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INTEGRATED PROTECTED AREA CO-MANAGEMENT (IPAC)

COMMUNITY BASED CLIMATE CHANGE ADAPTATION:
PLANNING THROUGH NISHORGO NETWORK



June 11, 2012

This report was produced for review by the United States Agency for International Development (USAID). It was prepared by International Resources Group (IRG).

Cover Photo:

This portrays an initiative of Landscape Development Fund (LDF) of the IPAC project. The LDF provided to the Central Co-management Committee of Tanguar Haor and implemented by the *Dakshin Sreepur* Union Co-management Committee for raising swamp plantation with 10,000 saplings at the periphery of *Pati Chorer Kanda* located in between the *Nowhal beel* and *Patlai River* of the *haor* basin and cover 10 ha of raised land(*Kanda*). Plant species includes *Hisol* (*Barringtonia acutangula*) and *Koroch* (*Pongamia pinnata*). After 10 years, 46 beneficiary households can start getting cash benefit by selling pruned branches with sustainable livelihood development whereas each household owns 217 trees.

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ACRONYMS

BCCTF	Bangladesh Climate Change Trust Fund
BCCRF	Bangladesh Climate Change Resilience Fund
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
CHT	Chittagong Hill Tracts
CMC	Co-Management Committees and Councils
CMO	Co-Management Organization
ECA	Ecologically Critical Areas
FD	Forest Department
GoB	Government of Bangladesh
GHGs	Green House Gases
IPAC	Integrated Protected Area Co-management
IPCC	Intergovernmental Panel on Climate Change
LNP	Lawachara National Park
MACH	Management of Aquatic Ecosystems through Community Husbandry
MoEF	Ministry of Environment and Forests
NAPA	National Adaptation program of Action
NGOs	Non-Governmental Organizations
NP	National Park
NS	Nishorgo Shahayak
NSP	Nishorgo Support Project
PA	Protected Area
REDD	Reducing Emissions from Deforestation and Forest Degradation
RKWS	Rema-kalenga Wildlife Sanctuary
SRF	Sundarban Reserve Forest
SNP	Satchari National Park
USAID	U.S. Agency for International Development
VCf	Village Conservation Forum
WB	World Bank
WS	Wildlife Sanctuary

EXECUTIVE SUMMARY

Bangladesh is one of the most vulnerable countries to climate change due to high population density with immense poverty, its geographical location near the Bay of Bengal and flat deltaic topography. Its high level of poverty and depleted ecosystem increase the vulnerability to the climate change, which has hindered the sustainable development goal of the country. Sustainable development in Bangladesh requires ensuring equitable economic growth, which is built upon a solid foundation of ecological and socio-economic resilience and key to this is an effectively managed and integrated Protected Area (PA) network of forests and wetlands.

The Nishorgo Network brings government and community stakeholders together to conserve a large number of forest and wetland PAs across Bangladesh through co-management. Co-management shares the roles, rights and responsibilities of PA conservation between government and PA-dependent communities, ensuring broad benefits of climate change adaptation and mitigation accrue to Bangladesh as a whole while PA-dependent communities benefit directly from increased capacity to adapt to climate change as well as through climate change-friendly livelihoods development opportunities. Nishorgo Network has built climate change adaptation capacity through the facilitation of nearly 1000 community-based climate change vulnerability assessments and action plans. Aggregated at the PA landscape level, these adaptation plans provide the basis for Upazila- and District-level climate change adaptation plans. More importantly, the planning process provided a unique opportunity for local communities to become informed, work together to find a voice, and become advocates for building climate change adaptation into local development planning.

Key to achieving scale in community climate change adaptation planning was the training and empowerment of nearly 1,000 Nishorgo Shahayaks (community facilitator / volunteers). Over the past year, a flipchart was developed and field tested, and then 35 batches of (an average of 30 Nishorgo Shahayaks) community facilitators participated in 3-day training programs that built skills in community facilitation, adult education, ecosystem conservation, and climate change vulnerability assessment and action planning. Nishorgo Shahayaks then returned to their communities and rolled-out climate change vulnerability assessment and action planning through a series of weekly and monthly meetings. This has resulted in more than 200,000 Bangladeshi's with increased understanding of and capacity to adapt to climate change as well as nearly 1000 community action plans that are currently being aggregated into more than 20 PA landscape-level climate change action plans.

The report summarizes the adaptation plans prepared by ranking vulnerabilities and relevant adaptation measures based on the local community perception. The report will be useful for preparing PA dependent communities to build climate resilient PAs and local community livelihoods.

I. INTRODUCTION

1.1. Background

While Bangladesh has made great progress towards sustainable development since independence in 1971, substantial challenges still exist. Maintaining the recent pace of economic growth and poverty reduction has become overshadowed by negative impacts of global climate change and natural capital degradation. Bangladesh is already experiencing erratic weather patterns resulting in increased incidence of flooding and drought, as well as increased incidence and severity of cyclones and other natural disasters. Continued success toward achieving sustainable development in Bangladesh requires ensuring that economic growth is built upon a solid foundation of ecological and socio-economic resilience and key to this is an effectively managed and integrated Protected Area (PA) network of forests and wetlands.

Incorporated as a centerpiece to the national development strategy, an effectively managed PA network provides a foundation for food security, climate change adaptation and mitigation, and poverty alleviation. This PA network provides a buffer against climate change impact, and contributes to the stabilization of environmental services – especially water flow – that so many Bangladeshis rely on for their day-to-day survival and long-term well-being.

The Nishorgo Network, established in 2004, brings government and community together to conserve more than 25 forest and wetland PAs across Bangladesh through co-management. Co-management shares the roles, rights and responsibilities of PA conservation between government and PA-dependent communities, ensuring broad benefits of climate change adaptation and mitigation accrue to Bangladesh as a whole while PA-dependent communities benefit directly from increased capacity to adapt to climate change as well as through climate change-friendly livelihoods development opportunities. Nishorgo Network has facilitated climate change mitigation through the reduction/sequestration of about 300,000 tons of Greenhouse Gasses (GHGs) through combined forest conservation and reforestation activities in and around PAs.

Nishorgo Network has built climate change adaptation capacity through the facilitation of more than 900 community-based climate change vulnerability assessments and action plans. Aggregated at the PA landscape level, these adaptation plans provide the basis for Upazilla- and district-level climate change adaptation plans. More importantly, the planning process provides a unique opportunity for local communities to become informed, work together to find a voice, and become advocates for building climate change adaptation into local development planning.

