



Government of the People's Republic of Bangladesh

# BANGLADESH CLIMATE CHANGE STRATEGY AND ACTION PLAN 2008

Ministry of Environment and Forests  
Government of the People's Republic of Bangladesh

# **BANGLADESH CLIMATE CHANGE STRATEGY AND ACTION PLAN 2008**

September 2008

**Published by:**

Ministry of Environment and Forests  
Government of the People's Republic of Bangladesh

**Published in:**

September 2008  
Dhaka, Bangladesh

**Citation:**

MoEF, 2008. Bangladesh Climate Change Strategy and Action Plan 2008. Ministry of Environment and Forests, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh. xvi + 68 pp.

**ISBN:**

984-8574-25-5

**Design**

INTENT, [www.intentdesign.net](http://www.intentdesign.net)

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# ABBREVIATIONS AND ACRONYMS

Annex 1 Parties	Industrialised countries identified in UNFCCC as responsible for mitigation
AWG-LCA	Ad Hoc Working Group on Long-term Cooperative Action under UNFCCC
BARI	Bangladesh Agricultural Research Institute
BDRCS	Bangladesh Red Crescent Society
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BIDS	Bangladesh Institute of Development Studies
BRAC	Building Resources Across Community
BRI	Bangladesh Rice Research Institute
BUET	Bangladesh University of Engineering and Technology
CBO	Community Based Organisation
CDM	Clean Development Mechanism
CDMP	Comprehensive Disaster Management Programme
CEGIS	Centre for Environmental and Geographic Information Services
CNRS	Center for Natural Resources Studies
COP	Conference of Parties of UNFCCC
CPP	Cyclone Preparedness Programme
CSR	Corporate Social Responsibility
DEM	Digital Elevation Model
DMB	Disaster Management Bureau
DoE	Department of Environment
DoF	Department of Forests
DPHE	Department of Public Health Engineering
FEJB	Forum of Environmental Journalists of Bangladesh
FFWC	Flood Forecasting and Warning Centre
GBM	Ganges-Brahmaputra-Meghna
GCM	General Circulation Model
GDP	Gross Domestic Product
GHG	Greenhouse gas
GIS	Geographic Information System
ICDDR,B	International Centre for Diarrhoeal Disease Research, Bangladesh
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
IWFM	Institute of Water and Flood Management
IWM	Institute of Water Modelling

LDC	Least Developed Country
LGED	Local Government Engineering Department
LUCF	Land use change and forestry*
LULUCF	Land use, land use change and forestry*
MDG	Millennium Development Goal
MoEF	Ministry of Environment and Forests
MoFDM	Ministry of Food and Disaster Management
NAPA	National Adaptation Programme of Action
NARS	National Agricultural Research System
NDMC	National Disaster Management Council
NGO	Non-Governmental Organisation
O&M	Operation and Maintenance
ppm	Parts per million
PRSP	Poverty Reduction Strategy Paper
REDD	Reducing Emissions from Deforestation and Degradation
RRI	River Research Institute
SAARC	South Asian Association for Regional Cooperation
SLR	Sea level rise
SPARRSO	Space Research and Remote Sensing Organisation
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
WASA	Water and Sewerage Authority
WARPO	Water Resources Planning Organisation

\* Terms and abbreviations used by UNFCCC

# GLOSSARY

<i>Aman</i>	Rice crop transplanted in the monsoon and harvested in November/December
<i>Boro</i>	Rice crop transplanted in January-February and harvested in May
<i>Char</i>	Low-lying river island
<i>Killa</i>	Raised earthen platform used as a flood shelter for humans and/or animals
<i>Monga</i>	Unemployment leading to seasonal hunger





# ACKNOWLEDGMENTS

Many people provided inputs to the thinking process behind the preparation of the BCCSAP document. The Ministry of Environment and Forests, in particular, acknowledges with gratitude the contributions of Mr. Qamar Munir and Mr. Rabindra Nath Roy Chowdhury, both Joint Secretaries of the MoEF; Dr. M. Asaduzzaman, Research Director, BIDS; Dr. Ainun Nishat, Country Representative, IUCN; Prof. Rezaur Rahman, BUET; Mr. Quamrul Islam Chowdhury, Chairman, FEJB; Mr. Md. Reazuddin, Technical Director, DoE; Dr. Rezaul Karim, Environment Specialist; Dr. Islam M Faisal of DFID and Mr. Steve Jones, Consultant. The views of government officials, civil society members and development partners in three separate stakeholders meetings enriched the document. The Government gratefully acknowledges their effort to improve the BCCSAP.

The Government also gratefully acknowledges and thanks the Department for International Development (DFID) of the UK Government for providing technical assistance in preparing this document.



# FOREWORD

Bangladesh is likely to be among the countries that are the worst affected by climate change. The Government of Bangladesh is acutely conscious of this, and has in fact been preparing to face this challenge for several years now. We realize that Climate Change is now an environmental as well as a developmental issue.

In 2005, we developed the *National Adaptation Programme of Action (NAPA)* after extensive consultations with communities across the country, professional groups; and other members of civil society. We have since taken this process forward, including through the adoption of the *Bangladesh Climate Change Strategy and Action Plan (BCCSAP)*, which will be the main basis of our efforts to combat climate change over the next ten years. This document has also been prepared after extensive consultations with all important sections of our citizens, including disadvantaged groups, such as those identified as *major groups* in Agenda 21.

The BCCSAP is designed as a 'living document'. This is because we are still uncertain about the timing and exact magnitude of many of the likely impacts of climate change. As we continue to implement our adaptation and mitigation programmes, we will deepen our understanding of the phenomenon. We will no doubt also keep ourselves informed of the latest developments in the science of Climate Change from experiences in other parts of the world, including through our participation in the process of UNFCCC and related fora. The *Strategy and Action Plan* therefore, anticipates periodical revision, as required.

Responsibility for implementing the various components of the BCCSAP will lie with line ministries and agencies, who will work in partnership with each other and with civil society and the business community. The *Ministry of Environment and Forests* will be responsible for coordinating activities under the *Action Plan* and intends to establish a *Climate Change Secretariat* to facilitate this work. The ministry will report to the *Steering Committee on Climate Change* (chaired by the Minister of Environment and Forests) and to the *National Environment Committee* (chaired by the Honourable Chief Adviser or Prime Minister).

We realize that the Government of Bangladesh needs to carry its people along with it to face this enormous challenge. However, we can be confident that we can draw upon the traditional resilience, adaptability and innovativeness of our people, who have battled natural disasters over the centuries. The BCCSAP will provide a framework for this national effort.

**Raja Devasish Roy**

Special Assistant to the Chief Adviser  
Ministry of Environment and Forests  
Government of the People's Republic of Bangladesh



# PREFACE

In the aftermath of the COP13 at Bali, Indonesia, the Government of Bangladesh increasingly felt the need for a climate change strategy to carry forward and coordinate activities in support of the Bali Action Plan. Subsequently, the Government has developed the Bangladesh Climate Change Strategy and Action Plan (BCCSAP) under the overall supervision of a Steering Committee chaired by the Special Assistant to the Chief Adviser of Government. The BCCSAP has been prepared through a fully consultative process involving government, civil society and development partners. Its main purpose is to articulate a strategy to manage climate change and its impacts in Bangladesh leading towards an action plan of programmes addressing the needs for substantive interventions with a definitive timeline for their implementation.

The BCCSAP is presented in two parts. The first part provides the background based on physical and climatic contexts, core socio-economic realities and policies in the country and the consequent rationale for a strategy on climate change. The thrust of the strategy is on sustainable development, poverty reduction and increased well-being of all vulnerable groups in society with special emphasis on gender sensitivity. The second part elaborates a set of programmes based upon six pillars or broad areas of intervention (not necessarily mutually exclusive) which have been elaborated in the first part. The BCCSAP sums up Bangladesh's current thinking on desirable activities to build climate resilience into the economy and society of Bangladesh through adaptation to climate change as well as mitigation for a low carbon development path.

The implementation of the BCCSAP will be financed through Government's own resources and external support that may be available from the development partners as well as the specific international funds created for the purpose. A monitoring mechanism will be set up during the implementation process by developing a set of indicators to measure progress.

I would like to thank all my colleagues in the Government who took part in the Steering Committee and guided the preparation of the BCCSAP. I would like to express my appreciation to all the experts including those from civil society who came forward to help in this national effort. I would also like to thank the development partners based in Bangladesh for their very useful and constructive comments in finalizing this document.

**A.H.M. Rezaul Kabir, *ndc***  
Secretary  
Ministry of Environment and Forests  
Government of the People's Republic of Bangladesh



# SUMMARY

Bangladesh is one of the most climate vulnerable countries in the world and will become even more so as a result of climate change. Floods, tropical cyclones, storm surges and droughts are likely to become more frequent and severe in the coming years. These changes will threaten the significant achievements Bangladesh has made over the last 20 years in increasing incomes and reducing poverty, and will make it more difficult to achieve the MDGs. **It is essential that Bangladesh prepares now to adapt to climate change and safeguard the future well-being of her people.**

Over the last 35 years, the Government of Bangladesh, with the support of development partners, has invested over \$10 billion to make the country less vulnerable to natural disasters. These investments include flood management schemes, coastal polders, cyclone and flood shelters, and the raising of roads and highways above flood level. In addition, the Government of Bangladesh has developed state-of-the-art warning systems for floods, cyclones and storm surges, and is expanding community-based disaster preparedness. Climate resilient varieties of rice and other crops have also been developed.

The challenge Bangladesh now faces is to scale up these investments to create a suitable environment for the economic and social development of the country and to secure the well-being of our people, especially the poorest and most vulnerable groups, including women and children.

The Government of Bangladesh's **Vision** is to eradicate poverty and achieve economic and social

well-being for all the people. This will be achieved through a pro-poor **Climate Change Strategy**, which prioritises adaptation and disaster risk reduction, and also addresses low carbon development, mitigation, technology transfer and the provision of adequate finance.

Sections I to V of the document provide the context, outline the implications and likely impacts of climate change in Bangladesh, provide an overview of different adaptation strategies and briefly outline mitigation issues. Sections VI to VII describe a ten-year programme to build the capacity and resilience of the country to meet the challenge of climate change over the next 20-25 years.

The **Climate Change Action Plan** is built on six pillars:

1

**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 programmes focus on the needs of this group for food security, safe housing, employment and access to basic services, including health.

2

**Comprehensive disaster management** to further strengthen the country's already proven disaster management systems to deal with increasingly frequent and severe natural calamities.



3

**Infrastructure** to ensure that existing assets (e.g., coastal and river embankments) are well-maintained and fit-for-purpose and that urgently needed infrastructure (e.g. cyclone shelters and urban drainage) is put in place to deal with the likely impacts of climate change.

4

**Research and knowledge management** to predict the likely scale and timing of climate change impacts on different sectors of the economy and socio-economic groups; to underpin future investment strategies; and to ensure that Bangladesh is networked into the latest global thinking on climate change.

5

**Mitigation and low carbon development** to evolve low carbon development options and implement these as the country's economy grows over the coming decades.

6

**Capacity building and institutional strengthening** to enhance the capacity of government ministries and agencies, civil society and the private sector to meet the challenge of climate change.

The needs of the poor and vulnerable, including women and children, will be prioritised in all activities implemented under the Action Plan. The Climate Change Action Plan comprises immediate, short, medium and long-term programmes.

The Climate Change Action Plan will be implemented under the overall guidance of the National Environment Committee, chaired by the Chief Adviser. It will be coordinated by concerned Ministry of Environment and Forests. Programmes funded under the Plan will be implemented by Ministries or their agencies, with the involvement, as appropriate, of civil society and the private sector.

The Climate Change Strategy and Action Plan has been developed by the Government of Bangladesh in consultation with civil society, including NGOs, research organisations and the private sector. It builds on the National Adaptation Programme of Action (NAPA), published in 2005. It will be reviewed and revised as experience and knowledge are gained in implementing adaptation and related research programmes.

There are 37 programmes listed in Annex 1. The annotations for justification, the kind of activities to be undertaken, and the responsible ministries/agencies for each of the programme within the six pillars outlined above is also provided in the Annex 1. These programmes would be elaborated with all details in consultation with the stakeholders at the time of their planning and implementation. This list of programmes is by no means exhaustive. It only outlines the first set of activities that are to be undertaken in line with the needs of the communities and the overall development programme of Bangladesh.

# I. INTRODUCTION

## Context

1. Since Bangladesh achieved Independence in 1971, GDP has more than tripled in real terms<sup>1</sup>, food production has increased three-fold<sup>2</sup>, the population growth rate has declined from around 2.9% per annum in 1974 to 1.4% in 2006 and the country is now largely food secure<sup>3</sup>. Over the last 20 years, growth has accelerated and the country is on track to become a middle income country by 2020. In four out of the last five years the economy has grown at over 6%<sup>4</sup>. Between 1991 and 2005, the percentage of people living in poverty declined from 59% to 40%<sup>5</sup> and the country's Human Development Index improved from 0.347 in 1975 to 0.547 in 2005<sup>6</sup>. Child mortality has fallen substantially and gender parity in primary education has been achieved.

2. Despite these successes, more than 50 million of our people still live in poverty<sup>7</sup>. Many of these people live in remote or ecologically fragile parts of the country, such as river islands (*chars*) and cyclone-prone coastal belts, which are especially vulnerable to natural disasters. In the recently released draft *Poverty Reduction Strategy Paper (2009-11)*, the Government of Bangladesh reaffirmed its commitment to the MDG targets, including halving poverty and hunger by the year 2015, through a strategy of pro-poor growth and climate resilient development.

3. Climate change will severely challenge the country's ability to achieve the high rates of economic growth needed to sustain these reductions in poverty. In coming years, it is predicted that there will be increasingly frequent and severe floods, tropical cyclones, storm surges, and droughts, which will disrupt the life of the nation and the economy. In the worst case scenario, unless existing coastal polders are strengthened and new ones built, sea level rise could result in the displacement of millions of people - 'environmental refugees' - from coastal regions, and have huge adverse impacts on the livelihoods and long-term health of a large proportion of the population. It is essential that Bangladesh prepares now to face the challenge ahead and to safeguard her future economic well-being and the livelihoods of her people.

4. Over the last three decades, the Government has invested over \$10 billion (at constant 2007 prices) to make the country more climate resilient and less vulnerable to natural disasters. Flood management embankments, coastal polders and cyclone shelters have been built, and important lessons learnt on how to implement such projects successfully in the dynamic hydrological conditions in Bangladesh and with the active participation of communities. A comprehensive system of disaster preparedness and

1. Govt of Bangladesh (1998) *Fifth Five-Year Plan, Planning Commission*, Dhaka and Govt of Bangladesh (2007) *Bangladesh Economic Survey, 2007*, Ministry of Finance, Dhaka.

2. As footnote 1.

3. Bangladesh Bureau of Statistics (1975 and 2007) *Statistical Yearbooks*, Dhaka

4. Govt of Bangladesh (2007) *Bangladesh Economic Survey, 2007*, Ministry of Finance, Dhaka.

5. Bangladesh Bureau of Statistics (2006) *Statistical Yearbook*, Dhaka

6. United Nations Development Programme (2007) *Human Development Report*, New York

7. Poverty is defined as nutritional intake of 2122 kcal or less

management, including *Standing Orders on Disaster*, which details the responsibilities of Government officials and others at times of disaster, has also been put in place. The Government demonstrated its competence in dealing with disasters in 2007 when the country suffered two serious floods and a severe tropical cyclone (Cyclone Sidr) in the same year.

5. The challenge now facing the country is to scale up its resilience and protect the lives and livelihoods of the people, especially the poorest and most vulnerable families, including women and children. The people and Government of Bangladesh are ready and willing to rise to this challenge.

## Putting the Bali Roadmap into action

6. The 13<sup>th</sup> Conference of Parties to the UN Framework Convention on Climate Change (UNFCCC), held in Bali in December 2007, launched the **Bali Action Plan**, which identified a set of actions essential to achieve a secure climate future. In the Conference, Bangladesh<sup>8</sup> emphasised the importance of specific interventions to ensure that the people have secure access to food, water, energy and livelihoods.

7. The statement given by Bangladesh, at the UN General Assembly in February 2008, on behalf of the Least Developed Countries (LDCs), emphasised the need for immediate international support to build the LDCs resilience to global warming and climate change. The resources currently available for adaptation are grossly inadequate to meet the needs of the LDCs, who will bear the brunt of climate change.

8. Adaptation is the priority for Bangladesh in the short to medium term. The country is already a world leader in the research, design and

implementation of adaptation strategies, and this work will continue. In the long-term, however, climate resilience will require deep cuts in greenhouse gas emissions by the "Annex-1 parties", including the developed industrialised nations. To achieve this, Bangladesh will work hard to ensure that the current round of climate change negotiations, leading to the establishment of a fair and equitable post-Kyoto Framework and outcome for developing countries at the 2009 Copenhagen Conference of Parties (COP-15), is successful.

## Vision, Strategy and Action Plan

9. The Government of Bangladesh's **Vision** is to eradicate poverty and achieve economic and social well-being for its entire people. We will achieve this through a pro-poor, climate resilient and low-carbon development **Strategy**, based on the four building blocks of the Bali Action Plan - adaptation to climate change, mitigation, technology transfer and adequate and timely flow of funds for investment, within a framework of food, energy, water and livelihoods security.

10. This will be achieved by implementing an **Action Plan**, which will have six pillars: (1) Food security, social protection and health; (2) Comprehensive disaster management; (3) Infrastructure development; (4) Research and knowledge management; (5) Mitigation and low-carbon development; and (6) Capacity building and institutional development. The Action Plan will be an integral part of national development policies, plans and programmes.

8. <http://www.unfccc.int/resources/docs/2008/awglca1/english/misc01.pdf>

## II. CLIMATE HAZARDS IN BANGLADESH

### Background

11. The Intergovernmental Panel on Climate Change (IPCC) predicts that global temperatures will rise between 1.8° C and 4.0° C by the last decade of the 21st century<sup>9</sup>. The impacts of global warming on the climate, however, will vary in different regions of the world.

