

CYCLONE DISASTER MITIGATION IN BANGLADESH

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I. Introduction

Bangladesh extends between 21° and 27° North latitude and 88° and 92.5° East longitude. The Bay of Bengal is in the south side of the country. The total area is 148,000 sq km and size of population is around 130 million (2001). Per capita income is around US\$ 482, one of the lowest in the world.

Most people live in rural areas and the literacy rate is low. The country has a unitary form of government with parliamentary democracy. Radio and television cover most areas of Bangladesh providing opportunity for easy communication flow. The country faces grave poverty conditions, which are accentuated by natural calamities like cyclone, flood, storm surge etc.

The country has been subjected to frequent natural disasters in many forms, particularly cyclonic storms and storm surges. From 1797 to 1998, 67 major cyclone storms and storm surges have been reported. These indicate that Bangladesh is prone to frequent destructive tropical cyclones associated with storm surge, particularly in pre-monsoon months of April-May and post-monsoon months of October-November. The low-lying coastal areas are particularly vulnerable, thus placing these population, infrastructure, agriculture, livestock and economic development in a high-risk situation. Cyclone disaster mitigation is a major concern in Bangladesh.

II. Cyclone and Coastal Environment

The coastal land of Bangladesh (710 km long) is of recent origin formed out of the process of sedimentation. Most parts of the area are, therefore, low lying which can be subject to inundation even under ordinary circumstances of tides. A tidal surge accompanied by a cyclone storm makes the situation alarming which is further exacerbated by the triangular shape of the Bay of Bengal. The wide shallow continental shelf is conducive to amplification of surges causing wide spread flooding.

Out of a total of 64, 19 southern districts having proximity to the Bay of Bengal have been grouped into the coastal zone in terms of three geo-physical characteristics: interplay of tidal regime, salinity in soil and water, and cyclone and storm surge. The coastal zone is a combination of land and sea with 250 coastal islands, large single tract of mangrove forest, Sundarban and long sandy beach in Cox's Bazar. The coastal zone has a population of 35.1 million (2001) which is 28% of the total population of the country. The zone contains many distinctive development opportunities which are constrained by very high concentration of natural and human induced hazards.

The human settlements in the coastal areas are mostly developed in an unorganized and isolated manner, primarily due to population pressure. In such a situation, community efforts to cope with disasters become extremely difficult.

There are certain environmental conditions, which lead to development of cyclones making the coastal human settlements vulnerable to destruction.

III. Cyclone Warning System in Bangladesh

Bangladesh Meteorological Department (BMD) is the source of cyclone warning in Bangladesh. BMD generates the warning and passes this on to public media and preparedness units for dissemination and follow-up action at periodic intervals. There are separate warning system for maritime ports and river ports.

There are major weaknesses in the cyclone warning system of the country. The existing cyclone warning system in Bangladesh is not something easy to understand, almost incomprehensible even to most of the educated people. The languages of special weather bulletins which are issued at the advent of cyclone formation and disseminated through radio and television are not simple, as a result the message it carries often fail to reach the general people. In the weather bulletins, simply storm surge height is forecasted without giving information about the stage (e.g. high/spring tide and low/neap tide) during the landfall of cyclones on the coast. The forecasting/warning system does not forecast the intensity of rainfall from the approaching cyclone. Finally, the state of accuracy of the forecasting/warnings of the arrival/landfall of cyclones is not out of question. In the past, many of the warnings of arrival/landfall of destructive cyclones had been inaccurate. Some of these issues are being addressed in recent reviews but actual changes are still awaited.

IV. Standing Orders for Cyclones

The Standing Orders for Cyclone (SOC) proclaimed by the Government of Bangladesh (GOB) as of November, 1985 and updated thereafter constitute the basic plan for coping with cyclone disasters. SOC laid down the guidelines for action at various stages of disaster by all government agencies to cope with situation arising out of cyclone havoc. Within the framework of SOC, concerned authorities are required to deal with unforeseen and complex situations swiftly using initiative and imagination. The local authorities are required to take necessary action to prevent or reduce loss or damage to life and property by making maximum use of local resources instead of waiting for external assistance.