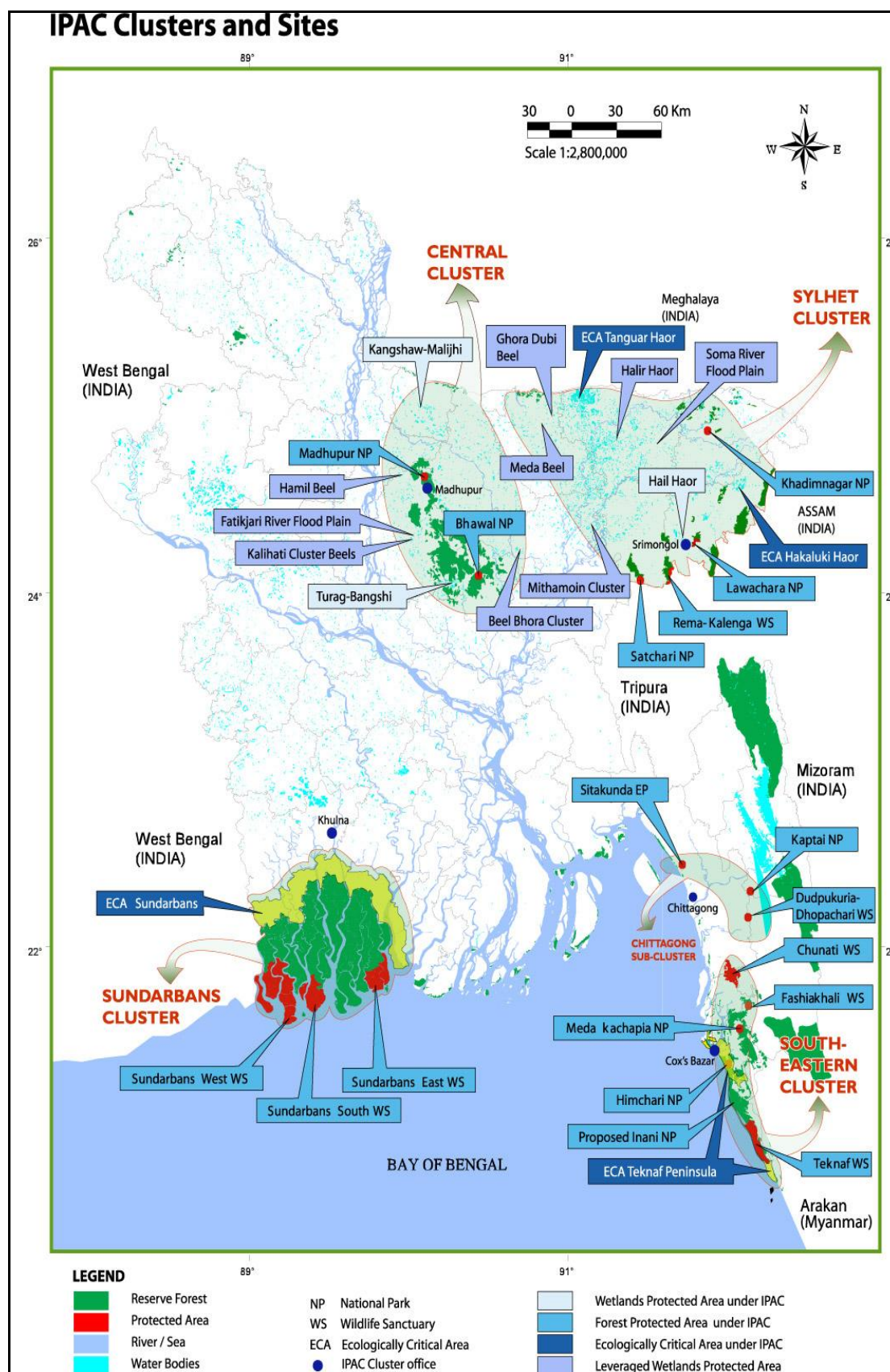


Figure 1: Map of IPAC site

1.2. Methodology

Key to achieving scale in community climate change adaptation planning was the training and empowerment of nearly 1,000 Nishorgo Shahayaks (community facilitator / volunteers). Over the past year, a flipchart was developed and field tested, and then 35 batches of (an average of 30 Nishorgo Shahayaks) community facilitators participated in 3-day training programs that built skills in community facilitation, adult education, ecosystem conservation, and climate change vulnerability assessment and action planning. Nishorgo Shahayaks then returned to their communities and rolled-out climate change vulnerability assessment and action planning through a series of weekly and monthly meetings. This has resulted in more than 200,000 Bangladeshi's with increased understanding of and capacity to adapt to climate change as well as nearly 1000 community action plans that are currently being aggregated into more than 20 PA landscape-level climate change action plans.

The Nishorgo Network community climate change vulnerability assessment and action planning process utilized the Nishorgo Network flipchart and was built around four community-level meetings and then a landscape-level field day to share results with local government. An outline of this process is presented below:

Community /VCF Meeting 1: Build Awareness of Climate Change, and the Vulnerability Assessment and Action Planning Process

- Nishorgo Shahayaks (NS) explain what Climate Change is, presenting impacts like sea level rise, increased incidence and intensity of cyclones, changes in temperatures, and changes in rainfall patterns, using graphics from the flipchart.
- NS facilitate a discussion to list community perceptions about Climate Change, including changes in the above mentioned impacts as well as possibly related changes in agriculture, wetlands, forest, flooding, etc. As a group, they decide what is related to Climate Change and what is not.
- NS explains Climate Change Vulnerability and Adaptation, clarifying key terms including exposure, sensitivity, adaptive capacity, and adaptation, using graphics from the flipchart.
- NS facilitates discussion on vulnerability and adaptation terminology, identifying community-specific priorities for vulnerability and adaptation.

Community /VCF Meeting 2: Community Vulnerability Assessment

- NS facilitates an assessment of vulnerabilities, including a listing and ranking of vulnerabilities. These can start with natural vulnerabilities (cyclones, floods, uncertain rainfall), social-dynamics (less predictable farming seasons, degraded water supply , cropland or village infrastructure damage from floods and cyclones), and support mechanisms (early warning systems, government or NGO programs). Vulnerability points are noted, ranked and agreed upon by community participants.

Community / VCF Meeting 3: Community Adaptation Options and Ranking

- NS facilitates a listing and ranking of adaptation measures to address vulnerability priorities. Ideas might include developing/strengthening early warning systems for cyclones or floods; repairing cyclone shelters; maintaining drainage to reduce threat of floods; raise key community infrastructure, etc.. It might also include water storage systems; crop diversification; climate/weather monitoring; agroforestry and soil management; and reforestation.
- NS facilitates ranking and finalization of Adaptation Options and Rankings.

Community/ VCF Meeting 4: Community Adaptation Plan Development

- NS facilitates the development of a Community Adaptation Plan that briefly describes the community, lists key climate change vulnerabilities, and then lists priority adaptation options. A matrix including Adaptation Option, Required Resources, Leader, and Cost is prepared. A simple monitoring plan is also included.

CMC-Local Government Adaptation Plan Sharing

- NS and VCFs facilitate a half-day Climate Adaptation Plan Field Days, bringing together representatives of all relevant communities to present their Adaptation Plans. Each community is provided a small area/stall to present their plans. A formal event with CMC and local government participants includes three community presentations on (1) Climate Change, (2) Climate Change Vulnerability Assessments, and (3) Climate Change Adaptation Plans. Opportunities are given to local government officials to support/buy-in to Community Adaptation Plans.



Figure 2: TOT for Nishorgo Shahayaks



Figure 3: Nishorgo Shahayaks are in group exercise

A data base has been developed with Microsoft ACCESS to capture the information collected in the plans. Then the data were analyzed in Microsoft Excel and a series of tables and graphs were prepared to interpret the results. Finally the report is prepared to present the climate change vulnerabilities identified at VCF level and also adaptation options prioritized by the communities to adapt with identified and ranked vulnerabilities. The report basically summarizes the adaptation plans prepared at the VCF levels. The result part of the report shows the PA wise highest ranked vulnerabilities and the prioritized adaptation measures for mitigating respective vulnerabilities.

3. CLIMATE CHANGE CHALLENGES AND OPPORTUNITIES IN BANGLADESH

3.1. Climate Change Challenges

Climate change is now the most important environmental as well as development issue for the country like Bangladesh which has significant implications for the country's physical, social and economic systems and the impacts of climate change on agriculture, health, water and sanitation, and biodiversity are already visible.

Bangladesh is one of the most vulnerable countries in terms of climate change and global warming. According to the German watch Global Climate Risk Index 2012, Bangladesh, Myanmar and Honduras were the countries most affected by extreme weather events from 1991 to 2010. Climatic changes in Bangladesh would likely exacerbate present environmental conditions that give rise to land degradation, shortfalls in food production, rural poverty and urban unrest. Circular migration patterns, such as those punctuated by shocks of migrants following extreme weather events, could be expected (IPCC 2007).

Most of the land area of Bangladesh consists of the deltaic plains of the Ganges, Brahmaputra and Meghna rivers (IPCC, 2007). A huge number of populations live in the low lying coastal areas of Bangladesh and they are directly exposed to sea level rise, which is the result of climate change. Ericson et al. (2006) estimate, using a coarse digital terrain model and global population distribution data, that more than 1 million people will be directly affected by 2050 in three mega deltas: the Ganges- Brahmaputra-Meghna delta in Bangladesh, the Mekong delta in Vietnam and the Nile delta in Egypt. In Bangladesh, it is projected that 4.8% of people living in unprotected dry land areas could face inundation by a water depth of 30 to 90 cm based on assumptions of a 2°C temperature increase, a 30 cm increase in sea level, an 18% increase in monsoon precipitation, and a 5% increase in monsoon discharge into major rivers. This could increase to 57% of people based on assumptions of a 4°C temperature increase, a 100 cm increase in sea level, a 33% increase in monsoon precipitation, and a 10% increase in monsoon discharge into major rivers. Some areas could face higher levels of inundation (90 to 180 cm) (BCAS/RA /Approtech, 1994). Not only that, accelerated global sea level rise and higher extreme water levels may have acute effects on human populations of Bangladesh because of the complex relationships between observed trends in SST (sea surface temperature) over the Bay of Bengal and monsoon rains (Singh, 2001), subsidence and human activity that has converted natural coastal defenses (mangroves) to aquaculture (Woodroffe et al., 2006). These coast living people are also vulnerable to natural disaster such as cyclone and storm surge. Worldwide, from 1980 to 2000, a total of more than 250,000 deaths were associated with tropical cyclones, of which 60% occurred in Bangladesh (ISDR, 2004). An assessment of surges in the past 100 years found that major events were confined to a limited number of regions, with many events occurring in the Bay of Bengal, particularly Bangladesh (Nicholls, 2003).

Coastal people are dependent on groundwater for their daily needs, and this dependency results high amount of ground water extraction. Han et al. (1999) noticed that over-exploitation of groundwater in many countries of Asia has resulted in a drop in its level, leading to ingress of sea water in coastal areas making the sub-surface water saline. India, China and Bangladesh are especially susceptible to increasing salinity of their groundwater as well as surface water resources, especially along the coast, due to increases in sea level as a direct impact of global warming.

