (1997 including amendments)

The Bangladesh Environment Conservation Rules (ECR), 1997, were the first set of rules promulgated under the ECA 95. Three amendments have subsequently been made (February and August 2002 and April 2003).

Rule 3 empowers the Government to declare an area as an '**Ecologically Critical Area** (ECA) if it is satisfied that the ecosystem of the area has reached or is threatened to reach a critical state or condition due to environmental degradation. The Government is also empowered to specify which of the operations or processes shall not be carried out or shall not be initiated in the ecologically critical area.

Rule 7 classifies industrial units and projects into four categories depending on environmental impact and location for the purpose of issuing an **Environmental Clearance Certificate** (ECC): Green, Orange A, Orange B, and Red.

- All existing industrial units and projects and proposed industrial units and projects that are considered to be low polluting are categorized under "Green" and shall be granted Environmental Clearance.
- For proposed industrial units and projects falling in the Orange-A, Orange-B and Red Categories, firstly a site clearance certificate and thereafter an environmental clearance certificate will be required. A detailed description of these four categories of industries is given in Schedule-1 of ECR'97 (Annex-1
- Apart from general requirement, for proposed industrial unit or project in the Red category, the application must be accompanied by a feasibility report, a n Initial Environmental Examination (IEE), an Environmental Impact Assessment (EIA) based on terms of reference approved by the DoE, and an Environmental Management Plan (EMP).
- As per ECR'97, all sectoral development projects must be screened based on schedule attached to the ECR'97 and, accordingly, environmental and social safeguard documents must be prepared for the respective projects in order to secure environmental clearance from the DoE.

The ECR'97 describes the procedures for obtaining Environmental Clearance Certificates (ECC) for different types of proposed units or projects. The application for such certificate must be in the prescribed form together with the prescribed fees laid down in Schedule 13, through the deposit of a Treasury Challan in favour of the Director General. The fees for clearance certificates have been revised in ECA 2010. Rule 8 prescribes the duration of validity of such certificate (three years for green category and one year for other categories) and compulsory requirement for renewal of certificate at least 30 days before expiry of its validity

5.1.3.3 Noise Pollution Control Rules (2006)

The Environmental Conservation Act, 1995, gives the authority to all the Union Councils, Paurasabhas, City Corporations and City Development Authorities to mark off the areas under their jurisdiction as silent, residential, mixed, commercial or industrial. They should also put signs to mark those areas. The Act describes the approved standard limits of sound in Schedules 1 and 2. In Schedule 1, silent area means an area up-to a radius of 100 metres around hospitals, educational institutions or special institutions or establishments identified/to be identified by the government. In the silent area it is prohibited to use any kind of horns of vehicles, audio signals

and loudspeakers. According to this act, daytime is counted from 6am to 9pm whereas night is considered from 9.00 pm to 6.00am.

5.1.3.4 The Motor Vehicle Ordinance, 1983

The Motor Vehicle Ordinance, 1983 imposed a penalty of maximum two hundred taka for those vehicles that emit smoke that poses health hazard in public places. It also restricts passengers from smoking in public service vehicles and in any other vehicles carrying a 'no smoking' notice. This ordinance is enforced only occasionally. More regular enforcement would help to reduce air pollution in big cities. However, of the penalty is currently very low and not a deterrent.

5.1.3.5 Water Act-2013

The Bangladesh Water Act 2013 aims to ensure "integrated development, management, abstraction, distribution, use, protection and conservation of water resources". It vests all rights over surface water, ground water, sea water rain water and water in the atmosphere in the State. Notwithstanding this, "rights over the surface water on any private land shall remain with the owners of such land", and such right to use the water shall be subject to the provision of the Act". Furthermore, the "right to potable water, and to water for hygiene and sanitation shall be treated as the highest priority right".

The Act makes a provision for constituting a National Water Resources Council headed by the Prime Minister. The Council is the highest decision-making body and is empowered to make policies, give instructions to develop a National Water Resources Plan for integrated development and safe abstraction of water and its proper use to ensure protection and conservation of water resources. The Council is also mandated to approve the National Water Resources Plan and ensure its implementation, as well as give advice to the Government to enter into agreement, through signing memorandum of understanding and/or signing conventions and treaty, with any Government and international or regional organization to undertake joint survey, exchange data/information with respect to common water resources and its abstraction and development and undertaking joint measures to prevent pollution of common water resources.

The Act also makes a provision for approving National Water Resources Plan prepared in accordance with the Water Resources Planning Act, 1992, containing, among other elements:

- Analysis of economic, natural, social, political, environmental, and ecological and institutional elements, characteristics and impact of water resources;
- Integrated use of surface and ground water emphasizing the highest possible use of rain water;
- Determination of water quality standard;
- Fixation of priority of water use;

The Act also makes further provision for:

- Declaration of a water stress area and management thereof;
- Preferential use of water in the water stress area and exemption thereof;
- Fixing the lowest safe yield level of aquifer and restrictions on abstracting groundwater; and
- Protection of flood control embankments - "to ensure the sustainability of the flood control embankment, no person shall, without the permission of the appropriate authority, be allowed to construct any house, establishment or any other structure on, or on the slope of such embankment."

Finally, if anybody deliberately violates or ignore the responsibility or protection under this Act, in that case, under the provisions of sub-section (2), she/he will imprisoned for a maximum of 5 years or fined up to maximum Tk. 10,000, or both.

5.1.3.6 The Forest Act, 1927 (amendment up to 2000)

The Forest Act of 1927 provides for reserving forests over which the government has an acquired property right. This act has made many types of unauthorized uses or destruction of forest produce punishable. The government may assign any village community its right to, or over, any land which has constituted a reserved forest.

The government has prohibited certain activities in the reserved forest area such as any intervention that: kindles, keeps or carries any fire; trespasses or pastures cattle, or permits cattle to trespass; causes any damage by negligence in felling any tree or cutting or dragging any timber; etc.

The hunting, capturing, driving, damaging wildlife or any parts are also prohibited in all part of Bangladesh under the Wildlife (Conservation and Security) Act 2012; and hunting, shooting and poisoning water is prohibited within forests under the Forest Act 1927. The Private Forest Ordinance of 1959 provides for the conservation of private forests and for the forestation, in certain cases, of waste-land in Bangladesh.

5.1.3.7 Protected Area Rule, 2017

The Protected Area Rule, 2017 provides for establishing a system of co-management for protected areas in which the Forest Department shares management responsibilities with local stakeholders. Co-management Committees are established involving relevant government agencies, elected members of Union Parishad, local elites and resources extractors along with members from ethnic groups. The Rule also provides for establishing a Village Conservation Forum (VCF) with local residents to function as official actors in motivating local people to better conserve resources, Community Patrol Group (CPG) members join the foresters in guarding the resources. Committees are empowered to collect revenue, 50% of which will be allotted to cover recurrent expenditure and to implement plans for landscape development and the well being of the society.

5.1.3.8 Wildlife Act 2012

The Wildlife Act of 2012 enabled the government to form a “Wildlife Advisory Board” of experts. The Board will assess present conditions and give direction from time to time in relation to the development and management of biodiversity, wildlife and forest. The Act empowered the government to declare any area as a protected area and can designate these as a sanctuary, community conservation area, safari park, eco park, botanical garden, wildlife reproduction center. The government can designate a landscape zone or corridor, buffer zone or core zone in relation to wildlife and plant preservation, protection and their smooth growth.

The Act also prohibited many activities including entrance, establishing or undertaking of any activities, disturbing or threatening any wildlife, or use chemicals, explosives or any other weapon or substances which may destroy wildlife habitat. Any person performing any kind of wildlife trade without a license may be be jailed for at least a year.

5.1.3.9 Biodiversity Act 2017

The Bangladesh Biological Diversity Act 2017 was enacted to enable the State to fulfil its international obligations having become a signatory to the Convention on Biological Diversity. Existing environmental laws broadly cover THE conservation of biodiversity and biosafety issues. So, the significance of this Act lies in introducing an Access and Benefit-Sharing (ABS) mechanism. The Act also promotes research on biodiversity and biological resources – leading to biotechnological inventions and their commercial utilization through preparing a nation-wide biodiversity register and documenting traditional knowledge (TK). The commercial utilisation will generate economic benefits which need to be shared in a fair and equitable manner.

5.1.3.10 Climate Change Trust Act, 2010

The Act established the Bangladesh Climate Change Trust (BCCT) under the Ministry of Environment and Forests (now MoEFCC). It has adopted various policies focusing mainly on adaptation as means of tackling the challenges of climate. Its functions include:

- The overall management of the Climate Change Trust Fund;
- Providing secretarial support to the Trustee Board on Climate Change and Technical Committee;
- Reviewing projects proposed for funding by different government ministries/divisions;
- Coordinating with different government ministries/divisions on the progress of their climate change mitigation projects;
- Liaising with beneficiaries, civil society, NGO, private sector and international organizations on climate change issues;
- Undertaking monitoring and evaluation of projects under implementation

5.1.3.11 The Protection and Conservation of Fish Act (1950)

This Act aims to conserve and manage the country's fisheries resources in a sustainable and environmentally-responsible manner. The act and associated rules have introduced a range of measures:

- Ban on the use of certain fishing equipment and techniques (e.g. dynamite fishing), and regulation for others (e.g. mesh size restrictions for some types of nets);
- Restriction on catch size for certain species;
- Seasonal fishing closure in certain areas;
- Regulation of certain activities which may cause pollution of water bodies;
- Regulation of activities which may obstruct water courses; and
- Establishment of fish sanctuaries and provision of rules for managing these areas.

This act primarily prescribes the manner in which dredging works must be carried so as to limit potential impacts on fisheries resources and ensure that fishermen have a reasonable level of access to dredging particular areas.

5.1.3.12 The Protection and Conservation of Fish Rules, 1985

These rules in line with the overall objectives of the Fish Act. They aim to ensure that sectoral development activities are conducted in a manner that does not cause damage to fisheries in inland or coastal waters:

- Section 5 requires that “No person shall destroy or make any attempt to destroy any fish by explosives, gun, bow and arrow in inland waters or within coastal waters”.
- Section 6 states that “No person shall destroy or make any attempt to destroy any fish by poisoning of water or the depletion of fisheries by pollution, by trade effluents or otherwise in inland waters”.

5.1.3.13 Pollution discharge management

Some of the legal instruments concerned with pollution are described briefly in Table 5.2. Where the government has not set standards in the ECR, International finance Corporation (IFC) standards⁶⁵ apply. Where government standards vary from IFC standards, the more stringent values apply when implementing development projects.

Table 5.2. Environmental pollution issues and related legal instruments

Environmental pollution issues	Legal instruments	Remarks
Gaseous emissions; Noise;	ECA (1995) and ECR (1997) including related all amendments	Schedules 2-11 of the ECR (1997) have been established to regulate uncontrolled emissions and discharges
Liquid and solid wastes discharges to the surrounding environment may ultimately impact natural resources	Noise Pollution Control Rules (2006)	Schedule of Noise Pollution Control Rules (2006).
Accidental events or unplanned events which may create catastrophic conditions and cause damage/degradation of the natural environment.	Forest Act (1927) and all amendments Wildlife Act (2012) Relevant WB guidelines.	Where there are no GOB regulations, WB guidelines apply.

5.1.3.14 Legal requirements for the protection of Ecological Critical Areas and Sundarbans World Heritage Sites

On 30th August 1999, under Section 5 (1) of the Environment Conservation Act 1995, the Ministry of Environment and Forest issue a notification in the official Gazette declaring an area extending 10 km beyond the boundary of the Sundarbans Reserved Forest on its landward periphery as an Ecological Critical Area (ECA). This prohibited all activities in the ECA, except those permitted by law, including: any industrial establishment causing pollution of soil, water, air quality and noise level; felling or collecting trees; hunting, catching or killing wild animals; fishing and other activities that are harmful for aquatic life; polluting water by disposing waste; and any other activity that could destroy or change the natural characteristics of soil and water.

Section 19 of The Environmental Conservation Area Rules, 2016 state that any change of land type within an ecological critical area is prohibited without permission of the DoE, and section 18 has a provision to prohibit different activities within an ECA including: felling or collecting trees; hunting, catching or killing wild animals; industrial establishment; fishing and other activities those are harmful for aquatic life; polluting water by disposing waste; and any other

⁶⁵ IFC General Environmental, Health and Safety guidelines and also IFC specific standards and guidelines for industries

activity that could destroy or change the natural characteristics of soil and water. There is also provision for imposing penalties

5.1.3.15 Legislation for the protection of World Heritage Site

The Sundarbans World Heritage Site was already afforded strict protection before its declaration by UNESCO - firstly as a reserved forest declared in 1875 under the Forest Act 1865; and secondly with its wildlife sanctuaries declared in 1977 by the Wildlife Order 1974. These acts were subsequently updated as the Forest Act 1927 and the Wildlife (Conservation and Security) Act 2012. The Forest Act 1927 restricts all rights within the boundary of declared forests. People are allowed to enter declared forests for specific purpose, but any damage caused to forest resources - even if by negligence - is a non-bailable and punishable offence. The Wildlife Act 2012 enables the government to prohibit activities such as:

- establishing or undertaking any industrial operations;
- harvesting, destroying or collecting any plants;
- setting any kind of fire;
- disturbing or threatening any wildlife, or using chemicals, explosives or any other weapon or substances which may destroy wildlife habitats;
- introducing any exotic animal or plant;
- dumping any materials detrimental to wildlife;
- felling any plant or part thereof except silvicultural operations required for natural regeneration of plants;
- diverting, stopping or polluting watercourses; or introducing any alien and invasive plant species;

Also, no person, institution or company shall establish or operate any industrial factory or brick-field within two kilometers from the boundary of a sanctuary. The Act further stipulates no person shall enter or reside in a sanctuary, except permitted by the law.

5.1.3.16 Additional protection of the Sundarbans under conventions

The government has ratified the Convention Concerning the Protection of the World Cultural and Natural Heritage (1972) and also the Ramsar Convention on Wetlands (1971). In doing so, it has committed to the international community to provide full protection against any activities likely to cause damage to the property declared. It is bound to notify the convention authorities of any activities that may lead to any damage to the properties. The government is required to submit periodic reports on the state of the properties and to attend convention meetings and comply with decisions taken at such meetings. Any listing of a property under such a convention makes the international community responsible and obligated to cooperate in the conservation and protection of such properties.

5.2 Environmental and social safeguards framework

5.2.1 *Environmental impact assessment*⁶⁶

Bangladesh initiated environmental impact assessment (EIA) guidelines in 1992 for the water sector development. The country enacted Environmental Conservation Act (ECA) in 1995 (including amendments) followed by Environmental Conservation Rules (ECR) in 1997 (including amendments) to govern all development activities, requirements of IEE/EIA studies based on the project categories and also obtaining of Environmental Clearance Certificate for each project. A number of evaluations have concluded that although performance is improving, it is not making full use of the potential of environmental and social impact assessment (ESIA).

5.2.1.1 *Legislative and regulatory provisions for EIA*

The National Environmental Policy (1992) required EIA for all new public and private projects. The Environmental Conservation Act (ECA) (1995) introduced mandatory provisions for environmental clearance of all industrial units and projects. Formal status for EIA was also given through the Environmental Conservation Rules (ECR) (1997) which provided a procedure for granting environmental clearance under article 7. The Environmental Conservation Act was amended through the Environment Court Act (Act No. 11 of 2000) with further amendments introduced in 2002 and 2003. Further amendments to the Rules were made in 2012, and to the Environment Conservation Act in 2010. Additionally, ECA rules for public comments have been drafted.

5.2.1.2 *Guidelines*

EIA-related guidelines are available for (a) industries (1997) and (b) the water sector - prepared under the Flood Action Plan (1992 and updated in 2003). The DoE has drafted EIA guidelines for several sectors including: coal mining, gas, pharmaceuticals, cement factories, water and transport sectors. The Water Resources Planning Organization (WARPO) and the Local Government Engineering Department (LGED) have developed their own EIA guidelines.

5.2.1.3 *Scope of EIA application*

EIA is required for all activities (private, public and foreign investment) that fall under the category of red projects as stipulated under Schedule One of the Environmental Protection Rules.

5.2.1.4 *Central EIA authority*

The Department of Environment (DoE) is the responsible body for implementing and enforcing EIA. Under the provision of the Environment Conservation Act, 1995, DoE and its six divisional offices, are authorized to review and approve the EIA reports and to process and issue environmental clearance for all types of industrial units and projects. They are also mandated to formulate environmental guidelines and advise the Government to reject manufacturing processes, materials and substances likely to cause environmental pollution. Within the office of the Director, a unit coordinates EIA-related services.

⁶⁶ Based on information on <https://www.eia.nl/en/countries/bangladesh/esia-profile>

5.2.1.5 Other key (governmental) parties involved in EIA, and their roles

The Ministry of Environment, Forest, and Climate Change (MoEFCC) is the principal government institution responsible for environmental activities in Bangladesh and for all matters relating to National Environmental Policy and regulatory issues. It plays key roles in planning, reviewing, monitoring and environmental initiatives and ensuring that environmental concerns are properly handled. MoEFCC supervises the DoE and can formulate policies and rules. The DoE has constituted a Technical Committee for the review process

5.2.1.6 Payment system

Project proponents pay a fee to obtain an Environmental Clearance Certificate, and a fee to renew the certificate once a year for Red, Orange – A and B category projects and once every three years for Green category projects.

5.2.1.7 Screening

Screening of projects is undertaken by the DoE based on a list contained in Schedule I of the Environment Conservation Rules (1997). Projects are placed in one of 4 categories based on location and impact on the environment (a location clearance is required for location and an environmental clearance is required for environmental impacts).

- Green - require no site clearance but an environmental clearance (all other categories require a site clearance);
- Orange A - requires a layout plan, process flow diagram and outlines of plans for relocation and rehabilitation;
- Orange B - require both an Initial Environmental Examination (IEE) and an EMP for clearance;
- Red - require a full EIA and an EMP.
- *Sensitive areas*: under the ECR (1997), the government may declare certain areas as sensitive. Projects in such areas require a full EIA.

5.2.1.8 Scoping

After an IEE is approved and the proponent has obtained a Site Clearance Certificate for the project, the proponent is allowed to begin preparation works for the project. For Red category projects, the DoE prepares a Terms of Reference in conjunction with the proponent which is used by the proponent to prepare an EIA. Scoping mainly involves baseline studies.

5.2.1.9 Assessment

The EIA Guidelines for Industries advise the use of checklists, matrix networks, overlays, environmental index using factor analysis, cost-benefit analysis and simulation modelling. It also suggests methodologies on impact evaluation, prediction and identification of mitigation measures. The guidelines suggest public participation. The public and NGOs are invited (discretionary) to give their views on the draft EIA report that is produced.

EIA reports are required to address standard contents:

- baseline studies;
- impact identification;
- impact prediction;
- impact evaluation;
- mitigation measures;
- monitoring program;
- special studies (for example risk assessment, rehabilitation study etc).

5.2.1.10 EIA review

The DoE is responsible for EIA report review through a technical committee which follows the industrial and water sector guidelines on review. In general, the DoE offices in each of the six divisions receive applications and issue Environmental Clearance Certificates for proposed investments within that division.

The divisional offices verify supporting documents and the divisional head then assigns an inspector for follow-up. The inspection report is treated as follows:

- Green and Orange A category projects – application submitted to the district office for decision
- Orange B category projects – application submitted to the district office which conducts inspection and prepares a review report. This report is sent to the divisional/regional office for decision.
- Red category projects – application submitted to the district office which conducts an inspection and prepares a review report. This report is sent to the divisional office and is then forwarded to the DoE Head Offices ECC Committee for decision.

5.2.1.11 Timeline for review

Article 11 of the Environmental Conservation Rules prescribes that for projects under category Red, the EIA report shall be approved or the application for an environmental clearance certificate shall be rejected within 60 working days from when the EIA report was submitted.

5.2.1.12 Compliance monitoring

There are no clear legal provisions for EIA compliance and monitoring. Monitoring is said to be conducted on an ad-hoc basis.

5.2.1.13 Non-compliance penalties

Suspension of clearance is possible. The ECA provides that failure to comply with any part of it may result in the punishment of a maximum of 5 years imprisonment or a maximum fine of 100,000Tk or both.

5.2.1.14 Stakeholder engagement

There are no legal requirement for public consultation during the EIA process or even for provision of information to affected people. The Environmental Conservation Rules do not mention public nor community. However, the water sector guidelines suggest public participation at the early stage of an EIA study and recognize the need to consider socio-cultural, physical and biological impacts. According the EIA guidelines for industries, opportunities for the public to participate are under the discretion of the Director General of DOE.

5.2.1.15 Appeal

The Environmental Courts Acts of 2000 establishes Environmental Appeal Courts for environmental offences (in general). Appeals can also be made to specialized magistrate courts where environmental laws provide for a penalty of an imprisonment not exceeding 2 years or a fine not exceeding 10,000Tk or both.

The decision on the issuance of an Environmental Clearance Certificate can be appealed.

Any person may appeal, within 30 days from the date of issuance of the notice. An appeal fee of 1000 Taka is charged to any appellant including the general public.

5.2.1.16 Number of EIAs conducted

In 2018, the DoE processed issued 6246 environmental clearance certificates.

5.2.1.17 Professional bodies

- The National EIA Association of Bangladesh (NEAB) comprises planners, practitioners and enforcement agencies. It works to create awareness of EIA in all sectors of Government planning. It has assisted in the development and extension of EIA, prescribing a code of conduct for EIA professionals, building national capability and establishing a liaison between EIA practitioners and policy-makers in Bangladesh
- The Bangladesh Environmental Lawyers Association (BELA) has played a role in the introduction of public interest litigation cases to higher courts (the High Court and the Supreme Court). An important achievement won by BELA in response to its appeal was the Supreme Court decision in 1998 to grant citizens and NGOs the right to enforce environmental laws.
- The Forum of Environmental Journalists, Bangladesh (FEJB) has been particularly effective in creating environmental awareness, and a number of State of the Environment Reports have been produced by civil society organizations.

5.2.1.18 Relevant links

EIA information is available on the website of the Department of Environment: <http://www.doe-bd.org/>

5.2.2 Strategic environmental assessment

A growing number of countries in the region that have introduced formal requirements for SEA, But Bangladesh currently has no legal or institutional framework for SEA. However, Some SEAs have been conducted with donor assistance and several SEA-related initiatives have been undertaken or are underway:

- Policies v through Bangladesh Water Development Board, 2017.
- In March 2019, staff of MoEFCC attended SEA training provided by SIDA/Niras, and support for SEA is being provided to MoEFCC by the Netherlands Commission for Environmental Assessment.
- The Bangladesh Water Development Board (BWDB) conducted a Strategic Environmental and Social Assessment (SESA) of the River Stabilization Plan under the Flood and Riverbank Erosion Risk Management Investment Program (report in 2016).

- A call for bids has been issued (February 2020) to conduct an SEA for the ' Payra-Kuakata' Comprehensive Plan.
- Strategic Environmental and Social Assessment (SESA) of River Stabilization (2016) under by consultants under the Flood and Riverbank Erosion Risk Management Investment Program (FRERMIP), Project-1).
- Country Environmental Analysis (CEA) of Bangladesh = a joint project of the Ministry of Environment and Forests (MoEF) and the World Bank (World Bank, 2006, 2012).
- The World Bank (2007) conducted an SEA for the Dhaka Metropolitan Development Plan: Strategic Environmental Assessment.
- The GoB began using policy SEA as a decision-making tool in late November 2006 at the request of Rajdhani Unnayan Kartripakha (RAJUK) and the Ministry of Housing and Public Works and finalized it in 2007.
- Another policy SEA included the development and conservation of the Sundarbans, the world's largest mangrove forest (World Bank 2012).
- SEA is also reflected in the development of a cumulative environmental assessment for the planning of development in the coastal zone of Bangladesh: "The SEA for Coastal Embankment Improvement project (ongoing)" (World Bank 2012)
- Hydrobiology (an environmental consulting company) reports online (2019) that it is working with Asian Development Bank (ADB) on an SEA for a renewable energy floating solar project in Bangladesh (source: <https://www.hydrobiology.biz/exciting-new-strategic-environmental-assessment-project-in-bangladesh/>)

5.3 Commitments to international conventions, treaties and protocols

Bangladesh has already had accessed to, ratified or signed a number of important multilateral environmental agreements (MEAs) related to environment protection and conservation of natural resources which have been already accommodated in the national policies of the country. The Environment Policy, National Conservation Strategy, National Biodiversity Strategy and Action Plan are examples of instruments that were influenced by obligations under international conventions, treaties and protocols (ICTPs).

Such ICTPs act as international guidelines that Bangladesh is obligated to comply with when implementing sectoral development activities and projects. Table 5.3 lists the important relevant ICTPs signed and ratified by Bangladesh.