12. In South Asia, the 4<sup>th</sup> IPCC Report predicts that monsoon rainfall will increase, resulting in higher flows during the monsoon season in the rivers, which flow into Bangladesh from India, Nepal, Bhutan and China. These flows are likely to further increase in the medium term due to the melting of the Himalayan glaciers. The IPCC also forecasts that global warming will result in sea level rises of

between 0.18 and 0.79 metres, which could increase coastal flooding and saline intrusion into aquifers and rivers across a wide belt in the south of the country, although most of the area is protected by polders. Rainfall is predicted to become both higher and more erratic, and the frequency and intensity of droughts are likely to increase, especially in the drier northern and western parts of the country.

13. Bangladesh is widely recognised to be one of the most climate vulnerable countries in the world. It experiences frequent natural disasters, which cause loss of life (see Box 1), damage to infrastructure and economic assets, and adversely impacts on lives and livelihoods, especially of poor people.



Photo: Boat playing on a city road

Source: CNRS, Dhaka.

9. Working Group 1, IPCC, *Climate Change 2007: The Physical Science Basis, Summary for Policy Makers*, p. 13, 2007.

### Box 1: Bangladesh - one of the most climate vulnerable countries

UNDP has identified Bangladesh to be the most vulnerable country in the world to tropical cyclones and the sixth most vulnerable country to floods\* (see table below).

**Most vulnerable countries to floods or cyclones  
(Deaths/100,000 people exposed to floods or cyclones)**

Floods			Tropical cyclones		
1.	Venezuela	4.9	1.	Bangladesh	32.1
2.	Afghanistan	4.3	2.	India	20.2
3.	Pakistan	2.2	3.	Philippines	8.3
4.	China	1.4	4.	Honduras	7.3
5.	India	1.2	5.	Vietnam	5.5
6.	Bangladesh	1.1	6.	China	2.8

\* Of major flood-affected countries reporting an average of over 200 deaths/year.

Source: UNDP (2004), A Global Report: Reducing Disaster Risk: A Challenge for Development  
<http://www.undp.org/bcpr>

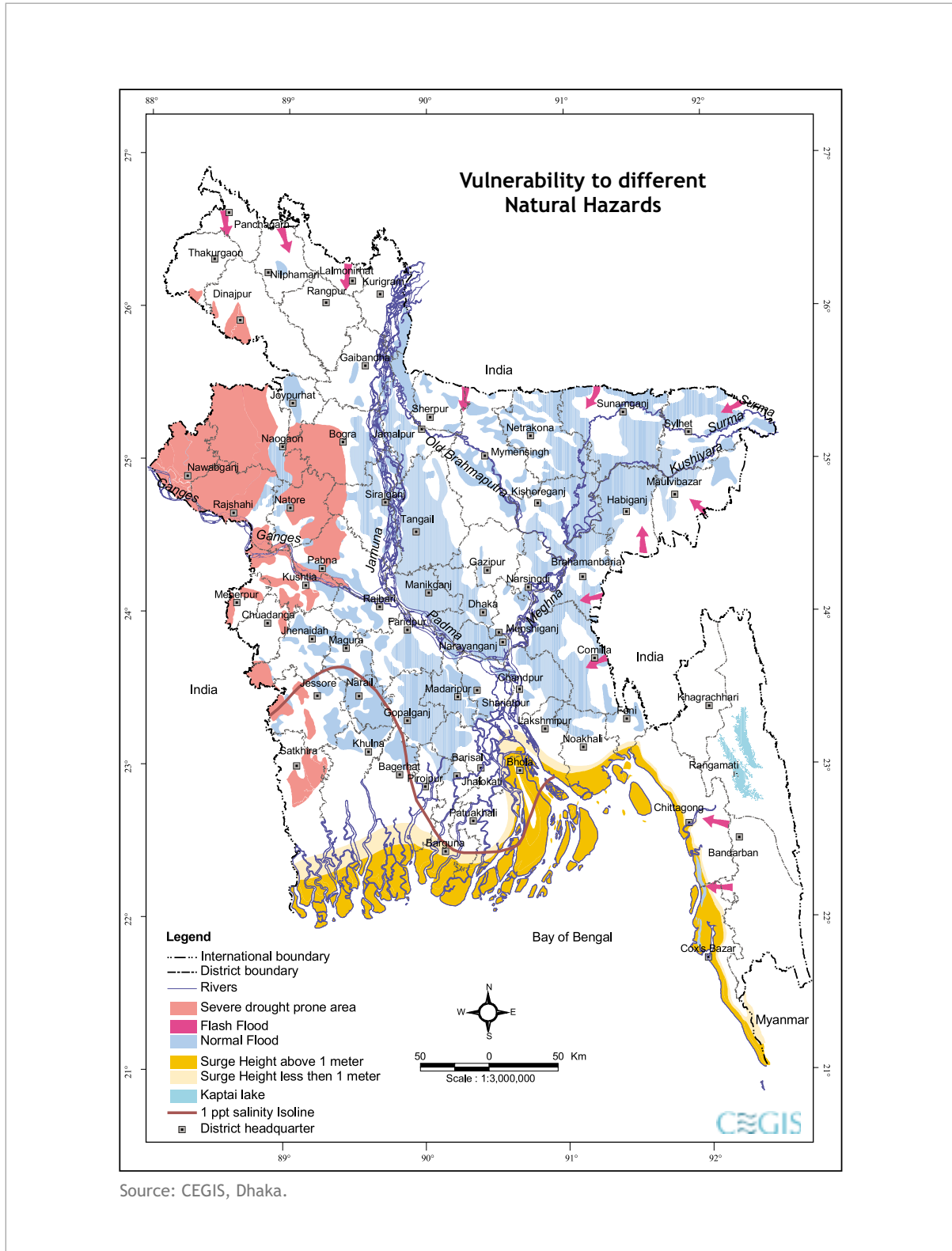
14. Bangladesh is susceptible to floods, tropical cyclones, storm surges, and droughts. The regions of the country affected by these different hazards are shown in Map 1.



Photo: Flood in rural Bangladesh

Source: CNRS, Dhaka.

Map 1. Areas affected by different types of climate-related disaster

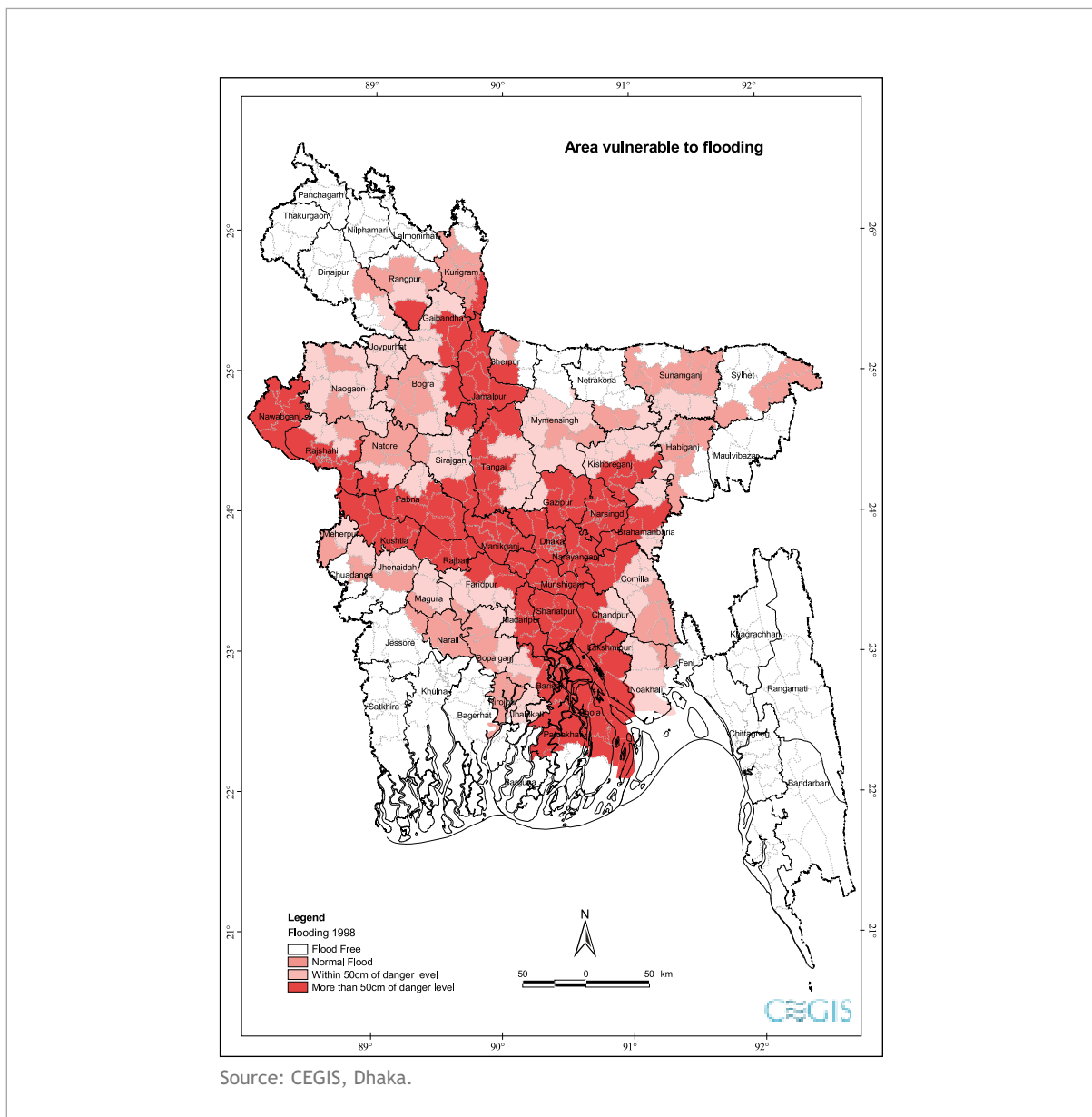


## Floods

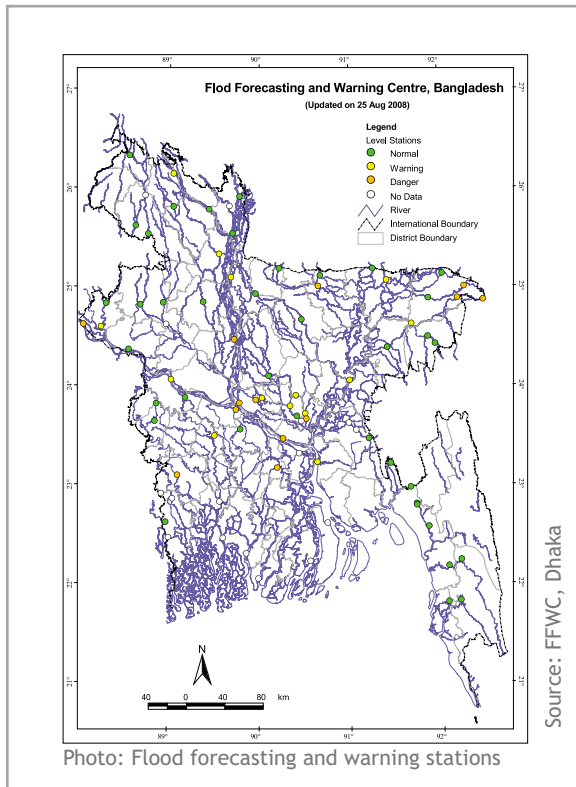
15. Most of Bangladesh lies in the delta of three of the largest rivers in the world - the Brahmaputra, the Ganges and the Meghna. These rivers have a combined peak discharge in the flood season of 180,000 m<sup>3</sup>/sec. (the second highest in the world,

after the Amazon) and carry about two billion tonnes of sediment each year. The topography of the country is mostly low and flat. Two-thirds of the country is less than 5 metres above sea level and is susceptible to river and rainwater flooding and, in lower lying coastal areas, to tidal flooding during storms (see Map 2).

Map 2. Areas vulnerable to flooding



Source: CEGIS, Dhaka.



16. In an 'average' year, approximately one quarter of the country is inundated. The people living in these areas have adapted by building their houses on raised mounds and adjusting their farming systems. In the past, people here grew low-yielding deep-water rice during the monsoon season. Now they mostly cultivate high-yielding rice crops, often using irrigation<sup>10</sup>. Once in every 4 to 5 years, however, there is a severe flood that may cover over 60% of the country and cause loss of life and substantial damage to infrastructure, housing, agriculture and livelihoods. During severe floods, it is the poorest and most vulnerable who suffer most because their houses are often in more exposed locations.



Photo: Flood in main road of Dhaka

Source: [www.poffet.net](http://www.poffet.net)

10. In areas covered by flood management projects, farmers can often grow a high-yielding rice crop, which is planted during the monsoon (*aman*) and another planted in the dry season, with irrigation (*boro*).



17. In the last 25 years, Bangladesh has experienced six severe floods (Box 2). In 2007, two successive and damaging floods inundated the country in the same season. During high floods, river bank erosion is common. It can result in the loss of thousands of hectares of agricultural land and scores of villages,

and displace many thousands of people from their homes. Flash floods can also be a problem in the more hilly north-eastern and south-eastern regions of the country. In box 3 the scale of the severe flooding in 2004 and 2007 is shown.

#### Box 2: Serious floods in the last 25 years

Event	Impact
1984 flood	Inundated over 50,000 sq. km, estimated damage US\$ 378 million
1987 flood	Inundated over 50, 000 sq. km, estimated damage US\$ 1 billion, 2,055 deaths
1988 flood	Inundated 61% of the country estimated damage US\$ 1.2 billion, more than 45 million homeless, between 2,000-6,500 deaths
1998 flood	Inundated nearly 100,000 sq. km., rendered 30 million people homeless, damaged 500,000 homes, heavy loss to infrastructure, estimated damage US\$ 2.8 billion, 1,100 deaths
2004 flood	Inundation 38%, damage US\$ 6.6 billion, affected nearly 3.8 million people. Estimated damage over \$2 billion, 700 deaths
2007 flood	Inundated 32,000 sq. km, over 85,000 houses destroyed and almost 1 million damaged, approximately 1.2 million acres of crops destroyed or partially damaged, estimated damage over \$1 billion, 649 deaths

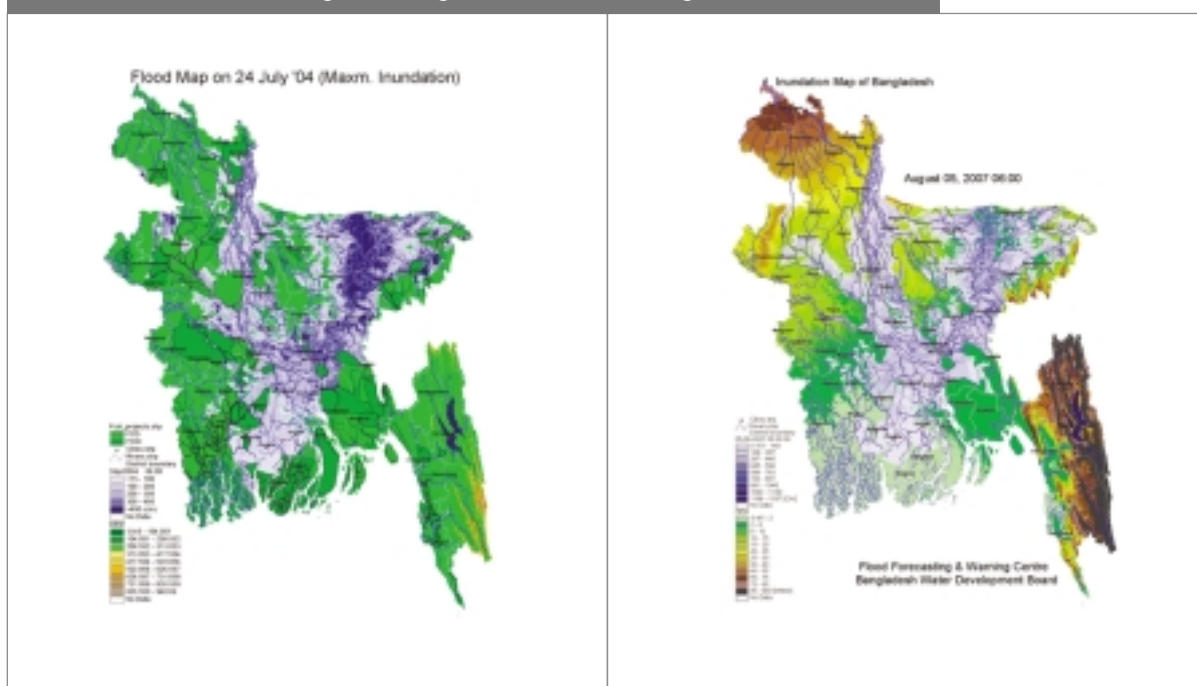
Sources: Government of Bangladesh (2005) *National Adaptation Programme of Action*, Ministry of Environment and Forests, Dhaka and Government of Bangladesh (2007) 'Consolidated Damage and Loss Assessment, Lessons Learnt from the Flood 2007 and Future Action Plan', Disaster Management Bureau, Dhaka.



Photo: River bank erosion

Source: CNRS, Dhaka.

Box 3: Satellite images showing the extent of flooding in 2004 and 2007



Source: FFWC, Dhaka.

