

# **Final Report**

Project #	(Official use)
Project title:	Sundarbans crab fattening in bamboo cages and mangrove restoration as adaptation to climate change
Country	Bangladesh
Year of the award	2009
Implementing organization:	Centre for Coastal Environmental Conservation (CCEC)
Partner Organizations:	----
NetRes	Thailand Environment Institute (TEI)
Project Duration	January 2010 - December 2011

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# Preface

Under the auspice of the United Nations Environment Programme (UNEP), the Asia-Pacific Forum for Environment and Development (APFED) launched a Showcase programme in 2006, through a regional network of policy research institutes called NetRes. The idea was to promote environmental management and sustainable development and assisting developing countries to implement environmentally sound policies, good practices, innovative activities and replication mechanism in the Asia-Pacific region involving NGOs.

The UNEP-APFED Showcase programme selected to support the project, “Sundarbans crab fattening in bamboo cages and mangrove restoration as Adaptation to Climate Change” project submitted by Centre for Coastal Environmental Conservation (CCEC), Bangladesh.

The Thailand Environment Institute (TEI) in Thailand was selected as one of the eight NetRes institutes for providing strategic advice and recommendations for facilitating the implementation and progress of the project activities.

The project has created Community Conserved Areas (CCA) i.e. buffer zone outside the polder embankment of Bangladesh Water Development Board (BWDB) through mangrove restoration and plantation to act as a protective barrier against natural disasters. The project also offers proof of the feasibility of community based crab fattening as an adaptation exercise in context to climate change in the Bangladesh Sundarbans coastal region.

# Location

## **Exact location of the operation:**

ShyamnagarUpazilla under Satkhira District of Bangladesh

**VILLAGE (24):** PurbaKashimari, Kashimari, Mominagar, Durgabati, Atulia, Nowabeki, BoroKupot, ChotoKupot, Bhamia, Dumuria, 9 No Shara, Burigoalini, Datinakhali, Kalbari, Munshiganj, Kalinagar, Kultali, Mathurapur, Harinagar, Shinghortali, Chunkuri, Chotobhetkhali, Jatintranagar, Mirgang

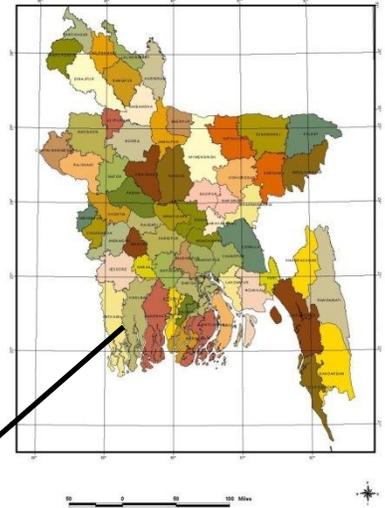
**UNION (6):** Kashimari, Atulia, Burigoalini, Gabura, Munshiganj, Ramjannagar