Table 5.3: International conventions, treaties and protocols ratified by Bangladesh

Sector	International convention, treaty or protocol	Description	Date Ratified	Date Entered into Force
Environment and biodiversity, environmental pollution	Convention on Biological Diversity (1992)	Requires signatories to develop national strategies (National Biodiversity Strategy and Action Plan) for the conservation and sustainable use of biological diversity.	03-05-1994	29-12-1993
	Convention on International Trade in Endangered Species of Wild Fauna and Flora (Washington 1973) – also known as CITES	Addresses the exploitation patterns and overharvesting that threaten species of flora and fauna. Under this Convention, the governments agree to restrict or regulate trade in species that are threatened by unsustainable patterns and to protect certain endangered species from overexploitation by means of a system of import/export permits.	20-11-1981	01-07-1975
	The International Plant Protection Convention (IPPC), 1951	Aims to secure coordinated, effective action to prevent and to control the introduction and spread of pests of plants and plant products.	01-09-1978	
	Kyoto Protocol (1997)	Commits its Parties to set internationally- binding emission reduction targets. This agreement is linked to the UNFCCC.	22-10-2001	16-02-2005
	United Nations Framework Convention on Climate Change (UNFCCC), 1992	Aims to achieve stabilization of greenhouse gas (GHG) concentrations in the atmosphere at a level low enough to prevent dangerous anthropogenic interference with the climate system.	Adopted in 1992 and enforced from 15-04-1994	15-04-1994
	Basel Convention on the Control of Transboundary Movements of Hazardous Wastes	Aims to reduce the amount of waste produced by signatories and regulate the international traffic in hazardous wastes.	01-04-1993	05-05-1992

Sector	International convention, treaty or protocol	Description	Date Ratified	Date Entered into Force
	and their Disposal (1989)			
	Convention on Wetlands of International Importance ("Ramsar 1971").	Provides a framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.	21-9-1992 (ratified)	1971
	Convention on the Conservation of Migratory species of wild Animals (Bonn 1979)	Aims to conserve migratory species within their migratory ranges.	01-12-2005 (ratified)-	1979 and enforced in 1983
	Vienna Convention for the Protection of the Ozone Layer (Vienna, 1985)	A framework for efforts to protect the globe's ozone layer by means of systematic observations, research and information exchange on the effects of human activities on the ozone layer and to adopt legislative or administrative measures against activities likely to have adverse effects on the ozone layer.	02-08-90 (ratified).	1985
	Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal, 1987).	Designed to protect the ozone layer by phasing out the production of numerous substances that are responsible for ozone depletion.	02-08-1990	1987
	London Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (London, 1990. Copenhagen Amendment).		18-03-1994	1990
	International Convention on Oil Pollution Preparedness, Response and Cooperation (London, 1990.)	Parties are required to establish measures for dealing with pollution incidents, either nationally or in co-operation with other countries.		Signed 30-11-1990 and enforced from 13-05-1995

Sector	International convention, treaty or protocol	Description	Date Ratified	Date Entered into Force
	Convention on persistent Organic Pollutants, Stockholm-2001	Aims to eliminate or restrict the production and use of persistent organic pollutants (POPs).	12-03-2007	2001 and effective 2004
Nuclear Pollution	The Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency is a 1986 treaty of the International Atomic Energy Agency (IAEA)	Parties agreed to provide notification to the IAEA of any assistance that they can provide in the case of a nuclear accident that occurs in another state that has ratified the treaty.	1988	1986
Aquaculture and Fisheries	Agreement on the Network of Aquaculture Centres in Asia and the Pacific (Bangkok, 1988.)	Recognises the importance of fisheries in the Asia Pacific region, that aquaculture plays a vital role in the promotion and better use of fishery resources and that the maintenance of a network of aquaculture centres in the region can make a significant contribution to the development of aquaculture.	15-05-90	1988
Land degradation	UN Convention to Combat Desertification (UNCCD) 1994	A legally binding international agreement linked to sustainable development. It addresses most vulnerable ecosystems and peoples living in the dryland area.	1995	1994
Cultural and natural Heritage	Convention Concerning the Protection of the World Cultural and Natural Heritage (Paris 1972)	Defines and provides for the conservation of world's heritage by listing the natural and cultural sites whose value should be preserved.	03-11-1983	23-11-1972
Sea, maritime safety and marine pollution	International Convention for the Safety of Life at Sea (SOLAS), 1974 (amended)	Specifies minimum standards for the construction, equipment and operation of ships, compatible with their safety.	04-11-2002	25-05-1980
	United Nations Convention on the Law of the Sea	Provides guidance on ship-based pollution control and management	1982	1982

Sector	International convention, treaty or protocol	Description	Date Ratified	Date Entered into Force
	(Montego Bay, 1982.)			
	The International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (MARPOL 73/78, The current convention is a combination of 1973 Convention and the 1978 Protocol, which entered into force on 2 October 1983.	Includes regulations aimed at preventing and minimizing pollution from ships - both accidental pollution and that from routine operations	4-11-2002	02-10-1983
	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1978	Prescribes minimum standards relating to training, certification and watchkeeping for seafarers which countries are obliged to meet or exceed.	1984	Entered into force in 1978
	International Convention for the Prevention of Pollution of the Sea by Oil (London, 1954 (as amended on 11 April 1962 and 21 October 1969.)	Applies to all ships, except tankers of under 150 tons gross tonnage and other ships of under 500 tons gross tonnage, registered in the territory of, or having the nationality of, a Party. Naval ships and ships engaged in whaling are excepted (art. 2). Discharges are prohibited, except when a ship is proceeding en route or when the instantaneous rate of discharge does not exceed 60 litres per mile.	28-12-1981	Entered in 1954 and amended in 1962 and in 1969
Women affairs	Convention on the Elimination of Discrimination against Women (CEDAW), 1984		2000	1984

6. Overview of Key Policies, Plans and Mega Projects Affecting SW Region

6.1 National policy and planning framework

The major sectoral policies implemented by the government are: Environment Policy (1992) and National Environment Policy (Amended) 2013; Forest Policy (1994); Fisheries Policy (1998); Water Policy (1999); Wetland Policy (1998); Agriculture Extension Policy (1995); Energy Policy (1995 and updated in 2005).

In addition, various strategies and plans address environmental and sustainability concerns: National Conservation Strategy (NCS) 1992; National Environment Management Action Plan (NEMAP) 1995; and Bangladesh Climate Change Strategy and Action Plan (BCCSAP) 2009. These policies are provide important guidance regarding the activities of ministries and public institutions.

The Five Years Plan (FYPs) include environmental goals but, in actual practice, these cannot be fulfilled due to short duration of the plans. Therefore, the government has initiated the Perspective Plan (a three year rolling development plan) as well as Vision 2021 and Vision 2041 which also address the Sustainable Development Goals (SDGs).

Key relevant sectoral policies, strategies and plans are listed in Table 6.1.

Table 6.1: National policies, strategies and plans relevant to sectoral development activities

Issue	Bangladeshi Policies	Brief description of the policies
Environmental management	The National Environment Policy 1992 (updated 2013)	The National Environment Policy (NEP), 1992 was Bangladesh's first environmental legislation, revised in 2013 to address climate change. The NEP 2013 also address the increased extent and magnitude of environmental degradation. It identifies the major impediments to environmental conservation: population growth, poverty, illiteracy, lack of awareness and healthcare services, limitation of arable land, unplanned development and urbanization, and industrialisation.
	The National Environment Policy 1992 (updated 2018)	This update focuses on fulfilling the constitutional policy to conserve the environment and biodiversity as a priority in association with national economic development activities. It also considers environmental disasters, natural calamities, and climate change-induced impacts on natural resources with the target of sustainable development.
	National Environmental Management Action Plan 1995	The plan covers the conservation of habitats and biodiversity including environmental management and quality of life. It identifies the main national environmental issues, including those related to the water sector such as flood damage, riverbank erosion, environmental degradation of water bodies, increased water pollution, shortage of irrigation water and

Issue	Bangladeshi Policies	Brief description of the policies
		drainage congestion; and identifies various specific regional concerns.
	National Conservation Strategy 1992	The strategy focuses on the conservation of environment
	National 3R Strategy 2010	The 3Rs concept concerns maximises the reduction reuse and recycling of resources in the manufacture, distribution and use of products consumed by society. In this context, government has formulated National 3R strategy for Waste Management 2010.
	National Water Management Plan, 2001 (approved by the National Water Resources Council in 2004)	The plan aims to achieve integrated development, management and use of water resources in Bangladesh over a period of 25 years. The Water Resources Planning Organization (WARPO) has been assigned to monitor the plan. The Plan's major programmes have been organized under eight sub-sectoral clusters: i) Institutional Development, ii) Enabling Environment, iii) Main River, iv) Towns and Rural Areas, v) Major Cities; vi) Disaster Management; vii) Agriculture and Water Management, and viii) Environment and Aquatic Resources.
	National Forest Policy 1994	The policy was the first step to recognise of the importance of people's participation in forestry. It commits to sustainable development, poverty alleviation, local people's participation in forest protection, and government support for forestry development.
	National Water Policy 1999	Provides guidance to ensure optimal development and management of water. All agencies and departments entrusted with water resource management responsibilities (regulation, planning, construction, operation, and maintenance) are required to enhance environmental amenities and ensure that environmental resources are protected and restored in executing their tasks.
	National Policy for Safe Water Supply and Sanitation 1998	Aims to ensure accessibility to all of water and sanitation services within the shortest possible time at a price that is affordable to all.
	Coastal Zone Policy 2005	Provides for management and support to the coastal region in a manner so that the people of the region can lead their life and livelihoods within a secure and conducive environment.
	Coastal Development Strategy 2006	The strategy is the instrument to implement the Coastal Zone Policy, identifying strategic priorities to guide interventions and investment in the coastal region for betterment of life and livelihood of the people of the region.
	Wetland Policy 1998	Provides guidelines for the protection of wetlands and related species.
	Bangladesh Climate Change Strategy and Action Plan (BCCSAP)	A comprehensive strategy to address climate change challenges in Bangladesh. Bangladesh Climate Change Strategy and Action Plan built on six themes:

Issue	Bangladeshi Policies	Brief description of the policies
	2009	- Food security, social protection and health - Comprehensive disaster management - Infrastructure - Research and knowledge management - Mitigation and low carbon development - Capacity-building and institutional strengthening.
	Bangladesh Delta Plan 2100	Aims to ensure an optimum level of water safety and food security, as well as economic growth and a framework for its implementation based on effective governance.
	National Adaptation Plan of Action (NAPA) - for Climate Change 2005 (updated 2009)	Identifies many adaptation measures to be taken by different ministries and departments - in line with decisions of UNFCCC.
	Bangladesh Standards and Guidelines for Sludge Management 2015	The guidelines support the mandatory requirements under the Environment Conservation Act, 1995 (amended 2010) for proper management of sludge and installation of effluent treatment plants (ETP). They provide extensive information and methods for all aspects of sludge management and operating effluent treatment plants, and disposal.
Energy, power and industry	Power System Master Plan 2016	Focuses mainly on: - the enhancement of imported energy infrastructure and its flexible operation; - efficient development and utilization of domestic natural resources (gas and coal); - construction of a robust, high-quality power network; - maximisation of green energy and promotion of its introduction; - improvement of human resources and mechanisms related to the stable supply of energy
	Power and Energy Sector Strategy Paper (PESSP) 2018	The main objective of this paper is the development of the energy and power sector to be able to ensure intended economic growth - Sector Outcome 1: Reliable, affordable, and efficient energy supply achieved and sustained; - Sector Outcome 2: Reliable, affordable, efficient, and quality power supply achieved and sustained; and - Sector Outcome 3: Well-articulated Demand Side Management (DSM) policy adopted and implemented.
	Renewable Energy Policy 2018	The policy aims to promote renewable energy generation: biomass, solar, hydro, wind, and tidal power.
	National Energy policy 1995 (updated 2005)	Aims to ensure proper exploration, production, distribution and rational use of energy sources to meet the growing energy demand of different zones, consuming sectors and consumers groups on a sustainable basis.

Issue	Bangladeshi Policies	Brief description of the policies
	Private Sector Power Generation Policy 1996 (amended 2004)	Aims to promote private sector participation in the generation of electricity in order to attain higher economic efficiency. The government is strongly committed to attract private investment for installing new power generation capacity on a build-own-operate (BOO) basis. The Power Cell was created in 1995 under the Ministry of Energy & Mineral Resources (MEMR) with a mandate to lead private power development, recommend power sector reforms and restructuring, conduct studies on tariffs, and to formulate a regulatory framework for the power sector.
	National Industrial Policy 2005 (updated 2016)	Aims to build the industrial sector and reduce unemployment, hunger and poverty through short-, medium- and long-term programmes to accelerate sustainable and inclusive economic growth of the country.
Agriculture, livestock, Fisheries	National Agriculture Policy, 1999	The overall objective of policy is to make the nation self-sufficient in food through increasing production of all crops including cereals and ensure an environmental management framework (EMF) for the River Management Improvement Programme (RMIP) and a dependable food security system for all. It stresses the need for research on the development of improved varieties and technologies for cultivation in water-logged and salinity affected areas.
	National Agriculture Policy, 2018	The main goal of the policy is to ensure food security and socio-economic development through productivity of crops, boosting production and raising farmers' income, diversifying crops, producing safe foods and developing marketing system, profitable agriculture and use of natural resources.
	National Poultry Development Policy 2008	Formulated to encourage development of the poultry industry and to control quality of inputs for sustainable poultry development.
	National Livestock Development Policy 2007	Addresses the key challenges and opportunities for the comprehensive sustainable development of the livestock sub-sector by creating an enabling policy framework.
	National Fisheries policy 1998 and National Fisheries Strategy 2006	The objectives of the policy are to: enhance fisheries production; maintain ecological balance and conserve biodiversity; fulfil the demand for animal protein; achieve economic growth through exporting fish and fisheries products; and alleviate poverty of the fishers. The strategy proposes ways in which the policy can be implemented and what support can be offered to guide the sector.
	National Shrimp Policy 2014	Emphasises promoting environment-friendly shrimp mixed cultivation for sustainable development of shrimp farming.

Issue	Bangladeshi Policies	Brief description of the policies
Land use	National Land Use Policy 2001	Identifies components for ensuring land use activities are aligned with environmental conservation and sustainability. Sets out mechanisms for land zoning in rural and urban areas.
Labour, occupational health safety	National Labour Policy 2012	Includes provisions to address wage discrimination along with assurance of equal wages and rights for women workers.
	National Health Policy 2011	Focuses on ensuring availability of primary health and emergency treatment facilities for all citizens and also extending easy and equitable access to quality health care facilities.
	Occupational Health and Safety Policy (OHS) 2013	Focuses on the improvement of OHS in all levels of the working environment. The policy also been developed in compliance with the ILO and WHO guidelines. Provides for compensation packages and rehabilitation procedures for affected workers, and enables workers to take issues the Labour Court for decision.
	National Children Policy 2011	Accords special priority to girl children. It emphasises counselling for adolescent girls, provision of sanitation facilities for girls in educational institutions and workplaces, and special security arrangements for girls during disasters.
Tourism	National Tourism Policy 2010	Covers: identification of tourist zones and attractions; development of the major tourist attractions and destinations; involvement of other local government organizations; development and marketing of eco-tourism; and encouragement of private sector investment.
Women affairs	National Women Development Policy 2011	Provides distinct guidelines on prevention of child marriage, removal of discrimination and protection against disabled girls, enhanced recreational and cultural facilities for female children, and removal of mental and physical abuse of women.

6.1.1 Policies, strategies and plans for the environment, fisheries and energy sectors

6.1.1.1 National Environment Policy 1992

The National Environment Policy of 1992 sets out the basic framework for environmental action, together with a set of broad sectoral action guidelines. It provides the broader framework for sustainable development for Bangladesh. It also identifies all major undertakings (projects) which will have a bearing on the environment (including setting up of an industrial establishment) and which require an IEE and EIA (to be approved by the DoE) before they can be initiated. Guidelines are provided for 15 sectors.

- ‘Energy and fuel sector’ (section 3.4): encourages the use of environmentally sound and less harmful fuel (section 3.4.1); promotes conservation of country’s fossil fuel reserve and renewable sources of energy (section 3.4.5); and requires EIA to be conducted before implementation of projects for extraction of fuel and mineral resources (section 3.4.6);

- Section 4.2 states that “in the rural areas the use of gas, coal, kerosene and petrol as fuel will be expanded in the rural areas, so that fuel wood, agricultural residues and cow dung are conserved. This will help the use of agricultural residues, and cow dung etc. as manure”
- Section 4.7 states that “appropriate measures will be taken to ensure that extraction, distribution and use of natural resources such as oil, gas, coal, peat etc. do not adversely affect air, water, land, the hydrological balance and the ecosystem”.
- Section 3: ‘Forest, wildlife and biodiversity’ directs the following:
 - Conserve wildlife and biodiversity, strengthen related research and help dissemination and exchange of knowledge in these areas; and
 - Conserve and develop wetlands and protection of migratory birds.

6.1.1.2 *The National Environmental Policy 2013*

The National Environmental Policy (NEP) (2013) is a revision of the National Environmental policy 1992, taking into account the threat of climate change to agriculture, water resources, public health, biodiversity, and infrastructure (in this regard, the government Adopted the Bangladesh Climate Change Strategy and Action Plan (BCCSAP), 2009). The NEP also provides a more up-to-date understanding of the extent and magnitude of environmental degradation. The government has also addressed such degradation and the adverse impacts of climate change through other national policies for agriculture, land use, forestry and industry, and in the sustainable development strategy and five-year plans. The NEP also commits to assessing the effectiveness and adverse impacts of already implemented projects to manage floods, drainage, and irrigation in the country.

The NEP outlines problems that impeded environmental conservation including population growth, poverty, illiteracy, lack of awareness and healthcare services, limited arable land, unplanned development and urbanisation and industrialisation. It commits to keeping rivers, creeks, wetlands free from pollution, and emphasizes the need to increase the uses of surface water rather than groundwater in agriculture and industry, and for drinking water. Furthermore, the NEP focuses on the need to apply the “polluter pays principle” and to adopt “3R: Recycle-Reduce-Reuse” in all spheres of life.

6.1.1.3 *National Environmental Policy 2018*

The vision of this updated policy is to ensure environmental and biodiversity conservation, pollution control and climate resilient infrastructure for sustainable development.

The policy focuses on:

- Biodiversity conservation for future generations;
- Reducing pressure on natural resources;
- Scientific exploitation of natural resources;
- Incorporating the valuation of ecosystem services in all government and private sector activities
- Establishing the right of local vulnerable people to be involved in the management of biodiversity;
- Natural resources
- Ecosystem restoration to ensure benefits from ecosystem services,
- Poverty reduction;

- Food security
- Establishing long term sustainability.

The policy also covers:

- Reducing pollution from point and non-point sources to ensure environmental quality including health and safety of people;
- Protecting the environment as an integral part of sustainable development;
- Government and private sector investment to manage pollution;
- Environmentally friendly economic development,
- Implementing climate-resilient development activities;
- Developing and amending all related necessary regulations and policies to ensure environmental protection
- Adoption the polluter pays principle and imposing a penalty on polluters to recover the costs of pollution;
- Adopting the 3R principal (reduce, reuse and recycle) in resources use;
- Sustainable use of ecosystem goods and services;
- An awareness development syllabus in the schools and colleges.

The updated policy includes detailed measures covering 29 sectors including: land and water resources management; air pollution control; safe food and water; agriculture; public health and health service; accommodation; housing and urbanization; education and mass awareness; forest and wildlife; biodiversity; ecosystem conservation and biosafety; hill ecosystem, fisheries and liv stock; coastal and marine ecosystem, ecotourism; industrial development; energy and mineral resources; communications and transportation; human resources management; climate change management and adaptation; disaster management; science, research, information and communication technologies; management of chemical substances; other pollution controls; friendly economic development; sustainable production and consumption; legal frame; organizational setup; and National Environment Policy.

The policy identifies agencies responsible to implement policy measures for each sector during their own development activities. In addition, it highlights the need for compliance with the all relevant international conventions, treaties and agreements.

6.1.1.4 National Environment Management Action Plan 1995

The National Environment Management Action Plan (NEMAP) is a wide ranging and multi-faceted plan which builds on and extends the statements set out in the National Environment Policy (NEP). It was developed to address issues and management requirements for a 10 year period (1995-2005) and set out the framework within which the recommendations of the National Conservation Strategy (NCS) were to be implemented. The NEMAP has several broad objectives:

- Identification of key environmental issues affecting Bangladesh;
- Identification of actions necessary to halt or reduce the rate of environmental degradation;
- Improvement of the natural and built environment;
- Conservation of habitats and biodiversity;
- Promotion of sustainable development; and
- Improvement in the quality of life of the people

6.1.1.5 The National Forest Policy 1994

The National Forestry Policy 1994 revised the National Forest Policy 1977 taking into account the National Forestry Master Plan (2017-2036). The major targets of the Policy are (a) conservation of the existing forest areas; (b) management of protected areas; (c), to bring about 20% of the country's land area under the afforestation programme; and (d) to increase the reserve forestland by 10% by 2015 through coordinated efforts of government and NGOs and active participation of the people.

The priority protection areas are the habitats which encompass representative flora and fauna in the core area of national parks, wildlife sanctuaries, and game reserves. Multiple-use of forest, water and fish of the Sundarbans through sustained management will be ensured, keeping the bio-environment of the area intact.

To achieve the policies goals, it is recognized that existing forestry sector-related laws will need to be amended and that new legislation will be required for sectoral activities.

6.1.1.6 The National Energy Policy 1995

The National Energy Policy 1995 provides for the utilization of energy for sustainable economic growth, supply to different zones of the country, development of the indigenous energy sources and environmentally sound sustainable energy development programmes. It highlights the importance of protecting the environment by requiring an EIA for any new energy development project and the introduction of economically viable and environment friendly technology.

Section 1.2 commits to "*ensure environmentally sound sustainable energy development programmes causing minimum damage to the environment*". Seven specific policy recommendations are listed under Chapter 1.9, of which three concern the environment:

- EIA should be made mandatory and should constitute an integral part of any new energy development project;
- Use of economically viable environment friendly technology is to be promoted; and
- Public awareness is to be promoted regarding environmental conservation

6.1.1.7 The National Water Policy 1999

The National Water Policy of 1999 was adopted to ensure efficient and equitable management of water resources, proper harnessing and development of surface and ground water, availability of water to all concerned and institutional capacity-building for water resource management. It has also addresses river basin management, water rights and allocation, public and private investment, water supply and sanitation and water needs for agriculture, industry, fisheries, wildlife, navigation, recreation, environment, preservation of wetlands, etc.

The policy provides the framework for the management of water resources in a comprehensive, integrated and equitable manner. It recognises that water is essential for human survival, socio-economic development of the country, and preservation of its natural environment. It states that it is vital that the continued development and management of the nation's water resources should include the protection, restoration, and preservation of the environment and its bio-diversity.

The Policy further states that excessive water salinity in the South West Region is a major deterrent to industrial growth. It also recognizes that pollution of both surface and groundwater around various industrial centers of the country due to untreated effluent discharge into water

bodies is a critical water management issue. The Policy suggests that the following matters should be considered:

- Establishment of zoning regulations for the location of new industries, considering fresh and safe water availability and effluent discharge possibilities;
- Effluent disposal will be monitored by relevant government agencies to prevent water pollution;
- Standards of effluent disposal into common watercourses will be set by WARPO in consultation with DOE;
- Industrial polluters will be required under law to pay for the cleanup of water- body polluted by them.

6.1.1.8 National Policy for Safe Water Supply and Sanitation 1998

The National Drinking Water Supply and Sanitation Policy (1998) goal is accessibility for all to water and sanitation services within the shortest possible time at a price that is affordable to all. The Policy charged that strategies be formulated at various levels in consultation with the Ministry of Planning. Policy objectives: (i) to improve the standard of public health and (ii) to ensure an improved environment. The policy addresses rural and urban areas separately as they differ in institutional aspects, content, and magnitude.

6.1.1.9 National Fisheries Policy 1998

The National Fisheries Policy provides the framework for the conservation and management of fisheries resources to ensure supply and enhance production. It addresses all the water bodies suitable for fisheries production and their fisheries resources conservation, development and management, including rivers and canals, haors and baors, floodplains, open and coastal water systems.

6.1.1.10 Wetland Policy 1998

The policy seeks to: conserve wetlands to sustain their ecological and socio-economic functions and further sustainable development; establish key principles for wetland sustainability and unsustainable practices; maintain existing levels of biodiversity; maintain wetland functions and values; and actively promote integration of wetland functions in resources management and economic development decision taking.

6.1.1.11 Coastal Zone Policy 2005

The policy provides general guidance so that coastal people can pursue their livelihoods under secured conditions in a sustainable manner without impairing the integrity of the natural environment. It sets several objectives including: the creation of sustainable livelihoods; intensifying the coverage of safe drinking water facilities, reducing vulnerabilities (including to climate change); and closing the gender gap. The policy suggested various structural development activities but it does not indicate environmental assessment for the development project in the coastal area.

6.1.1.12 National Water Management Plan 2001 (approved 2004)

The National Water Management Plan (NWMP) 2001 proposed to establish the integrated development, management and use of water resources in Bangladesh over a period of 25 years. Water Resources Planning Organization (WARPO) as been assigned to monitor the plan. It contains major programs under eight sub-sectoral clusters: i) Institutional Development, ii)

Enabling Environment, iii) Main River, iv) Towns and Rural Areas, v) Major Cities; vi) Disaster Management; vii) Agriculture and Water Management, and viii) Environment and Aquatic Resources. Each cluster comprises of a number of individual programmes, and a total of 84 sub-sector programmes, each described in an investment portfolio.

6.1.1.13 Bangladesh Climate Change Strategy and Action Plan (BCCSAP) 2009

The BCCSAP has 44 proposed specific programmes clustered under six pillars:

- Food security, social protection and health to ensure that the poorest and most vulnerable in society, including women and children, are protected from climate change and that all programs focus on the needs of this group for food security, safe housing, employment and access to basic services, including health.
- Comprehensive disaster management to further strengthen the country's already proven disaster management systems to deal with increasingly frequent and severe natural calamities.
- Infrastructure to ensure that existing assets (e.g., coastal and river embankments) are well maintained and fit for purpose and that urgently needed infrastructures (cyclone shelters and urban drainage) is put in place to deal with the likely impacts of climate change.
- Research and knowledge management to predict that the likely scale and timing of climate change impacts on different sectors of economy and socioeconomic groups; to underpin future investment strategies; and to ensure that Bangladesh is networked into the latest global thinking on climate change.
- Mitigation and low carbon development to evolve low carbon development options and implement these as the country's economy grows over the coming decades.
- Capacity building and Institutional strengthening to enhance the capacity government ministries, civil society and private sector to meet the challenge of climate change.

6.1.1.14 National Adaptation Plan of Action (NAPA) – for Climate Change, 2005 (updated 2009)

The updated NAPA identifies 38 adaptation measures to be implemented by different ministries and departments, facilitated by the Ministry of Environment Forests and Climate Change. It incorporated the findings of various studies on the impacts of climate change, vulnerabilities and adaptation needs. It was prepared in response to decisions of the United Nations Framework Convention on Climate Change (UNFCCC).

6.1.1.15 Power System Master Plan, 2016

An extensive energy and power development plan up to the year 2041 covering energy balance, power balance, and tariff strategies. It focuses mainly on:

- Achieving high economic growth rates and introduce energy-saving measures
- Enhancement of imported energy infrastructure and its flexible operation;
- Efficient development and utilization of domestic natural resources (gas and coal);
- Domestic renewable energy power generation (cumulative):
- Construction of a robust, high-quality power network;
- Improvement of human resources and mechanisms related to the stable supply of energy.
- Domestic biogas production;

- Cross-border energy imports.

6.1.1.16 Power and Energy Sector Strategy Paper (PESSP) 2018

Sets out a strategy for the energy and power sector to be able to ensure intended economic growth with three main targeted outcomes:

- Reliable, affordable, and efficient energy supply achieved and sustained;
- Reliable, affordable, efficient, and quality power supply achieved and sustained; and
- Well-articulated Demand Side Management (DSM) policy adopted and implemented.

