Seminar Report

IMPROVEMENT OF EARLY WARNING SYSTEM AND RESPONSES IN BANGLADESH TOWARDS TOTAL DISASTER RISK MANAGEMENT APPROACH DECEMBER 19-24, 2002, DHAKA, BANGLADESH.





Jointly Organized by

BPATC & DMB, Bangladesh in Collaboration with ADRC & UN OCHA, Japan

Bangladesh Public Administration Training Centre

ASIAN DISASTER REDUCTION CENTER

দুর্যোগ ব্যবস্থাপনা ব্যুরো D.M.B.

Seminar Report

Improvement of Early Warning System and Responses in Bangladesh towards Total Disaster Risk Management Approach

December 19-24, 2002, Dhaka
Bangladesh.

29 MAY 2003

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Table of Contents

Foreword vii

Acknowledgement ix

Editor's Note xi

Recommendations 1

Inaugural Session 9

Seminar Paper & Case Studies: 21

Geophysical Structure of Bangladesh with Special Reference to Earthquake 23
Dr. Shamsul Alam, Professor, Jahanirnagar University

Earthquake Prediction, Forecasting, Preparedness and Peoples Awareness: 35
Bangladesh Perspective-Dr. Md. Hossain Ali, Professor, BUET, Dhaka

Seismic Observation, Earthquake Information, Tsunami Warning and Earthquake 49
Prediction in Japan-Yuji Nishimac, Japan Meteorological Agency (JMA)

Earthquake Risk and Vulnerability Analysis: Japanese Practices and Lessons 61
Toshiaki Udono & Hidetoshi Kakiuchi, PASCO Corporation, Japan

How to Make Warnings Lead to Actions 71
Hiroaki Nakaya, Section Chief, Japan Meteorological Agency (JMA)

Hazard Mapping and Vulnerability Assessment 81
Toshiaki Udono & Hidetoshi Kakiuchi, PASCO Corporation, Japan

Introduction to Total Disaster, Risk Management Approach 93
Takako Izumi, Associate Humanitarian Affairs Officer UN OCHA

Cyclone Preparedness and Management in Bangladesh 97
M.M.H Khan Chowdhury, Consultant, Disaster Management Bureau

Japan's Countermeasure for the Earthquake: Lesson Learned from the 107
Great Hanshin Awaji Earthquake-Fumiaki Yoshimura, Senior Researcher, ADRC

Earthquake Education and Training in School, Training Centre and Community Level. 115
Shinji Itho, Supervisor, Educational Planning Office,
Hyogo Prefectural Board of Education

Case Presentation on Living with Disasters: A Study on 1991 Cyclone in 121
BangladeshMohammad Monjurul Hoque, Deputy Director, BPATC

Cyclone Prediction, Forecasting, Warning Systems and Dissemination Methods: Bangladesh Perspective-Md. Akram Hossain, Director, Bangladesh Meteorological Department 141

Flood Forecasting, Warning System and Flood Preparedness and Management in Bangladesh
Dr. Ainun Nishat, Country Representative, IUCN 149

Community Based Approach for Disaster Preparedness and Mitigation: Bangladesh Perspective-AKM Nashirul Huq, Member Director Staff, BPATC 155

Closing Session

Concluding Session : 171

Recap of the Working Sessions 179

Day-1 (19 December 2002) 181

Topic-1 : Geophysical Structure of Bangladesh with Special Reference to Earthquake

Topic-2 : Earthquake Prediction, Forecasting, Preparedness and Peoples Awareness: Bangladesh Perspective

Topic-3 : Seismic Observation, Earthquake Information, Tsunami Warning and Earthquake Prediction in Japan

Topic-4 : Earthquake Risk and Vulnerability Analysis: Japanese Practices and Lessons

Day-2 (20 December 2002) 185

Topic-5 : How to Make Warnings Lead to Actions

Topic-6 : Hazard Mapping and Vulnerability Assessment

Topic-7 : Introduction to Total Disaster, Risk Management Approach

Topic-8 : Cyclone Preparedness and Management in Bangladesh

Day-3 (21 December 2002) 189

Topic-9 : Japan's Countermeasure for the Earthquake: Lesson Learned from the Great Hanshin Awaji Earthquake

Topic-10 : Earthquake Education and Training in School, Training Centre and Community Level.

Plenary Session for Developing Earthquake Warning and Management System in Banglades

Day-4 (22 December 2002) 195

Topic-11 : Case Presentation on Living with Disasters: A Study on 1991 Cyclone in Bangladesh

Topic-12 : Cyclone Prediction, Forecasting, Warning Systems and Dissemination Methods: Bangladesh Perspective

Day - 5 (23 December 2002) 199

Topic -13 : Flood Forecasting, Warning System and Flood Preparedness and Management in Bangladesh

Topic-14 : Community Based Approach for Disaster Preparedness and Mitigation: Bangladesh Perspective

Day -6 (24 December 2002) 203

Concluding Function

Annexes

Seminar Schedule 205

List of Participants 110

Foreword

An effective warning system is a pre-requisite for minimizing the losses of lives and properties and also mitigates the sufferings of the millions from devastating effects of any disaster of a country. Warning systems play a vital role in organizing meaningful disaster preparedness involving various services and technical skills. At the same time, these warning systems need to be well coordinated amongst inter-departments and must be blended together so that the whole preparedness program can work smoothly. Bangladesh, like other South Asian countries, has a network of disaster preparedness that is designed to minimize the loss of life and damage. It is also meant for facilitating timely and effective rescue, relief and rehabilitation during tornado, cyclone and tidal surges.

Bangladesh is a disaster prone deltaic country having vast alluvial plain all around and in the southern part, it has a 710 km long coastal belt to the Bay of Bengal. Almost whole country is exposed to potential danger of various disasters like flood and earthquake, while coastal belt is found to be breeding ground of cyclonic storm and surges.

In response to this reality, the Government of Bangladesh has created Meteorological Department (BMD) for issuing reliable and timely disaster warning systems for general public, aviation and shipping, through Storm Warning Centre (SWC), which is connected by Microwave Link with the radars at Cox s Bazar and Khepupara under grant assistance by the Government of Japan.

Over the years, the warning system, as provided by these organizations, has proved to be useful in minimizing human death toll significantly and mitigating sufferings of common people from disasters like cyclone and flood. However, there is no warning system for the deadly disaster called earthquake. Considering the frequency of mild or moderate earthquakes, cyclonic storm surges and flood in Bangladesh, policy makers and professionals were prompt to develop and improve the country s early warning system. Moreover, in the context of international experience and in terms of resource and technological limitations, there is a room for further improvement and development of early warning system in Bangladesh.

Keeping these views in mind, Bangladesh Public Administration Training Centre (BPATC) and Disaster Management Bureau (DMB) in collaboration with Asian Disaster Reduction Centre (ADRC) and UN Office for the Coordination of Humanitarian Affairs (UN OCHA), Japan organized a training seminar on Improvement of Early Warning System and Responses in

Bangladesh towards Total Disaster Risk Management Approach on 19 24 December 2002 at BPATC, Dhaka, Bangladesh. The project was supported by the cabinet office, Japan and USAID/OFDA. The objective of this seminar was to improve the capacity in disasters preparedness and disaster responses in term of early warning system of various disasters with special reference to the earthquake and help both government and non-government organizations to adapt the appropriate policy options of the country. It was also intended to provide the scope to share practical experiences of early warning systems of ADRC, Japan in order to strengthen and further develop early warning system of Bangladesh.

Thirty-seven participants, from different government and non-government organizations and the Centre, attended the seminar. The seminar addressed the various issues of early warning system of Japan and Bangladesh with reference to some case studies. At the same time, the participants had worked out some recommendations for managing earthquakes, cyclone and flood. They got an invaluable opportunity to share their own experiences and ideas, which fostered a future projection regarding warning system and the total disaster management in Bangladesh.

Syed Shamsul Alam
Seminar Director
and
Director
Bangladesh Public Administration Training Centre

Acknowledgement

Bangladesh Public Administration Training Centre (BPATC) and the Disaster Management Bureau (DMB) wish to thank the Asian Disaster Reduction Centre (ADRC) and the UN Office for the Coordination of Humanitarian Affairs (OCHA) for extending their earnest cooperation for a successful arrangement of the seminar on Improvement of Early Warning System and Responses in Bangladesh towards Total Disaster Risk Management Approach. It is gratefully acknowledged the support provided by the Cabinet Office, Japan and USAID/OFDA.

Editor's Note

This report is designed to be informative and educative. It is expected that, those who are concerned with total disaster risk management in various capacities, will be benefited from the report. A number of issue-based high quality papers on disaster and innovative approaches were presented in the 6-day seminar. These papers have been included in the report in order that one can share the learning experiences of a developed country- Japan and a developing country- Bangladesh as also the two can share experiences and learn from each other. Others, within and outside, can compare their preparedness towards total disaster risk management approach and tailor their programmes accordingly, if appropriate.

This report is the outcome of the toil of a number of officers of BPATC. Md. Sharif Hassan, Benazir Ahmed and Md. Morshed Alom as rapporteurs of the seminar, prepared a first draft which was edited by Nandita Datta under my guidance. Besides, Syed Shamsul Alam, Seminar Director and Seminar Co-ordinator, Jesmin Ara Begum provided valuable assistance. Cumulation of these concerted efforts led to the preparation and publication of the report with funding support from ADRC and UN OCHA, Japan.

Mosharraf Hossain
MDS (Research & Consultancy).

Recommendations of the Seminar

Recommendations of the seminar for Earthquake, Cyclone and flood Management in Bangladesh

1. Recommendations of the Seminar for Earthquake Management

1.1 Brief Background Analysis

Bangladesh is located in an active seismic zone. Very recent experience shows that there is a risk of occurrence of earthquakes in future, but it is difficult to predict the time and place of the occurrence.

Therefore, we should be prepared to face the consequences of a severe earthquake. We shall have to create public awareness and respond to minimize the possible losses of lives and properties. Asian Disaster Reduction Centre (ADRC) and United Nations Office for the Coordination of Humanitarian Affairs (UN OCHA), Japan may extend further cooperation (both technical and financial in the identified areas) for "Earthquake Response Management Systems in Bangladesh".

1.2 Basic Support for Earthquake Response Management Systems

a. Research and studies on Earthquake Response Management Systems in Bangladesh will include evaluation of seismic hazards and vulnerability assessment involving geological perception and modeling, collection and preservation of historical data, development of data base and data analysis.

b. Preparation of standard (both macro and micro level) seismic hazard map and preparation of liquefaction zoning map with recent aerial photographs and topography and evacuation plan.

c. Institutional capacity building through establishment of coordination mechanism among concerned departments and agencies, providing fellowship programs, logistic supports, advanced training for rescue workers, training of trainers, exchange of technical specialists and professionals and transfer of latest technology.

d. Establishment of an earthquake research institute with modern research facilities and professional developments through multidisciplinary approach.

e. Provide fund for continuous research.

f. Establishment of regional and international cooperation among earthquake-prone countries for sharing and disseminating.

1.3 Required Support for Monitoring Seismic Events and Pre-Seismic Hazard Management

a. Establishment of required number of seismic stations and observatories for prediction and monitoring the seismic activities of the country, equipped with modern equipment like equipment for strong ground motion acceleration, velocity meter and geomagnetic monitoring instrument and high-speed computers, etc.

b. Strong network system among the observatories and establishment of a central monitoring system.

c. Development of data exchange process with the neighboring countries and other international seismic monitoring organizations.

d. Necessary software and expert services for installation of high-speed computers and other equipment including training for use and maintenance.

e. Proper assistance for concern departments and agencies involved in public awareness building.

f. Stockpiling of emergency logistic support-aids.

1.4 Required Support for Immediate Response for Post Seismic Hazards

a. Debris removal and heavy recovery equipment like heavy jack, crane, earthmover, forklifter and power shovel etc.

b. Early damage assessment.

c. Information linkages and networking for coordination and response among concerned departments and agencies like Government Organizations and Non-Government Organizations (GOs-NGOs) and other development partners.

d. Installation of modern radio systems and or if possible satellite telephone networks.

e. Recovery technology and sophisticated equipment like thermal imaging camera, heart-bit detecting unit, listening sensor, rescue camera, etc.

1.5 Required Support for Post Earthquake Management

a. Technical and engineering support for:

(i) Reinstallation and reestablishment of lifelines and other utility services.

(ii) Reconstruction of buildings, bridges, over and under passes, etc.

b. Technical and technological support establishment and management of data bank.

1.6 Systems/Services to be Developed through Internal Initiatives for Earthquake Response Management

a. Integrated awareness development and preparedness activity for seismic hazards.

b. Updating of Bangladesh National Building Code (BNBC).

c. Earthquake drill/simulation exercise.

d. Regulatory Body for land use planning and monitoring implementation evaluation of building codes.

e. Establishing field hospitals with adequate and appropriate facilities.

g. Inclusion of earthquake spectrum in education curriculum.

2. Recommendations of the Seminar for Cyclone Management

2.1 Developing Cyclone Warning and Management Systems in Bangladesh

a. Simplification of warning signals

b. Dissemination system of warning signals

c. Collection of data for cyclone forecasting system

d. Numerical weather prediction system

2.2 Simplification of Warning Signals

a. The existing number of warning signals should be minimized, simplified and made easily understandable by the common people with the specific explanation and indication of each signal.

b. Signals for the riverine and maritime ports should be merged together to avoid confusion and misunderstanding during cyclone period.

c. Forecast and Warnings should be addressed not only referring to the ports but also to the specific districts.

d. Cyclone warning messages should contain human aspects, human requirements and precautionary measures to be taken by the people for coping up with the disaster.

2.3 Dissemination System of Warning Signals

a. A microwave link between BMD Dhaka and DMB Dhaka for quick dissemination of warning signals should be established.

b. Web site may be launched at BMD Dhaka for easy access of the recipient of the warning signals.

c. A manual of the recipient of the warning signals should be published immediately by BMD and circulated to all concerned.

d. Warning signals may be processed and disseminated to the recipient as quickly as possible.

e. BTV/Private TV channel as well as Radio channels should broadcast forecast and warning signals repeatedly. In coastal areas Radio and TV broadcast should be made in local language for better understanding of the common people.

f. All organizations responsible for dissemination of warning signals and awaring the people starting from the national level to the union level should be activated to perform their specified duties before occurrence of the disaster as per standing order.

g. CPP volunteers should be equipped with more modern logistics to enable them for effective dissemination of warning signals and evacuate people from the disaster affected areas to the cyclone shelter.

h. Satellite communication system must be used for dissemination of warning signals in future.

2.4 Collection of Data for Cyclone Forecasting System

a. Present meteorological observation system in the country is old, obsolete and conventional type. The atomized system should be introduced. The Doppler Radar system may be introduced for achieving better accuracy in cyclone forecasting.

b. A satellite based dedicated telecommunication channel may be established between BMD, Dhaka and Braknell Meteorological Office, UK to have access to more global meteorological data.

2.5 Numerical Weather Prediction System

Numerical weather prediction techniques should be introduced in Bangladesh Meteorological Department for issuing short, medium and long-range weather forecasting for the country.

3. Recommendations of the Seminar for Flood Management

3.1 Flood Forecasting, Warning and Dissemination

a. Existing Flood Forecasting system should be improved and realistic.

b. Doppler Radar system with hydrological component should be established in Bangladesh for quantitative measurement of rainfall at the upstream in the Himalayan region.

c. More cooperation among Bangladesh, India, Myanmar, Nepal, Bhutan and China should be strengthened in exchanging water level and rainfall and flood warning data through automatized way.

d. Microwave link between BMD, Dhaka and Flood Forecasting and Warning Center, Dhaka should be upgraded from analogue to digital system for quick exchange of flood data.

e. Microwave link between Flood Forecasting and Warning Center, Dhaka and BTV should be revived.

f. Flood warning system should be simplified for better understanding for the people of flood prone areas.

g. Flood forecasting and warning should be region wise and different for urban and rural areas in the country.

h. High-resolution satellite imagery, geological and morphological maps along with active geographic information system (GIS) should be used to increase lead-time for flood forecasting.

i. An efficient system for dissemination of flood warning messages should be developed and transmitted regularly through radio /TV and other mass media.

j. Forecasting and issuance of early warnings for flash flood should be ascertained.

3.2 Flood Management

a. Flood prone and vulnerable areas should be identified and flood hazard maps should be prepared to plan and create awareness among people.

b. Research and preserve local and indigenous knowledge and techniques to cope with flood should be discovered.

c. Regular dredging or excavation of rivers is essential.

d. Use the Ox-Bow lakes as surface water reservoirs.

e. While under taking any development project that could affect the topography of any locality, river basin morphology must be considered.

f. Ecological aspect should be taken into account.

g. Zoning laws specially in urban areas and areas covered by newly built water control structure should be introduced.

h. During the flood, Flood Information Center (FIC) should be opened in the affected areas for any clarification and receiving and transmission of flood messages.

i. Maintenance work of embankment should be strengthened.

j. Flood damage assessment should be done properly by the competent authority.

k. Identify the vulnerability and capacity of the flood prone area.

l. Encourage the community for creating flood emergency fund.

m. Involve the community in the flood preparedness and response process.

n. Encourage the community for creating flood emergency fund.

o. Involve the community in the flood preparedness and response process.

3.3 ADRC can cooperate with Bangladesh in the following areas :

- Capacity Building
- transfer of latest technology
- Training of trainers
- Fund for continuous research.
- Regional Cooperation.

Inaugural Session

Welcome speech

Syed Shamul Alam
Director and Seminar Director
BPATC, Savar, Dhaka

Honourable Chief Guest, Chowdhury Kamal Ibne Ysuf, Minister for Disaster Management and relief
Respected Chairperson, Dr. Kamal Uddin Siddiqui, Rector, BPATC
Respected Special Guest, Secretary-in-Charge, BMM Mozharul Huq, ndc,
Eminent Scholars From ADRC & UN OCHA, Japan
Respected Director General From DMB and Representative from UNICF
Faculty Members of BPATC
Distinguished Participants
Ladies and Gentlemen

Assalamu Alaikum

Good Morning,

It is my pleasure and proud privilege to welcome you all to the inaugural session of a six-day long seminar on "Improvement of Early Warning System and Responses in Bangladesh towards Total Disaster Risk Management Approach" Jointly organized by BPATC & DMB, Bangladesh in Collaboration with ADRC & UN OCHA, Japan. We have among us Chowdhury Kamal Ibne Yusuf, Hon'ble Minister for Disaster Management and Relief, Government of the People's Republic of Bangladesh who has kindly consented to inaugurate the seminar. BMM Mazharul Huq, ndc, Secretary- in Charge, Ministry of Disaster Management and Relief is our special guest and we have our Hon'ble Rector who is presiding over this ceremony. On behalf of BPATC, we appreciate and express our deep gratitude to all of them for being with us this morning despite their heavy pre-occupation

You are aware that an effective early warning system is pre-requisite for minimizing the losses of lives and properties in organizing meaningful disaster preparedness. Realizing the importance of early warning system, government of Bangladesh has introduced warning system of cyclone,storm surges and flood. There is no specific warning system for deadly disaster of earthquakes. It is not a denying fact that an integrated early warning system covering cyclone, flood and earthquake is the part and parcel for comprehensive disaster management system in Bangladesh. Moreover, recent prediction by the local experts indicates that a severe earthquake may occur around this region causing mass destruction in Bangladesh.

We there fore, need to focus on developing an appropriate earthquake early warning system to face the adversities of life and strengthening the country's preparedness programme to

manage and handle the disasters properly keeping this view, Government has given top most priority and is striving its best effort to introduce modern earthquake warning system, which would be in a position to prepare the general people to take appropriate measure for mitigation. The government also considers that there should be international cooperation amongst the specialized organizations in finding out an appropriate ways and means for mitigating earthquake sufferings.

In line with this policy of Government, BPATC and DMB in collaboration with ADRC and UN OCHA Japan is organizing this international seminar on, Improvement of Early Warning System and Responses in Bangladesh. As over the years ADRC has contributed a lot to the building of capacities for disaster management in this region. The objective of this seminar is to share idea and exchange modern scientific knowledge and skills of early warning system of disasters with special reference to earthquake in Japan in order to evolve appropriate early earthquake warning system for Bangladesh. We hope that the ADRC scholars with their specialized experiences will address the key issues of earthquake in Japan to be tackled in improved and scientific management of disasters that would help us for developing early warning system.

During the six-day long seminar, fourteen paper will be presented by different scholars on three major themes. Seven papers will be presented by the Japanese scholars and the rest of the papers by the Bangladeshi scholars. There are two working sessions in each day which will be presided by senior professionals and eminent scholars of the respective areas. The paper presentation will be followed by floor discussions and questions and answers. For meaningful participation, we have invited representatives from all concerned agencies and organizations to actively participate in the discussion and to contribute by sharing their practical experiences. I hope that they would come up with a set of findings and recommendation for early warning system for Bangladesh.

I would like to express our gratitude and thanks to the ADRC and UN OCHA Japan for sponsoring and extending necessary cooperation for this seminar. We also acknowledge ADRC's contribution for sending seven eminent scholars and scientists to present the professional papes and to share their views and ideas in developing our early warning system of disaster. I thank Mr. Fumiaki Yoshimura, ADRC in particular for extending personal attention in managing and implementing this seminar. In fact, the cooperation extended by Mr. Fumiaki Yoshimura was the main instrumental factor for successful beginning of the seminar. I hope the relation between ADRC, Japan and BPATC will be strengthened through this collaboration and will look forward to work together in future in the area of disaster management for developing our training curriculum.

I thank you all.

Opening Statement

Ms Tokako Izumi
UN OCHA, Japan

Excellencies, distinguished respected Chairperson and Rector, BPATC, Mr. Kamal Uddin Siddiqui, Hon'ble Chief Guest, Minister for Disaster Management & Relief, Respected special Guest, Secretary, Ministry of Disaster Management and Relief, BBM Mozharul Huq, Faculty members of BPATC, Seminar Director, Dear participants of the seminar, ladies and gentlemen,

It is indeed an honor for me, on behalf of the delegates of the Office for the Coordination of Humanitarian Affairs (OCHA), to be given this opportunity to address opening remarks at this seminar. I would like to take the opportunity to thank BPATC for co-ordinating and organizing of this seminar.

Asia suffers more from natural disasters than any other part of the world. The last decade has seen a marked increase in the occurrence of natural disasters causing huge loss of life and material damage. Not only are the frequency and intensity of disasters but society is becoming more vulnerable due to its unsafe conditions, poor physical environment and fragile local economy.

OCHA is responsible for the coordination of humanitarian assistance, both for natural disasters and complex emergencies. Our mission statement is to mobilize and coordinate effective and principled humanitarian action, in partnership with national and international actors in order to: (1) alleviate human suffering in disasters and emergencies, (2) advocate for the rights of people in need, (3) promote preparedness and prevention and (5) facilitate sustainable solutions. Furthermore, OCHA attaches great importance to maintaining a holistic approach to disaster management.

In 2002, our office maintained close contact with UNRCs to monitor the developments, and assisted OCHA Headquarters in alerting the international community and disbursing OCHA Emergency Grants to Indonesia, China and Viet Nam. We have also promoted multi-level efforts in disaster response preparedness, notably through projects funded by the ASEAN foundation and the USAID/OFDA. In cooperation with-the Asian Disaster Reduction Center (ADRC), it organized three regional workshops for national government officials, regional organizations, and NGOs for disaster reduction and response. Through these activities, our office has promoted multi-dimensional cooperation and collaboration by advocating the Total Disaster Risk Management (TDRM) approach, which aims to address, holistically and comprehensively, the various concerns and gaps in disaster management. I will introduce the TDRM approach in detail during the session for Topic 7 scheduled tomorrow afternoon.

To develop an effective and efficient early warning and response system which is the main

theme of this seminar- in cooperation with government, organizations and communities, is one of the very crucial elements of the TDRM approach in order to ensure the effectiveness and quality of disaster risk management interventions.

I hope that the participants will have better understanding on the key elements of the TDRM approach through this seminar and this approach will be applied to activities related to disaster preparedness and response in your country.

In conclusion, I wish you a great success of this seminar as well as your commitments to the TDRM approach in Bangladesh.

Opening Speech

Mr. BMM Mozharul Haq, ncd
Secretary-in-charge, Ministry of
Disaster Managment and Relief.

Honourable Chief Guest,Chowdhury Kamal Ibne Yusuf , Minister for Disaster Management and Relief

Respected Chairperson, Dr. Kamal Uddin Siddiqui, Rector, BPATC

Distinguished Participants

Ladies and Gentlemen

Assalamu Alaikum

With great pleasure I welcome you all to the inaugural session of seimnar on "Improvement of Early Warning System and Responses in Bangladesh towards Total Disaster Risk Management Approach" jointly organised by BPATC & DMB in collaboration with ADRC & UN OCHOA Japan. I am very happy to be here as Special Guest and delighted to have amidst us Honourable Chief Guest, Chowdhury Kamal Ibne Yusuf, Minister for Disaster Management and Relief, Government of the People's Republic of Bangladesh, who has kindly consented to deliver the inaugural address. On behalf of Government of Bangladesh and BPARC, DMB I thank Mr. Chowdhury Kamal Ibne Yusuf, for being with us this morning despite his heavy preoccupations.

Distinguished Participants

Bangladesh faces various type of natural disasters through the years such as floods, cyclones, tornadoes earthquakes and river erosion. These disasters seriously hinder and delay the development process of Bangladesh. In line with present policy of disaster management, Government of Bangladesh is interested to render best possible service to the nation by devising the ways and means to mitigate the grave consequences of such disasters. The importance of the subject-matter of this seminar to the countries of Asia-Pacific, in particular to Bangladesh, can hardly be exaggerated, in view of the frequent occurrence of floods, cyclones, tidal bores, hurricanes and landslides.

With the increasing frequency of disasters occurring in the Bangladesh with all their wide-ranging socio-economic consequences, the necessity of sharing modern knowledge and technology from develop country can not be over emphasized. An urgent need for evolving proper strategies to face and tackle disasters is, therefore, well recognized by all. Keeping these view in mind Bangladesh Public Administration Training Centre as an apex and Disaster management Bureau jointly organised this seminar in collaboration with ADRC and UN OCHA, Japan.

The main objective of the seminar so far I have informed, is to strengthen the national capacity in early warning system in Bangladesh which will create an opportunity for disaster managers to review and identify the strengths and weaknesses of the present warning system in Bangladesh. Gather information on modern and effective early warning system practiced in developed countries with particular reference to Japan. Identify the challenges in introducing modern early warning system in Bangladesh. Learn from the Japanese experts about their experiences and their suggestions to improve the Bangladeshi warning systems. Familiarize the participants with the latest technologies used by Japan or other developed countries in forecasting disaster events and hence how Bangladesh can incorporate these technologies to their system.

Ladies and Gentlemen,

ADRC and UN OCHA-Japan with their specialized knowledge and skills on various disasters particularly on earthquakes are actively engage in evolving a proper disaster management strategy. We have requested both of these organisations to help us in improving and managing Early Warning System of our disasters with reference to earthquake. We believe that the team of experts from Japan would share their professional knowledge and skills with the experts of Bangladesh would provide a forum of learning and create the opportunity to evolve an appropriate warning system for Bangladesh. I have informed that BPATC invited mid-level officials associated with disaster management from 40 different organizations working in the field to attend the seminar. I believe that these officials would be able to share the ideas with Japanese experts and they would also be able to apply these knowledge and skills in their respective field.

We hope the cumulative expertise and experiences of the large number of scholars gathered here will help to highlight the key issues to be tackled in the improvement of early warning system and responses in Bangladesh and scientific management of disasters. It is expected that the seminar will come up with suitable recommendations and follow-up actions which will pave the way for a more effective approach to this subject.

Let me avail myself of this opportunity to put on record my gratitude to the Honourable Chief Guest, Chowdhury Kamal Ibne Yusuf , Minister for Disaster Management and Relief and respected Chairperson, Dr. Kamal Uddin Siddiqui, Rector, BPATC, I would like to extend my sincere thanks to representatives of ADRC and UN OCHA from Japan, and look forward to continue these cooperation with BPATC and DMB in future. We intends to continue our collaboration with both of you in implementing the training programme for disaster management, relevant to the Asia-Pacific region.

I once again cordially welcome you all.

Allah Hafez

Inaugural Speech

Chowdhury Kamal Ibne Yusuf
Hon'ble Minister for Disaster Management and Relief
The people's Republic of Bangladesh

Bismillahir Rahmanir Rahim
Respected Chairperson of the seminar, Rector, BPATC
Special Guest, Secretary, Ministry of Disaster management and Relief
Respected faculty members of Bangladesh Public Administration Training Centre (BPATC)
Seminar Director
Distinguished experts from Japan and representative of Asian Disaster Reduction centre (ADRC)
Dear Participants of the seminar
Assalamualikum and good morning

First of all, I would like to thank Bangladesh Public Administration Training Centre (BPATC) and Disaster Management Bureau (DMB) authority for inviting me as the Chief Guest of this seminar on "Improvement of Early Warning System and Responses in Bangladesh towards Total Disaster Risk Management Approach". I am happy to see that this seminar is being Jointly organized by Bangladesh public Administration Training Centre (BPATC) and Disaster Management Bureau (DMB) in collaboration with Asian Disaster Reduction Center (ADRC) and United Nations Office for the Coordination on Humanitarian Affairs (UN OCHA)

Bangladesh is a disaster prone country. It is located at the foothill of the Himalayan Ranges and the Bay of Bengal is located to the south of this country. This geographical setting has made the country prone to many natural disasters. Almost every year different natural disasters take place here and cause numerous damages in terms of life and property. It hampers the economic growth of the country. The major natural disasters faced by Bangladesh are Flood, Tropical Cyclone, Storm Surges, Tornado, River Bank Erosion, Drought, Earthquake and Arsenic Contamination in ground water.

