

## ASSESSING EROSION AND ACCRETION IN MEGHNA ESTUARY

## Deciding climate change adaptation and mitigation measures

The real situation in terms of extent of inundation and flooding due to climate change would be far more complex and different than shown by different studies. Research should be taken up immediately to assess the morphological responses to climate change in the Meghna estuary as well as other estuaries.

DR. MAMINUL HAQUE SARKER

A very severe earthquake of the magnitude of 8.6 on the Richter scale occurred in August 1950 with its epicenter close to the border of Assam in India and Tibet in China. This earthquake caused huge landslides in the Himalayas, estimated at about 45 billion cubic meter. Within a few years, most of the debris generated from the landslides entered into the Brahmaputra river through numerous tributaries in Assam. The fine fraction of sediment mainly consisting of silt and clay very quickly transported through the Brahmaputra/Jamuna river and deposited in the Meghna estuary area. It moved through the river slowly like a sand wave and caused significant changes in river morphology. Some recent research (by this writer) describes the responses of the rivers through widening and increasing of erosive capacity during the propagation of the sand wave. That was the main reason why the erosion along the Jamuna and Padma rivers was higher in the 1980s and 1990s than in the previous and later periods.

As the silt and clay fraction of sediment entered within a few years after the 1950 earthquake, it caused very rapid accretion of land in the Meghna estuary area. On the other hand, the leading edge of sand wave entered in the mid 1970s and contributed incremental accretion in the following decades. It took more than 50 years for all the extra sand fraction of sediment generated by the earthquake to enter into the Bay of Bengal from Assam.

## Erosion and accretion in the Meghna estuary area

A topographic map was created from a survey conducted 70 to 90 years ago, but the landform was revised in the aerial

Period	Erosion (Km <sup>2</sup> )	Accretion (Km <sup>2</sup> )	Net accretion (Km <sup>2</sup> )
1943 to 1973	890	2100	1210
1943 to 2008	1180	2970	1790

photographs of 1943 and 1944. This map provides the shorelines, locations and sizes of off-shore islands. Time-series satellite images covering the Meghna estuary area are available in CEGIS (Center for Environmental and Geographic Information Services) archives from which images of 1973 and 2008 were used to estimate the erosion and accretion. Maps and satellite images were georeferenced with a common projection system. To avoid errors due to tidal variations during the imaging period, a set of criteria was developed to define the shoreline of the estuary.

The long-term net accretion in the estuary has been estimated by different scientists by comparing different historical maps like James Rennel's map (1776) or Commander Lloyd's chart (1840) with the modern surveyed maps. The results of the estimates for the long-term net accretion in the Meghna estuary area are found to vary from 4 to 10 km<sup>2</sup> per year.

Comparing the map of 1943 with satellite images shows that from 1943 to 1973 net accretion was more than 1200 km<sup>2</sup>. It is assumed that most of the accretion occurred between 1950 and 1973, the net annual rate of accretion becomes more than 50 km<sup>2</sup>/year, which is 5 times higher than the long-term average rate. Later, the rate of net accretion slowed down and from 1973 to 2008 it became about 17 km<sup>2</sup> per year. The overall land gain after the earthquake of 1943 is about 1800 km<sup>2</sup>.

In 1957 and 1963 two cross-dams were built in Noakhali, which contributed to the rapid land formation and joining of the islands with the mainland. Nevertheless, the source of the huge sediment that increased net accretion more than 5 times than in other periods the massive landslides caused by the Assam earthquake in 1950. The rapid accretion in the following two decades was mainly due to the rapid transporta-

tion of silt and clay to the Meghna estuary.

## Noakhali district gains the most

As the bay penetrates several kilometers into the mainland of Noakhali in the northeast corner of the estuary, it is likely that the delta building process would be concentrated in Noakhali district. During the 1930s, most of Noakhali district town had been washed away by the Meghna river. After the earthquake the main branch of the Meghna river flowing through Noakhali rapidly silted up -- Char Alexander and Char Jabbar became part of the mainland causing it to advance about 40 km towards the south. Construction of cross-dams expedited this process. Accretion in Noakhali district was about 1000 km<sup>2</sup> which was nearly 5 times of erosion. Thus, over the last 60 years net gain of land has been about 800 km<sup>2</sup>.

Next to Noakhali district, accretion has been more than 4 times of erosion in Patuakhali district -- and thus net gain of land has been about 325 km<sup>2</sup> over the 60 years.