6.1.2 Agriculture, labour and women policies

6.1.2.1 National Agriculture Policy, 2018

The updated Agriculture Policy (2018) emphasises investment including quality seed production, fertilizer and irrigation management, bio-technology, farm mechanization, agriculture cooperative and marketing, women empowerment in agriculture, natural resource management, specialized agriculture, regional special agriculture, involvement of the youth force, agriculture rehabilitation, agriculture afforestation, safe and nutritious food production, use of information and communication technology.

The policy prioritises the enhancement of productivity, coordination of different ministries and organizations with the agriculture ministry, and use of knowledge and expertise both in the private and public sectors.

It also priorities coastal agriculture, haors and wetlands, hill agriculture, Barind agriculture, char land agriculture, natural disasters and agriculture rehabilitation, floods, extreme temperatures, cyclones, high and low tides, drought, thunderbolts, submergence and salinity. The policy identifies the need for research research and intervention at the farmer level to avoid loss of productivity.

6.1.2.2 National Labour Policy 2012

The National Labour Policy, 2012, includes provisions to address wage discrimination and assure equal wages and rights for women workers - so that women can engage in economic activities at home and abroad, and can enjoy equal opportunities in training.

Out of 33 conventions prepared by the International Labour seven have been ratified by Bangladesh under which the government has committed to uphold the rights and esteem of the women workers.

6.1.2.3 National Women Development Policy 2011

National Women Development Policy 2011 provides distinct guidelines on prevention of child marriage, removal of discrimination against disabled girls and their protection, secured and standard recreational, cultural and sports facility for the female child, and removal of mental and physical abuse of women, rape, dowry, family abuse and acid throwing.

The Ministry of Women and Children Affairs is directly or indirectly involved to promote and implement the National Women Development Policy (NWDP), 2011 as one of the core activities. In the light of the Constitutional obligations, the Five Year Plan and the international commitments, the NWDP-2011 has fixed 22 objectives towards the fulfillment of the policy.

6.2 Screening of policies, plans and programmes

Prior to the scoping phase, all policies, plans and programmes (PPPs) that have relevance to development in the SW Region were screened. A total 87 PPPs were identified covering 30 sectors and key issue areas and were then analysed. Several PPPs in the list could not be screened. Two were not available to the team (e.g. Defence Policy – for security reasons, Second Perspectives Plan – approved in principle, but government agencies still inputting). Three PPPs (plans for Khulna and Mongla) could not yet be accessed at the time as the team was unable to visit the relevant offices due to the Covid-19 pandemic – these PPPs will be screened later when the situation improves. Plans and major initiatives from India (particularly industrial and other developments in West Bengal) and hydropower dams in Nepal that have potential significant transboundary impacts on the SW Region and the Sundarbans have not yet been examined, but efforts are being made to identify and secure information about such plans.

For each PPP, a summary table of key features was prepared covering scope, key objectives, main activities and likely impacts. Using a standard impact matrix, a provisional assessment was made of whether individual PPPs would be likely to give rise to high, medium or low environmental, social or economic impacts (both positive and negative) based on expert judgement and experience. In some cases, particular impacts were already known to have occurred to a significant extent following PPP implementation in Bangladesh. In other cases, they were judged as likely to happen based on experience of implementing similar PPPs elsewhere in the world.

The full details and conclusions of this process are presented in the accompanying Mid-Term Screening Report.

Table 6.2 lists all the PPPs screened and indicates the impact score for each one.

Table 6.2: List of Screened PPPs

Negative impacts

Positive impacts



Sector	Code	Name of PPP	Impacts	
			Negative	Positive
Nine Key Sectors Identified by Forest Department				
Forestry	001	Forestry Policy 1994		
	002	National Forestry Policy 2016 (draft)		
	003	Bangladesh Forestry Master Plan, 2017-2036		
Fisheries	004	Chingri (Shrimp) Mohal Management Policy, 1992		
	005	National Fisheries Policy, 1998		
	006	The National Fisheries Strategy, 2006		
	007	National Shrimp Policy, 2014		
	008	Public Water Body (Jalmahal) Management Policy (PWBMP), 2009		
	009	Bhabadah Area Fish Gher Establishment Policy, 2019		
Water Resources	010	National Water Policy, 1999		
	011	National Water Management Plan, 2001		
	012	National Strategy for Water Supply and Sanitation, 2014		
Power and Energy	013	Power & Energy System Master Plan , 2016		
	014	Draft National Energy policy, 2006		
	015	Renewable Energy Policy of Bangladesh, 2008		
	016	Energy Efficiency and Conservation Master Plan up to 2030, (2015)		
	017	Gas Sector Master Plan 2018		
	018	Policy Guideline for Small Power Plant (SPP) in Private Sector, 2008		
	019	Power and Energy Sector Strategy Paper (SSP), 2018		
	020	National Action Plan for Clean Cooking, 2020-2030		
Tourism	021	National Tourism Policy, 2010		
Urbanization	022	National Urban Sector Policy, 2011 (draft)		
Industry	023	National Industrial Policy, 2016		
	024	National Policy for the Management of Radioactive Waste and Spent Nuclear Fuel, 2019		
	025	National Textile Policy, 2017		
	026	Leather and Leather Products Development Policy, 2019		
Transportation and Communication	027	Integrated Multi-Modal Transport Policy, 2013		
	028	National Land Transport Policy, 2004		
	029	Road Master Plan 2009		

Sector	Code	Name of PPP	Impacts	
			Negative	Positive
	030	Railway Master Plan, 2016-2045		
	031	<i>Discarded PPP – not relevant</i>		
Shipping	032	National Shipping Policy, 2000		
OTHER SECTORS				
Environment, Biodiversity and Climate	033	National Environment Policy, 2018		
	034	National Biodiversity Strategy and Action Plan for Bangladesh (NBSAP,B), 2016-2021		
	035	Country Investment Plan (CIP) for Environment Forestry and Climate Change, 2016-2021		
	036	National Adaptation Plan of Action (NAPA) – for Climate Change, 2005, updated 2009		
	037	Bangladesh Climate Change Strategy and Action Plan (BCCSAP), 2009		
	038	Bangladesh Climate Change and Gender Action Plan (CCGAP), 2013		
	039	Bangladesh Wildlife Master Plan, 2015-35		
Sundarbans	040	Integrated Resource Management Plan of Sundarbans, 2011		
Agriculture	041	National Agriculture Policy, 2018		
	042	National Organic Agriculture Policy, 2016		
	043	Agricultural Extension Policy, 2015 (draft)		
	044	National Dairy Development Policy, 2016		
	045	National Livestock Extension Policy, 2013 (Final Draft)		
	046	National Livestock Development Policy, 2007		
	047	National Integrated Livestock Manure Management Policy, 2015 (draft)		
	048	National Poultry Development Policy, 2008		
	049	National Integrated Pest Management Policy, 2002		
	050	Integrated Minor Irrigation Policy, 2017		
	051	Master Plan for Agricultural Development in the Southern Region of Bangladesh 2012		
	052	National Seed Policy, 1993 [EXCLUDED]		
	053	Bangladesh Second Country Investment Plan Nutrition-sensitive food system, 2016-2020		
Cultural affairs	054	National Cultural Policy, 2006		
Disasters	055	National Plan for Disaster Management, 2016-2020		
Economy	056	Export Policy of Bangladesh, 2018-2021		
	057	Medium Term Macro Economic Policy Plan, 2019		
Education	058	National Education Policy, 2010		
Food	059	National Food Policy, 2006		
	060	Food/Cash for Work (F/CFW) Program, 1974		
Health & Family Welfare	061	National Health Policy, 2011		
	062	Occupational Health and Safety Policy, 2013		
	063	National Labour Policy, 2012		

Sector	Code	Name of PPP	Impacts	
			Negative	Positive
Labour, Employment and Livelihoods	064	My Home and My Farm (Amar Bari Amar Farm) Program, 2009		
Land	065	National Land Use Policy, 2001		
Local Government, Rural Development and Cooperatives	066	National Rural Development Policy, 2001		
Mining		<i>No PPP yet prepared</i>		
Planning	067	Khulna Master Plan 2001 (South West) [not yet accessed due to Covid-19]		
	068	Khulna Detail Area Plan 2015-2020 (South West) [not yet accessed due to Covid-19]		
	069	Mongla Master Plan 2011-2031 (South West) [not yet accessed due to Covid-19]		
Population	070	Bangladesh Population Policy, 2012		
Posts, telecommunications & Information	071	National ICT Policy, 2009		
Science & Technology	072	National Science and Technology Policy, 2011		
Waste Management	073	The National Sanitation Strategy, 2005		
	074	National 3R Strategy for Waste Management, 2010		
Women and Children Affairs and Vulnerable Groups	075	National Women Development Policy, 2011		
	076	National Children Policy, 2011		
	077	National Action Plan on Women, Peace and Security, 2019-2022		
	078	Vulnerable Group Development (VGD) Programme, 2011		
	079	Vulnerable Group Feeding (VGF) programme, 1974		
National and Cross-sector PPPs				
	080	Bangladesh Delta Plan. 2100		
	081	Seventh Five Year Plan FY 2016 – FY 2020: Accelerating Growth, Empowering Citizens		
	082	National Sustainable Development Strategy (2010-21), 2013		
	083	First Perspective Plan of Bangladesh: 2010-2021		
	084	Coastal Zone Policy, 2005; and Coastal Development Strategy, 2006		
	085	Second Perspective Plan of Bangladesh: 2021-2041		

6.3 Cross-sector plans and strategies

Several of the national and cross-sector PPPs listed in Table 6.1 are of particular importance to the SW region as they are over-arching and set the overall framework for development over the next 20 years. The

scope and objectives of these PPPs are discussed in the following sub-sections. Further details including the main activities and their likely impacts are listed in the PPP summaries included in Appendix 1 of the SEA Screening Report (April 2020).

6.3.1 First Perspective Plan for Bangladesh: 2010-2021

For a summary of the scope, objectives, main activities, and likely impacts of the First Perspective Plan (FPP) for Bangladesh: 2010-2021 (approved 2012), see PPP Summary 085 Appendix 1 of the Screening Report (April 2020).

The First Perspective Plan (FPP) for Bangladesh (2010-2021) (approved 2012) - see PPP Summary 085 Appendix 1 of the Screening Report (April 2020) - provides a road map for accelerated growth and lays down broad approaches for eradicating poverty, inequality, and human deprivation. It also set out specific strategies and articulates the task of implementation through the two five-year plans: Sixth Five Year Plan (2011-2015) and the Seventh Five Year Plan (2016-2020). The key objectives of the FPP are:

- To transform Bangladesh into a middle-income country by 2021;
- To enhance agricultural production and ensure food security, the target of agriculture sector is that, by 2021, food deficiency will be eliminated and the country will attain self-sufficiency in food production;
- To develop an integrated and developed energy sector with a diversified fuel mix that will be the key driver of a sustainable local and national economy, while attaining global competitiveness in all sectors by 2021;
- To develop well-planned urbanization as well as multi-modal transport, integration of roads and highways;
- To develop an efficient, sustainable, safe and regionally balanced transportation system in which various modes complement each other, interface appropriately;
- To work towards stamping out poverty, discrimination, economic and social marginalization, disease and poor health, and sub-standard living conditions;
- To develop an effective disaster management strategy to tackle the challenges associated with disasters;
- To design social protection programmes that create assets and employment opportunities;
- To strengthen transparency and accountability of all government institutions as an integral part of a program of social change to curb corruption.

6.3.2 Seventh Five Year Plan (FY2016-FY2020)

For a summary of the scope, objectives, main activities, and likely impacts of the Seventh Five Year Plan (approved 2015), see PPP Summary 083, Appendix 1 of the Screening Report (April 2020).

The Seventh Five Year Plan (FYP) aims to develop strategies, policies and institutions that will allow Bangladesh to further accelerate job creation and reduce poverty as well as comply with new commitments to meet Sustainable Development Goal (SDG) targets. It focuses on achieving Bangladesh's Vision 2021 and continuing the success of the 6th FYP including:

- GDP growth acceleration, employment generation and rapid poverty reduction;

- A broad-based strategy of inclusiveness with a view to empowering every citizen to participate full and benefit from the development process.
- A sustainable development pathway that is resilient to disaster and climate change; entails sustainable use of natural resources; and successfully manages the inevitable urbanization transition.

It sets out plans and goals for development activities a range of sectors and themes: urbanisation, agriculture and livestock, transportation, power and energy, tourism, environment and climate change, disaster management, education, cultural affairs, industry, health, nutrition, social protection, local and rural development, youth development, religious affairs, service sector, poverty and inequality, mining, land management, women and children, forestry, and fisheries.

6.3.3 *Second Perspective Plan of Bangladesh (2021-2041)*

This plan was approved in principle by the National Economic Council (NEC) on 25 February 2020⁶⁷. It aims to make Bangladesh a higher-income and developed country by 2041. Government line ministries are currently adding their contributions. The final SPPB will be approved in due course. At present the SPP contains 12 chapters that outline targets for the next 20 years based on 4 pillars: governance, democratisation, decentralisation and capacity-building. Its main objectives are:

- To transform Bangladesh to a higher mid-income country by 2031, and a higher income and developed country by 2041;
- To further alleviate poverty, further strengthen good governance, and transform Bangladesh into a modern and world-standard digital country;
- To achieve per capita income on current price of US\$12,500 BY 2041;
- To reach 9% GDP growth rate by 2031, and 9.9% by 2041;
- To reduce extreme poverty rate from 9.38% in 2020 to 2.55% by 2031, and 0.6% by 2041;
- To reduce the poverty rate by 7% in 2031, and to below 3% in 2041;
- To ensure industrialisation and structural transformation and exemplary change in the agriculture sector and exported-oriented economy;
- To increase export earning to US\$150 billion by 2031, and to US\$ 300 billion by 2041;
- To contain inflation at 4.7% in 2031, and 4.4% in 2041;
- To raise the investment ratio to 40.6% in 2031, and 46.9% in 2041;
- To raise the national savings ratio to 41% of GDP in 2031, and 46.7% in 2041;
- To raise the revenue ratio to 19% of GDP in 2031, and to 24.1% in 2041;
- To keep gross expenditure at 24.4% of GDP in 2031, and 29.6% in 2041;
- To increase life expectancy to 75 years in 2031, and to 80 years in 2041;
- To maintain population growth rate at 1% in both 2031 and 2041.

⁶⁷ <https://unb.com.bd/category/Bangladesh/nec-clears-perspective-plan-to-implement-vision-2041/45298>

6.3.4 **Delta Plan**

For a summary of the scope, objectives, main activities, and likely impacts of the Bangladesh Delta Plan, see PPP Summary 082, Appendix 1 of the Screening Report (April 2020).

Bangladesh aims to attain a high middle-income country status and to address the expected impacts of climate change. Recent and future anthropogenic changes in the hydrological cycle due to e.g. climate change, construction of dams and barrages in the upstream countries in combination with increasing water demand are expected to make future water governance and management even more challenging. Faced with such challenges, the government accepted the need for an integrated approach to future land and water management in relation to water safety and food security. It acknowledged that a holistic plan was required - with a long-term vision and strategies commonly supported by all relevant stakeholders.

The Bangladesh Delta Plan (BDP), prepared by the General Economics Division (GED) of Bangladesh Planning Commission is the government's response. It is an integrated plan for water resources management with coordinated policy actions. It aims to maintain a long-term vision (to 2100) whilst prioritising short term 'no regret' actions and maintaining a balanced combination of investments, policies and institutions. BDP's stated mission is to:

- Ensure long term water and food security, economic growth and environmental sustainability while effectively reducing vulnerability to natural disasters and building resilience to climate change and other delta challenges through robust, adaptive and integrated strategies, and equitable water governance.

BDP has three higher level goals

1. Eliminate extreme poverty by 2030 Goal
2. Achieve Upper Middle Income Country (UMIC) status by 2030
3. Reach prosperous (developed) country status by 2041

Specific delta-related goals are:

1. Ensure safety from floods and climate change related disasters Goal
2. Ensure water security and efficiency of water usages
3. Ensure sustainable and integrated river systems and estuaries management
4. Conserve and preserve wetlands and ecosystems and promote their wise use
5. Develop effective institutions and equitable governance for in country and trans-boundary water resource management
6. Achieve optimal use of land and water resources

BDP identifies six hotspot - defined as "a place of significant activity or danger":

- Coastal Zone (27,738 km²);
- Barind and Drought Prone Areas (22,848 km²);
- Haor and Flash Flood Areas (16,574 km²);
- Chattogram Hill Tracts (13,295 km²);
- River Systems and Estuaries (35,204 km²);
- Urban Areas (19,823 km²).

These hotspots (Table 6.3) are areas where similar hydrological and climate change vulnerability characteristics and problems converge, and are influenced by natural hazards. In BDP 2100, a

hotspot is a broad grouping of districts and areas facing similar risks brought about by hydrology, climate change and natural hazards.

Table 6.3: Delta Plan hotspot issues and challenges

<i>Coastal Zone</i> • Cyclonic storms and tidal surges • Floods • Salinity • Waterlogging • River bank and coastal erosion • Fresh water scarcity • Groundwater level decline	<i>Chattogram Hill Tracts</i> • Fresh water scarcity • Drinking water supply • Inadequate sanitation services • Biodiversity decline
<i>Barind and Drought Prone Areas</i> • Fresh water scarcity • Flooding and waterlogging/drainage congestion • Groundwater level decline • Inadequate sanitation services	<i>River Systems and Estuaries</i> • Floods • Water quality • Sedimentation and Navigation • River bed changes, erosion and accretion Jamuna: 1770 ha, Ganges: 698 ha, Padma: 1298 ha, Lower Meghna: 2900 ha. Accretion: 57875 ha (1973-2018)
<i>Haor and Flash Flood Areas</i> • Fresh water scarcity • Flash floods/monsoon floods • Waterlogging/drainage congestion • Lack of water and sanitation services	<i>Urban Areas</i> • Waterlogging/drainage congestion • Fresh water scarcity • Waste and effluent management • Urban governance

** In all hotspots, degradation of environment is a common problem*

In developing the BDP, 26 baseline studies were conducted (Box 6.1). Examples include studies addressing climate change, natural resources, environment and ecology, investment and finance, governance, knowledge and data management (see box).

Box 6.1: Themes of baseline studies conducted for the Bangladesh Delta Plan

Water Resources

- i. Morphological dynamics of Bangladesh Delta
- ii. Water resources
- iii. Coastal Polder issues

Water Supply and Sanitation

- I. Public health, water supply and sanitation

Disaster Risk Reduction

- I. Climate change issues
- II. Disaster management

Spatial Planning

- I. Land resources
- II. Urbanization and settlement

Food Security

- I. Agriculture and food security
- II. Fisheries and livestock

Environmental Management

- I. Ecological Settings
- II. Forests and biodiversity
- III. Environmental pollution

Economics and Finance

- I. Growth of Population and Management in the context of resources setting
- II. Socio-economic and demographic condition
- III. Sustainable Transportation Infrastructures

Governance

- I. Information and creation of knowledge management Institution
- II. Institutional framework/ arrangement III. Regional cooperation

Various scenarios were developed based on environmental, socio-economic and policy factors, and were used to prepare strategies based on the adaptive delta modulation (ADM) principle – at national level, for hotspots, and for particular cross-cutting issues:

- Sustainable land use and spatial planning;
- Agriculture, food security and livelihoods;
- Trans-boundary water resources management;
- Dynamic inland water transport;
- Blue economy;
- Renewable energy;
- Earthquakes.

The next steps were to prepare an investment plan and implementation framework in three phases:

- a short-term plan by 2030- with 80 projects (65 for the development of infrastructure and the rest addressing the building of institutional capacity, efficiency and research) estimated to cost \$37.5 billion;
- a mid-term plan by 2050;
- a long-term plan by 2100.

The Delta Plan has also provided a focus for new research (e.g. Box 6.2).

Box 6.2: Integrated Assessment for the Bangladesh Delta Plan 2100: Analysis of selected interventions (2019)

The ESPA (Ecosystem Services for Poverty Alleviation) Deltas project (www.espadeltas.net) undertook an ambitious, interdisciplinary study of coastal Bangladesh and the lives of the millions of people who benefit from them. Many of the project's findings are integrated into the Delta Dynamic Integrated Emulator Model (ΔDIEM), which is designed to analyse the present and future of the delta in a policy-relevant way

The project assessed selected development options being considered as part of the BDP 2100. These options include the role of embankment maintenance, a new green belt 'buffer' zone along the coast, a strengthened coastal sea wall, and new polders in the south-central region to promote agriculture. Of these projects, the new polders in the south-central district appear most beneficial both in terms of enhancing incomes and removing people from poverty.

However, the project report notes that trade-offs with neighbouring regions due to displaced flooding need to be evaluated and suitable compensatory measures undertaken. The results also show that good maintenance of the existing polder embankments across the region is likely to maintain agriculture and associated livelihoods over the next few decades. The greenbelt and enhanced sea wall have less benefit over the next few decades, although they reduce the likelihood of embankment breaching during cyclones which is an important concern in this region.

Source: Rahman et al. (2019)

The BDP has received a certain amount of criticism, much reported in the media⁶⁸:

- Preparation of BDP is judged to have lacked adequate consultation, e.g. with other South-Asian countries that share rivers with Bangladesh, and with Bangladeshi experts on particular sectors. It is claimed that BDP relied too much on Dutch experts using their country's geographical and ecological experiences)
- BDP lacked sufficient studies (e.g. hydro-morphological studies) – further research is needed;
- Old governmental projects that are absorbed under BDP will require modification;
- Doubts that BDP will achieve expected outcomes;
- Planning the design of BDP has not considered existing permanent embankments and polders.

6.3.5 Coastal Zone Policy 2005 and Coastal Development Strategy, 2006

The Coastal Zone Policy 2005 and Coastal Development Strategy 2006 are concerned with economic development and poverty reduction in the coastal areas and have a cross cutting

⁶⁸ Examples include: Dhaka Courier - <https://www.dhakacourier.com.bd/news/Global/Delta-Plan:-A-brief-discussion/1074>; The Daily Star - <https://www.thedailystar.net/backpage/news/delta-plan-2100-taken-without-enough-groundwork-1686808>; Daily Observer - <https://www.observerbd.com/details.php?id=178862>

relationship with natural resources (water, land fisheries, agriculture, livestock, biodiversity, etc.), livelihoods and disaster management.

Both PPPs were outcomes of the Integrated Coastal Zone Management Plan (ICZMP) Project of the Water Resources Planning Organisation (WARPO). The Coastal Development Strategy aims to implement the policy. Both PPPs jointly cover activities to promote socio-economic development, disaster safety, preventing deterioration of the natural environment and enhancing the potential of the coastal region to contribute to national development. They cover 48 coastal upazilas of 19 districts including the SW region and include the marine Exclusive Economic Zone. The PPPs include:

- A code of conduct for sectoral development activities, and integrating and harmonizing development activities towards the common goal of poverty reduction, economic development, livelihood safety;
- Institutional reform and build capacity of the WARPO to co-ordinate development activities under Plans ICZMPs.

The goal of the policy is to create conditions in which the reduction of poverty, development of sustainable livelihoods and the integration of the coastal zone into national processes can take place. It has eight objectives:

- Economic growth;
- Meeting basic needs and opportunity for livelihoods;
- Reduction of vulnerabilities to natural disaster;
- Sustainable management of natural resources;
- Equitable distribution of benefits of disaster management, social development and economic development activities;
- Community empowerment;
- Women's development and gender equity;
- Conservation and preservation of critical ecosystem.

The strategy has nine priorities:

- Ensuring fresh and safe water availability (in the context of regional water resources management);
- Safety from man-made and natural hazards;
- Optimizing use of coastal lands
- Promoting economic growth emphasizing non-farm rural employment;
- Sustainable management of natural resources;
- Improving livelihood conditions of the people specially women;
- Environmental conservation;
- Empowering through knowledge management;
- Creating an enabling institutional environment.

6.4 Mega projects

The main elements of the Rampal coal-fired power station and the Padma bridge project, and their potential impacts are discussed in sections 3.6.1 and 3.6.2, respectively.

7. Environmental and Socio-Economic Objectives for Key Issues

One of the conventional tasks of scoping is to identify relevant criteria for assessment, e.g. goals and objectives against which the impacts of developments likely to arise when implementing PPPs can be determined. The assessment involves a professional expert judgement (based on experience and evidence from implementing similar PPPs) on whether implementing the PPP or pursuing a particular development will impede or enhance achieving each of the agreed objectives, and to what extent (e.g. to a high, medium or low extent/level). In the case of this SEA, it is proposed to assess different macro-economic growth strategies (see section 8).

Based on the list of key environmental, social and economic issues discussed in section 3.2, the team identified a set of objectives designed either to (a) avoid, reduce/minimise the scale of the issue (mainly for environmental concerns), or (b) to enhance/promote measures to address the issue (mainly for socio-economic issues) – see Table 7.1.

A review was also undertaken of the stated objectives of all 87 PPPs screened (see Appendix 1 of the Screening Report, April 2020) to identify those which are already set in government PPPs that are related to the key environmental, social and economic issues identified during scoping. These existing government PPP objectives are listed in Appendix 3 of this report). They have been drawn upon and incorporated in those objectives listed in Table 7.1.

Additionally, the selection of the objectives listed in Table 7.1 has been undertaken with close regard to the UN Sustainable Development Goals which Bangladesh has integrated into its Seventh Five Year Plan (FY 2016 – FY 2020). The relationship between the objectives and relevant SDGs is also shown in Table 7.1.