As you know that Bangladesh has the highest population density in the world and land is very limited, so a large number of poor people tend to settle in vulnerable areas of the southern part of the country. They settle in the newly accreted land in the coastal belt of Bangladesh which occasionally hit by tidal bore or devastating cyclone. Improved early warning system is very important for the coastal people in Bangladesh especially for flood and cyclone management.

Earlier in 1970, 0.3 million and in 1990, 0.14 million people died in Bangladesh in devastating cyclone due to lack of proper early warning system and disaster preparedness. We cannot stop natural disasters, but by improving our warning systems and with sufficient preparedness we definitely can mitigate the damage and save millions of lives.

Bangladesh is also located in an active seismic zone. Experts have predicted that severe earthquakes may occur in this region causing huge loss of life and properties especially in Dhaka city. As the Dhaka city is expanding and many high-rise buildings are being constructed, the impact of earthquake would be severe for the people of Dhaka. Development of improved early warning system in case of earthquake is a must.

I came to know that this seminar will deal with three main natural disasters: Flood, Cyclone and Earthquake. I hope that experts of both the countries will be facilitated by sharing their ideas and exchanging views. Though the Bangladesh; experts have experiences in managing floods and cyclones, they have little experience of managing earthquake. So, they will learn more from Japanese experts regarding earthquake prediction. Moreover, early warning system in Bangladesh is not satisfactory, Japanese experts can help us improving our warning systems. I hope that the seminar will greatly benefit the participants by which they will be able to utilize the knowledge gained here at their work place.

Finally, I like to thank the Japanese experts for coming all way from Japan to Bangladesh and taking keen interest in this seminar. I also like to thank ADRC and UN OCHA, Japan for their kind cooperation. I fervently hope that this will not be a one time affair between Bangladesh and ADRC, but a long lasting collaboration which will follow where Bangladesh and Japan can collaborate such type of seminars for the benefit of each other. Thank you ladies and Gentlemen.

Concluding Speech

Chairperson
Dr. Kamal Uddin Siddiqui
Rector
BPATC, Savar, Dhaka.

Respected Chief Guest of the seminar, Hon'ble Minister for Disaster Management and Relief, Chowdhury Kamal Ibne Yusuf
Respected Special Guest, Secretary, Ministry of Disaster Management and Relief, BBM Mozharul Huq, ndc
Faculty Members of BPATC
Seminar Director
Distinguished Resource Persons from Japan and Representative of Asian Disaster Reduction Center (ADRC)
Dear Participants of the seminar

Assalamualikum and Good Morning.

First of all I would like to thank the Hon'ble Minister for the Ministry of Disaster Management and Relief for being present here as the Chief Guest of this seminar on "Improvement of Early Warning System and Responses in Bangladesh towards Total Disaster Risk Management Approach" The seminar is being jointly organized by Bangladesh Public Administration Training Centre (BPATC) and Disaster Management Bureau (DMB) in Collaboration with Asian Disaster Reduction Center (ADRC) and the United Nations Office for Coordination of Humanitaria Affairs, (UN OCHA), Japan. I would also like to thank the Secretary, ministry of Disaster Management and Relief for his presence as the Special Guest and for the cooperation extended to BPATC in organizing the seminar.

We all are interested to know about tomorrow's weather for our day to day activities, development and comfort. Weather forecasts can give us the relevant information. At the same time warning can predict the impending disasters and we can take precautionary measures accordingly. From this point of view, this seminar is very important. It would give us insights on what can be done in forecasting disasters.

Bangladesh is a deltaic region of alluvial soil, cris-crossed by a network of mighty rivers with the Himalayan range to the North, the Arakan mountains to the East, the Bay of Bengal to the South and the vast stretch of the Indian land to the West. The combined effect of these special geographical features has significant bearings on the weather system of Bangladesh. Through the seasonal weather systems, Bangladesh becomes the worst victim of natural calamities, causing at times colossal loss of lives and properties. The common natural disasters faced Bangladesh are Flood. Tropical Cyclone, Storm Surges. Tornado, River Bank

Erosion, Drought, Earthquake and Arsenic contamination in ground water. All these natural calamities have direct bearing on country's economy and development efforts, and have important contributions to environmental degradation in the long run. Weather forecast and warning system are of utmost importance to all actors related to disaster mitigation in Bangladesh. The disasters are relatively costly in terms of lives lost and their long-term impact on economy. The average losses due to disaster were 530 deaths and 23614 million taka per year during the period from 1996 to 2000.

Bangladesh has a 710 km coastline. Natural disasters such as, cyclone with storm surges and flood occur almost every year in the country especially along the coastal districts. Of the most no table disasters of the last century, the 1998 flood was the longest in terms of total duration. The1970 cyclone was the most devastating in terms of the total number of deaths (caused nearly 3,00,000 deaths), and the 1972 and 1979 droughts had the most damaging consequences with 43% of population and 42% of the affected by each event.

The Asia -Pacific region has the highest level of seismicity on the planet and is the setting for many of the largest earthquakes. Bangladesh is located near the Alpide Himalayan earthquake belt. Although, the epicenters of major earlier earthquakes were located outside Bangladesh, the country is not totally safe from seismic hazard. For example,the Great Indian Earthquake or Assam Earthquake caused severe destruction throughout Bangladesh when there was not much the urban settlement in Bangladesh. There were several earthquakes in the past that severely affected this landmass. Considering the past, it is inevitable that there would be earthquakes in the future. As Japan has long experience in dealing with earthquakes, we can learn from their experience and get ready to face this devastating disaster. I think Japanese experts would share with us invaluable experiences in this regard.

Overpopulation, rapid urbanization and environmental degradation are also increasing vulnerability to disaster events and extent of destruction. Almost thirteen cities of the world, prone to natural disasters have high population density ranging 10-25 million, of which nine are in Asia. Dhaka, the capital of Bangladesh, is one of them. By 2015, it would be the 6th largest megacity in the world.

This six day long seminar on "Improvement of Early Warning System and Responses in Bangladesh towards Total Disaster Risk Management Approach" would address all these issues in detail. I hope that the participants of this seminar, who have come from various government and non government organizations related to disaster management will be greatly facilitated and apply the knowledge gained here to their work place.

I hope that this seminar would open up an avenue for further collaboration and cooperation between ADRC and BPATC. This is not the end but the beginning of institutional linkage between the two organizations.

Thak you.

Seminar Papers and Case Studies

Geophysical Structure of Bangladesh with Special Reference to Earthquake

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1. Introduction

1.1 What is geophysical structure?

A geophysicist applies the knowledge of certain physical principles such as magnetic attraction, the pull of gravity, the speed of sound waves and the behavior of electric currents -to determine the shape and arrangement of the internal structure of the earth. However, to the geoscientists, the term geophysical means any condition or event in the natural environment of the earth. It has two broad division: a) climactic and meteorological, & (b) geological and geomorphological while the climactic and meteorological events are related with atmosphere, the geological and geomorphological events are associated with the earth's interior and lithosphere. The geographica activity related to geological and geomorphological events include, among others avalanches, earthquakes, erosion, landslides, shifting sand, tsunami and volcanic eruptions (Burton & Kates, 1964). In the present context, emphasis has been given on the structural components of the interior of the earth. Past evidence suggests that EQ occurrences are associated with places of specific structural weaknesses. For instance, most earthquakes have occurred along the tectonic colision zone, which extends over 12,000 km from Indonesia through the Himalayas, the Middie East and the Alps to the western Mediterranean and North Africa (Fig. 1).

What is an earthquake?

An earthquake is the vibration of the earth produced by the rapid release of energy. This energy radiates in all directions from its source, the focus, in the form of seismic waves (Fig. 2) The surface location directly above the focus is called the epicenter. This seismic wave energy dissipates rapidly with increasing distance from the focus and the instrument used to record the event is called seismograph.

Two other important aspects earthquake magnitude and intensity should be mention here. Earthquake magnitudes refer the total energy of the seismic waves radiating outwards from the earthquake source. Charles F. Richter devised the original scale in 1930 for comparing earthquakes in California. The Richter scale of magnitude is logarithmic, in each unit measures a ten-fold increase in the amplitude of measured earthquake waves and a nearly 30 fold increase in energy.

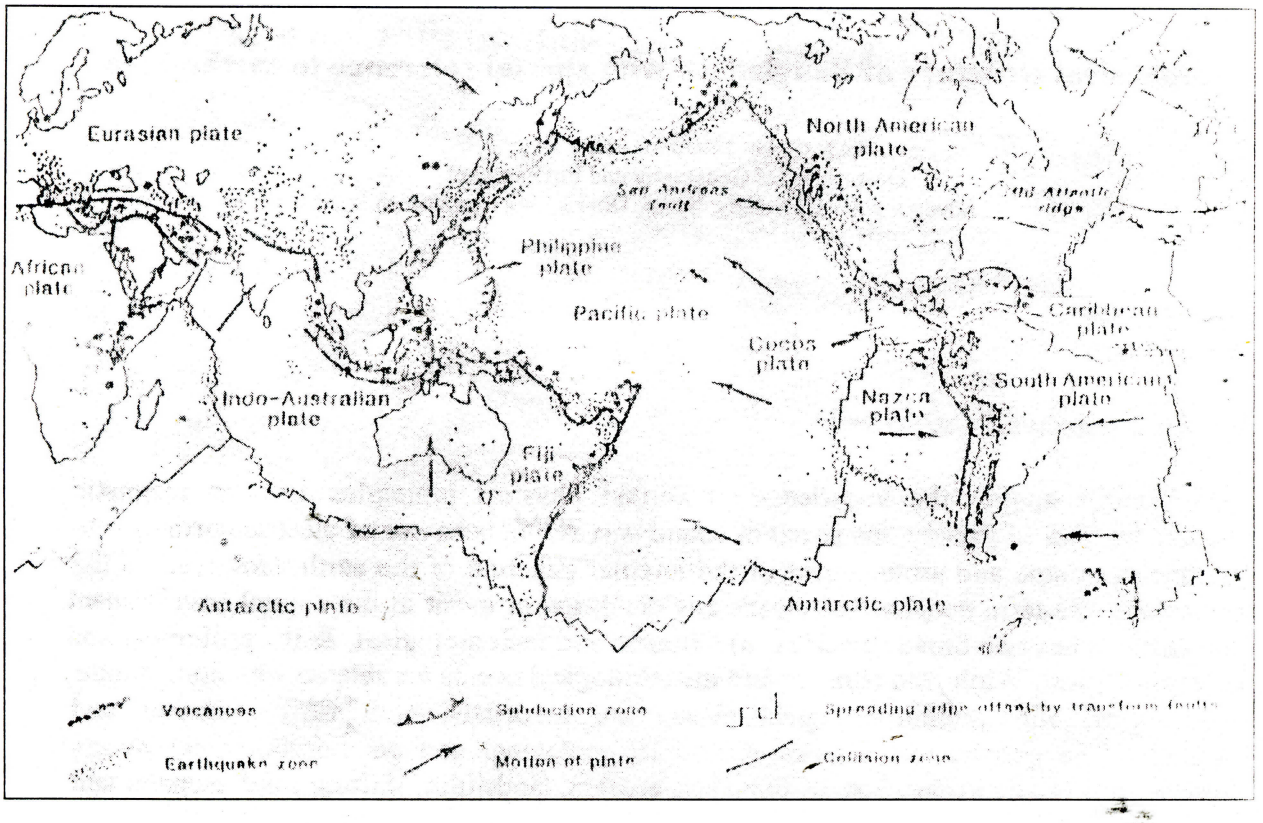


Fig. 1 : Plate Tectonics and Earthquake zone. Note the Indo-Australian plate is on collision course at north and eastward with Eurapion plate (Source: Smith 1996.)

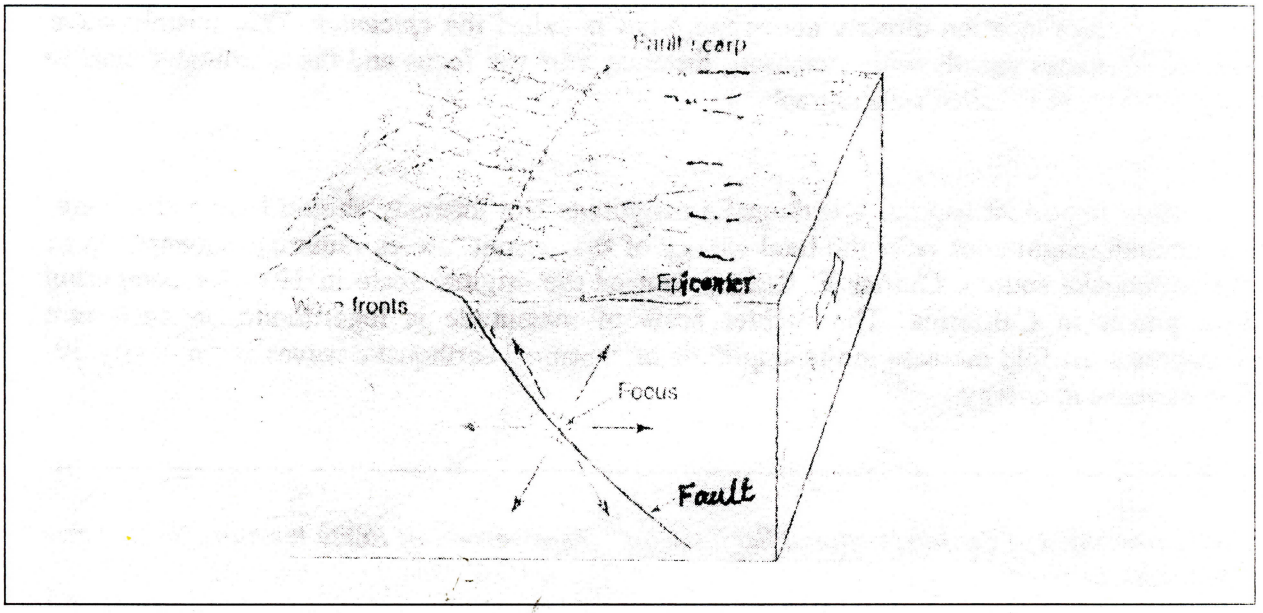


Fig. 2 : Earthquake Components, Note
The focus of all earthquakes is located at depth. The surface location directly above it is called the epicenter.

Earthquake intensity measures the degree of ground shaking that correlates more directly with hazard impact, In 1902 G. Mercalli developed a 12 point scale, later further refined as Modified Mercalli scale. Magnitude and intensity measure two different properties of earthquake, but it is possible to establish an approximate correlation between the two as below (Table 1)

Table1 : Relationshpi between Earthquake Intensity and Magnitude.

Intensity	Magnitude
Level I (detected by seismo -meters but felt by Very few people)	2
Level VIII (weak buildings, Walls and Chimneys fall)	6
Level XII (total destruction, ground seen to shake)	8.5

2. In a holistic view the geophysical structures of Bangladesh are very much part of the global sections According to plate tectonics theory, the lithosphere is comprised of 15 plates as appears in Fig.1 These lithospheric plates are continually on motion at a speed 20-50 mm/yr carried along by convection currents in the mantle (Smith, 1996) Most of the world's earthquakes and volcanoes occur along the tectonically active margins of theses major plates but they can occur at weak points within plates.

Three different mechanisms are associated with the constantly changing pattern of plates :

1. Divergence occurs when tectonic plates move apart and grow in area. Rift valley and volcanic eruptions and associated earthquakes are common in this zone e.g., Mid Atlantic ridge.

2. Collision takes place when the plates converge and reduce in size. Such collision course between the plates results in folded mountains like the Himalayas or the Alps. Besides, one of the two plates may bend down or pass beneath the other in a subduction zone. In Fig. I, it appears that the northern India (along with Bangladesh) as a part of Indo-Australian plate, is moving north and northeast ward pushing beneath the Himalayan folded margins, forming two deep seated fault trend which are considered to be one of the most seismic prone zones of the world (CEER, 19793. Transcursion takes place when two Plates slide past each other laterally along a series of tear or transcurrent faults. For example, the San Andrea's fault between the Pacific and North American plates and the Alpine fault in New Zealand separates the Pacific and Fiji plates.

These different movements result in a variety of earthquake phenomena and impacts:

Primary phenomena:
- Ground shaking
- Fault rupture
- Tectonic deformation

Secondary phenomena
- Soil liquefaction
- Land and mudslides
- Submarine avalanches
- Tsunamis

Primary impacts
- Buildings collapse
- Rupture of pipelines, bridges and other utilities

Secondary impacts
- Fires and explosions
- Flood from dam failures

3. Structural Provinces of Bangladesh

The Geological history of Bangladesh has been influenced by the regional tectonics. Based on available evidence on the surface and subsurface stratigraphy it is possible to divide Bangladesh into three major structural provinces (Fig. 3). The Pre-cambrian platform which includes (i) the Dinajpur shield and platform, (ii) the Shillong platform & (iii) the Basin provinces (Khan, 1991).

The Dinajpur shield and Platform occupy the northern two thirds of the Rajshahi Division. The Shillong platform forms narrow belt along the northern border of Netrokona and Sunamganj districts. The rest of Bangladesh forms the basin. The stratigraphic records of the Basin are indicative that the province underwent repeated folding and faulting in the geological past. The hilly regions of Chittagong Hill Tracts and Sylhet regions are formed by folded Basin Sediments.

The junction between the Precambrian platform and the Basin fore deep called the Hinge zone, a zone of weakness considered to be running south westward from Mymensingh to Calcutta. However, no incidence of earthquake has reported to this zone

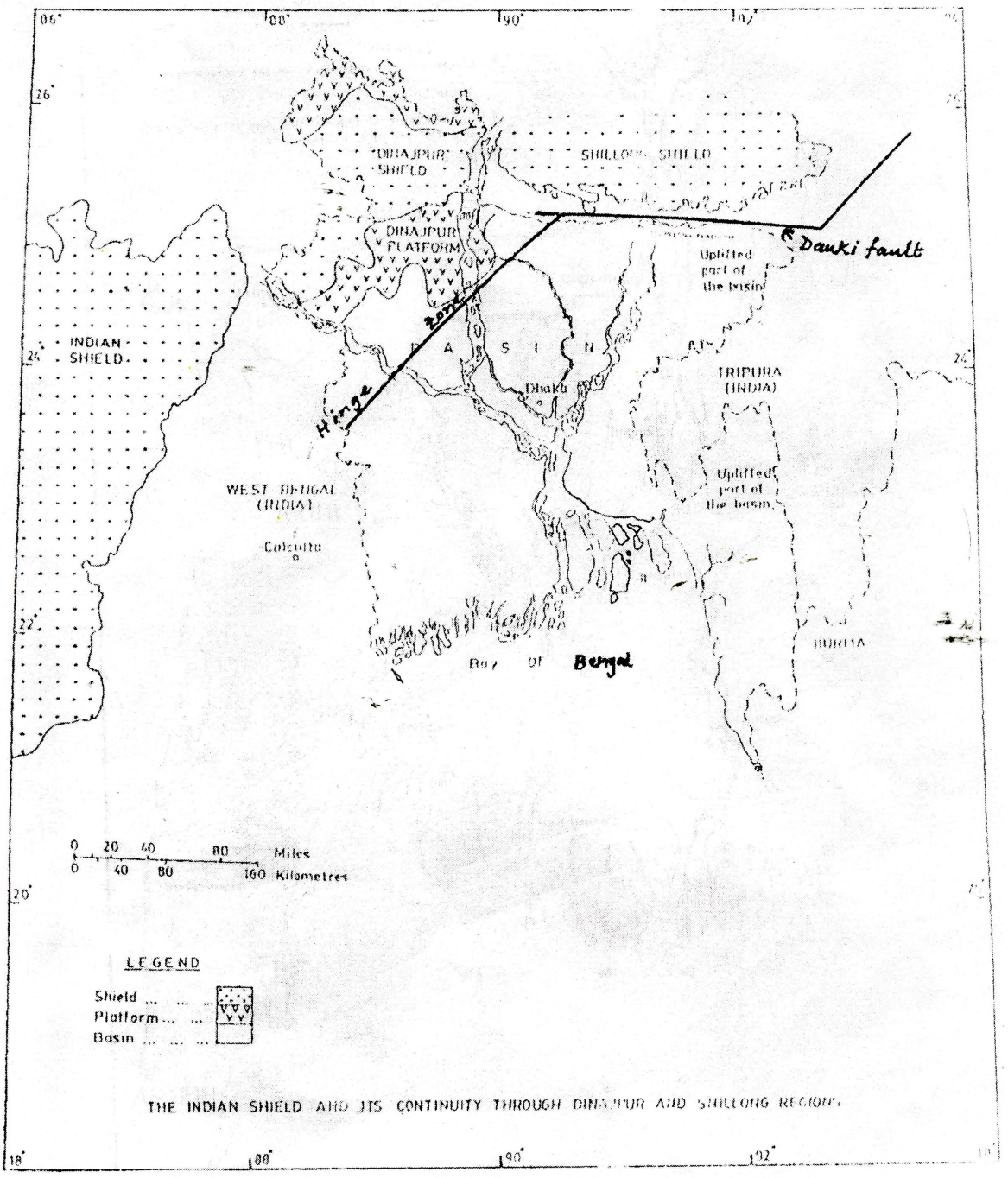


Fig. 3 : Tectonic Maps of Bangladesh (Source : Khan 1991)

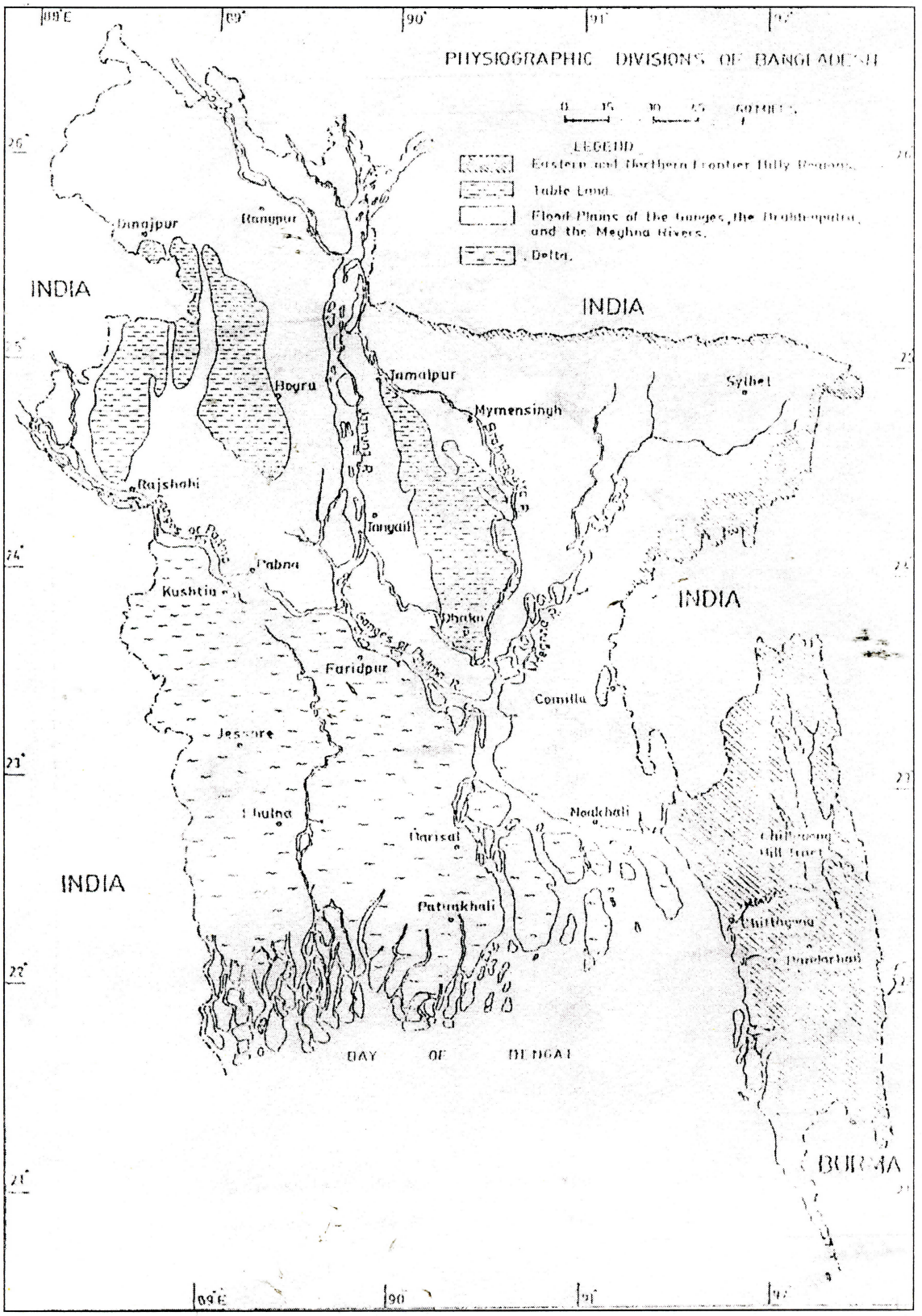


Fig. 4 : The four distinct regions of Bangladesh on the basis of formation and surficial characteristics.

yet. The Basin is flanked in the north east of Bangladesh by the Dauki fault wherein several earthquakes have been reported in the last 100 years (CEER, 1979). The eastern edge of the Basin met the Burmese Plate margin along the Arakan Yoma faulting. This zone is also recognized as the seismically active zone. The Assam-Dauki fault and the Arakan Yoma fault zones being very close to Bangladesh, any earthquake event originating in those areas may affect Bangladesh as happened in the past (CEER, 1979).

Topographic characteristic

Topographically, the Bangladesh may be divided into four distinct regions on the basis of formations & survival characteristics (Fig. 4) These are :

1. The eastern and northern hilly regions generally called Tertiary hills.
2. The terrace lands including the Barind, the Madhupur, the Lalma hill & Akhaura.
3. Flood plains of the Ganges, the Brahmaputra & the Meghna.
4. The Delta.

The hill regions occupy about 18% and the Terrace lands about 10% of Bangladesh. The Terrace land formed during Pleistocene period. Some of these Terrace lands are having a series of subsurface faults, The average elevation of this lands are appox.17m above MSL. The flood plains of the Ganges - Brahmaputra- Meghna cover approx.40 % of Bangladesh. Average elevation of the flood plains differs form 3 to 15 m above MSL. The deltaic region comprised of about 32% of Bangladesh, Covering the districts of Kushtia, Jessore, Faridpur, Khulna & Barisal.The elevation of the deltaic regions widely differs from north west to south and southeastward. Along the seafront election of the delta is less than 2 m and in the upper north it varies from 8 to 16 m above MSL.

These topographic diversities are critically important when earthquake damage extents are considered. The flood plains and deltaic regions are densely populated and the subsurface loose and unconsolidated sediments and high ground water level are liable to high damage extent in case of earthquake events.

The eastern and northern hill regions have undergone intense folding faulting in the past however, no earthquakes have so far been related to these faults in Bangladesh (CEER, 1979 Some faults have been identified in the Barind and the Madhupur terrace regions but no earthquake incidence have been connected with these faults.

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Considering the structural components of Bangladesh and the available historical records of the earthquake incidences, the CEER (1979) had the following observations :

- There are areas of high seismic activities beyond the north and east of Bangladesh frontier's and in the past, some major earthquake events originating in those areas have affected Bangladesh.

- The Dauki fault, lying along the northeastern border of Bangladesh is considered to be the single most important geological structure that has strong association with earthquake.

- In the last one hundred years, only two major earthquake events had their epicenter within Bangladesh. These are the Bengal earthquake of 1885, and the Srimangal earthquake of 1918. In both cases, the damage extents were limited to the surrounding areas.

- Frequent tremors have been felt in the northern Mymensingh and Sylhet districts and to the eastern part of Rangpur but southwestern parts experienced very little of earthquake event.

4. Seismic Zoning

The seismic zoning is a process of earthquake risk evaluation. The principal factors related to the compilation of seismic zoning involve: seismic history, geological setting and soil conditions Seismocity may be expressed in various types of maps. Plotting magnitude rated epicenters on a map can provide a qualitative indication of seismocity; higher the density of the epicenters, greater the seismocity. Isoseismal maps indicating area extent of strong ground shaking by particular earthquakes are also useful for zoning purpose. Besides, geological maps having details of stratigraphy, lithology, structure and tectonics and indication of fault lines are also useful for seismic zoning. However, It was cautioned that at times specific relationships between particular geological structures or features and earthquakes might be difficult to establish.

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Seismic zoning map of Bangladesh

Considering the ground conditions associated seismic factors and available information on the epicenter location, the Committee of Experts on earthquake (1979) has divided Bangladesh into three zones (Fig. 5). The northeastern part including the town Sylhet, Mymensingh and Rangpur are in Zone-1, the most active seismic zone of the country. Here, earthquake shocks with maximum intensity of IX of MM scale may be possible. Basic horizontal seismic coefficient suggested for this zone is 0.08. Dinajpur, Bogra, Tangail, Dhaka, Comilla and Chittagong fall in Zone II, where shocks of maximum intensity VIII are possible. The basic seismic coefficient in this zone is 0.05. Zone III covers the towns of Rajshahi, Pabna, Kushtia, Jessore, Faridpur, Khulna, Barisal, Patuakhali and Noakhali. Here, the maximum intensity is MM VII and seismic coefficient 0.04. It is expected that within the same seismic zone intensity of earthquake may vary due to the differences in local ground conditions.