## Sandwip, Hatiya and Bhola islands lose the most

Although net gain of land after the earthquake was very high, southward movement of the mainland caused huge erosion of the three large islands Sandwip, Hatiya and Bhola. For Sandwip net loss of land has been 160 km<sup>2</sup>, for Hatiya it has been 35 km<sup>2</sup> and for Bhola island it has been 230 km<sup>2</sup>. However, Bhola district as a whole has gained about 180 km<sup>2</sup> land.

## Adverse effects

Rapid advance of the mainland of Noakhali caused drainage congestion in the south of Comilla and north of Noakhali. Huge erosion of old and fertile land in Sandwip, Hatiya and Bhola can also be partly attributed to the rapid advancement of the mainland.

## What next

The long-term sediment yield in the three great rivers -- the Jamuna, the Ganges and the Meghna -- is about one billion tons per year. All extra sediment generated by the Assam earthquake has already reached the Bay. It is likely that the rapid accretion rate will slow down and come closer to the long-term net accretion rate i.e. less than 10 km<sup>2</sup> per year. While construction of many flood embankments and polders during the last 40 years has restricted floodplain sedimentation, sea level rise would certainly reduce the rate of net accretion.

## Effects of climate change and sea level rise

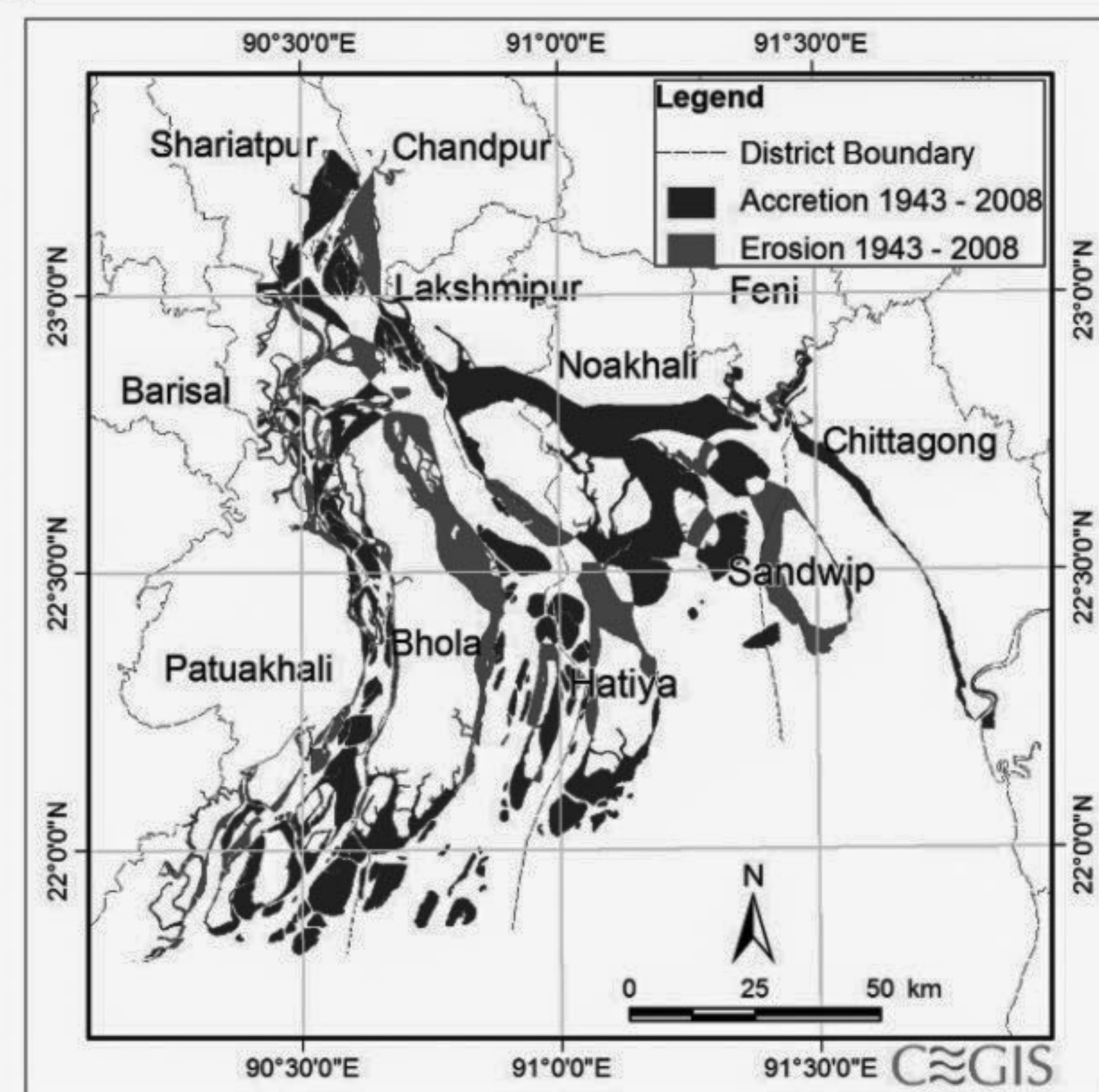
Global climate is changing over time, but due to human activities the expeditious rate of climate change and subsequent rise of sea level have become evident now. There are, however, uncertainties about the rapidity of climate change and magnitude of sea level rise in the next 100 years. Whatever might be the rate of sea level rise, there is no doubt that Bangladesh would be the worst victim of climate change. Due to low land elevation, one meter rise in sea level within the next 100 years may cause inundation or enhance drainage congestion in significant parts of Bangladesh.