Table 7.1: Proposed SEA objectives and related sustainable development goals

THEME		OBJECTIVE	Related SDGs
Environmental			
Protected areas and biodiversity	1	Reduce over-exploitation/degradation/fragmentation of forests & habitats, loss of biodiversity and ecosystem(s) integrity and services	6, 14,15
	2	Reduce illegal activities in PAs and forest areas	15
	3	Reduce introduction and spread of invasive alien species	15
Waste and pollution	4	Reduce poor management and unsafe disposal of solid and liquid waste (urban & industrial)	3,6,14
	5	Reduce all forms of pollution (air, land, water, plastics, noise, etc)	3,6,14,15
	6	Minimise emissions of greenhouse gases	13
	7	Minimise noise from boats/ships	15
Climate change and disasters	8	Reduce vulnerability to climate change and natural disasters (floods, storm surges, etc)	1,13
Land degradation	9	Minimise the footprint of transport services (rail, road, air, water-borne)	15
	10	Minimise erosion of river banks/water channels	15
Land use change	11	Minimise loss of agricultural land (e.g. to shrimp ponds)	15
Water	12	Reduce the decline in freshwater flow rates in rivers	6,15

THEME		OBJECTIVE	Related SDGs
Environmental			
Sediment	13	Reduce improper disposal of dredged sediments	15
Socio-economic			
Economic growth	14	Ensure significant economic development and diversification, & increase in economic growth	8,9
Employment	15	Enhance opportunities for employment and new/improved livelihoods (particularly for fisheries, agriculture, eco-tourism)	8,9
Power and energy	16	Increase energy efficiency and uptake of renewable energy	7,9
Health and sanitation	17	Improve health services and health of society (e.g. by reducing vulnerability to diseases)	3
	18	Improve and extend sanitation services	3,6
Climate change and disasters	19	Minimise loss of life, damage to property and infrastructure	13
Women and children	20	Improve gender equality and empowerment of women	4,5
	21	Improve and enforce controls on employing children	5,8,16
Education, skills and training	22	Improve access to education for all, increase attendance (by reducing drop-out rates), and improve skills development and training	4
Food	23	Increase food production	2
Migration	24	Reduce migration from rural (including disaster-prone and risk-prone) areas to urban areas	10
Conflicts and security	25	Reduce conflicts over use of land, forests and water	15
	26	Improve security for fishermen (eliminate kidnappings)	16
Cultural heritage	27	Preserve heritage sites (historic buildings, archaeological and cultural sites and enhance cultural diversity (e.g. language, arts, etc.).	11
Connectivity, access and mobility	28	Connect communities, and improve access to infrastructure, services and facilities	11
Agriculture	29	Increase agricultural production	2
Tourism	30	Increase volume of tourism, particularly eco-tourism	8

List of Sustainable Development Goals

1. **No poverty:** End poverty in all its forms everywhere
2. **Zero hunger:** End hunger, achieve food security and improved nutrition and promote sustainable agriculture
3. **Good health and well-being:** Ensure healthy lives and promote well-being for all at all ages
4. **Quality education:** Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
5. **Gender equality:** Achieve gender equality and empower all women and girls
6. **Clean water and sanitation:** Ensure availability and sustainable management of water and sanitation for all
7. **Affordable and clean energy:** Ensure access to affordable, reliable, sustainable and modern energy for all
8. **Decent work and economic growth:** Promote sustained and inclusive and sustainable economic growth, full and productive employment and decent work for all
9. **Industry, innovation and infrastructure:** Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation

THEME	OBJECTIVE	Related SDGs
	Environmental	
10.	Reduced inequalities: Reduce inequality within and among countries	
11.	Sustainable cities and communities: Make cities and human settlements inclusive, safe, resilient and sustainable	
12.	Responsible consumption and production: Ensure sustainable production and consumption patterns	
13.	Climate action: Take urgent action to combat climate change and its impacts	
14.	Life below water: Conserve and sustainably use the oceans, seas and marine resources for sustainable development	
15.	Life on the Land: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	
16.	Peace, justice and strong institutions: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	
17.	Partnerships for the goals: Strengthen the means of implementation and revitalise the global partnership for sustainable development	

8. Scenarios and Macro-Economic Growth Strategies

8.1 Background

In the Inception Report, it was proposed to base the SEA on assessing the impacts of development likely to arise (when implementing the suite of PPPs) under three economic growth trajectories: high, medium and low. But, during the scoping phase, further thought has been given to this idea.

We now propose to use the term ‘strategy’ rather than ‘trajectory’. The latter signals a course of development direction that is already taking place and is fixed. By comparison, ‘strategy’ implies a plan of action designed to achieve a long-term goal or overall aim – thus government can make a choice of the means by which it prefers to achieve its aims.

Work has been initiated in June 2020 (and will continue during July-August 2020) to:

- develop **scenarios** of plausible future development in the SW region for the next 20 years – as influenced by a range of interacting driving forces (drivers of change) (see section 8.2.3). It is important to stress that scenarios will not actually arise as envisaged due to uncertainties and unknown factors which will undoubtedly arise and will mould how things unfold); and then;
- informed by these scenarios, to develop **projections** of the developments that will be likely to arise over the next twenty years in the SW region under three proposed **alternative macro-economic development strategies**: high economic growth; green(sustainable) growth; and business-as-usual (see section 9.3). The latter strategy is equivalent to a standard alternative in SEA work - to ‘do nothing different’ or ‘change nothing’.

Developments’ include, for example, extent of new/upgraded infrastructure (e.g. kilometres of new railways and roads, numbers of new ports and airports), new industrial facilities (e.g. types/numbers of new plants and sites), changed environmental and social management regimes, changes to agricultural and fisheries activities (e.g. altered cropping patterns, expansion of shrimp farms).

8.2 Scenarios

8.2.1 Aim of scenarios

Scenarios focus on the joint effect of many factors (drivers of change) and provide alternative views of the future. They identify some significant events, main actors and their motivations, and they convey how the world functions.

Most strategies, policies, plans and programmes (PPPs) are ‘fixed’ in that they tend to assume a self-validating future – one usually based on extrapolation or prediction that dominates decision-making (and often is termed the **default scenario**). But we live in world of discontinuities, with sudden change and **uncertainties** and lead into **shocks and surprises**. Scenarios deal with “what if?” questions and helps clarify a vision of the way ahead, capable of modification but allowing progress.

Our use of scenarios in this SEA is to help us explore what the future might look like over the next 20 years and the likely changes of living in it. The scenarios being developed will aim to help

systematic thinking about and understanding of the nature and impact of the most uncertain and important driving forces likely to affect change over the next 20 years. But the purpose of preparing the scenarios is not to immediately decide which scenario is correct; rather it is to look at each plausible future scenario to help determine how robust are the projections we make for outcomes of the three macro-economic development strategies – it is important these strategies are able to hold up under the stream of real events.

8.2.2 The scenario development process

The framework for building scenarios, as per conventional practice, will be the use of vertical and horizontal axes which will be selected from the prioritised drivers (see section 8.2.3). Usually, in scenario development, different relevant pairs of drivers are plotted against each other to create quadrants (Figure 8.1). The quadrants for each pair of drivers selected represent four alternative futures for the interplay of those drivers, for which narratives are then prepared.

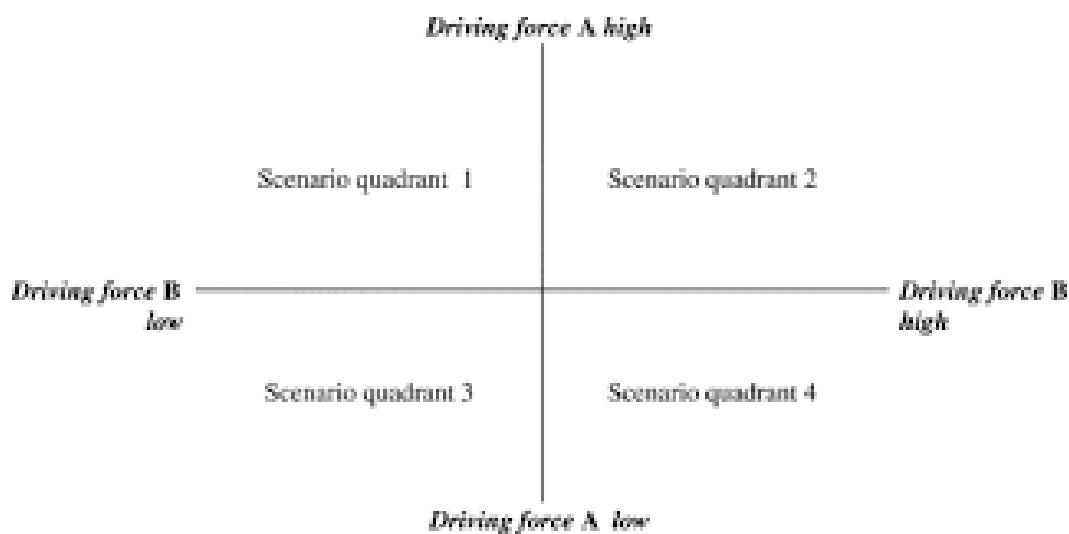


Figure 8.1: Framework for scenario development

The team will investigate the possibility of using the scenarios developed for the Bangladesh Delta Plan (GED 2017), and perhaps modifying them, as appropriate and necessary for the SEA work. These scenarios can be summarised as:

- Productive (Sufola), market driven delta: High pollution in short term, more environmental awareness in longer term.
- Resilient (Sohonio), dynamic delta: Nature is vulnerable, short term degradation, longer term protection of environment
- Moderate (Sushoma), delta under pressure: Increase of environmental degradation
- Active (Sokrio), basic needs first: Increase of environmental degradation

The ‘active’ scenario resembles the worst case while the ‘productive’ scenario is the best case scenario. The ‘resilient’ scenario is more adaptive to the effects of hazards induced by climate change and other vulnerabilities while the ‘moderate’ scenario indicates medium growth. Apart from these four scenarios, additionally there was also the business-as-usual scenario and the policy scenario.

The projections for the above Delta Plan scenarios are currently being updated under the second phase of the BDP2100, i.e. supporting the implementation of the Bangladesh Delta Plan (SIBDP)

following the basin wide approach. Region specific programmes are being formulated for the hydrological regions, e.g. North west, North central, Haor region, Coastal region (including South West, South Central and the South East) and the Hilly areas.

Keeping the scenarios used in the SEA work in line with those used in the Delta Plan would have considerable merit since the government is already committed to implementing the Delta Plan. However, these scenarios were based on two particular drivers: economic growth and climate change. It will be necessary to first determine if these two drivers are appropriate for the focus of the SEA. The team will therefore review a range of candidate drivers (Box 8.1) and identify those drivers which are likely to most influence future development in the South West Region of the next 20 years. These will then be used for scenario development through a sequence of expert workshops and brainstorming sessions during July-September 2020.

8.2.3 Drivers of change

Drivers of change are factors that have or are leading to change that are supporting or impeding development, economic growth and diversification, livelihoods, traditions, lifestyles and behaviours.

These drivers are important influences that were considered in shaping the scenarios and considering the projected outcomes of the three macro-economic growth strategies.

A candidate list of drivers of change has been identified (Box 8.1).

Box 8.1: Candidate list of drivers of change

Economic drivers

- Domestic demand (e.g. for imports);
- Markets (e.g. for exports);
- Lack of access to capital for domestic investors;
- Foreign direct investors
- Global financial crisis (since 2008, and now due to Covid-19 pandemic);
- Globalization and possible de-globalization as a result of Covid-19
- Capitalism;
- Tourism;
- Remittances.

Environmental drivers

- Climate change:
 - ⊖ Sea level rise - leading to migration away from vulnerable areas;
 - Salt water intrusion
- Natural disasters (storms, tidal surges):
 - Coastal erosion driving relocation;
 - Influencing use of building materials and designs

- More demand for building materials (dredging for material (i.e. sand), importing from other countries (i.e. China).
- Increasing soil salinity (mainly due to reduced fresh water flows in rivers and increasing abstraction for irrigation and urban use) - reducing land productivity (for crops and livestock).
- Increasing pollution of air, water and land – leading to increased health challenges;

Social drivers

- Covid-19 and future pandemics
- Increasing changes in lifestyles
- Out-migration – in search of work (e.g. in Middle East)
- In-migration to urban areas from rural areas;
- Cultural factors:
 - Increasing rate of women in paid employment;
 - Influence of colonisers and different visitors;
 - Threats of external influences on culture (e.g. from TV, films, internet, foreign visitors);
 - Changing alignment, balance and relationship between traditional and western values lifestyles.
- Gender factors:
 - Increase in domestic violence;
 - Women doing well in education – taking up paid employment (leading to having less time to spend with family and, in some States, less time to fulfil traditional family/community roles);
- Health;
- Access to education (plus high drop-out rates);
- Job opportunities;

Economic drivers

- Government policy to achieve transform Bangladesh into a middle-income country by 2021
- Government policy to achieve developed country status by 2041.
- Foreign direct investment
- Garment, textiles and leather industries

Governance and legal instrument drivers

- Legislation and regulations;
- National, Regional and Municipal policies;
- International accords to which Bangladesh is a signatory (e.g. UN treaties, conventions, etc);
- Institutional factors (weak coordination and integration of government agencies);

- Lack of skills and capacity;
- Politics.

Other drivers

- Donors (multilateral, bilateral, UN agencies, etc);
- Technology:
 - Phones and laptops;
 - White goods (fridges, televisions, air conditioners, etc) – making life easier/more comfortable (but increases energy demand);
 - Access to information and portals;
 - Enabling increased freedom of speech;
 - Affecting accountability and transparency – citizens are able to keep leaders and others accountable;
 - Allowing people to be more vocal about issues.
- Infrastructure
 - New Padma bridge – providing easier access to SW region
 - Expansion and improvement of railway network

During the ongoing work on scenarios, a range of criteria will be adopted used to distil the candidate list to a manageable list of key drivers, and then the selected key drivers will be used as a basis for scenario development.

8.3 Macro-economic growth strategies

The three proposed macro-economic growth strategies can be summarised as:

- **High economic growth:** of the “frontier” or “wild West” type – letting almost anything happen, pushing development policies and allowing investors to pursue any activity that might deliver high economic returns - with little or no concerns for the social and environmental dimensions and impacts of development initiatives. Some people might argue that this is the strategy that would be required, in reality, to reach the goal of achieving developed country status by 2041 as set by the government.
- **Green growth:** a balanced approach properly considering environmental and social consequences of economic development, with possibly a lower economic growth rate, but a search for maximising the national and regional natural and social capital/assets in the long-term in addition to the regular measures of development (GDP, built assets). This implies following a sustainable development pathway.
- **Business as usual:** pretty much development along the lines we see today – perhaps ad hoc, not well planned or coordinated, with minimal regard to environmental and/or social consequences. Basically the current situation plus whatever is already committed to (in the pipeline and going to happen anyway).

Once the scenarios have been developed, they will be used to inform the development of indicators and making projections for each of these macro-economic growth strategy (prospectively in August 2020).

One of the first steps of the main assessment phase of the SEA (now provisionally scheduled for November 2020 to February 2021), will be to organise a team workshop to undertake an initial assessment of the likely impacts (environmental and socio-economic) of each of the macro-economic growth strategies.

For each strategy, the developments and situations likely to arise will differ (possibly in type and nature, possibly in 'volume' or location/extent, etc.). Developments will arise as a result of continuing to implement existing PPPs or as revised and new PPPs are introduced, and will include projects, new/expanded/modernised infrastructure, other initiatives by the private sector, social change, etc. Developments will also be influenced by 'drivers of change' and external factors (climate change, trade dynamics, global economic factors, war, pandemics, etc.). The latter are things we cannot be certain about. The baseline theme papers are examining the influence of such external factors and our understanding of how they might influence future development. The factors that are being considered are, therefore, things that have a reasonable chance of occurring, but not mere speculation.

The outcomes will be presented in an Interim SEA Report which will be made available to all stakeholders for comment and national and stakeholder review workshops will be organised. Government will then be invited to select a preferred strategy which will then be subjected to deeper assessment.

9. Next Steps in the Sea Process

9.1 Stakeholder engagement

As noted in section 2.3.8 and set out in the Inception Report, the aim was to conduct a first round of stakeholder consultations during the scoping phase. This was to have involved multi-stakeholder workshops at national and regional levels and consultative events in all districts and in selected upazilas. In addition, it was planned to organise focus sessions for particular occupational groups (e.g. fisherfolk, farmers, urban dwellers, marginalised groups) and special meetings for women, where appropriate. In addition, the team aimed to conduct semi-structured interviews with key informants and random informal interviews in the field. However, Covid-19 has made this impossible to date.

In response, it had been hoped to restructure the work schedule and undertake the above programme during August to mid-October. But the continuing persistence of the pandemic makes this revised schedule still uncertain.

The Prospectus – which sets out the aims of the SEA and summarises the process – has been revised twice and the website updated accordingly to reflect the ongoing difficulties regarding the stakeholder consultation programme.

It is likely that the SEA will have to be taken forward during August-September based mainly on video conference sessions with targeted groups. Whilst not fully satisfactory, this will at least allow the SEA process to be explained to representatives of particular groups of stakeholder and for questions to be answered and feedback provided.

The team is hopeful that as the pandemic recedes and field travel and public meetings become possible in due course, it will be possible to arrange a broad programme of stakeholder consultations at later stages in the first few months of 2021 when further progress with the SEA will have been made and draft results will be available.

No specific timetable for this can be given at this time.

9.2 Institutional capacity survey

One of the 13 thematic baseline papers (Table 3.1) addresses institutional governance. A section of this paper will address existing institutional capacities which will be a fundamental concern when preparing the Strategic Environmental Management Plan (SEMP). The latter will set out a framework for monitoring the implementation of policies, plans and programmes and individual mega development activities. Thus, it will be critical to know whether institutions are in a position to assume and discharge the roles and responsibilities that will be assigned to them in the SEM. A dialogue will be necessary with institutions (individually and collectively) to consider these roles and responsibilities and to build consensus that the SEM sets out practical and workable recommendations. A first step in this process will be to undertake a survey of those institutions that are likely to have a role in implementing the SEM. Currently, due to the Covid-19 situation, it is not possible to undertake this survey. It will be carried later in 2020 out when conditions allow.

The survey will be conducted through a series of structured interviews with key personnel in relevant institutions - likely to include:

- Government ministries and departments – in the key sectors covering the PPPs summarised in the Screening Report;
- Other key organisations that may have an operational role to play as regards these PPPs (e.g. key NGOs, private sector organisations).

The survey will also examine information available in institutional documents and records and/or on websites.

If the Covid-19 restrictions persist for a long period, then it may be necessary to undertake a modified form of survey by email, using a questionnaire. There are some risks to this approach. Some contacts may not respond at all. Others may not see the email, and thus may not be able to respond, if they are working from home and do not have access government emails. Where they have private email addresses, the SEA team may well not know those private addresses. Further to this, some recipients may not respond to such emails as rigorously as needed or they may well lack access to the information required to complete a questionnaire. Therefore, there is a risk that the survey may be patchy.

The survey will aim to assess the capability of government Ministries/Departments and other relevant institutions - at different institutional levels (national, regional, local) - to manage and monitor SEMP implementation. The latter could include:

- undertaking recommended mitigatory or remedial environmental and/or socio-measures associated with PPPs; and
- monitoring environmental or social factors as may be recommended in the SEMP.

For each institution reviewed, interviews or a questionnaire will address the following:

- Mandate and responsibilities of the institution;
- Scope of the institution's work or operations
 - At what level does it operate: local, divisional, national and/or international levels?
- Organisational structure
 - what are the divisions, departments, sectors (include an organogram if possible) – particularly those with a role as regards environmental and or socio-economic concerns;
- Capacity
 - What is the institution's capacity as regards managing environmental and/or socio-economic concerns (specialist sections/units, staff complement, numbers (and qualifications if possible, e.g. graduates or not) of officers with environmental and/or socio-economic responsibilities);
- Financial resources
 - What is the annual budget for administrations, or amount of sales (or other measure) for private sector organisations,)
 - What access does the organisation have to international funding (e.g. from agencies like World Bank, Asian Development Bank, etc.);

- Observations
 - What gaps are there in the institutions?
 - Does it lack capacity (skills, available positions, budgets, equipment, etc.)?
 - What particular needs does the institution have?

A 1-2 page description of the survey results for each institution will be prepared, and overall conclusions will be drawn.

9.3 Scenario development and projections for macro-economic growth strategies

The previous chapter describes the process to develop scenarios and use these to inform making projections of the developments that will be likely to arise over the next twenty years in the SW region under three proposed alternative macro-economic development strategies.

This work will be undertaken during July-September 2020 and will provide the springboard to the next stage of the SEA process: the main assessment phase.

9.4 Further development of thematic baseline papers

The team has now developed initial working drafts of the 13 thematic baseline papers described in section 2.3.2. But they remain works-in progress. They will be further elaborated, enriched and verified during the July-September period through consultations with subject experts in Bangladesh.

9.5 Main assessment phase

It is currently planned to start the main assessment phase in mid-October 2020. As detailed in section 6.2.4, this will involve an initial assessment of the likely impacts (positive/negative, direct/indirect, domestic/transboundary, cumulative, and synergistic/antagonistic) of activities likely to arise under the possible alternative macro-economic growth strategies, and a subsequent deeper assessment of the preferred strategy.

The strategic environmental management plan (SEMP) will recommend how any likely negative impacts will be addressed (minimized or mitigated) and how any likely positive impacts may be enhanced and maximized.

The draft SEA report and SEMP will be subject to review by government and other stakeholders.

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Appendices

1. Revised terms of reference
- 2 The SEA team
- 3 List of stakeholders
- 4 List of objectives in Bangladesh policies, plans and programmes

Appendix 1: Revised terms of reference

Note: The revised Terms of Reference are contained as Appendix 1 of the approved Inception Report

1. Introduction

The Sundarbans is unique and has both local and global significance due to its diversity and rich ecosystems. The government's overall approach and vision is that the country's rapid growth and accompanying infrastructural and other developments must be eased-in and undertaken in a manner that safeguards natural resources and ecosystems, avoids negative environmental and socio-economic impacts and is sustainable; fulfilling both Vision 2021 and Vision 2041. In this context, the present government has commissioned a visionary initiative to undertake a comprehensive Strategic Environmental Assessment (SEA) for the sustainable conservation of the Sundarbans. This study aims to support striking a dynamic balance between the biodiversity and ecosystem services of the SW region and the Sundarbans and the current development drive to become a developed country by 2041.

Since independence in 1971, the nation has strived to pursue gradual and sustainable development. It culminated in the drive for the country's sustainable development agenda through striking a "right balance" between equitable national economic progress, human development and sound environmental management and protection. The present government initiated bold steps, widespread collaboration and unprecedented innovation to fast track the country's rate of development. To achieve developed country status, the nation has established new development paradigm through innovative approaches aimed at introducing a cohesive and integrated management system to ensure long-term sustainability, backed by integrated environmental strategies. Thus, an SEA is necessary for assessing the positive/negative, direct/indirect, domestic/transboundary and cumulative environmental and social impacts of development in the SW Region, including on the integrity and functioning of the Sundarbans and its Outstanding Universal Value, to inform future policies and decisions regarding development in the region.

Strategic Environmental Assessment (SEA) is a tool for assessing the environmental and socio-economic implications of policies, plans and programmes (PPPs) and ensuring the integration of these implications into their formulation and implementation. According to the Organization for Economic Cooperation and Development (OECD), *"SEA comprises analytical and participatory approaches to strategic decision-making that aim to integrate environmental considerations into policies, plans and program, and evaluate the inter linkages with economic and social considerations."*

Thus, in line with this OECD guidance, the present government has prioritized the consideration of environmental and socio-economic considerations in planning for the overall development of the South West Region.

The SW region is blessed with the Sundarbans, the largest mangrove forest in the world. This vast forest is also a wildlife sanctuary located at the delta of the Ganges River on the Bay of Bengal. The Sundarbans has been declared as a Ramsar site in 1992 and parts of the Sundarbans were designated by UNESCO as World Heritage Sites in 1997. The Sundarbans has received recent global attention due to concern about the consequences of the current drive towards development and existing and future challenges. Subsequently, UNESCO WHC requested the State

Party, Bangladesh, to undertake a comprehensive Strategic Environmental Assessment (SEA) (Decision 38 COM 7Bb.64 and 39 COM 7B.8) to assess the positive/negative, direct/indirect, domestic/transboundary and cumulative impacts at a landscape and regional scale and to uphold its Outstanding Universal Value (OUV).

The South West region is rapidly developing to achieve the national visions and goals and, subsequently, the government has formed policies, plans and programs (PPP) for development of the area through contributions from both the public and private sectors. An SEA is pivotal in assessing the environmental and socio-economic impacts of development (current and planned) in the South West region and contribute to the formulation of PPP's and influence the decision-making process.

The SW region of Bangladesh has high prospects for development thrusts, but is lagging behind the rest of the country in achieving the present development trajectory. The present government has thus taken this SEA initiative to boost socio-economic development of the region and at same time to ensure balance between development and the conservation of natural resources on a priority basis.

This SEA will cover the PPPs related to nine sectors namely, forestry, fisheries, water, power and energy, tourism, urbanization, industry, transportation/ communication and shipping.

2. SEA Project Area

Bangladesh is situated at the tail-end of the mighty Ganges-Brahmaputra-Meghna (GBM) river basins and as such, drains the entirety of flow generated within these basins. Being part of a network this massive, the country holds contrasting hydrological features which prompted its division into eight unique hydrological regions during the formulation of the National Water Management Plan (NWMP) in 2001.

The SEA covers the South Western Region of Bangladesh (see Figure 1), It is a rich coastal region and is home to the Sundarbans, the largest contiguous natural mangrove forest in the world. The study region comprises the South West hydrological region, fed primarily through the Ganges River System. This region is crisscrossed by a complex network of rivers and streams of varying hydrological and morphological characteristics providing a lifeline to the ecosystems of the region including that of the Sundarbans. The downstream flow from Ganges is via several river systems: the Gorai-Madhumati, Kapatakshya, Mathabhanga, etc. The four major river systems flowing through the Sundarbans are the Raimangal, Arpangasia, Sibsa-Passur and the Baleshwar.

Being primarily dependent on the Ganges flow, temporal decrease of downstream freshwater flow combined with progressing salinity intrusion – argued to result from climate change induced sea level rise and decreased upstream freshwater flow – has rendered this region vulnerable to natural disasters and has also greatly affected the ecosystem as well as livelihood of the people. Any future development scheme for the region has to be implemented keeping in mind the possible long-term as well as short-term impacts it might exert on the biodiversity and ecological balance of the region, especially the Sundarbans, and socio-economic conditions. A strategic environmental management plan will therefore greatly help in reinforcing a secured future for the region.