In the recent two decades, several earthquakes have been reported in Bangladesh. Some of these earthquakes have caused considerable damages. A list of the earthquakes is given in Table2. It appears from the Table that most of he earthquakes occurred in Zone-I and Zone - II, are in conformity with zoning pattern as prescribed by the expert committee.

Conclusion

Earthquake is a natural form of rapid hazard. Its occurrence is spatially regular in a sense that with a very few exceptions, it follows the earth's zone of structural weakness. Despite extensive research and development effort given on it, advance forecasting on its place of occurrence has not been possible with certainty. But with available technology and knowledge, the geoscientists are now in a better position than a couple of decades back to tell us more on the potential earthquake risk prone zones and the degree of associated vulnerability.

Although a major part of Bangladesh is outside the high seismic Zone-I, with a moderate tremor within the seismic Zone- I and II may be catastrophic, given the population concentration and uncontrolled construction of high rise structures on filling up land of the Dhaka, Chittagong, Sylhet and Rangpur urban areas. Development effort should be directed on establishing two more seismic observatories within Bangladesh as envisioned earlier without any more delay and to upgrade the existing Chittagong observatory.

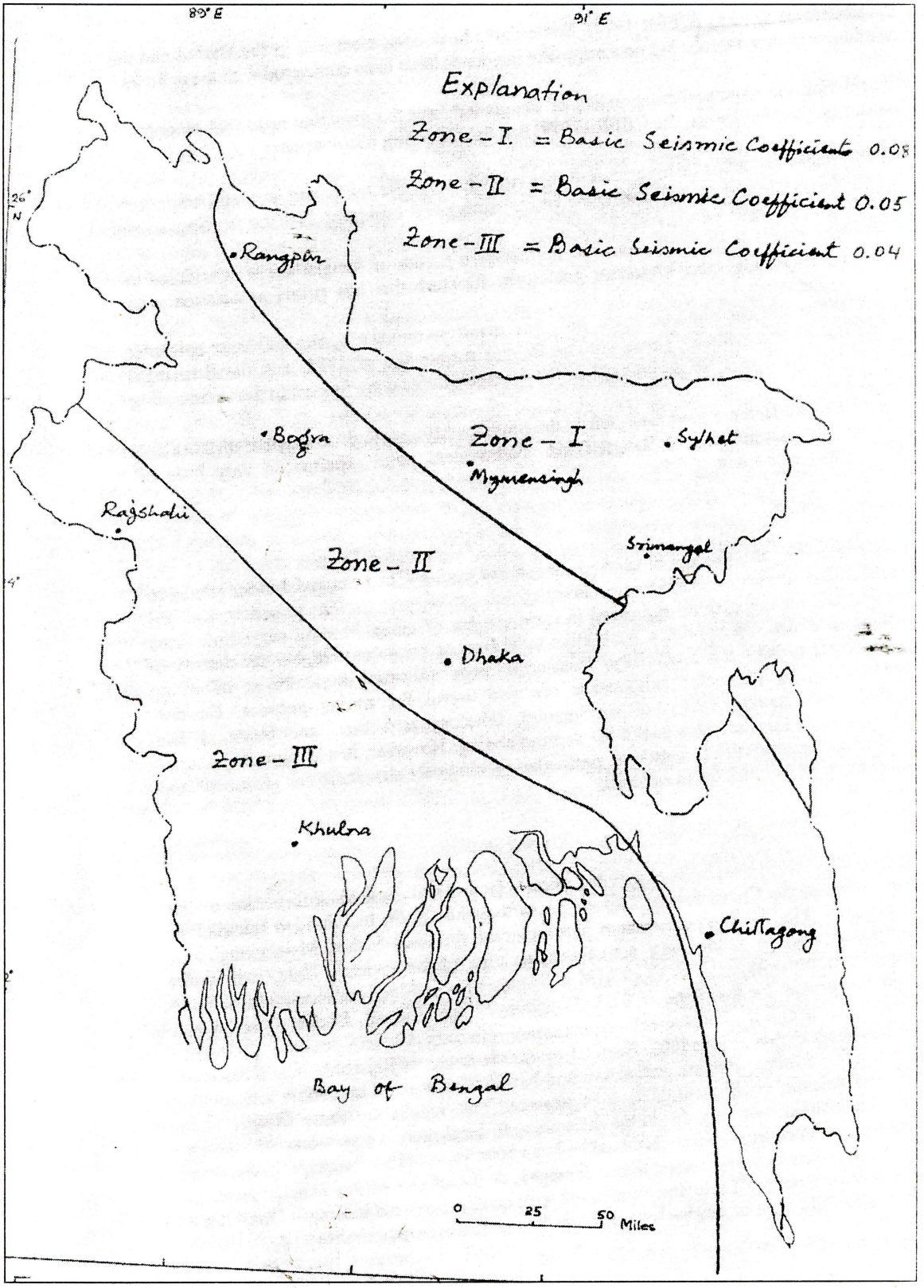


Fig. 5 : Seismic Zoning Map of Bangladesh (Source : CEER, 1969).

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Table 2 : Large earthquakes in Bangladesh

Origin	Region	Time/Year	Location	Magnitude	Comments
Near Chambal	S. Chitt Div	2 April 1762	22:ooN/92:00E		
Near Sylhet	N. Chitt Div	30 April 1868	24:50N/91:00E	7.5	
Near Dhaka	Dhaka Div	14 July 1885	24: ooN/90:00E		Great Bengal EQ
Near Kishoreganj	N. Dhaka Div	8July/1918 10:12:07	24: 50N/ 91:OOE	Mw 7.4	Srimanagal EQ
W. Durgapur	Dhaka Div	9 Sept./1923	25:25N/91:E	7.1(TS)	
N. Sylhet	N. Chitt Div	24 Dec . 1944 14:46:40	24:7N/92:20E	6.0(TS)	
Near Mohanganj	Dhaka-Chitt. Div border	19 May, 1945	25:10N90:9E	6.3 (TS)	
North Saidpur	Raj. Div	10 Dec. 1949 5:02:53	26:00N/89:00E	6.0 (TS)	
Near Vaniyachang	N. Chitt Div	24Dec 1950	24:40N/ 91:7E	6.3(TS)	
Near Netrokona	N. Dhaka Div.	12Jun 1956	24:8N/ 90:9E	6.0(TS)	
Near Netrokona	N. Dhaka Div.	21Jun 1963	24:8N/ 90:9E	6.2(TS)	
Bangladesh - Myanmar border		12May 1977	21:7:47N/92:9:9E	57(Msz)	
Near Sylhet	N. Chitt	6Feb. 1988	24.6N/ 91.5E	5.8(Mw)	2 people kille 100 injured
Bay of Bengal	Offshore	12Jun 1989	21:8N/89. 7E	Mw (5.6)	I person Killed, 100 injured
N. Indo -Bang border		8May 1997	24:8N/92:2:25E	Mw 6.0	Several injured damage to old build at sylhet.
S. Mizoram	outside Bangladesh	21Nov. 1997	22:21N/92.7E	Mw 6.1	Felt in Chitt., a 5 storey build Collapsed, 23 killed, over 200 injured
Maheshkhali Island	Chitt. Div	22 July 1999	21:54N/91:8E	ML. 4.7	Wide spread damage, 7 killed, over 500 injured, tidal surge occurred.
Off Kutuvdia Lsland	Chitt. Div	31 Dec.1999	21.43N/ 91:7E	ML 5.4	Tidal surge 4 feet high affected Cox s Bazar Coast.
Dhaka	Dhaka Div	19Dec. 2001 23.7	N/ 9040E	4.2 IMD	Slight damage MMVI) in the Dhaka city, over 100 injured in stampede at Central Jail.

Earthquake Prediction, Forecasting, Preparedness and Peoples Awareness: Bangladesh Perspective

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Abstract

Bangladesh is one of the most disaster-prone countries in the world. Although it is vulnerable to a wide variety of natural hazards, such as flood, cyclone and storm surge, drought, riverbank erosion and earthquake, most of the recent disasters have been caused by floods and cyclones. The low incidence of severe earthquakes during the last century has led to a situation where most of the population and some of the policy makers do not perceive seismic risks to be important. Recent assessment of seismicity of different regions in the country indicate that Bangladesh is bordered by highly seismic areas capable of producing damaging earthquake. Being the most densely populated country in the world, any future earthquake would be more disastrous in terms of loss of lives and properties compared to other natural hazards. Due attention should therefore be given to develop plan and strategies aimed to reduce loss of lives and properties in future earthquake. In this paper the earthquake risk facing Bangladesh is assessed and the rolle of information technology in assessment, monitoring and mitigation of earthquake hazard is discussed. Present status of earthquake hazard monitoring and mitigation measures available in the country are discussed and guideline for the future are presented.

1.0 Introduction

Earthquake is the shaking of the ground caused by release of energy due to sudden rupture of sections of the earth's lithospheric plates. Each year, more than 150,000 earthquakes are recorded by the Worldwide Network of Seismic Stations (WWNSS). Recently collected data from these sources, past earthquake data and geology indicate that Bangladesh is bordered by highly seismic belts along its northern, eastern and south-eastern boundaries. Two earthquakes having magnitude greater than 8.0 have occurred in the north-eastern and northern seismic belts in 1897 and 1934 causing widespread damage to the country. Many earthquakes of magnitude 7 to 8 have occurred within Bangladesh and also in both the aforementioned seismic belts causing damage to built up areas. Historical data shows that an earthquake occurred in 1664 having its epicenter close to Dhaka.

Presently earthquake stands as the number one natural disaster in terms of damage, destruction and loss of lives and properties. To reduce the earthquake hazards, steps must be taken to understand and quantify the earthquake problem, build structures capable of

resisting earthquake forces and develop early warning, monitoring and post disaster mitigation system. Countries facing earthquake hazards like the USA, Japan, China, Mexico and India have well developed building codes as well as advanced earthquake monitoring and forecasting system and post disaster mitigation capabilities, using these facilities damage to properties and loss of lives due to earthquake have been reduced in these countries.

Bangladesh is the most densely populated country in the world. Any future earthquake would affect more persons per square kilometer than in any other seismically active regions of the world which makes it most vulnerable to earthquake hazards. Earthquake hazard monitoring and mitigation system are almost non-existant in Bangladesh. Moreover it has been observed in the recent past that the country's civil defense and disaster preparedness schemes are also ill equipped to face the disaster associated with even minor earthquakes.

Time has come to understand by all concerned the magnitude and nature of earthquake hazard facing the country and take appropriate steps before it is too late.

2.0 Seismo-tectonic Set-up

Bangladesh is an alluvial plain with gentle slope towards the south and southeast, except in the eastern and extreme north eastern border regions where low, elongated hillocks known as Chittagong-Tripura Folded Belt protrude through the alluvium. The rocks are tightly folded with increase of intensity of folding towards east. N-S faults are also common.

The geological framework of Bangladesh is shown in Figure-1 which shows that foredeep is terminated in the northeast by a major fault, the Dauki fault at the southern margin of the Shillong Plateau. Some major earthquakes can be related to this fault. There are also numerous faults in the eastern part of the folded flank of the Fore deep. Here again there is no association of the faults with any major earthquake. Most recorded earthquakes and epicenters are located further east in Myanmar. The eastern margin of the Indian plate which runs through Myanmar, not far from the Bangladesh border, and northeast India (Arunachal Pradesh) is considered to be a corner of the northern and eastern margins of the plate. The Himalayan arc can be regarded as one of the most intensely active seismic regions of the world. In northeast India the Shillong Plateau and adjacent syntaxes between the two arcuate structures is one of the most unstable regions in the Alpine-Himalayan belt and produced three major earthquakes of magnitude greater than 8 within the last hundred years.

Two prominent tectonic features forming the boundary of Shillong Plateau towards west and south are the Dhubri and Dauki tear faults respectively. The plateau is bounded towards north by Main Boundary fault, towards northeast by Lohit thrusts, towards south-east by Naga thrust belts. This complex tectonic regime surrounding Shillong Plateau reveals that the area has experienced great compressive stresses resulting from northeastward drift of Indian plate along with westward overriding of Burmese plate (Das, 1992).

The faults in the 'Folded Belt' with mostly N-S trend have not been considered to be a source of major earthquakes. The Bogra fault has no surface indications but seismic and drilling data indicate that it has affected Precambrian to Pliocene formations. Recent studies postulate that the magnitude 7, 1885 Bengal earthquake and a number of earthquakes of smaller magnitude originated from this fault system (Bolt 1987; Ali and Choudhury, 1992).

The NE-SW lineament of central Sylhet may be the surface indication of a deep-seated fault. Recent mapping has established the existence of the Shahjibazar fault with a N-E trend, which may be related to the Meghna Lineament (Islam et al. 1991). Several historical earthquakes have occurred in the adjacent areas.

The above discussion of the tectonic framework of Bangladesh indicates that the north eastern part of the country is a zone of high seismic risk. Northern Bangladesh comprising greater Rangpur and Dinajpur districts is also a region of high seismicity. The Chittagong Tripura Folded Belt experiences frequent earthquakes, as just to its east is the'Burmese Arc" where a large number of shallow depth earthquakes originate. The presence of the Bogra fault system and other suspected basement faults, adds to the vulnerability to earthquake of the central part of Bangladesh.

3.0 Major Earthquakes Affecting Bangladesh

During the last 150 years, 7 major earthquakes (with M>=7) have affected Bangladesh as shown in Table 1

Table 1: List of Major Earthquakes Affecting Bangladesh.

Date	Name of Earthquake	Magnitude (Richter)	Epicentral Distance from Dhaka (km)
10 January, 1869	Cachar Earthquake	7.5	250
14 July, 1885	Bengal Earthquake	7.0	170
12 June, 1897	Great Indian Earthquake	8.7	230
8 July, 1918	Srimongal Earthquake	7.6	150
2 July, 1930	Dhubri Earthquake	7.1	250
15 January, 1934	Bihar-Nepal Earthquake	8.3	510
15 August, 1950	Assam Earthquake	8.5	780

Out of these, only two (viz. 1885 and 1918) had their epicenters with Bangladesh.

Fig. 2 shows a map showing location of epicenters of earthquakes with M>4.0 in Bangladesh and neighborhood.

4.0 Earthquake Prediction

Previous discussion clearly indicates that earthquake hazard exists for Bangladesh. Therefore the need for use of modern methods for prediction and monitoring of earthquakes can not be over emphasized. In the following sections the principles of earthquake prediction and monitoring are discussed with a view to assess their potential for use in Bangladesh.

It is recognized that being able to successfully and reliably predict the occurrence of earthquakes especially powerful ones, would save innumerable lives and properties. Throughout history, people have attempted to predict earthquakes in their area by observing and cataloging everything from strange animal behavior to "earthquake weather". In the last three decades, scientists have been working towards a goal to make earthquake forecasting about as reliable as weather forecasting. They wish to be able to predict not only the date and location of a quake, but also the intensity of damage to different regions. But in spite of the huge data gathered from innumerable earthquakes, scientists are yet to develop perfect techniques for short term prediction of earthquakes. However, it has been possible to recognize potentially hazardous areas and assess the likely impact on structures and buildings.

What is an earthquake prediction? U.S. National Academy of Sciences (1976) has given the following definition: "An earthquake prediction must specify the expected magnitude range, the geographical area within which it will occur, and the time interval within which it will happen, with sufficient accuracy so that the ultimate success or failure of the prediction can be easily judged. Only by careful recording of failures as well as successes can the eventual success of total efforts evaluated and total efforts be charted. Moreover, scientists should also assign a confidence level to each prediction. Even low confidence predictions would be considered and evaluated .

A few systematic approaches to earthquake prediction were undertaken by scientists during the 1970s and 80s. One of these approaches correlated the regularity of earthquake events with time taken for the stress build-up between two successive events.

After analyzing such data, forecast for the next rupture was made after taking into account of natural variables. But the prediction based on this approach made fail. Another approach relied on the inelastic volumetric increase found in the rocks due to the formation and prorogation of cracks within the region prior to an impending earthquake. Chinese scientists achieved a few successful prediction by extrapolating ongoing seismic activity in the earthquake-prone Jiashi County in China. In fact they predicted successfully the time and magnitude of three successive quake events in 1961. However, this approach could not be applied for prediction in isolated areas. Several signals preceding quakes have been suggested as precursors. Some of these are: variation of spurt in electromagnetic radiation, crustal movement and land deformation, foreshocks, changes in hydrological, biological and

geo-chemical spheres etc. However, none of these precursors was found to be viable when evaluated against the norms of acceptability.

Predicting earthquakes accurately appears to be complex and difficult task and here lies the challenge to science and technology.

4.1 Why predict earthquakes?

Besides the objective to lessen the damage to lives and properties, knowing the potential for earthquake can be useful in other ways also. Having information about the possibility of earthquakes would be very handy when choosing the site of major structures, such as a dam or nuclear reactor. Putting such a structure in an active area could lead to many more deaths and problems than having the same structure in a stable area.

At present, we can determine which areas of the Earth have the most potential for damage, but we cannot determine within a short time when a major earthquake will occur. We know form historical records and observation how often many faults move, thus we can tell which are due to move next. However, we can only guess with an accuracy of ±50 to 150 years; not very useful for evacuating towns before a quake. Narrowing the window of earthquake occurrence to a few hours or days would be extremely useful, but at the same time is the hardest part of earthquake prediction.

4.2 Harbingers of doom

It has been suggested that there are certain events which occur before earthquakes. Earthquake are caused by build up of strain in rocks. As stress builds up strain is produced, it can be measured and the maximum strain can be calculated. Using these data very general prediction about when the fault will rupture can be made. The most reliable sources of earthquake clues are changes in P-wave velocity, ground uplift or tilt, radon emission, electrical resistivity and the number of local earthquakes.

4.2.1 Changes in P wave velocity

It is known that the properties of rocks change before an earthquake, and the velocity at which various earthquake waves travel through them change as well. It was observed in the past earthquakes that the P-wave velocity changes by about 10%-15% before earthquakes. The measurements of velocity are very easy to make using seismometers. However, using this method alone, the precise location of the shock is difficult to predict and other clues to forthcoming earthquakes must be found.

4.2.2 Ground tilting

As stress builds up along a fault, the ground level can change. The ground often tilts or rises in the area of a coming earthquake. However to be recognized that many processes cause

the ground surface to rise or tilt including previous earthquakes, upcoming volcanic eruptions etc which makes this technique difficult to use as a predicting tool.

4.2.3 Fluctuation in radon gas emission

Deep wells have been noted to experience and increase in the release of radon gas in the area around a forthcoming earthquake.

4.2.4 Changes in electrical conductivity

The electrical conductivity of rocks in the area around earthquakes has been known to change just before shocks. Worldwide studies have been done on the conductivity of water saturated rocks in the lab and in the field which indicate that this could be a very helpful clue in forecasting earthquakes.

4.2.5 Patterns of foreshocks and aftershocks

In terms of prediction research, the most effort has been put into studying variation in seismicity rate. But, all of the studies have not produced a definite answer. In Italy, China, and California, earthquakes have been successfully predicted using a noticed increase in background seismic activity. Tiny shocks increase in number and magnitude leading up to a large shock. If these foreshocks can be recognized as such in enough time to warn people many lives can be saved. These five predictors do not all happen at the same time or for all earthquakes, rather, may occur in stages as shown in the following table:

Table 2 : Stages of Earthquakes

Stage I	Elastic strain builds up along a fault due to plate movement. All parameters are at their normal state. No uplift, radon increase, etc.
Stage II	Cracks begin to develop in crustal rocks in the pre-quake area. The buildup begins to be visible as an uplift of the area. The cracked rocks do not propagate P-waves as easily and their velocity slows in the area. Radon gas can escape through the newly formed cracks, and electrical resitivity decreases. The newly forming cracks and increasing stress may also result in a tiny increase in local seismicity.
Stage III	Groundwater from surrounding areas can now flow into the new cracks. Because the cracks are now filled again, the P-wave velocity can increase back to normal. The ground's uplifting also ceases and radon gas emission decreases. Electrical resistivity is still decreasing.
Stage IV	THE EARTHQUAKE
Stage V	This begins as soon as the main shock stops and consists of all the aftershocks.

5.0 Monitoring and Forecasting

Natural disaster monitoring has advanced much in recent years with the emergence of new technologies. Weather satellite and Doppler radar have revolutionalized severe storm forecast. Open communication channels between weather services, emergency management agencies, the media and the public have made advance storm warning effective in reducing loss of lives. While early warning of earthquakes have not been as well established, their advances in the near term are certain. The use of infrared remote sensing data, such as those provided by the NOAA meteorological satellites to forecast impending earthquake has also shown some promise (Qian, 1977).

5.1. Designing a disaster monitoring network

The United Nations Global Program for the Integration of Public Administration and the Science of Disaster was created in 1996 to help advance the sciences of disaster monitoring and their integration into public administration and disaster management. The Global Program operates on the principle that open communication between all players in a disaster scenario leads to better community preparedness and response.

At the First International Conference on the Integration of Public Administration and Science of Disaster (Jan 20-28, 1997, Beijing, China), the Workshop on Information Technology and International Networking gathered the experiences of public administrators, scientists, and general public and recommended the adoption of a "culture of networking and sharing". Three principles emerge:

5.1.1 Develop a global network and culture for sharing information

- Develop a global network of natural disaster information that allows open exchange of information among appropriate users.
- Take local technology and infrastructure into consideration.

5.1.2 Design for ease of use, robustness, readiness and for all users

- Design the network for ease of use and robustness;
- The overall network should be viewed as a tool for disaster research and management, and not just a repository of data on the Internet.
- Web site or any interface design should be simple and cross culture.

5.1.3 Training and continuous development

- Develop regular testing procedure to assure network and personnel readiness. The weakest part in an automated system is often the human link. Training and continuous participation of emergency managers, public administrators, scientists and other potential users will assure operational readiness and system usability.

- Established network communication can also be used for on-going discussion and sharing of experiences from all fields of disaster management. Virtual meetings are low cost and the exchanges can be achived to form a knowledge-base for disaster management.

5.1.4 Gather broad base support

- Promoting disaster network in schools and community keeps the disaster professional and public administrators connected with the people the network is intended to serve.
- Diversify funding sources and participation to include the private sector. Entrepreneurial energy can often accelerate technology development.

5.2 Monitoring Network

China currently has a large number of official and unofficial monitoring stations specializing in specific methods. A partial listing of some `proven' techniques (Zhang et al., 1996) is as follows:

Table 3 : Monotoring Techniques

Precursor type	Crustal deform	Hydro chem	Water well	Geo-magnetics	Geo-electricity	Gravity	Stress-Strain	EM-wave
No.of stations	.262	493	504	255	95	14	70	36

The National Center for Seismic Data and Information (NCSDI) under the State Seismological Bureau (SSB) manages a number of `intranets', incluidng a network of provincial analysis and prediction centers (APnet), 24-station Nnational Seismic Monitoring Network (NSMN), and the Northern China United Seismic Network (NCUSN). Data are pooled and disseminated directly to appropriate ministries. In some areas, local monitoring stations are linked by regular telephone and radio transmissions to a central monitoring office.

A collaborative network linking earthquake scientists and pubic administrators is proposed by the UN Global Programme. The objective is to improve utilization of the large body of scientific knowledge in earthquake monitoring in China by increasing exchange and collaboration among scientists working on different methods of earthquake monitoring.

It has been observed that, even among scientists supported by UNGP, different monitoring methods yield information on time, location, and magnitude of earthquakes that varies widely. Data are stored in different format and often, in analog form. In April, 1997, three scientists combined crustal stress, resonant tidal wave superposition, and infrasonic wave

methods to provide an accurate prediction of the Jiashi (Xingiang province) earthquake to the State Seismological Bureau (SSB). Quick public administrator response and evacuation of dwellers in unsafe buildings led to many lives saved (Li, 1997). It is only through open sharing of data from different methods, among all earthquake risk management professional, that we can advance the science of earthquake risk monitoring as a whole.

5.3 Collaboration and integration with pubic administrators

While we continue to establish the scientific foundation for the earthquake monitoring techniques, attention is also given to public administrators and their needs in applying earthquake data for real-time risk management tasks.

Regular forum for all parties to exchange ideas and update on risk management practices is best achieved through face-to-face meetings and conferences. However, virtual meeting is an economical way to allow scientists, public administrators and all concerned with earthquake risk management to develop working relationships and rapidly disseminate research findings as well as practical ideas.

6.0 Observational Facilities and Public Awareness: Bangladesh Scenario

The Meteorological Department established an observatory at Chittagong in 1954 with facilities for seismic and geomagnetic observations. This remains the only observatory in the country till today. The seismic equipment consisted of three-component short and long period, low magnification Sprengnether seismographs. The N-S component has been out of order for long time. The observatory also suffers from serious noise/vibration effects from nearby major highway and main railway lines and the sea is only a few hundred metres away.

Detailed evaluation of seismicity of the country calls for monitoring of all earthquakes of magnitude 4 and above occurring in and around Bangladesh. For this purpose a network, preferably a dense network of observatories is desirable.

There is lack of awareness not only among the public but also among the decision-makers about the earthquake hazard in the country. The main reason for this is that excepting the 1918 Srimongal Earthquake; no major earthquake has affected Bangladesh in the last century. Earthquake, as a natural hazard, appears to have been relegated in relation to the more commonly occurring natural disasters like flood, cyclone and storm surge, and river erosion. This has given rise to a sense of complacency with the result that excepting large engineering projects, earthquakes are not usually considered in design and construction. There is, therefore, an urgent need for educating the public and decision-makers about the threat posed by earthquakes in the country.

7.0 Conclusion

A review of the available data shows that considerable seismic hazard exists for major parts of the country. About 20 million people, representing one sixth of the current total population live in Zone I, i.e. areas that may be classified as "liable to severe damage" and another 60 million (i.e. 50 percent of the population) live in Zone II i.e. areas "liable to moderate damage". Some of the major city i.e. the capital Dhaka, with a population of 10 million and the major port Chittagong are in Zone II. Measures for overall disaster mitigation must, therefore, include recognition of earthquakes as a major natural hazard. Earthquake monitoring and hazard mitigation efforts must also be undertaken immediately to reduce loss of lives and properties and future earthquakes.