With affecting the coastal people climate change particularly affects the mangrove forests of Bangladesh. Evidence of the impacts of climate-related factors on mangroves remains limited to the severe destruction of mangroves due to reduction of freshwater flows and salt-water intrusion in the Indus delta and Bangladesh (IUCN, 2003). IPCC (2007) predicted that with a 1 m rise in sea level, 2,500 km² of mangroves in Asia are likely to be lost; Bangladesh would be worst affected by the sea level rise in terms

of loss of land Approximately 1,000 sq. km. of cultivated land and sea product culturing area is likely to become salt marsh. The additional stressors associated with climate change could lead to further declines in mangroves forests and their biodiversity (IPCC, 2007).

Although anthropogenic activity for instance rapid urbanization is the main reason behind wetland filling, climate change also play role to drying up wetlands by increasing the intensity of drought. Pan et al. (2003) found that wetlands in Asia are being increasingly threatened by warmer climate in recent decades. The precipitation decline and droughts in most delta regions of Pakistan, Bangladesh, India and China have resulted in the drying up of wetlands and severe degradation of ecosystems. This increase in drought ultimately hampers the crop production. Due to climate change, in Bangladesh, production of rice and wheat might drop by 8% and 32%, respectively, by the year 2050 (Faisal and Parveen, 2004).

To address climate change issues and its impacts, the Government of Bangladesh adopted The National Adaptation Program of Action (NAPA) in 2005. Following the NAPA the Bangladesh Climate Change Strategy and Action Plan (BCCSAP) was prepared in 2009. NAPA identified some challenges for adaptation which need to be addressed. Besides this some challenges may come in the future as lots of uncertainties exist in the climate change discourse.

Along with geo-physical position, poor economic condition makes the country more vulnerable. In Bangladesh 32 % of the population is below the national poverty line (WB 2010) and severe poverty is the big challenge for adaptation to climate change. To reduce the vulnerability to climate change we need to reduce exposure and improve the coping capacity of community. The major constraints in improving the country's adaptive capacity are poor resource base, inequalities in income, weak institutions, and limited technology (IPCC 2001).

Climate change issues need to be mainstreamed in the country's development programmes. Lack of coordination among ministries for mainstreaming climate change in national, sectoral and spatial development programmes is a big challenge. The institutional capacity including human resource quality in most government organizations is weak and needs substantial improvement if the challenges of climate change are to be faced squarely. One of the challenges for the country's climate change efforts is to strengthen the implementation capacity of the government institutions. Governance issue particularly ensuring transparency and accountability in managing climate change fund is another important challenge for Bangladesh to grab the fund from the international communities for implementing adaptation project.

3.2. Climate Change Challenges for Forestry and Wetlands

Natural resource bases, especially forests and wetlands, extend numerous goods and ecosystem services to landscape populace who are mostly depend on agriculture, fisheries and agroforestry practices for their livelihood. These means of livelihood often largely depends on local climate and changes in climate are becoming a growing concern for livelihood as well as ecosystem services. Hence comprehensive efforts are required to make their livelihoods and ecosystem resilience to climate change.

IPCC 2010 and many other studies affirmed devastating impacts of climate change on forests in the frame of sea level rise, increased incidence of climatic events like drought, cyclone, storms etc., rise in temperature and many others. Rapid change in climate over the years, along with other anthropogenic pressures, might cause forest ecosystems to lose their usual resilience, loss of biodiversity and eventually threat life-supporting ecosystem services. Sedjo and Sohgen (1998) pointed that a likely impact of climate change will be on biodiversity, particularly on endemic species with less capacity to migrate and mitigating the negative impacts of climate change on forests largely depends on enhancing capacity for adaptation. Similar incidence will be prominent in case of mangroves whereby sea-level rise cause inundation of large coastal ecosystem as well as increased salinity towards inland which will result in loss of plant and aquatic diversity. And during this process salinity tolerant plants will replace more sensitive indigenous species compositions. Eventually the unique ecosystems in forests and wetlands will lose their species composition, biodiversity and resilience which are now safeguarding lives, livelihood, and food security of millions of landscape population.

3.2. Climate Change Opportunities

Bangladesh has been successful in establishing two climate change funds - Bangladesh Climate Change Trust Fund (BCCTF) and Bangladesh Climate Change Resilience Fund (BCCRF). The Bangladesh Climate Change Trust Fund is administered by the Ministry of Environment and Forest (MoEF), is formed with the GoB contribution.

The Bangladesh Climate Change Resilience Fund is formed with donor support and is administered by the World Bank. The purpose of the two funds is to contribute to the implementation of the Bangladesh Climate Change Strategy and Action Plan (BCCSAP) with main focus on: (1) food security, social security and health, (2) disaster management, (3) infrastructure, (4) research and knowledge management, (5) reducing greenhouse gas emissions and a conversion to low-carbon development, and (6) capacity development.

Though high population density with immense poverty and geo-location make Bangladesh as one of the most vulnerable countries to climate change, forests, particularly the mangroves in Sundarbans, sequester a significant amount of carbon. However, the country still faces challenges to reduce deforestation and forest degradation. On the other hand, Bangladesh has successful experience in social forestry and coastal afforestation, pioneering in this region. Here local communities adopted collaborative management in 17 PAs for biodiversity conservation. As a recent initiative, REDD+ is particularly suitable for conserving remnant forests of the country including SRF. Recent progress with GOB and donors are developing REDD readiness, roadmap for REDD+ and developed carbon projects for the Sundarban Reserve Forest (SRF) and 7 other PAs in Bangladesh as candidate areas for REDD+.

4. CLIMATE CHANGE

VULNERABILITY ASSESSMENTS AND ACTION PLANS

4.1. Co-management platform

Bangladesh forests and wetlands over past decades have been declining and degrading under severe human pressure and poor governance, adversely impacting biodiversity, ecosystem services and food security. Conversely conservation and sustainable management of forests and wetlands can be and increasingly is one of the foundations of long term sustainable development in Bangladesh. Forests and wetlands remain the direct and indirect sources of livelihood and food security for millions of Bangladeshis and their conservation is a key component of adapting and mitigating the challenge of climate change. For example, wetlands directly support food security by providing fish accessible to poor people and provide water storage, protected forests secure watersheds (safeguarding downstream soils and water supplies) and mitigate carbon emissions, and mangrove and coastal forests help absorb the force of cyclonic surges.

Co-management (collaborative management involving local resource users, government and other stakeholders) has been taken up in many countries to improve the governance of natural resources, notably fisheries, water resources, and forests, including in Protected Areas (PAs). Although co-management can describe a broad range of arrangements, here it is considered to involve government, local communities and other relevant stakeholders sharing the rights, roles and responsibilities to conserve and sustainably manage forest and wetland Protected Areas. This involves empowering poorer local people in decision making processes for PAs, and government decentralizing and empowering its local managers to work in a transparent collaborative way with civil society. Ultimately co-management requires that government and local people develop and jointly implement a common vision, in this case of sustainable PAs. Co-management can link different levels in the hierarchy of management, and most recently flexibility and cross-stakeholder learning processes in the form of adaptive management have received attention. Compared with top-down systems, co-management is seen as improving efficiency (by increasing local compliance with conservation rules set by and with the community), and improving equity (through active participation of the poor in decision making). It is also often linked with measures to diversify and sustain or enhance the livelihoods of the poor, particularly to compensate for reduced access to protected areas. The management and administration of forests and wetlands in Bangladesh has a long history of state control. In forests this has been based on a professional Forest Department controlling all access and uses of forests for over a century based on top-down enforcement. In wetlands this has been based on the land administration leasing out short term fishing rights to individuals or groups to generate revenue without concern for resource sustainability or fisher livelihoods. Changes started on a pilot basis in the 1990s. In forests this took the form of social forestry in degraded forests allocating use rights to individual or small groups of households to restore tree cover and share benefits. In fisheries this involved community-based co-management (with the emphasis more on communities) in individual water bodies, and there was similar devolution of small water management schemes to communities at about the same time.

With USAID support, co-management was extended to three large wetland systems with formalization of government-community links from 1999 onwards under the MACH project, and with this experience it was tested on a pilot basis in five forest PAs under the Nishorgo Support Project. Co-management has since 2008 been taken up as the general approach to management of forest PAs, with USAID support extending to 18 PAs.

USAID's Integrated Protected Area Co-Management (IPAC) project contributes to sustainable natural resource management and enhanced biodiversity conservation in targeted forest and wetland landscapes

with the goal of preserving the natural capital of Bangladesh while promoting equitable economic growth and strengthening environmental governance. IPAC is implemented by the Ministry of Environment and Forests (MoEF) with the Ministry of Fisheries and Livestock (MoFL), through Forest Department, department of Fisheries and Department of Environment. The network of co-management organizations associated with forests, wetlands and ECA protected areas is now recognized as the Nishorgo Network. IPAC works directly with key stakeholders at the local level to support the further development and scaling-up of the conservation and co-management of protected forest and wetland ecosystems in the Nishorgo Network of Bangladesh with particular emphasis given to ensuring its long-term sustainability.