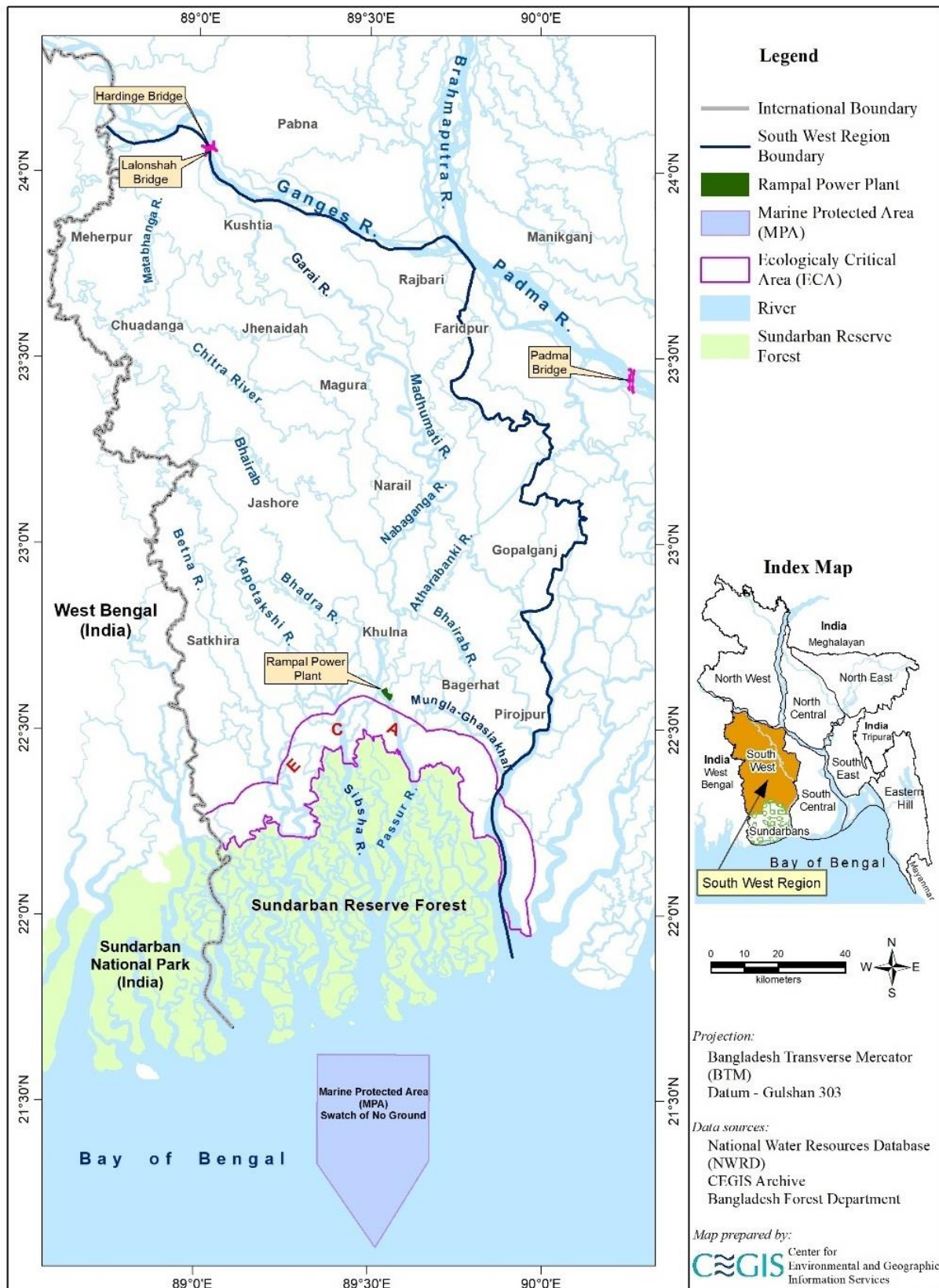


Figure 1: Map of the South-Western Region

3. Objectives

The following specific objectives have been for carrying out the SEA study:

- Consideration of environmental and socio-economic consequences of existing PPPs (national and SW region) that cover the SW Region and promoting that these issues be addressed when formulating and implementing future, as well as existing, PPPs with a view to promoting sustainable development in the region and conservation of the Sundarbans and its Outstanding Universal Value;
- Simultaneous assessment of the impacts of development initiatives on existing bio-physical settings and socio-economic conditions to facilitate informed decision-making regarding transitioning towards a sustainable, resilient and resource efficient economy;
- Identification of key stakeholders relevant to selected sectors and organizing consultation meetings to obtain knowledge on existing bio-physical settings and socio-economic conditions, impacts of current and proposed developments, and potential strategies for future development of the SW region;
- Development of alternative strategies to minimize the direct/indirect, domestic/transboundary and cumulative impacts of development on the Sundarbans and more widely in the South West Region;
- Make recommendations to improve environmental performance management in both the public and private sectors as regards future development activities; and
- Formulation of a comprehensive framework in the form of a Strategic Environmental Management Plan (SEMP) for the SW region to support decision making and monitoring of the implementation of policies, plans and programs that are likely to affect the environment and socio-economic conditions of the region and in particular the Sundarbans.

4. Scope of Works

4.1 Screening of relevant policies, plans and programmes (relevant to the period up to 2041) for both the public and private sectors - for key economic sectors, particularly: forest, fisheries, water, power and energy, industry, tourism, transportation and communication, urbanization and shipping - to identify those with potential to result in environmental and socio-economic impacts in the South West Region, including the Sundarbans, that will be addressed during the SEA.

4.2 Scoping to:

- Identify key sources of data and information – building on preliminary work undertake during the inception phases;
- Identify and summarize key laws, regulations, policies, strategies that concern environmental management and social conditions, and international commitments and conventions that Bangladesh is a signatory to;
- Review institutional roles, responsibilities and capacities as regards environmental management (national, SW regional and local levels);
- Review past regional, national and international studies, plans, reports and environmental/social assessments for relevant information that can support the SEA;

- Undertake stakeholder analysis (particularly as regards the nine key sectors) and prepare a participation strategy;
- Undertake key stakeholder consultations and organize workshops at national, regional and local levels – to:
 - ❖ explain the SEA (reason and process),
 - ❖ identify baseline data and development initiatives,
 - ❖ enable consultees to assist in scoping key issues and identifying SEA objectives; and record issues raised;
- Review of aims, objectives and key themes of selected PPPs;
- Initiate collection of baseline data and commission new research/field studies (where critically needed);
- Deepen identification of, and prioritize, key environmental and socio-economic issues that the SEA should take into consideration, including:
 - ❖ key environmental issues and challenges imposed by both natural and human interventions that significantly impact the region and the conservation of the Sundarbans (including those that are transboundary, i.e. arise from other regions of Bangladesh and from India);
 - ❖ current and potential sources of pollution as well as pollutant carriers that are important for human health, ecosystem functioning, and for conservation of the Sundarbans;
- Based on key themes and issues identified in reviewed PPPs and raised during consultations, develop draft SEA objectives, targets and indicators (including those specific to the Sundarbans) to provide a framework for assessment and monitoring PPPs during SEMP implementation;
- Prepare a draft baseline environmental and socio-economic profile of the South West Region, including a baseline describing the current environmental and ecological status of the Sundarbans;
- Circulate/discard the draft scoping report for stakeholder and public comment;
- Update of scoping report in response to comments.

4.3 The main assessment, to:

- Undertake scenario analysis using key drivers of change to inform preliminary environmental and socio-economic assessment of possible economic growth trajectories (high, moderate, business-as-usual),
 - ❖ Undertake initial assessment of environmental and socio-economic impacts of alternative economic growth trajectories.
- Prepare an interim SEA report covering the assessment of these trajectories and circulate to stakeholders for comment.
- Workshop for national level committee/steering committee review findings and confirm the preferred economic growth trajectory for deeper assessment.
- Detailed assessment of environmental and socio-economic impacts of the preferred alternative trajectory (positive/negative, direct/indirect, domestic/transboundary, cumulative, synergistic or antagonistic) relevant to the nine key sectors, including

- ❖ Analysing the available results of existing modelling of environmental and socio-economic factors (mainly those obtained using internationally recognized modelling tools);
- ❖ Undertaking new modelling, where appropriate, of key environmental factors (e.g. water quality, air quality, energy generation and use, energy and transport-related emissions, etc.) to estimate probable future pollution levels and subsequent impacts;
- Identify options to enhance positive impacts and minimize/mitigate negative ones
- Continue throughout this stage to marshal and analyse available baseline data and new data from any commissioned studies;
- Continue engagement with stakeholders;

4.4 Prepare draft final SEA report - covering:

- Methodology used
- Overview of public/stakeholder engagement activities undertaken
- Baseline profile
- Key issues addressed, including summary of stakeholder concerns and expectations, and how these have been addressed
- Description of authorities, jurisdictions and key institutions – their roles and responsibilities.
- Policy, legal and administrative framework.
- Development scenarios
- Initial assessment of significant environmental and socio-economic impacts of scenarios
- Deeper assessment of significant environmental and social impacts of preferred scenario.
- Conclusions and recommendations, e.g.
 - ❖ For avoidance/mitigation of negative impacts and enhancement of synergies and positive impacts.
 - ❖ For how existing PPPs might need to be adjusted/revised to minimize/mitigate potential negative environmental and/or socio-economic impacts, and how planned PPPs will need to address such potential impacts.
 - ❖ Recommendations for the integration of environmental principles such as polluter pay principle and the precautionary principle in the development, appraisal, and selection of PPPs;
- References
- Appendices

4.5 Prepare a draft Strategic Environmental Management Plan (SEMP) for the SW Region, and Sundarbans, with

- identified measures for monitoring the implementation of PPPs
- identified institutional roles and responsibilities and
- an auditing procedure for compliance with the SEMP.

5. Documents to be submitted with the proposal

- Original copy of Joint venture signed agreement on non-judicial stamps.
- Certification from the implementing agency for completion/ongoing of SEA by the consulting firm (at least for those SEA works mentioned in the EOI proposal).
- Report of at least one completed SEA work by the firm mentioned in the EOI proposal.

6. Approach and Methodology

The methodology to be followed is largely implied in section 4 above.

6.1 SEA Conducting Approach

The SEA will evaluate environmental and socio-economic impacts of development in the SW Region and make recommendations to improve the management of existing as well as emerging risks to the SW Region and the Sundarbans. It will be carried out in accordance with the SEA international best practice and the OECD DAC SEA Guidelines, through a multi-tiered approach which will include conceptualization of the study, identification of policies, plans and programs to be assessed, as well as issues to be addressed, consulting pertinent stakeholders, development of baseline environmental and socio-economic profile, and formulate alternative development economic development trajectories to be initially assessed.

The SEA will also be conducted in accordance with the eight UNESCO World Heritage Impact Assessment Principles that covers certain aspects such as ensuring rigorous environmental assessment of the multi-dimensional impacts of development programs and formulation of a Strategic Environmental Management Plan (SEMP), that incorporates measures for monitoring the implementation of PPPs and auditing compliance.

6.2 Methodology

6.2.1 Screening

Screening will be carried out to identify relevant PPPs which should be assessed during the SEA. Screening will be based on criteria to determine whether the PPPs are likely to result in significant environmental or socio-economic impacts in SW Region and/or the Sundarbans, having regard to their probability, duration, frequency, reversibility, and cumulative nature etc.

6.2.2 Scoping

Scoping will be carried out to identify key elements of selected PPPs and environmental and socio-economic issues which will be the main focus of the SEA. This will be through a series of tasks stated below:

a. Determining key elements of PPPs

The key elements of PPPs such as goals, objectives and strategic aims of selected PPPs will be reviewed and activities that will be likely to follow from their implementation will be identified. Elements will be identified through processes such as review of relevant documents, brainstorming sessions between relevant government and non-government agencies as required. Strategic aims under individual PPP may include the development of projects, investment in new technologies etc.

b. Determination of key environmental and socio-economic issues

Key issues will be identified through: the review of PPPs and key documents; consultations with stakeholders (government, private sector, civil society/NGOs, experts and others) – at national-regional-local levels; interviews with key informants, focus group sessions, and workshops.

c. Literature Review for Secondary Information

The study will identify and review existing policies, laws, regulations and institutions (at national, regional and local levels) relevant to the study. The review of institutional arrangements, roles, responsibilities and capacities at all levels will include identifying those institutions whose activities may affect the SW Region and Sundarbans. A review of relevant research studies, reports and environmental assessments will also be carried out to determine useful information to inform the SEA.

d. Preparing an environmental and socio-economic baselines profile

An Environmental and Social Profile of SW Region will be prepared covering all relevant factors and including the current status of the nine selected sectors and the Sundarbans. To aid this process, necessary information will be collected from available sources. Where relevant, baseline data will be assigned to a suitable year/ period. Where relevant and of a priority nature, field surveys will be conducted to collect primary data.

e. Development of Objectives, Indicators and Targets

For each of the key environmental and socio-economic issues, objectives will be identified, drawn in part from those contained in existing national and regional policies, plans, strategies and international commitments and associated memoranda of understanding. These objectives will provide a basis for impact assessment – assessing whether particular impacts will enhance or impede achieving individual objectives. For each objective, indicators will be identified (realistic indicators capable of being measured) to provide a qualitative or quantitative measurement (as appropriate) of progress towards achieving the objective, using internationally recognized indicators where appropriate. These will be used in implementing the SEMP.

f. Stakeholder Identification and Analysis

Stakeholder mapping will be done to identify pertinent stakeholders (including government institutions, private sector organizations, NGOs/CSOs and civil society) based on whether they will influence the implementation of proposed policies, plans and programs or in turn, be affected by or have a legitimate interest in them. Standard social tools (such as FGD, PCM) will be used for stakeholder analyses.

g. Consultation with stakeholders

The SEA scoping process will start through key informant interviews, focus group sessions and consultative meetings among the different stakeholders relevant to the nine sectors as well the Forest Department and Department of Environment. Such consultations will be carried out at national, SW regional and local levels. This will be done specifically to get a better understanding of the main objectives of the PPPs and stakeholder views, concerns and perspectives on them, and to identify key environmental, social, economic other issues to be addressed by the SEA and in the planning process.

h. Site visits

Field visits will be made to the study area for familiarization, consultative meetings and to observe conditions and features on the ground and identify issues/concerns that will need to be considered in the SEA. These include sensitive ecological features, industrial and manufacturing sites, urban areas, land use practices, areas vulnerable to climate change factors (eg sea level rise, increased salinity) and environmental and socio-economic challenges. The areas to be visited will be identified during the inception phase.

i. Key informant interviews

Key informants will be identified by the Team and experts of the MoEFCC. They will consist mainly of BFD and DoE officials, officials from the Local Government, Ministry of Forest officials, government officials from Power Development Board and Bangladesh Water Development Board and officials from the related public and private agencies, international NGOs. Public representatives and local leaders in SW Region will be also interviewed. Other officials from associations such as the Chamber of Commerce and domestic NGOs/CSO among others will also be consulted.

6.2.3 Preparation of Scoping Report

A draft scoping report will be developed to inform pertinent stakeholders about key elements of the PPPs, key environmental and socio-economic issues to be addressed with the aim of generating interim feedback that will help in finalizing the focus of the SEA. Following stakeholder feedback, a final scoping report will be prepared.

6.2.4 The main assessment stage

a. Identification of alternative economic growth trajectories

Scenario analysis will be undertaken to identify inform analysis and an initial assessment of impacts for alternative macro-economic growth strategies. A preferred strategy will be confirmed by the Ministry of Environment, Forest and Climate Change in consultation with other government agencies and stakeholders. This preferred strategy will then be subjected to deeper assessment.

b. Assessing potential environmental and socio-economic impacts

This will involve an initial assessment of the likely impacts (positive/negative, direct/indirect, domestic/transboundary, cumulative, and synergistic/antagonistic) of activities likely to arise under the possible alternative macro-economic growth strategies, and a subsequent deeper assessment of the preferred strategy. The SEMP will recommend how any likely negative impacts will be addressed (minimized or mitigated) and how any likely positive impacts may be enhanced and maximized. This SEA process will include the following tasks:

c. Predicting impacts of developments arising under the macro-economic growth strategies and assessing significance

Positive/negative, direct/indirect, domestic/transboundary, cumulative and synergistic/antagonistic environmental and socio-economic impacts of implementing PPPs under the macro-economic growth strategies will be assessed. Where appropriate, impacts will

be assessed in respect to base condition using internationally accepted standard mathematical modeling tools and techniques. Where possible, this will identify significance based on, for example, the nature and extent of change, the frequency of impact and probability of recurrence.

d. Mitigation of impacts

Strategic measures will be recommended to minimize and mitigate impacts based on their level of significance. It will involve preventive measures as well as reduction of magnitude or probability of occurrence. Remedial measures will also be recommended where impacts have already occurred. The SEMP will focus first on avoiding potential negative impacts and secondly on reducing unavoidable residual impacts.

6.2.5 Finalization of SEA]

Presentation of findings

The SEA Consultants team will synthesize and harmonize the study findings in a draft final SEA report and draft SEMP and present these at a multi-stakeholder validation workshop. Feedback will be incorporated as appropriate.

The provisional contents of the draft final SEA report are listed in section 4.4.

The draft SEMP will set out a framework for monitoring the impacts of implementing the selected PPPs and auditing compliance.

7. SEA Consultancy Outputs

- Inception, screening and scoping reports
- SEA report
- Strategic EMP for SW Region and Sundarbans including Monitoring and Auditing frameworks

Appendix 2: List of Stakeholders

1. Government Institutions/organization

Name of stakeholders	Designation	Organization
Md. Mohsin	Director General	Department of Disaster Management (DDM)
Major General Moin Uddin	Chairman	Bangladesh Rural Electrification Board
Dr. Md. Ruhul Amin	Director General (Additional Secretary)	Department of Bangladesh Haor and Wetlands Development (DBHWD)
Md. Alimuuddin	Director General	River Research Institute (RRI)
Abu Saleh Khan	Executive Director (in-charge)	Institute of Water Modeling (IWM)
Professor Dr. Anika Yunus	Head of the Department	Department of Water Resources Engineering, BUET
Professor Mohammad Rezaur Rahman		Institute of Water and Flood Management (IWFM), BUET
Md. Jobaer Alam	Associate Professor & Chairman	Department of Oceanography, Dhaka University
Md. Sakhawat Hossain	Assistant Professor and Chairman	Department of Disaster Science and Management, Dhaka University
Rear Admiral M Khaled Iqbal	Vice-Chancellor	Bangabandhu Sheikh Mujibur Rahman Maritime University (BSMRMU)
Commodore M Ziauddin Alamgir	Dean, Faculty of Maritime of Governance and Policy	Bangabandhu Sheikh Mujibur Rahman Maritime University (BSMRMU)
Dr. Rejuan Hossain Bhuiyan	Professor & Chairman	Department of Geography and Environment, University of Dhaka
SM Rezaul Karim	Minister,	Ministry of Fisheries and Livestock
Quazi Shams Afroz	Director General,	Department of Fisheries
Md. Mizanur Rahman	Chief Scientific Officer,	Fisheries Planning and Survey, Department of Fisheries
Kh. Mahbubul Haque	Project Director,	Sustainable Coastal and Marine Fisheries Project (SCMFP) and DD (Finance and Planning)
Dr. Md. Sharif Uddin	Project Director	Bangladesh Marine Fisheries Capacity Building project (BMFCB)
Joarder Anwarul Haque	Project Director	Union Level Aquaculture Technology Services Extension Project
Md. Alimuzzaman Choudhury	Project Director	Enhancement of Fish Production through Reforming Waterbodies Project
Ranajit Kumar Paul	Deputy Director,	Department of Fisheries, Khulna Division
MD. Abu Sayeed	District fisheries Officer	Khulna
Dr. Mohammad Khaleq Qanok	District fisheries Officer	Bagerhat

Name of stakeholders	Designation	Organization
MD. Moshir Rahman	District fisheries Officer	Satkhira
MD. Anisur Rahman	District fisheries Officer	Jashore
Jonab Mohammad Farukul Islam	District fisheries Officer	Narail
MD. Alfazuddin Sheikh	District Fisheries Officer	Jhenaidah
Md. Mosharraf Hossain	District Fisheries Officer	Chuadanga
DR. Shafiq	District Fisheries Officer	Kushtia
S M Ashikur Rahman	District Fisheries Officer	Magura
MD. Saifuddin Yahyea	District Fisheries Officer	Meherpur
Mr. Amir Hossain Chowdhury	Chief Conservator of Forests	Bangladesh Forest Department (BFD)
Mr. Muhammad Ahsanul Jabbar,	Chairman	Bangladesh Forest Industries Development Corporation (BFIDC)
Dr. A K M Rafique Ahmmed	Director General	Department of Environment (DoE)
Mr. Md Bashirul Al Mamun,	Divisional Forest Officer	Sundarbans West Forest Divisions
Dr. Md. Masudur Rahman,	Director	Bangladesh Forest Research Institute
Dr. Helal Siddiqui,	Divisional Officer	Silviculture Division Khulna
Mr. Parimal Singha,	Director	Bangladesh National Herbarium
Mr. Modinul Ahsan	Divisional Forest Officer	Wildlife Management and Nature Conservation Division
Dr. Jarin Akhter	Director	Institute of Forestry and Environmental Science University of Chattagram
Mr. Rakha Hari Sarkar	Chairman	Department of Botany, DU
Professor Humayun Reza Khan	Chairman	Department of Zoology, DU
Dr. Md. Khalilur Rahman	Chairman	Department of Soil Science, DU
Dr. Md. Badruzzaman Bhuyan	Chairman	Department of Tourism and Hospitality, DU
Dr. Rasheda Yasmin Shilpi,	Chairman	Department of Botany, JU
Prof. Dr. Md .Gulam Mostafa,	Chairman	Department of Zoology, JU
Prof. Dr. M. Monirul H Khan	Professor	Department of Zoology, JU
Prof. Dr. M A Aziz	Professor	Department of Zoology, JU
Prof. Mohammad Belal Uddin	Chairman	Shajalal University of Science and Technology, Sylhet Forestry and Environmental Science
Porf. Dr. Md Iftekhar Shams	Chairman	Forestry and Wood Technology Discipline, Khulna University
Prof. Dr. Md. Saiful Islam, Chairman	Department of Zoology, University of Rajshahi	Department of Zoology, University of Rajshahi
Nirmal Kumar Paul	Divisional Forest Officer	Management Plan Division, Boyra, Khulna
A. K. Fazlul Hoque	Professor	Forestry and Wood Technology Discipline, Khulna University
Dr. Md. Golam Rakkibu	Professor	Forestry and Wood Technology Discipline, Khulna University
Dr. Md. Nazmus Sadath	Professor	Forestry and Wood Technology Discipline, Khulna University

Name of stakeholders	Designation	Organization
Dr. Md. Kamruzzaman	Professor	Forestry and Wood Technology Discipline, Khulna University
Md. Sharif Hasan Limon	Professor	Forestry and Wood Technology Discipline, Khulna University
S.M. Rubaiot Abdullah	Assistant Professor	Forestry and Wood Technology Discipline, Khulna University
Dr. Muhammad Abdur Rouf	Professor & Head	Fisheries and Marine Resource Technology Discipline, Khulna University
Dr. Md. Nazmul Ahsan	Professor	Fisheries and Marine Resource Technology Discipline, Khulna University
Dr. Khandaker Anisul Huq	Professor	Fisheries and Marine Resource Technology Discipline, Khulna University
Dr. Md. Golam Sarower	Professor	Fisheries and Marine Resource Technology Discipline, Khulna University
Dr Lifat Rahi	Associate Professor	Fisheries and Marine Resource Technology Discipline, Khulna University
Dr. Salma Begum	Professor & Head	Department of Environmental Science, Khulna University
Dr. Dilip Kumar Datta	Professor	Department of Environmental Science, Khulna University
Dr. Atikul Islam	Professor	Department of Environmental Science, Khulna University
Dr. Abdullah Harun Chowdhury	Professor	Department of Environmental Science, Khulna University
Mr. Prosun Kumar Ghosh	Associate Professor	Department of Environmental Science, Khulna University
Dr. Sarder Safiqul Islam	Professor & head	Agro-technology Discipline Khulna University
Dr. Md. Matiul Islam	Professor	Agro-technology Discipline Khulna University
Mr. Khandoker Qudrata Kibria	Professor	Soil, Water and Environment Discipline, Khulna University
Mr. Md. Sanaul Islam	Professor	Soil, Water and Environment Discipline, Khulna University
Dr. Jagadish Chandra Joardar	Professor	Soil, Water and Environment Discipline, Khulna University
Md. Jahirul Hoque	Chief planning	Mongla port authority
Md. Bazlur Rahman	Deputy Chief Engineer	Mongla port authority
Aminur Rahman	Assistant Harbour Master (Op)	Mongla port authority
Javed Anowar	Director Planning	Bangladesh Inland Water Transport Authority
Sharmila Khanam	Deputy Director (Foreign Trade)	Bangladesh Inland Water Transport Authority

Name of stakeholders	Designation	Organization
Capt. Sawkat Sarder	G.M.(Marine)	Bangladesh Inland Water Transport Corporation
Md. Sharifur Rahman		Pyra Port Authority
Md. Shahadat Hossain	Assistant Manager (Planning)	Bangladesh Shipping Corporation
Md. Nasiruzzaman	Secretary	Ministry of Agriculture
Md. Al-Mamun	PS to Secretary (Additional Charge)	Ministry of Agriculture
Rawnak Mahmud	Secretary	Ministry of Fisheries and Livestock
Md. Azizul Islam	PS to Secretary (Deputy Secretary)	Ministry of Fisheries and Livestock
Dr. Mosammat Nazmanara Khanum	Secretary	Ministry of Food
Muhammad Masum Billah	PS to Secretary (Senior Assistant Secretary)	Ministry of Food
Kabir Bin Anwar	Secretary	Ministry of Water Resources
S. M. Sadik Tanveer	PS to Secretary	Ministry of Water Resources
Dr. Md. Abdul Mueed	Director General	Department of Agricultural Extension (DAE)
Dr. Abdul Jabbar Sikder	Director General	Department of Livestock (DLS)
M Badrul Arefin	Director General (Additional Secretary)	Food Planning and Monitoring Unit
Dr. Md. Abdul Wohab	Director General	Bangladesh Agricultural Research Institute (BARI)
Dr. Md. Shahjahan Kabir	Director General	Bangladesh Rice Research Institute (BRRI)
Dr. A.S.M. Anwarul Huq	Director General	Bangladesh Jute Research Institute (BJRI)
Dr. Mirza Mofazzal Islam	Director General	Bangladesh Institute of Nuclear Agriculture (BINA)
Dr. Nathu Ram Sarker	Director General	Bangladesh Livestock Research Institute (BLRI)
Bidhan Kumar Bhandar	Director General	Soil Resource Development Institute (SRDI)
Mr Md Matiar Rahman	Chief Engineer	Local Government Engineering Department (LGED)
Mr Md. Mokhlesur Rahman	Addl Chief Engineer, Current Charge (Khulna)	Local Government Engineering Department (LGED)
Mr Ratan Kumar Dey	Superintending Engineer (Khulna)	Local Government Engineering Department (LGED)
Mr Md Shafique Uddin	Managing Director	West Zone Power Distribution Company Ltd
	Superintending Engineer	West Zone Power Distribution Company Ltd
Mr S. M. Tariqul Islam	Assistant Professor, IDM-KUET	Khulna University of Engineering and Technology (KUET)
Mrs Anjum Tasnuva	Assistant Professor, IDM-KUET	Khulna University of Engineering and Technology (KUET)
Mr Riad Hossain	Lecturer, IDM-KUET	Khulna University of Engineering and Technology (KUET)