While assessing the extent of inundation or flooding due to different probable magnitudes of sea level rise and rainfall intensity, it is common practice in Bangladesh to consider that the bed level of the estuary, riverbed and river bank levels, floodplain and tidal plain levels would be constant in the future. Recent research of CEGIS indicates that as the rivers of Bangladesh carry huge amounts of sediment, the levels of riverbeds and banks as well as the bed and unpoldered tidal plains of the Meghna estuary will be raised as well considerably.

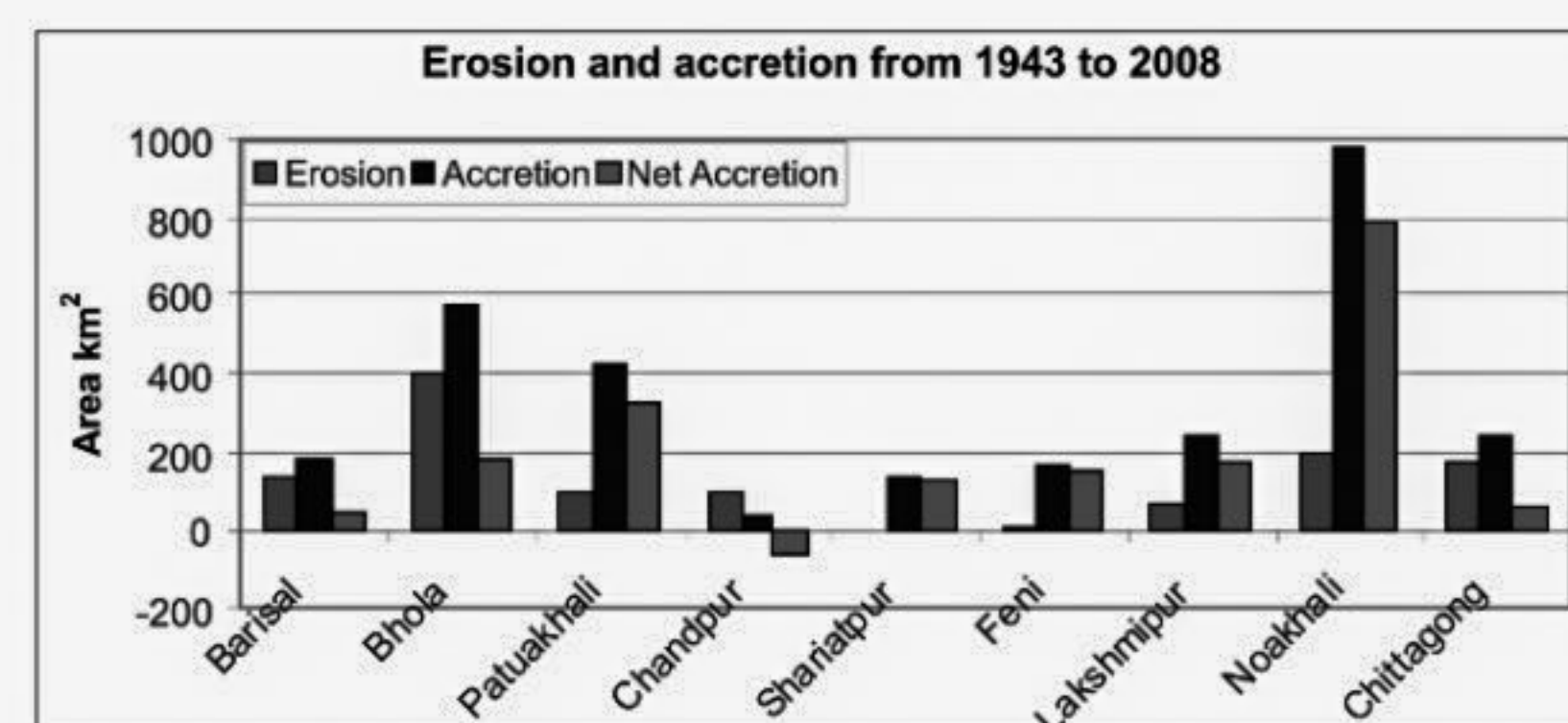
Proper sediment management based on better understanding on the sediment distribution processes in the floodplain, tidal plain and Meghna estuary may partly compensate for the inundation of the coastal area, but the difference between these two processes, however, depends on the rate of sea level rise in the coming decades. On the other hand, any adaptation measures without considering appropriate sediment management may further aggravate the situation by causing more drainage congestion and erosion in the coastal areas.

