Mangroves for the Future
INVESTING IN COASTAL ECOSYSTEMS

FRAMING ECOSYSTEM-BASED ADAPTATION TO CLIMATE CHANGE

Applicability in the Coast of Bangladesh

FRAMING ECOSYSTEM-BASED ADAPTATION TO CLIMATE CHANGE:

Applicability in the Coast of Bangladesh

Mokhlesur Rahman

Produced by Mangroves for the Future with the support of Danida, Norad and Sida.

Published by: IUCN, Dhaka, Bangladesh in collaboration with Mangroves for the Future, Bangkok, Thailand.

Citation: Rahman, M. (2014). ***Framing Ecosystem-based Adaptation to Climate Change: Applicability in the Coast of Bangladesh***, Dhaka, Bangladesh: IUCN, x+43pp.

ISBN: 978-984-33-6116-5

Cover Photo: A floating garden in Swarupkathi, Pirojpur, Bangladesh © Mokhlesur Rahman

Layout and Design: Sheikh Asaduzzaman

Photos: Mokhlesur Rahman

Printed by: Progressive Printers Pvt. Ltd.

Available from: Mangroves for the Future (MFF)
IUCN, International Union for Conservation of Nature
Bangladesh Country Office
House 16, Road 2/3
Banani, Dhaka 1213, Bangladesh

www.mangrovesforthefuture.org

PREFACE

Coastal communities in many parts of Asia are particularly vulnerable to the impacts of climate change, with increased severity of extreme weather events directly affecting the lives of millions of people and damaging the ecosystems and resources they rely on for everyday survival.

This report has been produced as part of the Mangroves for the Future (MFF) initiative. MFF is a unique partner-led initiative to promote investment in coastal conservation for sustainable development. Co-chaired by IUCN and UNDP, MFF works to restore coastal ecosystems to health as a contribution to building human resilience in coastal communities in Asia. The emphasis is on generating knowledge, empowering local communities and governments, and working to promote policy solutions that will support best practice in integrated coastal management.

Moving forward, MFF will increasingly focus on building resilience of coastal communities by promoting ecosystem-based approaches and by showcasing the climate change adaptation and mitigation benefits that can be achieved with healthy mangrove forests and other types of coastal vegetation.

Healthy coastal ecosystems play a major role in helping coastal communities to adapt to climate change impacts. Mangroves and other coastal vegetations support biodiversity conservation and enable improvements in livelihoods and human well-being, while also providing cost-effective risk reduction against such threats as coastal erosion, storm surges and tsunamis. Mangroves also offer potential for mitigating climate change impacts through their high carbon storage capacity, thereby contributing to the Reducing Emissions from Deforestation and Degradation (REDD+) process.

At the same time, MFF is working to improve the effectiveness of governance and management of coastal resources by promoting models of co-management, payment for ecosystem services and similar resource-sharing mechanisms that will benefit traditional coastal communities. This is particularly important given that conservation may often appear to have high opportunity costs when other uses of natural areas (notably aquaculture) are more profitable in the short term, and that the local communities most affected by natural resource decision making may not have a voice.

This report is one of many which highlight ecosystem-based approaches being developed and tested around Asia. It is being produced and shared by MFF in order to serve as a resource and learning tool for coastal management practitioners, but also to help in raising awareness of the many issues and challenges which surround the protection of Asia's coastlines and the communities they support.

ACKNOWLEDGEMENTS

This publication is the result of over two months desk-based and field-level work carried out by the author. During the course of work, the author received assistance from wider communities without which it would have not been possible to accomplish the task. The author gratefully acknowledges the guidance of Mr. Raquibul Amin, Regional Project Manager, MFF; Dr. Anwara Begum Shelly, MFF National Coordinator, Bangladesh; Mr. Enamul Mazid Khan Siddique, Assistant Project Manager (Bangladesh), MFF; Muhammad Mizanur Rahman, Field Coordinator (Bangladesh), MFF; Mr. Ishtiaq Uddin Ahmad, Country Representative, IUCN Bangladesh Country Office; and Dr. Istiak Sobhan, Programme Coordinator, IUCN Bangladesh. The author also expresses his special thanks to Mr. Kamal Uddin, Senior NRM Specialist of USAID funded CREL project for his suggestions on the content of this publication. The communities at different field sites who provided data and information on their EbA schemes have been the key component of this publication and the author also gratefully acknowledges their contribution. Special thanks are due to Dr. Paramesh Nandi, Project Manager, UNDP-CBACC project and Mr. Shahinur Rahman, Community Development Associate, Barguna site of the same project for providing relevant information on “ditch-and dyke” schemes being implemented under the project. The author would also like to recognize the contribution of Dr. Donald Macintosh, Ms. Jane Lawton and Mr. Sameer Singh for valuable edits of the manuscript and guidance towards finalization of this publication.

CONTENTS

ABBREVIATIONS AND ACRONYMS

BARI	Bangladesh Agriculture Research Institute
BAU	Bangladesh Agricultural University
BCCSAP	Bangladesh Climate Change Strategy and Action Plans
BCCRF	Bangladesh Climate Change Resilience Fund
BDT	Bangladesh Taka (US 1 = 79 BDT: 2013 rate)
BFRI	Bangladesh Forest Research Institute
BFRI	Bangladesh Fisheries Research Institute
BRRI	Bangladesh Rice Research Institute
BWDB	Bangladesh Water Development Board
CBA	Community based adaptation to climate change
CBACC-CF	Community-based adaptation to climate change through coastal afforestation (a project of UNDP)
CBD	Convention on Biological Diversity
CBD-AHTEG	Ad Hoc Technical Expert Group on Convention on Biological Diversity
CBOs	Community Based Organizations
CCA	Climate Change Adaptation
CCTF	Climate Change Trust Fund
CMC	Co-Management Committee
CRA	Community Risk Assessment
DAE	Department of Agriculture Extension
DDM	Department of Disaster Management
Dhap	Crop production systems on floating mat or hydroponics
DoE	Department of Environment
DoF	Department of Fisheries
DoL	Department of Livestock
DPHE	Department of Public Health Engineering
DRR	Disaster Risk Reduction
EbA	Ecosystem-based adaptation or Ecosystem-based approaches to adaptation
EMC	EbA Management Committee
FD	Forest Department
GHG	Greenhouse Gas
GIS	Geographic Information System

ICDDR-B	International Centre for Diarrheal Disease Research – Bangladesh
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
LGED	Local Government Engineering Department
LVA	Livelihood Vulnerability Assessment
MEA	Millennium Ecosystem Assessment
MFF	Mangroves for the Future – a regional initiative jointly chaired by IUCN and UNDP
MoA	Ministry of Agriculture
MoEF	Ministry of Environment and Forests
MoFL	Ministry of Fisheries and Livestock
MoL	Ministry of Land
MoLGRD	Ministry of Local Government and Rural Development
MoWR	Ministry of Water Resources
NAPA	National Adaptation Programme of Action
NGOs	Non-governmental Organizations
PAPD	Participatory Action Plan Development
PDO-ICZMP	Project Development Office for Integrated Coastal Zone Management Plan
PSC	Project Steering Committee
SRF	Sundarbans Reserved Forest – World's largest single unit of mangrove forest
SCBD	Secretariat of the Convention on Biological Diversity
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNDP	United Nations Development Programme
UNO	Upazila Nirbahi Officer (Chief Executive of Officer of Upazila/Sub-district)
UNFCCC	United Nations Framework Convention on Climate Change
UP	Union Parishad (Lowest administrative unit under local government)

ABSTRACT

The recent increase in exposure to natural hazards among the communities of Bangladesh is linked to the new generation of threats posed by climate variability and change resulting from anthropogenic activity. With its huge population, and as a largely rural, least developed country, adaptation is the priority option for Bangladesh to moderate the adverse impacts of climate change. One of the key reasons for the country's higher exposure to climate-induced threats is the fact that its people are heavily reliant on climate-sensitive natural resources. Natural ecosystems (such as wetlands, coastal ecosystems and forests) are highly sensitive to climate change and are often affected negatively, resulting in reduced ability to deliver ecosystem services to support biodiversity and livelihoods.

Adaptation is not a new approach in development, but there are still a number of challenges inherent in adaptation and in building resilience to climate-induced threats. This document emphasizes the adoption of ecosystem-based adaptation (EbA) to climate change. This means restoration, enhancement, conservation and wise use of natural resources (ecosystems) with the active engagement of local communities so as to enable natural ecosystems to function properly and deliver services for the benefits of nature and local livelihoods. This in turn builds societal resilience to the impacts of climate change. This report describes six different types of EbA currently being practiced in the coastal zone of Bangladesh; and an analysis is made in line with the ecosystem services derived from such ecosystem- based interventions, including relevant policy and institutional aspects. Finally, the report suggests approaches for effective planning, design and implementation of EbA schemes aimed at building social-ecological resilience in the face of shocks and uncertainties associated with climate variability and change in the coastal zone of Bangladesh and beyond.

Farmers are using reserved rain water in re-excavated canal to cultivate salt tolerant and low-irrigation crop varieties in the dry season; Gabura Island, Satkhira, Bangladesh.

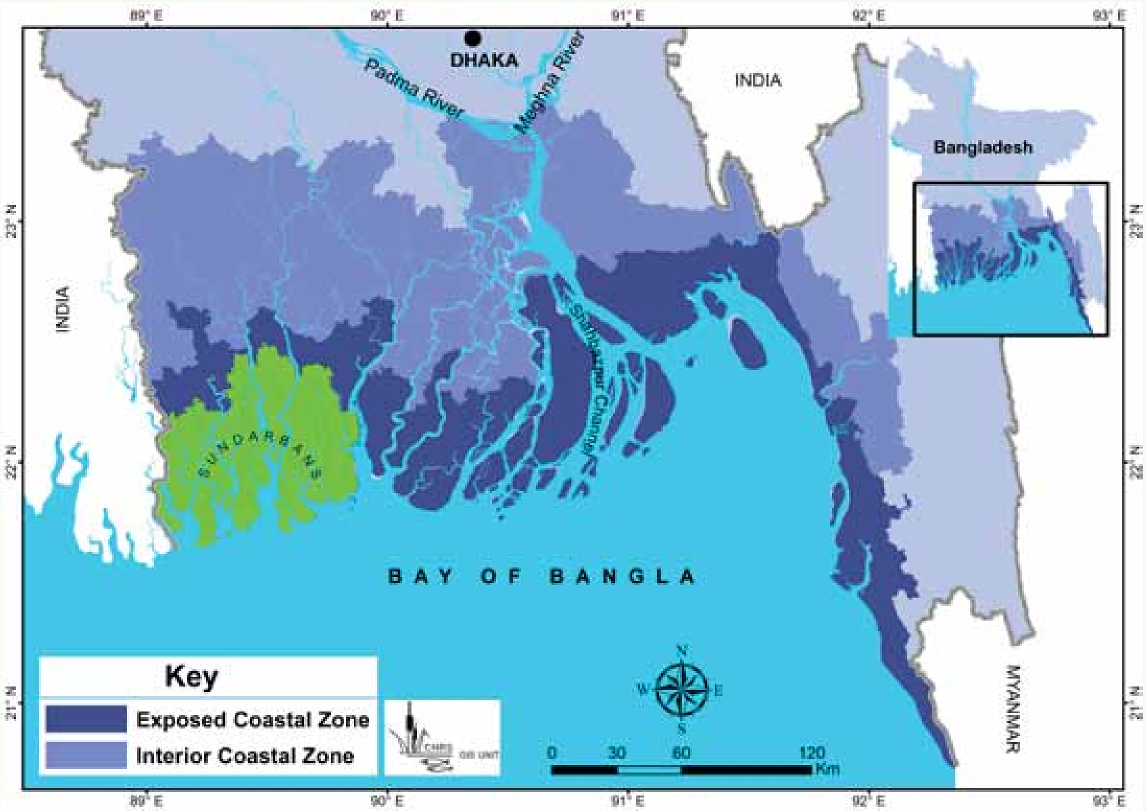
CHAPTER 1
INTRODUCTION

There is a growing consensus among global communities that human-induced climate change is happening and that the rate of change, based on modeling and empirical observation, is occurring much faster than previously anticipated (IPCC, 2012). Rising temperatures, increased and erratic patterns of precipitation, increased frequency and intensity of droughts, melting of glaciers, sea level rise, shorter and warmer winters, warming of the sea, and increased incidence of severe cyclones are considered to be linked to anthropogenic climate change (IPCC, 2007). Each of these physical changes due to climate change has multiple impacts on ecosystems and human society, and their collective impacts could be much greater, with the potential to jeopardize current and planned development outcomes (Stern, 2006). Bangladesh is considered to be highly vulnerable to climate change impacts due to its geographic location, high population density, low levels of infrastructure, low popular awareness of climate change and higher reliance on climate-sensitive natural resource-based production (such as agriculture, aquaculture) and extraction sectors (fishing, collecting various resources from forests, wetlands, mangroves, coral islands) (Ali, 1999; MoEF, 2005; Stern, 2006).