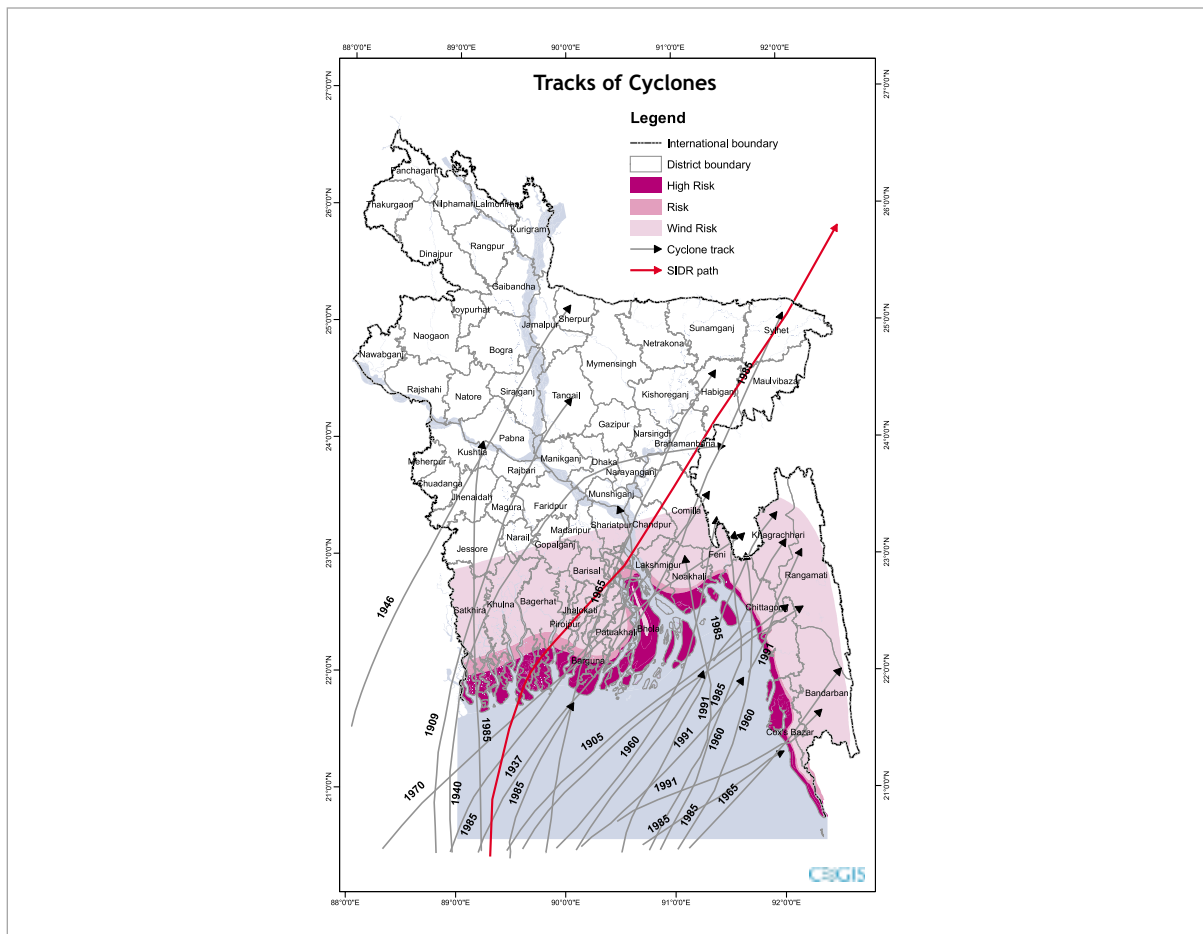
## Tropical cyclones and storm surges

18. A severe tropical cyclone hits Bangladesh, on average, every 3 years. These storms generally form in the months just before and after the monsoon and intensify as they move north over the warm waters of the Bay of Bengal. They are accompanied by high winds of over 150 kph and can result in storm surges up to seven metres high, resulting in extensive damage to houses and high loss of life to humans and livestock in coastal communities. The tropical cyclones in 1970 and 1991 are estimated to have killed 500,000 and 140,000 people, respectively. The storm surges are higher in Bangladesh than in

neighbouring countries because the Bay of Bengal narrows towards the north, where Bangladesh is located (See Map 3 - cyclone tracks). In recent years, general cyclonic activity in the Bay of Bengal has become more frequent, causing rougher seas that can make it difficult for fishermen and small craft to put to sea.

19. Bangladesh has a world-renowned community-based early warning system and has built cyclone shelters on stilts, so that the storm surge can flow underneath (see Box 4). These shelters typically provide refuge to over 700 people and have separate spaces for women and men. However, people are often reluctant to go to the shelters, leaving their livestock and other assets behind.

Map 3. Tracks of cyclones over last 50 years



Source: CEGIS, Dhaka.

#### Box 4: Multi-purpose cyclone shelters in coastal Bangladesh

The southern districts of Bangladesh along the Bay of Bengal are prone to severe tropical storms known as cyclones, which develop over warm tropical oceans and have sustained winds of 64 knots (74 miles/hour) or more. In addition to strong winds, cyclones also generate storm surges and huge waves. Water can rise as high as seven metres and flood waves can travel up to 30 miles inland. In order to protect people from severe storms and tidal surges, more than 2,100 cyclone shelters have been built in the coastal districts. Construction of cyclone shelters is one of six key mitigating measures along with embankments, afforestation, early warning systems, awareness building and communications.

A typical shelter is a concrete building, shaped like two sides of a triangle, facing into the wind. To enter, people climb the staircase at the back, as it is slightly more sheltered from the wind. Railings are placed on both sides of the staircase to help people climb when winds are very strong. Cyclone shelters can have one or two floors. There are separate rooms for men and women (children usually stay with the women). Windows have metal shutters as glass can break into pieces and cause injuries. There are water supply and toilets downstairs or close to the building.

Some 700 to 1,000 people can take refuge in a typical shelter, which may cost around £50,000 to build. Larger shelters can accommodate up to 2000 people and may have a different design.

Earlier shelters were built as single purpose structures but new ones are multi-purpose. They can also be used as local government offices, schools or health centres. Newer shelters may have a 'killa' (raised platform for livestock) nearby.

According to a government estimates, around 1.5 million people took refuge in cyclone shelters when Cyclone Sidr hit the coast of Bangladesh in November, 2007.

In 2007, cyclone shelters and the very effective early warning system helped limit the number of fatalities, to around 3,500. This is still 3,500 too many but a small fraction of the loss incurred in 1991 when some 140,000 lives were lost due to the less effective early warning system and lack of shelters. The multi-purpose cyclone shelter is a concrete example of indigenous adaptation to extreme climatic events in Bangladesh.



Photo: A multi-purpose cyclone shelter

Source: I M Faisal and <http://www.uwec.edu/> (photograph).

## Droughts

20. Droughts in Bangladesh are seasonal and can devastate crops, causing hardship to poor agricultural labourers and others who cannot find work. In these areas, *monga* (unemployment leading to seasonal hunger) is often a problem, especially in the months leading up to the November-December rice harvest. If the crop totally fails because of drought, the situation for poor people can become critical. Droughts most commonly affect the north-western region, which generally has lower rainfall than the rest of the country.



Photo: Severe drought condition

Source: CNRS, Dhaka.

## III. IMPACTS OF CLIMATE CHANGE

21. Climate change will exacerbate many of the current problems and natural hazards the country faces. It is expected to result in:

- **increasingly frequent and severe tropical cyclones**, with higher wind speeds and storm surges leading to more damage in the coastal region;
- **heavier and more erratic rainfall** in the Ganges-Brahmaputra-Meghna system, including Bangladesh, during the monsoon resulting in:
  - ▶ **higher river flows**, causing over-topping and breaching of embankments and widespread flooding in rural and urban areas,
  - ▶ **river bank erosion** resulting in loss of homes and agricultural land to the rivers;
  - ▶ **increased sedimentation** in riverbeds leading to drainage congestion and water-logging;
- **melting of the Himalayan glaciers**, leading to higher river flows in the warmer months of the year, followed by lower river flows and increased saline intrusion after the glaciers have shrunk or disappeared;
- **lower and more erratic rainfall**, resulting in increasing droughts, especially in drier northern and western regions of the country;
- **sea level rises** leading to submergence of low-lying coastal areas and saline water intrusion up coastal rivers and into groundwater aquifers, reducing freshwater availability; damage to the Sundarbans mangrove forest, a World Heritage site with rich biodiversity; and drainage congestion inside coastal polders, which will adversely affect agriculture (see Map 4);

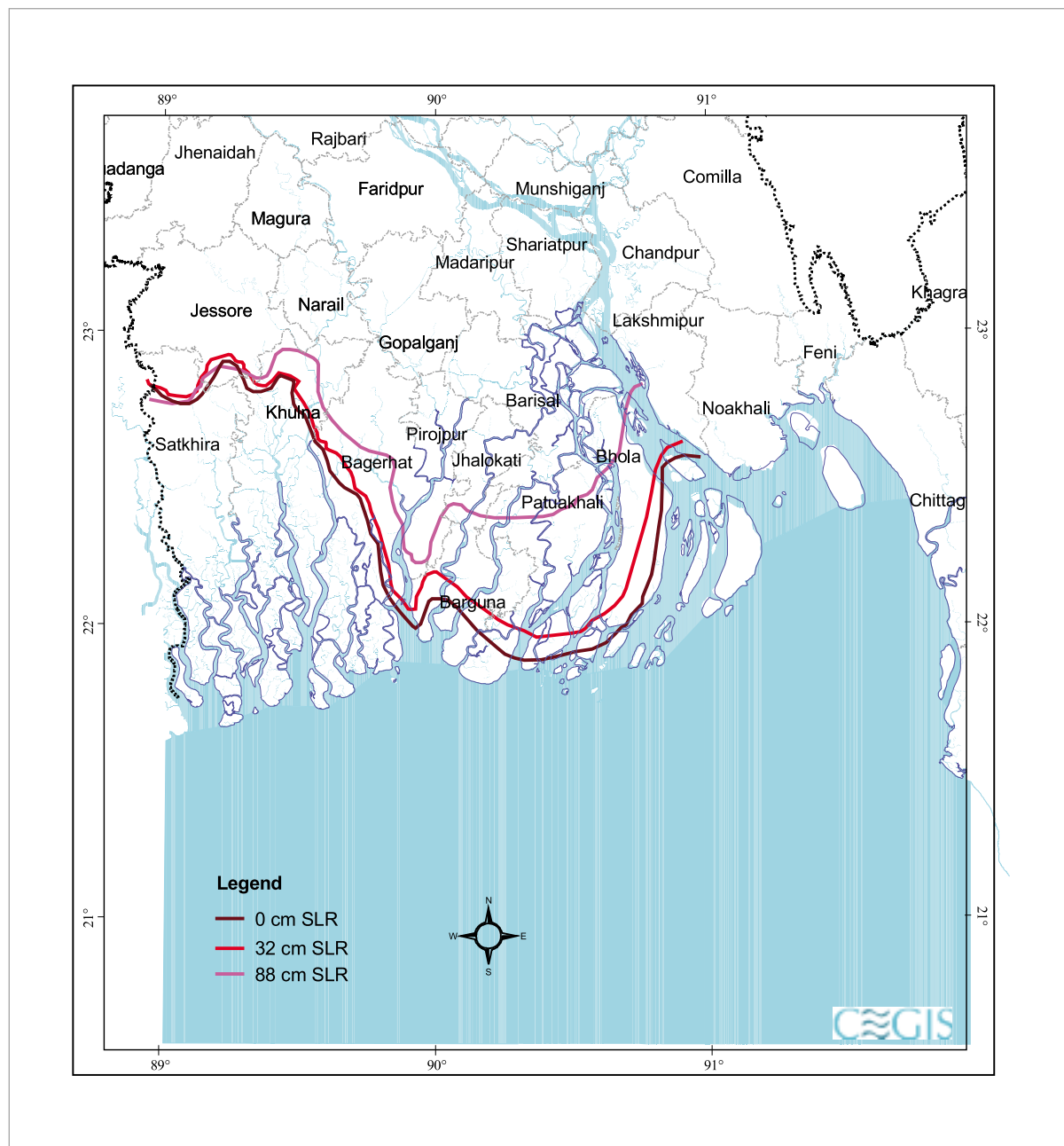
- **warmer and more humid weather** leading to increased prevalence of disease and disease vectors.

22. Each of these changes is likely to seriously affect agriculture (crops, livestock and fisheries). Although agriculture now accounts for only 20% of GDP, over 60% of people depend on agriculture directly or indirectly for their livelihoods. The higher temperatures and changing rainfall patterns, coupled with increased flooding, rising salinity in the coastal belt and droughts are likely to reduce crop yields and crop production. IPCC estimates that, by 2050, rice production in Bangladesh could decline by 8% and wheat by 32% (against a base year of 1990).

23. Shortage of safe drinking water is likely to become more pronounced, especially in the coastal belt and in drought-prone areas in the north-west of the country. This will impose hardship on women and children, who are responsible for collecting drinking water for their families. Increasingly saline drinking water may also result in health hazards, especially for pregnant women. Climate change is likely to adversely affect women more than men.

24. Increased river bank erosion and saline water intrusion in coastal areas are likely to displace hundreds of thousands of people who will be forced to migrate, often to slums in Dhaka and other big cities. If sea level rise is higher than currently expected, and coastal polders are not strengthened and/or new ones built, six to eight million people could be displaced by 2050 and would have to be resettled.

Map 4. Likely salinity ingress in Southern Bangladesh due to different SLR



Source: CEGIS, Dhaka.

**25.** All of these changes threaten the food security, livelihoods and health of the poor. People living on river islands (*chars*) and along the coastline (e.g., fishing families), are among the poorest people in the country. They will be seriously affected, as will others who lose their land to river erosion. Extremely poor households throughout the country, including many female-headed households, will suffer most from climate change.

**26.** Climate change is likely to increase the incidence of water-borne and air-borne diseases. Bacteria, parasites and disease vectors breed faster in warmer and wetter conditions and where there is poor drainage and sanitation. In view of this, it will be important to implement public health measures (immunisation; improved drainage, sanitation and hygiene) to reduce the spread of these diseases and to improve access to health services for those communities likely to be worst affected by climate change. Unless these steps are taken, the health of

many of the poorest and most vulnerable people will deteriorate. Acute illness is known to be one of the main triggers driving people into extreme poverty and destitution in Bangladesh.

**27.** Bangladesh has one of the highest population densities of any country in the world<sup>11</sup>. By 2050, the population will have grown from approximately 150 million, in 2008, to more than 200 million, with almost half of the people living in cities and towns. Dhaka will have become a mega city with a population of over 40 million. The impact of higher and more intense rainfall will be felt in urban areas, where drainage is already a serious problem and sewers frequently back-up in the monsoon season. The poor, who live in slums and informal settlements, often in low-lying parts of cities, will be worst affected. With rapid and unplanned urbanisation in Bangladesh, this is going to become an even more urgent and pressing problem.



Photo: Flood in an urban area

Source: [www.poffet.net](http://www.poffet.net)

<sup>11</sup>. In 2006, 140 million people lived in an area of 144,000 km<sup>2</sup> at a density of over 950 persons/km<sup>2</sup>.



**28.** Although there is some uncertainty about the IPCC forecasts on the timing and severity of these impacts, the directions of change are clear. Changes in rainfall patterns and in the frequency and severity of tropical cyclones and storm surges are likely to happen quickly (and may be happening already with Cyclone Sidr in Bangladesh and Cyclone Nargis in Myanmar happening within six months of each other). Other changes such as sea level rise are likely to be seen only after 20 years, possibly longer.



Photo: Devastation by SIDR

Source: web

## IV. ADAPTING TO CLIMATE CHANGE

**29.** The people of Bangladesh have adapted over generations to the risks of floods, droughts and cyclones. In areas where inundation is a risk, they raise their houses on mounds, above the normal flood level, and adjust their cropping patterns to take advantage of the flood waters. Farmers in all parts of the country adapt to local flooding and rainfall patterns by growing a range of indigenous and high-yielding varieties of rice and other crops. Rural roads, paths, tracks and other infrastructure, such as schools, are also raised above flood level, where possible.

**30.** The combination of frequent natural disasters, high population density, poor infrastructure and low resilience to economic shocks, makes Bangladesh especially vulnerable to climatic risks. The high incidence of poverty and heavy reliance of poor people on agriculture and natural resources increases their vulnerability to climate change.

**31.** Supporting communities and people in rural areas to strengthen their resilience and adapt to climate change will remain a high priority in coming decades. However, with increasing urbanisation and economic growth, the type of risks Bangladesh faces will change. New urban areas must be built to be climate resilient. This will call for better planning to ensure that the pattern of urbanisation takes account of the likely risks from climate change.

**32.** The direct annual cost to the national economy of natural disasters over the last 10 years (damage and lost production) is estimated to be between 0.5%

and 1% of GDP. As the economy grows, these costs are likely to increase in absolute terms and as a proportion of GDP, if climate change is not factored into long-term economic planning.

**33.** Since the 1970s, the Government of Bangladesh, with the support of development partners, has invested in:

- flood management schemes to raise the agricultural productivity of many thousands of km<sup>2</sup> of low-lying rural areas and to protect them from extremely damaging severe floods;
- flood protection and drainage schemes to protect urban areas from rainwater and river flooding during the monsoon season;
- coastal embankment projects, involving over 6,000 km of embankments and polder schemes, designed to raise agricultural productivity in coastal areas by preventing tidal flooding and incursion of saline water;
- over 2,000 cyclone shelters to provide refuges for communities from storm surges caused by tropical cyclones and 200 shelters from river floods;
- comprehensive disaster management projects, involving community-based programmes and early warning systems for floods and cyclones;

- irrigation schemes to enable farmers to grow a dry season rice crop in areas subject to heavy monsoon flooding and in other parts of the country, including drought-prone areas;
- agricultural research programmes to develop saline, drought and flood-adapted high yielding varieties of rice and other crops, based on the traditional varieties evolved over centuries by Bangladeshi farmers;
- coastal 'greenbelt' projects, involving mangrove planting along nearly 9,000 km of the shoreline.

34. These investments in 'climate proofing' the country have had a major impact on economic growth and poverty reduction. Average annual food grain production in Bangladesh has grown from about 9 million in the mid-70's to 28 million metric tonnes today, which has raised rural incomes and created jobs for poor people in agriculture and related sectors, and made the country largely food secure. Over the last 10-15 years, the number of fatalities from natural disasters has declined, as the country's ability to manage risks, especially floods and cyclones, has improved and community-based systems have been put in place.

35. Over the decades, Bangladesh has also learnt how to plan and implement these programmes more sustainably (e.g., to integrate capture and culture fisheries into the design and operation of flood management projects) by involving communities in planning, construction and management. We must undertake climate change investments with communities, learn from them, build on their

knowledge of their local environments, and ensure that proposed investments meet their needs.

36. The Government of Bangladesh recognises that tackling climate change requires an integrated approach involving many different ministries and agencies, civil society and the business sector. There is also a need to strengthen the capacity of Government and other organisations to plan and implement development programmes. Many development organisations need to strengthen their capacity so that they can implement their regular programmes more effectively and rise to the challenge of climate change.