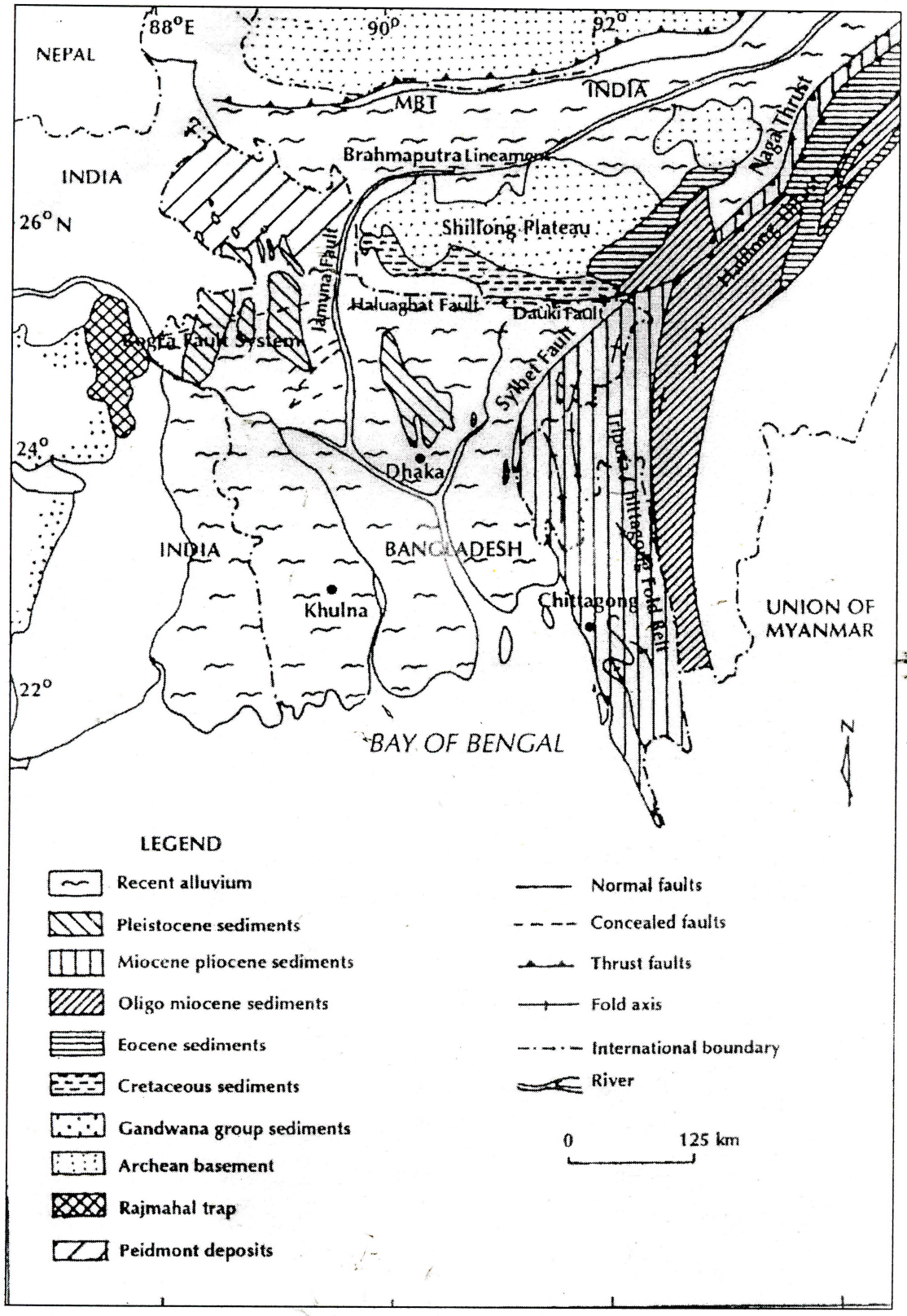


Fig. : 1 Geological framework of Bangladesh neighborhood

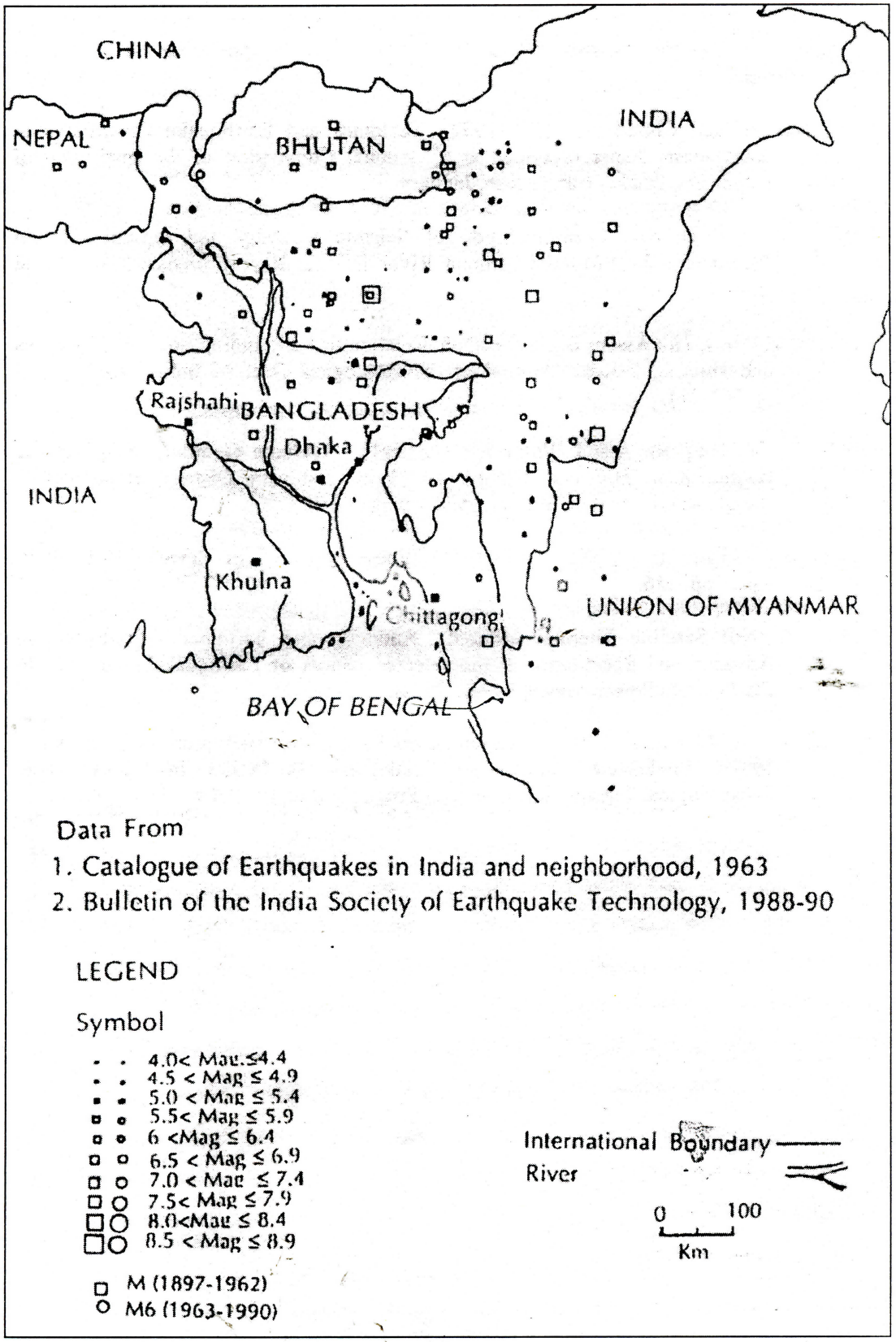


Fig. : 2 Seismic map showing epicentres in Bangladesh and neighbourhood

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Seismic Observation, Earthquake Information, Tsunami Warning and Earthquake Prediction in Japan

Yuji Nishimae, Japan Meteorological Agency (JMA)

1. Introduction

Japan is situated at one of the most seismically active areas in the world. Figure 1 shows tectonics around Japan. There have been occurring a lot of earthquakes and tsunamis which struck cities and towns causing sometimes destructive disasters. Figure 2 indicates destructive earthquakes that magnitude are larger than 5.0 and depth are more shallow than 100km from 1900 to 2001. Therefore, efforts for mitigation of such disasters have been continued as one of the most important national programs. The Japan Meteorological Agency (JMA) conducts seismic and tsunami observation, and issues information on those phenomena and tsunami warning in order to mitigate disasters.

2. Seismic Observation

In 1993, the Southwest off Hokkaido Earthquake Tsunami attacked Okushiri Island only several minutes after the earthquake. JMA constructed new earthquake monitoring network and processing system in order to provide tsunami warning in about three minutes after an earthquake occurrence. This new network consists of about 150 seismic stations. Figure 3 shows the distribution of the stations and data transmission lines. The short-period seismometer and/or the strong-motion accelerometer are installed at the stations. Figure 4 is the picture of our standard seismic observation site. All the data are continuously transmitted to the computer system at the Headquarters and five District Meteorological Observatories by exclusive telephone lines on a real time 24 hours a day.

The seismic intensity is convenient scale in order to evaluate the degree of the ground shaking which implies the degree of disaster. The seismic intensity has been measured immediately after an earthquake automatically by use of strong-motion accelerometer. The seismic intensity observation sites increased up to about 3000 stations until now. Figure 5 is their distribution and the picture of the intensity meter. The seismic intensity data are usually transmitted by telephone line but it is also possible to use the satellite link in order to transmit the data from the intensity observation network if the landline is damaged.

3. Tsunami Warning

When a large shallow earthquake occurs at sea area, tsunami often generates by crustal deformation of sea floor. When an earthquake occurs around Japan, JMA issues a tsunami warning in about three minutes after an earthquake.

The empirical method has been used for tsunami warning. In 1999, the new tsunami warning system was commenced. The numerical simulation techniques are used for the

tsunami warning. Figure 6 indicates the methodology of the new tsunami warning system. Many fault models are set around Japan(Figure 7), and tsunami waveforms are calculated by these fault models such as Figure 8. The results of the numerical simulations are stored in the computer system in advance. When a large earthquake occurs, the best tsunami waveforms by the earthquake will be searched from the database, and the tsunami wave heights will be issued at the each coast.

Tsunami also propagates far from earthquakes. For example, Chilean tsunami of 1960 caused severe damages at all over the Pacific coasts including of Japanese coasts. The Pacific Tsunami Warning Center (PTWC) in Hawaii was organized to mitigating the tsunami disaster of the Pan-Pacific countries. JMA issues tsunami warning based on a numerical simulations and the information from PTWC. JMA will also issue the tsunami advisory as the Northwestern Pacific Tsunami Advisory Center in the near future.

4. Procedure of Issuance of Earthquake and Tsunami Information

JMA is monitoring occurrences of earthquakes 24 hours a day, and after a felt earthquake occurs in Japan, the seismic data are immediately analyzed and the hypocenter and magnitude are determined. And then, appropriate statements are issued. Figure 9 shows the procedure of the information issuance. When an earthquake occurs and seismic intensity is 3 or above in JMA scale, the information including maximum seismic intensity and the observed region name is issued in about two minutes. After the hypocenter and the magnitude of the earthquake are determined, if necessary, tsunami warning are issued in about three minutes, and then the earthquake information is issued. This information is automatically transmitted to the organization related to disaster mitigation of central and local governments through the computer system and the residents through the government and broadcasting media. If the maximum intensity is less than 2 in JMA scale, the earthquake information would be issued after about 10 minutes. Figure 10 shows this flow chart. The satellite link is also used for dissemination of the earthquake information and tsunami warning/advisory. Japanese people mainly get the information from the broadcast media such as TV or radio. Now, they can get the information from the JMA's web site.

5. Monitoring of Seismicity Near Japan

JMA is observing the seismicity near Japan. Figure 11 is the epicenter distribution of the earthquakes determined by JMA in 2001. In 1997 started the concentration and the integrated analyses of observational data of earthquake obtained by JMA and universities, then the results of them are sent to the Headquarters for Earthquake Research Promotion under the Ministry of Education,Culture,Sports,Science and Technology for better understanding of seismological activities in the country. It is possible for us to understand the detail of the seismicity in and around Japan.

6. Earthquake Prediction in the Tokai Area

Tokai area(Figure 12) is considered as the area where the occurrence of the Tokai Earthquake is imminent. Earthquake predictions are generally very difficult and still in

the research stage. However, the Tokai Earthquake is considered to be predictable because the mechanism of the occurrence is clearer than the other earthquakes. A lot of instruments such as seismometers, strainmeters, tiltmeters and GPSs are deployed in order to identify the precursor phenomena of the Tokai Earthquake. Figure 13 indicates the distribution of the instruments, and the part surrounded with the blue solid line is the assumed source region.

JMA is watching the data transmitted from the instruments. If unusual phenomena would appear in the data, JMA convenes the Earthquake Assessment Committee. If the Committee admits that Tokai Earthquakes are anticipated to occur within few days, the Director-General provides the Prime Minister with the Earthquake Prediction Information. The Prime Minister announces an Earthquake Warning Statement for relevant organizations to take emergency activities.

7. New Technologies

7.1 Estimation of seismic intensity

JMA utilize for an information announcement of the seismic intensity from about 3000 intensity meters. However, there is an area in which the intensity meter is not installed yet. The seismic intensity of the area in which such an intensity meter is not installed is estimated from surrounding seismic intensity. Figure 14 shows the seismic intensity distribution of the western Tottori Prefecture earthquake in 2000 and the contour map of the estimated seismic intensity.

7.2 Nowcast earthquake information

There are two kinds of seismic waves called P wave and S wave. Generally, S wave amplitude is lager than P wave amplitude, and the earthquake disasters are usually caused by S wave. S wave propagates in lower velocity than P wave, and then might be possible to issue the earthquake information for the far field in several seconds before the arrival of S wave after the detection of P wave (Figure 15). This rapid earthquake information is called Nowcast earthquake information. Figure 16 shows examples of usage of Nowcast earthquake information.

Plate Tectonics around Japan

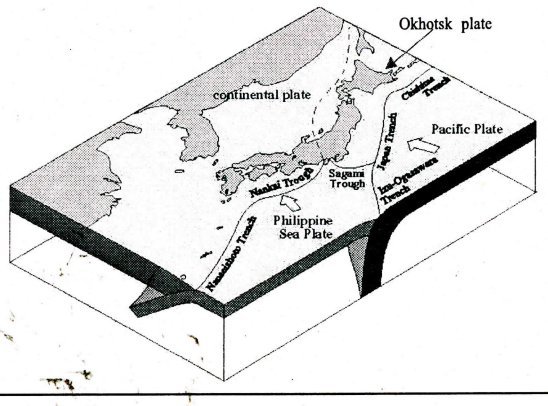


Figure 1

Figure : 2

Distribution of earthquakes (≦ .0, Depth <100km)causing damages(1900~2001)

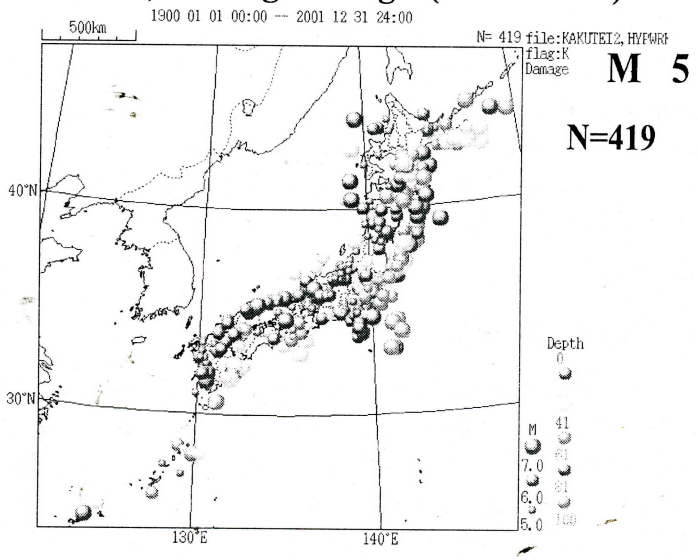


Figure : 3

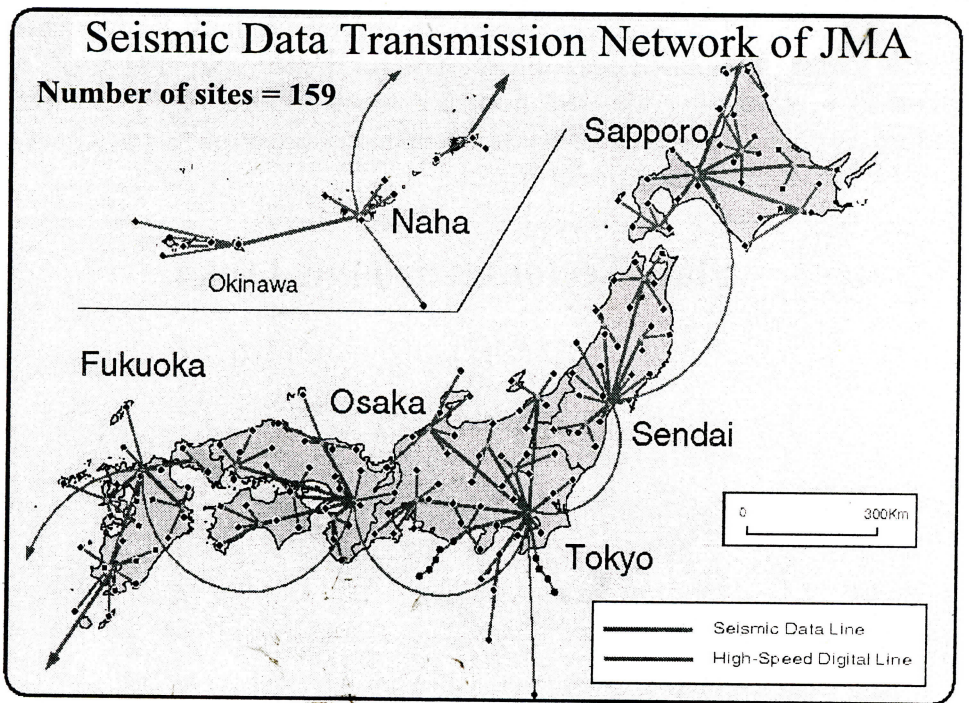


Figure : 4

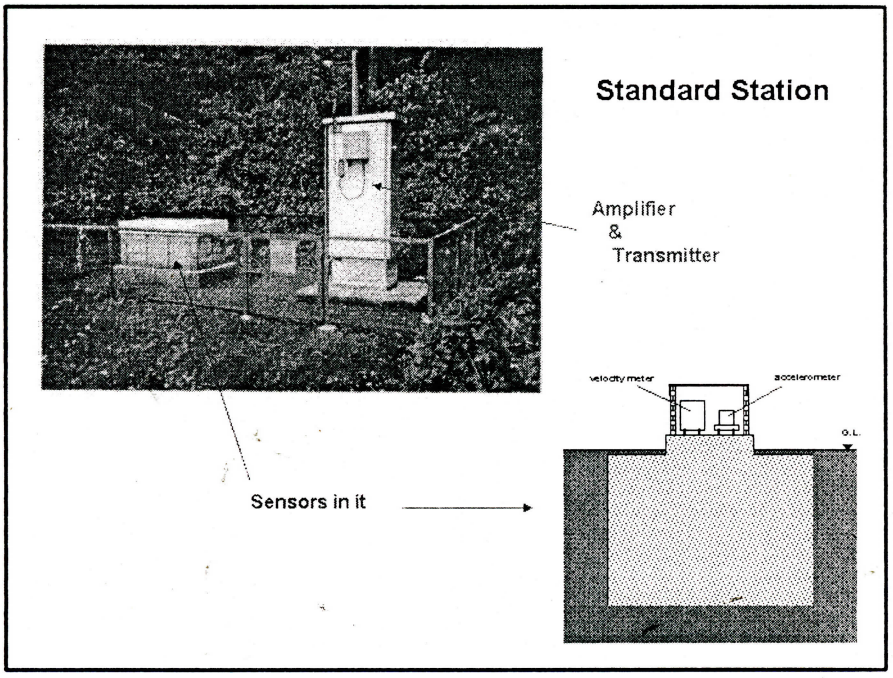


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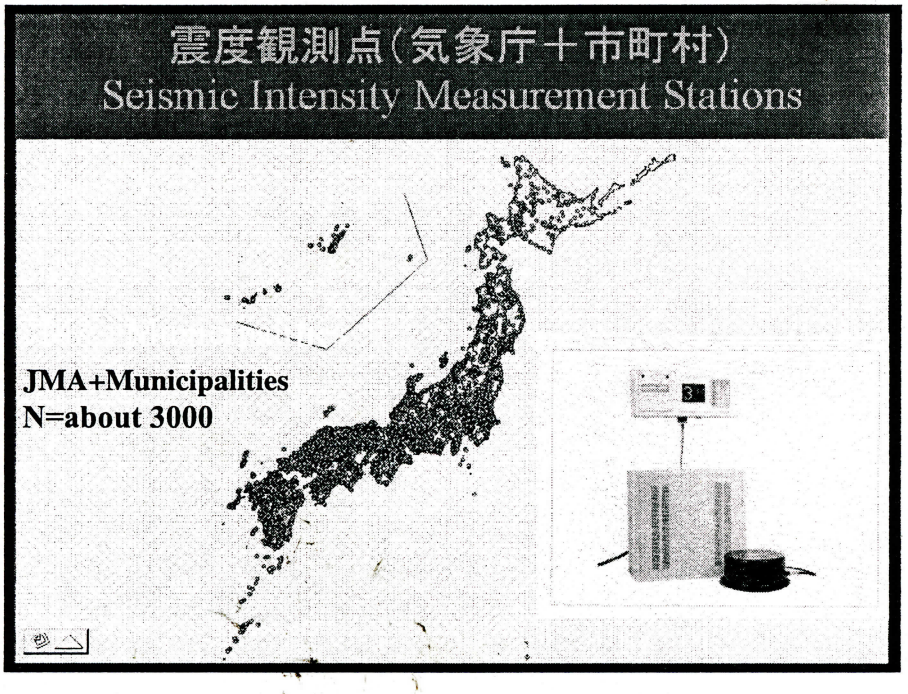


Figure : 6

Methodology of Advanced Tsunami Warning

Initial Tsunami Wave Estimation by Fault Model (100,000 different cases)

✚

Tsunami Propagation by Numerical Simulation with 2-4km grid size

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Database of Tsunami Heights and Arrival Times as a Result of the Simulation

Figure : 7

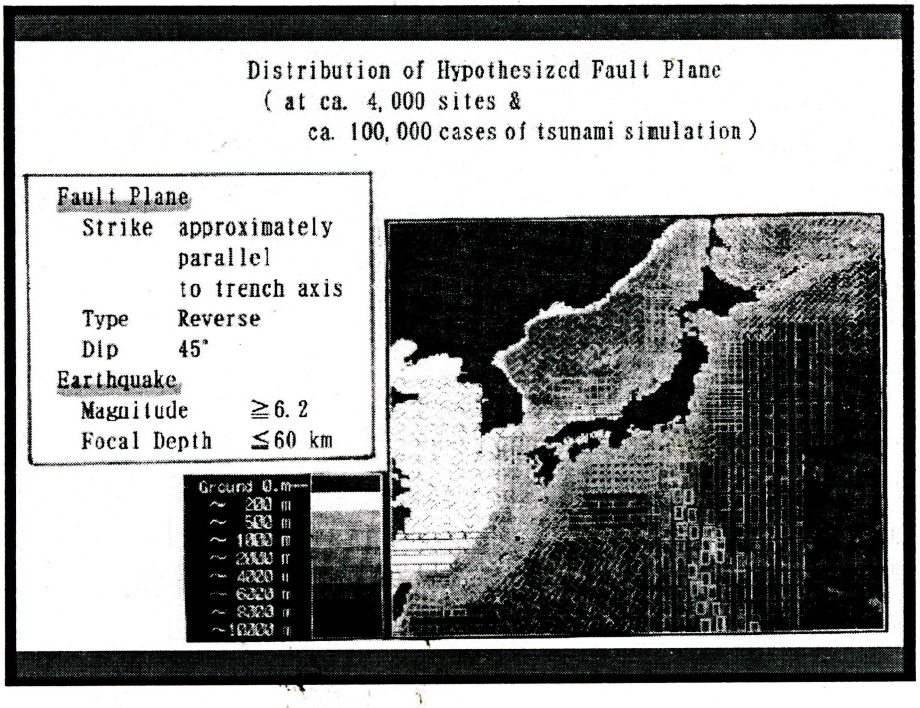


Figure : 8

Example of tsunami simulation

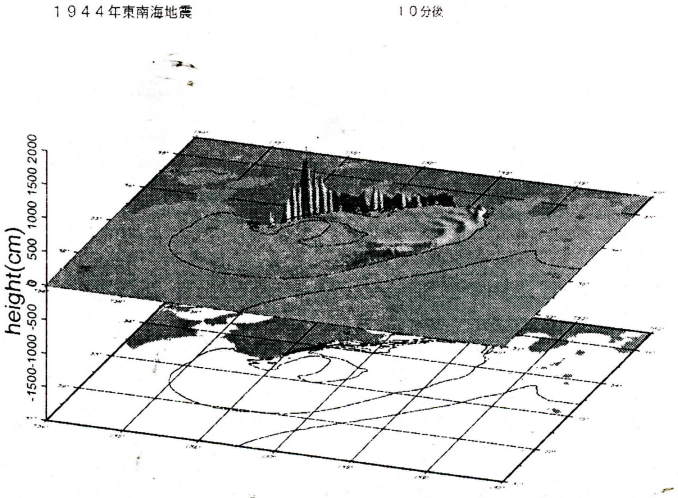


Figure : 9

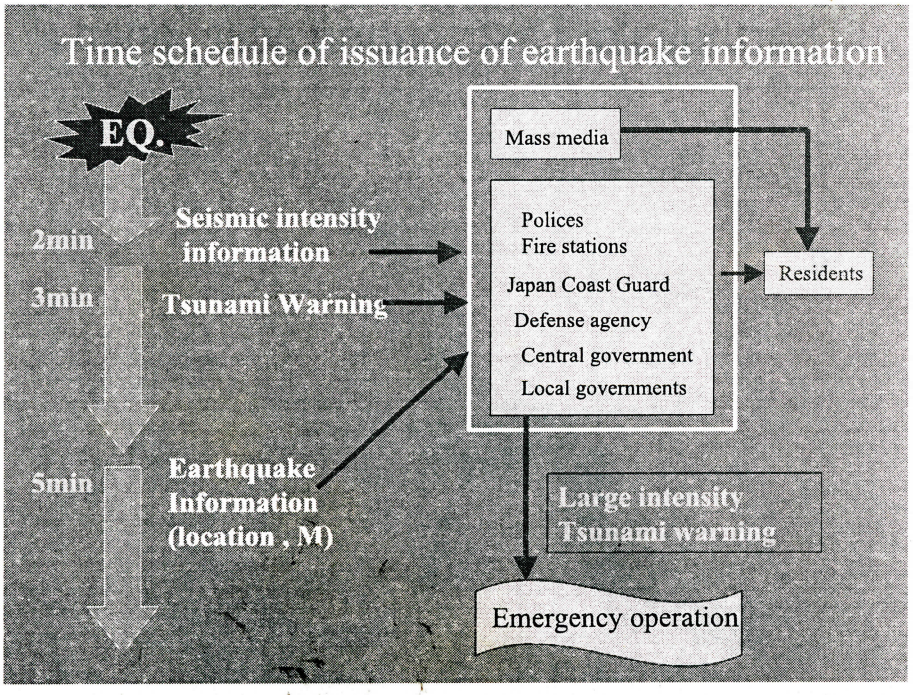


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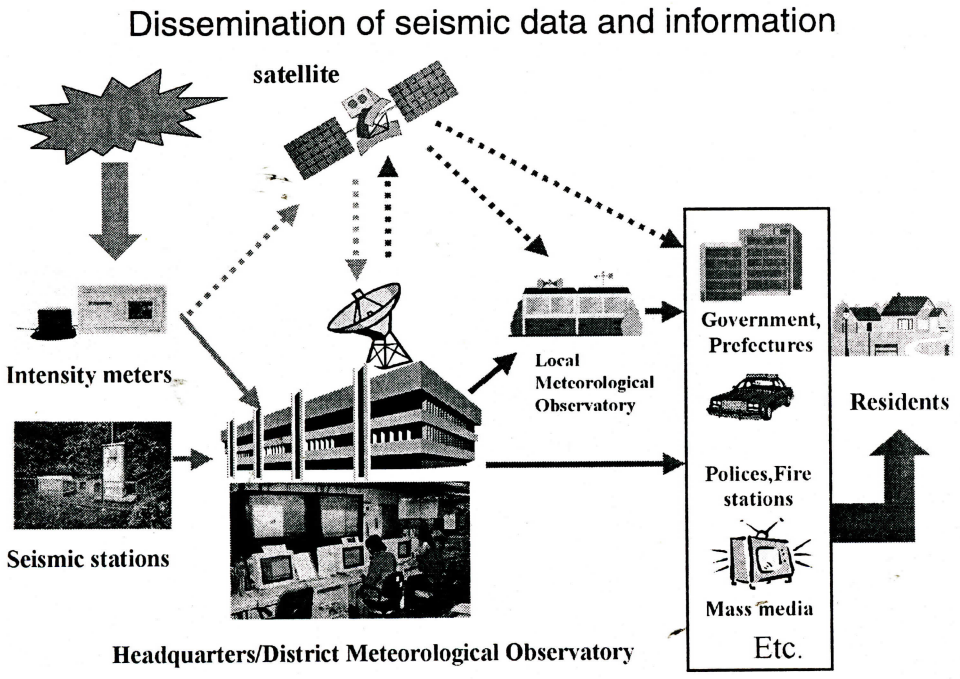