The guidelines for disaster preparedness and management under SOC is organized into 5 stages as follows:

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| (a) Pre-Disaster Stage | (Off-cyclone season) |
| (b) Alert Stage | (Signal No. I, II and III) |
| (c) Warning Stage | (Signal No. IV) |
| (d) Disaster Stage | (Signal No. V, VI, VII and VIII, IX, X) |
| (e) Post-Disaster stage | (Immediately after the cyclone till normalcy is attained) |

V. Institutional Arrangement

Being a disaster prone country, elaborate institutional arrangements are in place to deal with disasters, including cyclones. There are three committees and three institutions at the apex

level namely National Disaster Management Council, headed by Prime Minister, Inter Ministerial Disaster Management Committee headed by Minister, Ministry of Food, Disaster Management and Relief (MFDMR), National Disaster Management Advisory Council, MFDMR, Disaster Management Bureau and Directorate of Relief and Rehabilitation. There are broad based Disaster Management Committees in the field levels at district, upazilla and union headed by deputy commissioner, upazilla nirbahi officer and chairman at respective areas.

However, the most dedicated agency for cyclone disaster information dissemination and mobilization at the coastal level is the Cyclone Preparedness Programme (CPP). The CPP is an organization of large contingent of volunteers at the field who carry out the important function of mobilizing people at the community level to cope with cyclones. In the mode of CPP, Bangladesh has evolved a model organization for cyclone warning dissemination in the coastal belt. The CPP is located in the Bangladesh Red Crescent Society (BDRC) under the MFDMR of the government. The CPP is staffed by a small number of permanent officers at the headquarter in Dhaka and 8 coastal districts and comprises of little over 33000 volunteers, organized in teams of ten, which undertake specified cyclone emergency preparedness and post impact tasks. The volunteers disseminate the warning signals, alert the people, evacuate them to safe places, rescue marooned people after the cyclone, provide the injured with first aid, report on the losses and damages after preliminary assessment within twelve hours of the cyclone, etc. Each CPP team is provided with warning equipments like transistor radio, megaphone, siren, signal light, first aid kit, etc. Teams are also provided with cycles for communication and signal flags for hoisting in poles in cyclone shelters and other points to communicate warning signals to people in the coastal area.

After the formation of a cyclonic storm in the Bay of Bengal, the Storm Warning Centre of BMD issues special weather bulletins from time to time till the landfall. The volunteers are provided with Depression Tracking Map and they receive instruction from the CPP Control Room in Dhaka over wireless to plot the track in the map as bulletins are received from BMD.

The tasks of the volunteers include the arduous responsibility for wide dissemination of warnings by bicycle and foot and using megaphones and sirens, public address equipment, signal lights, signal flags, search and rescue, first aid treatment, evacuation and shelter, and welfare.

Many developing societies have significant number of illiterate population and they can be best reached through symbols. In Bangladesh, this is achieved through hoisting of coloured flags. The warning flags are hoisted in port, cyclone shelters, public buildings, community centers, local government organizations with coastal area following warning by BMD to communicate impending cyclone. The CPP volunteers ensure hoisting of flags. One flag is hoisted for caution, two flags for danger and 3 flags for great danger. Such displays can serve as medium of warning dissemination and at the same time prepare the community for appropriate response which will in turn increase the effectiveness of warning.

VI. Lessons of April 1991 Cyclone

The cyclone which struck Bangladesh on the night of 29-30, April, 1991 was particularly severe causing widespread damage, killing 138,882 people. There has been massive damage to life line systems as well as private properties. Total loss has been estimated at US\$2.07 billion dollars for all sectors.

The management of April cyclone provided valuable experiences to prepare for future to minimize losses of life and property and restoring normalcy at a faster pace. The experiences include efficiency in tracking, forecasting & issue of warnings, complexities of warning system, understanding of warnings, inadequacy of shelters, non-structural mitigational measures like afforestation, public awareness and community preparedness.