**UPAZILLA (1):** Shyamnagar

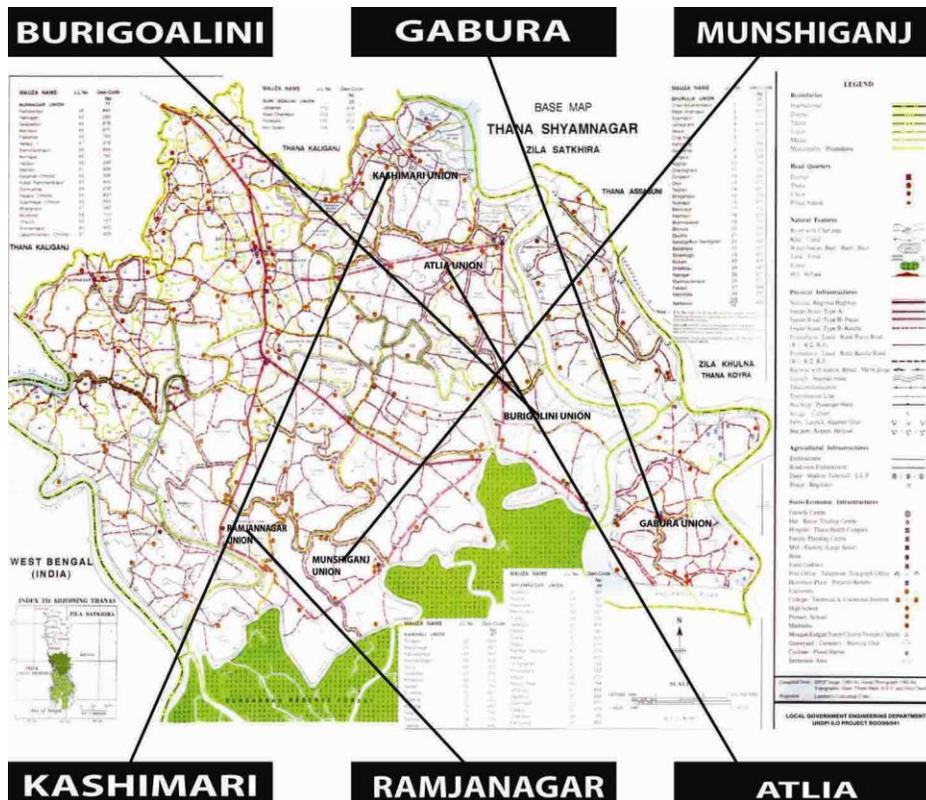
**DISTRICT (1):** Satkhira



# Location map



Map of Shyamnagar Upazilla



## **Acronyms**

<b>BFRI</b>	<b>: Bangladesh Fisheries Research Institute</b>
<b>BLC</b>	<b>: Boat License Certificate</b>
<b>BWDB</b>	<b>: Bangladesh Water Development Board</b>
<b>CCEC</b>	<b>: Centre for Coastal Environmental Conservation</b>
<b>CISS-KU</b>	<b>: Centre for Integrated Studies on the Sundarbans – Khulna University</b>
<b>DMC</b>	<b>: Disaster Management Committee</b>
<b>DRR</b>	<b>: Disaster Risk Reduction</b>
<b>FD</b>	<b>: Forest Department</b>
<b>FRI</b>	<b>: Forest Research Institute</b>
<b>NGO</b>	<b>: Non Government Organization</b>
<b>PMC</b>	<b>: Project Management Committee</b>
<b>PRA</b>	<b>: Participatory Rural Appraisal</b>
<b>SRF</b>	<b>: Sundarbans Reserved Forest</b>
<b>TEI</b>	<b>: Thailand Environment Institute</b>
<b>UNESCO</b>	<b>: United Nations Educational, Scientific and Cultural Organization</b>
<b>UP</b>	<b>: Union Parishad</b>
<b>UPZ</b>	<b>: Upazilla</b>
<b>WH</b>	<b>: World Heritage</b>

## EXECUTIVE SUMMARY

For decades, Bangladesh has been affected by natural disasters. However, the effect of “climate change” is causing an increase in the frequency and severity of the disasters, adversely affecting the agriculture, water and sanitation, infrastructure and the lifestyle of the community as a whole. Bangladesh is one of the most vulnerable countries in the world to climate change. In the last 30 years, the country has experienced several climate-related disasters including drought, extreme temperature, flood, storm, cyclone and tidal surge. The southwest coastal belt of Bangladesh Sundarbans is the frontlines of global climate change especially sea level rise. Bangladesh cyclone Sidr in 2007 and cyclone Aila in 2009 are the recent examples. Embankment erosion, water logging, increased salinity are the causes of concern. Again Global Disaster Alert and Coordination System (GDACS) has identified Khulna City as 9<sup>th</sup> Cyclone Risk City out of 327 City followed by Manila (Philippines), Alejandria (Egypt), Lagos (Nigeria), Monrovia (Liberia), Karachi (Pakistan), Eden (Yemen), Jakarta (Indonesia), Port side (Egypt); Kolkata (India) 10<sup>th</sup> (source: WB) based on the population density of coastal city.

In response, the country has initiated and implemented a number projects related to climate change adaptation and mitigation. Considering the vulnerability and high risk of Bangladesh Sundarbans coastal region, the Centre for Coastal Environmental Conservation (CCEC) has implemented the Showcase project “Crab Fattening and Mangrove Restoration as Adaptation to Climate Change” in cooperation with United Nations Environment Programme (UNEP), particularly Asia-Pacific Forum for Environment and Development (APFED) and Thailand Environment Institute (TEI).