Different social-ecological systems within a geographical area are impacted differently by climate change due to variations in socio-economic and biophysical features. In general, the poor and marginalized are the hardest hit due to their weak adaptive capacity and higher dependence on climate-sensitive natural resources for their livelihoods. Like human systems, ecological systems are also impacted by climate change and can become degraded and lose their capacity to deliver ecosystem services, which may generate resource use conflicts among users (Barnett and Adger, 2007). Barnett and Adger also argued that such conflicts would be higher among coastal resource users due mainly to their physical location at the forefront of climate change impacts (sea level rise, cyclones, flooding, saline intrusion and erosion).

Bangladesh has a coastline of 710 km, comprising 19 districts and 147 sub-districts, and is home to 35.1 million people (28% of the national population), the majority of whom are landless poor (PDO-ICZMP, 2004). The coastal communities are exposed to a multiplicity of hazards (viz. cyclones, storm surges, sea level rise, salinity, coastal flooding erosion, etc.) and those who suffer most live in the exposed coast that is bounded by the sea on the south (Figure 1). Rahman and Biswas (2013) analyzed cyclone data for the last 200 years and found that the number of occurrences of major cyclones has increased in recent decades from only three in the period from 1846 to1896, to 13 from 1897 to1947, then rising to 51 from 1948 to1998. Climate modeling results show that global warming will cause a sea level rise of between 0.18 and 0.79 metres by the end of the 21st century, which could increase coastal flooding, salinity intrusion and permanent inundation in many low-lying coastal countries, including Bangladesh (IPCC, 2007; MoEF, 2009). UNESCO (2007) reported that a 45cm sea level rise in the Bay of Bengal, combined with other forms of stress, could lead to the destruction of three quarters of the Sunderbans Reserved Forest (SRF) with major associated biodiversity and livelihood losses. In the face of the impacts of both climate and non-climate induced threats, urgent measures are needed to protect and sustain coastal ecosystems and livelihoods.

Broadly, there are two ways of tackling the impacts of climate change, viz. i) mitigation (avoiding or reducing the causes of climate change); and ii) adaptation (adjusting to climate-induced changes). The global benefits of mitigation are expected only in the long term. By contrast, adaptation benefits can be realized much faster in order to accommodate unavoidable climate change (IPCC, 2001; Ayres and Huq, 2009). However, the design and planning of effective adaptation interventions is constrained, among other things, by the lack of clear understanding of context-specific impacts of climate change on social-ecological systems.



Map 1: Bangladesh coast line shows exposed and interior costal zones

Over the last few years there has been progress in understanding, planning and implementing adaptation interventions in developing countries, including Bangladesh. Various methods and approaches of adaptation have been piloted and lessons documented across countries. Popular adaptation approaches include community-based adaptations (CBAs) and ecosystem-based adaptations (EbAs), which are facilitated in different contexts in Bangladesh and in other countries. Of these two approaches, the former focuses more on adaptation ideas and actions by local communities to address local level climate-induced threats; while the latter is based on ecosystem management that is resilient to climate change threats - it aims to restore and preserve ecosystem components in order to achieve sustained ecosystem services for the benefits of local communities for their livelihoods.

It is recognized globally that healthy ecosystems provide valuable services (e.g. food, clean water, carbon sequestration, flood and erosion control), while at the same time building societal resilience to climate change impacts (MEA, 2005; Munang *et al*., 2013). This background demands an improved understanding of impacts of climate change on ecosystems and livelihoods in order to develop effective adaptation strategies and actions for social-ecological resilience through practice of EbA.

It is against this backdrop, through the Mangroves for the Future (MFF) initiative, that IUCN Bangladesh has facilitated the implementation of EbA in the coastal zone of Bangladesh involving relevant development actors (government agencies, NGOs, local government bodies) and local communities. This report was prepared in order to generate awareness among the wider communities and stakeholders about the importance and effectiveness of EbA in shaping climate change adaptation strategies in Bangladesh, and other countries in the region with similar geo-spatial and biophysical features.

This report was prepared based on data and information gathered both from primary and secondary sources, including feedback from relevant experts. Short field visits were also made to incorporate lessons from the coastal areas of Bangladesh on some current EbA practices.


© IUCN / Enamul Mazid Khan Siddique

Coastal plantation is a large scale EbA initiative of Bangladesh which is considered successful in spite of many challenges

Communities arround the mangroves make their living by extracting non-timber forest resources; Satkhira Range, Sundarban, Bangladesh.

CHAPTER 2
ECOSYSTEMS, LIVELIHOODS AND CLIMATE CHANGE ADAPTATION

2.1 Ecosystem Services and Livelihoods

A natural ecosystem is a dynamic complex of plant, animal and microbial communities and their non-living environment interacting as a functional unit. For example wetlands, forests, coral reefs and other ecosystems, each of which has specific biotic and abiotic factors interacting among them. Natural ecosystems are thus multiple-resource systems that provide multiple services for community livelihoods and environmental integrity. The Millennium Ecosystems Assessment (MEA, 2005) described four different categories of ecosystem services for the benefit of human beings (Figure 2):

- ***Provisioning services*** (products obtained from ecosystems) – food, fuel, fodder, fruits, thatching materials, freshwater supplies, grazing, genetic resources, etc.
- ***Regulating services*** (benefits obtained from regulation of ecosystem processes) – pollution control, biodiversity regulation, water and air quality regulation, water flow regulation, flood control, pollination, carbon sequestration, etc.
- ***Cultural services*** (non-material benefits obtained from ecosystems) - ecotourism and recreation, education and research, cultural heritage, religious values, etc.
- ***Supporting services*** (services necessary for the production of all other ecosystem services) - soil formation, photosynthesis, nutrient cycling, etc.

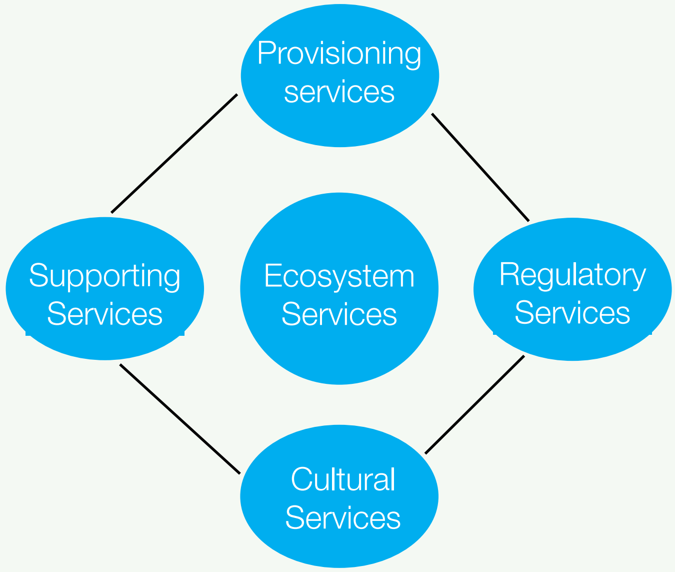


Figure 1: Ecosystem Services (MEA, 2005)

It is evident that the recent changes in climate-related factors have already started affecting ecosystems and biodiversity, and that this trend will further intensify with further changes in global climate (CBD, 2009). Global climate scientists suggest that approximately 10% of species assessed so far will face increasingly high risk of extinction for every 1°C rise in global mean temperature (IPCC, 2007). IPCC (2012) further warned that rates of species extinctions will accelerate, which would negatively impact the goods and services that species and ecosystems provide for human well-being. In addition to biodiversity and livelihood values, ecosystem services also influence disaster risk reduction and adaptation to climate change (Midgley *et al*., 2012)

A well-managed ecosystem has the ability to absorb shocks and stresses associated with climate change and thus contribute to adaptation to climate change and disaster risk reduction. Munang et al. (2013) explains that a well-managed ecosystem increases the resilience of natural systems and societies to climate change impacts by maximizing co-benefits of mitigation of climate change (carbon sequestration) and providing physical defenses from climate-induced disasters. Degraded ecosystems, on the other hand, lose capacity to build resilience and to sequester carbon, thereby increasing their vulnerability to climate change and disasters (Munang et al., 2013). They further explain that unmanaged ecosystems are highly susceptible and that exposure to shocks and climate change will exacerbate the degradation of ecosystems, triggering disasters and reducing natural and social resilience against these disasters. It suggests actions aimed at managing ecosystems to deal with climate-change induced hazards and impacts on livelihoods, otherwise known as ecosystem-based approaches to adaptation (EbA).

2.2 Ecosystem-based Adaptation to Climate Change

The main objective of EbA is to promote societal resilience through the management and conservation of ecosystems in order to reduce peoples' vulnerability to climate change (adaptation) as well as to build resilient ecosystems in the face of climate change impacts. At its core, EbA is about ensuring the capacity of ecosystems to generate essential services needed for climate change adaptation of socio-ecological systems, and it requires ecosystems to be managed as components of a larger landscape of which human activities are part (Devisscher, 2010). EbA is defined by different scholars differently, but all agree on the core principle of maintaining healthy ecosystems to deliver various services for building resilience of dependent communities in the face of climate change impacts. The Convention on Biological Diversity (SCBD, 2009) emphasizes the role of ecosystems and biodiversity in adaptation action and noted:

> "Ecosystem-based Adaptation integrates the use of biodiversity and ecosystem services in an overall adaptation strategy that includes the sustainable management, conservation and restoration of ecosystems to provide services that help people adapt to the adverse effects of climate change."

Chapin *et al.* (2009), however, focus on management of ecosystems linking with social systems and defines EbA as:

> "…management of ecosystems within interlinked social-ecological systems to enhance ecological processes and services that are essential for resilience to multiple pressures, including climate change. "

Shereen (2013) emphasizes the resilience of ecosystems and the services they provide to society and explained EbA should "where relevant, take into account strategies to increase ecosystem resilience and protect critical ecosystem services on which humans depend to reduce the vulnerability of human and natural systems to climate change."

The EbA approach benefits local communities by recognizing the inter-connectivity between ecological, social-cultural, economic and institutional structures and processes. Midgley *et al.* (2012) shows three inter-related development components (viz. community-based natural resource management, climate change integrated conservation strategies, and community based adaptation) in EbA that, collectively, ensure sustainable development and build resilience in the face of a changing global climate. EbA addresses the role of environmental services in reducing the vulnerability of natural resource dependent communities to the impacts of climate change using a multi-sectoral and multi-scale approach (Vignola *et al.*, 2009). It builds on the increasing evidence that natural resources can play an important and cost-effective role in adaptation to climate change (Colls *et al.*, 2009).

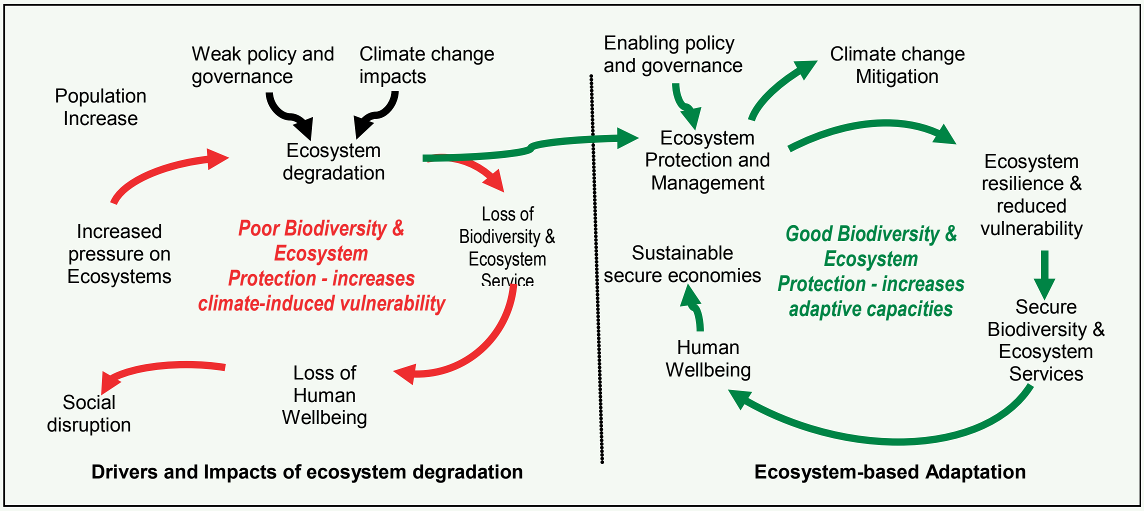


Figure 2: Ecosystem degradation, climate change and EbA (Adapted from Munang *et al.*, 2013).