Name of stakeholders	Designation	Organization
Dr. Tawfiq-e-Elahi Chowdhury	Energy Adviser to the Hon'ble Prime Minister	Prime Minister's Office
Dr. Ahmad Kaikaus	Principal Secretary, PM office	Prime Minister's Office
Dr. Sultan Ahmed	Secretary of the Power Division	Power Division, MoPEMR
Md. Anisur Rahman	Senior Secretary, E&M R Division	Energy and Mineral Resources Division, MoPEMR
Dr. Shamsul Alam	Member (Senior Secretary), GED	General Economic Division, Planning Commission, GOB
Mohammad Hossain	Director General	Power Cell, MoPEMR
Mustak Muhammad	Member P&D, BPDB	Bangladesh Power Development Board (BPDB)
Md. Jakir Hossain	Member, Generation	Bangladesh Power Development Board (BPDB)
	Director, Renewable Energy	Bangladesh Power Development Board (BPDB)
Maqbul-E-Elahi Elahi	Member, ERC	Energy Regulatory Commission
Md. Aiub Khan Chaudhury	Director, Planning	PETROBANGLA
Md. Tazul Islam	General Manager (Exploration)	PETROBANGLA
AKM Ruhul Islam Chaudhury	General Manager (Environment and Safety)	PETROBANGLA
Dr. Dillip Kumar Datta	Professor, Environmental Science Discipline	Khulna University
Dr. Abdullah Harun Chowdhury	Professor, Environmental Science Discipline	Khulna University
Md. Yakub Elahi Chaudhury	Executive Director (P & D)	Power Grid Company Bangladesh
Md. Alomgir Hossain	Project Director (SDE), Grid Extension Project in the South-Western Region of Bangladesh	Power Grid Company Bangladesh
Md. Mohibul Haque	Senior Secretary, Ministry of Civil Aviation and Tourism	Ministry of Civil Aviation and Tourism
Md. Atiqul Huq	Additional Secretary (Tourism & Planning)	Ministry of Civil Aviation and Tourism
Mrs. Lubna Yasmine	Deputy Chief (Planning Section)	Ministry of Civil Aviation and Tourism
Mr. Ram Chandra Das	Chairman (Additional Secretary), BPC	Bangladesh Parjatan Corporation (BPC), MoCAT
Ms. Abeda Akhter	Director (Planning & Commercial) and Joint Secretary	Bangladesh Parjatan Corporation (BPC)
Mr. Bayzeed	Manager, BPC, Mongla, Bagerhat	Bangladesh Parjatan Corporation (BPC)
Md. Mohibul Haque	Senior Secretary and Chairman (BTB), Ministry of Civil Aviation and Tourism.	Bangladesh Tourism Board
Mr. Javed Ahmed	Chief Executive Officer (Additional Secretary)	Bangladesh Tourism Board

Name of stakeholders	Designation	Organization
Abu Tahir Muhammad Zaber	Director (Marketing, Planning & Public Relation), (Joint Secretary)	Bangladesh Tourism Board
Mohammad Saiful Hassan	Deputy Director (Research & Planning)	Bangladesh Tourism Board
Md. Amir Hosain Chowdhury	Chief Conservator of Forests	Department of Forest
Md. Moyeen Uddin Khan	Conservator of Forests, Khulna Circle, Khulna	Department of Forest
Md. Bashirul-Al-Mamun	Divisional Forest Officer, Sundarban West Division, Khulna	Department of Forest
Dr. Md. Masudur Rahman	Director, Bangladesh Forest Research Institute	Bangladesh Forest Research Institute
Dr. A S M Helal Uddin Ahmmed Siddiqui	Divisional Officer (C.C.), Mangrove Silviculture Division, Khulna	Bangladesh Forest Research Institute
Md. Akramul Islam	Research Officer, Mangrove Silviculture Division, Khulna	Bangladesh Forest Research Institute
Dr. Md. Abu Hena Mostofa Kamal	Secretary, Ministry of Cultural Affairs	Ministry of Cultural Affairs
Md. Abdul Mannan Ilias	Additional Secretary (Plan. & Dev.)	Ministry of Cultural Affairs
Nadira Sultana	Deputy Secretary (Archaeology and museum)	Ministry of Cultural Affairs
Mr. Md. Hannan Mia	Director General (Additional Secretary)	Department of Archaeology (DOA)
Gazi Md. Wali-ul-Hoque	Deputy Director (Admin), Joint Secretary	Department of Archaeology
A K M Syfur Rahman	Assistant Director, Khulna Division	Department of Archaeology
Mr. N M Zeaul Alam PAA	Senior Secretary	Information and Communication Technology Division
Md Mamun-Al-Rashid	Additional Secretary (Planning and Development Wing)	Information and Communication Technology Division
Mst. Sheren Shobnom	Deputy Secretary (Policy Section)	Information and Communication Technology Division
Md. Nazrul Islam	Secretary, Road Transport and Highways Division	Ministry of Communication
Mr. Chandan Kumar Dey	Additional Secretary (Development Wing)	Ministry of Communication
Mr. Md. Mahbuber Rahman	Deputy Chief (Planning & Programming)	Ministry of Communication
Mr. Md. Muksodur Rahman Patwary	Secretary, Ministry of Land	Ministry of Land
Mr. Md. Abdul Haque	Additional Secretary (Development)	Ministry of Land
Mrs. Ishrat Jahan	Deputy Secretary (Khasland)	Ministry of Land
Mr. Mohammad Mezbahuddin Chowdhury	Secretary, Ministry of Shipping	Ministry of Shipping

Name of stakeholders	Designation	Organization
Mr. Bhola Nath Dey	Additional Secretary (Development)	Ministry of Shipping
Mr. Md. Ubaidul Hoque	Deputy Chief (Planning)	Ministry of Shipping
Mr. Md. Fazlur Rahman	Additional Secretary (Development)	Ministry of Education
Mrs. Khaleda Akhtar	Deputy Secretary (Development)	Ministry of Education
Mostafa Kamal Uddin	Senior Secretary, Ministry of Home Affairs	Ministry of Home Affairs
Mr. Md. Nurul Islam	Secretary, Ministry of Religious Affairs	Ministry of Religious Affairs
Dr. Moazzem Hossain	Additional Secretary (Development)	Ministry of Religious Affairs
Dr. Md. Obaidullah Hannan	Professor, Forestry and Wood Technology Discipline	Khulna University
Dr. Mahmood Hossain	Professor, Forestry and Wood Technology Discipline	Khulna University
	Minister	Ministry of Home Affairs
	Senior Secretary, Public Security Division	Ministry of Home Affairs
	Secretary, Security Service Division	Ministry of Home Affairs
	Minister	Ministry of Social Welfare
Mr. Md. Rezaul Ahsan	Secretary	Ministry of Social Welfare
Mr. Sheikh Rafikul Islam	Director General (DG)	Directorate of Social Welfare
Mr. Supriya Kumar Kundu	Director General (DG)	Bangladesh Rural Development Board
Md. Mahbub Hossain	Secretary	Secondary and Higher Secondary Division
Munshi Shahabuddin Ahmed	Secretary	Technical and Madrasah Education Division
Md Akram-Al-Hossain	Secretary	Ministry of Primary and Mass Education
Dr. Tarun Kanti Shikder	Additional Secretary (Admin-1)	Ministry of Primary and Mass Education
Kazi Rowshan Akhter	Secretary	Ministry of Women and Children Affairs
Md. Shahadat Hossain	PS to Secretary	Ministry of Women and Children Affairs
Parveen Akhter	Director General	Department of Women Affairs
Dr. Khan Ahmed Sayeed Murshid	Director General	Bangladesh Institute of Development Studies
Dr. Binayak Sen	Research Director, BIDS	Bangladesh Institute of Development Studies
Md. Asadul Islam	Secretary (Health Service Division)	Ministry of Health and Family Welfare
Md. Ali Noor	Secretary, (Education and Family Welfare Division)	Ministry of Health and Family Welfare

Name of stakeholders	Designation	Organization
Prof. Dr. Mohammad Abul Kalam Azad	Director General (Health)	Directorate General of Health Service (DGHS)
Quazi A. K. M. Mohiul Islam	Director General	Directorate General of Family Planning
Major General Md Mahbubur Rahman	Directorate General	Directorate General of Drug Administration (DGDA)
Prof. Dr. Shaila Hossain	Director	Center for Medical Education (CME)
Dr. Dilip Kumar Roy	Chairman	Bangladesh Homoeopathic Board (BHB)
Prof. Mohammad Shahidullah	President	Bangladesh Medical and Dental Council (BM & DC)
Muhammad Mahbubul Hoque	Secretary	Pharmacy Council of Bangladesh
Suraiya Begum	Register	Bangladesh Nursing and Midwifery Council (BNMC)
Md. Asadul Islam	Secretary (Health Service Division)	Ministry of Health and Family Welfare
Md. Ali Noor	Secretary, (Education and Family Welfare Division)	Ministry of Health and Family Welfare
K M Ali Azam	Secretary	Ministry of Labour and Employment
A.K.M. Mizanur Rahman	Director General (Additional Secretary),	Department of Labour
Md. Helaluddin Ahmed	Senior-Secretary , Local Government Division	Ministry of Local Government, Rural Development and Co-operatives
Md. Rezaul Ahsan,	Secretary, Rural Development & Co-operative Division	Ministry of Local Government, Rural Development and Co-operatives
Md. Ataur Rahman	Deputy Secretary (Training)	National Skill Development Council (NSDC)
Mrs. Sabina Ferdous	Deputy Secretary	National Action Plan on Women, peace and Security (NAP-WPS)
Akbar Hossain	Addl Secretary & Project Director	Amar Bari Amar Khamar
Md. Abdus Samad	Deputy Secretary	Ministry of Water Resources
Md. Amirul Islam	Deputy Secretary	Ministry of Agriculture
Md Emdadul Hoq Chowdhury	Deputy Secretary	Ministry of Local Government, Rural Development and Cooperatives
Rehana Yasmin	Deputy Secretary	Ministry of Ports, Shipping and Inland Water Transport
Subrata Bhowmik	Deputy Secretary	Ministry of Fisheries and Livestock
A.M. Aminul Haque	Director General	Bangladesh Water Development Board (BWDB)
Bodrun Nahar	Director General(In charge)	Water Resources Planning Organization (WARPO)
Md. Mahmudur Rahman	Member	Joint Rivers Commission

Name of stakeholders	Designation	Organization
Md. Sayedul Islam	Chairman	Bangladesh Agricultural Development Corporation
Md. Abdur Rashid Khan	Chief Engineer	Local Government Engineering Department
Md. Saifur Rahman	Chief Engineer	Department of Public Health Engineering
Mohammed Belayet Hossain	Executive Director	Bangladesh Setu Kotripokho
Khaja Miah	Chairman	Bangladesh Inland Water Transport Corporation (BIWTC)
Commodore Golam Sadeq	Chairman	Bangladesh Inland Water Transport Authority (BIWTA)
Dr. Muzibur Rahman Howlader	Chairman	NRCC
Engr. Taqsem A Khan	Managing Director	Dhaka Water Supply and Sanitation Authority (DWASA)
Mr. Shamsuddin Ahmed	Director	Bangladesh Meteorological Department
Talukder Abdul Khaleque	Mayor	Khulna City Corporation
Brigadier General Md. Abdul Mukim	Chairman	Khulna Development Authority
Dr. S. M. Moniruzzaman	Head of the Department	Department of Civil Engineering, Khulna University of Engineering & Technology
Dr. Md. Saiful Islam	Director	Institute of Disaster Management, Khulna University of Engineering & Technology
Ashrafun Nahar	Chief Executive	WOMEN JOB CREATION CENTRE (WJCC)
Md. Tajul Islam Mia	Deputy Secretary (Sairat)	Ministry of Land
Md. Asaduzzaman	Deputy Secretary (Acquisition)	Ministry of Land
Md Masud Karim	Additional Secretary (Law)	Ministry of Land
Md. Taslimul Islam ndc	Additional Secretary	Ministry of Land
Md. Abdullah, P Eng.	Managing Director	Khulna Wasa
Md Ahsanul Kabir	Professor	Khulna University
Dr. Mohammad Shahanur Alam	Secretary	Khulna Development Authority (KDA)
Shuvro Chandan Mahali	Town Planner	Satkhira Municipality
Md. Abdul Halim	Secretary	Ministry of Industries
Md. Anwar Hossain	Senior Secretary	Ministry of Science and Technology
Lokman Hossain Miah	Secretary	Ministry of Textiles and Jute
Mahbubul Hoq	Chairman	Bangladesh Atomic Energy Commission (BAEC)
Engr. Md. Muzammel Haque	Chairman	Bangladesh Atomic Energy Regulatory Authority (BAERA)
Md. Mostaque Hassan, ndc	Chairman	Bangladesh Small and Cottage Industries Corporation (BSCIC)
Major General S M Salahuddin Islam, BP, SPP, ndc, psc	Executive Chairman	Bangladesh Export Processing Zones Authority (BEPZA)

Name of stakeholders	Designation	Organization
Paban Chowdhury	Executive Chairman	Bangladesh Economic Zones Authority (BEZA)
Professor Dr. Md. Akhtaruzzaman	Vice Chancellor	Institute of Leather Engineering and Technology (ILET)
Dr. Madhu Sudan Saha	Principal Scientific Officer & Officer In-Charge	Leather Research Institute (LRI)
Rehana Akter Ruma	Additional Secretary	Bangladesh Tanners' Association (BTA)

2. Private/non-government institutions/organization

Name of stakeholders	Designation	Organization
Harry Verweij	Ambassador	Royal Netherlands Embassy
Sudipto Mukerjee	Resident Representative, UNDP Bangladesh	United Nations Development Program (UNDP)
Derrick Brown	Mission Director	USAid
Hasin Jahan	Country Director	WaterAid
Asif Saleh	Executive Director	Brac
Tomoo Hozumi	UNICEF Representative in Bangladesh	UNICEF
M. Anisul Islam	Director	Center for Natural Resources Studies (CNRS)
Mr. Francis Atul Sarker	Executive Director	CARITAS Bangladesh
Mr. Kamalindu Karmaker	Director	ANNESHA Foundation
Kabir Bin Anwar	Chairman	ISABELA Foundation
Ms. Sharmeen Murshid	Chief Executive Officer	BROTEE
Mr. H S Mozaddad Faruque	President	Bangladesh Water Partnership (BWP) under Global Water Partnership (GWP)
Dr Saleemul Huq	Director	International Centre for Climate Change and Development (ICCCAD)
Ainun Nishat, PhD	Professor Emeritus	Center for Climate Change and Environmental Research (C3ER-Brac University)
Dr. A Atiq Rahman	Executive Director	Bangladesh Center for Advanced Studies (BCAS)
Bangladesh Frozen Foods Export Association (BFFEA)		
Seafood Industry Directory		
American Centre For International Labor Solidarity		

Name of stakeholders	Designation	Organization
Anjuman Samaz Kollayan Shongstha		
BRAC		
BURO Bangladesh		
Chalantika Jubo Society		
Center for Natural Resource Studies		
Community Welfare Foundation		
CARITAS		
Dipte Foundation		
Loving Care for the Oppressed Society		
Jagrata Juba Shangha		
PATHIKRIT		
Satkhira Unnayan Sangstha		
Mr. Raquibul Amin,	Country Representative	IUCN Bangladesh
Mr. Tanjir Hossain	Action Aid Bangladesh	Action Aid Bangladesh
Mr. Enamul Mazid Khan Siddique,	Project Coordinator, Water Governance	Oxfam Bangladesh
Mr. Mohammad Feisal Rahman,	Research Coordinator	International Centre for Climate Change and Development (ICCCAD)
Dr. Mokhlesur Rahman,	Executive Director	Center for Natural Resource Studies (CNRS)
Dr. Jahangir Alom,	Country Representative	Wildlife Conservation Society
Mr. Jahin Shams Sakkhar,	Programme Development Specialist	Uttaran
Mr. Md. Maksudur Rahman,	Chief Executive, BEDS	Bangladesh Environment and Development Society (BEDS)
Mr. Swapan Kumar Guha	Executive Director	Rupantar
Mr. Mostafa Nuruzzaman	Chief Executive	Shushilan
Mr. KaziWahiduzzaman,	Executive Director	Nabolok
Dr. Md. Anwarul Islam	Chief Executive Officer	WildTeam Bangladesh
Mr. Philip Gain,	Director	Society for Environment and Human Development (SEHD)
Dr. Abdur Rob Mollah,	Chairman	Nature Conservation Management (NACOM)
Mr. Farid Uddin Ahmed	Executive Director	Arannayk Foundation

Name of stakeholders	Designation	Organization
Officiating		Bangladesh Shipping Agent Association
Robert D Simpson FAO	Representative in Bangladesh	Food and Agriculture Organization of the United States (FAO)
Mr Giasuddin Choudhury	Deputy Team Leader (DTL), SIBDP	Support to Implementation of Bangladesh Delta Plan
Zubair K. M. Sadeque	Energy Finance Specialist, South Asia	World Bank, Bangladesh Office
Jyotsana VARMA (Ms)	Principal Country Specialist	Asian Development Bank, Bangladesh Resident Mission
HIRATA Hitoshi	Chief Representative, Bangladesh Office	JICA, Bangladesh Office
Mr. A.M. Khurshedul Alam	Chief Executive Officer (CEO)	North West Power Generation Company Ltd (NWPGL)
Mashuda Parvin	Manager (Environment)	North West Power Generation Company Ltd (NWPGL)
Engg. Md. Salhauddin	Deputy - General Manager (Development)	Sundarban Gas Company Limited
Angan Kanti Das	Member (P& D)	Rural Electrification Board (REB)
Moinuddin Hasan Rashid	Director, Power Division	United Power Plant Ltd.
Industrial Headquarters 1		Bashundhar Group
Director	Director, Petromax, LPG	Petromax, LPG
Prof. Anu Muhammad Anisur Rahman	Professor, Department of Economics, Jahangirnagar University	National Committee to Protect Oil Gas Mineral Resources Power and Ports
Mowdudur Rahman	Director, CCEC	Centre for Coastal Environmental Conservation (CCEC)
Rev. Mark Munshi	Executive Director, CSS	CHRISTIAN SERVICE SOCIETY (CSS)
Mr. Farid Uddin Ahmed		Arannayk Foundation
Dr Mohd. Abdul Quddus	Senior Program Officer	Arannayk Foundation
Mr. Bakuluzzaman		SHUSHILAN
Khondkar Anisur Rahman	Executive Director	PRISM Bangladesh Foundation
Md. Almasur Rahman	District BRAC representative	BRAC Khulna Regional Office
Deb Prosad Sarker	Executive Director	LOCOS
Md. Azadul Kabir Arzoo	Executive Director	Jagorony Chakra Foundation
	Regional Manager, Khulna	NGO Forum For Public Health
	Regional Manager, Jessore	NGO Forum For Public Health
	Regional Manager, Barisal	NGO Forum For Public Health

Name of stakeholders	Designation	Organization
Mr. Rizwan Ahmed	Head of Program	NGO Forum Bangladesh
Zia Choudhury	Country Director	CARE Bangladesh
Rubaiyat Mansur Mowgli	Country Representative, Principal Researcher	Wildlife Conservation Society
Prosanta Kumar Biswas	Executive Director	Socio Economic Development Organization for the Poor (SEDOP)
Mohammad Akmal Shareef	Country Director	Mohammad Akmal Shareef, Country Director
Khursid Alam, Ph.D,	Executive Director	Community Development Centre (CODEC)
Momotaz Khatun	Executive Director	ASHROY FOUNDATION
Mazharul Isla	Program Coordinator, Medical waste management	Prism Bangladesh
Dr. Rubana Huq	President	Bangladesh Garment Manufacturers and Exporters Association (BGMEA)
Commodore Mohammad Abdur Razzak (Retd.)	Secretary	Bangladesh Garment Manufacturers and Exporters Association (BGMEA)
Mr. Mohiuddin Ahmed Mahin	Chairman	Bangladesh Finished Leather, Leather goods and Footwear Exporters Association (BFLLEA)
Dr. Samiya Selim	Director	Center for Sustainable Development (CSD), ULAB
Dr. Hamidul Huq	Professor, Faculty of Economics	United International University

Appendix 3: List of Objectives in Bangladesh Policies, Plans and Programmes

(Derived from analysis of PPP objectives)

Environmental Issues	Objectives	Source PPP
<i>Pollution and waste (solid and liquid):</i> • Surface waters. Brackish and sea water • Groundwater • Air • Oil • Waste disposal • Plastics	• To control pollution • To ensure pollution management • To improve quality of life of consumers by reducing indoor air pollution (particulate matter, carbon monoxide) • To reduce the worst environmental effects of transport; • To reduce air and water pollution • To ensure protection of Sundarbans from pollution oil spills • To prevent waste disposal into the sea; • To eliminate waste disposal on open dumps, rivers, flood plains by 2015 and to promote waste recycling	034 084 021 028 048 002 036 076
<i>Water flow dynamics in rivers</i>		
<i>Water management</i>	• To conserve land and water resources • To address issues related to the harnessing and development of surface and ground water and its efficient and equitable management • To ensure water availability to all including the poor, underprivileged, particularly women and children; • To improve quality of life through equitable, safe and reliable access to water for production, health, and hygiene • To ensure the provision of clean water in sufficient and timely quantities for multi-purpose uses and preservation of the aquatic and water-dependent eco-systems • To ensure – as a basic human right - safe and sustainable water supply, sanitation and hygiene services for all, leading to better health and well-being; • To protect and preserve human health, water supply and sanitation facilities from the adverse impact of natural and man-made disasters and climate change • To protect, preserve and enhance the urban environment, particularly water bodies	001 010 010 011 011 012 012 023

Environmental Issues	Objectives	Source PPP
Irrigation Groundwater	Improving water management-related infrastructure by engaging both government and non-government sectors, e.g. renovation of water canals, embankments, water controlling regulators;	042
	To improve water management and rejuvenating productivity of degraded lands;	052
	Ensuring long-term water	082
	To enhance water security and efficiency of water usages;	082
	To ensure sustainable and integrated river systems and estuaries management;	082
	To achieve optimal and integrated use of land and water resources;	082
	To ensuring proper and judicious use of existing water resources to maximise water productivity;	051
	To create a balance in surface and ground water for irrigation purposes to ensure efficient water use through sustainable and suitable technology;	051
	To maximise benefits of water use through regional planning for irrigation.	051
	To improve surface water irrigation system;	052
Sedimentation and siltation (fluvial and tidal)		
Dredging and disposal		
Salinity:		
- Groundwater - Soil		
Noise - particularly due to shipping in Sundarbans		
Deforestation	- To arrest deforestation and degradation of forests - To ensure strict sustainable management of state forests	003 003
Habitat fragmentation	To ensure the conservation of natural habitat	035
Environmental & ecosystem degradation	- To maintain environmental and ecological equilibrium in the Bhabadaha area - To restore degraded forests, and wetland ecosystems - To protect the marine ecosystem; - To conserve and preserve wetlands and ecosystems and promote their wise use; - Conservation and preservation of critical ecosystem	009 035 036 082 087

Environmental Issues	Objectives	Source PPP
<i>Loss of biodiversity</i>	• To enhance biodiversity by enrichment of degraded forests and conserving natural forest; • To maintain ecological balance and conserve biodiversity • To improve wildlife management and conservation practices in protected areas and other habitats • To maintain biodiversity • To conserve biodiversity • Equitable sharing of benefits arising out of utilizing the genetic resource). • To ensure biodiversity conservation using community participatory methods; • To halt the loss of threatened species of flora and fauna • To conserve and restore the biodiversity of Bangladesh as an essential component to ensure the wellbeing of the present and future generations and equitable sharing of benefits • Protect, restore, sustain and enhance the biodiversity of Sundarbans and its surrounding	001 005 003 034 035 035 035 035 040 041
<i>Invasive alien species</i>	• To restrict the impacts of IAS	035
<i>Pests</i>	• To enable farmers to grow healthy crops in an increased manner and thereby increase their income on a sustainable basis while improving the environment and community health. • to reduce use of hazardous and toxic chemicals and bio pesticides.	050 050
<i>River bank erosion</i> – due to port expansion and boats		
<i>Climate change</i>	• To create a strong green belt of climate resilient plantations on newly accreted coasts and vacant public lands • To deal with adverse impacts of climate change • To make development resilient to climate change • To promote pro-poor, climate resilient and low carbon development; • To increase the country's resilience to climate change; • To reduce and/or eliminate the risks climate change poses to national development.	003 034 037 038 038 038

Environmental Issues	Objectives	Source PPP
- Sea level rise - Salt water intrusion - Erratic rainfall & distribution - Increased average temperatures - Cyclones & storm surges - Greenhouse gases	- Provide for and implement appropriate climate change mitigation and adaptation options and opportunities - To provide a sustainable development pathway that is resilient to climate change, - To address climate change issues including adaptation, technology transfer, mitigation and development and capacity building in all relevant areas - especially agriculture, industry, energy, transport, utilities, urban housing and shelter; - To reduce the wood biomass harvest and reduce Green House Gases (GHGs) emissions - To encourage adoption of low carbon emission technologies; - To promote Integrated Livestock Manure Management (ILMM) and sustainable production of livestock - including reducing intestinal methane emissions	041 083 084 021 034 048
Infrastructure	To develop climate resilient infrastructure	052
Exceptional floods (with potentially damaging water levels): - Freshwater floods (due to rain) upstream - Tidal - Poor drainage infrastructure		
Land use changes	- To prevent alarming loss of agricultural land, which is needed to increase production to meet the food demand of the growing population; - To prevent wasteful use of acquired land; - To prepare guidelines to ensure the best utilization of land through zoning system according to nature of land in different region of the country;	067 067 067