The project engaged local people, especially crab collectors (fisherman) to prove crab fattening as a climate adaptation mechanism or appropriate technology and reduce the impact of natural disasters through mangrove restoration.

As a Member Organization of IUCN Bangladesh and with the long experience on environmental education, biodiversity conservation, capacity building of the Sundarbans stakeholders, the CCEC has leased out 12 acres of land along the Sundarbans coastal belt for creating buffer zone involving 100 local people known as Mangrove Protection Society (MPS). The CCEC has also reduced the poverty levels of 50 crab collectors, including developing coordination between government agencies and project beneficiaries. A detailed project implementation plan was prepared and submitted to TEI, in time. A number of reports such as the quarterly report, interim report, and research reports were produced besides link established with Fisheries Research Institute and Centre for Integrated Studies on the Sundarbans (CISS), Khulna University.

# 1. OUTLINE OF THE EVALUATION STUDY

## 1.1. Project Background

The project site and beneficiaries are concerned to Shyamnagar Upazilla (sub district) under Satkhira district of Bangladesh. Shyamnagar is located at 22.3306°N 89.1028°E. The Upazila is bounded by Kaliganj and Assasuni Upazila on the north, Sundarbans and Bay of Bengal on the south, Koyra and Assasuni upazilas on the east, West Bengal of India on the west. Isamoti is the border River between Bangladesh and India. The main rivers here are: Raymangal, Kalindi, Kobadak, Kholpetua, Arpangachia, Malancha, Hariabhanga and Chuna. South Talpatti Island at the estuary of the Hariabhanga is notable place. The project area falls within Sundarbans Impact Zone (SIZ) and above 2-3 meter Mean Sea Level.

Shyamnagar Upazila consists of 13 Union Parishad (UP) with an area of 1968.24 km<sup>2</sup>. It is the biggest UPZ in size in Bangladesh. A camp of Border Guard Bangladesh (BGB) located at Nildumur, and a Forest Range office is located at Burigoalini. Shyamnagar consists of 13 union parishads, 127 mouzas and 216 villages. Average literacy in upazila is 28.1% (male 38% and female 17.4%). There are 5 colleges, 28 high schools, 98 madrasas, 96 government primary schools. Most of the people are dependent on Sundarbans Reserved Forest (SRF) resources for their livelihood. About 32.93% people are engaged with this work. Main exports are paddy, jute and shrimp. It has 46,592 household units and total area 1968.24 km<sup>2</sup>. As of the 1991 Bangladesh census, Shyamnagar has a population of 265,004. Males constitute 50.46% of the population, and females 49.54%.

The area is highly vulnerable to climate change impacts. Every year natural disasters, such as cyclones, take a toll on numerous human lives and damage coastal resources. Bangladesh cyclone Aila 2009 is a recent example. Gradual salinity increase is the greatest threat for the region. Livelihood, biodiversity, agricultural production, drinking water and health hazards, especially for the women and children, becomes acute due to salinity intrusion in the area.

A major portion of the population is dependant on the Sundarbans for their livelihood. Agriculture, shrimp farming, day labor, small trades such as fish, shrimp fry are remarkable. Population boom, poverty, settlement, resettlement and various infrastructures causes deforestation and reduction of crop land areas. These consequences have negative impacts on

livelihood and biodiversity of the project areas. Shrimp farming is also replacing the agriculture activities due to increased salinity, but no such shrimp policy is adopted by the government while Bangladesh Water Development Board has developed a policy for the plantation on the embankment and borrow pit. Under the Environment Conservation Act of 1995, the establishment of any industry or infrastructures causing pollution of soil, water, air or sound is strictly prohibited and is not executed within and around 10 km of the Sundarbans Ecologically Critical Area (ECA).

The project tried to address the issues of climate change risks and adaptation, mangrove deterioration, and poverty of local communities in Bangladesh by adopting two major strategies;

- i) Crab fattening in bamboo cages and
- ii) Mangrove restoration through regeneration & plantation using bamboo fencing

The project introduced and attempted to commercialize crab fattening in bamboo cages as an adaptation strategy to climate change and mangrove restoration reducing disaster risks for the most vulnerable communities living in the high risk Sundarban coastal zone of Bangladesh situated at the mouth of Bay of Bengal. People involved in crab harvesting, marketing and exporting will be able to escape from natural disaster risks by protecting river bank erosion and also benefiting from the make use of molt /water crab harvested by the crab collectors. Practicing the crab fattening in commercial scale from pilot basis thus investigate the feasibility to adapt climate change scenarios and make a green buffer zone in 12 acres land spread over 5 km. along the Sundarbans coast protecting riverbank erosion and tidal surge. This also ensured livelihood security of 150 Sundarbans stakeholders.