VII. Mitigation Measures

The vulnerability of coastal population to cyclones and accompanying surges calls for various mitigational measures, some of which are already in place. Structural mitigational measures like cyclone shelters, killas, coastal embankment, improving housing conditions and the like as well as non-structural mitigation measures like coastal afforestation, public awareness, community preparedness, local level contingency planning, social mobilization etc have been initiated to mitigate cyclone disaster in the coastal zone of Bangladesh. After the devastating cyclone of 1970, GOB and other agencies undertook construction of multi-purpose cyclone shelters. Since then, the number of shelters have increased from 300 to 1275 through new constructions. Besides, with external assistance additional 2500 shelters have been constructed.

For protection of the low lying agricultural land in the coastal belt from inundation and infusion of saline water during high tide coastal, embankments of low height has been provided by the government in almost all the coast belt. These embankments have so far been protecting the agricultural land from high tide and also resisting the small surges. But during the 1991 cyclone these embankments could not resist the high and severe surge. Although it has been able to dissipate the impact of the forceful surge at the initial stage but as the tidal surge toppled the embankments, the embankment got damaged and washed away in many places. Further the water which entered the main land while receding damaged the embankment. The sluice gates were not sufficient to cope with the rush of receding water.

It has been observed that places where the embankments did not have sufficient afforestation got easily damaged. As such adequate attention are being paid by government to this aspect under the Integrated Coastal Zone Management Plan. As to coastal afforestation at present in quite a significant areas afforestation have been developed along the embankments for protection of the embankments against cyclonic surge and monsoon waves. This has worked very well. It not only saved the embankments but also reduced the impact of the surge to a great extent.

These afforestation work in the coastal area was started in the year 1966 with the planting of seedlings on the slopes of embankments. Species used in coastal afforestation are:

- *A CA CIA ARABILA*
- *CA TECH U*
- *SONNERATIA APA TALA*
- *AU1CENNIA OFFICIALS*
- *BRUGUIERA GYMNORHIZA*
- *NYP FRUTICANS*

It was observed that in some lengths of the embankment afforestation work has been done inappropriately on the top instead of on the slope. As a result these areas got damaged during

severe surge. The protection from cyclone damage afforded by the Sundarbans natural mangrove forests prompted the Forest Department to commence this program of afforestation in different districts namely Chittagong, Noakhali, Bhola, Barisal and Patuakhali. The program continued under various schemes due to its beneficial affects.

VIII. Activities in Progress

Following the devastating cyclone of 1991, disaster management activities have been upgraded through a 3 year UNDP technical assistance project of 5 million US dollars involving various programmatic steps. The result of which was observable in the public response to 1994 cyclone.

Another comprehensive Disaster Management Programme, with technical assistance of UNDP is presently in operation for integration of disaster and development concept as well as for improvement in coordination in response to disasters at all levels. The different components of the programme include logistics and operational support, community participation perspective, social & gender issues, public health, physical facilities and urban disaster with very limited emphasis on coastal afforestation as a strategy towards mitigation of cyclone and related storm surge impacts.

Mention has already been made about the initiation of coastal afforestation activities in the coastal zone as of 1966. The shocking loss of lives in the cyclones of 1970 and 1991 provided impetus towards more attention to afforestation in the coastal region for combating disasters like cyclone and related storm surge.

The Ministry of Water Resources (MWR) created a specialized organization namely Water Resources Planning Organization (WARPO) as the focal point for water resources policy planning as well as targeted development of coastal zone of Bangladesh. WARPO has initiated an Integrated Coastal Zone Management (ICZM) Plan (2001-2005), the second phase of which is now under implementation. Under the first phase, the Water Development Board of the MWR undertook a project entitled Coastal Embankment Rehabilitation Project for increasing the height of existing embankments on its own and afforestation under the Department of Forest, Ministry of Environment and Forest (MoEF) of the government.

One of the significant achievements of WARPO under MWR is the formulation and adoption of Coastal Zone Policy (CZP) by the GOB containing declaration on coastal zone, coastal zone management including ICZM, policy framework as well as enabling institutional environment. In terms of reduction of vulnerabilities, the policy, among others state that sea dykes will be regularly maintained as first line of defense against storm surges and afforestation on it as an on-going activity and programs shall be initiated to encourage everyone in the community for tree plantation in a planned manner in the coastal zone with emphasis on social forestry, other forms of plantation, plant care and maintenance. As to afforestation, the CZP emphasized three aspects viz afforestation in the coastal areas including newly created chars, conservation of forests and extension of social forestry.