Munang *et al.* (2013) argued that EbA approaches ensure healthy ecosystems and their flow of services, thereby providing opportunities for sustainable ecological and economic outcomes, while at the same time safeguarding people and ecosystems against the negative impacts of climate change and climate variability (Figure 3). According to Munang *et al.* (2013), in addition to grassroots resilience, EbA also meets multiple policy and development objectives for society and the environment by achieving i) a win for climate change adaptation and mitigation; ii) a win for socio-economic and livelihood development; iii) a win for environmental protection and biodiversity conservation; and iv) a win for contributing to sustainable economic development.


Canal re-excavation in Gabura Island
Satkhira, Bangladesh.

CHAPTER 3

EBA PRACTICES IN THE COASTAL ZONE OF BANGLADESH

3.1 EbA Case Studies

Although the EbA approach has not been included officially in discussions around development and adaptation landscapes in Bangladesh, in practice there are some examples of development /adaptation activities that address ecosystem management, livelihood enhancement and disaster risk reduction. Such activities also contribute to building social-ecological resilience to absorb both climate and non-climate induced shocks and thereby support adaptation to climate change impacts.

Questions remain, however, as to which development interventions can really be labeled EbA? This can be addressed following the principles suggested by the Millennium Ecosystem Assessment (MEA 2005) and IPCC (2007) as interventions that:

- Contribute to ecosystem conservation (restoration, protection, preservation and wise use) that enable them to provide ecosystem services (provisioning, regulatory, cultural and supporting) to moderate adverse effects of climate-induced threats on social and ecological systems.
- Help adjustment of natural (ecosystem components and functions) and human systems (livelihood, food security) to the adverse effects of climate change (viz. restoration of degraded ecosystems to provide livelihood benefits).
- Are targeted to "exploiting benefits from changed conditions" (due to climate change) that contribute to livelihoods benefits (such as floating agriculture in waterlogged areas).

Based on these criteria, six case studies from the coastal zone of Bangladesh are presented in the following section that can be termed examples of EbA.

Case study 1:

Community-based large-scale mangrove afforestation in the coastal zone

Location: Three upazilas in three coastal districts (Barguna, Bhola and Noakhali).

Ecosystems: Coastal mudflats/ intertidal lands, mangrove ecosystem.

Lead Agency: Community-based Adaptation to Climate Change through Coastal Afforestation (CBACC-CF) project of the Ministry of Environment and Forests (MoEF) and executed by the Forest Department (FD).

Vulnerability context

Historically the coastal area of Bangladesh has been exposed to cyclones and storm surges, sea level rise, coastal erosion and salinity intrusion which are increasing in frequency and intensity due to global climate change and intensifying the extent of damage and fatalities. Coastal embankments in most places are failing to provide adequate security in the face of these hazards largely due to poor maintenance. However, the use of mangroves as green belts has been shown to provide an important first line of defence by reducing the speed and strength of cyclonic storms, thereby helping to protect coastal communities, infrastructure and livelihood assets.

© Shahinur Rahman, CBACC Project, UNDP

Enrichment mangrove plantation in the project with mixed species for sustainability

EbA activities of the project

The project is building social-ecological resilience by planting mangroves on 6,100 hectares of newly accreted coastal land that is exposed to cyclones and storm surges. The project personnel along with field level officials from the Forest Department (FD) and local communities jointly selected suitable land for mangrove afforestation located in inter-tidal areas. In order to ensure a supply of quality saplings of different mangrove species, the FD organized mangrove nurseries near the plantation sites and involved poorer community members in project sites (mostly women) in nursery activities. The male members of poor coastal households were engaged in plantation activities, allowing local communities to earn extra income from nursery and plantation activities which helps support their adaptive capacity.

The project is creating new mangrove ecosystems in different parts of the exposed coast, which are not only improving the coastal environment, but also ensuring the services that the local community will derive from mangroves; this in turn contributes to enriching biodiversity and community livelihoods. The project planted multiple species of mangrove trees (enrichment plantation) as opposed to traditional afforestation programs where only one or two species are planted, and which in 15 years or so become susceptible to disease /pest infestation and face high mortality (Figure 4). By contrast, the enrichment plantation of the project with multiple mangrove species is better able to absorb environmental shocks and provide ecosystem services for a longer period.

The other major focus of the project was to improve community livelihoods adjacent to afforested areas with the expectation that the participating community would protect the mangrove forest to maintain a coastal green belt and sustain ecosystem benefits. To this end, the project also provided training and inputs support to vulnerable coastal households to diversify and enhance their livelihood options, including their employment in plantation and nursery development activities. Key livelihoods support packages included agriculture, horticulture, aquaculture, livestock rearing, ditch-and-dyke farming systems and strip plantation with community share systems (social forestry). The project formed a co-management committee (CMC) including representatives of local government, local elites and concerned government agencies headed by the chief executive office of the sub-district to facilitate implementation of project activities, manage conflict resolution and to provide policy and legal supports needed by the project.

Key lessons

The planted mangroves provide multiple adaptation benefits to coastal communities through various ecosystem services. They also have mitigation benefits through carbon sequestration. This intervention contributes to building the resilience of coastal ecosystems and biodiversity and is helping to build resilient coastal communities in the face of climate change impacts.

Limitations

Despite the adaptation and mitigation benefits of mangrove afforestation, there are some limitations which need to be addressed to derive sustainable benefits from the project. These include:

- Mangroves are planted in isolated coastal charlands[1] engaging communities as labourers, but there is no modality for community engagement, or establishing a co-management system towards achieving mangrove-centered ecosystem-based adaptation to climate change impacts. In addition, mangrove plantations are seen as an isolated and stand-alone activity rather as an integrated coastal ecosystem-based approach to adaptation to climate change stressors.
- Restored mangroves provide habitats for fish and other coastal-marine biodiversity, but there is no action towards improved management of coastal ecosystems and biodiversity and there is no involvement of the Department of Fisheries (DoF) and Wildlife Wing of the Forest Department in the project.
- Coastal charlands are owned by the Ministry of Land (MoL), but their engagement in settling land-related disputes and sustainability of mangroves as coastal green-belts is inadequate.
- Mangroves are reported to be threatened due to pest attacks (stem borers), especially in places close to agricultural lands (rice farming). In addition, cattle grazing in coastal charlands poses a major threat to mangroves. To date no land use zoning plan has been adopted or initiated for successful restoration of mangrove ecosystems.

[1] Newly accreted lands in the coastal intertidal zone and sand bars within and along riversides.

Case study 2:
Community-based small-scale mangrove restoration

Location: Shora village in Ramjannagar Union, Shyamnagar Upazila, Satkhira District.

Ecosystem: Mangrove ecosystem (restored in coastal village ecosystem).

Implementing Agency: Caritas Bangladesh, Forest Department (FD) and local communities.

Vulnerability context

The settlements and assets of Shora village, Ramjannagar Union are threatened by tidal waves as the earthen embankment built to protect them has been weakened due to erosion. Villagers reported an increased frequency of abnormally high tides in recent times, which may be due to climate change-induced sea level rise. This has increased the risk of embankment collapse and saltwater inundation.

In order to address the problem, local community members approached Caritas Bangladesh and negotiated with FD to help with mangrove planting along the embankment to create a micro-level green belt aiming to protect the embankment, as well as to create a mangrove micro-ecosystem at village level (Figure 5).

© Mokhlesur Rahman, CNRS

Mangrove restoration along the embankment, Shyamnagar

EbA activities of the project

An agreement was signed between the FD and the village-based mangrove forest preservation committee (formed by Caritas Bangladesh) to undertake mangrove restoration activities with the goal of protecting settlements and the embankment from tidal surges and consequent erosion, motivating local communities to plant and conserve mangroves, contributing to biodiversity conservation and reducing risks related to climate-induced hazards such as cyclones and tidal surges.

Mangrove afforestation was undertaken along the coastline in a 25-hectare area using a variety of species such as *Bain* (*Avicennia officinalis*), *Keora* (*Sonneratia apetala*), *Goran* (*Ceriops decandra*), *Gewa* (*Excoecaria agallocha*) and *Kakra* (*Bruguiera gymnorrhiza*). Various non-mangrove species such as *Epil Epil* (*Leucaena leucocephala*), *Akashmoni* (*Acacia auriculiformis*), *Babla* (*Acacia nilotica*) and *Neem* (*Azadirachta indica*) were also planted on the slopes of a 1.5km long earthen embankment. A seven- member forest preservation committee was formed by Caritas to look after the day-to-day management of the rehabilitated mangroves and forest cover. The total cost of the activity (plantation related) was BDT 78,000 equivalent to USD 1,000.

Key lessons

The project has demonstrated that mangrove afforestation along the coastal embankments can reduce the impact of tidal surges and cyclonic storms, and in turn protect the embankment from tidal erosion. Successful implementation of the project was due to the engagement of the FD with community-based initiatives, which ensured that the community received technical support from the FD in species selection and plantation management. Engagement of the Union Parishad as local government helped in managing local conflicts and protecting the plantation afterwards. This micro level EbA opens up conduits for communities to work directly with a government agency (FD in this case) and local government on similar efforts in future.

Limitations

The following are key limitations of the approach in light of EbA:

- The project primarily focused on planting mangroves along embankments to protect them from tidal waves and surges, but full consideration of a mangrove-based ecosystems approach was not included in the project.
- A social forestry approach was adopted through which communities obtain benefits from felling planted trees (mainly non-mangroves), but this will result in negation of the adaptation and mitigation benefits of the forest after 10-15 years, and the communities will again become exposed to hazards.
- The services that mangrove ecosystems provide in support of social-ecological systems seemed poorly understood by the communities and other stakeholders.
- Other land and water-based livelihood activities across village landscapes were not integrated, taking into consideration the type of climate stressors and vulnerabilities affecting these coastal communities.

Case study 3:

Ditch-and-dyke schemes for year-round cultivation in saline-prone coastal lands

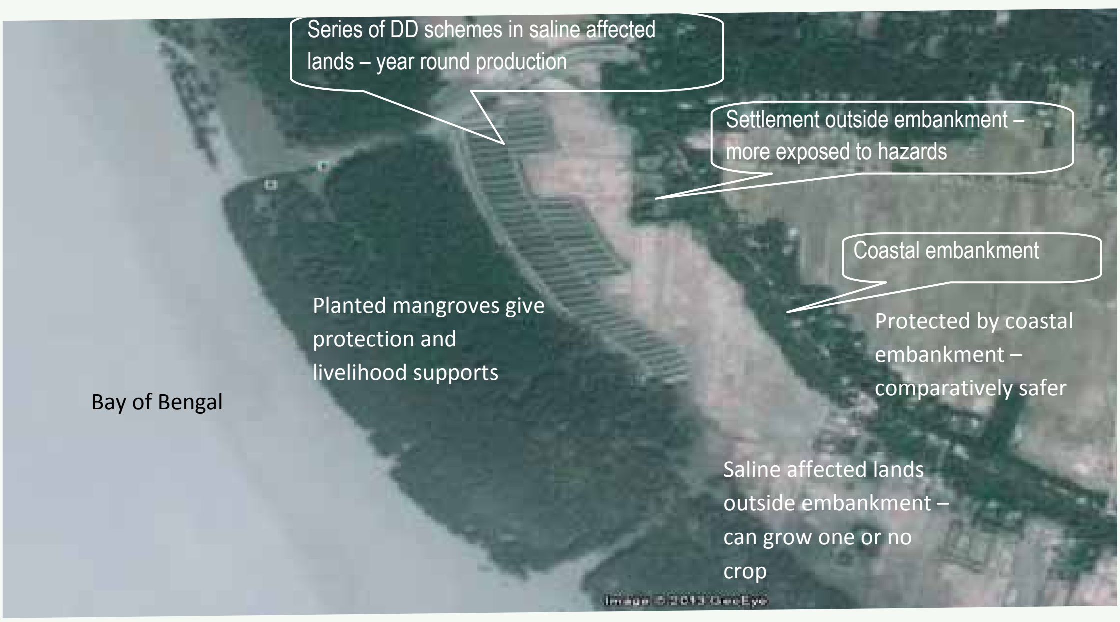
Location: Three coastal districts of Bangladesh (Barguna, Bhola and Noakhali).