## **1.2. Project Overview**

The UNEP-APFED Showcase awarded-2009 project titled "Sundarbans crab fattening in bamboo cages and mangrove restoration as an adaptation to climate change" was implemented by the Centre for Coastal Environmental Conservation (CCEC) in cooperation with United Nations Environment Program (UNEP) and with monitoring and technical advice from the Thailand Environment Institute (TEI) from January 2010 to December 2011 in the south west coastal belt of Shyamnagar Upazila under Satkhira district of Bangladesh.

Crab fattening activities both in bamboo cages and open mud fattening were carried out involving 50 crab harvesters and forming crab harvesters association. Both 50 crab beneficiar-

ies and 162 Mangrove Protection Society (MPS) families i.e 324 (162 x 2) members (247 men and 77 women) were selected based on the Focus Group Discussion (FGD) using questionnaires. The crab harvesters collected and released molt crabs from Sundarbans Rivers and canals and crab/shrimp farms.

Mangrove restoration was accomplished by leasing lands from BWDB and forming Mangrove Protection Society (MPS) involving climate vulnerable embankment communities through nursery raising and bamboo fenced plot plantations.

The beneficiaries were supported both in kind and cash for example Boat License Certificate (BLC), gear/boat accessories and training support. A total of 75 crab collector beneficiaries were trained and supported for alleviating poverty. The number of crab harvester beneficiaries were raised from 50 to 75 considering the geographical location of the crab harvester cluster, previous working relationship and request from the local government. Poster, leaflet and banners were displayed throughout the project activities in Shyamnagar project area.

overty reduction support was given to all 75 Sundarbans stakeholder project beneficiaries for crab fattening in bamboo cages and open mud fattening activities by leasing lands for farm preparation, fencing and guarding by the project. Thus socio-economic status of the families is much improved and has lessened the hardships of project beneficiaries. Besides mangrove plantation being accomplished in 12 acres outside BWDB polder 5 Shyamnagar under Satkhira district which in turn protection of coastal embankment, rehabilitation of mangrove ecosystem and food, nutrition, fire wood and most economic demand of the project participants will be fulfilled in the long run. Also reduce the risks of natural disaster and support to combat climate change impacts of the vulnerable communities.

### **1.3. Study Objectives :**

- i. Reducing the impact of natural disasters through local resources and mangrove restoration
- ii. Increasing income of the number of local communities participating in the project
- iii. Enhancing coordination and cooperation between related organization and public

The main objective of the evaluation of the project was to conduct a review of the effectiveness of the project as measured by the stated objectives versus outcome and make recommendations for the future. Relevance, effectiveness, efficiency impact, cost-effectiveness, adoptability, sustainability, geographic coverage, target beneficiaries, community participation, capacity-building, and co-ordination were examined as key factors.

#### **1.4. Scope of Work:**

The scope of the study included compiling research activities, research information and analysis of the Showcase project in the field of climate change adaptation. For example: Crab fattening in bamboo cages and open mud fattening initiates within the two years activity for alternative livelihood options as experimental basis Thus, climate vulnerable coastal communities are giving priority to open mud fattening for crab fattening. According to the research, salt tolerant rice cultivation, fish culture in rice field, vegetable growing in the homestead, cow fattening, and goat-raising are the other alternative activities for income generation of the climate risk communities. Besides disaster risk reduction through mangrove plantation and rehabilitation is a concern of the project.

Future research work can be undertaken on the mangrove species in context to survivability, rapid growth, and embankment erosion protection capacity by assessing the degree of attachment between the soil and root and carbon sequestration reducing global warming.

Involvement of women in nursery-raising and guarding of plantation plots, formation of crab association from rural population; and link with Bangladesh Fisheries Research Institute BFRI and Khulna University (KU) are the major scopes to work.