4.2. Process and results

IPAC has been promoting Nishorgo Network through collaborative management of natural resources in 25 PA sites which are geographically located in 5 IPAC clusters namely Southeastern cluster in Cox's bazar, Chittagong cluster in CHT and Chittagong, Northeastern cluster in Greater Sylhet, Central Cluster in Gazipur, Tangail and Sherpur districts and Sundarban cluster in Bagethat, Khulna and Satkhira districts. In case of forest PA landscapes, the lowest level of co-management platforms are Village Conservation Forums (VCFs) while in wetlands Resource User Groups (RUGs) and Village Conservation Groups (VCGs) are in ECAs.

IPAC Climate Change Vulnerability Assessment and Adaptation Plan Development initiative targets nearly 1000 community groups active in the Nishorgo Network co-management platform. Built into monthly VCF meetings and facilitated by Nishorgo Shahayaks, this initiative followed a stepped process that builds awareness of climate change, conducts a vulnerability assessment, lists and ranks adaptation strategies, and leads to the preparation of village-level adaptation plans that can be implemented directly and/or rolled-up to PA landscape level for sharing and leveraging support from local government. These plans can also be integrated into CMC co-management plans.

Findings of these CCA plan processes are shown below, by clusters:

Sundarbans cluster

The world's largest mangrove forests, the Sundarbans including the six Wildlife Sanctuaries (WS), and the Sundarbans ECA are covered in this IPAC Cluster. The flagship species, the Royal Bengal Tiger resides in the Sundarbans and it is one of the highest tiger dense forests in the world. The Sundarbans is located adjacent to the Bay of Bengal and so performs as natural fencing against high tides, storms and cyclones for the coastal areas in particular and Bangladesh in general. The Cluster is in the south-western part of Bangladesh and covers 5 districts and 17 Upazilas. The cluster comprises of 7 Protected Areas, including 6 Wildlife Sanctuaries in the Sundarbans and 1 ECA adjoining the Sundarbans. The total area of Sundarbans Reserved Forest (SRF) is 600,017 ha which includes six PAs. The landscape area is about 160km in length and 10km wide where IPAC is carrying out activities. There are about 104,429 households and 708,291 people in the coastal surroundings of the Sundarbans.

Analysis of the climate change adaptation plans prepared at VCF level exhibits that tidal surge, salinity increase, flood, cyclone, heavy rainfall and river bank erosion are the major vulnerabilities being faced by the local communities. Among those, in East Sundarbans salinity intrusion and cyclone are identified as most significant vulnerability while in South Sundarbans river bank erosion is the most important one followed by tidal surge, salinity and flood. In case of East Sundarbans, tidal surge and flood are the highest vulnerability types followed by salinity intrusion and cyclone. In the Sundarbans region, it has been found from the community perception that tidal surge, salinity intrusion, cyclone and flood are very critical level.

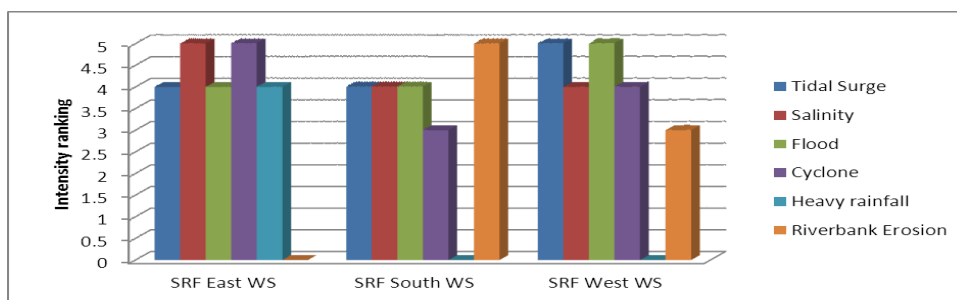


Figure 4: Vulnerability type and intensity ranking at Sundarban Cluster

The community identified the most appropriate adaptation measures for identified vulnerabilities. In case of Sundarbans East construction of community-based shelter centers are identified as the most vital adaptation measures for both cyclone and flood, followed by disaster preparedness. Further increasing awareness and early warning systems are also considered necessary to face cyclones in the region. Construction of embankments is considered necessary for controlling salinity intrusion, flood and tidal surge. Moreover, introduction of salinity tolerant crops and construction of water reservoirs are also considered suitable for control of salinity intrusion. In case of heavy rainfall, raised houses, roads and canal banks, and construction of culverts are priority adaptation options.

For Sundarbans West, construction of community-based cyclone shelters, tree plantation, increasing awareness, strengthening houses and construction of cattle shelters are prioritized for cyclones affected areas, while for tidal surges community considered raised houses and roads, increasing awareness and construction of community-based cyclone shelter centers as high priority adaptation options. Other selected adaptation options for tidal surge include construction of cattle shelter centers, pre-disaster management and warning construction and maintenance of embankments, repairing the bank of river, caged fish culture and tree plantation. In case of salinity intrusion, introduction of salinity tolerant crops, rain water harvesting and repairing the bank of river are considered good options. For floods, raised houses and roads, flood tolerant tube-well establishment and raising the embankments are selected as most prioritized adaptation options, followed by construction of community based shelter centers, flood tolerant toilet establishment, increasing awareness and tree plantations.

For Sundarbans South, construction of embankment is identified as a suitable adaptation option for controlling floods, tidal surges and river bank erosion. For cyclone, strengthening and raising houses, raising roads, construction of community-based cyclone shelter center are considered necessary. For flood, other options include raised houses and roads and pre-disaster management measures, while for tidal surges options include raised houses and roads, construction of community based shelter centers and raising the embankments. Introduction of salinity resistant crops and changing landuse patterns (shrimp cultivation to agriculture) are the most vital adaptation options considered suitable for salinity intrusion areas.

Table 1: List of prioritized adaptation measures for the East Sundarbans

Sl	Adaptation measures	Vulnerability Types	Timeframe
1.	Pre-disaster management	Flood, Cyclone	Short-term
2.	Construction of community based shelter center	Flood	Long-term
3.	Construction of embankment	Flood, Salinity, Tidal Surge	Long-term
4.	Salinity resistant crop cultivation	Salinity	Long-term
5.	Construction of water reservoir	Salinity	Short-term
6.	Raising canal bank	Heavy rainfall	Short-term
7.	Raising the houses/roads	Heavy rainfall	Short-term
8.	Construction of culvert	Heavy rainfall	Long-term
9.	Increasing awareness	Cyclone	Short-term

10.	Early warning system	Cyclone	Short-term
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Table 2 List of prioritized adaptation measures for the West Sundarbans

Sl	Adaptation measures	Vulnerability Types	Timeframe
1.	Construction of community based shelter center	Cyclone, Flood, Tidal Surge	Long-term
2.	Increasing awareness	Cyclone, Flood, Tidal Surge	Short-term
3.	Raising the houses/roads	Flood, Tidal Surge	Short-term
4.	Salinity tolerant crop cultivation	Salinity	Long-term
5.	Tree plantation	Cyclone, Flood, Tidal Surge	Short-term
6.	Rain water harvesting	Salinity	Short-term
7.	Construction of area based cattle shelter center	Cyclone, Tidal Surge	Short-term
8.	Pre-disaster management	Cyclone, Flood, Tidal Surge	Short-term
9.	Strengthening the houses	Cyclone	Short-term
10.	Repairing the bank of the river	River Bank Erosion	Long-term
11.	Construction of embankment	River Bank Erosion, Tidal Surge	Long-term
12.	Raising the embankment	River Bank Erosion,	Long-term
13.	Caged fish culture	Flood, Tidal surge	Short-term
14.	Flood endured tube well establishment	Flood	Short-term
15.	Community based saving account establishment	Cyclone	Short-term
16.	Village based team building for disaster preparedness and combat	Cyclone	Short-term
17.	Flood endured toilet Establishment	Flood	Short-term
18.	Establishment of village information center	Cyclone	Short-term

Table 3 List of prioritized adaptation measures for the South Sundarbans

Sl	Adaptation measures	Vulnerability Types	Timeframe
1.	Construction of embankment	Flood, River Bank Erosion, Tidal surge	Long-term
2.	Raising the houses/roads	Cyclone, Flood, Tidal surge	Short-term
3.	Construction of community based shelter center	Cyclone, Flood, Tidal surge	Long-term
4.	Pre-disaster management	Cyclone, Flood, Tidal surge	Short-term
5.	Salinity resistant crop cultivation	Salinity	Short-term
6.	Strengthening the houses	Cyclone,	Short-term
7.	Raising the embankment	Tidal surge	Long-term
8.	Tree plantation	Flood	Short-term
9.	Changing the course of the river	River Bank Erosion	Long-term
10.	Changing landuse pattern (Shrimp cultivation to agriculture)	Salinity	Long-term

Central Cluster

Central cluster represents a unique composition of forest and wetland protected areas. This cluster extends its activities in 4 (2 forest and 2 wetland) Protected Areas comprising 79,500 hectares (3 Forest Divisions : Tangail, Mymensingh and Gazipur; and 3 Fisheries Districts : Tangail, Gazipur and Sherpur) including a core zone of 15,360 hectares. Nearly 1.3 million people (in 9 Upazillas and 32 Union Parishads) are impacted in the IPAC PAs landscapes where local communities subsist on agriculture, fishing, forestry, garments, handicrafts, fruits and vegetable cultivation activities.