Ecosystems: Coastal saline-affected (inter tidal) lands.

Implementing Agency: Ministry of Environment and Forests (MoEF) and Forest Department (FD) as lead agencies; they also involved other agencies like DoF (Department of Fisheries), DAE (Department of Agriculture Extension), DoL (Department of Livestock), BAU (Bangladesh Agricultural University), MoL (Ministry of Land) and BARI (Bangladesh Agriculture Research Institute).

Vulnerability context

Coastal lands on the sea side of the protective embankment (outside the embankment) are highly susceptible to moderate to high soil salinity and thus are not suitable for farming. This land is exposed to tidal saline water inundation particularly in wet season and thus the land is saline-affected. Most of this land is unproductive and remains fallow much of the year, except in some places where farmers can grow rice in the monsoon season when high rainfall reduces the soil salinity.



Ditch-and-dyke (DD) schemes in saline-prone lands in Noltona Union, Barguna sadar.

EbA activities of the project

The project has worked with the community to change the land form of this saline-affected area by excavating ditches and raising dykes with the excavated soil, creating a series of ditches and dykes from flat land (Figure 6 and Figure 7). The ditches retain monsoon rainwater (freshwater) in sufficient volume to maintain water levels almost year-round, making them suitable for fish culture. The dykes are raised to a level that keeps them free from tidal inundation and helps protect the scheme areas from salinity intrusion. These ditch-and-dyke schemes have been initiated on khas lands, which are mostly under the control of FD, and are then provided to landless households. Most of these people live outside the embankment, where they are very exposed to cyclones and storm surges. Eight ditches and dykes have been constructed on one hectare of land, with one given to each of eight households.

The beneficiaries are now using the ditches for fish culture almost year round using the freshwater stored during monsoon rains; and they have chosen to culture rare carp, tilapia and golda prawn (*Macrobrachium rosenbergii*). When the water level in the ditches falls in the dry season, they harvest the stocked fish and sell them in local markets to avoid fish mortality due to drought. They have also been given ducks, which they raise in the ditches, and they are able to use the raised dykes for agriculture, horticulture and forestry, for short, medium and long-term benefits. The freshwater from the ditches is used to irrigate the crops and trees on the dyke. Farmers are asked to use organic manure in dyke-cropping, including regular mulching to minimize the effects of soil salinity. Common vegetables cultivated include sweet gourd, pumpkin, bitter gourd, eggplant, tomatoes, beans, spinach and amaranth.

Key Lessons

Ditch-and-dyke schemes provide adaptation benefits through year-round crop production and beneficial use of saline-affected lands, while mitigation benefits are generated through carbon sequestration by the trees grown on the dykes.

This approach to land use has proven to be successful in bringing coastal saline-prone lands which otherwise would remain barren for most of the year under year-round production. It is suggested that MoL should facilitate further availability of land to relevant agencies in order to extend the ditch-and-dyke schemes and provide poor coastal households access to barren lands for productive purposes, thereby building resilience in the face of climate change impacts.

© Shahinur Rahman, UNDP

A partial view of DD schemes with mangroves at the back

Limitations

The ditch-and-dyke method (or Triple F model - fish, fruit and forest) is a good example of community level adaptation as it has restored saline-affected unproductive lands and brought them under year-round production systems. However, the following are the key limitations of the schemes in relation to EbA:

- The activity and action from the project is limited to ditch-and-dyke areas only – the adjacent lands, water bodies, embankments, settlements and mature mangroves on the seaward side, and coastal waters and other resource systems, are not integrated and brought under management interventions, and thus the concept of integrated coastal ecosystem management is not applied in practice.
- Although an EbA scheme, communities view this as ‘climate resilient livelihoods’ due to lack of proper orientation to climate change impacts and EbA.
- Most planning is done at a high level without giving due consideration to the views, needs

and experience of the participating communities.

- The land tenure system, which will give ownership to participating communities, has yet to be settled with the MoL; this is complex and time consuming, and if communities are not given long-term ownership, the activities may be terminated at the end of the project.

Case study 4:

Hydroponics – floating agriculture in waterlogged areas

Location: Initially started in the southwest coastal zone, then expanded to other wetland areas.

Ecosystem: Wetland ecosystem - mainly caused due to water logging/drainage congestion.

Agencies involved: Local communities initiated hydroponics in the southwest and then various NGOs disseminated this technology in other wetland /waterlogged areas of the country.

Vulnerability context

Some parts of southwestern coastal areas have been affected by drainage congestion and have become waterlogged, transforming cropland areas into wetlands, which are then unsuitable for agriculture. Fishing opportunities are subsequently created, but they are not sufficient to compensate for the loss of agricultural land. As a result, an innovative floating agriculture practice was developed to create new opportunities for income and food security and livelihoods (Figure 8). With more land likely to be submerged due to increased rainfall, flooding and sea level rise as a result of climate change, floating agriculture has significant potential to be used as an adaptation measure. This initiative has been developed by the farmers in order to help them cope with or adapt to waterlogged conditions, allowing them to benefit from the physical changes to croplands caused by poor drainage.

EbA activities of the project

This innovative method of floating agriculture was invented in the late 1960s before the climate change discourse, but it has become particularly relevant in this new scenario, which will likely bring more intense rains and exacerbate existing waterlogging issues. The system involves: a) making floating mats of water hyacinth and other aquatic vegetation available in these wetlands in early monsoon; and b) laying down organic manure (cow dung and other materials) to make beds for growing vegetables and vegetable seedlings on a commercial basis, or for personal consumption. At the end of the monsoon, when the water dries up, the floating beds are pushed to people's homesteads on the edges of wetlands and the organic matter is used to cultivate winter vegetables alongside the winter (*boro*) rice. This type of farming, or gardening, is commonly called "*dhap*" farming

in the southwestern coastal zone. Women are heavily involved in nursery rearing of seedlings and taking care of the floating beds.

This type of agriculture is done on an isolated basis and simply takes advantage of the available water, rather than taking a holistic approach to ecosystem management of land and water in the wider catchment. It does, however, capitalize on changing land types and uses the excess water beneficially for food production and income generation. In this way, it corresponds to the IPCC (2007) definition of adaptation, which is an innovation, or change in practice, that …"exploits beneficial opportunities".


© Mokhlesur Rahman, CNRS

Floating vegetable gardening (*dhap* farming) in waterlogged area, Pirojpur

Key lessons

The *dhap* farming system provides adaptation benefits through crop production during the monsoon season in waterlogged areas, which otherwise would have remained non-productive. This innovative form of floating agriculture is beneficially exploiting the water resources which result from both climate (high rainfall) and non-climate (poor drainage due to faulty water management) factors. The *dhap* farming method is profitable if weather is favourable, but farmers have experienced high seedling mortality on *dhap* beds when it rains heavily over consecutive days (erratic rainfall which will be more frequent in a changing climate), resulting in higher investment and lower profit. This practice can be replicated in other waterlogged areas, but efforts should be made to ensure it does not exclude some segments of the population especially the landless poor.

Limitations

- The activities are mostly carried out by landed farmers focusing on floating agriculture during monsoon season, but there is no collective action with regard to water /fisheries management, which is also a part of the ecosystem.
- Efforts could have been made to address wider ecosystem management at landscape level that could correct the drainage congestion problem, or the initiative could have taken into account other resource or production systems to achieve greater adaptation benefits.

There is no integration of relevant institutional actors in this initiative who could facilitate and enhance the production and extraction of sub-systems in the landscapes.

- Landless and poor communities are mostly engaged as labourers in the floating farming system, with the exception of a few who lease lands and practice *dhap* farming.

Case study 5:

Integrated fish-vegetable/ fruit-rice cultivation in drainage-congested rice fields

Location: Pirojpur-Bagerhat- Barisal areas.

Ecosystem: Cropland ecosystems.

Implementing agency: Local communities.

Vulnerability context

Some parts of southwestern coastal districts are affected by drainage congestion largely due to the construction of roads and embankments without providing adequate bridges and culverts, which causes localized drainage congestion, particularly during monsoon. This localized drainage congestion started affecting *amon* rice production in the monsoon season, which has been the main crop in the area. Local people also reported that this situation did not exist in the past (15-20 year ago), but it is now a problem for the landed farmers. This issue is being exacerbated by climate variability and changes which impact negatively on rice crops and the communities that depend on them.

© Mokhlesur Rahman, CNRS

Lease cultivation in waterlogged rice fields in Pirojpur area of southwest Bangladesh

EbA activities of the project

A new cultivation practice locally called the "lease farming system" is being practiced in some parts of Pirojpur District, which is located in a coastal area of the southwest. Farmers in the area have excavated trenches in their rice fields to hold excess rainwater and raised dykes to prevent further rainwater entering from adjacent lands. They cultivate a variety of vegetables and fruit trees on the raised dykes, or bunds, as well as aquaculture in the trenches (Figure 9 and Figure 10). This conversion was prompted by a minor waterlogging problem that was caused by road construction in the area. The road system in the area reduced water drainage and this affected the production of *amon* rice during the monsoon season. Now under the lease farming system they cultivate vegetables and fish as well as their usual rice crop year-round in the same field.

Key lessons

The lease farming practice has some similarities to the ditch-and-dyke schemes as practiced by the households under the UNDP-CBACC project in the coastal areas; both involve fish culture in ditches, or drains, and vegetable cultivation on raised dykes. This type of farming system is suitable in coastal areas where localized waterlogging affects traditional agricultural farming systems. The techniques involved have high potential for replication among the coastal farmers as it is likely that the incidence of intense monsoon rainfall will increase with climate change and cause drainage congestion in many coastal sites.

© Mokhlesur Rahman, CNRS

A farmer measuring water salinity using an easy to use kit

Limitations

- Only a few farms in the landscape adopted this farming system by converting their crop lands to trenches and bunds (dykes) to deal with drainage issues.
- This project represents a more individualistic approach, with no collective action, and other farmers in the same landscape having similar problems did not attempt to change their farming practices.
- The concept of "landscape-based" management was not taken into account. The project was limited to small pieces of land in a wider landscape ecosystem, which as a whole needs to be brought under integrated land-water-fish-crop management systems.
- Other relevant institutional actors (such as DAE, DOF, BWDB) were not engaged in the process, which otherwise could have facilitated improvement of the production systems through cropland ecosystem management approaches for wider benefits.

Case study 6:
Coastal wetland habitat restoration

Location: Shyamnagar, Satkhira District.

Ecosystem: Wetland ecosystems (coastal canal).

Implementing agency: Caritas Bangladesh, together with local communities.

Vulnerability context

In Jelekhali Village, a 5.3 km long canal used for retaining rainwater in a coastal saline-prone area had been the key source of freshwater for both irrigation and freshwater fisheries. The canal was under a common pool resource regime and was used by the community for irrigating their crops and for subsistence and commercial fishing. Due to siltation and gradual encroachment, the canal almost dried up, and some influential people from the area started practicing aquaculture in deeper pockets of the canal by putting in fences. As a result, the canal became degraded and lost its wetland characteristics and common pool features, leaving the landless poor excluded from accessing benefits. With climate change there has been an increase in heavy rainfall during monsoon season which is causing frequent flooding while in the dry season prolonged drought causes scarcity of surface water for irrigation that affects agriculture and fishing.

© Mokhlesur Rahman, CNRS

A partial view of canal rehabilitation in Shymanagar, Satkhira shows irrigated winter rice on the right side of the canal

EbA activities of the project

Local communities with the help of an NGO (Caritas Bangladesh) restored the degraded canal, with the goal of creating access to freshwater for irrigation and year-round aquaculture, improving the livelihoods of the poor and marginalized communities, and building their ability to adapt to the effects of changing climatic factors (Figure 11). In theory, restoration of wetlands, or any natural ecosystem, can be treated as a "no regret" adaptation as the restored ecosystem acquires the ability to deliver multiple services for the environment and local communities, whether the climate is changing or not. With the active engagement of local communities, local government and local administrators, Caritas rehabilitated the canal by removing the illegal encroachers. Freshwater in the restored canal is now being used for small-scale fish culture and irrigation in the adjacent crop fields. The total cost of the project was BDT 620,596 (US$ 7,956)[2], and it has delivered a range of social-ecological benefits to local people. The community also shared 20% of the cost of canal rehabilitation in kind by providing free labour.