## Priorities for adaptation and mitigation

The real situation in terms of extent of inundation and flooding due to climate change would be far more complex and different than shown by different studies. Research should be taken up immediately to assess the morphological responses to climate change in the Meghna estuary as well as other estuaries, rivers, floodplains and tidal plains. Such research would help to generate more reliable extent of inundation and flooding pattern based on which adaptation and mitigation measures could be



Erosion and accretion from 1943 to 2008



Erosion and accretion from 1943 to 2008

planned. More research should be directed to (i) finding out the most efficient way of injecting sediment into the existing polders to cope partly with sea level rise where sediment is abundant in the surrounding rivers and (ii) diverting sediment laden flow to the most vulnerable and deeply flooded back swamp areas in southwest and south-central

Bangladesh.

Acknowledgement: Mr. Giuddin Ahmed Choudhury, Executive Director, CEGIS, Mr. Sonkor Chandra Sinha, CEGIS and Ms. Fahmida Nur, CEGIS.

Dr. Maminul Haque Sarker is currently working for the Center for Environmental and Geographic Information Services (CEGIS).

## Addressing gender concerns in adaptation discourse

It is widely acknowledged that any cut in public expenditure has a direct impact on poor and marginal groups, among which women are the most disadvantaged. In addition to financing, policy support towards creation of access for women to knowledge, skills and resources would be necessary to optimise benefits for them.

SHARMIND NEELORMI

It is widely acknowledged that the negative effects of climate change are likely to hit the poorest in the poorest countries hardest. In climate change discourse, attempts to link gender and climate change may seem rather far-fetched. There have been few publications to establish this linkage. Most of the approaches toward tackling the threats focused on scientific and technological aspects of the problem, ignoring the social issue.

Even Intergovernmental Panel on Climate Change (IPCC) focuses on "systems" rather than people, writes about power plants rather than consumption, ignoring the gender insights. After years of relentless efforts by women professionals and activists, it is now accepted that women are among the most vulnerable groups to the impacts of climate change. However, if the underlying reasons of women's (and men's) specific vulnerabilities are not analysed and addressed

properly, the effect will remain merely rhetorical.

The Government of Bangladesh has allocated 100 million USD as climate fund for 2009-2010. The initiative is a pioneering one to face the change through enhancing people's adaptive capacity. The Ministry of Environment and Forest is already in the process of scrutinizing the proposals for on ground adaptation. Government agencies as well as NGOs and CBOs have been invited to participate in this process.

The government must ensure mainstreaming of gender perspectives into national policies, action plans and other response measures on sustainable development and climate change by carrying out systematic gender analysis, collecting and utilizing sex-disaggregated data, establishing gender-sensitive indicators, criteria and benchmarks, and developing practical tools to support and monitor the programmes in a gender-sensitive way.

For every conceived adaptation mea-

sure, a gender-sensitivity analysis must be made mandatory to ensure that women's differential needs and priorities are adequately addressed along with those of the rest of the community.