Study shows that vulnerability types in the central cluster include mainly drought, flood, heavy rainfall, water logging and storm. In Bhawal NP, drought and heavy rainfall are categorized as severe while in Modhupur NP all three vulnerability types (drought, heavy rainfall and storm) are rated as severe. In case of Turag-Bongshi river basin, drought and flood are ranked as severe while in Kangsha-Malijhee river basin, flood is very severe followed by drought and water-logging.

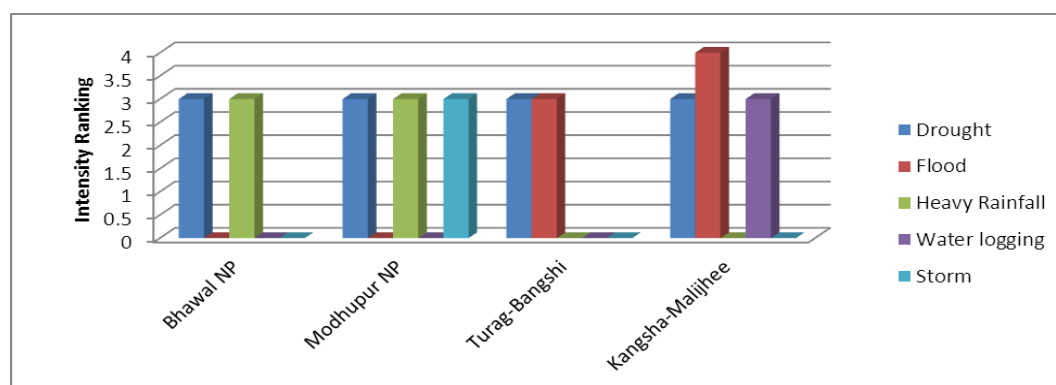


Figure 5: Vulnerability type and intensity ranking at Central Cluster

Study exhibits that drought tolerant crop cultivation and tree plantation are considered to be the highest priority adaptation measures for drought in Bhawal NP followed by development of irrigation system and deepening of existing canals and rivers. Establishment of deep tubewell and rain water harvesting were also chosen as suitable options in some cases for drought prone areas in and around Bhawal NP. In case of heavy rainfall, deepening the canals and rivers, improved drainage facilities and construction of culverts were identified as candidate adaptation options. For Modhupur NP, tree plantation, improved irrigation system and drought tolerant crop cultivation are priority measures to face of droughts, while in case of heavy rainfall improved drainage facilities and tree plantation are prioritized measures. Community representatives identified extensive tree plantations in PA landscapes to face frequent storms. Kangsha-Malijhee river basin communities prioritized deepening the canals and rivers as a priority adaptation option against flood, water-logging and drought. Construction of embankment is also considered for flood affected areas while construction of water reservoir and improved irrigation system were opted to adapt against drought

Table 4: List of prioritized adaptation measures for Bhawal National Park

Sl	Adaptation measures	Vulnerability Types	Timeframe
1.	Drought tolerant crop cultivation	Drought	Long-term
2.	Tree plantation	Drought	Short term
3.	Improved irrigation system	Drought	Long-term
4.	Deepening the canals and rivers	Drought, Heavy rainfall	Long-term
5.	Improve drainage facilities	Heavy rainfall	Long-term
6.	Construction of culvert	Heavy rainfall	Long-term
7.	Establishment of deep tube well	Drought	Long-term
8.	Rain water harvesting	Drought	Short term

Table 5 : List of prioritized adaptation measures for Kangsha-Malijhee river basin

Sl	Adaptation measures	Vulnerability Types	Timeframe
1.	Deepening the canal/river	Drought, Flood, Water logging	Long-term
2.	Construction of embankment	Flood	Long-term
3.	Construction of water reservoir	Drought	Long-term
4.	Improved irrigation system	Drought	Long-term
5.	Tree plantation	Drought, Flood	Short-term
6.	Establishment of deep tube well	Drought	Long-term

Table 6 : List of prioritized adaptation measures for Modhupur NP

Sl	Adaptation measures	Vulnerability Types	Timeframe
1.	Tree plantation	Drought, Heavy rainfall, Storm	Short-term
2.	Improved irrigation system	Drought, Heavy rainfall	Long-term
3.	Drought tolerant crop cultivation	Drought	Long-term
4.	Improve drainage facilities	Heavy rainfall	Long-term
5.	Alternative income generation	Drought, Heavy rainfall	Short-term
6.	Community based saving account establishment	Drought, Heavy rainfall, Storm	Short-term
7.	Deepening the canals and rivers	Drought, Heavy rainfall,	Long-term
8.	Construction of culvert	Heavy rainfall	Long-term
9.	Strengthening the houses	Heavy rainfall, Storm	Short-term
10.	Establishment of deep tube well	Drought, Heavy rainfall	Long-term
11.	Increasing awareness	Drought, Storm	Short-term
12.	Construction of water reservoir	Drought, Heavy rainfall	Long-term
13.	Establishment of village information center	Heavy rainfall, Storm	Short-term

Table 7 : List of prioritized adaptation measures for TB

Sl	Adaptation measures	Vulnerability Types	Timeframe
1.	Establishment of Deep tube well	Drought	Long-term
2.	Construction of embankment	Flood	Long-term
3.	Raising the houses/roads	Flood	Short-term
4.	Deepening the canals and rivers	Drought, Flood	Long-term
5.	Improved irrigation system	Drought	Long-term
6.	Construction of community based shelter center	Flood	Short-term
7.	Increasing awareness	Flood	Short-term

Sylhet Cluster

The Sylhet cluster is located in the northeast part of Bangladesh and consists of diversified ecosystems such as hill forests, natural rain forests, watersheds of important rivers and wetlands, plains, agriculture, and significant wetlands, ECA and a Ramsar site. Total landscape area of PAs is around 125,736 hectares (including core zone of 35,871.8 hectare), **where nearly 6 lakh people are impacted by climate change.** Sylhet Cluster also represents a unique composition of forest and wetland protected areas. The cluster covers all 4 districts of Sylhet division (i.e. Hobiganj, Moulvibazer, Sylhet and Sunamganj) comprising 13 Upazillas. Major rivers are Surma, Kushara, Boulai, Patlai, Monu and Khoai, with hundreds of *charas* and streams flowing from the surrounding hills.

In Sylhet cluster the study reveals that drought, flood, storm and early flood are major types of vulnerabilities with various intensity ranging from critical to severe. In Hail haor, drought, storm and flood are ranked as very severe type of vulnerabilities. In Hakaluki haor, flood and flash flood are very severe type. In Tanguar haor, basin flood is identified as critical followed by drought, storm and flash flood as very severe. In case of forest PAs namely LNP, RKWS and SNP, drought is identified as very severe while flood and storm are ranked as severe. In Khadimnagar NP, storm is graded as very severe while drought is identified as severe.