Key lessons

Re-excavation of the canal not only ensured the required supply of freshwater, it also enhanced the ability of local communities to manage it for irrigation, fish culture and capture fisheries. This demonstrates that ecosystem (canal) restoration contributed to building community resilience in the face of climate change. There are many canals in the coastal areas that are silted up or encroached on for individual gain which could be restored and rehabilitated for both ecosystem and social benefits as a way of adapting to the impacts of climate change. Government support, institutional coordination, community participation and funding provisions will enable success of this kind of EbA intervention.

Limitations

- A small segment of the wetland ecosystem (part of a canal) was restored, without taking into account the interconnected nature of canal systems including rivers and *beels* (seasonal lake-like wetlands) at the wider landscape level.
- From the EbA perspective, water management issues in the coastal zone should take into account a holistic land-water system including fisheries, biodiversity, farming systems and water demands for other livelihoods purposes which were not considered here.
- Lack of effective involvement of relevant government agencies, such as Department of Agriculture Extension (for climate-smart farming systems), Department of Fisheries (for climate smart fisheries and aquaculture) and Ministry of Land (for *khas*[3] management) and other relevant agencies, may hinder sustainability of the intervention in the longer term.
- The project did not address the key issue of encroachment of *khas* lands /wetlands, and conversion and fragmentation for private use, mainly by influential shrimp farmers in adjacent (upstream and downstream) areas of the rehabilitated canal. Effective EbA should involve stewardship of these wetlands and bring them all under an integrated landscape resource management system within a defined watershed.

---

[2] 1 US $ = BDT 78.00
[3] State owned lands

3.2 Discussions on EbA Case Studies

The EbA case studies presented above have facilitated improved ecosystem management, which demonstrated increased ability of ecosystems to deliver services for the benefits of the natural environment, as well as community livelihoods. All these ecosystem-based management interventions were found to have facilitated adaptation to climate change impacts over short, medium and longer timescales. These ecosystem-based management outcomes contributed to both ecosystem and economic benefits that are necessary elements for adaptation to climate change.

Colls *et al.* (2009) grouped EbA outcomes necessary for adapting to climate change impacts into five broader development areas; viz. disaster risk reduction, livelihood sustenance and food security, sustainable water management, biodiversity conservation, and carbon sequestration. A brief overview of the relevance of each of these development areas to the cases follows.

Disaster risk reduction

Climate change will increase the frequency and intensity of natural disasters across countries of the world with concomitant losses and damages, while EbA has high potential to reduce the impacts of such disasters. It is observed that all six EbA schemes under study have contributed to reducing the disaster risks to varying degrees depending on the nature and scale of interventions.

For example, EbA schemes on mangrove afforestation and reforestation in coastal inter-tidal charland areas (Case 1) and along the coastal embankments at village level (Case 2), have both primarily safeguarded local communities and assets against cyclones, storm surges and tidal flooding by reducing the risks of disaster, and thereby reducing their vulnerabilities to hazards. The ditch-dyke systems (Case 3) transformed the land areas affected by increased salinity and tidal flooding to saline and inundation-free ditches and dykes now being used by the local poor for year-round aquaculture and agricultural farming.

Similar disaster risk reduction outcomes are visible in the case of the integrated fish-vegetables-rice cultivation systems - locally called “lease cultivation systems” (Case 5) - in the southwestern coastal districts where drainage congestion used to damage rice production. The new systems of farming created opportunities for disaster-affected people to get year-round farm outputs, instead of only one rice crop (often partial due to damage) in a year. In the coastal districts where drainage congestion is acute (Case 4), and has crop lands have been submerged for the entire wet season. Here farmers have been practicing floating agriculture and the technology has proven to be effective in not only reducing the risk of disaster, but also opening up conduits for new production systems.

High soil and water salinity in the dry season is a common hazard in the saline-prone southwestern districts. Land grabbing, siltation and conversions of canals has further intensified salinity-related problems, particularly in the dry season when the shortage of freshwater for irrigation and fishing is acute. The EbA scheme on canal rehabilitation (Case 6) reduced such salinity-induced problems in the area by making freshwater stored in the canal available to enable farmers to produce two rice crops a year, while at the same time raising freshwater fish in the rehabilitated canal. In addition to disaster risk reduction, all these EbA schemes also contributed to achieving secure and enhanced livelihoods.

Livelihood sustenance and food security

EbA can also play a vital role in reducing the predicted impacts of climate change on livelihoods and food security. Each of the EbA schemes in the case studies have improved livelihoods and food security for local communities. The mangrove afforestation and reforestation schemes (Case 1) are providing mangrove-based livelihood options for local communities by making available fish, shrimps, crabs, fuel, fodder, thatching materials etc. for poor and marginalized households in the area. Mangrove plantations also help by creating new coastal lands available for agriculture, grazing and settlements. In addition to the benefits derived from extraction and production systems, the project involved communities in mangrove nursery rearing and plantation activities, which directly created employment opportunities for the poor.

Small village-based mangrove plantations along the village embankments (Case 2) also support community livelihoods and food security as local people can now harvest *Keora* seeds to make pickles and sell them for income. In addition, fruit from the non-mangrove species is supplementing householder nutritional needs and the branches, leaves and twigs are being used for cooking, helping to reduce fuel costs. Local communities will also get a major share of non-mangrove trees planted on the embankment after 15 years when the trees will be cut. The proceeds from the timber sales will be shared among the local communities.

The planted mangroves provide various ecosystem services for the benefits of local environment and community livelihoods (Figure 12). Such benefits include: provisioning services (food, fuel, fodder, timber, fish, shrimps, crabs, etc.), regulatory services (climate and water flow regulation, erosion control, disaster risk reduction, carbon sink), cultural services (ecotourism, education and research) and supporting services (soil formation, photosynthesis, nutrient cycling, habitats for fish, shrimps, crabs, etc.).

The innovative ditch-and-dyke schemes in the saline-prone coastal lands (Case 3) demonstrated dramatic examples of increased crop and fish production and thereby created opportunities for poor households to earn additional income. Project records show that each household earned average income of BDT 20,000 (US $256) from vegetable production on dykes per year, with some better-managed dykes producing twice that amount. On average, each household also generated income of BDT 12,000 from fish per ditch per year. The ditch-and-dyke schemes are also quite cost-effective. For an average cost of US$330 for constructing one unit (one ditch and one dyke), beneficiaries generated US $1,000/family/year in the first year.

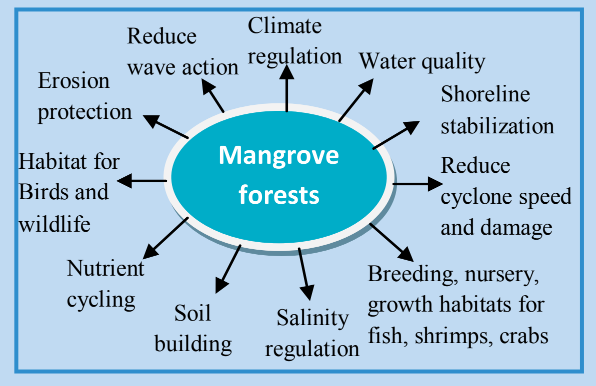


Figure 3: Ecosystem services of mangroves (regulatory and supporting).

The floating agriculture practices (Case 4) support the livelihood and food security of local communities in many ways. They provide food, fuel, manure, etc. (provisioning services) for the waterlogged affected people as well as creating income earning opportunities for poor people in the area, including women. As reported, many poor women were employed in seed bed preparation, manure gathering and rearing of seedlings to plant on the *dhaps* (floating mats).

Like floating agriculture, the “lease farming system” (Case 5) in waterlogged lands also provides more income from diversified farming systems than rice cultivation alone. This system creates a year-round source of income through cultivating diversified crops, vegetables and fruits as well as income from fishing/aquaculture. One such lease farmer reported that he earned about Tk. 30,000 (US $385) from his 0.07 ha of land in 2013, as well as receiving a sufficient quantity of vegetables for household consumption (Table 1), while a single rice crop would not generate more than BDT 5,000 (US $64).

Livelihood benefits from the canal rehabilitation scheme (Case 6) were also significant. Many farmers are now benefiting from the availability of freshwater in dry season by being able to grow double rice crops as opposed to growing only *amon* rice in monsoon. Growing rice is more labour-intensive than shrimp farming, so the cultivation of two rice crops created employment opportunities for many local poor. In addition, many households cultivate vegetables and fish together as an integrated system, and some people have started duck rearing in the canal. Rice cultivation in monsoon and winter seasons has ensured the availability of hay as fodder and this has encouraged households to keep cattle. Integrated rice and fish (mostly *golda*: giant freshwater prawn) farming has added extra income to local households living along the canal. On top of the livelihood benefits, EbA schemes have also facilitated sustainable water management, which is crucial for effective adaptation to a changing climate.

Table 1: Varieties of vegetables and grown in the scheme and the sale values of products

Sl. no.	Name of crop/ vegetables	Amount sold (BDT)	Cultivation period	Remarks
1.	Cabbage	10,000.00	Mid-October to mid-March	Grows better
2.	Kohlrabi	1,000.00	Mid-October to mid-March	Moderate
3.	Okra/Ladies' fingers	1500.00	Mid-April to mid-September	Grows better
4.	Country bean	1,500.00	Mid-April to mid-March	Grows better
5.	Bitter gourd	2,000.00	Year round	Grows better
6.	Yard long bean	1,000.00	Year round	Moderate
7.	Bottle gourd	3,000.00	Year round	Grows better
8.	Ash gourd/Wax gourd	1,500.00	Mid-April to mid-September	Moderate
9.	Bilati Amra (fruit)	3,200.00	Multi year	Grows better
10.	Banana	2,000.00	Year round	Moderate
11.	Papaya	2,000.00	Year round	Grows better
12.	Indian spinach	500.00	Mid-April to mid-September	Moderate
13.	Red amaranth	1,000.00	Mid-October to mid-March	Moderate
14.	Stem amaranth	300.00	Year round	Moderate
15.	Mustard		Mid-October to mid-March	Moderate
	Total	**30,500.00**		

Water is one of the most important and key determinants for sustaining life systems on the earth. The availability of water will be severely impacted by changing climate, which is often manifested as erratic rainfall. In some cases, an excess of water, in other cases a shortage of water under a changing climate regime, will affect the lives and livelihoods of people, natural ecosystems and biodiversity. As such, one of the key aims of EbA schemes is the sustainable management of water resources. High tides and storm surges will cause damage to coastal landscapes, settlements, aquaculture and agriculture; intense heavy rainfall may cause damaging floods; and prolonged drought will create a severe scarcity of water. All these weather-related stressors will affect both production and extraction systems, including ecosystem structures, functions and delivery of services.

The coastal mangroves (EbA Cases 1 and 2) will regulate storm surge and flooding damage, while the ditch-and-dyke schemes (Case 3) ensure freshwater availability in saline-prone coastal lands for aquaculture and agricultural production, thereby building adaptive capacity in settings that are prone to disaster. Adaptation to excess water (due to drainage congestion) that inundates lands for longer periods and affects rice farming in coastal districts, can be achieved using floating agricultural and lease farming systems (Cases 4 and 5). These EbA schemes demonstrate better management of water resources in such contexts, and use the excess water beneficially for enhancing diverse production systems that contribute to enhanced livelihoods and food security; in other words building adaptive capacity to face environmental shocks. As observed in “lease farming”, water from the drains (dug in croplands) is used to irrigate vegetable and fruit crops, as well as to support fish culture.

The canal rehabilitation scheme in saline-prone coastal areas (Case 6) can help to solve drainage congestion, waterlogging and salinity problems; and the freshwater available can be used for fish-culture and irrigation of crops. In the case study, a seven-member village committee was formed to oversee the water management issues of the scheme, which also helped build the capacity of local communities to take collective action. The rehabilitated canal increased productivity and provided various ecosystem services, i.e., provisioning services (food, fuel, fodder, etc.), regulatory services (water flow regulation, pollution abatement) and supporting services (nutrient cycling, water supply) for the benefits of local communities; and these services contributed to their adaptive capacity. Improved drainage and reduced flooding created opportunities for freshwater fish culture in the canals for the poor, and enabled collective initiatives to take up aquaculture using freshwater fish species.

Another key outcome of EbA schemes is the conservation of biodiversity, which is being increasingly threatened due to the impacts of climate change.

Biodiversity conservation

A major focus of EbA is to restore and conserve degraded or semi-degraded ecosystems as well as to enhance existing ecosystem structures and functions including conservation and management of biodiversity. One of the key assessment indicators of EbA is increased biodiversity of flora and fauna.