37. The main Government of Bangladesh ministries involved in climate change are the Ministries of: **Environment and Forests** and its agencies (e.g. the Department of Environment - DoE and Department of Forests - DoF); **Food and Disaster Management** (MoFDM), which includes the Disaster Management Bureau (DMB) and the Comprehensive Disaster Management Programme (CDMP); **Water Resources**, which includes the Bangladesh Water Development Board and other research and forecasting organisations; **Local Government, Rural Development and Cooperatives**, which includes the Local Government Engineering Department (LGED) and the Department of Public Health Engineering (DPHE); **Agriculture**, including the National Agricultural Research System, which develops new crops and practices suited to different climatic and salinity conditions in the country; **Livestock and Fisheries**; **Energy**; and **Health**. Key roles and responsibilities are described in Box 4.

**Box 4: Government Ministries and Agencies involved in responding to climate change**

The *Ministry of Environment and Forests* is the focal ministry for all work on climate change, including international negotiations. It provides the Secretariat for the recently-established National Environment Committee, which ensures a strategic overview of environmental issues and is chaired by the Chief Adviser. Immediately after the Bali Conference (COP 13), the Government formed the National Steering Committee on Climate Change. It is headed by the Adviser, Environment and Forests and comprises secretaries of all relevant ministries and civil society representatives. It is tasked with developing and overseeing implementation of the national Climate Change Strategy and Action Plan. Five technical working groups were also constituted on adaptation, mitigation, technology transfer, financing and public awareness.

In 2005, the Government of Bangladesh launched its National Adaptation Programme of Action (NAPA), in partnership with other stakeholders, which highlights the main adverse effects of climate change and identifies adaptation needs. The Climate Change Cell in DoE under the Ministry of Environment and Forests supports the mainstreaming of climate change into national development planning and has developed a network of 34 'focal points' in different government agencies, research and other organisations.

The *National Disaster Management Council* (NDMC), headed by the Chief Adviser/Prime Minister, is the highest-level forum for the formulation and review of disaster management policies. The Inter-Ministerial Disaster Management Coordination Committee is in charge of implementing disaster management policies and the decisions of the NDMC, assisted by the National Disaster Management Advisory Committee.

The *Ministry of Food and Disaster Management* is the focal ministry for disaster management. Its *Disaster Management Bureau* (DMB) is the apex organisation responsible for coordinating national disaster management interventions across all agencies. It is a technical arm of the Ministry of Food and Disaster Management. It oversees and coordinates all activities related to disaster management at national and local levels. In 2000, the Government published *Standing Orders on Disaster*, which provide a detailed institutional framework for disaster risk reduction and emergency management and defines the roles and responsibilities of different actors. The *Comprehensive Disaster Management Program* (CDMP), a donor funded programme, aims to strengthen the DMB and shifts the emphasis away from relief to disaster preparedness and risk reduction.

The Meteorological Department and SPARRSO, under the Ministry of Defence, and the Flood Forecasting and Early Warning Centre of Bangladesh Water Development Board, under the Ministry of Water Resources, are two of the key institutions in this field.

*Other ministries.* There are 35 or more other ministries also responsible for sectors that are vulnerable to the effects of climate change, including agencies responsible for water resources, health, agriculture, urban planning, roads and transport.

**38.** Bangladesh has a large and vibrant civil society sector, which includes world-renowned organisations like BRAC and the Grameen Bank. Civil society has made a major contribution to poverty reduction and has increased the resilience of poor people to natural disasters, through its microfinance, income generation, health and education programmes. Civil society's experience and capacity will be used to develop innovative approaches to adaptation (including possible partnerships with the private sector).

**39.** Bangladesh has pioneered community-based approaches to reducing vulnerability to climate change, which are being shared with other developing countries (See Box 5).

**40.** The Government of Bangladesh has made climate change an integral part of the new draft Poverty Reduction Strategy Paper, which outlines its strategy for the next three years and which will lay the foundation for continuing efforts to achieve the MDGs and build a fair, equitable and just society in Bangladesh. Despite past efforts, the country has a long way go to eradicate poverty and provide opportunities for all the people. Some 56 million people still live in poverty (27 million of them in extreme poverty)<sup>12</sup>; 62 percent of households lack access to sanitation, at most 68 percent of children complete primary school<sup>13</sup>; and our old, disabled and vulnerable people lack adequate social protection services. The draft PRSP highlights the likely impacts of climate change on the development of Bangladesh and the importance of putting in place a framework for action as an integral part of the country's Poverty Reduction Strategy.

12. Bangladesh Bureau of Statistics (2006) *Preliminary Report on Household Income and Expenditure Survey, 2005, Dhaka.*

13. Bangladesh Bureau of Statistics (2006), *Statistical Yearbook, 2006, Dhaka.*

### Box 5: Think global, act local: the tale of *Sona Mollar Dangi*

From the district town of Faridpur, it took about an hour by motorized boat to reach Sona Mollar Dangi, a small village of 26 households (around 250 people) on an island in the middle of the mighty river Padma. Some twelve years ago, Sona Molla, the respected village elder, and his family moved onto this newly formed 'char.' That was the fifth time Sona Molla had to relocate in search of a piece of land where he could settle down with his family and make a living. Over the years, others followed him and a new community called the *Sona Mollar Dangi* (elevated land of Sona Molla) was born.

Life was good for a while until came the disastrous flood of 1998. The entire village went under water for weeks. Sona Molla and his kin had to move to high ground in distant places. After the flood, they thought they would now be safe for many years as the last big flood was in 1988. The next big one will not come before 2008, they thought.

Unfortunately, climate change driven by global warming proved them wrong. Not only did they experience long heat waves but also the entire island went under water twice during devastating floods in 2004 and 2007. Sona Molla, now in his 70s, was at a loss - this was very unusual. Something was seriously wrong. Sona Molla felt that the community needed to come together and do something collectively. The char was still stable and provided reasonable livelihoods; if only the disasters were less frequent.

It was at this moment that the field workers of Faridpur Development Agency (FDA, a local NGO funded by the UK through its Comprehensive Disaster Management Programme), moved in to help this remote village. With FDA's help, the community came up with a plan to save the village from recurrent floods.

Sona Mollar Dangi is a whole new community now, bustling with enthusiasm and hope. With support from FDA, they managed to raise all 26 households above the 1998 flood level by a good 1.5 feet. This means all the houses and barns are on safe ground now, so are the backyard gardens, poultry sheds and seedlings of woody and fruit trees. Soon, they will lift all hand tube-wells to the same level as the homesteads and build new sanitary latrines. All this will cost less than US\$ 300 per family.

People are now talking about setting up a primary school and a weekly health clinic. With their income and assets secured, they are beginning to dream of a brighter future. Perhaps, they will even have electricity soon? The main power grid is still far out of their reach but one household has recently switched to a climate friendly alternative - a small solar panel installed on the tin roof. It generates enough power to run four 10-watt fluorescent tube lights and a black & white TV.

The simple and hard-working people of Sona Mollar Dangi had never done anything to make Mother Nature angry. But they are facing the brunt of her anger anyway. While the rest of the world are debating who is blame for global warming and who is to pay for it, the resilient people of Sona Mollar Dangi stand out as a radiant example of how to brave climate change.



Photo: A house in Sona Molla village

## V. MITIGATION

41. Even though Bangladesh's contribution to the generation of greenhouse gases is miniscule, Bangladesh wishes to play its part in reducing emissions now and in the future (see Box 6). The Government of Bangladesh emphasises energy efficiency as well as renewable energy development, particularly solar homes and biogas plants. In recent years, in partnership with civil society, it has implemented a major nationwide programme of social forestry and has planted coastal 'greenbelts' as a key adaptation-mitigation strategy. As we industrialise and develop our coal reserves, we will seek the transfer of state-of-the-art technologies

from developed countries to ensure that we follow a low-carbon growth path. Bangladesh is also committed to reducing greenhouse gas emissions from agriculture and urban waste management.

42. Currently, Bangladesh has two Clean Development Mechanism (CDM) projects concerned with solar energy and waste management. We look forward to increasing the number of similar programmes and experimenting with new instruments to generate carbon credits and facilitate carbon market financing in the future.

### Box 6: Greenhouse Gas (GHG) Emissions and Mitigation

Bangladesh's contribution to emission of green house gas (GHG) is miniscule. In 2005, the total GHG emissions from Annex 1 parties was 18.2 billion tonnes of CO<sub>2</sub> equivalent (excluding Land Use, Land Use Change and Forestry - LULUCF). Including LULUCF, it was 16.7 billion tonnes CO<sub>2</sub> equivalent. In contrast, the 122 non-Annex 1 parties emitted a total of 11.9 billion tonnes (with LUCF) and 11.7 (without LUCF). Bangladesh emitted only 0.053 to 0.045 billion tonnes (with or without LUCF) - less than one-fifth of one percent of world total - reflecting its extremely low consumption of energy.

Bangladesh is a low energy-consuming but energy-starved country. Its energy consumption in 2004-05 was 89 kg per capita. Only Nepal, among its neighbours in South Asia, consumes less energy on a per capita basis. Despite the low level of energy use, the country is unable to meet even the present demand for energy. This demand is likely to rise at least 50 percent faster GDP per capita in coming years. These figures indicate why energy security is a fundamental issue of development in Bangladesh. While there is scope to raise efficiency in production and consumption of energy, thus lowering GHG emissions, such activities must not jeopardise the legitimate demand for and supply of energy.

The other major sources of GHG emission in Bangladesh are methane from flooded rice fields and waste, particularly in urban areas. Raising irrigation and water use efficiency through improved agronomic practices and proper waste management is likely to lower emissions of methane from these sources.

## VI. TOWARDS A CLIMATE CHANGE STRATEGY AND ACTION PLAN

43. The Government of Bangladesh is committed to increase the country's resilience to climate change; reduce the risks climate change poses to national development; and rapidly develop the country, following a low-carbon growth path. We believe firmly that development is the most effective way to reduce poverty and build resilience to climate change.

44. To do this we have already made climate change an integral part of our national development strategy and have started to build the country's capacity (communities, civil society, the private sector and Government) so that we are able to tackle the impacts of climate change, in a routine way, as part of the development process. We must scale up this work urgently. Any delay will increase the risks associated with climate change, which could be expensive to manage later on but, more importantly, the human costs will be immeasurable. Our strategy prioritises adaptation, but also focuses on low carbon development, mitigation, technology transfer and the provision of adequate finance.

45. The Government of Bangladesh has recently established a National Climate Change Fund, with an initial capitalisation of \$45 million, which will focus mainly on adaptation. We are also going beyond our borders to try to find common cause with our

neighbours to manage climate change impacts through regional action plans, as demonstrated in the 2008 SAARC Ministers of Environment meeting, held in Dhaka. We are also seeking to enhance cooperation with neighbours on key issues, including water security.

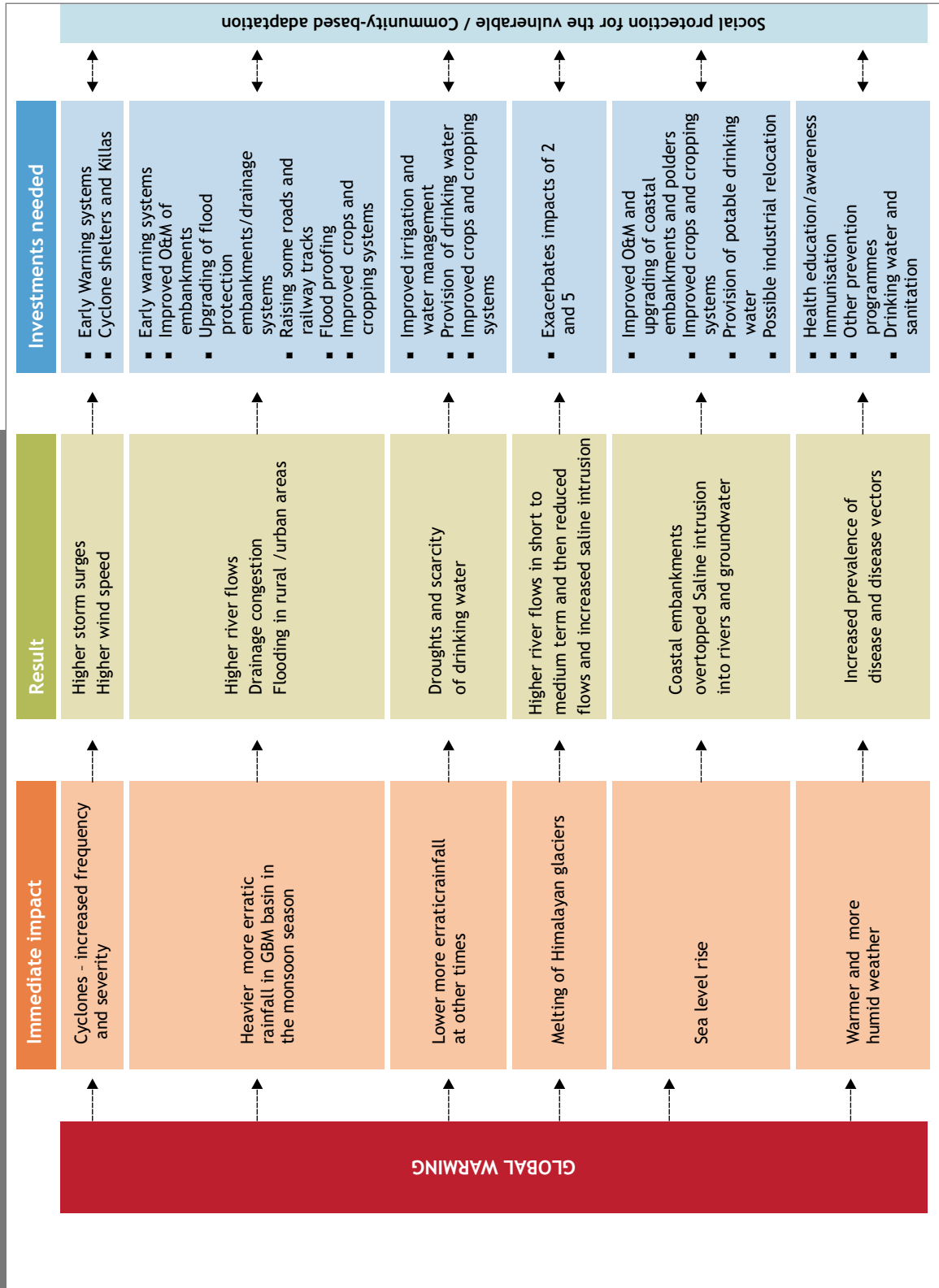
46. The National Adaptation Programme of Action (NAPA), launched by the Government of Bangladesh, in 2005, provided a response to the urgent and immediate needs of adaptation and identified priority programmes. The National Capacity Self-Assessment for implementing the provisions of multilateral agreements, including the Climate Change Convention, was launched in 2007.

47. Adaptation to climate change will place a massive burden on Bangladesh's development budget and international support will be essential to help us rise to the challenge. **Bangladesh is seeking the strong political commitment and support of the international community to assist in implementing its long-term climate-resilient strategy. We call on the international community to provide the resources needed to meet the additional costs of building climate resilience.**

48. The likely impacts of global warming on Bangladesh and required types of investment are shown in the schematic diagram in Box 7.



Box 7: Likely impacts of global warming on Bangladesh and required investments



Note: The arrows in this diagram are not meant to denote linear relationships between boxes. The relationships between and within boxes are very complex and are not captured by this diagram

## THE CLIMATE CHANGE ACTION PLAN

49. The Climate Change Action Plan is a 10-year programme (2009-2018) to build the capacity and resilience of the country to meet the challenge of climate change. The needs of the poor and vulnerable, including women and children, will be mainstreamed in all activities under the Action Plan. In the first five year period (2009-13), the programme will comprise six pillars:

### 1. Food security, social protection and health

Climate change is likely to impact most severely on the poorest and most vulnerable in society. Every effort will be made to ensure that they are protected and that all programmes focus on the needs of this group for food security, safe housing, employment and access to basic services, including health. Under this pillar we will:

- 1.1 Increase the resilience of vulnerable groups, including women and children, through development of community-level adaptation, livelihood diversification, better access to basic services and social protection (e.g., safety nets, insurance) and scaling up
- 1.2 Develop climate change resilient cropping systems (e.g., agricultural research to develop crop varieties, which are tolerant of flooding, drought and salinity, and based on indigenous and other varieties suited to the needs of resource poor farmers), fisheries and livestock systems to ensure local and national food security
- 1.3 Implement surveillance systems for existing and new disease risks and ensure health systems are geared up to meet future demands
- 1.4 Implement drinking water and sanitation programmes in areas at risk from climate change (e.g., coastal areas, flood-and drought-prone areas)

### 2. Comprehensive Disaster Management

Comprehensive Disaster Management systems will be further strengthened to deal with the increasingly frequent and severe natural catastrophes as a result of climate change. We will build on and extend our proven experience in this area. Under this pillar we will:

- 2.1 Strengthen the government's capacity and that of civil society partners and communities to manage natural disasters, and ensure that appropriate policies, laws and regulations are in place
- 2.2 Strengthen community-based adaptation programmes and establish them in each of the disaster-prone parts of the country
- 2.3 Strengthen our cyclone, storm surge and flood early warning systems to enable more accurate short, medium and long-term forecasts

### 3. Infrastructure

It is imperative that existing infrastructure (e.g., coastal and river embankments) is well-maintained and fit-for-purpose and that urgently needed infrastructure (e.g., cyclone shelters, urban drainage) is put in place to deal with the likely short and medium-term impacts of climate change. Under this pillar we will:

- 3.1 Repair and rehabilitate existing infrastructure (e.g., coastal embankments, river embankments and drainage systems, urban drainage systems) and ensure effective operation and maintenance systems
- 3.2 Plan, design and construct urgently needed new infrastructure (e.g., cyclone shelters, coastal and river embankments and water management systems; urban drainage systems, river erosion control works, flood shelters) to meet the changing conditions expected with climate change
- 3.3 Undertake strategic planning of future infrastructure needs, taking into account the likely (a) future patterns of urbanisation and socio-economic development; and (b) the changing hydrology of the country, because of climate change