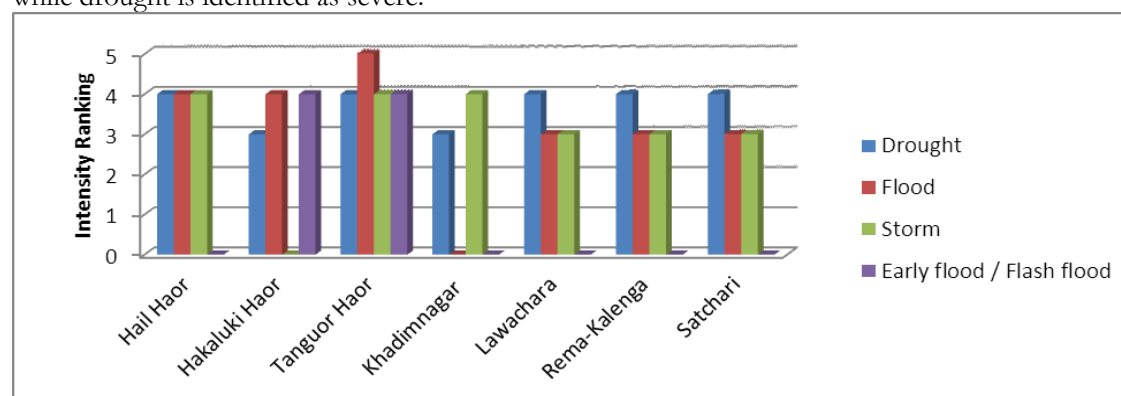


Figure 6: Vulnerability type and intensity ranking at Sylhet Cluster

In Hail Haor, construction of embankment and raised houses/roads are recognized as priority adaptation options for flood, followed by construction of community- based shelter center, pre-disaster management measures and increasing awareness. Community considers establishment of deep tube well and drought resistant crop cultivation as priority adaptation options during drought. Other options for drought are deepening the canal/river, improved irrigation system, digging pond and tree plantation. Construction of community- based shelter center and tree plantation are selected as suitable for adapting against storms. In Hakaluki haor, deepening the canals/river is considered as the priority adaptation measures for drought, flash flood and flood, while other priority options for drought are establishment of deep tube well, tree plantation, construction of sluice gate and drought tolerant crop cultivation. For flash flood, other priority options are construction of sluice gate and construction of embankment, followed by repairing the riverbanks and tree plantation. Pre-disaster management measures, increasing awareness and construction of community-based shelter center are categorized as priority adaptation options for flood. In case of Tanguar Haor raising the embankment is considered as priority adaptation option for both flash flood and flood while other options for flood are Construction of Embankment, Tree Plantation and Construction of Road. Establishment of Deep tube well is considered as only option for drought.

In forest PAs of Sylhet region namely Lawachara NP, Satchari NP, Rema-Kalenga WS and Khadimnagar NP, establishment of deep tube well is identified as a highly prioritized adaptation measure for mitigating drought. Other options are construction of water reservoirs, deepening the canal/river, drought tolerant crop cultivation, rain water harvest, develop irrigation system and tree plantation. In case of flood as an identified vulnerability for RKWS, SNP and LNP, adaptation options considered suitable are construction of embankment, deepening the river/canal, pre-disaster management measures including increasing awareness and AIGAs. Strengthening houses, increasing awareness and tree plantation are priority adaptation measures identified for storm mitigation in all 4 forest PA landscapes

Table 8 : List of prioritized adaptation measures for Hail Haor

Sl	Adaptation measures	Vulnerability Types	Timeframe
1.	Construction of embankment	Flood	Long-term
2.	Raising the houses	Flood	Short-term
3.	Establishment of deep tube well	Drought	Long-term
4.	Construction of community based	Flood and Storm	Long-term

	shelter center		
5.	Pre-disaster management	Flood	Short-term
6.	Tree plantation	Storm and Drought	Short-term
7.	Drought tolerant crop cultivation	Drought	Long-term
8.	Increasing awareness	Flood	Short-term
9.	Deepening the canals and rivers	Drought	Long-term
10.	Improved irrigation system	Drought	Long-term
11.	Alternative income generation	Drought	Short-term
12.	Digging pond	Drought	Short-term
13.	Strengthening the houses	Storm	Short-term

Table 9 : List of prioritized adaptation measures for Hakaluki Haor ECA

Sl	Adaptation measures	Vulnerability Types	Timeframe
1.	Deepening the canals and rivers	Drought, Flash Flood, Flood	Long-term
2.	Pre-disaster Management	Flood	Short-term
3.	Establishment of deep tube well	Drought	Long-term
4.	Tree plantation	Drought, Flash Flood	Short-term
5.	Construction of sluice gate	Drought, Flash Flood	Long-term
6.	Construction of embankment	Flash Flood	Long-term
7.	Drought tolerant crop cultivation	Drought	Long-term
8.	Increasing awareness	Flood	
9.	Construction of community based shelter center	Flood	Long-term
10.	Repairing the bank of the river	Flash Flood	Long-term
11.	Alternative income generation	Flood	Short-term
12.	Raising the houses/roads	Flood	Short-term

Table 10 : List of prioritized adaptation measures for Khadimnagar NP

Sl	Adaptation measures	Vulnerability Types	Timeframe
1.	Establishment of deep tube well	Drought	Long-term
2.	Tree plantation	Storm	Short-term
3.	Strengthening the houses	Storm	Short-term
4.	Construction of water reservoir	Drought	Short-term
5.	Deepening the canals and river	Drought	Long-term

Table 11 : List of prioritized adaptation measures for Lawachara NP

Sl	Adaptation measures	Vulnerability Types	Timeframe
1.	Increasing awareness	Storm, Drought, Flood	Short-term
2.	Alternative income generation	Storm, Drought, Flood	Short-term
3.	Establishment of deep tube well	Drought	Long-term
4.	Construction of community based shelter center	Storm	Long-term
5.	Strengthening the houses	Storm	Short-term
6.	Raising canal/river Side	Flood	Long-term
7.	Construction of embankment	Flood	Long-term

Table 12 : List of prioritized adaptation measures for Rema-Kelanga Wildlife Sanctuary

Sl	Adaptation measures	Vulnerability Types	Timeframe
1.	Establishment of deep tube well	Drought	Long-term
2.	Pre-disaster management	Flood, Storm	Short-term
3.	Alternative income generation	Drought	Short-term
4.	Increasing awareness	Drought, Flood	Short-term
5.	Strengthening the houses	Storm	Short-term
6.	Construction of community based shelter center	Flood	Long-term
7.	Construction of embankment	Flood	Long-term
8.	Deepening the canals and rivers	Flood	Long-term
9.	Drought tolerant crop cultivation	Drought	Long-term
10.	Tree plantation	Drought	Short-term
11.	Flood tolerant tube well establishment	Flood	Short-term

Table 13 : List of prioritized adaptation measures for Satchari NP

Sl	Adaptation measures	Vulnerability Types	Timeframe
1.	Establishment of deep tube well	Drought	Long-term
2.	Increasing awareness	Storm	
3.	Construction of embankment	Flood	Long-term
4.	Strengthening the houses	Storm	Short-term
5.	Tree plantation	Drought, Storm	Short-term
6.	Deepening the canals and rivers	Flood	Long-term
7.	Elevated and paved canal/river Side	Flood	Long-term
8.	Construction of road	Flood	Long-term
9.	Construction of community based shelter Center	Flood	Long-term
10.	Drought resistance crop cultivation	Drought	Long-term
11.	Pre-disaster Management	Storm	Short-term
12.	Improved irrigation system	Drought	Long-term
13.	Rain water harvesting	Drought	Short-term

Table 14 : List of prioritized adaptation measures for Tanguar haor

Sl	Adaptation measures	Vulnerability Types	Timeframe
1	Raising the embankment	Flash flood, Flood	Long-term
2	Construction of embankment	Flood	Long-term
3	Establishment of deep tube well	Drought	Long-term
4	Tree plantation	Flood	Short-term
5	Construction of road	Flood	Long-term

South-eastern Cluster

Southeastern Cluster is situated in the southeastern part of Bangladesh. The longest sea beach in the world, the Bay of Bengal and beautiful hilly river Naf tides over the southeastern cluster and covers the National Park, Wildlife Sanctuaries, and ECA PAs within its geographic focus. There are 7 (6 forest PA and 1 ECA) protected areas under this cluster with the total 123,339 hectare area in the districts of Cox's Bazar and Chittagong, and 3 Forest Divisions (Wildlife Management and Nature Conservation Division, Chittagong, Cox's Bazar South and North Forest Divisions).

Study shows that in Southeastern cluster, flood, cyclone, salinity, landslides, tidal surge and heavy rainfall are rated as vulnerabilities in terms of intensity throughout the forest PA sites. In case of Chunati WS, flood is classified as critical vulnerability and cyclone is very severe. In case of Fasiakhali WS, cyclone is

identified as very severe, while flood and salinity are severe. In Himchari NP a number of vulnerability types are identified: tidal surge, flood, cyclone and land slide and all are rated as very severe. At Medakachapia NP landscape, both the flood and salinity are identified as severe vulnerabilities. At Teknaf WS, flood is found as critical while cyclone is placed very severe.