The EbA schemes explored in the case studies demonstrated positive impacts on biodiversity. The mangrove afforestation and reforestation schemes (Cases 1 and 2) demonstrated increased biodiversity both in the target area and neighbouring areas. For example, in mangrove-based schemes increased availability of fish, shrimps, crabs, mollusks, honey bees, and diverse floral species are reported which not only enhanced the quality of ecosystems but also increased opportunity for the community to derive livelihood benefits through consumption and selling of such marketable species. The canal rehabilitation scheme in a saline-prone area (Case 6) created opportunities for various freshwater aquatic biodiversity to re-colonize the wetlands and thus contribute to overall productivity of the wetland ecosystems that in turn help ecosystems and communities to become resilient against climate change impacts. Besides, all these EbA schemes also created or enhanced habitats for diverse species of wildlife such as amphibians, reptiles, birds, mammals etc in the area. The ditch-and-dyke and lease farming schemes (Cases 3 and 5) also contributed to support of local biodiversity including agricultural crop diversity, as land and water create opportunities for practicing crop diversification which is recognized as one of the effective adaptive measures (in agriculture) in a changing climate. In addition to these adaptation benefits, EbA also contributes to mitigating global climate change through carbon sequestration and regulating air quality.

© IUCN / Enamul Mazid Khan Siddique

Species ranging from insects to mammals live in the coastal plantations; Hatiya, Noakhali

Carbon sequestration

Some adaptation schemes have co-benefits of adaptation to and mitigation of climate change effects. It is reported by the Community Based Adaptation to Climate Change (CBACC) project that 6,100 ha of planted mangroves have the capacity to sequester nearly 600,000 tons of carbon per year which helps to mitigate the impacts of climate change. Ditch-and-dyke systems also act as carbon sinks due to the forest and wetland components on the dyke and edge plantations and ditches. Although small in size, mangrove afforestation along coastal embankments at the village level can also help sequester carbon and contribute to mitigation efforts. Apart from these direct contributions to carbon sequestration through tree planting, the contribution of EbA to mitigation is also achieved through restoration and sustainable management of degraded ecosystems that act as carbon sinks which otherwise would have acted as sources of carbon which both cause and accelerate global warming. The extent of adaptation and mitigation outcomes and benefits of EbA vary in accordance with the nature and scale of schemes. Some schemes may produce measurable outcomes within a shorter timescale while some may take medium to longer time periods to produce tangible benefits. For examples, canal rehabilitation and ecosystem connectivity establishment may produce results in just a few months to a year, while other schemes such as mangrove afforestation may take up to five to six years to show measurable change in ecosystem structure and function. Another aspect of EbA is the scale, which is measured by the size of the scheme (how small or large in extent). Conceptually, an EbA scheme may be very small (limited in a village setting) or quite large (covers several districts) depending on various factors such as the size of the respective ecosystems, availability of funding and capacity of implementing agencies.

Canals are arteries and veins of agro-ecosystem in the coastal zone.

CHAPTER 4
SCALE OF EBA

EbA can be implemented at any scale in line with the size and dimensions of the ecosystems under management. This could range from a micro-scale of a few hectares to hundreds of hectares, while the meso-scale may comprise several hundreds of hectares with several thousands of people in the catchment covering one or more large interlinked ecosystems (wetlands-forest-crop lands). The macro-scale covers larger ecosystems or multiple interlinked ecosystems which are diverse in nature and may cover several thousands of hectares spread over multiple sub-districts. Figure 15 illustrates the different scales at which EbA can be applied.

Micro-scale EbA

Ideally, a small catchment covering one to a few villages with relatively small defined ecosystems, whether a wetland or a defined part of a forest, or defined area of coastal zone, or part of a landscape or hill slope, can be a suitable area for micro-level EbA practices. As an example, a wetland basin located between Fultala, Dhankhali, Kultali and Jelekhali villages in Munshigonj mouza[4] of Munshigonj Union, Shyamnagar Upazila of Satkhira District would represent a micro-scale setting for practicing EbA (Figure 4.A). This area is characterized by having a seasonal beel (wetland) covering around 200 hectares, which is traversed by a major semi-perennial canal that is connected to rivers at both ends. This canal (Kultali khal) is the source of water in the beel, and in addition to seasonal rainwater gives the wetland ecosystem basin a seasonal aquatic-terrestrial feature, providing freshwater fish, shrimps, water for agriculture (rice and non-rice crops), various aquatic vegetation (provides food, fodder grasses, fuel and organic manure - water hyacinth and others) as ecosystem services for the people of four villages (Fultala, Kultali, Dhankhali and Jelekhali), with a population of around 6,000.

Meso-scale EbA

The meso-scale is appropriate for larger ecosystems such as wetlands or forests at the larger landscape level. An example of an area appropriate for practicing meso-scale EbA is the entire Gabura Union of Shyamnagar upazila of Satkhira District (Figure 4.B). The union comprises 15 villages and several hundred hectares of crop lands, shrimp farms, canals and low lying *beels*. It is surrounded by rivers, giving it an island-like setting, and is protected by a coastal embankment erected to save crops and assets with sluice gates to control water inside the polder. EbA in this area should focus on management of saline and freshwater

Figure 4: Micro (A), meso (B) and macro (C or D with dotted line) scales of EbA in the context of management of the SRF

4 Mouza is the smallest administrative unit

regimes for production (shrimp and fish aquaculture and agriculture); extraction (fishing and collecting various other aquatic and terrestrial products for livelihoods); and household purposes including drinking water.

When working at the meso-scale, the ecosystem and cultural diversity represented may make it necessary to create nested micro-scale EbA units which can be managed in an integrated way to produce the benefits at meso-scale. For example, some parts of Gabura union are suitable for rice farming, some parts for salt water shrimp farming, some areas are under single crops and some areas are suitable for double crops based on land elevation, water availability and salinity gradients. As a result, some nested smaller units (such as shrimp farming dominated units, rice farming dominated units) can be demarcated and brought under management and all these units collectively can produce EbA benefits at wider or meso-scale.

Macro-scale EbA

The scale of EbA is relational and not a hard and fast fixed physical boundary. For example, if it is considered the management of a larger part of the Sundurbans Reserved Forest (SRF), the entire western part of the SRF can be considered as macro scale for EbA (Figure 4.C). However, a macro-scale may cover even larger areas such as the entire SRF and its adjacent areas (Figure 4.D with dotted line). At macro-scale, the management areas can cover several meso-scale EbA units which can be brought under an integrated management system. Due consideration should be given in planning the management interventions to individual interlinked units to produce benefits over wider landscapes for diverse communities. However, the scale also depends on various other factors such as capacity, resources, land use, social-cultural systems, land elevation and inundation patterns, disaster vulnerability, transboundary issues etc.

© Mokhlesur Rahman, CNRS

The ditch and dyke infront is adaptation at micro-level and the mangrove plantation in the back is at meso level

Mangrove snails resemble adaptation capacity of species in changing conditions.

CHAPTER 5
POLICY-LEVEL APPROACHES TO EBA IN BANGLADESH

5.1 Policy and Institutional Aspects

Currently, there is no explicit policy or strategy at the national level that recognizes and facilitates implementation of EbA in Bangladesh to address the adverse impacts of climate change on social-ecological systems. However, there are two guiding documents that facilitate the adoption of adaptation-mitigation measures at national scale. The first – National Adaptation Program of Action (NAPA) - was prepared and submitted to UNFCCC in 2005 with 15 priority adaptation interventions (MoEF, 2005). The first intervention relates to "community-based adaptation to climate change through coastal afforestation (CBACC-CF)", which is now being implemented in four coastal upazilas as a pilot by the FD under the supervision of the MoEF and technical backstopping of UNDP. Activities that support mangrove afforestation and reforestation and community livelihoods is globally treated as EbA and in this sense Bangladesh NAPA addressed EbA in its priority adaptation planning. The other strategy document is the Bangladesh Climate Change Strategy and Action Plan (BCCSAP) which was first developed in 2008 and then updated in 2009 (MoEF, 2009). This document, however, lacks explicit focus on EbA approaches to enhance resilience of ecosystems and communities in the face of climate change impacts.

EbA addresses ecosystem management but also focuses on community engagement, wise use and livelihood development. Since ecosystems are multiple-resource systems, active engagement of multiple agencies and actors is critical to achieving successful EbA schemes or projects, and roles and responsibilities of relevant institutional actors should be ensured from the outset. In addition, EbA planning and implementation of activities and actions should be guided and governed under a policy regime that will ensure the required legal, policy and institutional supports are available as and when needed.

Reviewing the case of the CBACC-CF project (Case studies 1 and 3) it can be seen that various other ministries and agencies are involved in implementation processes (Table 2). The key elements of the project include i) afforestation (mangroves in coastal charlands and strip plantation on roadside and embankments with non-mangrove species), ii) fish-fruit-forest schemes in coastal saline-prone *khas*[5] lands exposed to varying degrees of tidal flooding, iii) climate-resilient agriculture and horticulture, iv) pond aquaculture, v) livestock rearing, vi) capacity building and institutional development, and vii) disaster early warning systems/ disaster risk reduction.

In implementing all these seven broad activity packages, the project involves other concerned government agencies and actors who have skills and mandates in their respective areas. Without the involvement of these agencies, implementation of the project would not have been possible. For example, if the Ministry of Land (MoL) had not allocated *khas* lands to the project beneficiaries, the

5 State-owned lands

implementation of the ditch-and-dyke system ("triple F model") would not have taken place. Similarly, without the approval of BWDB, strip plantations on coastal embankments could not be established. Key institutions for this adaptation project and their roles are presented in Table 2.

Table 2: Institutional actors in implementing CBACC-CF project.

Institutions	Role and level of engagement
1. MoEF (Ministry of Environment and Forests)	Lead ministry – coordinating and facilitating
2. FD (Forest Department)	Lead agency implementing and coordinating with other agencies and actors
3. Bangladesh Forest Research Institute (BFRI)	Technical support in enrichment plantation (multi-species) in mangrove areas
4. MoFL (Ministry of Fisheries and Livestock)	Supporting the project through DoF and DoL
5. DoF (Department of Fisheries)	Technical support in aquaculture, training and inputs - but limited to demonstration farmers only
6. DoL (Directorate of Livestock)	Technical support in livestock component, training, inputs – but limited to beneficiary households only
7. MoA (Ministry of Agriculture)	Supporting the project through DAE
8. DAE (Department of Agriculture)	Technical support in agricultural activities, training, inputs - but limited to demonstration farmers only
9. Bangladesh Agriculture Research Institute(BARI)	Supply of saline-tolerant vegetable varieties. Indirect support (not directly working with project communities at site level)
10. Bangladesh Agricultural University (BAU)	Supply of seeds of mono-sex Tilapia and jujube. Indirect support
11. Bangladesh Rice Research Institute (BRRI)	Supply of saline-tolerant rice varieties. Indirect support
12. MoWR (Ministry of Water Resources) through Bangladesh water Development Board (BWDB	Allowing the project to adopt social forestry along the coastal dykes. Loosely involved.
13. Local government (UP and UZ)	Conflict management, coordination – represented in local co-management committee (CMC).Loosely involved.
14. Upazila Administration	Chair the CMC, conflict resolution, process facilitation and coordination
15. Department of Disaster (DDM)	Assist in designing community centre and disaster early warning systems. Indirect support.
16. Dept of Social Welfare & Youth	Member of CMC, knowledge management for IGA and cooperative - loosely involved
17. MoLGRD (Ministry of Local Government and Rural Development)	Through LGED assist in infrastructure development. Indirect support and loosely involved