### 4. Research and knowledge management

Research will be undertaken to estimate the likely scale and timing of climate change impacts on different sectors of the economy, to inform planning of future investment strategies. We will also ensure that Bangladesh is effectively linked to regional and national knowledge networks, so that Bangladeshi organisations and the general public are aware of the latest research, lessons and technologies available in other countries. Under this pillar we will:

- 4.1 Model climate change scenarios for Bangladesh by applying global climate change models and methodologies at regional and national levels
- 4.2 Model the likely hydrological impacts of climate change on the Ganges-Brahmaputra-Meghna system to assess likely future system discharges and river levels in order to derive design criteria for flood protection embankments
- 4.3 Monitor and research the impacts of climate change on ecosystems and biodiversity
- 4.4 Research the likely impacts of climate change on the macro-economy of Bangladesh (a Bangladesh 'Stern Report') and key sectors (e.g., livelihoods and food security) and contribute to developing a climate-proof national development plan
- 4.5 Research the linkages between (a) climate change, poverty and vulnerability and (b) climate change, poverty and health (disease incidence, nutrition, water, sanitation) in order to identify possible interventions to increase the resilience of poor and vulnerable households to climate change
- 4.6 Establish a Centre for Research and Knowledge Management on Climate Change (or a network of centres) to ensure Bangladesh has access to the latest ideas and technologies from around the world, and ensure that data is widely and freely available to researchers

## 5. Mitigation and low carbon development

Even though Bangladesh's contribution to the generation of greenhouse gases is very low, we wish to play our part in reducing emissions now and in the future. Under this pillar we will:

- 5.1 Develop a strategic energy plan and investment portfolio to ensure national energy security and lower greenhouse gas emissions
- 5.2 Expand the social forestry programme on government and community lands throughout the country
- 5.3 Expand the 'greenbelt' coastal afforestation programme with mangrove planting along the shoreline
- 5.4 Seek the transfer of state-of the art technologies from developed countries to ensure that we follow a low-carbon growth path (e.g., 'clean coal' and other technologies)
- 5.5 Review energy and technology policies and incentives and revise these, where necessary, to promote efficient production, consumption, distribution and use of energy

## 6. Capacity building and institutional strengthening

To meet the challenge of climate change, the capacity of government ministries and agencies, civil society and the private sector will be strengthened. Under this pillar, we will:

- 6.1 Review and revise, where appropriate, all government policies (sector by sector) to ensure that they take full account of climate change and its impacts
- 6.2 Mainstream climate change in national, sectoral and spatial development planning (in government ministries and agencies, local government, the private sector, civil society and communities) and ensure that impacts on vulnerable groups and women are prioritised in plans
- 6.3 Build the capacity of key government ministries and agencies to take forward climate change adaptation (e.g., Ministry of Food and Disaster Management, Bangladesh Water Development Board, Local Government Engineering Department; National Agricultural Research System, the health system, the Ministry of Women's and Children's Affairs)
- 6.4 Build the capacity of the government to undertake international and regional negotiations on climate change. Regional and international cooperation is essential in order to build necessary capacity and resilience
- 6.6 Build the capacity of the government, civil society and the private sector on carbon financing to access various global climate funds

## Programmes and Sub-programmes

50. Details of the Programmes and Sub-programmes to be implemented under the Action Plan are given in Annex 1.

## Implementing the Action Plan

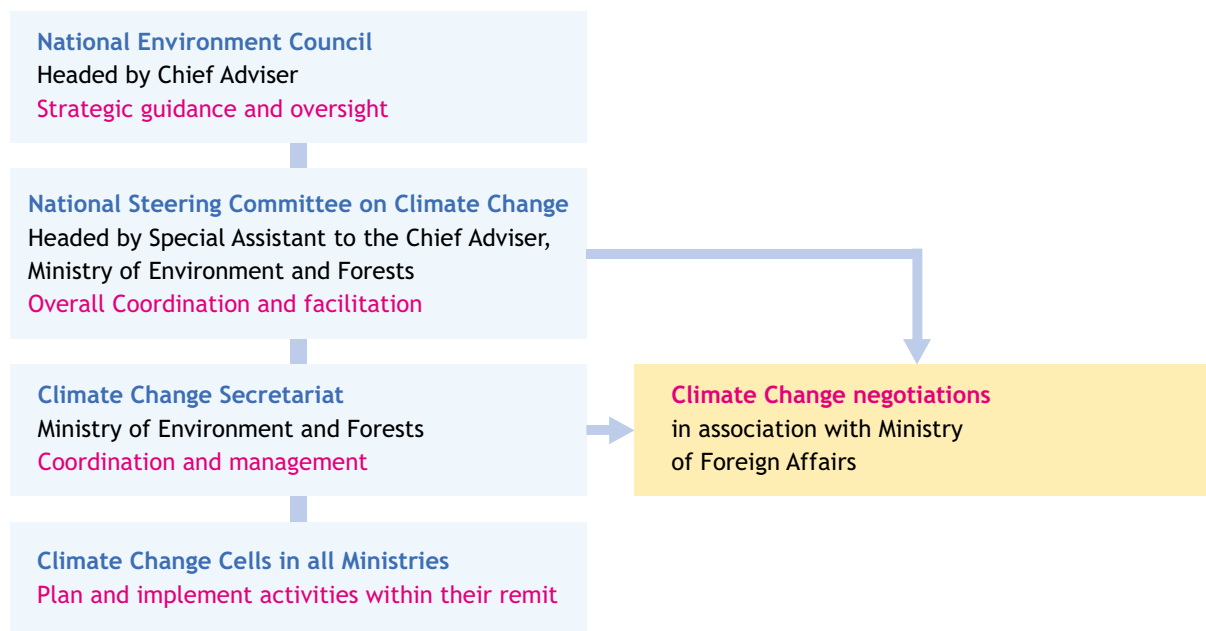
51. The Government of Bangladesh recognises that we need to strengthen our institutions to respond effectively to the enormous challenges of climate change. A National Steering Committee on Climate Change has been established to coordinate and facilitate national actions on climate change (see Box 8). It is chaired by the Special Assistant to the Chief Adviser and comprises the Secretaries of all climate-affected Ministries and Divisions, and representatives of civil society and the business community. It reports to the National Environment Committee, chaired by the Chief Adviser. The National Environment Committee and the National

Steering Committee on Climate Change also provide guidance on international climate change negotiations, including bilateral, multilateral and regional programmes for collaboration, research, exchange of information and development. A Climate Change Secretariat will be set up in the Ministry of Environment and Forests, to support the National Steering Committee on Climate Change. It will work with climate change cells in all ministries.

52. The Bangladesh Climate Change Strategy and Action Plan was developed through a participatory process involving all relevant Ministries and agencies, civil society, research organisations and the business community. Programmes funded under the Action Plan will be implemented by line ministries and agencies, with participation, as appropriate, of other stakeholder groups, including civil society, professional and research bodies and the private sector.

53. The BCCSAP will be reviewed periodically and revised, as necessary, in line with emerging scientific and technical knowledge and the outcomes of global negotiations under UNFCCC and other UN-led climate change negotiation processes.

Box 8: Climate Change Action Plan Organisation Chart



## Financing the Action Plan

**54.** The Ministry of Environment and Forests is currently working out the cost of implementing the ten-year Action Plan, in consultation with Line Ministries. A distinction is being made between activities which are part of the regular national development programme and the incremental work that will be financed under the Action Plan. Cost-effective priority programmes for immediate implementation and others to be started in the next 5 years will be identified, with special attention on the needs of the poorest and most vulnerable in society, the need to create an enabling environment to promote climate resilient investment, and on ensuring that knowledge, data and experience on adaptation is shared with other countries in the region.

**55.** It is estimated that a \$500 million programme will need to be initiated in Years 1 and 2 (e.g., for immediate actions such as strengthening disaster management, research and knowledge management, capacity building and public awareness programmes, and urgent investments such as cyclone shelters and selected drainage programmes) and that the total cost of programmes commencing in the first 5 years could be of the order of \$5 billion.

**56.** The Government of Bangladesh has established a National Climate Change Fund. Development partners may contribute to this fund, establish different funds or use other financing mechanisms.



## ANNEX 1 BCCSAP PROGRAMMES

<b>Theme</b>	<b>T1: Food Security, Social Protection and Health</b>
<b>Programme</b>	<ul style="list-style-type: none"> <li>P1. Institutional capacity for research towards climate resilient cultivars and their dissemination</li> <li>P2. Development of climate resilient cropping systems</li> <li>P3. Adaptation against drought</li> <li>P4. Adaptation in fisheries sector</li> <li>P5. Adaptation in livestock sector</li> <li>P6. Adaptation in health sector</li> <li>P7. Water and sanitation programme in climate vulnerable areas</li> <li>P8. Livelihood protection in ecologically fragile areas</li> <li>P9. Livelihood protection of vulnerable socio-economic groups (including women)</li> </ul>
<b>Theme</b>	<b>T2: Comprehensive Disaster Management</b>
<b>Programme</b>	<ul style="list-style-type: none"> <li>P1. Improvement of flood forecasting and early warning</li> <li>P2. Improvement of cyclone and storm surge warning</li> <li>P3. Awareness raising and public education towards climate resilience</li> <li>P4. Risk management against loss on income and property</li> </ul>
<b>Theme</b>	<b>T3 : Infrastructure</b>
<b>Programme</b>	<ul style="list-style-type: none"> <li>P1. Repair and maintenance of existing flood embankments</li> <li>P2. Repair and maintenance of cyclone shelters</li> <li>P3. Repair and maintenance of existing coastal polders</li> <li>P4. Improvement of urban drainage</li> <li>P5. Adaptation against Floods</li> <li>P6. Adaptation against tropical cyclones and storm surges</li> <li>P7. Planning and design of river training works</li> </ul>
<b>Theme</b>	<b>T4: Research and Knowledge Management</b>
<b>Programme</b>	<ul style="list-style-type: none"> <li>P1. Establishment of a centre for knowledge management and training on climate change</li> <li>P2. Climate change modelling at national and sub-national levels</li> <li>P3. Preparatory studies for adaptation against sea level rise</li> <li>P4. Monitoring of ecosystem and biodiversity changes and their impacts</li> <li>P5. Macroeconomic and sectoral economic impacts of climate change</li> </ul>
<b>Theme</b>	<b>T5: Mitigation and Low Carbon Development</b>
<b>Programme</b>	<ul style="list-style-type: none"> <li>P1. Improved energy efficiency in production and consumption of energy</li> <li>P2. Gas exploration and reservoir management</li> <li>P3. Development of coal mines and coal fired power stations</li> <li>P4. Renewable energy development</li> <li>P5. Lower emission from agricultural land</li> <li>P6. Management of urban waste</li> <li>P7. Afforestation and reforestation programme</li> </ul>
<b>Theme</b>	<b>T6: Capacity Building and Institutional Strengthening</b>
<b>Programme</b>	<ul style="list-style-type: none"> <li>P1. Revision of sectoral policies for climate resilience</li> <li>P2. Main-streaming climate change in national, sectoral and spatial development programmes</li> <li>P3. Strengthening human resource capacity</li> <li>P4. Strengthening institutional capacity for climate change management</li> <li>P5. Main-streaming Climate Change in the Media</li> </ul>



## Programme – T1P1

<b>Theme</b>	T1. Food Security, Social Protection and Health
<b>Programme</b>	P1. Institutional capacity and research towards climate resilient cultivars and their dissemination
<b>Objective</b>	To build the institutional capacity of research centres and expertise of researchers to develop climate resilient cultivars of food and other crops.
<b>Justification</b>	<p>Global warming will alter the ambient conditions under which crops grow. Initially, higher temperatures and increased concentrations of carbon dioxide may increase food grain yields due to increased photosynthesis. However, temperatures are predicted to increase by over 2° C and carbon dioxide concentrations to exceed more than 450 ppm, which will reduce yields of current cultivars of cereals, such as rice and wheat. In addition, increased droughts, floods and saline intrusion, in different parts of the country, will also cause crop losses</p> <p>Research work has started at BIRRI, BARI and other research centres under NARS to develop cultivars adapted to likely future climatic conditions. There is an urgent need to develop the research capacity of these institutes and scientists, and to provide better research facilities</p> <p>The impact of climate change on many other food (e.g., potatoes) and non-food crops (e.g., jute) is largely unknown. Research must be initiated to understand these impacts and find out how to minimise adverse changes</p> <p>It takes 7-8 years to breed new cultivars, certify them and release to the farmers through the extension system. In view of this, indigenous varieties will be screened to identify those that can withstand, at least partially, the adverse impacts of climate change on yields. After participatory field trials, they will be disseminated to farmers</p>
<b>Actions</b>	<ol style="list-style-type: none"> <li>A1. Collection and preservation of local varieties of robust cultivars and documentation of their characteristics</li> <li>A2. Research to develop climate resilient varieties of rice (i.e., heat, drought, salinity and submergence- tolerant varieties)</li> <li>A3. Research to develop climate resilient cultivars of wheat and other food and non-food crops, including vegetables</li> <li>A4. Field trials and dissemination to farmers of the local robust cultivars and the newly developed varieties, in partnership with the extension service and NGOs</li> <li>A5. Strengthening the capacity of key research institutes and scientists to undertake the work</li> </ol>
<b>Timeline</b>	Medium to Long term
<b>Responsibility</b>	BIRRI, BARI and other NARS organisation

## Programme – T1P2

<b>Theme</b>	T1. Food Security, Social Protection and Health
<b>Programme</b>	P2. Development of climate resilient cropping systems
<b>Objective</b>	The development of climate resilient cropping systems appropriate to different agro-climatic regions and sub-regions
<b>Justification</b>	<p>It is predicted that climate change will result in increasingly frequent and severe floods in the central part of the country; flash floods in the north-eastern and eastern parts of Bangladesh, adjacent to Meghalaya and Tripura; and droughts and low and erratic rainfall in north-western and western Bangladesh. Salinity is likely to increase in the south-western and south central parts of the country; rainfall is likely to become more erratic in the Chittagong Hills; and, the coastal islands will face increased salinity and cyclonic weather.</p> <p>These changes will require farmers to modify their current cropping systems or change to alternative systems. Research is needed to develop and field test alternative systems, adapted to likely future conditions, so that choices are available for farmers as climatic conditions change. The associated seed supply and extension mechanisms also have to be developed</p> <p>Research and development will be undertaken by BRRI, BARI and other national research institutes and their regional research stations (see T1P1), in partnership with selected NGOs</p>
<b>Actions</b>	<ul style="list-style-type: none"><li>A1. Identify likely changes in agro-economic zones and probable climatic parameters</li><li>A2. Develop climate resilient cropping patterns suited to different regions of the country</li><li>A3. Field level trials of climate resilient cropping patterns and associated water management systems</li><li>A4. Develop seed supply and extension mechanisms</li></ul>
<b>Timeline</b>	Medium and long term
<b>Responsibility</b>	Ministry of Agriculture, NARS

## Programme – T1P3

Theme	T1. Food Security, Social Protection and Health
Programme	P3. Adaptation against drought
Objective	To develop drought management options for farmers
Justification	<p>Climate change is likely to result in increasingly erratic rainfall patterns and droughts</p> <p>Traditionally the main rice crop was <i>aman</i>, which was planted in the monsoon and harvested in the post-monsoon period. It currently accounts for over 40% of rice production. Since <i>aman</i> can suffer from drought stress, farmers developed indigenous methods of supplementary irrigation. Since Independence, major irrigation projects (e.g., the GK Project and Teesta Barrage) were developed to provide supplementary irrigation in the worst affected parts of the country</p> <p>Farmers in these areas are currently reporting increasingly frequent drought affecting the <i>aman</i> crop. With climate change, these conditions are likely to be exacerbated. The development of appropriate adaptive measures combining robust indigenous and new cultivars (T1P1), new cropping systems (T1P2) and improved water management practices need to be developed, tested and disseminated to farmers</p>
Actions	<p>A1. Prepare GIS maps of areas vulnerable to droughts</p> <p>A2. Develop and test adaptive measures in drought-prone areas by combining appropriate cultivars, cropping patterns and land and water management practices, and effective dissemination to farmers</p>
Timeline	Short to medium term
Responsibility	Ministry of Agriculture and Ministry of Water Resources, in association with the extension service

## Programme – T1P4

<b>Theme</b>	T1. Food Security, Social Protection and Health
<b>Programme</b>	P4. Adaptation in the fisheries sector
<b>Objective</b>	The development of adaptation strategies in the fisheries sector
<b>Justification</b>	<p>Climate change is likely to adversely affect freshwater and marine fisheries in Bangladesh (e.g., the spawning of freshwater species; water temperatures in ponds and inland fisheries are likely to increase; saline water is likely to extend further inland in the south of the country, which will change the aquatic ecosystem and production of fish in this zone; and turbulent and rough weather along the coast may prevail for longer durations adversely impacting on the livelihoods of fishermen)</p> <p>It is important that these potential impacts are identified and research and management strategies developed, tested and made ready, in anticipation of climate-related changes</p>
<b>Actions</b>	<ul style="list-style-type: none"><li>A1. Assess potential threats to fish spawning and growth of fish in the freshwater fisheries sector and develop adaptive measures, including pond fisheries, river-based cage aquaculture etc</li><li>A2. Assess potential threats to fish spawning and growth of fish in the coastal zone and brackish water and develop appropriate adaptive measures and cultural practices</li><li>A3. Assess potential threats to the marine fish sector and develop adaptive measures</li><li>A4. Assess potential impacts on the shrimp sector and develop appropriate adaptive measures and cultural practices</li></ul>
<b>Timeline</b>	Medium to long term
<b>Responsibility</b>	Ministry of Fisheries and Livestock, Department of Fisheries, Fisheries Research Institute, in association with selected NGOs