Figure : 11

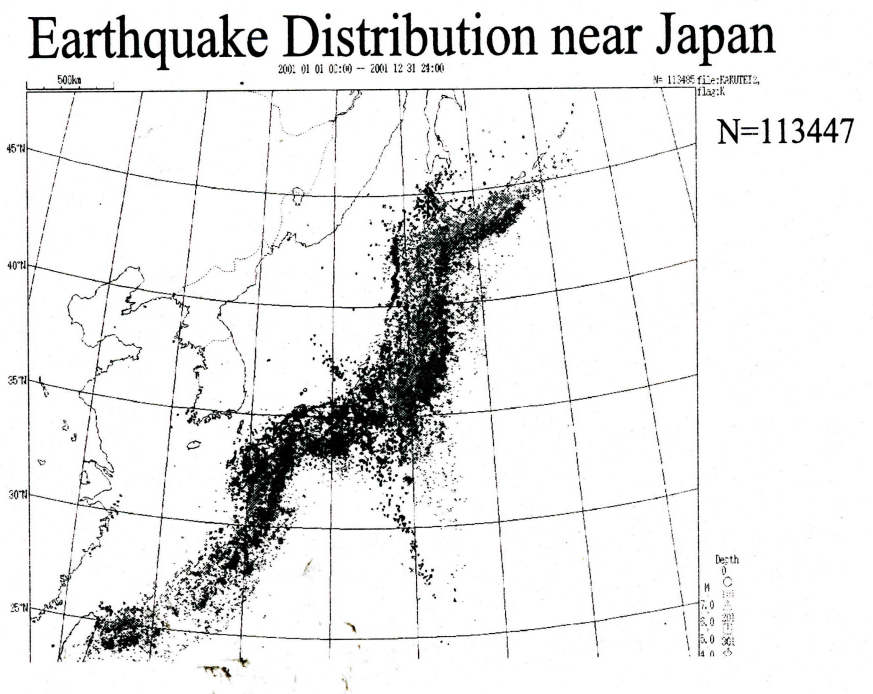


Figure : 12

Areas under Intensified Measures against Earthquake Disasters

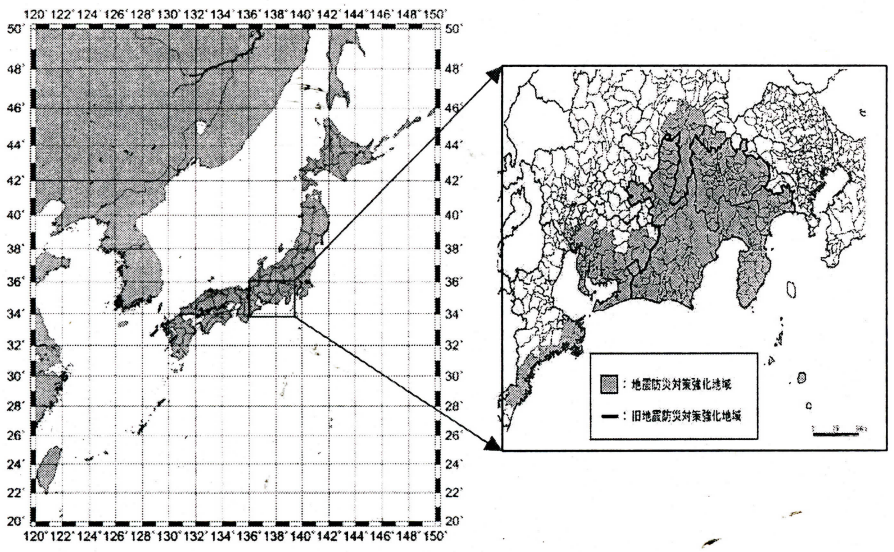


Figure : 13

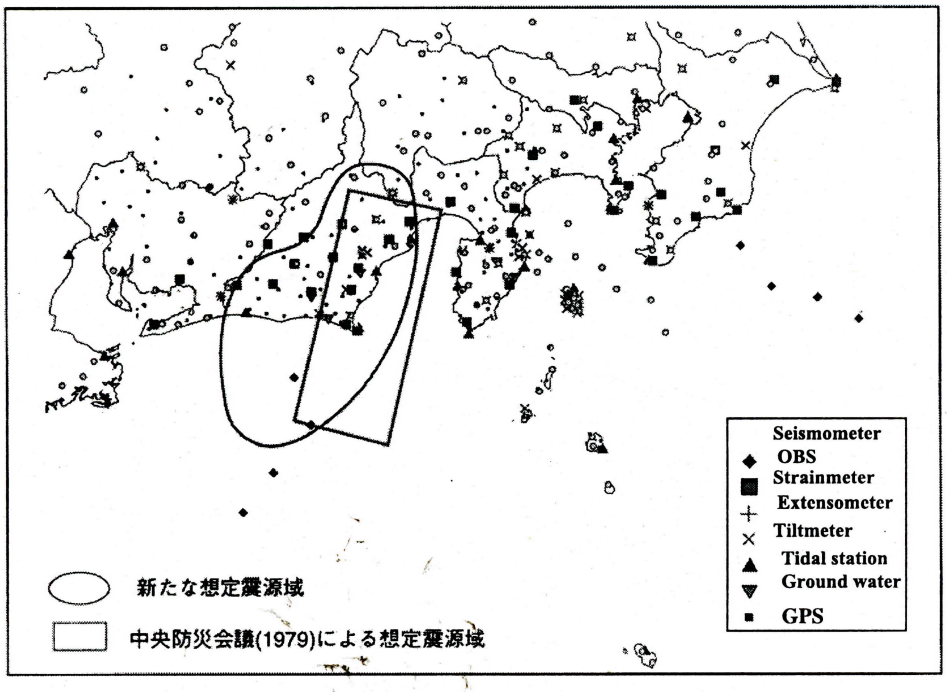


Figure : 14

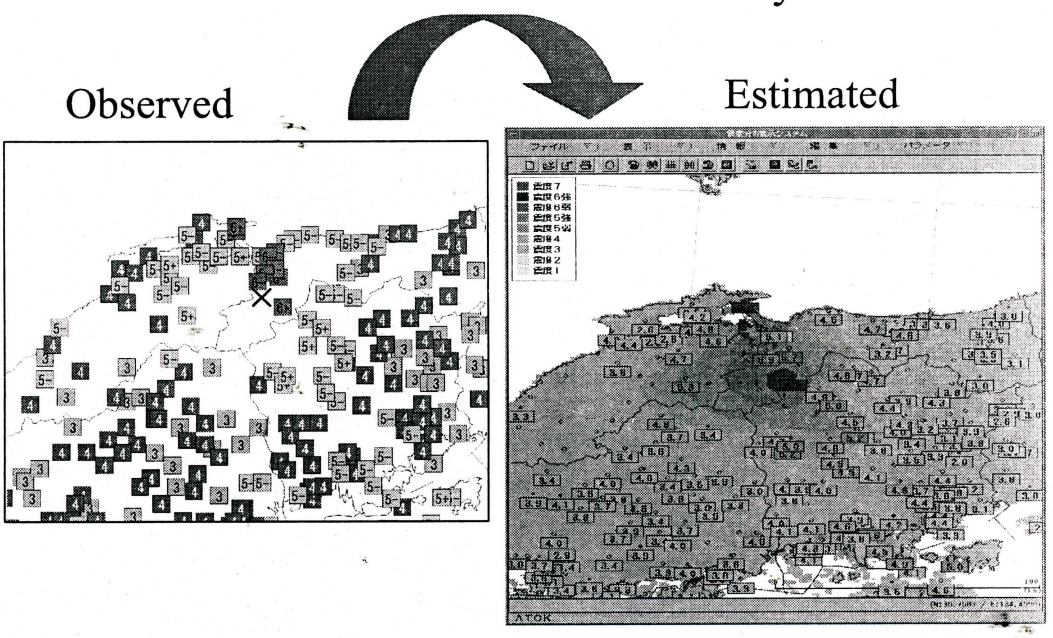


Figure : 15

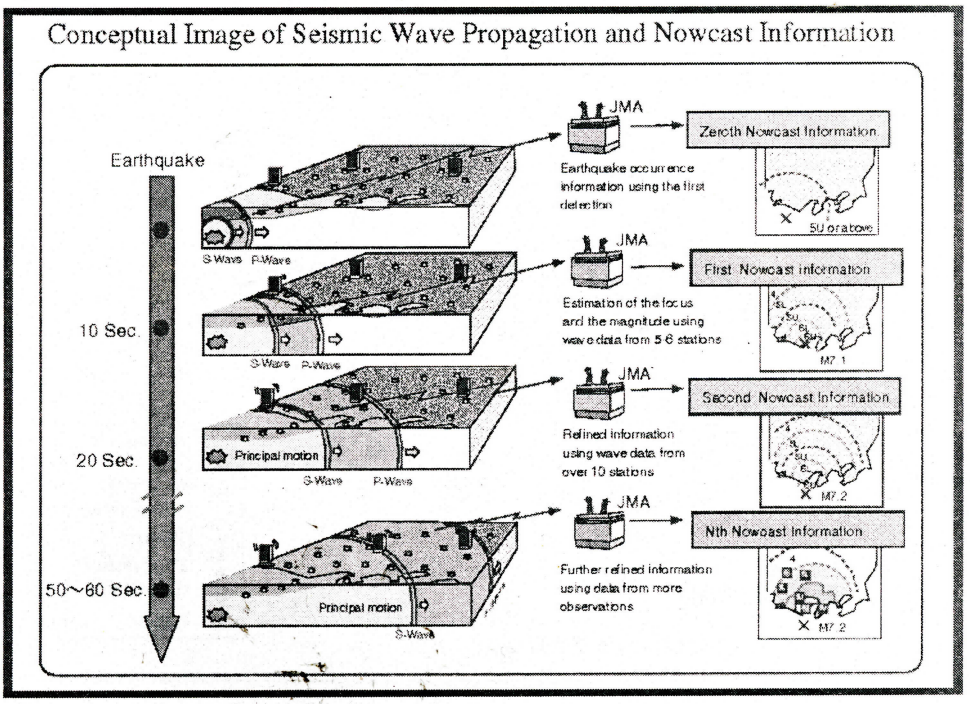
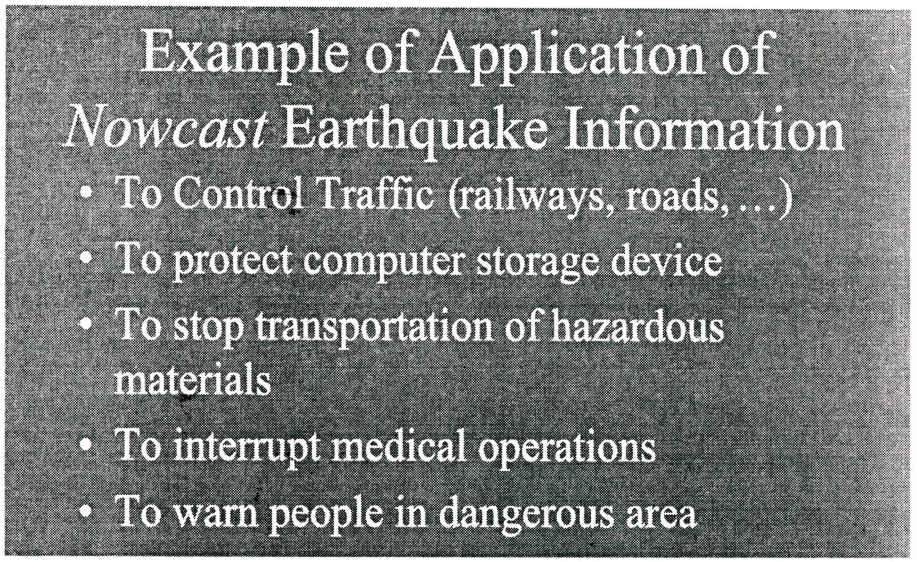


Figure : 16

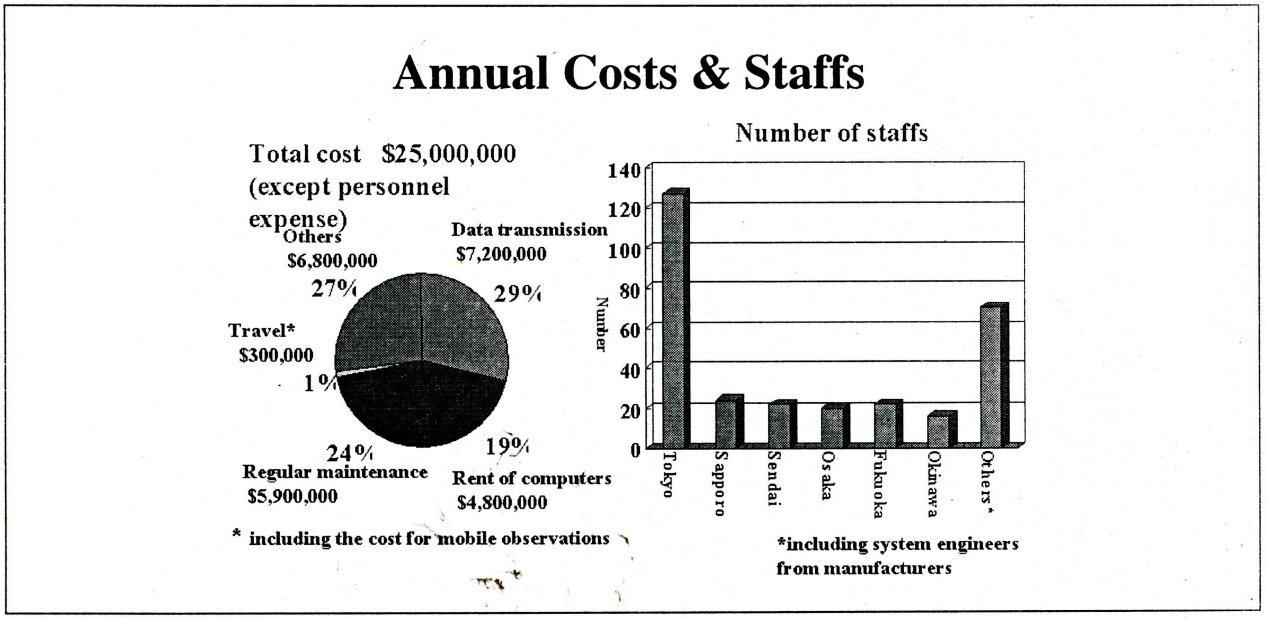


Appendix

Staffs and Budget

About 300 staffs at JMA's seismological and volcanological division are working for the earthquake analysis, volcanic observation and operation and maintenance of the network now.

The total of the JMA's annual budget is about $270,000,000 and about $25,000,000 is spent for the services for seismological and volcanological monitoring and information issuance including operating and maintaining the networks except personnel expense (figure below).



Earthquake Risk and Vulnerability Analysis: Japanese Practices and Lessons

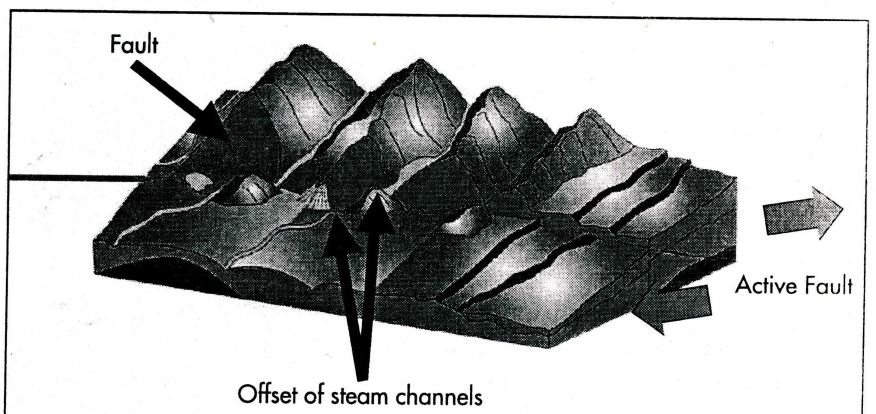
Toshiaki Udono, Hidetoshi Kakiuchi
PASCO Corporation, Japan

1. Mechanism of Earthquakes and Damage Caused by Them

1.1 Mechanism

An earthquake is triggered by a sudden fault movement in a zone of the crust where the accumulated strain surpassed the level that the rock can sustain. Driving force provided by the expansion of Indian Ocean floor causes the collision of the Indian Sub-Continent with the Eurasian Continent, the formation of Himalayan mountain building, and remarkable intra-plate earthquake activity along the fault systems. Also many earthquakes are occurring along the oceanic trenches where oceanic plates are subducting under continental plates.

How to recognize the faults expected to generate future earthquakes. There are observed some geologic features of active faults. For example, fault scarps continuously observed along a line, systematic offset of stream channels and valleys, lost ponds, and so on. The evidence of accumulative movement along a fault is used to judge the activity of underlying fault. When a Quaternary deposit is displaced by a fault and some cumulative features of displacement is observed, then the fault is identified as an active fault and from the evidence of repeated fault movements the next fault movement and accompanying earthquake event will be predicted.



Prime Minister's Office; Seismic Activity of Japan Figure 2-21

The larger the unit fault displacement is, and then the magnitude of associated earthquake becomes larger.

1.2 Damage

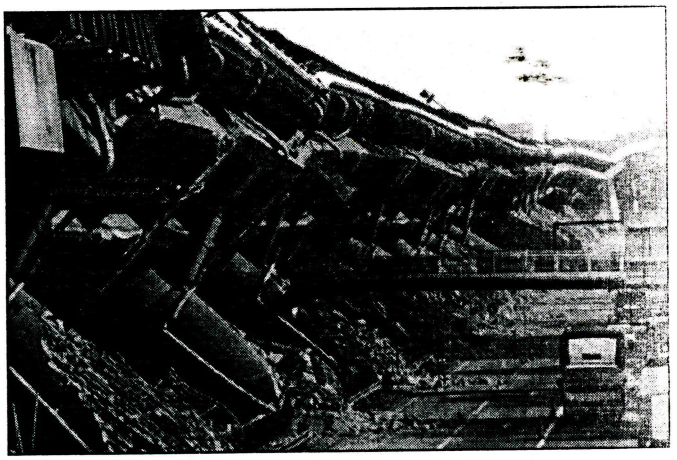
Large earthquakes have caused various types of damage:



- **Structural damage of buildings and houses.**

This photo shows damaged buildings by strong ground motions. Various types of structures such as RC buildings, embankments, high-rise bridges and railways were destroyed. Lifelines such as sewage ducts, gas and power lines were also severely damaged by the strong shaking caused by the earthquake.

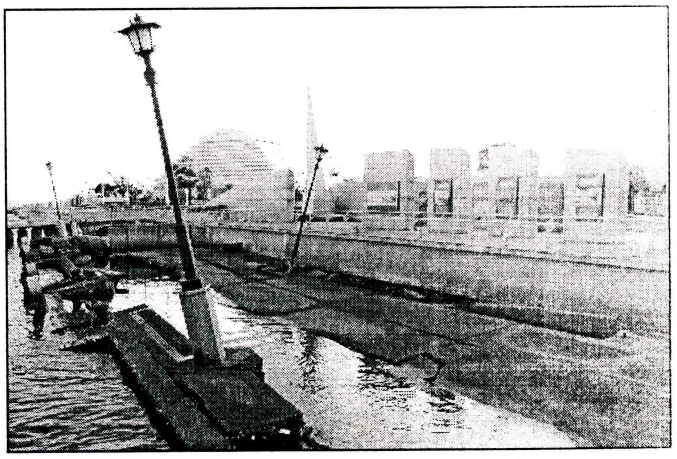
- This photo shows the collapsed expressway of considerable length by turning down to the mountainside of the city. Beforehand, no Japanese experts could predict for this kind of damage to occur in the modern expressway designed by the recent seismic design force.



- Fires started after the earthquake at several blocks of residential area swallowed over the wide area causing many loss of lives



- This photo shows severe liquefaction occurred over the reclaimed lands along the coast and in the port area. However, modern buildings and warehouses in the port area were structurally survived regardless to the severe liquefaction, soil spread and subsidence of the surrounding soil.



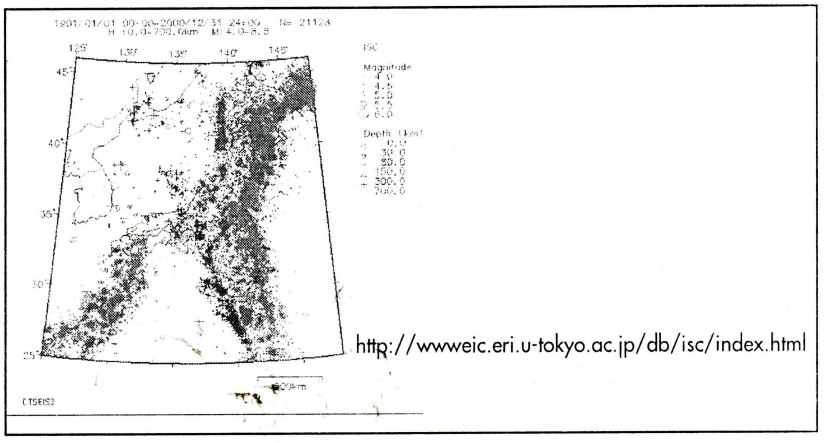
- This photo shows fall-out of mountain slopes and land slides observed in the event of 1984 Naganoken Seibu Earthquake of Magnitude 6.8 occurred near the active volcano Mount Ontake in Nagano prefecture of central Japan.



2. Earthquakes in Japan and Earthquake Damage Analysis

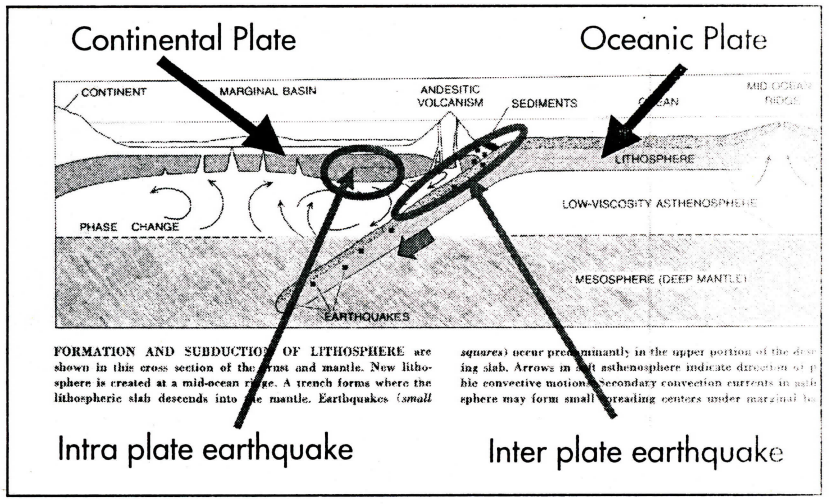
2.1 Earthquakes in Japan

Earthquakes often occur in Japan. The country has experienced damage from a number of large earthquakes over the years. Next figure shows a distribution of the earthquakes that have occurred in the twentieth century.



2.2 Why do earthquakes often occur in Japan?

Japan is located along the boundary of an oceanic plate and continental plate. Places where earthquakes occur often are relatively few. Hypocenters match the boundaries between plates. The oceanic plate is subducted beneath the continental plate. Therefore, the ground is exposed to strong stress and sometimes breaks.



FORMATION AND SUBDUCTION OF LITHOSPHERE are shown in this cross section of the crust and mantle. New lithosphere is created at a mid-ocean ridge. A trench forms where the lithospheric slab descends into the mantle. Earthquakes (*small squares*) occur predominantly in the upper portion of the descending slab. Arrows in the asthenosphere indicate direction of probable convective motion. Secondary convection currents in the asthenosphere may form small spreading centers under marginal basins.

2.3 Earthquake assessment in Japan

In Japan, the National, prefectural and municipal governments make disaster prevention plans at different levels.

a) The National Government has established the Disaster Measures Basic Law and the Large-scale Earthquake Countermeasures Special Measures Law. Based on these laws, the Cabinet Office includes the Central Disaster Prevention Council. The council makes basic disaster prevention plans.

b) Prefectural governments also have disaster prevention councils that make disaster prevention plans for each prefecture.

c) Disaster prevention councils of cities, towns, and villages make disaster prevention plans appropriate for their respective situations.

Disaster prevention plans include

a) Disaster prevention and precautions,

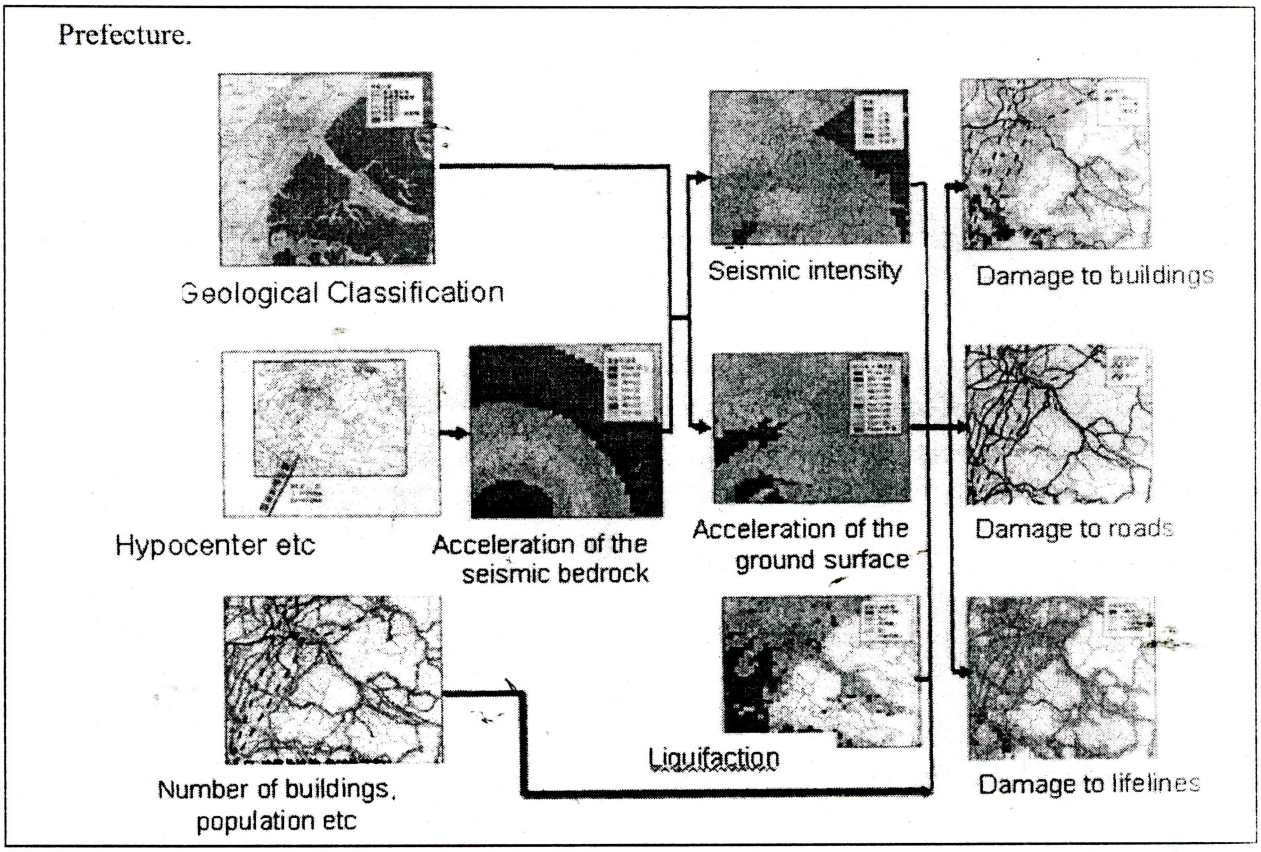
b) Emergency measures,

c) Disaster restoration and rehabilitation.

Earthquake risk and vulnerability analysis is very important when making these plans.

3. Actual Situation of Earthquake Analysis

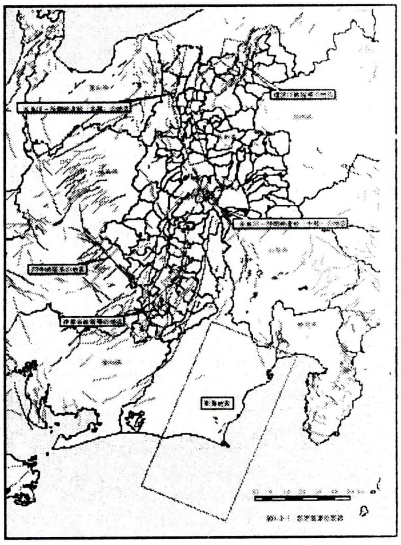
This diagram shows the overall flow of the analytical procedure by referring to a case in Nagano Prefecture.



3.1 Prediction of an earthquake

(1) Research about past earthquakes: Time, scale, location, and damage from past earthquakes are studied based on records and research of active faults.

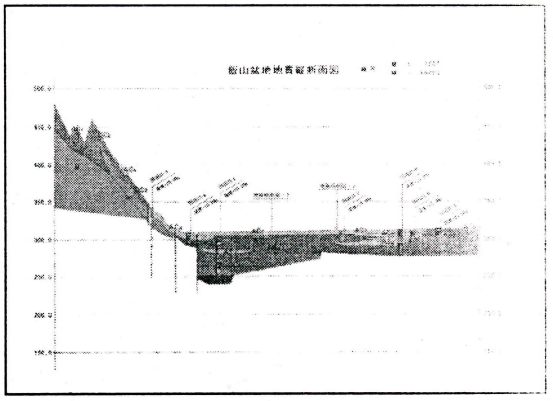
(2) Prediction of an earthquake and earthquake source fault: An earthquake that will most likely occur is assessed by studying the activity of active faults, their cycles, time elapsed from the last action, and situation of micro-earthquakes. Concretely, the location of an earthquake source fault and magnitude are decided.



3.2 Estimation of seismic ground motion

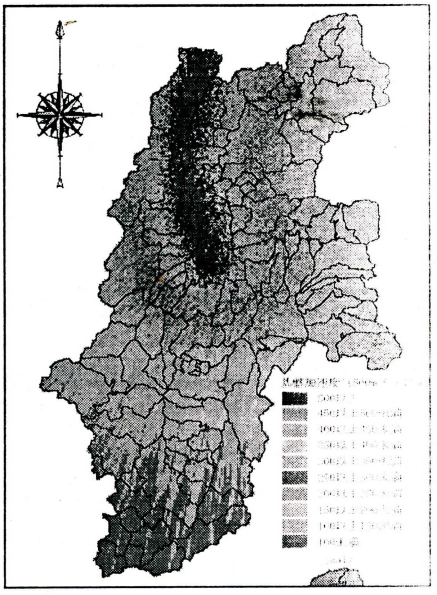
3.2.1 Ground classification

To estimate seismic ground motion, underground structure needs to be clarified because shaking of the ground surface differs largely according to underground structure. First, the depth of hard rock bed in deep ground is measured by boring or geophysical exploration. Secondly, shallow ground is checked. Structure of the new gravel layer that covers the ground surface is checked. Compactness of the ground and ground water level are also important.



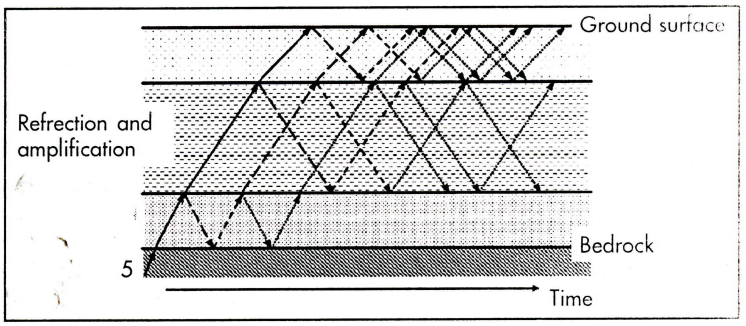
3.2.2 Estimation of seismic ground motion

Seismic ground motion is predicted in next two steps.



(1) First, seismic ground motion on the bedrock is estimated. Waveform of seismic ground motion caused by a fault movement (when rock bed breaks and shifts) is estimated. How the wave is transmitted within the rock bed is also predicted. Hypocenter is in the center of the dark brown area. It is shown as a plane, not as a point, because it is a fault. The further from the hypocenter, the weaker the motion is.

(2) Secondly, seismic ground motion on the ground surface is estimated. Seismic intensity that is the amount of shaking at the ground surface is indicated. Seismic ground motion goes through rock bed and is amplified in soft ground close to the surface. Simulation calculation is made based on geological structure. Seismic intensity is used to predict damage done by an earthquake.