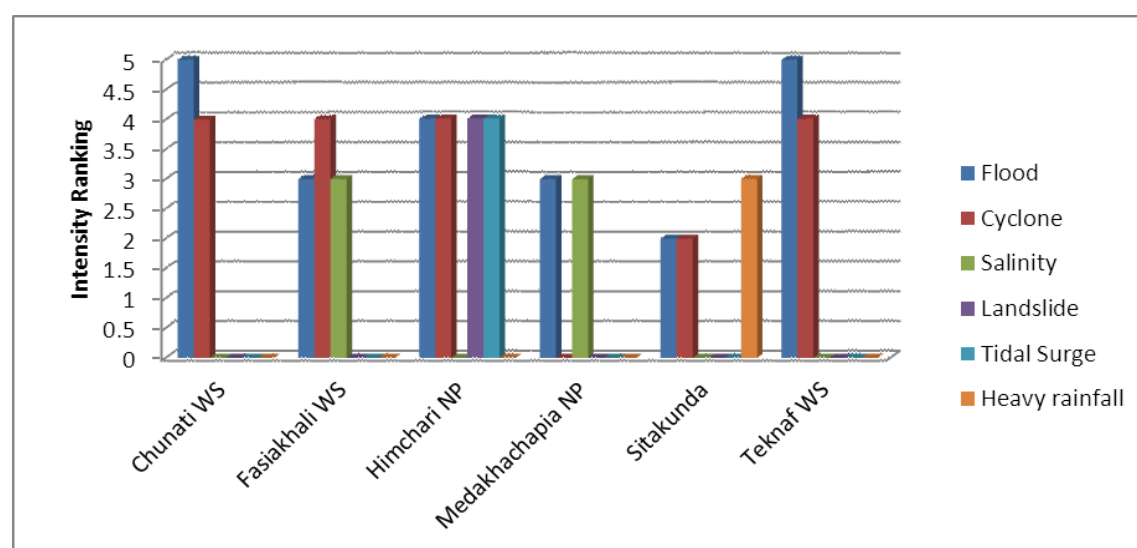


Figure 7: Vulnerability type and intensity ranking at Southeastern Cluster

In Chunati WS, strengthening the houses is categorized as the highest priority adaptation option for cyclone followed by construction of community- based shelter center, alternative income generation and tree plantation. Deepening the canal/river, repairing of road, construction of embankment, increasing awareness and raising the houses/ roads are identified as priority options for flood. In case of Fasiakhali WS, tree plantation is the major priority adaptation option for cyclone, while deepening the canal/river is categorized as priority option for flood. Repairing and raising the bank of the river/canal are considered as adaptation option for flood. Establishment of deep tube well is opted as adaptation option for salinity prone areas. In Himchari NP, construction of community- based shelter center and tree plantation are considered as option for cyclone, whereas tree plantation, construction of embankment, deepening the canal/river and food storage are selected for flood prone areas. For tidal surge, tree plantation, construction of community- based shelter center and construction of embankment are considered as suitable options, while for land slide, tree plantation and stopping hill cutting are identified as relevant.. Construction of embankment is considered as priority adaptation option for flood and salinity in Medakachapia NP. Additionally pre-disaster management measure and deepening the canal/river are considered suitable for flood mitigation. Salinity resistant crop cultivation is also considered suitable for adaptation in salinity areas. Tree plantation is picked up as an adaptation option for tidal surge. In Teknaf WS, construction of cyclone shelter is identified as highest priority for adaptation for cyclone, followed by early warning system, timely evacuation, communication with different Government Organization/NGOs for post-disaster supports, tree planation and strengthening the houses. Construction of embankment is highly prioritized as adaptation measure against flood.

Table 15: List of prioritized adaptation measures for Chunati WS

Sl	Adaptation measures	Vulnerability Types	Timeframe
1.	Deepening the canal/river	Flood	Long-term
2.	Repairing of road	Flood	Long-term
3.	Strengthening the houses	Cyclone	Short-term
4.	Construction of embankment	Flood	Long-term
5.	Increasing awareness	Flood	Short-term
6.	Raising the houses/roads	Flood	Short-term
7.	Construction of community based shelter center	Cyclone	Long-term

8.	Raising canal/river side	Flood	Long-term
9.	Alternative income generation	Cyclone	Short-term
10.	Tree plantation	Cyclone	Short-term

Table 16 : List of prioritized adaptation measures for Faiskhali WS

Sl	Adaptation measures	Vulnerability Types	Timeframe
1.	Tree plantation	Cyclone	Short-term
2.	Deepening the canal/river	Flash flood, Flood	Long-term
3.	Repairing the bank of the river	Flood	Long-term
4.	Raising canal/river side	Flood	Long-term
5.	Construction of embankment	Flash flood	Long-term
6.	Establishment of deep tube well	Salinity	Long-term
7.	Repairing of road	Flash flood	Long-term

Table 17: List of prioritized adaptation measures for Himchari NP

Sl	Adaptation measures	Vulnerability Types	Timeframe
1.	Tree plantation	Cyclone, Flood, Land slide, Tidal surge	Short-term
2.	Construction of community based shelter center	Cyclone, Flood, Tidal surge	Long-term
3.	Construction of embankment	Flood, Tidal surge	Long-term
4.	Deepening the canal/river	Flood	Long-term
5.	Store food	Flood	Short-term
6.	Stopping hill cutting	Land slide	Short-term

Table 18: List of prioritized adaptation measures for Medha Kachapia National Park

Sl	Adaptation measures	Vulnerability Types	Timeframe
1.	Construction of embankment	Salinity	Long-term
2.	Salinity resistant crop cultivation	Salinity	Long-term
3.	Pre-disaster management	Flood	Short-term
4.	Deepening the canal/river	Flood	Long-term
5.	Tree plantation	Tidal surge	Short-term

Table 19 : List of prioritized adaptation measures for Teknaf WS

Sl	Adaptation measures	Vulnerability Types	Timeframe
1.	Construction of community based shelter center	Cyclone	Long-term
2.	Early warning system	Cyclone, Flood	Short-term
3.	Time wise evacuation	Cyclone, Flood	Short-term
4.	Construction of embankment	Flood	Long-term
5.	Communication with different government organization/NGOs for post-disaster	Cyclone, Flood	Short-term
6.	Tree plantation	Cyclone	Short-term
7.	Strengthening the houses	Cyclone	Short-term

Chittagong and CHT Cluster

Chittagong & CHT Cluster represents its uniqueness of blend of National Park and Wildlife Sanctuary PAs and the country's hill forests and beautiful lakes full of biodiversity. The total area of this cluster is about 49,190 hectares covering 3 PAs (Kaptai National Park under Chittagong Hills Tract, Dudpukuria-

Dhopachari Wildlife Sanctuary under Chittagong South Forest Division, and Sitakunda Reserved Forest under the Sitakunda Botanical Garden Division). The PAs harbor ethnic communities and rich biodiversity. These PAs are important for the adoption of appropriate climate change strategies due to their closeness to Bay of Bengal resulting their landscape areas very much vulnerable. The areas are very much renowned for different types of vegetable production, agriculture, pond and lake fish culture, bamboo and handloom products and Jhum cultivation. Local communities depend on nearby forests for wood, and minor forest product like bamboo and bush meat.

The findings of village level adaptation plans exhibit that Dudpukuria-Dhopachari WS landscape is mostly vulnerable from cyclone and drought. In case of DDWS both cyclone and drought are rated as very severe vulnerability ranking. In Kaptai NP, cyclone, drought and flood vulnerability types categorized as severe.

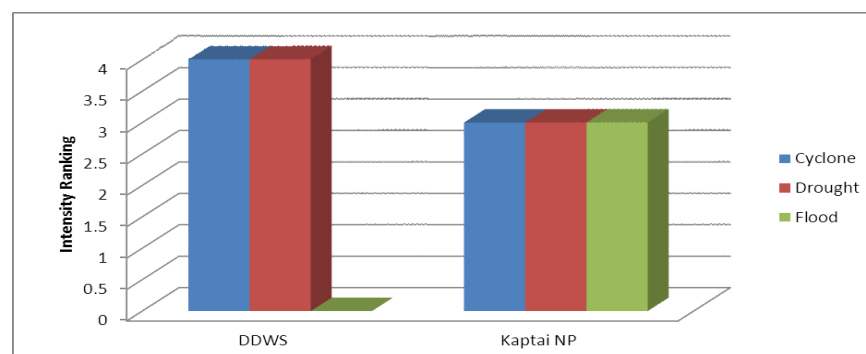


Figure 8 : Vulnerability type and intensity ranking at CTG & CHT Cluster

Dudpukuria-Dhopachari Wildlife Sanctuary

Community identified and prioritized adaptation measures to combat climate change vulnerabilities they face. In Dudpukuria-Dhopachari WS, tree plantation, pre-disaster management measures and establishment of deep tube well are identified as highly prioritized adaptation measures against cyclone and drought. Other important identified adaptation options for cyclones are increasing awareness, strengthening the houses and construction of community -based shelter center while digging pond, improved irrigation system, rain water harvesting and construction of water reservoir were found suitable for drought. In Kaptai NP landscape, tree plantation is identified as the highest priority adaptation option against cyclone, drought and flood, while increasing awareness, construction of community- based shelter center and pre-disaster management activities are other important measures to adapt against cyclone and flood. Further in Kaptai, improved irrigation system and establishment of deep tube well are also identified option for drought mitigation.