The ICZM has initiated a second phase program starting 2006 with 24 Priority Investment Programs involving 22 line agencies of the GOB and these have been disseminated for implementation. To coordinate these multi-level and multi-sectoral activities, the MWR has been designated as the lead Ministry and WARPO as the lead agency with institutional arrangements for overall coordination. At the apex, there is the National Council to provide policy direction for

ICZM, particularly in implementation of Coastal Development Strategy. The policy implementation will be facilitated by Inter-Ministerial Steering Committee (SC), Inter-Ministerial Technical Committee (TC), Program Coordination Unit (PCU) and Focal Points in all the 22 agencies.

One of the Priority Investment Program concerns the MoEF relating to Development and Settlement of Accreted Land with assistance from other agencies like Bangladesh Water Development Board (BWDB), Department of Forest (DoF), Department of Public Health Engineering (DPHE) and Local Government and Engineering Division (LGED).

Development and Settlement of Accreted Land is continuation of the earlier initiative of the Forest Department (FD). The rationale of this priority program is that mangrove plantation in the newly accreted Char lands stabilizes the land in the quickest possible time and help to enlarge the accreted areas. The proposed project with a budget line of 35.61 million US dollars aims at, among other things, identification of newly accreted land along the waterline suitable for plantation and create / enhance plantation coverage. The components in terms of mitigational measures will involve the following:

1. Newly accreted land in the form of mud shall be utilized for planting mangrove plants,
2. The existing mangrove forests shall be managed through participatory way,
3. The degraded/depleted forests land shall be planted and plantation will act as green wall/wind break for cyclones and water flow reduction in storm surges.

It is significant to note that out of 24 Priority Investment Programs, only one is focussed on afforestation, although this received a considerable emphasis in the CZP. This is a reflection of very limited emphasis being placed on forests and trees as environment friendly and sustainable mitigational activities for protection against cyclone and storm surge in the coastal zone.

The review of activities in progress also indicate serious lack of coordination and integration between disaster management activities of MFDMR and MWR with respect to mitigational measures for cyclones and storm surges. This aspect should be reevaluated in terms of cost-effectiveness and achieving synergy in disaster mitigation in the coastal belt.

IX. Recommendations

1. Efforts should be continued to increase accuracy of forecast as well as landfall for enhancing credibility of warnings to ensure preparedness and response.
2. Considerable sophistication has been gained in storm surge forecasting. This gain should be reflected in providing more specific information regarding surge height and location warnings to permit effective evacuation.
3. Focused awareness activities are required to increase public awareness of storm surge, flooding and rainfall related to cyclone
4. Increased investment should be made in warning presentation, dissemination and public understanding to reap the full benefit of considerable public investment in forecasting.
5. The content of the warning message should be straightforward and simple for common people to understand as well as elicit timely response from disaster preparedness organizations and personnel in cooperation of the likely affected community.