3.3 Estimation of liquefaction risk

Liquefaction risk is estimated using an expression based on soil property, ground water, and intensity (acceleration) of seismic ground motion. Liquefaction easily occurs when loose deposit sand contains a lot of water. The risk is high in places with thick deposits carried from rivers like Bangladesh.

3.4 Estimation of ground disaster risk

When an earthquake occurs in a mountainous region, slopes of mountains sometimes collapse (slope failure) and large-scale landslides occur. Risk of these is estimated by geographical landform, incline, and seismic intensity. For example, a steep convex slope close to a hypocenter easily collapses.

3.5 Estimation of tsunamis

An earthquake from the bottom of the ocean may cause tsunamis. How waves are transmitted is simulated and calculated. The results of the calculations can be shown graphically as shown right figure.



3.6 Damage estimation

What I have explained so far are the procedures to estimate the phenomena caused by earthquakes. Now, I would like to talk about damage estimation.

3.6.1 Damage estimation for buildings

Houses made of wood or stone collapse easier than reinforced concrete buildings. Three-story buildings collapse easier than one-story buildings. We classify buildings per structure and determine how easily each type of building becomes damaged (damage rate). We then calculate the number of buildings that will collapse based on the actual number of buildings. To estimate an earthquake's damage to buildings, data of the existing buildings is necessary. Damage rate can be calculated by correlating the damage to buildings from past earthquakes with their seismic intensity.

3.6.2 Estimation of damage caused by fires

If an earthquake occurs when many people are preparing dinner, many fires will occur because fallen furniture and walls will catch on fire.

The probability of fires occurring differs according to the season and time. Therefore, we determine fire occurrence rate for each situation and scale of earthquake in order to estimate the number of fires. Fire occurrence rate can be

calculated by correlating the number of fires caused by past earthquakes with their seismic intensity.

3.6.3 Estimation of human damage

People die or get injured because of falling buildings and fires that occur later. We use a relational expression for the number of completely collapsed buildings from records of past earthquakes in order to estimate the number of dead. We also estimate the number of evacuees based on damage to buildings. Data about the number of people living in specific areas is necessary.

3.6.4 Estimation of other damage

Damage to other items can be estimated.

For roads, damage to bridges, slopes, and bankings can be estimated. Other than that, damage to railroads, airports, embankments along rivers, reservoirs, dams, and lifelines such as waterworks, sewers, power lines, and telephone lines can be assessed.

3.7 Hazard map

Assessment results are intelligibly shown in a map called a hazard map. Damage from earthquakes is complicated, so expression of hazard should be highly worked out. Ones that show the strength of seismic ground motion are often made. Nagano Prefecture has made a CD-ROM with narration.

4. Required Things for Assessment

What I have talked about is how damage is estimated in Japan. This method requires detailed information, including data about the geology, building, population and so on. We are able to calculate the damage rate in Japan because we can statistically analyze the correlation between earthquakes and their damage. I believe that doing the following will help you to better estimate damage.

1. Research about past earthquakes: Study the time, place, and scale of past earthquakes and places and types of damage done by them.
2. Research about active faults: Study active faults that cause earthquakes and estimate when, where, and at what scale the next earthquake will occur.
3. Making a database about geological data: Make a database about boring carried out in various places and accumulate information about the ground.
4. Making a database about buildings and population: Make a database about the distribution of buildings and people that may suffer from an earthquake. Regular administrative information should be adequate.

Damage can be roughly estimated based on the damage rate calculated from past earthquakes. I recommend you to start by doing this.

5. Earthquake Countermeasures Based on Assessment

Lastly, I would like to talk about basic measures to prevent and reduce damage done by earthquakes.

1. Estimation of damage: You can find a good place to start after estimating damage using a method like I introduced today.
2. Measures to reduce damage: Make structures and lifelines earthquake-resistant.
3. Guidance for the land use: Regulate the land use that is most likely to be damaged by an earthquake.
4. Establishment of disaster prevention bases: Prepare bases that can act as bases for rescue operations and restoration in the event of an earthquake.
5. Stock for necessities for rescue operations: Store food, water, medicine, and other materials necessary for rescue operations at disaster prevention bases.
6. Disaster prevention education: Instruct residents how to deal with damage done by earthquakes and what to do in the event of an earthquake.
7. Establishment of a disaster prevention system: Decide on a governmental rescue operation system and regional rescue operation system in advance.

How to Make Warnings Lead to Actions

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Forecast Division, Forecast Department
Japan Methorological Agency (JMA)

1. Warning Basics

Each country duly has developed and held different definitions of warnings. Japanese definitions are stipulated in Japanese Meteorological Service Law of 1952 as: "Warning is a forecast to alert that a grave disaster is likely to take place." For your reference, Advisory is "a forecast issued to advise that disaster is likely to take place." And, forecast is "to issue an announcement of the predication of phenomena based on the results of the observation." In the U.S.A., warning is: "forecast issued when a particular hazard is 'imminent' or already occurring (e.g., tonado warning)." Advisory is: "advisories are issued for weather situations that cause significant inconveniences but do not meet warning criteria and, if caution is not exercised, could lead to life-threatening situations. Advisories are issued for significant events that are occurring, are imminent, or have a very high probability of occurrence." Since each and every country has its own geographical and meteorological features, it is natural and required to develop its own definitions. Through the process, the purpose and what decision makers required of warnings will be made clear.

Warnings are designed to cover specific types of disasters. Thus it is up to users to decide the range of warnings. As for Japan, weather warnings are extended from storm, snow-storm, heavy rain, to heavy sonow. Other warnings include: ground-loosening, storm-surge, high waves, inundation and floods. Japan is susceptible to torrential rain, which causes landslide, debris flow, and (flash) floods. In general, Japan experiences flash floods as opposed to prolonged floods, since it is a mountainous country. Urban floods and inundation's wreak tremendos havoc on Japan, since urban areas have assets and that is where economic activities take place. Let's not be block-headed to select the list of disasters to be warned. As a rule, certain conditions need to be fulfilled to stand as usable warnings. First, the event to be covered is a significant one in terms of cost and casualties. Second, consequences of the event must be manageable and able to be handled, for warnings cannot be of values if our action or inaction does not affect their results. Third, the occurrence of the event needs to be predictable by a means of forecast technology, etc. Vagueness cannot be avoided completely, it is a matter of degree. We may be able to predict its occurrence and duration.

Questions arise concerning how we should warn and what content warnings should convey. Who should say what when, where, and to whom? Each term of interrogate needs to be answered in a clear language. The writer cannot provide the answer; it lies in the mind of your local officials, people, and ex-victims. What would they tell you? Ask, survey, and have research on it. There is no other way to make warnings effective than to have a concrete and down-to-earth approach to obtain local knowledge through quality survey and interviewing. In other words, there needs to be a communication between those who design warnings at central level and those who are actually exposed to the natural hazards' threat and unitize the warnings (feedback mechanism).

For warnings to be effective, its legal implication must be clear. Their issuers must have legal authority, otherwise, there would be confusion among people as to the situation and the coming events. Legal aspects extend to the receivers: to whom should warnings be directed? The objectives of warnings-to whom, needs to be stipulated in legal language. The contents of warning are naturally determined therefrom. In general, forecast and warning in nowadays require: the degree of impacts expected, the locations to be stricken, and the time when the impact is expected to be most severe.

Who should say warning message? Details argument cannot be followed here, but as a rule: He who has the knowledge and legal mandate. But here, a possibility to pursue joint warnings are to be hinted. As we have seen before, local government can be a best vehicle to put strong mandate to the warnings, since in general they have the authority to enforce laws. For example, evacuations (get people out of harms' way) and stalling factories and traffic as necessary are mostly upon the shoulders of local governments. The basis of the JMA pursuing joint-warning scheme with local governments resides here.

It is my belief that warnings ought to be directed to local people. As generally observed, all disasters are local. Therefore, warnings ought to be directed to local residents first and foremost. "Tell it to those who are at the highest threat of the disasters." It is not for entertainment of outsiders (e.g., foreign media) or just another note for high government officials. Transmittance must be so sorted that people at risk will bail themselves out of the harm in time.

To decide the contents of warning, involvement is a 'must.' As society grows complex, common sense in one segment of society is not shared with others. We should not presume that forecasters know the expectation and readiness of first responders. Let's beware of "fragmentation of society." Of course, to the extent the society and technology is primitive, it's OK to presume what is needed (or may be the best) in your mind. But please have a watchful eye. Let's view an example from the JMA's.

11:20 AM, July 16, 2002 announced by Niigata Local Weather Office sado Is.: Heavy Rain warning; Gale, High Wave, Flood advisories

The peak of heavy rain has passed, but the risk of sediment disasters remains the highest in the past several years. Be alert to landslides and debris flows. Also, take heed to inundation and high water of rivers.

(Abbreviated....)

Expectecd rain and flood

Sado Is. (warning): 150mm/24hr

Objects of alert : landslide, debris flows, high water of rivers, inundation of lowlands, gale, high tide, low visibility due to dense fog.

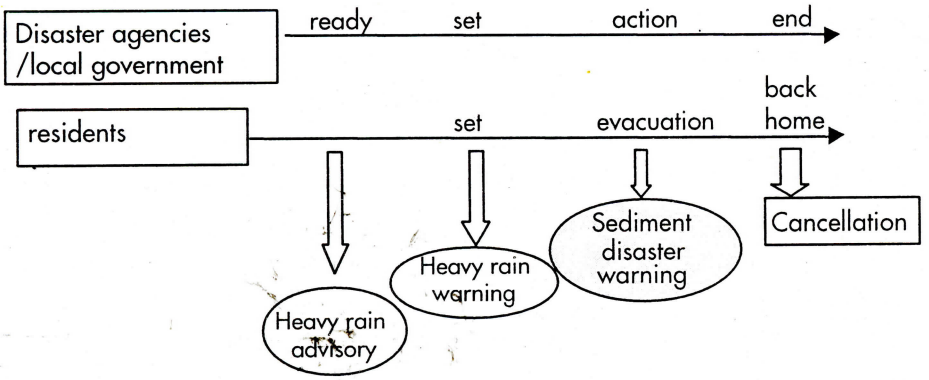
Cause : Typhoon No. 7

Sado Is. : Status change from flood warning down to flood advisory

The elements contained in the warning can be dissected in several parts as follows:

1. Time of issuance
2. Name of the office announcing
3. Types of disasters expected
4. Locations to be stricken
5. Main body
6. Quantitative parts (for advanced users)
7. Objects of alert (meant to give a hint to response activities)
8. Cause
9. Status change (change from the previous period is important)

Timing of issuance is also critical for warnings to be used. The situation is different from one country to the other and needs your analysis. For Japanese heavy rain case, the model becomes as follows:



You can make up your own model and develop the proper timing yourself. And these are the basics of warnings. I would once again want to stress the importance of paying attention to basics, for too many problems can be traced back to negligence of the basics.

2. Historic Overview (Japanese case)

Historic development of modern warnings started from the Europe and the United States. Japan, as a new entrant to world game and competition, made a horrendous effort to catch up. Each area and country geared up weather warnings for similar and different reasons and rationales: European invention of weather chart is due chiefly to military and maritime necessity. American drive for technology such as telegraph is also backed by naval necessity, but there are signs that welfare of the poor was considered. Japanese case shows maritime concern in its 1st place: one of the characteristics is its initial reliance on conventional methods. Japan opened the country officially in 1853. Tokyo weather office was established in June 1875. An prussian man Knipping proposed to undertake storm warnings to Japanese government in 1881. The 1st storm warning wast issued on May 26, 1883. In 1884, weather forecast was initiated also. There is a story about the inception of Japanese weather warning systems. in believe that most non-western countries share the same or similar situations and experiences. Knipping was primarily focusing on warning rather than forecast, presumably because daily routine workload seemed unbearable to his staffs. It's all classic modernization problem in Japanese case. Time must be standardized; clocks must be in wide use.

Where were observational equipment and trained staff? Evidences show, however, that some local government issued flood warning by collecting rainfall data through telegraph networks. Warning preceded forecast in Japan! Once weather warning is institutionalized, various improvement was made possible. The writer would like to add one more point on flood warnings. River authorities have independent observation networks in Japan. Data sharing was challenging in the 1950s. As a result Joint Flood Warning was created in 1955, essentially remains the same.

Consolidation of data is fiscally blocked in Japan. One lesson from Japanese case is to consolidate authority as early as possible before too many agencies made a hard turf. Two examples are considered below: fire warning and flood fighting warning. Both are made by local authorities. Upon issuing fire warning, certain conducts get restricted such as: smoking, use of fire outside, slashing & burning in fields. Flood fighters are activated following flood fighting warning. Transportation and communication for flood fighting have the highest priority. Chiefs of flood fighters are authorized to make residents collaborate with them. "Flood fighting" is a term used to indicate bundles of activities to protect people when water stage reaches high and its rapid torrent threatens people'l lives. Having written too much on evacuation, this term may sound odds. But people fight back rivers to protect people when water stage reaches high and its rapid torrent threatens people's lives. Having written too much on evacuation, this term may sound odds. But people fight back rivers to protect their

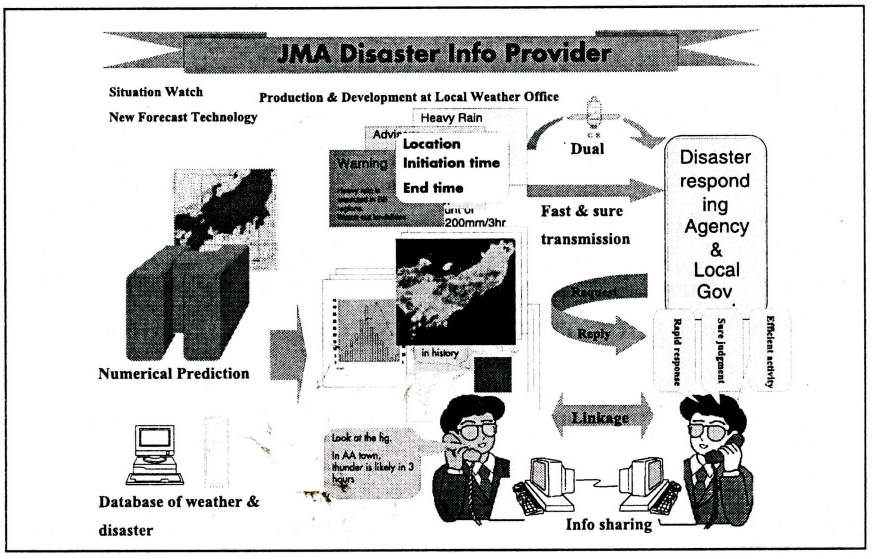
lives and properties. It is local people's duty to do their best to defend their own land in Japan. Evacuation is a last resort for them. Be alert, however, since such fighting is not realistic against cyclones and high tide. We should just run away. These are more activity-oriented warnings. Let's be flexible in pondering possibilities of workable warnings.

3. Hard and Painful Lessons

Three lessons from Japanese disasters draw the readers' attention concerning the establishment of joint flood warning (1994), mandatory transmission (1952), with a story of Tya-maru typhoon, and preparation of local response plans (1961).

The typhoon Kathleen in 1947 necessitated the birth of joint flood warning. It struck Tokyo areas on September 15, 1947, with its lowest pressures 989 hPa, and brought 1,930 causalities. A typhoon with an extravagant amount of rainfall caused servere flood and sediment disasters throughout the great Tokyo region. People had no time to flee. Needless to say, public works are necessary. But in addition to levee and dam work, the dispersion of scattering information came to attention. E.g., weather office knew about typhoons, river authority knew gauge and rainfall data, but proper actions were not taken. The solution: Consolidate the information and make integrated warning. The birth of joint flood warning system enables us to utilize different expertise to its limit.

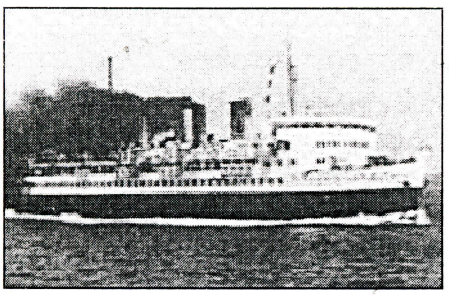
Successive typhoons led to the mandatory transmission of warnings: Kathleen 1947, Jane 1950, and Ruth 1951. Importance of weather warnings came to legislators' attention around 1950, issuing successive executive orders to make its transmission mandatory. 1952 saw the passage of Weather Service Law, which includes the mandatory clause. Means of transmission have developed since then: from telegraph to fax, then to ascertainable web-based push e-mail. Warnings used to be fee-based. Made free after the WWII. The figure of Japanese latest system of transmission is as follows:

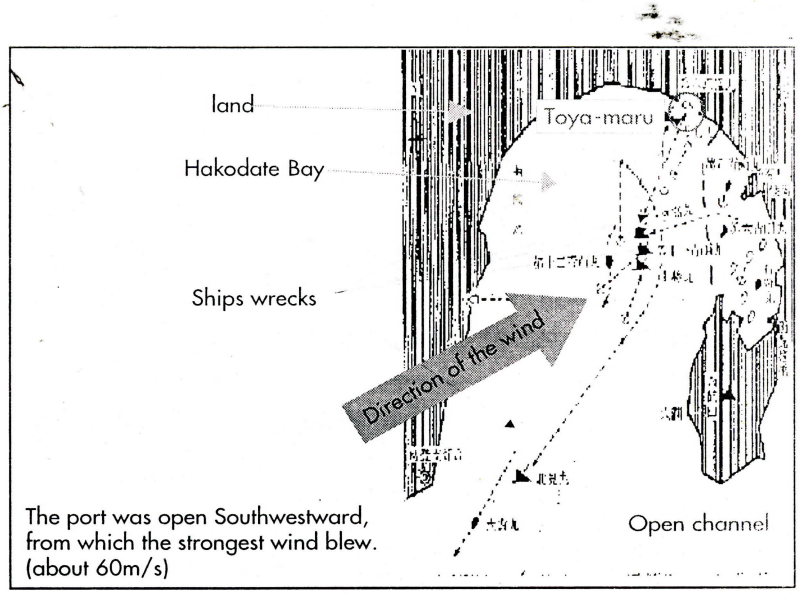


There are reasons to make transmission mandatory. Warnings are not carried by discretion or by charity; it is, and must be, carried under law with responsibility, because everyone has something else to do in time of pressing crisis and without mandates it will not be carried out. This mandate on local government is accompanied with financial support form the central government. In the history of warning, drop warning was used when all other means failed. Flag warnings is used in Bangladesh are very practical way. People should be taught the meanings of each signs beforehand though. The way fishermen make their living and how actually they respond to flags is also waiting your careful search. Since without getting rid of underlying obstacles, warnings will not be complied nor followed upon.

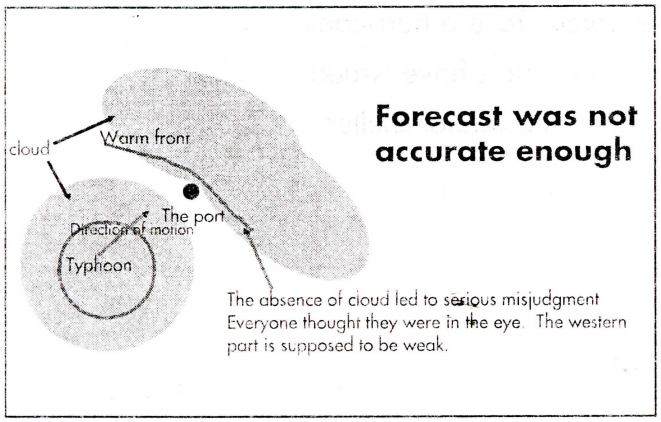
Toya-maru is a name of the ship that sunk due to a typhoon storm in 1954, which became then-world 2nd worst maritime disaster. The record: 1954.9.26, 960hPa, death and missing 1,698.

Raid Typhoon Marie (110km/hr) came to Hakodate Bay- the mother port of the ship "Toya-maru" This ship connected Japanese main island with the northern large island "Hokkaido." The ship was boarded full. Typhoon Marie was eventually called to be "Typhoon Toya-Mura" obviously named after the ship which sank. The picture and figure will be a better explanation (the capacity of the ship was 1,128 passengers with automobiles and trains).





Weather forecast was not accurate enough. The worst course; the course was not predicated by weather office due to the lack of intensive observatory.



This case was ended up with a maritime investigation. A lesson derived from the case was to enhance forecast more ad to set clear standard and procedure for deporting.

The typhoon Ise-Bay raised another question in 1959, when it struck low-lying newly developed areas near Nagoya in 1959. The death toll went beyond 5,000. It was a strong typhoon with 929.5 hPa as its lowest pressure. 4 points were made clear upon investigation and improvements were made concerning them. First, the cause of tremendous calamity can be explained partly by high tide. Second, over development of low tide-susceptible areas in a few decades worsened the conditions. Third, power failure due o strong wind cut communication; and warnings were not adequately conveyed to those who needed them most. Forth, local response plans were not well documented nor creating of it was mandatory.

4. Integral Assessment of Disaster Response System

Disaster response constitutes a system, whose input is disaster agents and output damages. The capacity of the society is almost likened to be the system. In order to structure the system conceptually, everything must be positioned in a network of means and objectives. But, This is difficult because our natural inclination is toward complacence. In our daily work, we look upon the achievement of tasks-direct objective, as an ultimate goal, forgetting to which higher ends they are conductive. Warnings, as they are important, do not in and of itself produce values. Users materialize the values by changing the course of action according to the warnings. Therefore, development of warnings and information must be commensurate with that of action codes and its enforcement.

Decision must be sustained by all kinds of support tools. Local resident can be equipped with such tools as following checklists (taken from the U.S. for reference).

Suggested advice during a hurricane warning.

- Listen for weather updates and stay informed.
- Keep portable radio and flashlight on hand-with fresh batteries.
- Clear your yard of loose objects.
- Move your boat to safe harbor and moor securely. Do nto stay with boat.
- Store drinking water in clean containers.
- Shutter or board all windows and secure double-door entrances.
- Plan your evacuation route know where to go, and fill your car's gas tank.

- If ordered to evacuated - obey immediately. Take a hurricane evacuation kit.
- Do not enter evacuated areas until local officials have issued an all-clear.
- Evacuated manufactured homes for more substantial shelter.

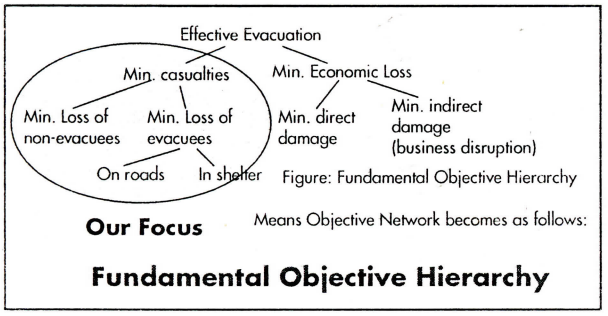
Suggested evacuation supplies

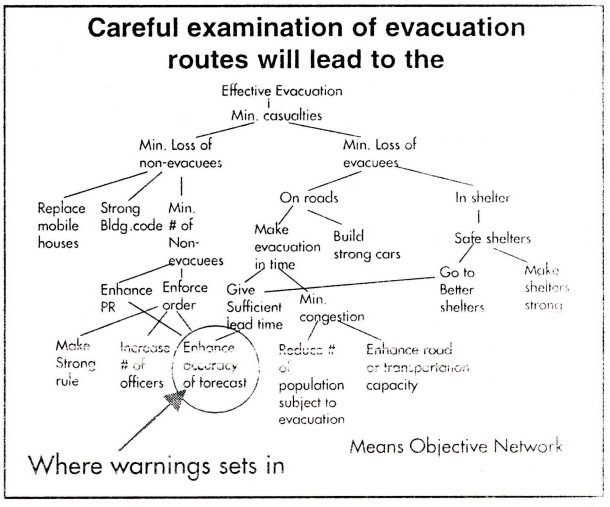
- First aid kit
- Two-week supply of medicine
- Blankets or sleeping bag
- Extra clothing
- Lightweight folding chairs/cots
- Personal items including books, toys, and snacks
- Infant necessities
- Important papers (Valid ID) and money

One advice for you is to develop a kind of these things-to-do lists in your localities.

At this point, it may be valid to show a fundamental objective hierarchy of warning and evacuation. Warnings must be positioned in a network to show its utility.

Position of warning in a means objective network is important too. In the network, the lower activities contribute to the achievement of its higher activity. These networks show that warning alone cannot solve all the problems at hand. Warning is not a panacea (all-curing medicine), nor is it so designed from the beginning. Thus, all-inclusive, integral approach needs to be taken. Too much expectation on warning alone is baseless and could be dangerous.



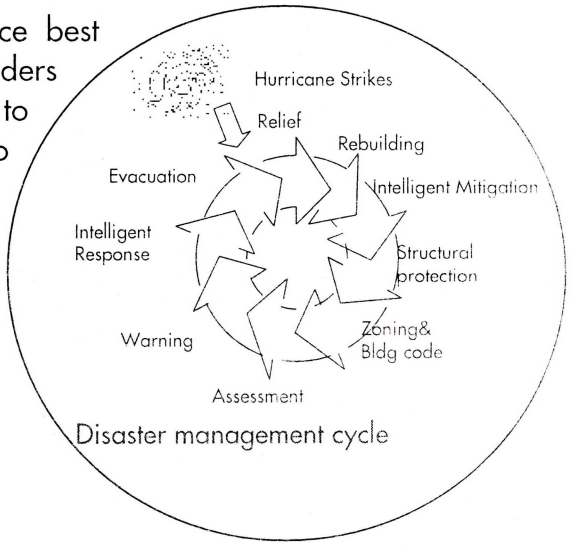


Fundamental objective hierarchy

Creation of evacuation map. This kind of map is more necessary than a mere hazard map, and can be created by very simple traffic study, measuring and estimating evacuation clearance time beforehand. Most roads however, will not be usable I time of floods and

cyclones due to inundation. If that is the case, traffic congestion could be a problem. Providing buses may be necessary for those who have no means of transportation but feet.

We need to go down deep to local areas since best knowledge lies in the mind of local folks. Outsiders cannot help you in this regard. It's up to you to analyze what can be done and what you would do in severe weather. Specification of warnings will be determined upon their answers and requests. For example, if preparation takes weeks, seasonal watch would be much better than short-notice warnings.



Disaster management cycle

5. Concluding Remarks

Cautionary notes are as follows:

- Warning is not for record keeping, it is for precautionary action.
- Modernization in and of itself is not the purpose.

Recommendations are as follows:

- Beware of seasonal migration and population dynamics.
- Build a well-balanced functional system (transmission, communication).
- Develop action codes with mandate.

I would like to extend my maximal appreciation for the readers' patience and participatory reading through the materials. For further questions and contacts, my contact is:

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Thank you.

Hazard Mapping and Vulnerability Assessment

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1. Disaster Prevention

A disaster occurs at the point of contact between social activities and a natural phenomenon of unusual scale.

Natural disasters occurring in larger scale may yield serious impact on society and economy, and result in a national loss.

Disaster prevention should be one of the most important policies of the Government of a country. "One who can rule rivers can rule a country, too" - An old theme of statesmanship.

Although, difficult to avoid natural phenomena such as rain and volcanoes, it is essential how you get on with them to reduce their impacts and to strengthen durability against them. Thus, we need to take measures for disaster prevention.

In short, disaster prevention is necessary to protect human lives, properties and social infrastructure against disaster phenomena.

One of the basic solutions to reduce the loss of life and damages is to remove the disaster phenomenon or the point of contact with the social activities. But it is often very difficult.

However, it is possible to moderate a phenomenon by taking measures:

- Making phenomena difficult to occur, that is, removal of causes. For example, construction of levees and dams.

- Even if it occurs, it should not affect social activities. For example, elevate the foundation of houses.

1.1 Five types of information necessary for disaster prevention

1. **What:** What occurs, what kind of phenomenon does come up? For example, a heavy rain causes a flood, a landslide or a debris flow. A volcano erupt lava, pyroclastic flow and so on.

2. **Where:** Where does such a phenomenon appear? How extensive is the range of damage?

3. **How:** How large is the scale of phenomenon? For example, there is a heavy rain of 500mm in one day, or lava flow of 300,000 m^3. How does the phenomenon make progress? How does it come up? For example, there is a scenario of volcanic eruption such as Earthquake occur first→then erupt Ash→then Pyroclastic flow → then Lava flow.

4. **When:** When does a phenomenon occur or when is it apt to occur? What is the frequency or probability of occurrence? For example, there is a heavy rain that occurs once for 30 years, or a great volcanic eruption that occurs once for 200 years.

5. **Who:** Who suffers from a disaster? How high is the grade of disaster? How many deaths or building breakdowns? How much is the total loss?

2. Hazard Map

The above 5 items under 4W1H can be represented on a map. This is a hazard map.

2.1 Functions of hazard map

The functions of a hazard map are to know the phenomenon and to make it known to residents. (Su Wu, a famous Chinese strategist, says If you know your enemy and yourself, you will not be in danger even in 100 combats.)

The hazard maps cannot stop a disastrous phenomenon. But the effective use of hazard maps can decrease disasters.

2.2 Objective of hazard map

The objective of hazard maps is to provide residents with the information on the range of damages and the disaster prevention activities. It is the important point to provide residents with understandable clear information.