Table 20 : List of prioritized adaptation measures for Dudpukuria-Dhopachari WS

Sl	Adaptation measures	Vulnerability Types	Timeframe
1.	Tree plantation	Cyclone, Drought	Short-term
2.	Pre-disaster management	Cyclone	Short-term
3.	Establishment of deep tube well	Drought	Long-term
4.	Increasing awareness	Cyclone	Short-term
5.	Strengthening the houses	Cyclone	Short-term
6.	Construction of community based shelter center	Cyclone	Long-term
7.	Digging pond	Drought	Long-term
8.	Improved irrigation system	Drought	Long-term
9.	Rain water harvesting	Drought	Short-term
10.	Construction of water reservoir	Drought	Long-term
11.	Early warning system	Cyclone	Short-term

Table 21 : List of prioritized adaptation measures for Kaptai National Park

Sl	Adaptation measures	Vulnerability Types	Time frame
1.	Tree plantation	Cyclone, Drought, Flood	Short-term
2.	Increasing awareness	Cyclone, Flood	Short-term
3.	Construction of community based shelter center	Cyclone, Flood	Long-term
4.	Pre-disaster management	Cyclone, Flood	Short-term
5.	Developed irrigation system	Drought	Long-term
6.	Establishment of deep tube well	Drought	Long-term

5. LESSONS LEARNT AND RECOMMENDATIONS

Climate change adaptation is important for conserving biodiversity and ensuring sustainable natural resources management required resilient for ecosystem and livelihoods for the resources dependent communities in IPAC PAs and their land scapes.

The key lessons drawn from the IPAC VCF level adaptation planning process are the following.

Communities are aware of climate change and its impacts. IPAC works directly with the grassroots communities who are directly dependent on PA resources for their livelihoods. The Nishorgo Shahayaks (community facilitator) have very efficiently captured the views of the communities through climate change planning process.. Since the communities are experiencing the impacts of climate change through their life experience the issues of climate change are not new to them. They are able to understand changing pattern of climatic events such as increasing temperature, frequency and intensity of cyclone, and increasing salinity. As their livelihoods are directly affected by the impacts of climate change, they are able to realize the impacts of climate change intimately..

Climate Change adaptation initiatives in Bangladesh have not extended to community level. As one of the most vulnerable country of the world Bangladesh has raised its voices to international community to get support for its climate change adaptation program. Though a number of projects are being implemented in Bangladesh, a very few projects are focusing on community level adaptation. Although NAPA has suggested a number of adaptation options focusing on country's geo-morphological areas, site specific adaptation plans are not yet prepared and implemented. As a result adaptation measures taken at national level are not being extended to community level in a scalable manner.

Climate change adaptation needs to be integrated into development planning. Climate Change is now an environmental as well as a development issue. Considering the impact of climate change in Bangladesh, any development intervention should address the climate change issues. For sustainable development the climate change issues should be mainstreamed into policies and programs of different sectors.

Adaptation options already practiced by the community need to be ramped-up. Historically communities in Bangladesh are experiencing natural disasters and they have their own resilience, adaptability and innovativeness. They are already doing some adaptation measure to support their life and livelihoods. We need to take appropriate mechanism to ramp-up these innovative and traditional adaptation options. The local community people have already devised mechanisms to adapt in the changing scenario of the climate. We should explore the community knowledge that need be incorporated in national level climate change plans.

Agriculture should be climate resilient. Climatic factors such as temperature, rainfall, growing concentration of atmospheric carbon dioxide and solar radiation are closely linked with agriculture production. Therefore, agricultural production would be major concern in recent years due to changing climatic conditions. A significant amount of crop yield may hamper due to fluctuations of these climatic parameters. Therefore inputs used in agriculture need to be climate resilient. Extensive research needs to be conducted and water logging, drought and salinity resistant seeds need to be supplied to farmers. Appropriate cultivation technology need to be invented to adapt with changing climatic condition. Availability of pure drinking water, in the face of increasing climate change vulnerabilities, is a growing challenge in coastal communities. Intrusion of salinity, sea level rise and cyclones are likely to become frequent and widespread. While working with grassroots communities at PA landscapes it became evident that providing pure drinking water is found to be the entry point to make local community adapt with climate change vulnerabilities and support PA dependent communities' livelihood.

6. CONCLUSION

The report identified and PA wise ranked vulnerabilities and adaptive measures based on community based adaptation plans prepared at the VCF level. It reveals that the vulnerability contexts, which vary across the PAs, are characterized by geographical region with predominant ecosystem. Adaptation options vary based on community's perception and experience and also their access to information and knowledge. The report reflects the community perception and adaptation plans prepared at the very local level (VCF level). The report will be useful for preparing PA dependent communities to build climate resilient natural resource base and sustainable management of forest and wetland PAs.

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ANNEX I: FORMAT OF THE ADAPTATION PLAN PREPARED AT VCF LEVEL.

নিসর্গ নেটওয়ার্ক

এলাকা ভিত্তিক (ভিসিএফ)/জনগোষ্ঠী ভিত্তিক জলবায়ু পরিবর্তন জনিত অভিযোজন পরিকল্পনা

প্রথম অংশ : বর্তমান ব্যবস্থাপনা (Management Situation) / অবস্থা

ভিসিএফ এর নাম :-

রক্ষিত এলাকার নাম :

অবস্থান (গ্রাম, ইউনিয়ন, উপজেলা, জেলা) :-

জনসংখ্যা :- জন পুরুষ :- জন নারী :- জন

শিক্ষিত জনগোষ্ঠীর শতকরা হার :- %

ভূ-প্রকৃতি :

অবকাঠামো (পাকা সড়ক, কাঁচা সড়ক, শিক্ষা প্রতিষ্ঠান, বেড়ীবাঁধ, আশ্রয় কেন্দ্র, হাট / বাজার ইত্যাদি) :-

নদ-নদী, খাল :-

বিল / জলাশয় / হাওড় / বিল (সংখ্যা / এলাকার পরিমাণ) :-

বনাঞ্চল (বনের ধরন, প্রধান প্রজাতি ও পরিমাণ) :-

কৃষি জমি ও উৎপাদিত ফসল :-

প্রকৃতিক দুর্যোগ (দুর্যোগের ধরন, সময়কাল ও ক্ষয়ক্ষতি) :

ছক- ১ : প্রাকৃতিক দুর্যোগের তথ্যাবলী

দুর্যোগ	দুর্যোগের তীব্রতা (খুববেশী, বেশী, মধ্যম, কম)	সময়কাল (মাস)	কতটি পরিবার ক্ষতিগ্রস্ত হয়েছে	প্রাসঙ্গিক তথ্য

ছক - ২ : দুর্যোগের মাত্রা নির্ধারণ

দুর্যোগের ধরন	সংকটপূর্ণ	খুব গুরুতর	গুরুতর	গুরুতর নয়	আদৌ কোন ঝুঁকি নেই

ছক- ৩ : দুর্যোগের ফলে ক্ষতিগ্রস্ত খাত নির্ধারণ

দুর্যোগের ধরন	কৃষি	মৎস্য	পশুসম্পদ	যোগাযোগ অবকাঠামো (রাস্তা / ঘাট / ব্রিজ / কালভার্ট)	অবকাঠামো (বাড়ী / ঘর / প্রতিষ্ঠান)	স্বাস্থ্য	শিক্ষা (স্কুল / কলেজ)	জীবিকা	অন্যান্য

দ্বিতীয় অংশ : জলবায়ু পরিবর্তন জনিত অভিযোজন পরিকল্পনার সুপারিশসমূহ

ছক-৪ : অভিযোজনের উপায় বিশ্লেষণ

দুর্যোগ/বিপন্নতার ধরন	অভিযোজনের উপায়	এ ধরনের কাজ করা হয় কিনা	কেন করা হয় না	না হলে কি করতে হবে

ছক-৫ : অভিযোজনের পরিকল্পনার ছক

এলাকার নাম	বিপন্নতার ধরন	অভিযোজনের উপায়সমূহ		প্রয়োজনীয় সম্পদ	মূল্য নির্ধারণ	দায়িত্বপ্রাপ্ত ব্যক্তি/প্রতিষ্ঠান	মন্তব্য
		স্বল্প মেয়াদী	দীর্ঘ মেয়াদী				
						স্থানীয় ইউনিয়ন পরিষদ	

ছক-৬ : গোষ্ঠী ভিত্তিক অভিযোজনের পরিকল্পনা বাস্তবায়নের মনিটরিং

কার্যক্রম	সূচক	অর্জিত সাফল্য (সংখ্যাগত)					মন্তব্য
		১ম কোয়ার্টার	২য় কোয়ার্টার	৩য় কোয়ার্টার	৪র্থ কোয়ার্টার	মোট	

USAID's Integrated Protected Area Co-management Project

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