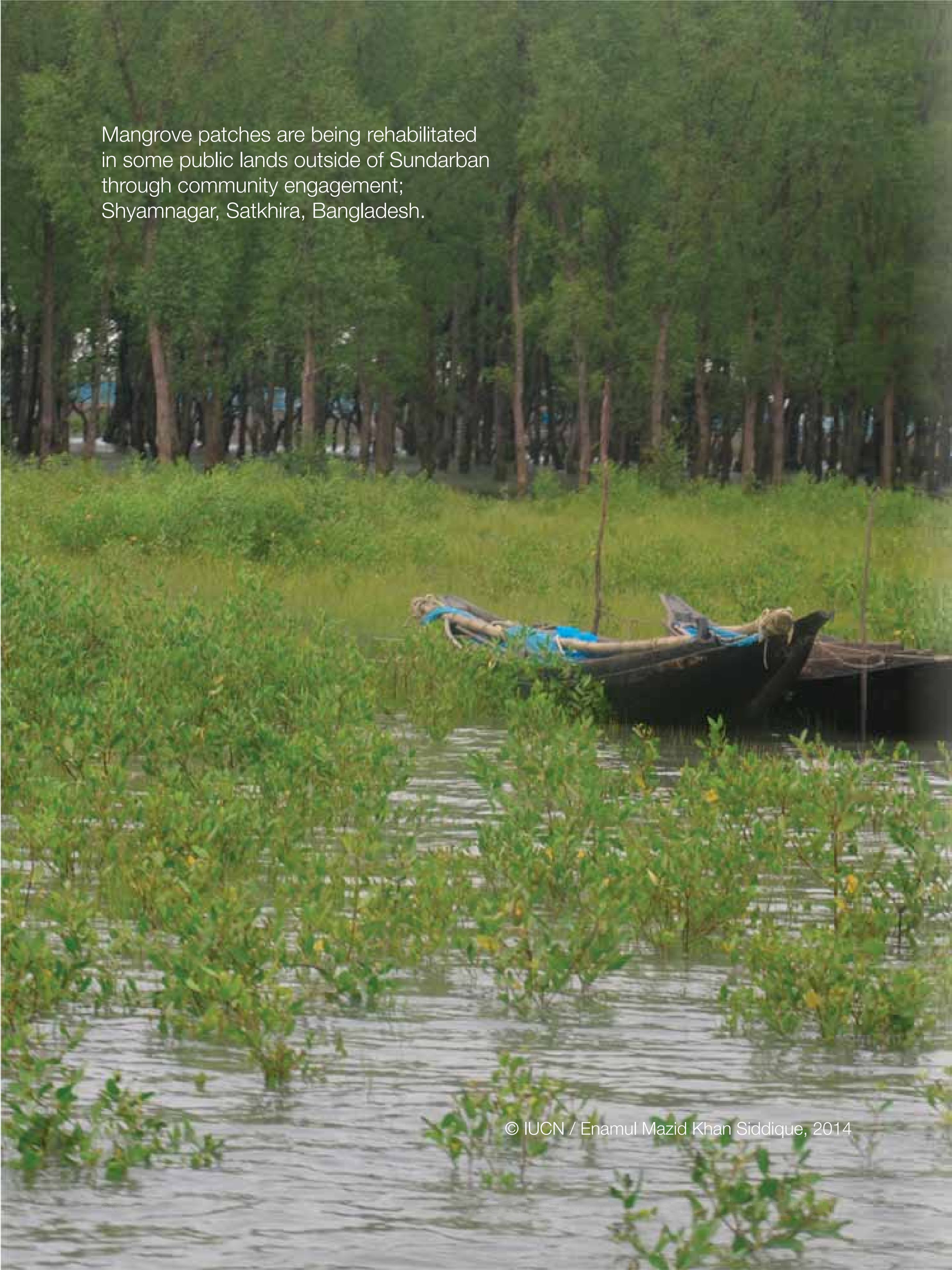
Institutions	Role and level of engagement
18. Local and National NGOs	Knowledge management. Indirect support, contractual tasks
19. Dept of Women's Affairs	Knowledge management and gender equity. Indirect support
20. Ministry of Land (MoL)	Facilitate supply of khas lands for plantations and demonstration of fish-fruit-forest schemes in coastal areas. Indirect support
21. UNDP	Technical monitoring and coordination
22. Lal Teer private seed company	Provide quality seeds to project farmers. Indirect support.

Table 2 is a clear illustration of why EbA must take a multi-stakeholder approach, as the activities deal with multiple-resource systems in a given bio-physical and social setting. Ensuring that there are effective mechanisms for coordination among various relevant government and private sectors has been a big challenge for planning and implementing EbA effectively in Bangladesh.

5.2 Constraints in Practicing EbA in Bangladesh

Integration of EbA into mainstream national development policies and plans in Bangladesh is constrained by a number of factors. Key constraints that affect the planning, implementing and monitoring effectiveness of EbA are presented below:

- Poor understanding of the concept of EbA among stakeholders and how it differs from other forms of adaptation approaches.
- Lack of reliable time series data on social, economic, ecological and climate attributes that are necessary for adaptation planning.
- Lack of case studies and best practices relevant to ecosystem approaches that demonstrate the benefits of investment in EbA.
- Local government at grassroots level is often not effectively engaged in development / adaptation planning and implementation activities.
- Land tenure-related problems and inter-ministerial competing mandates and preferences (viz. lands under FD are leased to people by the district /local administration without consultation with the FD).
- Conversion, privatization and fragmentation of wetlands leave no physical space for ecosystem restoration and enhancement which are the essential focus of EbA.
- Short-term leasing of wetlands makes implementation of EbA by local communities difficult.
- Non-availability of climate models at local or sub-national levels.
- Poor documentation of best practices and lack of information-sharing among the agencies also hinders the mainstreaming of EbA in national adaptation planning.
- Poor coordination among concerned agencies, sectors and sub-sectors, and territorial conflicts among agencies, represent significant barriers to effective implementation of EbA.



Mangrove patches are being rehabilitated in some public lands outside of Sundarban through community engagement; Shyamnagar, Satkhira, Bangladesh.

CHAPTER 6
TOWARD A MODEL FOR EBA IN THE COASTAL ZONE IN BANGLADESH

An optimal EbA strategy is built on the principle of maintaining “ecological structure and functions” at any defined “ecosystem of landscape scale” in combination with “multi-functional land uses” and “multi-scale benefits” for “multi-occupational groups” including the extremely poor. EbA approaches should give equal focus to bio-physical aspects of ecosystem management and development, as well as to community participation and livelihood development based on the wise-use principle in accessing and utilizing ecosystem services. The following five basic considerations may be useful in planning effective EbA schemes:

1. Management interventions should be designed to restore and conserve ecosystem structure and functions, so that the given ecosystem is able to provide its services for environmental and societal benefits.
2. Any intervention should be consistent with the types and extent of impacts of climate variability and change on the given ecosystems and community livelihoods.
3. Relevant institutional actors (public and private) should be involved effectively in the process from planning to implementation and monitoring of activities and results.
4. Community participation and incorporation of local/ indigenous knowledge should be embedded in management planning and interventions in order to capitalize on the knowledge, experience and skills of local actors in order to avoid mal-adaptation; and to ensure community ownership of ecosystem management into the future.
5. EbA is a relatively new concept and thus documentation and dissemination of best practices and experiences will be critical and should be built into EbA project planning from the outset.

EbA should not be equated with conventional development projects as it focuses on adaptation to climate change impacts vis-a-vis restoration and conservation of ecosystems and community livelihoods. EbA aims at building resilient social-ecological systems, including disaster risk reduction in the face of climate change impacts. With this background in mind, the following steps are critical in planning and implementing effective EbA schemes in a given setting.

Selection of site and scale for EbA - EbA can be practiced in a single ecosystem, or multiple interconnected and interrelated ecosystems in a given landscape, as mentioned above (Scale of EbA, Section 4). The scale of the interventions may vary from a single village to several hundreds of villages based on the type, extent and nature of ecosystems involved and the availability of resources, including the capacity of implementing agency or agencies. From the start-up stage, however, a micro-scale is advisable to gain experience and capacity, before moving to the landscape level.

Biophysical characterization of the ecosystem - Once the site (ecosystem) is selected, the next step is characterizing the bio-physical status of the area or ecosystems. This involves a range of tools, including visits and observations, mapping and time series data analysis from primary and secondary sources. A multi-disciplinary staff team is needed to collect and collate various data and information on context-specific social-ecological systems and sub-systems and their inter-linkages, including disaster and climate-induced vulnerabilities of ecosystems and local communities. This activity will generate data on the current state and status of ecosystem components, features and historical trends, land use changes with causes and effects, and qualitative and quantitative aspects of physical ecosystem components, including both climate and non-climate related stressors that affect the social-ecological systems. These information bases will help to draw the bio-physical boundary of the ecosystem to be managed, as well as to conceptualize the necessary broader management interventions.

Socio-economic characterization of the ecosystem – A greater understanding of the socio-economic features of the relevant communities is needed in designing of an EbA intervention. It includes understanding of social and occupational status of a community; their dependence on ecosystems for livelihoods; historical land use patterns and trends; and impacts of human and policy interventions on ecosystems, including delineation of social boundaries of the given ecosystem.

Stakeholder analysis – Once the physical and social features have been documented, the next step is to understand the actors and players who depend on various ecosystem goods and services, and who have interests and influence in utilizing and managing the ecosystems. An understanding of the role of women and indigenous groups, including various occupational classes dependent on ecosystem services for their livelihoods, would very useful in planning EbA interventions. But this has to be done in a comprehensive manner so as to understand the roles and responsibilities of each stakeholder group and sub-group (for example, in an aquaculture group there are two sub-groups -- fish farmers and shrimp farmers) and their knowledge, attitudes and practices relevant to management, as well as their degree of reliance on ecosystem components and services, should be documented and incorporated when designing actions. The outputs from this activity will help in planning the extent of stakeholder participation and roles in EbA.

Problem identification and Participatory Action Planning – the next step is to develop comprehensive management plans for the ecosystem following EbA approaches. This involves first identifying the issues, in conjunction with a climate vulnerability assessment, so that both climate and non-climate related stressors are documented with their degree of impacts based on community experience and observation. Analysis of time-series data and GIS-based mapping of changing attributes over time, incorporating impacts of climate variability and change and validation at local level, would form a part of the community-level planning processes. All relevant stakeholder groups should take part in the ecosystem-level planning processes to develop EbA schemes, including major intervention packages.

Effective community participation in assessing local climate-induced threats on their livelihoods and ecosystem components/ resources can contribute to the development of more effective EbA interventions. In this regard, Participatory Action Plan Development (PAPD), Community Risk Assessment (CRA) and Livelihood Vulnerability Assessment (LVA) tools can be applied. When designing consensual adaptation interventions, it is important to ensure that actions that might affect ecosystems negatively (such as wetland or forest conversion, fragmentation, draining of wetlands) should be avoided, or alternative solutions should be explored.

Institutional arrangements for EbA – Creating an enabling institutional arrangement is critical in developing a sustainable EbA approach. For EbA in a coastal setting, consideration should be given to defined physical and social boundaries in a given landscape, with a defined hydrological regime; for example, a river basin, which will usually comprise of multiple resource systems upon which local livelihoods depend:

- wetlands, (rivers, canals, beels, ox-bows, pond, seasonal floodplains);
- agricultural lands (rice and non-rice including horticulture/ agro-forestry):
- aquaculture systems (fish /shrimps ghers, crab fattening, pen and cage aquaculture);
- forests (mangroves and non-mangroves), wildlife, livestock, settlements, croplands, wetlands/ fisheries, etc.

Therefore, planning and implementing EbA requires engagement of multiple institutional actors; and all activities across sectors and sub-sectors have to be harmonized and integrated in line with the principles of EbA. Figure 5 shows possible institutional actors for an ideal EbA scheme.

At least three levels of institutional support should be incorporated in implementing EbA.

Community level: where local communities are to be organized into small groups based on livelihood categories to create Community-based Organizations (CBOs) such as fisher CBOs, farmer CBOs, aquaculture CBOs and women's CBOs. Each occupationally categorized CBO will take part in designing, implementing and monitoring their respective EbA interventions and develop locally agreed resource-use norms or systems based on the wise-use principle (i.e sustainable harvest of resources). Collectively over time, the CBOs will begin networking among themselves, so that adaptation interventions and resource-use patterns of one category of CBO do not adversely affect other occupational CBOs.

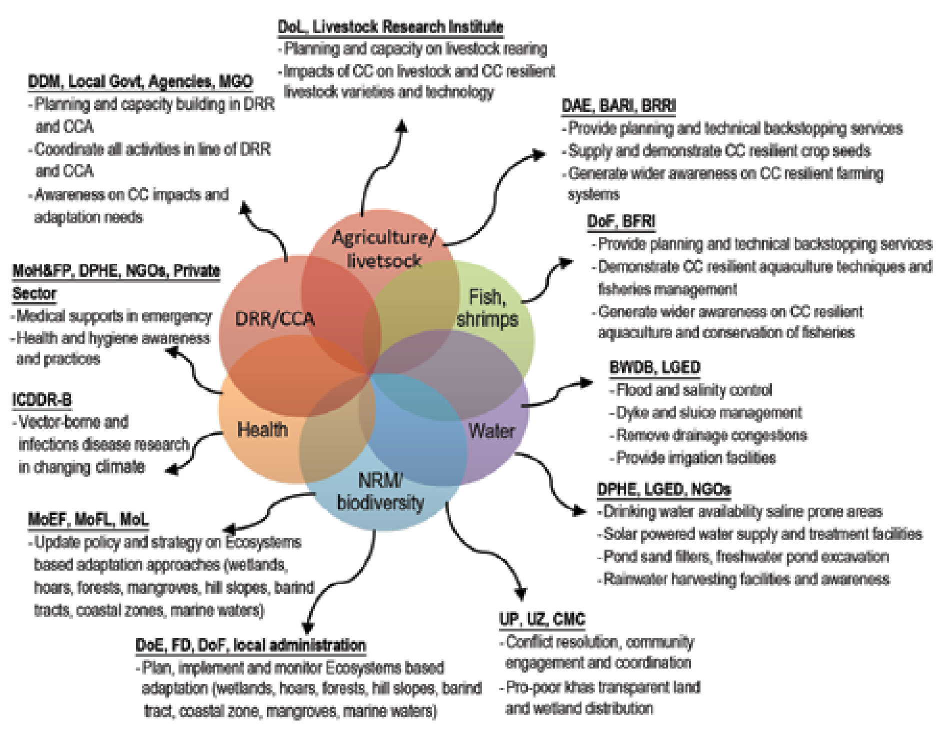


Figure 5: Ecosystem components and institutional responsibilities for effective EbA approaches.