#### **1.5. Study Period :**

The study area was planned for two years from 1<sup>st</sup> January 2010 to 31<sup>st</sup> December 2011

## **2. STUDY METHODOLOGY**

### **2.1 Evaluation Questions:**

Along with Sea level rise, increased salinity and water logging, Sundarbans coastal region of Shyamnagar-Sundarbans under Satkhira district is facing threats of frequent disasters. For example, Bangladesh cyclone SIDR of 2007 and cyclone AILA of 2009. The purpose of this evaluation is to provide guidance for future activities of the implementing organization and also to inform the local community of the results of the survey/evaluation. The field work was carried out by CCEC Bangladesh team by using a questionnaire (Annex: evaluation questions), which was developed to receive responses from the local community in the following specific areas:

1. Crab fattening technology
2. Ecological Mangrove Restoration (EMR) and plantation technique
3. User outreach and cultural program
4. Monitoring and evaluation program

The evaluation methodology incorporated a number of different tools in order to collect both quantitative and qualitative data on the introduction and adopting Climate change adaptation strategies and practices.

### **2.2 Methodology:**

The study adopted the following methodology to collect information for two research activities such as Crab fattening in bamboo cages and open mud fattening; and Mangrove restoration as adaptation to climate change;

- (a) Review of secondary data from relevant organisations for example; forest department, Union Parishad, Upazilla Parishad and NGOs
- (b) Interviews and trainings of the key stakeholders
- (c) Baseline survey

Key points of the implementation for crab fattening includes; selection of 75 Sundarbans crab collector beneficiaries through a baseline survey using a questionnaire (copy attached in Annex). Group formation, group discussion and trainings were conducted involving representatives of Bangladesh Fisheries Research Institute (BFRI). Trained beneficiaries were engaged in crab fattening both in two cages and one open mud fattening activities. A Project Management Committee (PMC) is formed for the monitoring and evaluation of the crab fattening activities by involving both beneficiaries and CCEC representatives.

Key points of the implementation for mangrove restoration includes; selection of 150 beneficiaries, administer questionnaires, conducting Participatory Rural Appraisal (PRA) research information analyses, leasing out lands from BWDB polder number 5 Shyamnagar. Group formation, group discussions, conducts trainings involving the trainer from Bangladesh Forest Research Institute (Mangrove Silviculture Division) and Fisheries Research Institute (FRI). Two nurseries and six plantation plots were established in 12 acres land out of 57 acres land leased out from Bangladesh Water Development Board (BWDB).

### **2.2.1 Meetings and workshops**

Meetings with MPS, Crab beneficiaries, BFRI, CISS-KU and local government were held regularly. Mangrove related meetings were with eight small groups (Six plantation and two nurseries) and 162 members of Mangrove protection Society (MPS). Every month one meeting was held with each of small groups which were recorded in the resolution book in presence of field supervisor and some with both supervisor and project co-ordination. Meeting with crab beneficiaries were held with five small crab groups and crab co-operative society involving 75 crab beneficiaries. Regular meeting once in a month was held and recorded in the resolution book. The meetings with the Bangladesh Fisheries Institute (BRRI), Center for Integrated Studies on the Sundarbans (CISS-KU), local Government and peoples representation, Forest Department (FD) were also held regularly.



## 2.3. Schedule of the study

stakeholder survey, mobilization of beneficiaries	January – April 2010
MOU with BWDB, CISS-KU, Formation of MPS, Crab Association, Crab fattening and mangrove restoration, LOA signing between TEI and CCEC , quarterly report	May - August 2010
Follow up Crab fattening/ mangrove restoration activities, project site visit by TEI , Quarterly report	September-December 2010
Monitoring and Evaluation launched by PMC	January - April 2011
Follow up Crab fattening/ mangrove restoration activities; Quarterly report	May- August 2011
Follow up Crab fattening/ mangrove restoration activities, Final report submission	September - December 2011

Details are provided in Annex.