2.3 Types of hazard map

There are two types of hazard maps:

(1) **Residents-educating type:** This type of map has the main objective to inform the residents living within the damage forecast area of the risk of danger. The information on spots of danger or places of safety and the basic knowledge on

disaster prevention are given to residents. Therefore, it is important that such information is represented in an understandable form. Usually smallscale map.

(2) **Administrative information type:** This type of map is used as the basic materials that the administrative agencies utilize to conduct disaster prevention services. These hazard maps are used to establish the warning system and the evacuation system, as well as to give the ground for land use regulations. They may be used in preventive works. Usually rather large scale map.

2.4 Impacts of hazard map

All hazard maps are not unconditionally acceptable to residents. Land owners and land developers may fear about the fall of land prices and oppose to the public release of the maps.

In addition, river administrators (within the Government) may oppose to the public release of the maps, fearing the criticism of residents that the administrators are neglecting preventive works even though they know the possibility of disasters well.

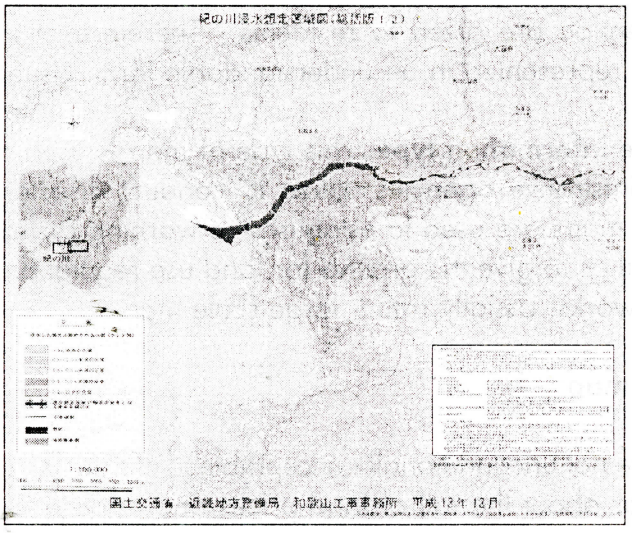
3. Examples of Hazard Maps

Now, I will introduce some examples of hazard map. All these have been collected via Internet.

- Floods
- Debris flows, Landslides, Slope failures
- Volcanic eruption (lava flow, pyroclastic flow, ash fall)
- Earthquake, Tidal waves ("tsunami")

3.1 Examples of flood hazard map

This flood hazard map was prepared by Wakayama Construction Work Office under the Ministry of Land, Infrastructure and Transport and publicly released on Internet. This map shows the flooded areas by water depth. The location of flooded land is indicated clearly. Wakayama City is located here.

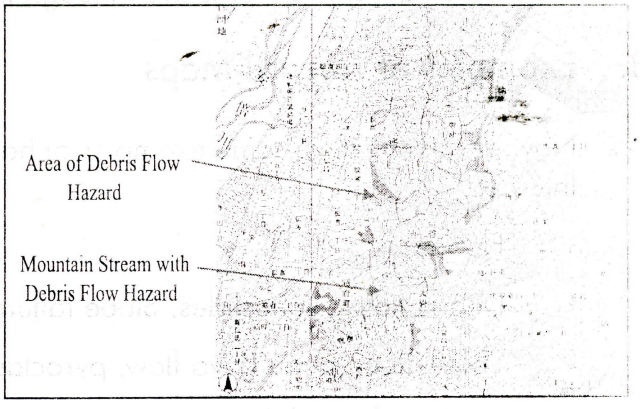


(http://www.kkr.mlit.go.jp/wakayama/kinokawa/hinokawa/hanran/w_1.html)

3.3 Debris flow hazard map example

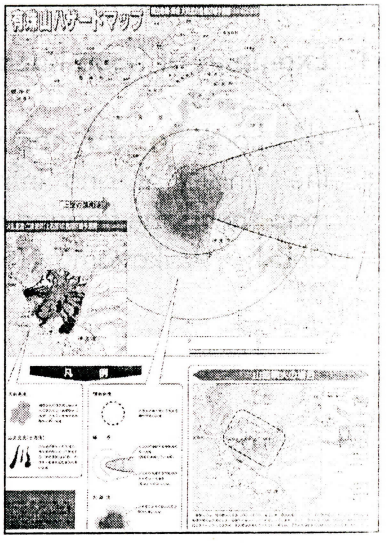
This map is published by Shizuoka Prefecture on Internet, and it is a WEB GIS. There are small streams running along the mountains, and there are hazardous areas distributed just under these mountains.

(http://sabougis.pref.shizuoko.jp/VewDoseki.htm)



3.3 Volcanic hazard map example

This map was created in 1995 and released by a town named Sobetsu-cho in Hokkaido. This mount Usu erupted in 2000, but caused no human casualties. Because, this hazard map had already published.



3.4 Earthquake hazard map example

This map was prepared by Nagano Prefecture Office to forecast the seismic strength. Here is the highest earthquake vulnerable area.

4. Natural Conditions of Japan

Now, I will briefly describe the natural conditions of Japan and disasters to help your understanding.

Japan has 70% of total land as mountains with many steep rivers. The high population is concentrated on narrow plains. The yearly average rainfall reaches 1750mm. The flows of rivers are high. Once we had a heavy rain, a flood, slope failure and debris flow occured concurrently. In addition, our country is located near the plate boundary. So there are 86 active volcanoes. The Izu Miyake Island has erupted since 2000 and all the residents on the island have been evacuated up to now. In Japan, we have many earthquakes every year and in 1995, Kobe here suffered a tremendous disaster.

5. Hazard Map Creating Procedure

As I have explained, Japan is in the natural conditions susceptible to disasters. Therefore, Japan has the high necessity of disaster prevention and the technology of disaster prevention has been developed.

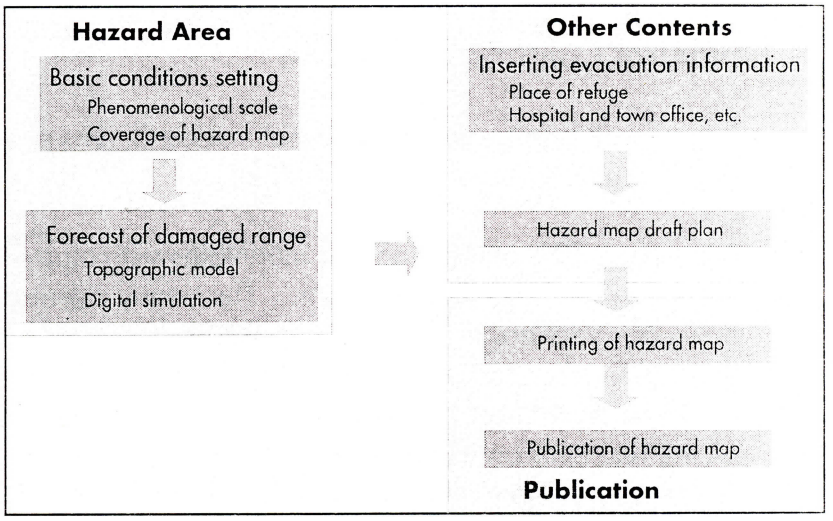
First of all, it is necessary to know the past history of disasters before creating a hazard map. Also, the measured data such as rainfall should be arranged so as to ensure statistical analysis. The topographic and geologic studies to trace the evidences of disasters should be made in the field as necessary. The results of these activities are represented in the form of a map. This map is called a disaster record map.

The Landform map is also an important information source. Flood plains, alluvial fan, mountains and valleys are formed through past floods, earthquakes and volcanic activities.

If you cannot produce a quantitative hazard map, as I will explain later, even a landform map will be useful instead of a hazard map. If you use aerial photos (satellite data), you can produce a landform map easily even though no topographic map is available. From the viewpoint of disaster prevention, I would recommend you to produce such landform map, which may be called a disaster factor map .

5.1 The procedure of creating a hazard map

The procedure of creating a hazard map can be divided into three processes:



(1) (Left square) Forecasting a range of disaster: To define a) the subject phenomenon and b) its scale and c) forecast the range of disaster using the digital simulation technology.

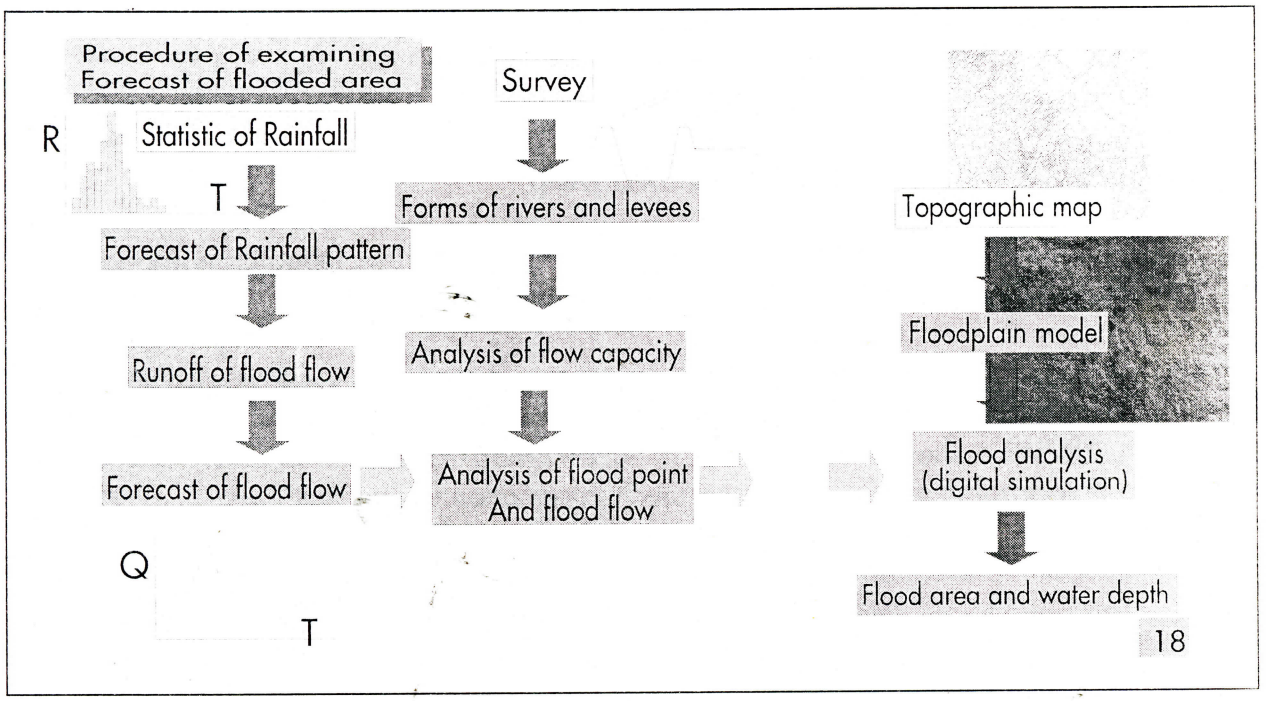
(2) (Upper right square) Collecting the disaster-related information to be inserted in the hazard map and representing the information in the hazard map.

(3) Publishing the maps by distributing directly to people or through Internet or by any other means. Then, the disaster prevention activity will start using the hazard map.

5.2 The method of forecasting the range of disaster

I will explain the method of forecasting the range of disaster in more detail using an example of flood.

- A flood is caused by a heavy rain. So rainfall is forecast. The rainfall pattern is defined based on the past records of heavy rains and statistical calculations. In Japan, a heavy rain that may occur once for 100 years is often assumed for this purpose.
- It is calculated how high the discharge is in case of such heavy rain. This is called runoff analysis.
- The cross-sections of a river are collected and calculate the limit flow that a river can have. This is called flow capacity.
- If the runoff quantity of a river is higher than its flow capacity, the river is flooded. Then, the flooded location and the discharge are defined.
- The water movement of a flood flow is calculated in digital computation using a elevation model of a floodplain. This is called flood simulation, and the calculated results are water depth, flow velocity and flow direction.
- The calculated results are represented in a map. It is better to use GIS.



6. Considerations in Creating a Hazard Map

I will explain the points to be considered in producing a hazard map.

- As a hazard map is created, the topographic map of the subject area is needed. The topographic models and ortho-photw maps that can be acquired from a satellite may be used.

- It is necessary that the data for which any potential phenomenon can be forecast is made available with the scientific ground.

- As the objective of a hazard map is to inform residents of a potential disaster, the map should be created with the representations and contents that are understandable to non-professional people.

- The digital analysis that I have introduced you before should be supported by complete data and a considerable cost is required for calculations. No matter how high the data accuracy is, the digital computation is a forecast. There is something that cannot be represented by computation. In addition, if any phenomenon and its scale are different from the forecast ones, the range of disaster will also be different. Thus, it is necessary to recognize the limitation of these hazard maps.

- Digital analysis is not the only method. A disaster history and a disaster landform classification map are also important information for disaster prevention.

Therefore, it is necessary to combine these for use in forecasting a disaster pattern. However, the land form classification map has a disadvantage that the scale of a phenomenon is not clear.

7. Contents to be Inserted in a Hazard Map

The contents to be inserted in a hazard map are the following, though it is unnecessary to include all items, which are selectable for each purpose:

- A base map is required. As the base map, a topographic map or a photographic map (ortho-photos) can be used. I think,the topographic map is more effective to understand the information for a hazard map than ortho-photos. Because, a photographic map contains too much information to interpret it.

- Disaster prevention information is the first important information that should be informed to resident. Mainly, the forecast area of disaster should be included and the past disaster records may be included as needed. Or, the map can be divided into both types.

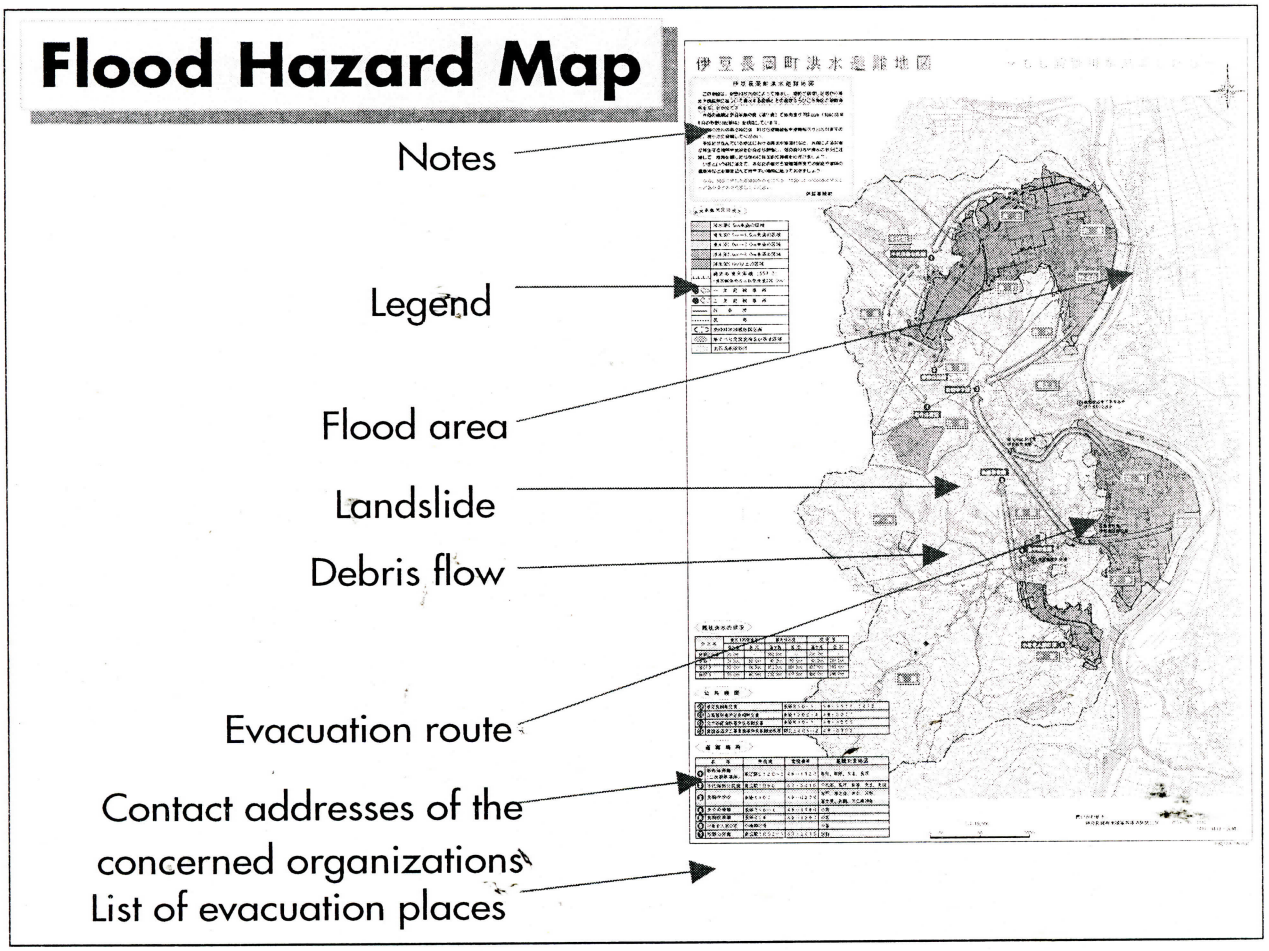
- The second information to be disseminated to residents is evacuation-related information. The places for refuge and evacuating routes to be used in case of a disaster are shown in the map. Residents can know their evacuating route and places of refuge from the hazard map. In addition, the system and rules to accurately inform the warnings on an impending disaster and evacuation to residents are also described in the map, such as for example, a forecasting siren or a warning siren.

- The mechanism of disaster phenomena and the basic knowledge on natural phenomena are also described.

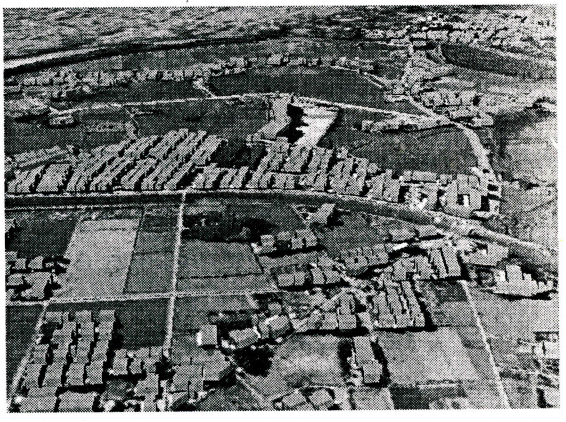
7.1 This is an example of flood hazard map.

The method of reading the hazard map is explained upper left in the map. The legend is put under it. This map represents the forecast flooded areas in blue color by water depth. The past floods are also shown another symbole. The hazardous spots such as debris flows and landslides are also indicated. So, one can know the spots that should not access to in case of a heavy rain. Some places of refuge and evacuating routes are also shown in the map. The disaster prevention organizations and the places of refuge are listed lower left in the map.

This map has almost the same contents, which are represented in a familiar way using illustrations. The green spot in the map are schools. A school is an important facility used as a place of refuge.



8. Hazard Maps and GIS



Hazard maps are very compatible with GIS. First, the GIS is very useful in arranging a high volume of data necessary to produce a hazard map. Then, it can be used for analysis of places of refuge. Three-dimensional representations are available. Digital cartography is also available. So, it is possible to test a method of creating an easy to read hazard map. Recently, there are cases in which maps are publicly released using the Internet GIS technology.

Now, let me show these examples.

9. Hazard Maps and Preventive Measures

9.1 General

The use of hazard maps is one of the means for disaster prevention. Producing a hazard map is not the final target. Then, what should be done when a hazard map is completed? It is mainly to disseminate the hazardous areas to residents and to take warning and evacuating measures.

9.2 Publication, dissemination and education of hazard maps

- A hazard map is significant only when it is publicly released to residents, it is usable for residents in evacuation and when the lives are rescued.
- Administration should make efforts to repeatedly disseminate disaster prevention information to residents by means of hazard maps. It is necessary to furnish residents with school education and disaster prevention training once a year or more and repeatedly disseminate the disaster prevention information in various methods. It is better to plan events which will increase the residents participation. Repeat over and over. Not at once.
- Furthermore, Administration must establish safe refuge facilities, a forecasting and warning system, the method of transmitting disaster prevention information and a method of guiding the evacuation. For this purpose, the forecast disaster aeras in hazard maps will be very useful.

9.3 Hazard maps and preventive works

Hazard maps are not directly related to preventive works, but using hazard maps, it is possible to estimate the cost of damages due to a disaster. Further, hazard maps can be used for the economic evaluation of a preventive work and its Benefit Cost (B/C) analysis. As a result, the priority order of preventive works can be determined.

9.4 Importance of monitoring and data collection

- As I described in the hazard map creating procedures, it is necessary to collect basic data for creating a hazard map. It is necessary not only to know the past disaster history, but also to collect the data that is statistically significant to estimate the scale of a phenomenon and to determine the criteria for forecasting and warning.
- Flood forecast requires rainfall and flow measurements. A seismograph is also required to predict an earthquake.

10. Total Disaster Prevention System

Lastly, I will talk on a total disaster prevention system.

I have already explained that there are various types of hazard maps to represent the different phenomena. I think you would have understood that hazard maps are one of the means of disaster prevention, rather a cheap method than constructing dams. However, a total disaster prevention system is very important to protect human life and conserve the national land.

Around a volcano, an earthquake may occur and a debris flow and a mudflow come up if a heavy rain falls. If the landform is complicated, the disaster phenomena will be diverse and different. The places of refuge should be safe against all types of disaster. Therefore, it is necessary to integrate hazard maps to respond to these different types of disaster.

Administrative agencies have to undertake the shared functions that are different in national, prefectural and village levels. Police, public works, press and transport etc have individual functions, but tie-ups among these functions are needed. In short, a total disaster prevention plan is necessary.

Climatic disasters that have occurred in various areas of the world may have been affected by global warming. If so, disaster prevention is not a problem in the regional and national level, but it should be considered in the global level. The global tie-up and cooperation in disaster prevention beyond regions and countries are needed to sustain the life on the Earth.

I would be very happy if this presentation will be useful for all of you. Thank you very much.

Introduction to Total Disaster Risk Management Approach

Takako Izumi
Associate Humanitarian Affairs Officer
OCHA Kobe, Japan

Ladies and gentlemen : It is my honor to introduce the Total Disaster Risk Management (TDRM) Approach in this seminar.

ADRC and OCHA kobe office are fully aware that millions of people are very vulnerable to various types of natural hazards in Asia.The vulenerability to disasters especially that of the poor, is growing relatively fast. In the last five years, unprecedented disasters have impoverished millions of people and caused economic damage in terms of billions of dollars, without considering indirect damage. Disasters not only set back local and national socio-economic development, but also slow down social and economic development underway. Therefore, promoting coordination and collaboration in the field of disaster reduction and response has become one of our shared priorities in Asia. We are searching for moe effective approaches, linking the work of disaster reduction and response in a holistic and coordinated manner.

Last June, ADRC and the OCHA Kobe office co-organized a consultative meeting on Regional Cooperation in Disaster in Katmandu,with the support of USAID/OFDA and UNDP Nepal. The participants examined available data relating to economic growth and disparities, social vulnerability, depletion of water resources, urbanization trends, global climate change and environmental degradation, and then concluded that the impact of disasters is virtually certain to increase dramatically in the near future. It was in this context that the participants discussed the range of possible interventions to mitigate disaster impact, in order to complement government efforts. One of the four recommendations that participants agreed to follow up on is to promote the TDRM approach in the region, in order to minimize loss of life and property.

First of all, two points should be emphasized: The first is that natural disaster are not 'natural', but rather man-made. Disasters are the consequences of natural hazards and human actions. Human societies have the capacity to recognize the risks and factors that could lead to or cause disasters and the appropriate interventions to control or manage them. In other words, disasters can be prevented, or at least their destructiveness can be minimized. Human action or inaction to high risk and vulnerability to natural hazards could spell the difference.

The objective of the TDRM approach is (1) to address holistically and comprehensively the various concerns and gaps in different phases of the disaster management cycle by considering the underlying causes of disasters and the broader set of issues and contexts associated with disaster risk and its management, (2) to prevent or mitigate disaster through the enhancement of local capacity and capability especially in recognizing and reducing disaster risks and (3) to enhance coordination among communities and their national governments in all the phases of disaster cycle, thereby enabling communities to participate in the decision making process for disaster management.

Towards this end,the TDRM approach must adopt a holistic framework that could ensure the effectiveness and quality of disaster risk management interventions. The TDRM approach should be comprehensive as it integrates the disaster risk management approach in all phases of the disaster cycle, and ensures the involvement and contributions of the community and various sectors and field of disciplines. The adoption of a holistic framework necessarily entails the development, establishment and appreciation of enabling mechanisms that complement an effective disaster risk management plan. These mechanisms concern issues related to policy, strategy, capacity, coordination and allocation of funds.

A clear comprehensive policy is needed as guidance to address all aspects of disaster management. Such a policy ensures that mitigation is given proper priority, that disaster response preparedness is not overlooked , and that effective risk management is facilitated. Strategic planning enables risk reduction measures to be adopted in both development and disaster management contexts.

Capacity for mitigation programming allows the cross-sector integration of risk reduction measures through effective programmers. The national coordination body ensures that the principles of the TDRM approach are used to guide the programmes related to development and disaster management, and ensures the involvement and contribution of all the stakeholders. Allocation of sufficient funds for disaster risk management will not only reduce the death toll and economic damage, but also help sustain development investment and thus alleviate poverty.

The effectiveness of disaster risk interventions are ensured when the community and people at risk are directly involved in risk management. The involvement of communities in disaster prone areas not only allows problems to be defined correctly and responsive measurers to be designed and implemented,but also allows people to respond to designed and implemented, but also allows people to respond to disasters more efficiently and effectively with existing local resources.

It is possible to identify and manage disaster risks in six systematic steps: Establish the disaster risk context, Identify the disaster risks, Analyze the disaster risks. Assess and priorities the disaster risks, Treat the disaster risk and lastly, Monitor, Review and Communicate. In general, this process aids decision makers in determining possible outcomes of risks and undertake appropriate measures to control mitigate their impact based on reliable information and the available resources. In this regard disaster risk management promotes good disaster management practice, and therefore, should be implemented in all sectors.

To conclude, I would like to re-emphasise four points:

1. Natural' disaster is a misleading terminology, wrongly implying that disasters are the acts of God, and thus unpreventable. The public must understand that hazards are natural; disasters have much to do with human knowledge, behavior and actions.

The TDRM should be considered a development issue, needing long term strategic planning and allocation of funds. The TDRM must be an essential part of development programmes.

The approach will enable us to know what kind of risks that we live with,where the risks are and who are vulnerable to potential disasters. with such knowledge, disaster response work can be better prepared before disasters occur, including contingency planning, stockpiling of relief items, and provision of emergency funds and location selection for evacuation planning.

Of fundamental importance in the TDRM approach is hazard mapping and vulnerability assessment. This diagnosis ensure good decisions in choosing appropriate interventions and in ensuring the best use of limited resources.

To promote the TDRM approach enables the national governments to have a holistic and comprehensive knowledge and information on disaster risks and vulnerabilities, and allows the government coordination body to ensure disaster preparedness and response.

Cyclone Preparedness and Management in Bangladesh

M. H. Khan Chowdhury
Disaster Management Consultant
Disaster Management Bureau (DMB)

Part 1 : Cyclone Preparedness

1. Introducation

Bangladesh is a South Asian Country and geologically a part of the Bengal Basin, one of the largest geosynclinals in the world. The country is geographically located at the northern fringe of the tropics, bounded between 20°34' to 26°38' N latitude and 88°01' to 92°41' E longitude having area 147,570 sq. km. approximately. It has 4,685 km. long boundary of which the coastline is 710 km. long, all are lying along the Bay of Bengal. The land is the largest delta in the world with its unique location at the lower part of the basins of three mighty rivers, the Padma (Known as the Ganges in India), the Brahmapurtra and the Meghna . The country is characterized by the flat terrain of alluvial soil cris-crossed with intricate system of over 230 rivers, canals and streams. It is also the very geogrqphical location which places Bangladesh in such a way that the Himalayan range remains to its north and its southern coast is at the northern tip the Bay of Bengal which converges near the coast Lick a funnel towards the Meghna estuary.

Bangladesh due to its unique geographical location is dominated by annual alternating winds known as monsoon from south-west during summer and north-east during winter. These two monsoons are separated by two transitional seasons i.e. premonsoon and post-monsoon. Out of these four seasons, the three seasons, namely premonsoon, SW monsoon (due to south-west winds during summer) and post monsoon not only contribute majaor part of the annual rainfall of the country, but are also responsible for various disastrous natural manifestations of which cyclones with associated storm-surges are the most devastation. In fact, Bangladesh is one of the mast disaster prone countries of the world and becomes worst victim of natural disasters almost every year in respect of loss of life, property damage and socio-economic destruction.