To ensure this, the following steps need to be taken:

- Address the lack of gender-disaggregated data in the area of climate change. International human rights standards and principles underline the need to adequately assess and address the gender-differentiated impacts of climate change.
- Gender-specific vulnerability assessments are important in determining adaptation options. Vulnerability should be assessed through the eyes of the vulnerable themselves and here separate consultations with the women in a vulnerable community appear extremely important to decide gender-differential vulnerability and gender-sensitive adaptive responses.
- Building capacity of women to have the skill and confidence to engage with climate change debates at the local, national, regional and international levels (for example through advocacy training) in order to entrench gender in local, national and international policies and measures.
- Identify the contributions of women as agents of change in adaptation to climate change at the local level.
- Assess women's differential vulnerability within a given geo-physical, socio-economic and institutional

context.

- Take steps to reduce the differential vulnerability of women.
- Increase the participation of women representing vulnerable communities or vulnerable women in assessing their vulnerability and in decision making on climate change adaptation at different levels.
- Build the capacity of women to design and implement adaptation programs beyond their household activities.
- Ensure that adaptation policies and measures are directly targeting and benefiting vulnerable women and as such, ensure that no less than 30% of the adaptation fund is earmarked for the programmes directly targeting and benefiting vulnerable women.
- Build the capacity of organisations working on "gender and adaptation issues" at the local level, particularly local government institutions where women's direct participation is ensured.
- Monitor the status of vulnerable women and respond to their changing needs and priorities.

There is an unmet need to CREATE A MECHANISM THROUGH WHICH GENDER AUDIT CAN BE REGULARLY DONE AND MONITORED. For this a high level committee, comprised of gender and climate change experts and policy makers, is suggested.

## Institutional adaptation vs community based adaptation

Large-scale adaptation efforts are often beyond the capacity of local communities and hence supported by state run agencies and institutions. Institutional adaptations are often government supported public initiatives. In contrast, community based adaptation (CBA) to climate change is a community led process. In both cases, effectiveness of adaptation depends on communities' priorities and needs, knowledge, capacities, and state of empowerment of people to plan for and cope with the adverse impacts. CBA can complement institutional adaptation through enhancing household/community level resilience. While the supportive roles of CBA are acknowledged, CBA alone cannot ensure lasting resilience building efforts without appropriate institutional facilitation.

It is widely acknowledged that any cut in public expenditure has a direct impact on poor and marginal among which women are the most disadvantaged group. In addition to financing, policy support towards creation of access for women to knowledge, skills and resources would be necessary to optimise benefits for them.

## Leadership awaits Bangladesh

Over the years, Bangladesh has drawn a considerable attention regarding her rather high vulnerability to climate change and scientific contribution to climate discourse. More recently, however, the country achieved international respect due to her leadership towards addressing climate challenges in an

integrated and planned manner. The country surely led the world in a number of counts: (a) the concept of community based adaptation found its roots in Bangladesh, (b) the first ever National Adaptation Programme of Action (NAPA) was submitted by Bangladesh to UNFCCC, and (c) it has been the first country to produce Climate Change Strategy and Action Plan (BCCSAP). To complement such actions, the government placed resources from its own public exchequer to start financing adaptation -- the first of its kind amongst LDCs.

While the entire developing world has been looking at Bangladesh for proactively dealing with the imminent crisis instead of merely submitting to eventual consequences, she has embarked upon the task to make sure that her difficult financing choices are made to ensure significant reduction in vulnerability of poor and marginalised people. How best can she build resilience? Whether the capacity of her millions of people, including women and the marginalised, would be enhanced to such a degree that the perceived risks to their livelihoods could successfully be removed? Whether adequate financing should be placed to empower women at risk with knowledge, skill and know-how? The world is eagerly watching.

Sharmind Neelormi is Associate Professor, Department of Economics, Jahangirnagar University and with Focal Point, Asia, Gender and Climate Change Network, GenderCC (neelormi1@yahoo.com).

## Disaster risk reduction: Mitigation approach



Building awareness

ZAM KHAIRUZZAMAN

It was a hot summer noon at Dakkhin Haldibunia under Chila union of Mongla upazila of Bagerhat district. Braving the scorching heat, a large number of villagers, both men and women, thronged Dakkhin Haldibunia Registered Primary School ground. A group of schoolgirls enthralled the large gathering by performing a 'Zarigan'. The 'Zarigan' audience was cautioned that 'time is short (as climate is changing) and all must act before time runs out'.