## 3. RESULTS

The main results are;

- (a) Increased income of 50 households through applying appropriate technology for crab fattening reflected in evaluation question answer interview in qualitative measures
- (b) Protecting polder embankment and reforesting mangrove areas by creating a Community Conserved Areas (CCA) and
- (c) Creating a buffer zone via mangrove restoration to act as a protective barrier against natural disasters

Research Component	Indicators of Development					
	Number of beneficiaries	project output	Link with Institutions	Capacity Building Training	Conservation Regulations	Remarks
<b>Crab Fattening</b>	75	<ul style="list-style-type: none"> <li>• Formation of crab association</li> <li>• Crab fattening both in cages and open mud fattening</li> </ul>	<ul style="list-style-type: none"> <li>• Fisheries Research Institute (Brackish Water Center)</li> </ul>	<ul style="list-style-type: none"> <li>• Skill development on crab fattening in bamboo cages and open mud fattening</li> </ul>	<ul style="list-style-type: none"> <li>• January and February is ban period for crab harvesting in SRF Rivers and canals</li> <li>• <a href="#">Bangladesh Crab Export Regulation, 1998</a></li> </ul>	<ul style="list-style-type: none"> <li>• The project process crab fattening as a climate adaptation mechanism and appropriate technology</li> </ul>

Research Component	Indicators of Development					
	Number of beneficiaries	project output	Link with Institutions	Capacity Building Training	Conservation Regulations	Remarks
					<ul style="list-style-type: none"> <li>Harvesting is ban below 200 gm for male and 130 gm for female crab</li> </ul>	gy and mangrove restoration reduces the impact of natural disasters by creating buffer zones.
<b>Mangrove Restoration</b>	162	<ul style="list-style-type: none"> <li>Formation of Mangrove Protection Society (MPS)</li> <li>12500 survival saplings</li> <li>7 mangrove species: kewra (<i>Sonneratia apetala</i>), bain (<i>Avicennia affinis</i>), kankra (<i>Bruguiera gymnorrhiza</i>), passur (<i>Xylocarpus mekongensis</i>), sundri (<i>Heritiera fomes</i>), khalisha (<i>Aegiceras corniculatum</i>), and golpata (<i>Nypa fruticans</i>).</li> <li>Eight plots in 12 hac. reduce erosion in 5 km embankment</li> <li>Benefit sharing from the mangrove plantation BWDB-40%, MPS-50%, local government-5% and NGO-5%</li> </ul>	<ul style="list-style-type: none"> <li>Bangladesh Water Development Board (BWDB)</li> <li>Forest Department/Forest Research Institute (Mangrove Silviculture) and Centre for Integrated Studies on the Sundarbans (CISS), Khulna University.</li> </ul>	<ul style="list-style-type: none"> <li>Skill development in mangrove restoration and management.</li> </ul>	<ul style="list-style-type: none"> <li>The Environment Conservation Act (ECA, 1995) strictly prohibits "natural forest destruction and felling or logging of trees" within and around 10 km areas of the Sundarbans Reserved Forest (SRF).</li> </ul>	

### **3.1 Project Implementation**

Main inputs expected from the project can be summarized as

1. Survey on the beneficiaries selection
2. Mobilization of the beneficiaries
3. Memorandum of Understanding (MOU) between
  - (i) CCEC and BWDB
  - (ii) CCEC and CISS under Khulna University and
  - (iii) CCEC and Thailand Environment Institute (TEI) and the actual inputs followed the same thus no discrepancy is observed between planned and actual input and activities excepts for increasing the number of beneficiaries from 50 to 75 for crab fattening and 100 to 162 for mangrove plantation in order to maintain the consistency of the former groups and association.

#### *Planned and Actual Input*

- APFED financial support (partial) in US dollars = \$ 29500
- CCEC contribution (in kinds) includes staff time; logistics support; utilities; furnished office space and support staff time; support towards planning/execution of the project activities.
- TEI's inputs consists of supports towards making Memorandum of Understanding (MOU) between TEI and CCEC, revising project proposal, finalizing work plan and time frame; planning/execution of project activities, site visits/participation in the ToT and awareness raising workshops; writing reports; and periodic supervision/monitoring/evaluation of project.

### **3.2 Relevance**

- **Priority of the Targeted Issues**

The project area is located in the southwest corner of Bangladesh and is influenced by the Bay of Bengal. The area is in high risk of climate change. Bangladesh Cyclone Aila in 2009 and Cyclone Sidr in 2007 are the examples.

Regular cyclone, warning signals for the coastal communities especially the fishermen, tidal surge, and increasing salinity are reducing the production of Sundarbans Reserved Forest (SRF) resources which in turn are threatening the livelihood of

Sundarbans resource harvesters. Thus, mangrove plantation and rehabilitation activities are more important compared to any other activities for sustainable livelihood, rehabilitation of Sundarbans stakeholders and reducing natural disaster risks.