## Programme – T1P5

<b>Theme</b>	T1. Food Security, Social Protection and Health
<b>Programme</b>	P5. Adaptation in livestock sector
<b>Objective</b>	Development of options for adaptation in the livestock sector
<b>Justification</b>	<p>Higher ambient temperatures, as well as floods and droughts, are likely to adversely affect poultry and livestock. Higher temperatures will limit the growth of chicken, broilers and other birds such as pigeons and ducks. Grazing lands may no longer be productive due to rising salinity in coastal areas and droughts. Higher temperatures and humidity may affect animal health through the more rapid breeding of parasites and bacteria. These changes are likely to seriously affect the livelihoods of livestock farmers and the availability of livestock products in Bangladesh</p> <p>It is necessary to understand these processes, develop appropriate adaptive measures, field test them and make them available to livestock and poultry farmers, many of whom are among the poorest and most vulnerable people in the country</p>
<b>Actions</b>	<p>A1. Assess potential threats to the poultry sector, develop adaptive measures and disseminate among farmers</p> <p>A2 . Assess potential threats to the livestock sector, develop adaptive measures and disseminate among farmers</p> <p>A3. Strengthen veterinary services systems, including animal health measures in light of the likely increase in disease prevalence</p>
<b>Timeline</b>	Medium to long term
<b>Responsibility</b>	Ministry of Fisheries and Livestock, Department of Livestock, Bangladesh Livestock Research Centre, in association with selected NGOs

## Programme – T1P6

<b>Theme</b>	T1. Food Security, Social Protection and Health
<b>Programme</b>	P6. Adaptation in health sector
<b>Objective</b>	Research and monitoring on the impacts of climate change on disease patterns and the social and economic costs of disease. Develop adaptative measures
<b>Justification</b>	<p>The 4<sup>th</sup> IPCC report indicates that one of the major impacts of global warming and climate change will be an increase in vector borne diseases (e.g., malaria and dengue fever). Recent studies by the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B) demonstrate that diarrhoeal diseases are on the increase, which they attribute partly to increased flooding and drainage congestion. This is expected to get worse with climate change. Global warming will also raise temperatures in the summer season, increasing the incidence of heat strokes, which could be further aggravated by shortages of drinking water. Possible other threats from other vector borne diseases such as Kala-azar and typhoid have yet to be assessed</p> <p>It is important that the monitoring of diseases linked to climate change is upgraded and research undertaken to develop adaptative strategies that can be put in place as needs emerge</p>
<b>Actions</b>	<ul style="list-style-type: none"><li>A1. Research on the impact of climate change on health (including the incidence of malaria and dengue, diarrhoeal diseases, heatstroke) and the cost to society of increased mortality, morbidity and consequent fall in productivity</li><li>A2. Develop adaptive strategies against outbreaks of malaria, dengue and other vector borne diseases and invest in preventive and curative measures and facilities</li><li>A3. Develop adaptive strategies against diarrhoeal and other diseases, which may increase due to climate change, and invest in preventive and curative measures and facilities</li></ul>
<b>Timeline</b>	Medium to long term
<b>Responsibility</b>	Ministry of Health and Family Planning, in association with research centres (IDCCR,B) and others

## Programme – T1P7

<b>Theme</b>	T1. Food Security, Social Protection and Health
<b>Programme</b>	P7. Water and sanitation programme for climate vulnerable areas
<b>Objective</b>	Ensure adequate water supplies and improved sanitation
<b>Justification</b>	<p>One of the MDG targets (under MDG 7) aims to halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation</p> <p>Attainment of this MDG target in Bangladesh will be seriously challenged by climate change. Access to drinking water, which is already a problem in parts of the country (e.g., areas with saline surface and groundwater; drought-prone areas) is likely to get worse. Sanitation will be affected by poor drainage and flooding in many parts of the country</p> <p>In Bangladesh, the increasing prevalence of droughts will adversely affect availability of surface water and drinking water from hand tubewells and will require investment in deep set ground water technologies, conservation of water and rainfall harvesting, in some regions. Also, in the coastal zone, as sea level rises, salinity will move inland making safe drinking availability a big challenge. Urban areas are likely to be especially vulnerable to reduced surface and groundwater availability</p> <p>There is a need to monitor the availability of drinking water (both quantity and quality) and to develop strategies to increase supplies of drinking water and to provide improved sanitation services, as climate change becomes evident</p> <p>In the meantime, every effort should be made to ensure that people currently living in drought-prone and saline affected areas are provided with adequate services</p>
<b>Actions</b>	<p>A1. Monitor changes in water quality and quantity available for drinking and forecast future changes due to climate change</p> <p>A2. Plan for and invest in additional water supply and sanitation facilities</p>
<b>Timeline</b>	Short, medium and long term
<b>Responsibility</b>	Ministry of Local Government and various local government bodies and NGOs in rural and urban Bangladesh

## Programme – T1P8

<b>Theme</b>	T1. Food Security, Social Protection and Health
<b>Programme</b>	P8. Livelihood protection in ecologically fragile areas
<b>Objective</b>	To address, in a timely and effective way, adverse impacts on livelihoods in ecologically vulnerable areas
<b>Justification</b>	Climate change will impact upon the regions in Bangladesh in different ways. Those which are already ecologically fragile may become more so due to changes in temperature and more erratic rainfall patterns. Climate related disasters may destroy people's homes, and incomes and employment could be threatened in many areas. Strategies will be needed to help people in these regions become climate resilient and ensure their economic and social well-being. Special attention will be paid to impacts on women and children. Affected regions are likely to include the coastal zone, river chars, hilly areas (e.g., the Hill Tracts) and inland wetland areas
<b>Actions</b>	A1. Comprehensive and participatory planning and investment for climate resilience against erosion in income, employment and human health in coastal, char, hilly and wetland regions
<b>Timeline</b>	Short, medium and long term
<b>Responsibility</b>	Various line ministries, in collaboration with NGOs



## Programme – T1P9

<b>Theme</b>	T1. Food Security, Social Protection and Health
<b>Programme</b>	P9. Livelihood protection of vulnerable socio-economic groups (including women)
<b>Objective</b>	Ensure equitable and sustainable development of all vulnerable socio-economic groups
<b>Justification</b>	<p>Climate change will impact on different socio-economic groups in Bangladesh in various ways. The poor and the non-poor will be affected differently because of their contrasting asset bases and incomes. Among the poor, however, some groups will be more vulnerable than others. The most vulnerable may need support to maintain their livelihoods. T1P8 will focus on people living in ecologically fragile areas. This programme will address the needs of the poor and vulnerable, across the country</p> <p>Groups that will be considered include: fishing families, who will be affected by changes in freshwater and marine ecosystems; poor and marginal farmers, who will be at greater risk from crop failure than better-off farmers and will need special attention to protect them from income losses due to climate change; people who are physically and mentally challenged who may need special protection. Women and children are generally more vulnerable than men, especially in poor households, and all programmes will thus prioritise the needs of women and children</p> <p>In some cases, the programme will provide protection against loss of employment and income, in others, health needs may be more acute; and for some social welfare measures through transfer programmes may be necessary. It will be necessary to assess the needs of vulnerable groups separately and tailor programmes of support accordingly</p>
<b>Actions</b>	<p>A1. Comprehensive and participatory planning and investment to protect the livelihoods (income, employment, health) of groups who will be especially severely impacted by climate change (e.g., marginal and small farmers, fishermen particularly those fishing in estuaries and the seas, the infirm and elderly, people with physical and mental disabilities)</p> <p>A2. Comprehensive study of the impact of climate change on women and gender relations and the development of recommendations to address these in all actions under the BCCSAP</p>
<b>Timeline</b>	Short, medium and long term
<b>Responsibility</b>	Various line ministries, including Agriculture, Food and Disaster Management, Women's Affairs, and Health, in partnership with NGOs

## Programme – T2P1

<b>Theme</b>	T2. Comprehensive Disaster Management
<b>Programme</b>	P1. Improvement of flood forecasting and early warning systems
<b>Objective</b>	Improvement of the existing flood forecasting and early warning systems by increasing lead times and strengthening dissemination mechanisms
<b>Justification</b>	<p>Bangladesh is highly regarded for its competence in flood forecasting and early warning systems. Currently, the Flood Forecasting and Warning Centre (FFWC) of the Bangladesh Water Development Board (BWDB) issues flood levels forecasts for 24, 48 and 72 hours. These forecasts are released through e-mails as well as placed on a web-site. However, there is scope for improvement</p> <p>1. <u>Dissemination</u>. The current practice of releasing warnings in terms of river stage are not easily understood by local communities, while the absence of digital elevation models (DEM) makes it difficult for flood forecasting modellers to relate river stage to likely flood levels at different locations in the countryside. T3P5, below, would develop a DEM for areas vulnerable to floods. It is important that this is used by flood forecasters, together with information on river stages to improve forecasts for floodplain communities</p> <p>2. <u>Lead times</u>. It would be helpful to communities and the authorities to have longer range forecasts, even though they are not always reliable. FFWC has the capacity to make 10 day forecasts. It should be encouraged to do so and the usefulness of the new forecasts assessed</p>
<b>Actions</b>	<p>A1. Review of the hydro-meteorological data network and the setting up of telemetric stations</p> <p>A2. Improvement in dissemination of warnings by (a) combining river stage and DEM information; and (b) making 10 day forecasts</p> <p>A3. Awareness building programmes at community level on warnings produced and released by FFWC</p>
<b>Timeline</b>	Immediate and continuing
<b>Responsibility</b>	Ministry of Water Resources and its various agencies; civil society organizations active in disaster management and media

## Programme – T2P2

<b>Theme</b>	T2. Comprehensive Disaster Management
<b>Programme</b>	P2. Improvement of cyclone and storm-surge warning
<b>Objective</b>	Improvements in cyclone and storm surge warnings and dissemination
<b>Justification</b>	<p>One of the main impacts of global warming may be an increase in cyclonic weather and storm-surges. Dissemination of cyclone and storm-surge warnings is done, at community level, through the Cyclone Preparedness Programme (CPP) Volunteers of the Bangladesh Red Crescent Society (BDRCS). The CPP, managed by the BDRCS and supported by the Ministry of Food and Disaster Management, covers the Chittagong coastal belt as well as the south-central part of Bangladesh. During Cyclone Sidr, gaps in the CPP network were exposed. There is thus an urgent need to review the system and make improvements, where necessary</p> <p>In recent years, the Bay of Bengal has become more turbulent, with Warning No-3 announced more frequently than before. Traditionally, rough seas were experienced during pre-monsoon and post-monsoon periods. Now turbulent seas occur virtually round the year. Rough seas adversely affect the fishing practices and livelihoods of fishermen. The entire coastline of Bangladesh is vulnerable to cyclones and associated storm-surges</p> <p>Bangladesh follows a set of warning numbers, ranging from 1 - 11 that was originally designed for maritime shipping and inland navigation. To make it more relevant to communities it has recently been revised. The newly revised warning system is yet to be put in to practice. A major campaign must be launched to introduce the new warning system</p>
<b>Actions</b>	<p>A1. Review of the present cyclone and storm-surge warning systems and make improvements, where necessary</p> <p>A2. Improvement in cyclone and storm-surge warning dissemination to local communities, through awareness campaigns</p>
<b>Timeline</b>	Immediate
<b>Responsibility</b>	Ministry of Food and Disaster Management, Bangladesh Red Crescent Society, NGOs and CBOs (community based organisations) working in the coastal areas and media

## Programme – T2P3

<b>Theme</b>	T2. Comprehensive Disaster Management
<b>Programme</b>	P3. Awareness raising and public education towards climate resilience
<b>Objective</b>	Community based disaster preparedness and improved resilience
<b>Justification</b>	<p>A major result of climate change is likely to be an increase in climate-related natural disasters. There may be an increase in the magnitude and intensity of floods, agricultural droughts, storm-surges and cyclones, and other disasters (e.g., coastal and river bank erosion and landslides triggered by heavy rainfall and drainage congestion in urban areas)</p> <p>Bangladesh has developed a comprehensive and effective disaster management system. The Standing Order on Disaster provides guidance to local communities and the authorities, at various levels, on their roles and responsibilities during and immediately after a disaster has struck. It also lays out procedures for alerting local communities when a disaster such as a flood, cyclone or storm-surge is likely to occur</p> <p>Despite this, there is a need to raise awareness among communities and officials at all levels on the likely increased incidence of natural disasters. Some areas where urgent attention may be given include shelter management, search and rescue and health issues during and after disasters</p>
<b>Actions</b>	<p>A1. Awareness raising programmes among local communities about impacts of Climate Change</p> <p>A2. Train local communities on shelter management, search and rescue, and health issues related to disaster management</p>
<b>Timeline</b>	Immediate and continuing
<b>Responsibility</b>	Ministry of Food and Disaster Management, Bangladesh Red Crescent Society, NGOs, CBOs working in the coastal areas, media (print and electronic)

## Programme – T2P4

<b>Theme</b>	T2. Comprehensive Disaster Management
<b>Programme</b>	P4. Risk management against loss of income and property
<b>Objective</b>	To put in place an effective insurance system for risk management against loss of income and property
<b>Justification</b>	Climate change is likely to result in loss of income and property to people, households, enterprises, and infrastructure. Communities and families try to climate proof in several ways (e.g., raising the mounds on which they build their houses to protect them from floods and the use of adapted varieties of crops). In addition, insurance against climate-related losses may also be an effective risk reduction mechanism. The Government will partner with the insurance industry and NGOs to develop new insurance products for people, households and enterprises against climate related losses
<b>Actions</b>	<ol style="list-style-type: none"><li>A1. Devise an effective insurance scheme for losses in property due to climate change impacts</li><li>A2. Develop an effective insurance scheme for loss of income from various sources to persons, households and enterprises</li><li>A3. Pilot the insurance schemes and if successful, establish insurance systems for lowering risk of adverse impact of climate change</li></ol>
<b>Timeline</b>	Medium to long term
<b>Responsibility</b>	Ministry of Finance and other line ministries, and the insurance sector and NGOs

## Programme – T3P1

<b>Theme</b>	T3. Infrastructure
<b>Programme</b>	P1. Repair and maintenance of existing flood embankments
<b>Objective</b>	Ensure continued flood protection by repairing and rehabilitating existing flood embankments
<b>Justification</b>	<p>Earthen embankments have been constructed by the Bangladesh Water Development Board (BWDB), along most major and medium-sized rivers in the country and also some minor rivers. They are the key structural component of the flood management system in the country</p> <p>The heights of the embankments were designed based on recent major floods and/or statistical analysis of past river stage data. For embankments along major rivers a 50 year return period was used. For protection of Dhaka city, the level of safety was a 100 year flood</p> <p>Many of these embankments are in poor shape due to lack of proper maintenance. In many places the embankments are cut by local people to drain water from the land into the rivers. Although these gaps are filled in again, these points remain vulnerable to breaches. In many places the appurtenant structures, such as sluices and regulators no longer function properly</p> <p>Embankments have provided security from flooding and, as a result, many people have moved into protected floodplain areas. The traditional approach of building homes on raised mounds has more or less been abandoned. Farmers go for high yielding variety of crops because of the security provided by the embankment and associated drainage systems. Given this, it is very important to rehabilitate existing river flood embankments so that they are fully functional and able to provide the level of security for which these were constructed</p>
<b>Actions</b>	A1. Assess the condition of all existing flood embankments and prepare GIS maps A2. Immediate repair and rehabilitation of existing embankments and appurtenant structures taking future forecast flood levels into account
<b>Timeline</b>	Immediate
<b>Responsibility</b>	Ministry of Water Resources and its agencies

## Programme – T3P2

<b>Theme</b>	T3. Infrastructure
<b>Programme</b>	P2. Repair and maintenance of existing cyclone shelters
<b>Objective</b>	To make existing cyclone shelters safe and functional
<b>Justification</b>	<p>The entire coastal belt of Bangladesh is vulnerable to cyclones and storm surges. Some of the major cyclonic storm surges in 1970, 1991 and 2007 exceeded 7 meters. Existing coastal embankments can be overtopped by high storm surges, which are likely to become more frequent with global warming. Most of the cyclone shelters constructed in 1960 and 1970 require urgent repair and maintenance. Many of the shelters built after 1991 cyclone also need repair</p> <p>The cyclone shelters in Bangladesh are considered a major success among disaster management professionals. However, during Cyclone Sidr, many people who sought refuge in cyclone shelters were scared for their safety because of the poor condition of the structures. As another storm surge may hit the coast of Bangladesh, anytime, and at any location, cyclone shelters along the entire coastal belt must be urgently made fully functional and operational</p>
<b>Actions</b>	<ol style="list-style-type: none"><li>A1. Survey and prepare GIS based maps showing the location of all cyclone shelters on the coastal belt of Bangladesh and a database describing their present status and repair needs</li><li>A2. Plan for the immediate repair and, where necessary, redesign of cyclone shelters, including their approach roads</li><li>A3. Repair and reconstruction of cyclone shelters and approach roads/tracks</li><li>A4. Awareness building in communities and establishment of Community Shelter Committees and running of training programmes, including regular rescue and rehabilitation practice</li></ol>
<b>Timeline</b>	Immediate
<b>Responsibility</b>	Ministry of Food and Disaster Management, Red Crescent Society, private sector under their CSR programmes and NGOs

## Programme – T3P3

<b>Theme</b>	T3. Infrastructure
<b>Programme</b>	P3. Repair and maintenance of existing coastal polders
<b>Objective</b>	Repair and reconstruct the existing polders in the coastal belt of the Bangladesh
<b>Justification</b>	<p>The coastal belt of Bangladesh faces severe cyclonic weather and storm surges at regular intervals. It is predicted that such natural calamities will hit the coastal belt with increasing frequency and intensity. The experience of Cyclone Sidr, in 2007, shows that damage was the greatest in unprotected areas and where the storm surge had breached the dyke (e.g., in Southkhali of Sharankhola Thana)</p> <p>For over 25 years, much of the coastline of Bangladesh has been protected by over 7,000 kms of earthen embankments in the form of polders. A recent study by CEGIS shows that most of the polders need urgent repair. People living behind these embankments enjoy security from high spring tides and have been able to improve their agricultural practices. Although, such dykes cannot protect against high cyclonic storm surges, they are critical to the livelihoods and safety of people in the region</p>
<b>Actions</b>	<ul style="list-style-type: none"><li>A1. Survey of the condition of coastal polders and preparation of GIS maps with present coverage of areas protected by these polders</li><li>A2. Plan, design and cost immediate repairs of existing dykes, based on future projected sea level rises and storm surges</li><li>A3. Reconstruction and repair of polders/embankments to design height and section</li></ul>
<b>Timeline</b>	Medium term
<b>Responsibility</b>	Ministry of Water Resources and its agencies