Environmental Issues	Objectives	Source PPP
	- To acquire the least amount of land for urbanization and development projects or any other purpose and ensure best utilization of land; - To preserve land specially the government khash land to meet the requirements in future for different development activities; - To ensure land use is favourable to ecology; - To make best use of land for poverty alleviation and employment and to reduce trend of increasing landless people. - To achieve optimal and integrated use of land and water resources;	067 067 067 067 082
Use of land and natural resources	- To ensure optimum utilization of land resources and meet increased demand for housing and urban services through public-private and other partnerships; - To ensure sustainable harvesting of resources - Support and improve community-based co-management approaches for activities in and around Sundarbans - To provide a sustainable development pathway entails sustainable use of natural resources - To ensure environmental protection for humans, ecosystems and resources which will support conservation, augmentation and efficient utilization of natural resources; - Sustainable management of natural resources.	023 035 041 083 084 087
Sensitive areas (e.g. baors, protected areas)	To reduce the multiple anthropogenic pressure on Sundarbans mangrove ecosystem	035
Rivers, lakes and other water bodies	Sustainable and environment friendly management of lakes, floodplains, canals, ditches and coastal areas (estuary) with the participation of core fishermen.	008
Soil fertility	- To promote use of sludge (a bi-product of methane production in biogas plants) as a soil conditioner, organic fertilizer, organic pesticide and vermi compost. - To improve soil fertility by combining soil physical, chemical and biological properties	048 043
Water-logging	- To establish fish ghers in a planned way by removing water logging - To prevent and cope with waterlogging and saline condition;	009 036
SOCIAL ISSUES		
Urbanisation	To strengthen the beneficial aspects of urbanization	023

Environmental Issues	Objectives	Source PPP
	- To create a decentralized and participatory process of urban development in which the central government, the local government, the private sector, the civil society and the people all have their roles to play - To provide a sustainable development pathway successfully manages the inevitable urbanization transition. - To ensure affordable urban housing - To ensure management of slums;	023 083 084 084
Access to basic needs and services	- To ensure access to basic services - To ensure the improvement of the socio-economic conditions of the rural people to increase their income and fulfil the basic needs; - To make efforts to fulfil the needs of rural people through proper identification of the problems for socio-economic upliftment of the rural poor and disadvantaged people and producers, especially the small, marginal and the landless farmers;	023 068 068
Livelihoods: - Conflicts between economic sectors - Access to resources (e.g. in Sundarbans) - Salinity - Forest dependency	- To ensure social justice and inclusion by measures designed to increase the security of poor people through their access to varied livelihood opportunities, secure tenure and basic affordable services; - To increase purchasing power and livelihood opportunities of the people. - To make 'positive change in livelihood of ultra poor women with attention to protect further deterioration of living condition'. - Meeting basic needs and opportunity for livelihoods; - To reduce the dependence of forest-dependent communities on forests through creating alternate and riskless sources of income	023 061 080 087 003
Poverty	To alleviate poverty of the fishers	005

Environmental Issues	Objectives	Source PPP
	- To reduce poverty and improve socio-economic condition of fishing community by creating self-employment; - To achieve freedom from hunger and poverty; - To alleviate poverty. - Poverty reduction by environmental conservation and protection. - Poverty alleviation; - To reduce poverty by meeting new challenges arising from the increased rate of rural to urban migration, growing ageing population etc; - To maintain standards of living of the labour force; - Poverty alleviation and sustainable development - Poverty alleviation of the children; - Contributing to poverty reduction through temporary support to poor populations; - Supporting the socio-economic development of the extreme poor. - To eliminate extreme poverty by 2030; - To achieve rapid poverty reduction - To stamp out poverty	009 023 029 034 045 059 065 066 078 081 081 082 083 085
Out-migration		
Health & sanitation	- To promote public health and safety. - To develop capacity to live a healthy life - To assure health, safety and security of all citizens through multifaceted initiatives to reduce crime and violence - Ensure availability of primary health and emergency treatment facilities for all citizens; - Increase and extend easy and equitable access to quality health care facilities for service recipients; - To raise awareness and ensure rights and equity in preventing and mitigating diseases. - To ensure quality healthcare to all citizens by innovative application of ICT; - To provide an affordable and sustainable sanitation and hygiene service to all communities through inter-agency collaboration and community participation	011 023 023 063 063 063 073 075

Environmental Issues	Objectives	Source PPP
	with special attention to the needs of women and girls and those in vulnerable situations;	
	To ensure environmental sustainability through hygiene practice and through end of open defecation	075
	To promote healthy behaviour	080
	Preventing diseases of disaster affected people and children	081
	To ensure safe and adequate water supply and hygienic sanitation	084
	To stamp out disease and poor health, and sub-standard living conditions	085
Occupational health	To ensure occupational health and safety at workplaces;	064
	To raise awareness amongst all employed people engaged in both formal and informal sectors about potential occupational risks and hazards	064
	To develop mechanism to ensure labourers' safety and social security at home and abroad;	065
	To ensure appropriate international work place standards for all labour;	065
	To develop safe and hygienic working environments, ensuring the safety of labourer's lives and assets;	065
Water-borne, respiratory & salinity-related diseases	To promote Integrated Livestock Manure Management (ILMM) and sustainable production of livestock – including reducing threats to public health	048
Diet and food	To provide resilience-based food security through variety of subsistence while ensuring sustainable supply of resources	041
	Achieving healthy and un-adulterated milk and milk products production;	045
	Maintenance of standards of milk and milk products	045
	To promote sustained improvements in income, nutrition, and employment for the landless, small and marginal farmers; and	047
	Integrate multi-sectoral approach to tackle hunger and malnutrition and achieve the Sustainable Development Goals (SDGs).	047
	Mobilise funds and align sectoral and cross-sectoral food and nutrition security (FNS) related programmes.	054

Environmental Issues	Objectives	Source PPP
- Inadequate health facilities and access - Arsenic contamination (of drinking water & irrigated rice)	To ensure uninterrupted, safe and nutritious food supply (especially for women and children);	054
	To increase food availability;	061
	Balanced distribution of food through the country	061
	To increase food consumption	062
	Ensuring food security for poor and destitute people;	080
	Providing food transfers to unemployed people during recession;	081
	Ensuring long-term food security	081
	To ensure food security and eliminate food deficiency by 2021	082
		085
	To ensure liveable environment at home and at the workplace.	023
Safety and hazard management	To ensure quality reproductive health services;	072
	To ensure availability of family planning methods;	072
	Nuclear	
	To achieve and maintain a high level of safety in radioactive waste and spent nuclear fuels management;	025
	To ensure that during all stages of RW and SNF management there are effective defences against potential hazards such that individuals, society and the environment are protected from harmful effects of ionizing radiation, now and in the future;	025
	To ensure safety, security and safeguards of the RW management facilities during operation and after closure;	025
	To ensure safety, security and safeguards of the SNF interim storage facility during operation;	025
	To ensure all RW and SNF are managed in safe, secure, sustainable and cost effective manner;	025
	To ensure safe management of DSRS and NORM when applicable;	025

Environmental Issues	Objectives	Source PPP
Transport	- To improve safety and reduce accident rate; - To provide a safe and dependable transport service; - To create awareness regarding better standard of life and safety; - To improve road safety and reduce road accidents; - To provide environmental and social protection - To ensure safety of water transport;	028 029 029 030 030 032
Extreme weather and natural disasters	- To increase their resistance to extreme weather events – by strengthening and maintenance of existing buildings such as hospitals, medical centres and houses in the coastal and digester-prone areas; - Strengthen forecasting system for natural disasters (e.g. floods, cyclones) in disaster prone areas. - To save lives, protect investments, and achieve effective recovery and rebuilding. - To incorporate disaster management aspects in plan and programmes of sectoral ministries and agencies to ensure they are risk-informed; - To ensure inclusion of disability, class, ethnicity, religious minority and to address gender in all plans and programmes - To align emerging disaster risks (earthquake) and emphasize urban disaster risks (fire, building collapse); - To effectively reduce vulnerability to natural disasters and build resilience to climate change and other delta challenges through robust, adaptive and integrated strategies, and equitable water governance. - To ensure safety from floods and climate change-related disasters; - To provide a sustainable development pathway that is resilient to disaster - To develop an effective disaster management strategy to tackle the challenges associated with disasters; - Reduction of vulnerabilities to natural disaster;	036 044 057 057 057 057 082 082 083 085 087
Gender-related issues and children	To involve all sectors of the community, including women and the poor, in participatory decision-making and implementation processes;	023

Environmental Issues	Objectives	Source PPP
	• To eliminate gender discrimination in the work place; • To eliminate all types of child labour; • To ensure gender equity and women's empowerment; • To establish equal rights of men and women in areas of state and public life in the light of the constitution of Bangladesh; • To ensure security and safety of women in all areas of state, social and family life; • To ensure the socio-economic, political, administrative and legal empowerment (of women); • To establish human rights of women; • To ensure full and equal participation of women in the mainstream socio-economic development; • To bring up women as educated and skilled human resources; • To deliver the women from the curse of poverty; • To remove existing male-female disparities. • Ensuring child rights in the light of the Constitution of Bangladesh, Child Act and International Charters/ Conventions; • Elimination of all forms of child abuse and discrimination; • Elimination of all forms of abuse of and discrimination to female children; • Participation of children and taking their views into consideration with regards to their in overall protection and best interests. • To engage more communities and institutions in initiatives to promote social cohesion and prevent conflict, violent extremism, and gender discrimination. • To increase women's meaningful participation in maintaining peace and security, including peace building and conflict resolution processes, peacekeeping missions, disaster management and response, humanitarian assistance, and the prevention of violent extremism. • To protect women's safety and well-being and to ensure that their needs, priorities and rights are addressed in the emergency situations of natural disasters and humanitarian crises. • To promote women empowerment.	065 065 072 077 077 077 077 077 077 077 077 077 077 077 078 078 078 078 079 079 079 080

Environmental Issues	Objectives	Source PPP
	- To ensure good governance, with effective participation and women's empowerment. - Women's development and gender equity	084 087
Education and skills	- To ensure access to education - To stimulate the intellectual and practical qualities of the learners so that moral, human, cultural, scientific and social values are established at personal and national levels; - To remove socio-economic discrimination irrespective of race, religion and creed and to eradicate gender disparity; to develop non-communalism, friendliness, global fraternity, fellow-feeling and respect for human rights - To ensure the marginal competencies of learners at each level so that they are discouraged from rote learning, rather use their own thoughtfulness, imagination and urge for curiosity; - To ensure skills of high standard at different areas and levels of education so that learners can successfully compete at the global context; - To put special emphasis on the extension of education, giving priority to primary and secondary education; - To motivate the students to show dignity of labour; - To enable students to acquire skills in vocational education to facilitate self-employment, irrespective of levels of education; - To extend the use of information and communication technology (ICT) instrumental in educational process at every level - To develop a sound and technically oriented, skilled labour force. - To expand the reach and quality of education to all parts of the country using ICT, ensure computer literacy at all levels of education and public service, and facilitate innovation, creation of intellectual property and adoption of ICT through appropriate research and development - To raise awareness of the values of biodiversity - Make community leaders and media personal aware of biodiversity conservation through conducting training	023 060 060 060 060 060 060 060 060 065 073 035 035
Low environmental awareness		

Environmental Issues	Objectives	Source PPP
- High male dropout - Agricultural skills - Energy	- To promote education and awareness-raising and increase skills and knowledge about organic agriculture, and harness/strengthen indigenous knowledge; - To promote generation and adoption of new knowledge and science on products, mechanical devices and improved systems of livestock manure management	042 048
Loss of traditional knowledge		
Loss of cultural heritage	- To protect, preserve and enhance the historical and cultural heritage of cities and enhance their aesthetic beauty - To identify, protect, preserve and present the cultural traditions and heritage of the people; - To uphold national culture, tradition, religion and belief of all communities in Bangladesh regardless of caste, class, religion, origin etc.; - To protect and prevent the weakening of national culture and heritage due to the influence of other cultures as a result of globalisation; or in other word to meet the wave of globalization and conceive positive elements and resist negative effects; - To build coordination between cultural affairs and economic activities; - To protect and preserve ethnic culture, tradition and heritage; - To promote cooperation among all communities.	023 055 055 055 055 055 055
Security – kidnapping of fishermen		
Seasonal tourism		
Illegal activities:		
Poaching and hunting	To prevent illegal occupants and activities in forests through the participation of local people;	001
- Logging - Poison fishing - Illegal tree cutting - Trafficking of wildlife products - Corruption - Illegal occupancy	To enhance navigability by rescuing Khal/river/land from illegal occupancy	009

Environmental Issues	Objectives	Source PPP
<i>Rights</i>	• Preservation of land rights, ownership and interests of the small and marginal land holders • To ascertain socio-economic rights of grass roots people engaged in shrimp production • To empower every citizen to participate fully in, and benefit from, the development process • To ensure the rights of citizens, quality health and sanitation services, minimum shelters for all including access to services and utilities, quality education, creating social safety net, women's advancement and rights; • Community empowerment	004 004 083 084 087
INSTITUTIONAL ISSUES		
<i>Institutional and regulatory issues</i>	• To strengthen forestry sector institutions to enable them to deliver in accordance to emerging needs of society • To ensure that staff capacity, technical skills and knowledge (re fisheries) are retained in key core areas • To strengthen necessary infrastructure, technical and administrative management of the (shrimp) sector in order to increase shrimp production, alleviate poverty and increase export earnings • To accelerate the development of sustainable public and private water delivery systems with appropriate legal and financial measures and incentives, including water rights and water pricing • To bring institutional changes that will help decentralise the management of water resources and enhance the role of women in water management • To develop a legal and regulatory environment for decentralisation, sound environmental management, and improved investment for the private sector; • Improvement of human resources and mechanisms related to the stable supply of energy • To ensure regionally balanced urbanization through decentralized development and hierarchically structured urban system	003 006 007 010 010 010 013 023

Environmental Issues	Objectives	Source PPP
	- To devolve authority at the local urban level and strengthen local governments through appropriate powers, resources and capabilities so that these can take effective responsibility for a wide range of planning, infrastructure provision, service delivery and regulatory functions; - To remove unnecessary control and formulation of laws and regulations conducive to providing (transport) service; - To determine the roles of the government and private sectors; - Adopting Public Private Partnership in improving environmental quality; - To promote risk governance in DM programmes, including compliance, oversight and accountability; - To illustrate to ministries, NGOs, civil society and the private sector how their work can contribute to the achievements of the strategic goals and government vision for DM. - To strengthen institutional capacity for developing modern, time appropriate, people centred and functional working force; - To create enable environment for institutional arrangements, legal instruments and human resources to work and able to rapidly increase and sustain sanitation services. - To develop effective institutions and equitable governance for in-country and trans-boundary Water Resources Management;	023 029 029 034 057 057 065 075 082
Good governance	- To ensure good governance by enhancing transparency and establishing accountability - To develop the local government systems including enhancing capacity and effectiveness of Union Parishads (smallest administrative unit in rural areas) to create a congenial atmosphere for formulating and implementing local level plans - To ensure good governance, with effective participation and women's empowerment. - To strengthen transparency and accountability of all government institutions as an integral part of a program of social change to curb corruption	023 068 084 085

Environmental Issues	Objectives	Source PPP
ECONOMIC ISSUES		
<i>Employment and income generation</i>	- To develop a strong foundation of structural transformation focused on securing employment. - Rural employment generation - Income generation for rural poor people - Play a role in inclusive growth by means of generating quality and income generating employments through industrialization - To create skilled and active manpower for overall socio-economic development of the society and ensure suitable employment opportunities according to their skills; - To create a skilled manpower base to meet international standards and strengthen management systems to serve both national and international requirements; - To establish good working environment in both formal and informal sectors following international labour standards; - To ensure employment opportunities and a discrimination-free working environment for small ethnic groups, disabled, physically challenged and backward people of the society; - To increase income generation activities - To achieve employment generation - To design social protection programmes that create assets and employment opportunities;	059 062 062 024 065 065 065 065 080 083 085
<i>Infrastructure</i>	To ensure the development of physical infrastructure, balanced distribution of resources among people and marketing of the products	068
<i>Industrialisation:</i>	- Achieve economic growth through industrialization by the combined effort of public and private investment, and improving socio-economic condition of people through generating large scale employment; - Increase the contribution of industrial sector from 29% to 35%, and the contribution of manpower 18% to 25%, aiming to achieve the government's Vision-2021; - To develop an integrated and developed energy sector with a diversified fuel mix that will be the key driver of a sustainable local and national economy, while attaining global competitiveness in all sectors by 2021;	024 024 085

Environmental Issues	Objectives	Source PPP
- Power generation – oil, gas, coal - Renewable energy	- Enhancement of imported energy infrastructure and its flexible operation; - Efficient development and utilization of domestic natural resources (gas and coal); - Domestic renewable energy power generation (cumulative): 2,470MW (by 2021), and 3,864MW (by 2041) - Construction of a robust, high-quality power network; - Domestic biogas production: 790,000m³/day (including additional 600,000m³/day by 2031, 3 million m³/day by 2041) - Cross-border Energy Imports: 3,500~8,500MW (by 2031), 9,000MW (by 2041) - To achieve energy security for the country through the supply of sustainable energy services for all at affordable prices, and exploitation of mineral resources in an environmentally sustainable manner. - To provide direction for domestic natural gas production, infrastructure development, and import facilities and distribution of natural gas 100% of new coal-based power plants use super-critical technology; 400 MW of wind generating capacity; 1000 MW of utility-scale solar power plant - National level: Small power plants in private sector. - The SPPs will be developed on a Build-Own-Operate basis. The plant size could be 10 MW or higher size plant. - Sector Outcome 1: Reliable, affordable, and efficient energy supply achieved and sustained; - Sector Outcome 2: Reliable, affordable, efficient, and quality power supply achieved and sustained; and - Sector Outcome 3: Well-articulated Demand Side Management (DSM) policy adopted and implemented.	013 013 013 013 013 013 013 017 018 018 018 019 019 020 020
	- Harness the potential of renewable energy resources and dissemination of renewable energy technologies in rural, peri-urban and urban areas - Enable, encourage and facilitate both public and private sector investment in renewable energy projects - Develop sustainable energy supplies to substitute indigenous non-renewable energy supplies;	020 015 015

Environmental Issues	Objectives	Source PPP
- Bio-energy - Energy efficiency - Clean energy - Pipelines - Petroleum - Cement - Special economic zones	Scale up contributions of renewable energy to electricity production and to heat energy;	015
	Promote appropriate, efficient and environment friendly use of renewable energy;	015
	Facilitate the use of renewable energy at every level of energy usage.	015
	Create enabling environment and legal support to encourage the use of renewable energy and Promote clean energy for CDM;	015
	Achieve the targets for developing renewable energy resources to meet five percent of the total power demand by 2015 and ten percent by 2020.	015
	To encourage use of renewable energy for irrigation;	051
	To diversify and upgrade new energy and biological products through improved management of livestock manure, help generate socio-economic benefits of livestock farming and enrich soil fertility;	048
	To capture energy efficiency of production in factories, buildings and nationwide economic activities, which can reduce the unit energy consumption per production, floor areas and GDP, respectively.	016
	Promote Clean Cooking System in the country with several objectives:	021
	To save energy,	021
Fisheries and shrimp production	- To achieve self-sufficiency in shrimp production - To ensure competitive price of shrimp in the international market. - To increase shrimp production at expected level by keeping harmony with socio-economy, environment, geomorphology, climate change and supply system; and inventing a sustainable and environment friendly technology of shrimp culture and application of the same - To improve productivity of brackish water shrimp and capture fisheries; - To enhance production of freshwater shrimp and fish - To enhance fisheries production - To achieve economic growth through exporting fish and fisheries products	004 004 009 052 007 005 005

Environmental Issues	Objectives	Source PPP
	To sustainably manage fisheries and fishing habitat for inland and marine ecosystem	036
Forestry	To create employment opportunities	001, 002, 003
Agriculture	- To promote agribusiness development through value addition activities - To develop each rural household as a sustainable an agro-based income generating unit through optimum utilization of human and economic resources (labour, land, water etc.); through e-financial inclusion i.e. fund mobilization followed by family farming livelihood and income generation of the under privileged smallholders of the country. - To enhance agricultural production and attain self-sufficiency in food production by 2021;	052 066 085
<i>Crops and fruit farming</i>	- To increase agricultural productivity; - Promoting a selection of region-specific crops (e.g. water melon, sweet potato, wheat, ground nut, sunflower, etc) and cropping intensity) - Increasing vegetable and fruit cultivation at homestead level; - Increasing cultivation of cash crops, e.g. wheat, Aus (the second rice crop sown March/April); - To identify the regions, places and crops suitable for organic agriculture. - To explore potential new national and international markets for organic agricultural products - Promoting adoption of new agricultural technology to suit a changing climate - To ensure prosperous agriculture and engage the non-government sector in seed development. - To ensure availability of improved crop varieties suitable for high-input and high output agriculture, - To facilitate balanced development of public and private sector seed enterprises Increase public private participation in agricultural extension, with provision of incentives to follow existing rules and regulations (e.g. by providing quality seed,	052 042 042 042 043 043 044 053 053 053

Environmental Issues	Objectives	Source PPP
Agricultural extension	fertilizers, importation of agricultural machinery, improved distribution and marketing);	
	• Prioritise the dairy industry as animal agriculture on a par with crop agriculture;	045
	• Improving grass production to support milk production;	045
	• Improved weather forecasting to improve the dairy sector;	045
Dairy farming	• Expanded research, extension and development of human resources;	045
	• To become self-reliant to satisfy the national demand of milk, meat and egg for fast growing populace through increased productivity thereby accelerating economic growth, employment and income generation and reducing poverty	046
	• To promote sustainable improvements in productivity of milk, meat and egg production including processing and value addition;	047
	• To promote smallholder dairy development	052
	• To facilitate increased private sector participation and investments in livestock production, livestock services, market development and export of livestock products and by-products.	047
	• To improve poultry products, especially eggs and meat, to meet protein demand of the country'	046
	• To help to create new entrepreneurs, build more job opportunities, improve waste the management system and develop efficient human resources for poultry development.	049
Livestock production	• To prioritise the production, development, extension, quality control export and import of poultry products.	049
Poultry farming	• To promote smallholder poultry development	049
		052
Economic growth	• Achieve high economic growth rates with an average annual growth rate of 7.4% until 2025 and introducing energy-saving measures. To facilitate economic development, employment generation, reduction of inequality and poverty eradication through appropriate regulatory frameworks and infrastructure provisions;	013
	• To encourage sustainable consumption and production	023

Environmental Issues	Objectives	Source PPP
	- To secure a smooth transition to higher middle country status by 2021 and developed country status by 2041, e.g.: by improving the level of savings, investment, and revenue collection lags; - To develop a strong foundation of structural transformation focused on raising productivity - Ensuring economic growth - To achieve upper middle income status by 2030; - To become a prosperous country beyond 2041. - To achieve GDP growth acceleration - To ensure accelerated growth without compromising environmental sustainability and social equity; - To transform Bangladesh into a middle income country by 2021; - Economic growth;	035 059 059 082 082 082 083 084 085 087
Tourism	- To control ecotourism within the carrying capacity of forests - To establish the tourism industry as a developing and sustainable sector, contributing to the national economy, generating employment; promoting socio-economic development (by involving local people with local government organizations), and maintain ecological balance and protect biodiversity - To ensure tourism generates employment and contributes to poverty alleviation; - To enable tourism to earn foreign currency; - To develop and maintain eco-tourism tourism - Provide enhanced eco-tourism facilities and visitor recreation opportunities	002 022 022 022 022 041
Textiles, Leather & Garments	- To establish a flourishing, safe and environment-friendly textiles and garment sector - To increase productivity, employment opportunities and investment in the sector; - To strengthen the primary textile sector to fulfil local demand for textiles and to promote a medium and high value added export oriented garments industry; - Increase production of leather and leather products using advanced and environment friendly technology	026 026 026 027
- Textiles - Leather		

Environmental Issues	Objectives	Source PPP
Garments	Ensure advance infrastructure development for effective and efficient industrialization;	027
	Earn 5 billion US Dollar from exporting leather, footwear and leather products by 2024;	027
	Increase the contribution of the leather sector to GDP (from current 0.5% to 1.0% by 2024);	027
	Ensure of suitable environment to make national & internationally accepted products to be a strong competitor	027
Transport	To reduce cost of transporting goods and thus costs to public;	028
	To aid export competitiveness, through lower transport costs;	028
	To take advantages of Bangladesh's geographical position to trade through an efficient transport sector;	028
	To ensure that transport meets social needs in terms of cost accessibility to all sectors of society.	028
	To maintain an economic and environmental balance;	029
	To expand the role of transport in the ever increasing economic activities;	029
	To reduce the transport cost of goods for export;	029
	To ensure growth of traffic commensurate with economic development;	029
	To introduce an integrated transport system;	029
	To provide alternate transport systems;	029
	To protect the value of RHD's road and bridge assets;	030
	To improve the connectivity of the road network;	030
	To enhance and develop the strategic road network to meet economic and traffic growth targets;	030
	To improve the <i>Zila</i> (District) Road network to enhance connectivity to the country's growth centres;	085
	To develop well-planned urbanization as well as multi-modal transport, integration of roads and highways;	085
	To develop an efficient, sustainable, safe and regionally balanced transportation system in which various modes complement each other, interface appropriately	032

Environmental Issues	Objectives	Source PPP
- Railways - Water transport and shipping	To allow the railways to play a greater role in the overall transport sector with a view to contributing to economic and social development;	031
	To prepare the railways for playing a transport role in regional and international context;	031
	To integrate railway network through a multi-modal approach;	031
	To increase railway efficiency with interventions to make best use of assets;	031
	To obtain a greater share of the freight market, with more efficient management of railway assets and improved financial efficiency (all NLTP goals).	032
	To improve navigability of waterways;	
	To facilitate both national and international passenger movement	032
	To develop a balanced and integrated transport network through adoption of strategies/programmes;	033
	Integrating inland water transport sub-sector with the existing road transport system	033
Disasters	Promotes risk informed planning and implementation of investment initiatives for business continuity in disasters	057
	To explore investment areas in public and private sectors, and in hazard prone regions, communities	057
Exports	To infuse dynamism into export operations and enhance; competitiveness in trade and commerce and thus strengthen the position of Bangladesh in the competitive world;	058
	To achieve exports of \$60 billion by 2021, \$50 billion from ready-made garments (RMG);	058
	To ensure product and market diversification with a view to achieve MIC status by 2021;	058
	To ensure compliance and best-practices to enhance exports;	058
	To assist exporters in different forms;	058
	To promote Bangladeshi goods worldwide;	058
	To attract FDI in export sector for high-value products;	058
Markets	Ensuring stability of market price of basic food items;	081