- **Needs of the Target Group / Target Area**

Target beneficiaries are Sundarbans stakeholders. They depend on Sundarban's crab resources. High tide, unusual tidal surge, frequent natural disasters and fresh water reduction from the Ganges causing low production of SRF resources. Again tiger attacks, and piracy are causes of concern why the stakeholders are losing interest in Sundarbans resource harvesting. But the stakeholders are familiar with the crab fattening exercise and it is feasible with saline environment. Thus, the target beneficiaries adapt with Sundarbans coastal environment. Also, mangrove plantation and regeneration are effective in protecting embankment breaching and River bank erosion. The target area is one of the most vulnerable to climate change.

- **Relevance of Project Scope, Expected Outcome and Approach**

The project area is situated at the extreme tip of Sundarbans and bordered the Sundarbans and human settlement protected by coastal polder embankment. Along with the increasing salinity, livelihood of the coastal communities of the area is gradually depending on fish and crab. Rivers, canals and estuaries are the breeding ground of shrimp, crab and fish. Long experience of the Sundarbans stakeholders and availability of crab above all one of the adaptation strategies for crab fattening.

- Impact

### **3.3 Effectiveness:**

Skill development of 75 beneficiaries on crab fattening in bamboo cages and open mud fattening activities is accomplished through training of Fisheries Research Institute. Poverty reduction of the beneficiaries through crab fattening eventually enable them for changing their lifestyle. Socio-economic status of the beneficiaries is improved. Opportunity for consultation and receiving technical assistance is created by establishing linkages among government, non-government and research organizations for example Forest Department, Fisheries Research Institute, Mangrove Silviculture and Center for Integrated Studies on the Sundarbans (CISS) of Khulna University.

Rehabilitation and plantation of mangrove of 12 acres of BWDB land outside polder embankment by establishing two nurseries and planting 12000 mangrove plants of various species in six plantation plots. Economic and environmental benefit of the beneficiaries is achieved through food, fuel, furniture and the protection of embankment. Proliferation opportunity of various aquatic biodiversity is created. Reduce the impacts of cyclonic hit and tidal surge.

### **3.4 Self-reliance of the Project :**

Knowledge and experience acquired through crab fattening and mangrove restoration techniques enabling the beneficiaries to earn more income for self reliance. And the experience is inbuilt in their lifelong process for future income to other areas after the end of the project. Again the other communities will be informed and will benefit through the project beneficiaries by replicating the exercise in other locations in the coastal region of Bangladesh. Establishment of 50% ownership for the project beneficiaries along with the ownership of the local government (10%), and BWDB (40%) (through signed agreement) enhances the economic benefits of the beneficiaries and makes the project sustainable.

### **3.5. Participation**

Participation of the 237 target beneficiaries, project departments BFRI, and CISS, Khulna University through awareness meeting and training displaying leaflet, poster and banner was successful. The awareness meeting news was published in the local dailies (Annex: p-44). With the active participation of 75 crab collectors, demonstration of crab fattening exercise at Shyamnagar BWDB polder No. 5 coastal area has been proved as a good source of poverty reduction. With the active participation of 100 mangrove beneficiaries, mangrove plantation and rehabilitation was found to be as a buffer to protect embankment erosion. Mangrove rehabilitation is also found to be an ideal habitat for biodiversity, its reproduction, ecological balance and maintenance of food chain. Beneficiaries will get nutritional food, fuel wood, and economic benefit from the plants in near future. Embankment breaching and erosion will be protected in the mangrove planted area thus reduce the impact from natural disasters especially cyclone.

### **3.6. Conclusion**

Based on the activities we can conclude that the project as formulated and executed was successful and did have significant contributions towards climate change adaptation strategies through crab fattening and mangrove restoration activities.

Community based Mangrove Protection Society (MPS) and Crab Collector Association (CCA) were excellent innovations for rural communities in the Sundarbans area to adapt to the adverse impacts of climate change. The cultural pot was effective for public campaign awareness and sensitizing coastal communities.

Overall we can state that the project did make valuable contributions towards the proposed objectives and was successful in its implementation.