6. The warning message content should contain optimum information on storm surge, flood and rain with area specification to orient the public to the need for evacuation from critical area to minimize loss of lives.
7. The warning message should contain information on what is to be done to minimize loss of lives and properties by the individuals and community. Such information will provide outlet for positive action on the face of cyclone threat.
8. The warning contents should be customized to meet the needs of different type of users while maintaining the common theme of cyclone threat.
9. In societies with dense population, the pressure on land plus attraction of coastal land fertility attracts people to settle in fringe land or islands in the coast. Regulatory framework on land use in the coastal areas should be developed and enforced to reduce vulnerability.
10. Legal framework should be developed for disaster management activities to give legal cover to evacuation from critical areas and provide protection to abandoned properties.
11. The wording of the warning should be simple, reflect language differences within a country, use local dialects and culturally recognizable characters.
12. The warning messages should be disseminated through multiple medias for the community as well as specific users by combining modern and traditional modes.
13. The BMD should develop user friendly websites, post weather related information in these sites and warning messages to take full advantage of information super highway to reach tropical cyclone warnings to disaster preparedness personnel and community leaders.
14. Attempt should be made to develop volunteers at the community level under appropriate organizational arrangement as vehicle for tropical cyclone warning message dissemination on a door to door basis in a cost-effective manner. Such organization could also work on preparedness and response with community involvement. The Cyclone Preparedness Program (CPP) in Bangladesh can serve as an useful model of grassroots level organization for cyclone mitigation.
15. Warning signals in the form of flags or similar symbols culturally acceptable to the community should be adopted for easy dissemination of warning signals in societies with low literacy level and with limited communication infra-structure.
16. Resources should specifically mandated to increase public awareness of impact of cyclone and warning messages to trigger specified actions and undertake long term mitigational measures including the role of forests and trees. Such deployment of resource should be treated as investment and should be made part of development planning of every tropical cyclone prone country.
17. Knowledge, Attitude and Practice (KAP) survey on cyclone warning should be initiated on systematic basis in every tropical cyclone prone country on periodic basis and after every major cyclone to establish benchmarks and monitor progress in public understanding and internalization of cyclone warnings in the life style of individuals and communities inhabiting the coastal belts. Such survey findings would be very useful pointer to policy makers for investment decisions and meteorological departments to assess preparedness of the communities at risk of losing invaluable lives
18. KAP survey should be conducted on non-structural mitigation measures particularly on the role of forests and trees to assess awareness level, carry out motivational work and integration of forest and tree friendly behavior in the life style of people living in coastal zones. This is critical for disaster mitigation as well as long term welfare of people.
19. KAP survey on cyclone warning should be also conducted on other stakeholders viz political decision makers, disaster preparedness personnel, non-government organizations and others involved in disaster preparedness activities including the

aspects of afforestation to identify the need for training and orientation type of activities to ensure service provider preparedness.

20. Social impact study of cyclone mitigation particularly related to afforestation should be conducted on periodic basis with joint team of plantation experts, disaster managers and social scientists in every cyclone prone society, A compilation of the result of such studies should be published by FAO to promote the '*culture of promotion*'.
21. Special policies, mediums and mechanisms should be evolved to remove gender and age bias in existing disaster preparedness activities to meet the under-served but most vulnerable sections of the people who have been the primary victims of cyclone related disasters.
22. Public awareness activities should be carried out on a sustained basis throughout the year, may be with more intensity in cyclone seasons, particularly with regard to role of forests and trees in cyclone impact mitigation.
23. Meteorological departments should give attention to special needs of specific occupational categories like fishermen for cyclone warning due to more vulnerability.
24. Disaster management including long term non-structural mitigational measures should be made integral part of development planning in cyclone prone countries, particularly developing ones, to evolve the concept of investment in disaster prevention and permit mainstreaming of disaster mitigation angle in every organ of the government as well as budgetary process.

X. Conclusion

The observations made above points to considerable progress that has been made in cyclone disaster mitigation in Bangladesh as well as further efforts required in reducing loss of life and properties through cyclones and related storm surges. Further activities are required for integration of disaster mitigation related activities of different departments as well as strengthening of institutional mechanisms through decentralization and local level disaster planning. The planning process at the central level need to recognize the interface between disaster and development. There is also a need to mount a high level awareness and advocacy programme to create a better level of perception of disaster management including the aspects of long term mitigation.

Effective disaster mitigation measures are vital to lifeline of coastal communities of all cyclone prone countries. Developing countries with limited infra-structure and resources to cope with impact of cyclones should receive particular attention of the international community in capacity building. Research and development activities centering around cyclone mitigation including long term measures like afforestation should receive priority attention of academic community in developing societies.

All these and related activities call for a higher level of investment in preparedness, shelter construction, afforestation, institutional arrangement, policy formulation and community involvement for improved cyclone disaster mitigation for protecting coastal belt inhabitants from the severe affect of cyclonic disasters and involving them in such process in Bangladesh and that of the region.