The colourful event was organised as part of the climate campaign being conducted under a project titled, 'Improved Food and Livelihood Security in the Context of Increased Disaster Risk and Climate Change Project' in Mongla upazila of Bagerhat district recently. Dhaka Ahsania Mission, Prodiplan, Caritas Bangladesh and ADD Bangladesh have been jointly implementing the project being funded by donor agency CAFOD, UK.

"The choir girls are providing vital knowledge and understanding of basic concepts and terms, such as weather, climate, climate change, disaster risk,

etc.", remarked Project Coordinator Md Mukhlesur Rahman of Dhaka Ahsania Mission, organiser of the show. "We want to get the idea across that time is running out and all must rise to the challenge." He emphasised that to achieve any result, citizens must take part and the event aims to raise awareness among general people.

The 'Zarigan' was followed by an integrated disaster risk reduction simulation exercise.

The exercise was part of making people understand their already developed response plan so that when a disaster hits, they would know what to do. The drill helps the communities identify hazards in their surrounding, identify their needs and develop disaster response plans.

During a courtyard meeting at another village named Kanainagar under Chandpai union in Mongla upazila, Dhaka Ahsania Mission field supervisor Tara Biswas discussed and listened to women's views on climate change, food security and the roles and resources that men and women can play and have access to. Local farmers have already observed changes in the seasonal patterns of rainfall, decreases in the amount of rainfall and diminishing water resources and rise in salinity. In addition, they are concerned about dwindling forest cover which had in past served as a source of supplementary food. Strategies to cope with these changes include livelihood diversification.

Meanwhile, the authorities of Chhabed

Khan Secondary School at Dakkhin Chila in Mongla conducted an essay competition with a theme: 'Climate Change, Disaster Preparedness and Mitigation'. The participants of this activity were students of the high school. The activity was aimed to engage school students in disaster risk reduction (DRR) issues and enhance the awareness level of students about the importance of community initiatives in DRR, especially school-based communities.

Disasters can hit at any time and at any place. But they always hit poor people the hardest. For poor people, climate change is not just another cause of economic loss. It threatens the very possibility of escape from poverty.

Global warming is increasing the severity and frequency of cyclones, storms, droughts and floods. If poor communities do not adapt to a changing climate, these events could well keep on increasing their distress.

Rising sea levels mean that low-lying coastal areas of Bangladesh may disappear altogether. These resulting disasters have a devastating impact on poor people's ability to farm and therefore their access to food.

"We need to be aware of what is happening," said Chandpai UP member Debola Sarker, also group leader of ward committee. "I grew up in a place where there were clear water bodies and now they are no longer there," she lamented.

Bagerhat district has a population of

15,97,554 people and is a coastal area. The district has been affected by several disasters like cyclone Sidr, tidal wave, severe floods over the past decades. Frequency of natural disasters has increased owing to climate change.

One lakh 37 thousand beneficiaries have been brought under the project. Mass awareness campaigns on livelihood security and climate change issues are being geared up in the project areas. The activities help them in attainment capacity to combat disaster and its management.

Contacted, Mongla Upazila Nirbahi Officer Md Saidur Rahman said the government is rendering all-out help to Dhaka Ahsania Mission and other NGOs in combating disaster. He said, work on an embankment already started with assistance of WFP for protection of people and property in the area from the onslaught of coastal surge.

The project activities are also raising capacity of the Union Disaster Management Committees besides women headed families of the targeted population, disabled people and those living at risk of HIV/AIDS.

Under the programme, income of the families of targeted population in Mongla upazila is being increased by conducting environment-friendly farming -- pisciculture, livestock raising and through adoption of alternative means of livelihood.

Food production has also increased

considerably in the upazila as small and marginal farmers are using sustainable farming technology.

Till now, 14 opinion exchange meetings have been organised among representatives of the Union Disaster Management Committees. Two training programmes on disaster management have been conducted for representatives of Union Parishad (UP). Fourteen monthly meetings have been organised to strengthen union level committees. Two triennial meetings have been arranged among Community Advocacy Group members and Union Disaster Management Committee for establishing strong linkage and activities. Two workshops have been organised for union level disaster reduction planning. Community Action Group and Union Disaster Management Committee have been formed for identifying community volunteers aiming at disaster preparedness and raising mass awareness through posters and leaflets. For implementation of the project, Radio spot management, orientations for sending warning messages, pre-disaster, during disaster and post-disaster action trainings are being conducted for different community groups. Besides, radio and megaphone have been distributed among various Action Groups.

ZAM Khairuzzaman is a working journalist.