Appendix 4: List of issues raised by stakeholders during April-May 2020

Organisation/ independent individual	Name of Stakeholder	Comment/feedback/suggestions on key issues or SEA process/other matters				Action/response by SEA team
		Environment	Social	Economic	SEA process/other matter	
	Junaid K. Choudhury				- Assess individual projects - Do new research on particular issues - Need forestry/fisheries experts	- Not the role of SEA - SEA can only use existing published information - Already in team. Also engaging outside experts
		Deforestation & forest degradation. Soil and water		Polder construction, prawn farming		Already included, or addressed in theme papers
Univ Dhaka	Anwarul Islam				Consult public & stakeholders fully on wide range of issues	This is the aim
Sustainable Forests & Livelihoods Project	Ishtiak Ahmed	- Need narrative of current environmental setting - Geomorphological and hydrological factors - Water pollution - Mangrove loss - Monitoring ecological changes - Ecosystem services - Fish & wildlife			- Need 'authority to enforce SEMP - Community-based management & monitoring	- Will make recommendations for coordinating SEMP - Captured in baseline theme papers - Included - Included - Included - Addressed in SEMP - Included - Addressed in SEMP
Khulna University	Prof Salma Begum	Erratic rainfall & distribution may be replaced by changing ecosystem issues			Suggested structural changes to issues table	- Not necessary - Not accepted
Independent consultant	Dr Haseeb Irfanula				Comments on prospectus contents: - Definition of SW region; - Emergence, role & steps of SEA; - Timescale of SEA and issues; - Types of impact;	Points already addressed or to be covered in theme papers, scoping report or SEA report

Appendix 4: List of issues raised by stakeholders during April-May 2020

Organisation/ independent individual	Name of Stakeholder	Comment/feedback/suggestions on key issues or SEA process/other matters				Action/response by SEA team
		Environment	Social	Economic	SEA process/other matter	
					• Inter-linkages; • Soil pollution; • Rivers & other water resources; • Issues linked to climate change; • Expert review of reports;	
Jahangirnagar University	Prog M.A. Aziz	• Transboundary dialogue with India on water flow • Sea-face erosion due to increasing intensity of storms and tidal surges • Degradation of forest in and around the Dubla fishing village • Acid rain due to industrialisation • Melting of Himalayan glaciers – affect on freshwater flow	• Illegal livestock grazing on the north-eastern fringes of the Sundarbans – affecting habitat quality, & creating human-tiger conflicts			• Will be addressed in theme papers • Will be addressed in Delta morphology theme paper • Will be addressed in theme paper • Will be addressed in appropriate theme papers • Will be addressed in theme papers • Will be addressed in Sundarbans theme paper
Khulna University	Prof Prosun Kumar Ghosh				• Comments on order of Table 2 of Prospectus. Suggests to order according to issues related to : [physical & biological environment, pollution & climate change.	• Noted
Khulna University	Prof Sharif Hasan Limon	• Agrochemical pollution • IAS – blastwater management	• Salt tolerant agroforestry development for AIG • Medical facilities on the waterways/mobile			• Noted • Noted • Noted • Noted

Appendix 4: List of issues raised by stakeholders during April-May 2020

Organisation/ independent individual	Name of Stakeholder	Comment/feedback/suggestions on key issues or SEA process/other matters				Action/response by SEA team
		Environment	Social	Economic	SEA process/other matter	
CNRS	Sorwar Hossain	6 dolphin sanctuaries = hotspots - Protection of regeneration mangrove sapling - Intrusion of saline water into cropland	- Illegal fry harvesting: shrimp, crab, fish, position fishing - Lack of drinking/fresh water in Sundarbans			- Noted - Noted - Noted - Noted - Noted
Socio Economic Development Organisation for the Poor SEDOP	Prosanta Kumar Biswas				Agrees with list of key issues	Noted
IUCN India	??	- Major developments in Ganges basin in India – effect on sediment - Hydropower dams in Nepal may affect river flow & sediment		Push for inland navigation in West Bengal, India		- Noted - Noted – will look at transboundary issues - Ditto
IUCN Asia Region (Bangkok office)	Andrew White	- Underwater acoustic noise pollution from increased boats affects dolphins - Light pollution from Mongla port - Mangroves sensitive to reduced water flows				- Will provide paper in Nature journal - Noted - Noted
Bangladesh Environment and Development Society	Md Maksudur Rahman				- Address transboundary issues - Build bridge between Govt & NGOs - Consider SDGs	- Included (working with IUCN) - SEA will be multi-stakeholder - Included in setting assessment objectives
International Centre for Climate Change & Development	Asharaful Siddique				What kind of impacts will be addressed – quantitative or qualitative	Mainly qualitative. Maybe some quantitative for water/surface water pollution.

Appendix 4: List of issues raised by stakeholders during April-May 2020

Organisation/ independent individual	Name of Stakeholder	Comment/feedback/suggestions on key issues or SEA process/other matters				Action/response by SEA team
		Environment	Social	Economic	SEA process/other matter	
OXFAM	Enam		Need to engage women		Need local language materials	- Prospectus will be in Bengali - Will organise womens' meetings
Wildlife Conservation Society	Dr Jahangir Alom	Wildlife is important (terrestrial & aquatic)				Covered in PPPs screened and baseline theme papers
IUCN	Dipu	- Wildlife issue important in 9 key sectors - Include big wildlife projects (e.g. for dolphins)	Address livelihoods		Share reports	- Wildlife addressed, All sectors/issues addressed – not just 9 in original TOR - Noted. But SEA not focused on projects - Already covered - Agreed
Dhaka University	??			Marine area/blue economy is import		Covered
CNRS	Mokhles	- Ramsar site not mention in prospectus - Indicate dolphin sanctuary on maps - Prolonged drought critical in Sundarbans - Transboundary issues (migratory birds, fish, turtles)	- Consider water-food-biodiversity links/nexus - Co-management Committees as stakeholders - Address tribal issues - Fishing ban & restrictions in protected areas in Sundarbans affects livelihoods		Clarify which ministry responsible for SEA	All noted and will be addressed

Appendix 5: The SEA team

1. About CEGIS

The Centre for Environmental and Geographic Information Services (CEGIS) was established in 2002 as a national institution and a public Trust. It functions as a self earning, not for profit Trust under the aegis of the Ministry of Water Resources with a 15-member Board of Trustees.

CEGIS is the only scientifically independent organization in Bangladesh for integrated environmental analysis using GIS, Remote Sensing (RS), IT and databases. It provides solutions to issues and problems regarding water resources, land resources, agriculture, fisheries, engineering, transportation and environment, etc., and recommends technical options based on local realities that are feasible from the socio-economic and institutional point of view.

CEGIS is a multidisciplinary group of highly qualified scientists and technical professionals. 130 of the 200 staff are professional experts in different disciplines including:

- forms of integrated environmental and social analysis and assessment, baseline studies and monitoring studies;
- preparation of environmental guidelines and resettlement action plans;
- analytical framework for planning for integrated water resources management (IWRM);
- spatial analysis using GIS and RS for flood monitoring, drought assessment and monitoring, river plan-form changes, river erosion and accretion prediction, flood damage assessment;
- development of Digital Elevation Model (DEM),
- land-use planning, urban planning;
- database management and IT, and development of web based spatial database, MIS and decision support systems (DSS) for planning, designing, implementation and monitoring of water sector projects, etc.

<https://www.cegisbd.com/>

2. About Integra Consulting

Integra Consulting is based in Prague, Czech Republic. It has been providing expertise in strategic environmental assessment (SEA), environmental impact assessment (EIA), sustainable development, climate change adaptation and eco-innovations since 2006. By operating in many regions and countries (from Western Europe to South-East Asia), Integra's projects cover a large diversity of actions from policy advisory and strategic planning to field implementation including inventories.

<https://www.integracons.com/>

3. The team

The individual experts in the team are listed in Table A5.1.

Table A5.1: Team members

Name	Expertise/Responsibility	Organization
Prof. Barry Dalal-Clayton, PhD	Team Leader	Integra
Zahir Uddin Ahmed	Deputy Team Leader	CEGIS
Dr Jean-Roger Mercier*	Environmental assessment	Integra
Dr Vladislav Bizek	Environmental modelling	Integra
Dr Manimul Haque Sarker	River morphology	CEGIS
Mir Sajjad Hossain	Transboundary water management	CEGIS
Motaleb Hossain Sarker	Tourism	CEGIS
Dr Mahmood Hossain	Mangrove ecology	CEGIS
Dr Dilruba Ahmed	Gender and stakeholder participation	CEGIS
Md. Shahidul Islam	Remote sensing	CEGIS
Dr Mohammad Zashim Uddin	Plant taxonomy	CEGIS
Jalal Ahmed Choudhury	Power and energy	CEGIS
Dr Kazi Md. Noor Newaz	Ecology and biodiversity; and legal and regulatory review	CEGIS
Dr Chowdhury Saleh Ahmed	Policy and institutional affairs	CEGIS
Dr Moinul Hossain	Land transportation	CEGIS
Md. Tariqul Islam	Forest management	CEGIS
Apurba Kumar Sarker	Economic policy planning and investment	CEGIS
Capt. Md. Sayedul Hoque Khan	Water navigation	CEGIS
Mohammad Abdur Rashid	Agriculture and land use	CEGIS
Kazi Kamrull Hassan	Environmental planning	CEGIS
Dr Farhana Ahmed	Transportation and infrastructure planning, and scenario development	CEGIS
Mohammed Mukteruzzaman	Fisheries	CEGIS
Sarazina Mumu	Urban development	CEGIS
Md. Firoz Alam	GIS data analysis and mapping	CEGIS
Sudipta Kumar Hore	River morphology	CEGIS
Laila Sanjida	Tourism	CEGIS
H. M. Nurul Islam	Water quality and pollution	CEGIS
Mushfiq Ahmed	Biodiversity and wildlife	CEGIS
Dr Md Shibly Sadik	Environment and disaster management	CEGIS
Md Shifuddin Mahmud	Livelihoods	CEGIS
Tanvir Ahmed	Flood modelling	CEGIS
Bhuiya Md Tarmin Al Hossain	Climate change modelling	CEGIS
Kushal Roy	Climate change	CEGIS
Pronab Kumar Halder	Industry and power	CEGIS
Md. Monowar-ul Haq	Water resources management	CEGIS
Ahmed Zulfikar Rahaman	Hydrology and climate change	CEGIS
Mohammad Kamruzzaman	Ecology and biodiversity	CEGIS
Abdul Halim Farhad Sikder	Soils and environment	CEGIS
Md. Ashis Mawla	Education	CEGIS
Faisal Ahmed	Security, conflict and power structure	CEGIS
Hifzur Rahman	Public health	CEGIS
Tanvir Ahmad Rifat	Population and demography	CEGIS

Name	Expertise/Responsibility	Organization
Amith Dutta	Ethnicity and culture	CEGIS
Abul Kashem Md Hasan	Website development	CEGIS
Md Anisur Rahman	Website development	CEGIS

* Sadly Dr Mercier passed away on 5th July 2020.

Appendix 6: Thematic baseline papers and responsible teams

Note: task leaders shown in italics

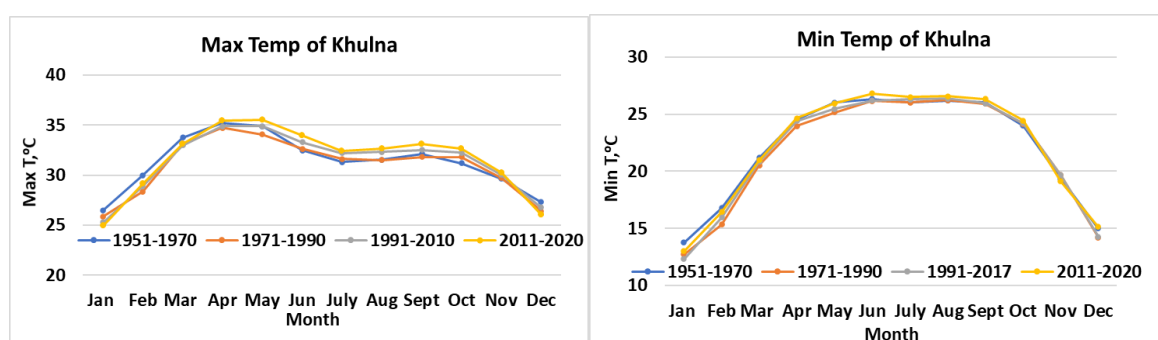
SL	Topics of thematic baseline papers	Responsible Professionals
1.	Climate and climate change	<i>Ahmed Zulfiqar Rahaman</i> Bhuiya Md Tarmim Al Hossain
2.	Pollution and waste	<i>H.M. Nurul Islam</i> Dr Md. Shibly Sadik
3.	Delta morphology, river dynamics, floods and water management	<i>Tanvir Ahmed</i> Sudipta Kumar Hore
4.	Land resources	<i>Md. Monowar-ul Haq</i> Gazi Md. Riasat Amin <i>Mohammad Abdur Rashid</i> Abdul Halim Farhad Sikder
5.	The Sundarbans, other ecosystems and wildlife conservation	<i>Mushfiq Ahmed</i> Dr Mahmood Hossain Md. Amanat Ullah Dr Zashim Md Tariqual Islam
6.	Tourism in SW Region and Sundarbans	<i>Ms Laila Sanjida</i> Motaleb Hossain Sarker
7.	Fisheries, agriculture and other land uses	<i>Md Shahidul Islam</i> Md Nasrat Jahan
8.	Infrastructure	<i>Kazi Kamrull Hassan</i> Dr Farhana Ahmed
9.	Power and energy	<i>Pronab Kumar Halder</i> Jalal Ahmed Choudhury
10.	Urbanization	<i>Sarazina Mumu</i>
11.	Economic and industrial development in SW region	<i>Apurba Kumar Sarker</i> Dr Chowdhury Saleh Ahmed
12.	Social trends and challenges	<i>Muhammad Shifuddin Mahmud</i> and CEGIS Social Team
13.	Institutional governance	<i>Dr Chowdhury Saleh Ahmed</i>

Appendix 7: Analyses of climatic data records

(A) Analyses of temperature records for Bangladesh and the South West Region

Rahaman (2019) analysed long-term data for maximum and minimum temperature recorded at the Bangladesh Meteorological (BMD) station Khulna over the climate normal (WMO, 2017)⁶⁹ period 1971-2000. This study revealed that, in the pre-monsoon, monsoon and post-monsoon seasons, the maximum and minimum temperature of Khulna ranged between 30-35°C and 20-26°C, respectively. During the winter season, the maximum and minimum temperature at Khulna ranges between 25-30°C and 12-16°C, respectively.

CEGIS analysed the 70 years long-term climatic data (1951-2020) for Jessore, Khulna (Figure A7.1) and Satkhira stations to indicate changes in bi-decadal seasonal climate trend over the South West Region. This analysis shows that monsoon season (June-September) maximum temperature has increased almost 0.8°C in Satkhira, 1.2°C in Khulna and 1.4°C in Jessore during 1951-1970. During the post-monsoon season (October-November) the increase was lowest in Satkhira (0.7°C) and highest in Jessore (1.5°C). In comparison, the maximum temperature decreased by 0.3°C in Jessore, 0.8°C in Satkhira and 1.2°C in Khulna in the winter season (December-February) during the same bi-decade. Similarly, gradual warming of the monsoon season is indicated by increases in minimum temperature over the last 70 years – ranging from 0.40C in Khulna to 0.7°C in Satkhira. Pre-monsoon and post-monsoon temperatures have not changed significantly. However, winter season minimum temperature has increased on an average by 0.3°C at the three stations (not significant).



(Source: CEGIS Analysis)

Figure A7.1: Seasonal trend of maximum and minimum temperatures at Khulna

⁶⁹ Climatological normals form a benchmark or reference against which conditions (especially current or recent conditions) can be assessed, and secondly, they are widely used (implicitly or explicitly) as an indicator of the conditions likely to be experienced in a given location. Climatological standard normals produced by the World Meteorological Office (WMO) are averages of climatological data computed for the following consecutive periods of 30 years: 1 January 1981 to 31 December 2010, 1 January 1991 to 31 December 2020, etc. (source: https://www.wmo.int/pages/prog/wcp/wcdmp/GCDS_1.php).

Nishat and Mukherjee (2013) analysed seasonal temperature trends for Bangladesh. Their analysis shows that, over the past few decades, most of Bangladesh experienced warmer winters with a prominent increase in the minimum temperature.

Rahman *et al.* (2016) analysed 40 years (1971-2010) spatio-temporal climate data over Bangladesh (see Figure A7.2) and found an upward trend in annual mean (0.020°C to 0.028°C per year), minimum (up to 0.019°C per year) and maximum temperature (up to 0.015°C per year) over the South West Region.

Mondal *et al.* (2013) investigated the trend in temperature for the Khulna region. They found no trend in annual average minimum temperature in the overall record, but an increase of 0.05°C and 0.1°C per year for the periods 1980-2010 and 1983-2010, respectively. They also indicated an increasing trend (significant at 99% level of confidence) in the diurnal temperature range (the difference between the daily maximum and minimum temperatures) during May to October. However, such trends have become non-significant and decreasing in recent years.

Roy *et al.* (2017) analysed time series temperature data from eight meteorological stations in southwest Bangladesh⁷⁰ for the period 1948-2014 and found that annual mean temperature trend varies spatially. They concluded that the average annual temperature had increased significantly ($p < 0.05$) in the South West Region at a rate of 0.006°C per year between 1948 and 1990, increasing to 0.024 °C per year since 1990.

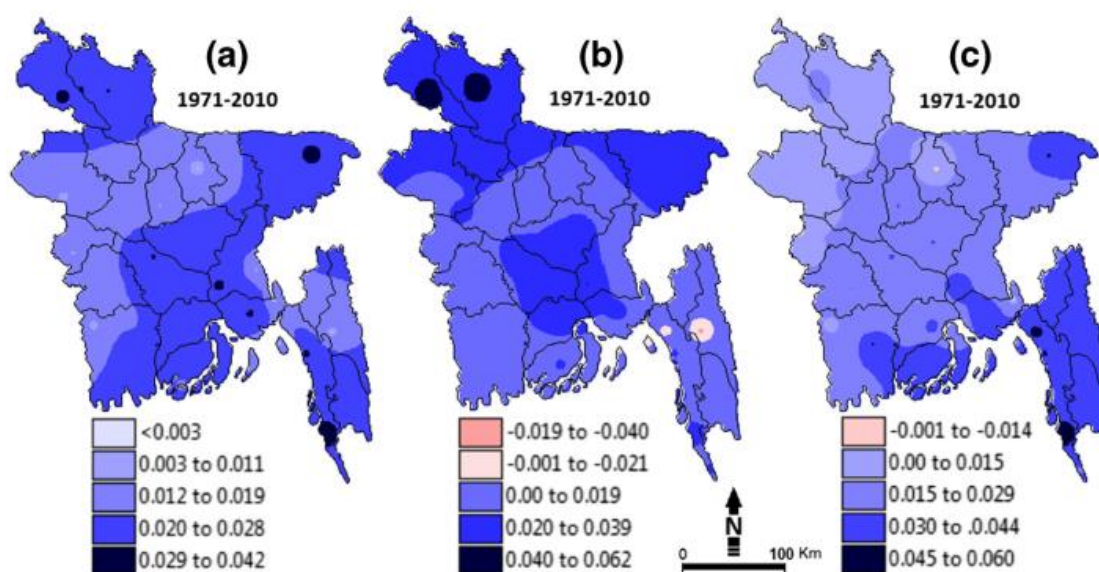


Figure A7.2: Temperature trends (°C per year): a) mean, b) mean minimum and c) mean maximum (reproduced from Rahman *et al.*, 2016)

⁷⁰ Khulna, Jessore, Barisal, Satkhira, Faridpur, Mongla, Patuakhali and Bhola.

Brammer (2014, 2016) analysed daily maximum and minimum temperature data for the period 1959-2008, and found no evidence of changes linked to global warming. He reports (Brammer 2014, page 219) irregular changes in maximum, mean and minimum temperatures at Jessore, Satkhira and Khulna during this period.

(B) Analyses of rainfall records for Bangladesh and the South West Region

Analysis of long-term rainfall records (1951-2020) by CEGIS indicates an increasing trend of annual and seasonal rainfall in the South West Region, except for the post-monsoon season in Khulna where there is an erratic pattern found with both increasing and decreasing trends. By the 1991-2010 bi-decade, average annual rainfall had increased by 135 mm in Khulna and 215 mm in Jessore and Satkhira compared to 1951-1970 (see Figure A7.3). The average decadal increment was 22.5 mm and 36 mm, respectively. Almost 90% of this increase occurred in winter, pre-monsoon and monsoon period.

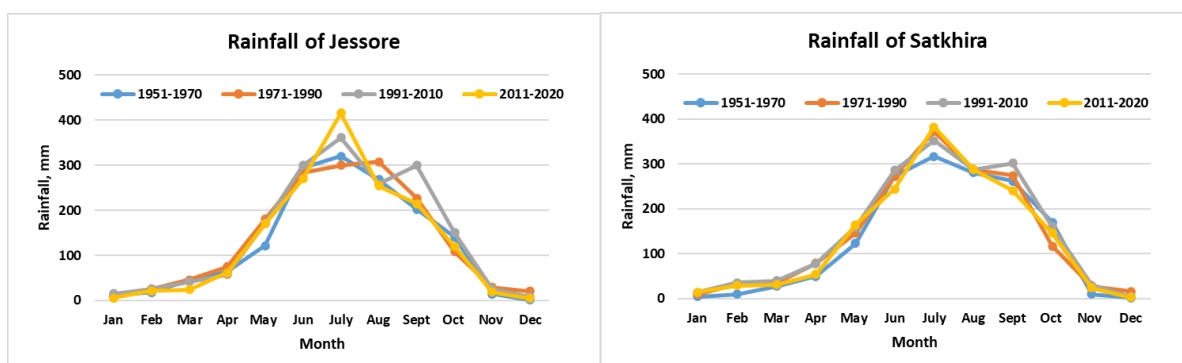


Figure A7.3: Seasonal rainfall trends at Jessore and Satkhira

Apart from this analysis, various authors have analysed time-series data for rainfall and concluded increasing trends of annual total rainfall, but with an irregular trend of seasonal rainfall, especially for the pre-monsoon and post-monsoon:

- Nishat and Mukherjee (2013) observed an overall increase in the mean seasonal rainfall in all seasons. The maximum increase was about 100mm during the pre-monsoon (March-May) and monsoon (June-August). An increase in pre-monsoon seasonal rainfall is also reported by MoEFCC (2018);
- Roy *et al.* (2017) analysed annual rainfall data for the period 1948-2007 all over Bangladesh. They found rainfall increased at a rate of 8.4 mm/year over this period, but the changes were not spatially and temporally homogenous - particularly for the South West Region;
- Mondal *et al.* (2013) analysed rainfall data for 1948-2010 for the Khulna region and determined increases of 8 mm, 31 mm, 9 mm and 6 mm per decade during the winter, monsoon, post-monsoon and pre-monsoon seasons, respectively, although only winter rainfall showed a significant trend ($p < 0.05$);
- Shahid (2010) also found a similar trend for the period 1948-2007 for Khulna. Satkhira and Jessore:

- Khulna: annual increase 7.79mm/year; post monsoon increase 1.80mm/year; and winter increase 0.45mm/year ($p < 0.05$);
- Satkhira: annual increase 6.97mm/year;
- Jessore: annual increase 7.62mm/year, monsoon 4.70mm/year, pre-monsoon 2.76mm/year, all significant at $p < 0.05$;
- In addition, the number of rainy days has been found to be increasing at 0.8 days per year (significant at 99% level of confidence) (Mondal *et al.* (2013).
- Rahman *et al.* (2016) found downward trends in pre-monsoon rainfall (decrease of 2-4 mm/year) and post-monsoon rainfall (decrease of 0-2 mm/year) across the region with remarkable rainfall variability or evidence of erratic rainfall (46%-50% and 83%-88%, respectively, for the pre- and post-monsoon seasons) (Figure A7.4).

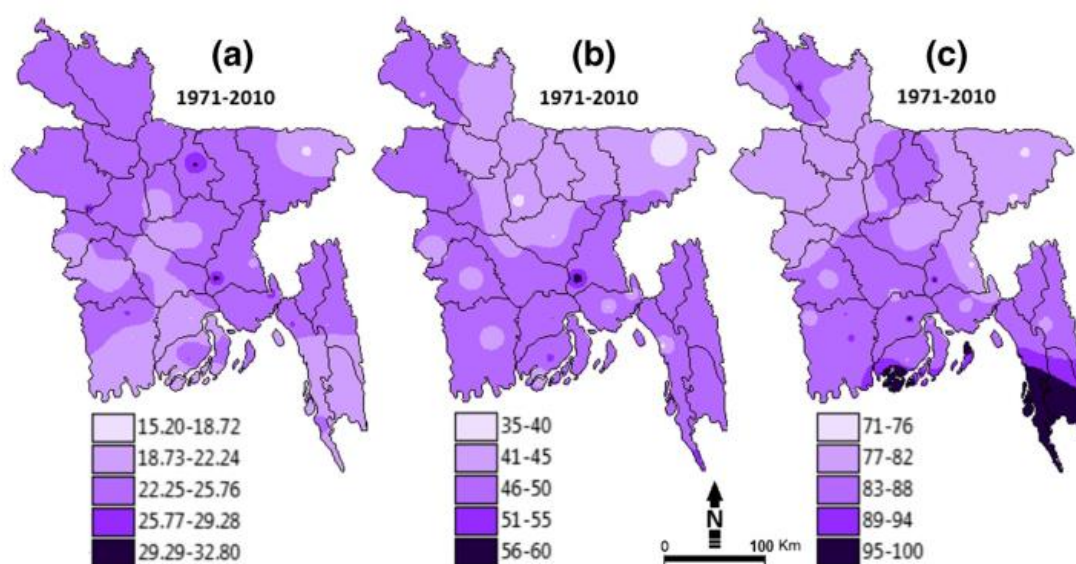


Figure A7.4: Variability of rainfall in Bangladesh (% per year): a) annual, b) pre-monsoon and c) post-monsoon (reproduced from Rahman *et al.*, 2016)