### **4. LESSONS LEARNED**

Crab fattening and mangrove restoration activities have been proved as climate change Adaptation practices and viable strategies for the Shyamnagar project area. Crab fattening can be a special Income Generation Activity (IGA) on a commercial scale, provided there is effective implementation of the Bangladesh Crab Export Regulation 1998. This is due to crab collectors are engaged illegal harvesting of crab fries from Koira River, outside the project area but adjacent to Sundarbans Reserved Forest (SRF). This illegal harvesting is patronized by the middleman of Bajua, Foila and Katakhalia under Mongla and Rampal UPZ in Bagerhat district adjoining Chandpai Range and Dhangmari Station of the Bangladesh Forest Department. This indiscriminate (< 200 gm for male and < 130 gm for female crab) crab harvesting in Koyra River may lead Sundarbans aquatic ecosystem imbalance which in turn livelihoods of all crab collector of SRF might be insecure. No negative impact was observed in crab fattening and no risk of tiger attack. Along with the crab fattening, the families' i.e the wives of the crab fattening beneficiaries can be associated for pickle making from mangrove fruits especially keora (*Sonneratia apetala*). As a result the women can produce mangrove pickle while staying at home and can be a source of income for poverty reduction. Alluvial sediment: Silty clay sediment carried by the tidal river disrupts the natural regeneration process and also increases the mortality of the planted saplings.

Open-mud fattening was more profitable and less risky compared to fattening in bamboo cages thus some more research projects can be undertaken in relation to climate change adaptation strategies related to livelihood of the Sundarbans stakeholders. Open mud fattening exercise was beneficial because more molt crabs can be accommodated within open

mud fattening and high market value with the growth rate compared to bamboo cages. Community ownership led the active participation of the beneficiaries to perform their role in project activities and explore the opportunities.

The ban season for crab harvesting in the Sundarbans wild (from January to February) required us to rearrange the schedule of the implementation for crab fattening activities by the beneficiaries and procuring Boat License Certificate from Forest Department. The TV channel [www.banglanews24.com](http://www.banglanews24.com)) in Bangladesh has shown interest to make news of the APFED Showcase project based on the climate change adaptation practice in the Sundarbans coastal belt of Bangladesh the Bangla language online news in the national level has shown the interest to make a report on the project. Understanding and full cooperation between NetRes (TEI) and IO (CCEC, Bangladesh) and the excellent communication between the APFED Showcase Facility and NetRes (TEI) were key to the success of this project.

## **5. RECOMMENDATION**

### **5.1. By implementing organization (CCEC) to NetRes (TEI)**

- There is a need to promote further develop the implemented project involving the existing beneficiaries
- There is also a need to replicate the project in other areas of Khulna region
- Recommend government of Bangladesh to find ways and means to support the crab harvesters during crab breeding and ban time (January-February) following the Hilsha fish in Bangladesh in which Government support the Hilsha fishermen by providing 30 kg rice/month to each of 10000 fishermen during the ban period. On the other hand, TEI may also recommend for creating more Community Conserved Areas (CCA) in Bangladesh by purchasing lands for example NC-IUCN has initiated Purchase Nature by buying or leasing lands in the buffer zone of Protected Areas/Reserved Forest.

### **5.2. By NetRes/(TEI) to implementing organization (CCEC)**

- CCEC has successfully implemented the project, which signifies the possibility of local communities in vulnerable areas (concerning climate change impacts) to adapt themselves with changing climate. The project implementation is also proved to be one of the suitable climate change adaptation strategies, which can be implemented in some areas of Bangladesh.

Due to a short period of the project, CCEC should continue to monitor the outcomes of implementation activities at the implementation site from time to time. The monitoring activities should particularly pay attention to the socio-economic changes of stakeholders (involving in both crab fattening and mangrove restoration) and the ecological improvements of the mangrove rehabilitation and could be a research project all by itself in the near future – having this knowledge will greatly increase the value of scaling-up and replication of activities in other areas.

- Continuous monitoring will provide valuable and tangible data for further improving the project and for implementing the same type of project in other areas. Another excellent idea in partnering with the private sector could move the practice from subsistence economy into growth especially companies in facilitating and developing a market for crabs and other products produced by stakeholders. This cooperation would further make stakeholders become more self-reliant.
- With the current implementation results and the new outcomes of the implementation (as suggested in a previous point), CCEC should draw strong lessons learned and practical notes that can be used by other organizations to implement the same kind of project in other areas.
- CCEC may cooperate with other NGOs for promoting the implementation in other areas of Bangladesh and be in contact with local and national governments for further promotion of the project activities.