## Programme – T3P4

<b>Theme</b>	T3. Infrastructure
<b>Programme</b>	P4. Improvement of urban drainage
<b>Objective</b>	To prevent drainage congestion and water logging that may result from heavy rainfall in urban areas
<b>Justification</b>	<p>The current storm drainage systems of the major cities were designed using historical rainfall data. It is likely that these design capacities will be exceeded in future. One of the major impacts of climate change is likely to be an increase in the number of episodes of short duration and heavy rainfall. This will result in water logging due to drainage congestion</p> <p>Major cities will be increasingly vulnerable. Parts of Dhaka are already waterlogged regularly as the designed drainage capacity of the city's sewer system is not able to cope with the load. This has occurred a number of times in recent years and the frequency is increasing. In July 2007, Chittagong experienced unusually heavy rainfall that triggered a series of landslides and a major part of the city was waterlogged</p> <p>In existing cities, the drainage capacity of the sewer system must be improved to prevent major water logging. In new urban areas adequate sewers must be designed and constructed to take account of the likely impacts of climate change</p>
<b>Actions</b>	<ul style="list-style-type: none"><li>A1. Assess the drainage capacity of major cities (Dhaka, Chittagong, Rajshahi, Khulna) and investigate structural and non-structural causes of water logging within the cities and their immediate surroundings using hydro-dynamic models</li><li>A2. Assess the drainage capacity of selected old district towns (Comilla, Mymensingh, Sylhet, Barisal etc.) and investigate structural and non-structural causes of water logging within the cities and their immediate surroundings</li><li>A3. Design and invest in improvements in the drainage capacity of the major cities</li><li>A4. Design and invest in improvements in the drainage capacity of selected towns</li></ul>
<b>Timeline</b>	Medium term
<b>Responsibility</b>	Ministry of Local Government and Rural Development with the Local Government Engineering Department, Dhaka WASA, Chittagong WASA

## Programme – T3P5

<b>Theme</b>	T3. Infrastructure
<b>Programme</b>	P5. Adaptation against floods
<b>Objective</b>	To make flood prone areas more resilient
<b>Justification</b>	<p>One of the main impacts of climate change will be the increased frequency and intensity (duration and level) of floods. The main river floods in Bangladesh are the result of three major factors: (a) rainfall across the border in Assam, northern India and Nepal; river water levels in vulnerable areas prior to heavy rainfall; and (c) outfall conditions (i.e. level of the coastal water at Chandpur)</p> <p>The floods in 1995, 1998, 2000, 2004 and 2007 either exceeded the previous highest water level or rose very close to such levels. High floods are likely to be more common with climate change. The 3<sup>rd</sup> IPCC report predicted that monsoon rainfall could increase by at least one-third over the next fifty years. This would result in the over-topping of existing flood embankments (T3P1)</p> <p>In view of this, hydrological modelling of the Brahmaputra-Ganges-Meghna basin, for different climate change scenarios is needed to estimate future river flows and flood risks. Based on these data, a plan to upgrade structural measures against likely future floods can be made</p> <p>Key non-structural measures for flood management include flood proofing and flood plain zoning. Once a new flood vulnerability map and associated Digital Elevation Model is developed, flood proofing measures may be planned, especially in the most vulnerable areas, including <i>chars</i>. Flood plain zoning will also support setting up of high value infrastructure such as power stations and industrial units in safe locations</p>
<b>Actions</b>	<ul style="list-style-type: none"> <li>A1. Hydrological modelling of the Brahmaputra-Ganges-Meghna Basin against future climate change scenarios to estimate future flood levels and risks in Bangladesh</li> <li>A2. Develop a Flood Vulnerability Map based on future projected climatic parameters</li> <li>A3. Plan, design and construct flood management infrastructure (embankments and/or others as appropriate) in light of likely future flood levels</li> <li>A4. Flood Plain Zoning corresponding to various levels of vulnerability</li> <li>A5. Long term improvement of flood forecasting and warning including installation of a telemetric network and weather and hydrological RADARS, and development of Digital Elevation Models (DEM)</li> <li>A6. Plan and implement non-structural flood-proofing measures</li> </ul>
<b>Timeline</b>	Medium to long term
<b>Responsibility</b>	Ministry of Water Resources and its agencies

## Programme – T3P6

<b>Theme</b>	T3. Infrastructure
<b>Programme</b>	P6. Adaptation against future cyclones and storm-surges
<b>Objective</b>	Plan and implement an investment programme to ensure that the coastal area, including all islands, adapts to future cyclones and storm surges
<b>Justification</b>	<p>The entire coastal belt of Bangladesh is vulnerable to cyclones and storm surges. Under T3P2 and T3P3, existing embankments and shelters would be repaired. This programme would provide for protection against future increases in tropical cyclones and storm surges, due to climate change</p> <p>To protect the coastal belt, an extensive network of polders has already been constructed in Bangladesh. However, with the sea level rises expected as a result of climate change, the heights of the dykes will need to be raised further. Also, there are some additional lands and small islands, which need to be protected through the construction of new polders or extension of existing ones</p> <p>With sea level rise, drainage congestion may become a major problem in the polders. River levels will be higher, making it more difficult to drain local rainfall from the polders. Also, the capacity of the existing sluices and regulators may be insufficient. These water management structures will need to be assessed and remedial measures undertaken, where necessary</p> <p>The current network of cyclone shelters will also need to be reviewed and plans made to replace or raise them, as required</p> <p>The importance of thick belts of mangroves in reducing the destructive capacity of storm surges, was demonstrated during Cyclone Sidr. An expansion of the 'green belts' would afford extra protection and increase livelihoods opportunities for the poor</p> <p>The possibility of 'building with nature' to increase the rate of accretion will also be tested and implemented, where appropriate</p>
<b>Actions</b>	<p>A1. Analysis of meteorological data to improve predictions of changes in the pattern of cyclonic events</p> <p>A2. Planning to upgrade existing coastal polders and appurtenant structures in the coastal region (see T3P3)</p> <p>A3. Planning and designing to construct new polders in the coastal belt and islands</p> <p>A4. Plan and develop coastal green belts as a measure against storm surge</p> <p>A5. Repair, maintenance, and construction, as appropriate, of cyclone shelters for protection against storm surge (following T3P2)</p>
<b>Timeline</b>	Medium to long term
<b>Responsibility</b>	Ministry of Water Resources, Ministry of Environment & Forest, Ministry of Food & Disaster Management

## Programme – T3P7

<b>Theme</b>	T3. Infrastructure
<b>Programme</b>	P7. Planning, design and construction of river training works
<b>Objective</b>	Put in place effective river training works to control river bank erosion
<b>Justification</b>	<p>Climate change is likely to increase rainfall in the Brahmaputra-Ganges-Meghna basin in the monsoon season. This will result in higher river flows and possibly increased velocities. This is likely to cause further instability in the already unstable river system. Higher rainfall in upper catchments may also cause increases in sediment movements. Overall, river systems are expected to become more unstable as a result of climate change. River bank erosion is likely to become more frequent</p> <p>Although river bank erosion is difficult to predict, mathematical modellers at CEGIS have recently developed predictive models for the major rivers. Elsewhere, proper physical observation and interpretation of geomorphological movements will help us to predict and to alert communities about the threat of river bank erosion</p> <p>River bank erosion has severe impacts on the livelihoods of affected people. Farmers lose their agricultural land and can become paupers over-night due to river erosion. In the eleven guiding principles of the Flood Action Plan, river bank erosion control was recommended as a major element of water management. The National Water Policy strongly supports river management work. The disaster management community now recognises river bank erosion as one of the most serious natural disasters</p> <p>Bangladesh is criss-crossed by alluvial rivers, many of which are very agile and erosion prone (e.g., the Jamuna, Padma, the lower Meghna, Kushiara, Arial Kha). In view of this, river training works should be taken up in an organized and comprehensive fashion, as part of a long term programme. Since it is expensive, river training should be designed based on proper physical as well as hydro-dynamic modelling. Several components of the Flood Action Plan focused on river training works. Lessons learnt from these activities and experience of river training works at the Hardinge Bridge and the Jamuna Bridge may provide guidelines for effective, durable and sustainable river training works. Hydro-dynamic modelling exercises will assist us in establishing the costs of river training that may result from climate change</p>
<b>Actions</b>	<p>A1. Preparation of GIS maps and identification of erosion prone areas including monitoring mechanisms</p> <p>A2. Physical and hydro-dynamic modelling</p> <p>A3. Design of river training programme and projects</p> <p>A4. Execution of river training works</p>
<b>Timeline</b>	Medium to long term
<b>Responsibility</b>	Ministry of Water Resources with support from IWM, IWFM, CEGIS, WARPO and RRI

## Programme – T4P1

<b>Theme</b>	T4. Research, and Knowledge Management
<b>Programme</b>	P1. Establishment of a centre for research, knowledge management and training on climate change
<b>Objective</b>	To increase institutional and human capacity on research and knowledge management related to climate change, and to train sector professionals
<b>Justification</b>	<p>Although Bangladesh has been in the forefront of awareness raising on adaptation and on-the-ground adaptation research, the knowledge and information generated remains scattered. A comprehensive move towards adaptation and mitigation supported by technology transfer and financial flows (as envisaged in the BCCSAP) requires an up-graded system of knowledge creation, dissemination and training</p> <p>Bangladesh has already suggested that an International Adaptation Research and Training programme should be established in the country as an international public facility for all to draw upon. While this may be an ultimate goal, a more urgent need is to set up a centre or network of institutions to be (a) a source of all available national information, reports and knowledge, and (b) a virtual technology bank, including on financial mechanisms related to both adaptation and mitigation. It would also track and provide information on the state of climate change negotiations</p> <p>A dedicated web portal would be established, which would track all national and within country policies, rules and regulations, and news related to climate change debates. The information managed by the Centre will be available to the public. In essence, it would be a one-stop data and information bank on climate change for all related national activities</p> <p>The Centre would also arrange for training programmes on issues related to adaptation and mitigation and would support activities in collaboration with universities, research centres and other agencies</p>
<b>Actions</b>	<p>A1. Establish a centre and/or network for research on climate change and climate change impacts and their management</p> <p>A2. Establish a virtual technology bank</p> <p>A3. Develop and maintain a dynamic web portal</p> <p>A4. Develop training programmes for high and mid-level officials of the Government, NGOs and private organisations/associations and provide training in collaboration with research centres and universities</p>
<b>Timeline</b>	Immediate and continuing
<b>Responsibility</b>	Ministry of Environment and Forests, research organisations, universities

## Programme – T4P2

<b>Theme</b>	T4. Research and Knowledge Management
<b>Programme</b>	P2. Climate change modelling at national and sub-national levels
<b>Objective</b>	Develop, maintain and update a detailed and operational General Circulation Model (GCM) for Bangladesh
<b>Justification</b>	<p>The 4<sup>th</sup> IPCC report established that global warming and climate change are caused by increasing concentrations of green house gases caused by anthropogenic factors. It predicted that temperature rises will vary in different parts of the world and used a number of global circulation models to generate future climate scenarios at global and regional levels</p> <p>In order to generate more precise climate change scenarios for Bangladesh, it is necessary to develop appropriate GCM models. These models should be calibrated down to district and sub-district levels and teams of specialists should be able to work on selected model/models, to simulate future conditions under different scenarios and assumptions. The models would use small grids to predict climate change scenarios with increasing precision</p>
<b>Actions</b>	<ul style="list-style-type: none"><li>A1. Build capacity for construction of GCM models with small grids</li><li>A2. Construct appropriate GCM models with small grids to obtain regional variations in weather and building capacity to operate and update them</li><li>A3. Collect additional field data for effective use of the calibrated models to predict future climate change</li><li>A4. Link up regional climate change models to generate better boundary conditions</li></ul>
<b>Timeline</b>	Immediate and continuing
<b>Responsibility</b>	Bangladesh Meteorological Department, Universities, research organisations, FFWC

## Programme – T4P3

<b>Theme</b>	T4. Research and Knowledge Management
<b>Programme</b>	P3. Preparatory studies for adaptation against sea level rise (SLR) and its impacts
<b>Objective</b>	Monitoring and modelling to predict sea level rise (SLR) and its impacts
<b>Justification</b>	<p>One of the main threats of climate change is sea level rise (SLR) caused by the thermal expansion of sea water and the melting of snow and ice. These factors may be compounded locally by tectonic activities. The 4<sup>th</sup> IPCC Report predicts that, over the next 100 years, sea levels will rise by up to 79 cms along the Bangladesh coast though some scientists consider this a conservative estimate</p> <p>The sea level rise threatens the low-lying coastal belt and small islands. Much of our coast is protected with 4 to 5 meter high dykes and will be further protected with additional planned polders. The main impacts of SLR would be:</p> <ul style="list-style-type: none"> <li>▶ salinity ingress causing the rivers in the coastal belt to become brackish or saline. This would have serious impacts on production of food grains</li> <li>▶ rises in river levels, which would impede drainage from polders, resulting in water logging, which would also adversely affect agriculture</li> </ul> <p>Currently, there is no data collection programme to monitor SLR. Since water levels in the Meghna estuary can rise due to monsoon winds by more than 1.5 meters, estimating the SLR resulting from global warming will be complex. However, the task should be taken up urgently</p>
<b>Actions</b>	<p>A1. Setting up data collection network stations to monitor sea level rises and salinity along with other appropriate hydro-meteorological data</p> <p>A2. Modelling the inundation and salinity impacts of SLR by specific time lines</p> <p>A3. Modelling and predicting the socio-economic and health impacts of SLR</p> <p>A4. Planning industrial relocation, taking account of private and social costs</p>
<b>Timeline</b>	Short, medium and long term
<b>Responsibility</b>	Ministries of Defence, Shipping, Agriculture, Industries and Energy and Power

## Programme – T4P4

<b>Theme</b>	T4. Research and Knowledge Management
<b>Programme</b>	P4. Monitoring of ecosystem and biodiversity changes and their impacts
<b>Objective</b>	Understanding ecosystem dynamics and their implications for biodiversity changes, and adaptation strategies
<b>Justification</b>	<p>One of the objectives of the UNFCCC is to urgently reduce GHG emissions, so that ecosystems and their flora and fauna have time to adjust to climate change. However, adverse impact of climate change on bio-diversity and ecosystems are being reported from many parts of the world. The Species Survival Commission of IUCN expects that reptiles and amphibians will be the first victims of climate change. Movements of insects and butterflies towards northern latitudes, as the earth gets warmer, are already being reported. Changes in the flowering patterns of plants may adversely affect the life cycles of fauna that depend on them, if they cannot adapt quickly enough</p> <p>Salinity levels are also likely to increase significantly in the coastal belt. Mangrove ecosystems which are already under serious stress for anthropogenic reasons will suffer heavily due to further increases in salinity. These could alter the entire ecosystem of the Sundarbans and cause the extinction of some species</p> <p>In view of these expected changes, a systematic monitoring mechanism should be put in place to assess the impact of climate change on ecosystems and bio-diversity. This would involve training of researchers and monitors, and develop a monitoring system covering all major ecosystems. A participatory impact monitoring mechanism involving communities and academic experts will be designed. Pertinent physical, chemical and biological data will also be collected. The changes that take place in livelihood patterns due to ecological and biodiversity changes will also be assessed and policy recommendations and appropriate actions suggested</p>
<b>Actions</b>	<p>A1. Set up a well-designed monitoring system to evaluate changes in ecosystem and biodiversity, covering all important and sensitive ecosystems</p> <p>A2. Develop participatory monitoring systems by involving local trained people such as school teachers, communities and academic researchers</p> <p>A3. Report changes in ecosystems and biodiversity and asses the implications, including those for the livelihoods of local people, and recommend adaptation measures</p>
<b>Timeline</b>	Medium to long term
<b>Responsibility</b>	Ministry of Environment and Forests, Ministry of Agriculture, Ministry of Health, Ministry of Fisheries and Livestock



## Programme – T4P5

<b>Theme</b>	T4. Research and Knowledge Management
<b>Programme</b>	P5. Macroeconomic and sectoral economic impacts of climate change
<b>Objective</b>	To identify likely macroeconomic and sectoral impacts of climate change and plan adaptation and mitigation strategies
<b>Justification</b>	<p>The pioneering report by Lord Stern published in January, 2007 drew the world's attention to the impacts of climate change on the global economy. He stated that poor countries and the poor people in them will be hardest hit. This is especially true for countries such as Bangladesh, which are very vulnerable to climate related events</p> <p>Bangladesh has been experiencing strong economic growth in recent years and is on track to become a middle-income country by 2020. It is important that we understand the impacts that climate change will have on (a) macro-economic growth and stability; (b) different sectors of the economy, and (c) different regions and socio-economic groups, in the short, medium and long terms</p> <p>This programme will evaluate the impact of climate change on the macro economy and carry out sector-by-sector analyses. Other studies will assess the economic and social impact on the poor in vulnerable locations and on vulnerable groups in society, including women and children. Women and children are expected to be more adversely affected by climate change than men and the analyses will use gender-disaggregated data where possible</p>
<b>Actions</b>	<ol style="list-style-type: none"> <li>A1. Evaluate the impact of climate change on the macroeconomy of Bangladesh including impacts on growth, employment, trade patterns, inflation, balance of trade (a Bangladesh Stern Report)</li> <li>A2. Sectoral economic impacts of climate change for major sectors such as agriculture, industry, services, health, transport and financial services such as insurance</li> <li>A3. Assess the impacts of climate change on poverty and on people living in vulnerable areas such as <i>chars</i>, coastal plain and islands, low-lying floodplains, upland areas and <i>monga</i>-prone areas</li> <li>A4. Assessment of climate change and its impacts on out-migration</li> </ol>
<b>Timeline</b>	Medium term
<b>Responsibility</b>	Ministry of Finance, sectoral ministries, Ministry of Women Affairs, Ministry of Social Welfare, Ministry of Chittagong Hill Tracts, Universities, Research Organisations