Upazila level: where an EbA Management Committee (EMC) or Co-Management Committee (CMC), comprising of relevant government agency officials, local government bodies, and community representatives, will be established and headed by the UNO (Upazila Nirbahi Officer: Chief Executive Officer of the upazila). This CMC will be the key institution that will locally guide, assist and promote effective EbA at the grassroots level. The CMC will facilitate the process and resolve conflicts and disagreement among the community groups as well as among different government agencies, and also ensure effective coordination. Among the key roles of the CMC would be providing legal and policy support in restoration of ecosystems, recovering encroached khas lands/ wetlands and facilitating pro-poor and pro-environmental management of wetlands, forests and khas lands for successful implementation of EbA.

National level: in the form of a Project Steering Committee (PSC) with the key role of providing policy, legal and administrative support and guidance to implement EbA from the central level. The PSC should comprise relevant ministerial and departmental representatives who are in the position of taking decisions on behalf of their respective entities. This PSC is a generic form of institution at the ministry level formed for any donor- supported project.

Implementation of interventions: once the participatory community action plans have been developed and the institutional arrangements are in place, it is time to implement the consensual EbA interventions through direct engagement of communities (CBOs or their representatives). Before implementation, awareness-raising, capacity development and monitoring and legal regimes must be put in place to ensure that the wise-use principle for restored resource systems is understood and adhered to.

Farmers harvesting from integrated prawn-fish-rice farm in Gabura Island, Satkhira, Bangladesh

© IUCN / M. Mizanur Rahman, 2014

CHAPTER 7
CONCLUSIONS

The importance of the ecosystem-based approach to adaptation has been well recognized at the global level as a means to address the adverse effects of climate change. Nationally, there is no policy of adopting EbA in Bangladesh, but in reality EbA is being practiced at community level, and in different projects; or at least there are some components of projects that are closely aligned to EbA principles. EbA is also useful as a cost-effective and sustainable approach which applies local measures to tackling the impacts of climate change. These impacts have already started to affect the capacity of ecosystems to deliver the ecosystem goods and services vital to human survival. This is more pronounced in the least developed countries, like Bangladesh, where the majority of the population depends on climate-sensitive production and extraction sectors for income and livelihoods. It is also recognized that ecosystem management can contribute to climate change adaptation and mitigation as co-benefits alongside biodiversity conservation and community livelihoods.

A number of countries across the south have skewed their adaptation focus towards sustainable management of ecosystems in order to enable ecosystem resilience, and at the same time build resilient livelihoods and communities in the face of climate change impacts.

There are a number of mechanisms already in place to support this approach through various technological and financial institutions at the global level, such as the Convention on Biological Diversity (CBD), Global Environment Facility (GEF) and the Least Developed Country Fund (LDCF). The Government of Bangladesh has also created funds (CCTF-Climate Change Trust Fund) from its own resources primarily focused on introducing adaptation measures in different climate change hotspots of the country. These funds are administered through a climate change cell formed under the Ministry of Environment and Forest (MoEF) and so far 62 adaptation and mitigation projects have been approved that are being implemented by different government agencies. In addition to the government's own sources, a multi-donor trust fund, called the Bangladesh Climate Change Resilient Fund (BCCRF) is also now in operation, and is being administered by the World Bank. EbA can be promoted in Bangladesh utilizing these funding mechanisms. The Department of Environment (DoE) has implemented a three-year coastal and wetland biodiversity conservation project with funding from the CCTF; and the FD is implementing a five- year coastal forestry and livelihoods project with funding from the BCCRF. It is important that these projects document and share lessons learned widely to other relevant entities within Bangladesh and beyond.

However, there are still significant challenges in effectively designing, implementing and monitoring the effects of EbA on social-cological systems in a given setting. There is a risk that mal-adaptation can occur if EbA is not well planned and coordinated, or if proper assessments of the type and extent of climate change impacts and climate variability on ecosystems and dependent communities are not undertaken.

It is also important to ensure that policy makers and project managers understand that EbA is not a stand-alone intervention in an ecosystem, but a comprehensive multi-sectoral, multi-resource integrated programme that is in line with the effects of a changing climate. Although the existing examples of EbA in coastal Bangladesh demonstrate some limitations in conceptualizing the holistic nature of EbA, there are, nonetheless, some positive cases which can be improved, refined and replicated in other coastal zones and mainland ecosystems.

Different adaptation technologies and approaches are in use in different parts of the country, but most are narrowly focused, scattered, and work best as short-term coping mechanisms, rather than as holistic adaptation approaches. Examples include demonstrations of climate-resilient crop/rice varieties, but without providing adequate technology; distribution of poultry, but without ensuring proper vaccination, feed and care; and digging ponds in the saline zone for drinking water without providing adequate support to maintain water quality for drinking. Most often this segmented targeting of individuals, households or communities is biased toward donor preferences and objectives, rather than reflecting the local demands of communities who have multiple adaptation needs to become climate-resilient, based on different hazards and the diversity of resource systems upon which they subsist. By contrast, EbA can better address the climate change impacts at wider landscape levels, where different occupational groups are dependent on a variety of ecosystem services, and require adaptive capacities to absorb shocks due to environmental disturbances.

Bangladesh is considered a pioneer in developing adaptation practices in response to climate-related hazards. The historical experience and skills of Bangladeshi communities in living with and adjusting to the effects of a range of climate-induced hazards (such as flooding, cyclones, storm surges, and drought) has helped the communities and relevant institutions to become adaptable. Their recent ecosystem-based adaptation responses, as documented here, can provide valuable lessons to other countries vulnerable to the impacts of climate change.

© IUCN / Enamul Mazid Khan Siddique, 2014

Healthy ecosystems are prerequisite of healthy communities.

REFERENCES

Ali, A. (1999). Climate change impacts and adaptation assessment in Bangladesh. Climate Research 12: 109–116.

Ayers, J and Huq, S. (2009). The Value of Linking Mitigation and Adaptation: A Case Study of Bangladesh. Environmental Management 43:753–764.

Barnett J and Adger W.N. (2007). Climate change, human security and violent conflict. Political Geography 26: 639-655.

Chapin, FS, T.V. Callaghan,Y. Bergeron,M. Fukuda, J.F. Johnstone, G. Juday and Zimov, S.A. (2004). Global change and the boreal forest: thresholds, shifting states or gradual change? Ambio 33: 361-365.

Colls A, Ash N and Ikkala, N. (2009). Ecosystem-based Adaptation: a natural response to climate change. Gland, Switzerland: International Union for Conservation of Nature and Natural Resources (IUCN).

Devisscher, T (2010). Ecosystem-based Adaptation in Africa, Rationale, Pathways, and Cost Estimates, Sectoral Report for the AdaptCost Study, Stockholm Environment Institute.

IPCC (2001). Synthesis Report. Contribution of Working Groups I, II and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change, R.T. Watson and the Core Writing Team (eds.). Cambridge University Press, Cambridge, England, 365pp.

IPCC (2007). Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani J.P. Palutikof P.J. van der Linden and C.E. Hanson (eds.). Cambridge University Press, Cambridge, England. 976pp.

IPCC (2012). Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, England and New York, USA. 582 pp.

MEA (Millennium Ecosystem Assessment) (2005). Ecosystems and human well-being: wetlands and water synthesis. World Resources Institute, Washington, DC.

Midgley G, Marias S, Barnett M and Wagsaether K. (2012). Biodiversity, climate change and sustainable development – harnessing synergy and celebrating successes. Final Technical Report. World Bank.75pp.

MoEF (2005). National Adaptation Programme of Action (NAPA), Ministry of Environment and Forests, Government of Bangladesh, Dhaka.

MoEF (2009). Bangladesh Climate Change Strategy and Action Plan 2009, Ministry of Environment and Forests, People's Republic of Bangladesh, Dhaka, Bangladesh. 76pp.

Munang R, Thiaw I, Alverson K, Mumba M, Liu, J and Rivington, M (2013). Climate change and Ecosystem-based Adaptation: a new pragmatic approach to buffering climate change impacts. Current Opinion in Environmental Sustainability 2013: 5:xx–yy. www.sciencedirect.com.

PDO-ICZMP (2004). Living in the Coast: People and Livelihoods. Project Development Office-Integrated Coastal Zone Management Plan (PDO-ICZMP), Water Resources Planning Organization, Government of Bangladesh.

Rahman M.M. and Biswas S.K. (2013). Feasible Solution of Protection and Adaptation Strategy for Coastal Zone of Bangladesh. Pakistan Journal of Meteorology 8: 9-19.

Secretariat of the Convention on Biological Diversity (2009). Connecting Biodiversity and Climate Change Mitigation and Adaptation: Report of the Second Ad Hoc Technical Expert Group on Biodiversity and Climate Change. Montreal, Technical Series No. 41, 126 pp.

Shereen D. (2013). Lessons learned from implementation of Ecosystem based Adaptation: Climate Ready Estuaries case study. U.S. Department of State. http://unfccc.int/files/ adaptation/ Nairobi _workprogramme/workshops_and_meetings/application/pdf/shereen2.pdf

Stern N. (2006). Stern Review, The Economics of Climate Change: Executive Summary, at http:// www.hm-treasury. gov.uk/Stern_review_report.htm

UNESCO (2007). Case studies on Climate Change and World Heritage.

Vignola R, Locatelli B, Martinez C, Imbach P (2009). Ecosystem-based adaptation to climate change: what role for policy makers, society and scientists? Mitigation and Adaptation Strategies for Global Change 14: 691-696.

Mangroves for the Future
INVESTING IN COASTAL ECOSYSTEMS

About Mangroves for the Future

Mangroves for the Future (MFF) is a unique partner-led initiative to promote investment in coastal ecosystem conservation for sustainable development. Co-chaired by IUCN and UNDP, MFF provides a platform for collaboration among the many different agencies, sectors and countries which are addressing challenges to coastal ecosystem and livelihood issues. The goal is to promote an integrated ocean-wide approach to coastal management and to building the resilience of ecosystem-dependent coastal communities.

MFF builds on a history of coastal management interventions before and after the 2004 Indian Ocean tsunami. It initially focused on the countries that were worst affected by the tsunami -- India, Indonesia, Maldives, Seychelles, Sri Lanka and Thailand. More recently it has expanded to include Bangladesh, Cambodia, Pakistan and Viet Nam.

Mangroves are the flagship of the initiative, but MFF is inclusive of all types of coastal ecosystem, such as coral reefs, estuaries, lagoons, sandy beaches, sea grasses and wetlands.

The MFF grants facility offers small, medium and large grants to support initiatives that provide practical, hands-on demonstrations of effective coastal management in action. Each country manages its own MFF programme through a National Coordinating Body which includes representation from government, NGOs and the private sector.

MFF addresses priorities for long-term sustainable coastal ecosystem management which include, among others: climate change adaptation and mitigation, disaster risk reduction, promotion of ecosystem health, development of sustainable livelihoods, and active engagement of the private sector in developing sustainable business practices. The emphasis is on generating knowledge, empowering local communities and advocating for policy solutions that will support best practice in integrated coastal management.

Moving forward, MFF will increasingly focus on building resilience of ecosystem-dependent coastal communities by promoting nature based solutions and by showcasing the climate change adaptation and mitigation benefits that can be achieved with healthy mangrove forests and other types of coastal vegetation.

MFF is funded by Danida, Norad, and Sida.

Learn more at: www.mangrovesforthefuture.org

UNDP IUCN FAO UNEP Wetlands International Udenrigsministeriet DANIDA Danmarks Udviklingssamarbejde Norad SWEDEN