## Programme – T5P1

<b>Theme</b>	T5. Mitigation and Low Carbon Development
<b>Programme</b>	P1. Improved energy efficiency in production and consumption of energy
<b>Objective</b>	Ensure an energy secure and low-carbon development of the economy
<b>Justification</b>	<p>Bangladesh is one of the lowest energy consuming and green house gas (GHG) emitting countries. Our energy consumption is around 90 kgoe (kilogramme of oil equivalent) per capita, the lowest in South Asia except for Nepal. We emit less than one-fifth of 1 percent of the total global emission of carbon dioxide equivalent in the world</p> <p>However, Bangladesh is also an energy-inefficient country. If we raise the efficiency with which we produce and consume energy, we may be able to increase energy supply while lowering carbon emission. This could allow us to lower carbon emissions without jeopardizing energy security and growth</p> <p>We should carefully assess how we can become more efficient in producing and consuming energy. This will involve identifying any technical, economic or regulatory/policy constraints to help improve performance and to learn how these constraints can be overcome. Improving our efficiency may require the use of new technologies which could be costly and will thus need additional financial resources</p> <p>It will be important to take a medium to long-term view in analysing alternative investments since, once investments are made, it would be expensive to change them</p>
<b>Actions</b>	<p>A1. Study the future energy needs of the country and find out the least cost energy supply path that satisfies future energy demand based on the desired growth path of the economy</p> <p>A2. Raise energy efficiency in power production, transmission and distribution through appropriate investments</p> <p>A3. Raise energy efficiency in agricultural and industrial processes through appropriate policies and investments</p> <p>A4. Raise energy efficiency in domestic and commercial/service sectors through appropriate policies and investments</p> <p>A5. Raise energy efficiency in transport sector through appropriate policies and investments</p>
<b>Timeline</b>	Medium to long term
<b>Responsibility</b>	Ministry of Power & Energy, Ministry of Industry, Ministry of Agriculture, Ministry of Transport, Ministry of Finance, Universities and Research Organisations

## Programme – T5P2

<b>Theme</b>	T5. Mitigation and Low Carbon Development
<b>Programme</b>	P2. Gas exploration and reservoir management
<b>Objective</b>	Enhance energy security and ensure low-emission development
<b>Justification</b>	<p>Bangladesh has modest reserves of natural gas. Known reserves are expected to be used up in about a decade. Further gas exploration is possible. Finding new gas reserves would increase the country's energy security and may make it possible to remain on a low carbon growth path because natural gas is the cleanest of all fossil fuels in terms of CO<sub>2</sub> emission</p> <p>Although there is currently a gas shortage, reserves in existing gas-fields could be higher than current estimates. There is an urgent need to improve reservoir management, although the data to do this is limited. Collecting and analysing such data could lead to the discovery of increased reserves of gas in existing wells or in their environs</p> <p>In conclusion, both exploration and reservoir management could lead to substantial increases in supplies of gas</p>
<b>Actions</b>	A1. Invest in gas exploration A2. Invest in reservoir management
<b>Timeline</b>	Medium to long term
<b>Responsibility</b>	Ministry of Power and Energy

## Programme – T5P3

<b>Theme</b>	T5. Mitigation and Low Carbon Development
<b>Programme</b>	P3. Development of coal mines and coal fired power station(s)
<b>Objective</b>	Maximising coal output and managing coal fired power stations in a carbon-neutral way
<b>Justification</b>	<p>Bangladesh is geologically one of the least explored countries. However, the exploration that has taken place, indicates that there may be substantial amounts of coal at shallow depths in some parts of the country. This coal is believed to be of high quality. While there are debates regarding the desirability of different mining methods, coal could help to satisfy the rising demand for energy</p> <p>There are three considerations related to coal mining and its use for power generation. Firstly, if open pit mining is used, coal bed methane may escape into the atmosphere. To avoid this, the methane should be first captured and liquefied for subsequent consumption. Secondly, to avoid high carbon emissions, Bangladesh would need to invest in 'clean coal technology' for power generation. Such technology is not cheap and would have to be imported. Thirdly, coal mining has environmental and social costs, which would have to be carefully considered</p>
<b>Actions</b>	<p>A1. Review coal mining methods and undertake a feasibility study to assess the technical, economic, social and environmental feasibility of coal mining for power generation (including factors such as how to capture coal bed methane)</p> <p>A2. If the feasibility study is positive, invest in coal mining and coal-fired power generation plants using clean coal technology</p>
<b>Timeline</b>	Medium term
<b>Responsibility</b>	Ministry of Power and Energy

## Programme – T5P4

<b>Theme</b>	T5. Mitigation and Low Carbon Development
<b>Programme</b>	P4. Renewable energy development
<b>Objective</b>	Maximising the use of renewable energy sources to lower GHG emission and ensuring energy security
<b>Justification</b>	<p>The scope for developing renewable energy supplies (e.g., solar, wind, tidal, geothermal and modern biomass technologies) has not been explored well in Bangladesh</p> <p>There is some use of solar power for limited domestic purposes. The main barrier to expanded solar energy use is the capital cost. However, since the cost of solar cells and solar panels in global markets is expected to gradually fall, Bangladesh should encourage entrepreneurs who wish to start solar projects, possibly through incentives</p> <p>The potential of harvesting wind energy, though recognized for many years, has not produced tangible results so far. The initial capital cost remains the main stumbling block. High variations in wind speed and sharp seasonal changes also present difficulties. The tidal range of the coastal belt is considered to be adequate for the generation of tidal power. However, there has not been any attempt to harvest such energy. Biogas development remains in its infancy. Even the popularisation programmes for improved cooking stoves, which save a lot of fuel wood, have had limited success</p> <p>There are, then, technical, economic, social and institutional barriers to the adoption of renewable technologies. However, since renewable technology for power generation or direct use is carbon-neutral or nearly so, technologies such as these should be considered. The country has already set up a Sustainable Energy Development Authority to popularise renewable energy technologies. It should be provided with adequate financial and other support so that renewable energy becomes a part of the move towards a low-carbon development path</p> <p>Each of these technologies, however, will need to be evaluated carefully to understand the technological and economic barriers and potential. If start-up costs are high, the issues of subsidy or other support may have to be considered. Power generation policy should also take these technologies into account in its planning</p>
<b>Actions</b>	<p>A1. Investments to scale up solar power programmes</p> <p>A2. Research and investment to harness wind energy, particularly in coastal areas.</p> <p>A3. Feasibility studies for tidal and wave energy</p> <p>A4. Study of the techno-economic, social and institutional constraints to adoption of improved biomass stoves and other technologies</p>
<b>Timeline</b>	Immediate
<b>Responsibility</b>	Ministry of Power and Energy; Ministry of Environment and Forests, private entrepreneurs

## Programme – T5P5

<b>Theme</b>	T5. Mitigation and Low Carbon Development
<b>Programme</b>	P5. Lower emissions from agricultural land
<b>Objective</b>	Raise productivity of agricultural land and lower emissions of methane
<b>Justification</b>	<p>Emission of greenhouse gases (GHGs) from agricultural land is a major concern. Wet agricultural land produces methane (CH<sub>4</sub>). Nitrogenous (N<sub>2</sub>) fertilizers also contribute to GHG emission</p> <p>A major reason for methane emissions is that rice fields are kept continuously flooded, which scientists now say is unnecessary. If this is the case, methane emissions could be reduced, water use efficiency could be raised and carbon dioxide emissions from burning diesel, the main fuel for irrigation, could be cut. Such land use practices would need to be supported through further on-farm research and extension activities</p> <p>This is an example of what the UNFCCC calls land use, land use change and forestry (LULUCF). Issues related to forest management, deforestation, reforestation, and afforestation will be covered in T5P7. This programme aims to lower emissions through improved cropland management</p>
<b>Actions</b>	<p>A1. Support to research and on-farm trials of new water management technology on crop (including rice) land</p> <p>A2. Support to agricultural extension service to popularise new water management techniques for rice production</p>
<b>Timeline</b>	Medium to Long term
<b>Responsibility</b>	Ministry of Agriculture, NARS and Agricultural extension services

## Programme – T5P6

<b>Theme</b>	T5. Mitigation and Low Carbon Development
<b>Programme</b>	P6. Management of urban waste
<b>Objective</b>	Ensure liveable cities while lowering GHG (methane) emissions
<b>Justification</b>	A major portion of the urban waste of Bangladesh is composed of organic materials, which produce methane (CH <sub>4</sub> ) as they decompose. The unit contribution of methane to global warming is much higher than that of carbon dioxide. Methane could be captured for subsequent use or waste could be incinerated to produce electricity. Proper management of urban waste could thus be an important area for mitigation while ensuring a cleaner city. Furthermore, the lowered emissions could be traded in the carbon market
<b>Actions</b>	A1. Design of urban waste dumps so that methane can be captured in all major urban areas A2. Using CDM mechanism to set up small power plants by capturing the produced methane from waste dumps
<b>Timeline</b>	Immediate
<b>Responsibility</b>	Ministry of Local Government, private entrepreneurs

## Programme – T5P7

<b>Theme</b>	T5. Mitigation and Low Carbon Development
<b>Programme</b>	P7. Afforestation and reforestation programme
<b>Objective</b>	Provide support to scale up afforestation and reforestation
<b>Justification</b>	<p>Forestry is an important way to sequester carbon. In addition, the afforestation and reforestation of degraded land contributes to food security by providing fruits and other edible products; energy security by providing fuel wood; livelihood security by employing people in forest plantations; harvesting and trade in forest products; and can protect land from soil erosion and landslides, particularly in hilly areas. Afforestation and reforestation thus address multiple needs</p> <p>This programme needs to be divided into several sub-programmes. For the coastal belt, selection of species will be a major concern. As salinity is expected to increase with rising sea levels, emphasis should be given to saline tolerant species. For freshwater wetlands, suitable submergence tolerant species such as Hijol (<i>Pongamia pinnata</i>) and Coroch (<i>Barringtonia actangula</i>), which can also protect against wave erosion, could be used</p> <p>Much of Government owned reserve forest land is largely without trees. Well-designed and adequately-funded programmes, involving local communities, are needed to reforest these lands. A well designed forest of mixed species will support ecosystem and biodiversity conservation and may be a good source of carbon-trading through the REDD</p> <p>Social and homestead forestry has gathered momentum in recent years. It needs to be further encouraged as it supports the livelihoods of the poor and local communities</p>
<b>Actions</b>	<p>A1. Provide support to existing and new coastal afforestation programmes taking into account the future rise in salinity levels due to sea level rise</p> <p>A2. Develop an extensive wetland afforestation programme to protect settlements against wave erosion</p> <p>A3. Study the scope for carbon credits under REDD and invest, if appropriate, in reforestation of degraded reserve forests</p> <p>A4. Provide support to existing and new homestead and social forestry programmes and enhance carbon sequestration</p> <p>A5. Research the suitability of various tree species for their carbon-locking properties for designing various forestry programmes keeping in mind other environmental and socio-economic functions of forestry</p>
<b>Timeline</b>	Immediate and continuing
<b>Responsibility</b>	Ministry of Environment and Forests



## Programme – T6P1

<b>Theme</b>	T6. Capacity Building and Institutional Strengthening
<b>Programme</b>	P1. Revision of sectoral policies for climate resilience
<b>Objective</b>	To integrate climate change issues into development policy and action
<b>Justification</b>	<p>The Government and the people of Bangladesh realise that climate change is going to impact adversely on many sectors and threatens the nation's economic and social achievements. Our food, water, energy and livelihood (including health) security are threatened. An integrated approach is needed to counter this. Climate change management needs to be integrated into the development activities of different sectors. Sectoral policy statements need to be modified to take account of and become consistent with climate change impacts and their management</p> <p>The National Water Management Plan recognizes the need to make water sector activities resilient to climate change. However, the only sectoral policy that explicitly incorporates climate change considerations is the Coastal Zone Policy of Bangladesh, which was drafted in 2005 when knowledge and understanding about climate change was available</p> <p>There is also a need for a National Climate Change Policy to guide the integration of climate change issues into development planning and to provide a framework for sectoral policies. All policy formulation should be carried out in a consultative way by involving key officials of concerned ministries/sectors together with professionals, academics, NGOs and civil society leaders, as well as the general public</p>
<b>Actions</b>	<p>A1. Draft a consultation paper on the National Climate Change policy, the integration of climate change issues into development planning and sectoral policies and how they should be formulated for discussion with key stakeholders</p> <p>A2. Incorporate climate change concerns in all sectoral policies and strategies through appropriate revisions in consultation with relevant stakeholders</p> <p>A3. Publish the National Climate Change Policy</p>
<b>Timeline</b>	Immediate
<b>Responsibility</b>	MoEF, Cabinet division

## Programme – T6P2

<b>Theme</b>	T6. Capacity Building and Institutional Strengthening
<b>Programme</b>	P2. Mainstreaming climate change in national, sectoral and spatial development programmes
<b>Objective</b>	Integration of Climate Change management in all aspects of development action
<b>Justification</b>	<p>The Bangladesh Government is committed to integrate climate change into all aspects of national, sectoral and spatial development in the country. This will require: (a) incorporating climate change into policies, plans, programmes and projects; (b) establishment and building the capacity of ministries and agencies so that they are able to do this (e.g., building on the climate change cells in each ministry); (c) focusing, to start with, on those specific sectors, where climate change will be a key issue (e.g., water, agriculture, food, disaster management, health, forests, energy and power, transport and communication, women affairs and Chittagong Hill Tracts)</p> <p>The task of guiding and supervising the national development programme rests with the Planning Commission. Two changes are required in the process by which ministries and agencies prepare and submit proposals to the Planning Commission:</p> <ul style="list-style-type: none"> <li>▶ the Planning Commission, in consultation with the National Steering Committee on Climate Change and sectoral ministries, should introduce a set of design and planning parameters for projects, for selected target years (e.g. 2030, 2050 and 2100), which take into account likely climate change impacts</li> <li>▶ the pro-formas, which the Planning Commission requires for project proposals (TPP, PP etc.) are designed to ensure that all elements for taking decisions for climate resilience or climate sensitivity are included and correctly reflected. These will need to be revised to ensure that project designers are aware of climate change issues and that concerns have been appropriately included in the planning process</li> </ul>
<b>Actions</b>	<p>A1. Establish and build the capacity of climate change cells in ministries and agencies to incorporate climate change considerations in all planning processes</p> <p>A2. Agree design and planning parameters for project design for selected years.</p> <p>A3. Modify the Project Proforma in an appropriate way</p>
<b>Timeline</b>	Immediate
<b>Responsibility</b>	All relevant ministries; Planning Commission

## Programme – T6P3

<b>Theme</b>	T6. Capacity Building and Institutional Strengthening
<b>Programme</b>	P3. Strengthening human resource capacity
<b>Objective</b>	Development of adequate human capacity to effectively manage climate resilient development programmes and to take part in international negotiations
<b>Justification</b>	<p>Adequately trained people do not currently exist in the country to develop and implement climate change policies, programmes and projects. Due to this lack of expertise, Bangladesh has been unable to grasp opportunities to effectively use new global financial instruments. Also, climate change negotiations have now entered a phase where constant tracking and taking decisions at short notice are required. While Bangladesh has so far had been in the forefront of such negotiations, she has often been unable to take part fully because of a shortage of expertise in key areas. The AWG-LCA negotiations need expertise of the highest order</p> <p>Available expertise is neither adequate nor always of the right type. It is therefore necessary to build human resource capacity in all these relevant areas across Government departments, private business and civil society, as all will be involved in different aspects of climate change management and action</p> <p>Activities will include short and long training at home and abroad, study tours, exchange programmes, and financing for attending negotiations</p>
<b>Actions</b>	<ul style="list-style-type: none"><li>A1. Enhance the capacity of Government staff for policy, programme and project formulation, and implementation, through training and in other ways</li><li>A2. Enhance capacity of key staff of Government, private sector organisations and NGOs on accessing international and national Carbon and climate Change Funds</li><li>A3. Enhance the human resource capacity within and outside Government for Climate Change negotiations</li></ul>
<b>Timeline</b>	Short to medium term
<b>Responsibility</b>	All relevant sectoral ministries, agencies, private sector, NGOs, universities and research organisations

## Programme – T6P4

<b>Theme</b>	T6. Capacity Building and Institutional Strengthening
<b>Programme</b>	P4. Strengthening institutional capacity for climate change management
<b>Objective</b>	Develop strong organisations to effectively respond to climate change
<b>Justification</b>	<p>Mainstreaming climate change issues in national and sectoral development will require strong organisations and a robust institutional framework to ensure that the activities are sustained over the next several decades and beyond</p> <p>Some of the organisations will be new (e.g., climate cells in ministries and their agencies); others will have to be reformed and strengthened. In all cases, organisations will need to be provided with adequate logistics and other facilities (the development of human resource capacity is separately dealt with under T6P3), for which adequate financing will have to be ensured</p> <p>There is a pressing need to strengthen a number of existing organisations that are already underperforming in implementing the regular development programme</p>
<b>Actions</b>	<p>A1. Setting up of mechanisms for inter-ministerial and inter-institutional coordination at various levels of the Government, and for managing new adaptation and planned mitigation funds</p> <p>A2. Organisational reform and strengthening of key Government and others agencies</p>
<b>Timeline</b>	Immediate
<b>Responsibility</b>	All relevant sectoral agencies, private sector, NGOs and others

## Programme – T6P5

<b>Theme</b>	T6. Capacity Building and Institutional Strengthening
<b>Programme</b>	P5. Main-streaming Climate Change in the Media
<b>Objective</b>	Raising public awareness across the country by main-streaming climate change issues in the print and electronic media
<b>Justification</b>	Bangladesh media has been pro-active in mounting public awareness on climate change issues for last two decades. Journalists have been proactive in sensitising the country on various environmental issues. But, given the scale of climate-induced adverse impacts on the national economy, livelihoods and eco-systems, the people requires to more aware while Bangladesh vibrant print and electronic media can play that effective role in a very comprehensive manner to help bring in positive changes in public opinion to make policy changes. Media can also help take people in a climate-friendly low-carbon development pathway. Bangladesh media can also help raise national negotiation capacity by infusing public debate on climate change issues in both print and electronic media and keep track of on going negotiation streets as watchdogs
<b>Actions</b>	<ul style="list-style-type: none"> <li>A1 Capacity Building and Training print and electronic journalists</li> <li>A2 Exposure visits to climate change hot spots across the country and tracking global negotiations</li> <li>A3 State of Climate Change Reports, Earth Files, Features, Photo-Features</li> <li>A4 Media networking</li> </ul>
<b>Timeline</b>	Immediate
<b>Responsibility</b>	Ministry of Environment and Forests, Ministry of Information, Press Institute of Bangladesh