2. Cyclones in the Bay of Bengal

Tropical storms or cyclones are, in fact, not unique to Bangladesh. Many other tropical countries have to bear the brunt of these extreme natural phenomena. In the east even countries as north as Japan are lashed by cyclones. Philippines, Taiwan, Indonesia, Northern Australia, tropical USA and the Caribbean islands all suffer due to cyclones frequently. As such, there is a globally accepted scientific definition of cyclones. Cyclones are, therefore, defined as relatively small and intense low-latitude worm-core low pressure systems having circulations in anti-clockwise direction in the Northern Hemisphere and in clockwise direction

in the Southern Hemisphere with characteristic extremely strong circulatory winds >35 knots i.e.> 40 mph i.e > 64 kph without fronts. The tropical storms or cyclones are known to form over eight regions of tropical oceans with the exception of the West Atlantic and Central Pacific east 140° W. Bay of Bengal is one of these eight regions where they form in two preferred seasons, namely (I) per-monsoon and (ii) Post-monsoon. This implies that the onset and retreat of SW- monsoon are determining factors for the cyclone development activity in the Bay of Bengal. As per the statistical record, cyclones forming In the Bay of Bengal contribute only 5% to 6% of the global total but they are the deadliest at the coast of Bangladesh accounting for about 80-90 percent of global losses in terms of lives and properties. The average annual frequency of tropical disturbance (winds < 64 Kph) in the Bay of Bengal ranges between 12 and 13, out of which 5 attain the cyclonic strength (i.e. winds > 64 kph) with 2 during per-monsoon season and 3 in the past-monsoon season. Most of these cyclones make landfall either at the eastern coast of India or at the Bangladesh coast. Some of these go to Sri Lanka or Myanmar coast at times.

3. Causes of Cyclone Disasters

Cyclones are the recurring features in Bangladesh. There are, in fact, two perferred seasons for cyclogenesis in the Bay of Bengal with breading place over the Andaman Sea and the South Bay. In the process of cyclogenesis, some of the low-pressure systems intensify into cyclopes as they initially move towardes west or northwest over the Bay. As some of these recurve at times towards north or northeast, the entire coast of Bangladesh is vulnerable during these two seasons.

As cyclone approach to Bangladesh coast, the whirling intense surface winds, atmospheric presure gradients and dragging water column form deep sea to shallow water in combination generate sea-actions, causing abnormally high water levels known as storm-surges which move towards Bangladesh following the cyclone track. In the last century for example, the deadliest cyclone of November 12, 1970 made landfall at Bangladesh coast near Bhola with storm-surge of hieght more than 10 m and wind speed 222 km/hr taking a toll of 0.3 million human lives and putting property losses to more than a billiuon US dollar. Again on April 29, 1991 the killer cyclone struck Bangladesh coast near chittagong with storm-surge height 6.3 m causing death of nearly 0.14 million people and property losses exceeding two billion US dollar. The storm-surge associated with the catastrophic cyclone of November 1, 1876 striking Bangladesh coast was more than 13 m, which is the highest ever recorded storm -surge in the world. The cyclones of 1919, 1961, 1663, 1965, 1985 and 1988 were also of severe nature. During all these cyclone on slarghts, it was the abnormal storm-surge which contributed to the colossal losses of human lives and property destructions.

There are some specific reasons for abnormal storm surge height along Bangladesh coast. In fact, six distinct features of the Bay of Bengal can be of importance to mention. These are (i) concave shape of the Bay of Bengal, (ii) convergence of the northern tip of the Bay like a funnel towards theMeghna estuary, (iii) large continental shelf of Banglasesh coastline, (iv)

large tidal range, (v) complex coastline and (iv) innumerable inlets from land to the Bay.

4. Cyclone Forecast and Warning Signals

4.1 Cyclone Forecast

In applied meteorology forecasting is the most difficult and challenging aspect requiring fulfillment of following four basic per-requisites :

i) Timely observations

ii) Reception and exchange of observational data

iii) Plotting of observed data on relevant charts and data application in computer modeling.

iv) Analysis and interpretation.

Like every other country in the world, Bangladesh has a national meteorological service known as Bangladesh Meteorological Department (BMD) to take and exchange meteorological observations, forecast meteorological events including extreme ones, and process and preserve meteorological data as climatological information. Meteorological forecast including cyclone prediction involves round the clock observations of various meteorological parameters at synoptic hours. BMD has a network of 35 synoptic surface observatories, 11 pilot balloon observatories, 3 rawin-sonde observatories, 4 radar stations and 1 satellite imagery receiving station. Observations at synoptic hour, when plotted on relevant weather charts, give a complete three dimensional picture of the state of the atmosphere from surface to the upper level at the instant. The Storm Warning Center (SWC), Dhaka is the specialized unit of BMD to make real time use of the meteorological observations for forecasting and warning at national level. Meteorological data received from home and abroad synoptic hours are used at the SWC to prepare the following weather charts round the clock;

i) Sea-level pressure chart

ii) Upper air streamline chart

iii) Maximum temperature chart

iv) Minimum temperature chart

v) Isallobaric chart

vi) Prognostic chart

vii) Constant Pressure chart

viii)Tephigram

All these weather charts after thorough analysis provide relevant meteorological information which a forecaster uses in real time routinely to extract information about behaving tendency of weather systems including cyclones. Along with these charts a forecaster also makes best use of I) climatological charts, ii) radar echoes, iii) satellite imageries and iv) computer information. It is, however, true that techniqes used for a particular weather system are not altogether applicable to other systems. In fac each weather system there are a number of techniques/ methods which a forcaster usually uses. A good number of techniques are in use at the Storm Warning Centre (SWC) for track predicition of cyclones in the Bay of Bengal. These are :

i) Persistence technique
ii) Climatological technique
iii) Climatological-cum-Persistence technique
iv) Synoptic or Steering technique
v) Steering and Persistence technique
vi) Statistical technique
vii) Satellite technique
viii)Numerical modeling technique.

At present there are PC -based indigenous small scale cyclone tracking models at SWC which use STEEPER and CLIPER methods developed by working meteorologists there. Estimation of storm intensity is done by using D'V orak model which uses developed by working meteorologists there. Estimation of storm intensity is done by using D'Vorak model which uses high resolution infrared (IR) and visible satellite imageries.

4.2 Warning Signals

The warning signals are the integral parts of cyclone prediction processes. The warning signals for cyclone, which are in operational use at present, have two sets: one for sea- ports and the other one is for river ports. There are eleven signal numbers meant for sea-ports and four signal numbers for river ports. Importantly the fact to be remembered that the cyclones (i.e. tropical disturbances) are constantly in motion generally, except in some cases of stagnant condition for some time. Therefore the warning signal number for a threatened and affected locality and ports may be sequentially up-graded or down graded. This means that signal number I may be upgraded to signal number II, then to signal number III, to signal number IV and so on corresponding to the intensity of the impending cyclone and its distance from port under reference or down graded when the cyclone is moving away. However, in case of rapid movement of weather condition due to considerable weakening or accelerated movement of the cyclone away from the port under reference, the downgrading of signal number may jump to more than one or two level as per the necessity.

It is also important to note that when the first SWB i.e. Special Weather Bulletin (with signal number 1) is issued by SWC, the corresponding meteorological conditions are not yet prevailing over the port and its surrounding localities. As such, the purpose of the signal number I, given in SWB, is to warn all concerned about the impending occurrence of given meteorological conditions. The appropriate lead time to expect the range of wind speeds given for a particular signal number is valid only when the signal is put into effect for the first time. Thus, the associated meteorological conditions are expected in 36 hours or more when the SWB with signal number I, II and III are put in effect initially in 24 hours in case of SWB with signal number IV, in atleast 18 hours in case of signal number V, VI and and VII and in atleast 10 hours in case of signal number X. The delineation of areas with reference to port for given signal number is theoretically based on the intensity, size of circulation the forecast direction and the speed of movement of cyclone at the time of issue of SWB forecast direction and the speed of movement of cyclone at the time of issue of SWB. The change in intensity, size of circulation or movement of the cyclone also determines the change in signal number over a given locality and port.

5. Confusions about Warning Signals

There exist some anomalies in the existing warning signals for cyclone. Experiences show that two different types of signal numbers (one set for sea-port and another for river-port) for the same cyclone and also too many numbers starting from signal number I to XI are confusing to the common people. The signal numbers in use starting with wind speed (i. e. intensity of cyclone) at initial few steps do not conform with the cyclone intensity at all the higher stages of the set numbers up to X. For example danger signal numbers V, VI and VII are meant for cyclone of the same intensity. Similar is the case with great danger signal numbers VIII, IX and X. In fact, the signal numbers V, VI and VII in case of danger signals and signal numbers VIII, IX and X in case of great danger signals are, at present, Used, taking into account the crossing point (or area) of the cyclone with reference to particular sea-Port. Basides, although the highest signal numbers VIII, IX and X are given on the basis of wind speed at 117 km/hr, there is no scope to go for further higher signal even in case of cyclone wind speed reaching 200 km/hr or more. Moreover, the contents of the SWB containing signal numbers are too lengthy, more technical and not specific in many respects for easy understanding by general public.

6. Government Efforts

Because of the existing anomalies, need was felt to simplify the signal numbering on the basis of cyclone intensity with shortening of stages and bringing improvement in the contents of the SWB by making it more precise, easy to understand and peoples requirements oriented. Initiative towards this end was taken by the Government under project BGD/91/021. After lot of discussions amongst the experts of the concerned organizations/ agrencies thorugh a

series of meeting under a steering Committee, a partial draft of the revised signal numbers based on cyclone intensity was completed while the works for the simplification of the contents of the SWB and other necessary details could not be taken up.

As one of the interventions under the project BGD/92/002 completed on 30 June, 2002, the revised signal numbers have been reviewed and the contents of the cyclone warning (i.e. SWB) for each revised signal number have been simplified, made specific and easily understandable in draft form. The drafts been submitted to the government for consideration.

7. Draft Revised Signal Numbers and SWB

In case of draft revised signal numbers, there are practically six instead of eleven steps in the existing set for sea-port. The signal set of revised signal numbers is meant for both sea-port as well as river- port. In the simplified contents of the SWB (cyclone warning), the sentences have been made precise and simple with information needed by the people and the decision makers. Contrary to the existing format of SWB for different signal numbers, four sub-heading, namely meteorological condition, signal(s) impact of the winds and precautionary measures have been suggested under which the contents would come point wise in the SWB. In the revised format of the cyclone warnings, human aspects and requirements for coping with cyclone disaster have been given priority over the technical aspects.

8. Problems of Existing Cyclone Prediction Systems

The efficiency of cyclone forecast warning systems as well as coordination between various agencies concerned have over the years, notably improved. In the warning system for cyclone tracking, landfall and intensity, the capabilities of telecommunication circuits, weather radar network and high resolution NOAA and GMS satellite receiving systems have been enhanced. In spite, the system in respect of (I) data plotting, analysis and prediction based on numerical model; (ii) well-proven storm-surge model (iii) storm track model; (iv) extensive storm-surge data set; and (v) Surge simulation studies is still far from satisfactory. Improvement in all these areas needs expedite attention of the GoB for resource mobilization and international technological support.

9. Conclusion:

The entire coastal belt from Raimongal river to the west and Teknaf to the southeast is exposed to the potential danger of tropical cyclone with associated storm surges. Living in such condition, the GoB V_2T has been continuously making endeavor to find out innovative solutions towards coping with recurring sequence of cyclone disasters through enhancement of early warning systems based on science, technology and research so as to ensure sustainable socio-economic development of the country.

Part 2 : Cyclone Management

1. Conceptual Evolution of Disaster Management in Bangladesh.

In the past upto late 80's in Bangladesh, disaster management has generally been perceived to mean management after a disaster has occurred (i.e. disaster response). But based on the lessons learned from 1988 flood and 1991 cyclone and the experiences gained over years, there has been at the level of policy makers of the Government of Bangladesh (GoB) a shift of emphasis from conventional disaster management practices (i.e. response and recovery) to risk reduction activities within the generic term Disaster Management' commonly referred to prevention, mitigation, preparedness relief and response, rehabilitation and reconstruction. The concept is relatively new but firmly rooted in the GoB's realization that conventional practices failed to meet the demands for public safety during major emergency and/ or disaster situation. It is recognized by the GoB that the cumulative impact of hazards over the past few decades remains as one of the most serious setbacks to Bangladesh's development and poverty alleviation. The Government believes that the adverse impact of natural disaster can be effectively reduced through mitigation measures, planned preparedness, response and rehabilitation programs.

2. Instituional Arrangements :

In the course implementation of a short term project followin the devastating floods of late 1980s and the killer cyclone of 1991, the evolving concept of overall disaster management helped GoB to take a number of significant steps towards establishing institutional arrangements from national to the union levels for systematic and coordinated management of all disasters. These are :

1. Re-naming of the Ministry of Relief and Rehabilitation as the Ministry of Disaster Management & Relief (MDMR.)
2. Etablishment of a disaster management organization named Disaster Management Bureau (DMB) in 1993.
3. Establishment of Council and Committees at the national, district, upazilla and union levels for overall disaster management.
4. Establishment of Emergency Operation Center (EOC) at the MDMR for information exchange during emergency period related to impending disaster

The Council and Committees are:

At National Level

i) National Disaster Management Council (NDMC) : headed by the Prime Minister to formulate and review the disaster management policies and issue directives to all concerned.

ii) Inter-Ministerial Disaster Management Coordination Committee (IMDMCC): headed by the Minister in-charge of the Ministry of Disaster Management & Relief (MDMR) to implement disaster management policies and decisions of NDMC/ Government.

iii) National Disaster Management Advisory Committee (NDMAC): to be headed by an experienced professional having been nominated by the Prime Minister.

iv) Cyclone Preparedness Program Implementation Board (CPPIB) : headed by the Secretary, MDMR to review the prepardness activities in the face of initial stage of an impending cyclone.

v) Disaster Management Training and Public Awareness Building Task Force (DMTATF): headed by the Director General of Disaster Management Bureau (DMB) to coordinate the disaster related training and public awareness activities of the GO, NGOs and other organizations .

vi) Focal Point Operational Coordination Group on Disaster Management (FPOCG) : headed by the Director General of DMB to review and coordinate the activities of various departments/ agencies related to disaster management and also review the Contingency Plan prepared by concerned departments.

vii) NGO Coordination Committee on Disaster Management (NGOCC) : headedby the Director General of DMB to review and Coordinate the activities of concerned NGOs in the country.

viii)Committee for Speedy Dissemination of Disaster Related Warning Signals (CSDDWS) : headed by the Director General of DMB to examine, ensure and find out the ways and means for speedy dissemination of warning/signals among the people.

At Field Level

(i) District Disaster Management Committee (DDMC): headed by the Deputy Commissioner (DC) to coordinate and review the disaster management activities at the district level.

(ii) Upazilla Disaster Management Committee (UZDMC): headed by the Upazilla Nirbahi Officer (UNO) to coordinate and review the disaster management activities at the upazilla level.

(iii) Union Disaster Management Committee (UDMC) : headed by the Chairman of the Union Parishad (UP) to coordinate, review and implement the disaster management activities of the union.

* These field level committees have representation from NGOs, Social Organizations, Local Govt. Bodies apart from the Government Departments.

EOC = Emergency operation Centre.

3. Emergency Response and Relief Management :

For the purpose of emergency response and relief management prior to disaster and post-disaster periods, the GoB has established a mechanism to operate under the requirements which are as follows:

- Warning dissemination and warning
- Search and rescue ;
- Health care ; and
- Relief operations.

The EOC located at the Ministry of Disaster Management & Relief (MDMR) is the operational unit of MDMR. The first information of emergency situation due to impending disaster activates the EOC and it functions until further order on the overall direction from IMDMCC/MDMR for handling the situation. EOC maintains liaison with forecasting and warning centres (i.e. Storm Warning Centre and Flood Forecasting and Warning Centre), Cyclone Preparedness Program (CPP), district level disaster management committees, NGOs and other concerned actors throughout the disaster period. As such, dissemination of warnings in time at the grass-root levels through CPP (in case of cyclone), DCs (Deputy Commissioners), UNO (Upazilla Nirbahi Officers), Electronic and news media is ensured. For eventual evacuation EOC's role remains vital to maintain link with all actors involed in the operation. As an information exchange organ of the MDMR, EOC acts closely on the directives of IMDMCC/MDMR to establish contact with DCs and UNOs and maintains feedback from the field in respect of search and rescue.

In the face of disaster, for those who become injured and shocked medical teams at the directives given by NDMC and IMDMCC are mobilized by the Ministry of Health and Family Welfare (MoHFW) with necessary medicines and kits, and they rush to the affected areas for primary health care and treatment. If the devastation takes large scale dimension of national catastrophe, and social organizations comprising competent doctors quickly move to the scenes with medicines/necessary items and work alongside the GoB's medical teams. After primary medical care seriously injured and sick persons are taken to the hospitals, if necessary. Under primary medical during disaster period, department of Public Health (DPH) of MoHFW also ensures supply of oral saline, WPT etc. for the affected people.

The relief management system during disaster situation in the country recognizes the key role of the Cabinet Secretary in the Inter-Ministerial Disaster Management Coordination Committee (IMDMCC) and in supervising the district administration and ensures the services of the Armed Forces as well as NGOs Working in the country. Under the system there is well established organization named Directorate of Relif and Rehabilitation (DRR) within the administrative control of the MDMR. The DRR acts during emergency situation and operates relief activities for distribution to the remote field levels under the supervision of the controlling

Ministry. The DMB as a dynamic professional unit under MDMR performs specialist functions at the time of Emergency to help EOC by extending technical support services through MIS/GIS for information exchange.

4. Recovery and Rehabilitation :

The GOB has an elaborate system of need assessment at the grass-root levels in which UDMCs and UZDMCs play important role. For quick assessment for both immediate and long-term needs, the pre-designed demand forms are made available to the management committees at the field levels to be filled in and sent to the DDMCs for onward transmission to the MDMR/ IMDMCC. Immediately after each disaster, the process starts operation and continues till the time affected people become able to get back to their normal economic activities.

5. Conclusion

Bangladesh has an elaborate, establised and experienced disaster management system from national down to the union level. As comprehensive control on the natural hazard, most frequent to Bangladesh is not possible, Bangladesh will have to live with natural disasters. Living in such condition, the GoB has been continuously making endeavour to make preparedness and mitigation measures under the total disaster management program as sufficient as possible so as to ensure sustainable development of the country as a whole.

The task is difficult but with the help of UNDP and other development partners it has been possible for the GoB to undertake an umbrella program approach known as Comprehensive Disaster Management Program (CDMP) which encompasses all aspects of risk management and will facilitate to move from a single agency response and relief culture to a whole of government holistic strategy to address the issue of community vulnerability. CDMP is therefore, a strategic institutional and programming framework that is meant to optimize the reduction of long-term risk and the operational capacities for responding to emergencies and disaster situations. This approach is consistent with the GoB's vision towards building greater self-reliance, awareness, empowerment of the community people to cope with and recover from disasters.

Japan's countermeasure for Earthquake: Lessons learned from The Great Hanshin-Awaji Earthquake

Fumiaki Yoshimura, Senior Researcher
Asian Disaster Reduction Center

The earthquake occurred in January 1995. the magnitude was just 7.3 though, It happened directly underneath the Metropolitan Area. In addition, epicenter was very shallow; It was just 16 km deep. So Intensity scale was 7, which was the largest degree in japan.

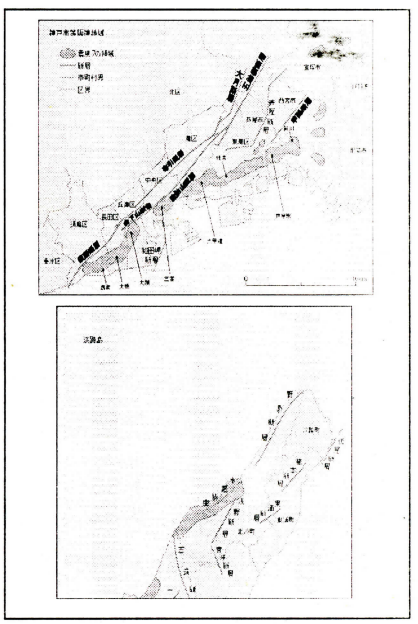
Fig. 1 shows heavily damaged area. These lines are active faults.

The red are a is intensity 7 area, which was most heavily damaged area.

The heavily damaged area was parallel to the active faults.

And those areas are capital of prefecture, center of governmental function and economy.

Fig-1 Active Faults & Heavily Damaged Area



Deaths and Damage

Deaths : 6,432 in all stricken areas

Injured : 43, 792 (10,683 Seriously injured)

Fully/Half-destroyed structures : Approx 517,730

Shelters and evacuees at peak :

1,153 shelters, 317,000 evacuees

Damage in yen Approx. 10 trillion (85 Billion US $)

Fig. 2 shows the number of Casualties in Natural Disasters in Japan. In Japan, after the huge typhoon in 1959, holistic approach for disaster reduction had been done, so the typhoon and floods disaster had been drastically decreased.

But we were not well prepared for earthquake.

As a natural disaster, the earthquake caused the heaviest damage after the World War II.

Fig -2. The Number of Casualties and the Missing in Natural Disasters in Japan

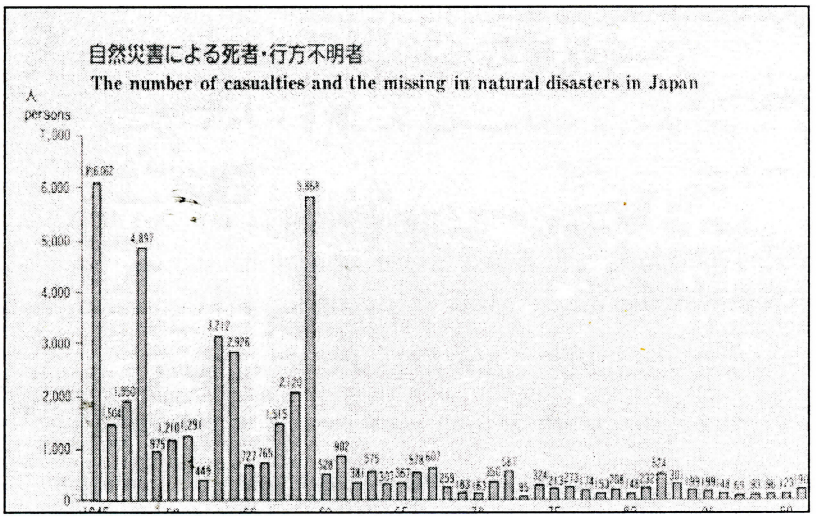
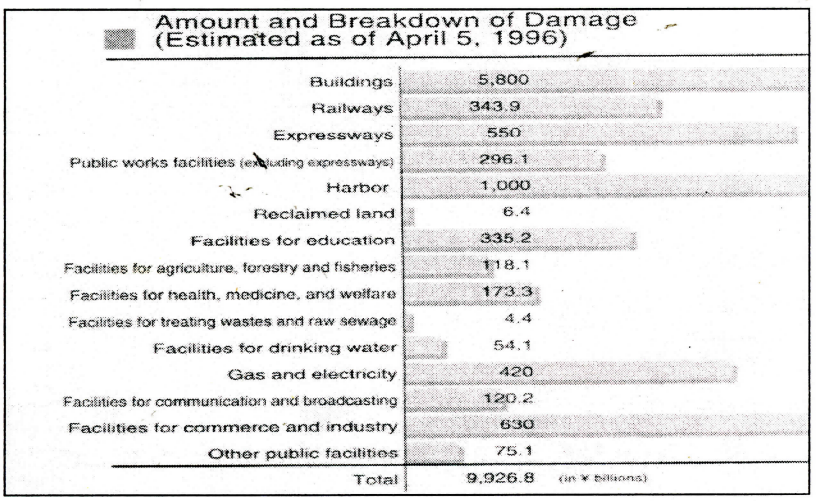


Fig -3 Amount and Breakdown of Damage



Estimated Damage was about 10 trillion yen or about 85 billion dollar. Out of this, about 60% was building s damage.

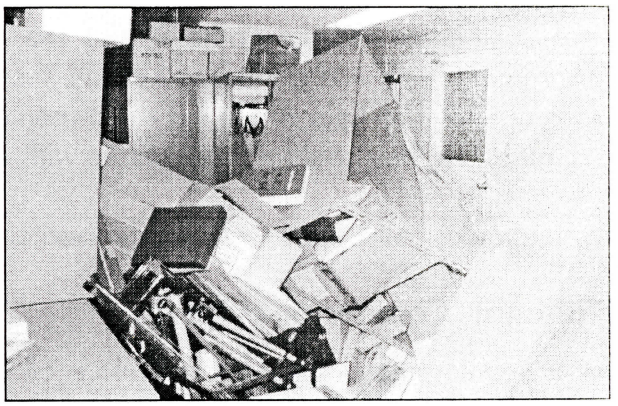
Lesson 1: Delay of First Response

Because the earthquake hit the capital of the prefecture directly, first response was very slow. Not only headquarter, but also communication system, even satellite telecommunication systems were destroyed. So it took three days for national government to grasp the entire damage.

Fig.4 Kobe Municipal Government



Fig.5 Hyogo Prefecuture Government



National Countermeasure 1

As a counter measure for delayed response, the National government established the Cabinet Information Collection Center. At the Same time, the government established the Minister of State for Disaster Management, and Chief cabinet Secretary for Crisis Management. Also the Government developed disaster information systems, which are Early Estimation System and Emergency Measure Support System.

The Japan Meteorological Agency and Local Governments developed Seismic Intensity Observation System with Seismographs.

There are 3,000 Seismic intensity observation points nationwide. Based on the information from those observation points, the government developed Early Estimation System and Emergency Measure Support System. Using those systems, within 30 minutes after the earthquake, damage information can be estimated.

Fig.6 Early Estimation System

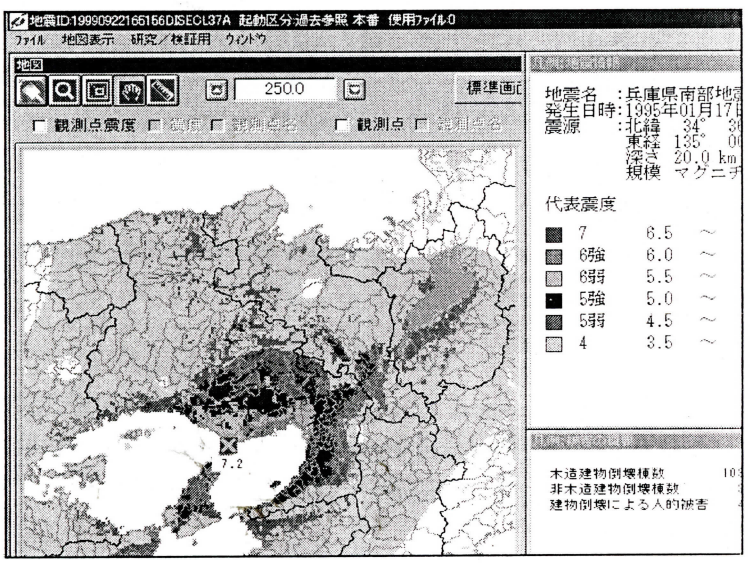
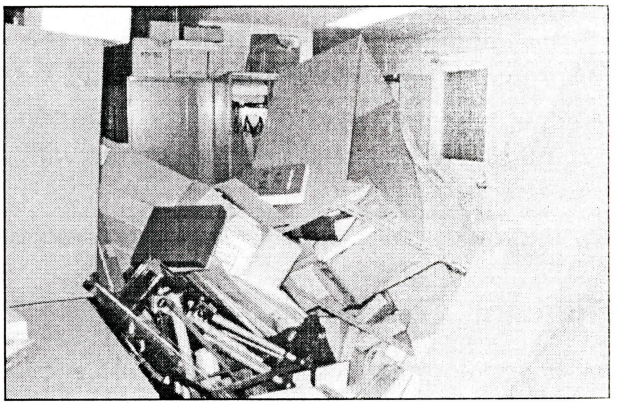


Fig.4 Kobe Municipal Government



Fig.5 Hyogo Prefecuture Government



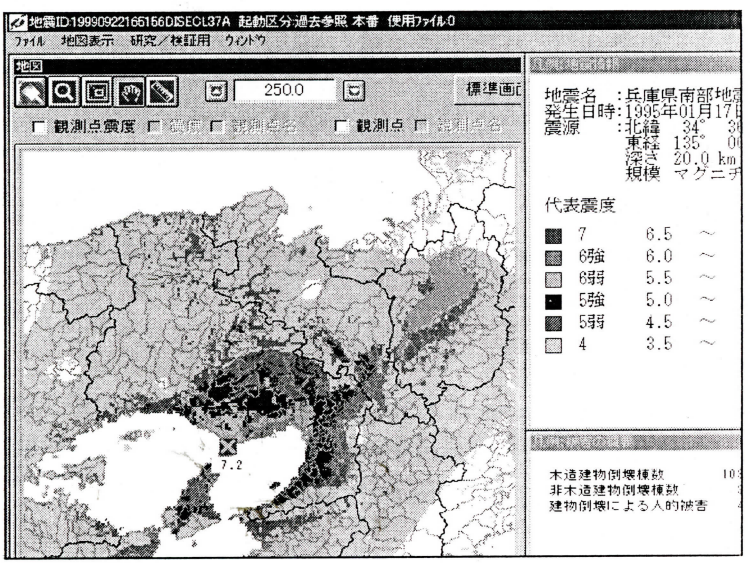
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Fig.6 Early Estimation System



Lesson 2: Coordination Among Organizations

Because the earthquake damage was too huge for government to cope with, and local government itself was damaged heavily, they could not request the national government or other agencies to help at the very first moment. Also, hospitals were too busy to cope with casualties, so they could not cooperate with other medical agencies.

For example. helicopters were rarely used on first day

National Countermeasure 2

As a countermeasure for coordination, all related organizations built nationwide support system for disaster emergency response.

One is support system by National Agencies, Like National Police Agency, Fire and Disaster Management Agency, Coast Guard & Self Defense Forces.

Second is inter Prefectures Mutual Support Agreement.

Third is Medical agencies cooperation, which are transport action plan, designation of Emergency hospital and Designation of Heliport.

Fig.7 Prefecture's Disaster Management Center

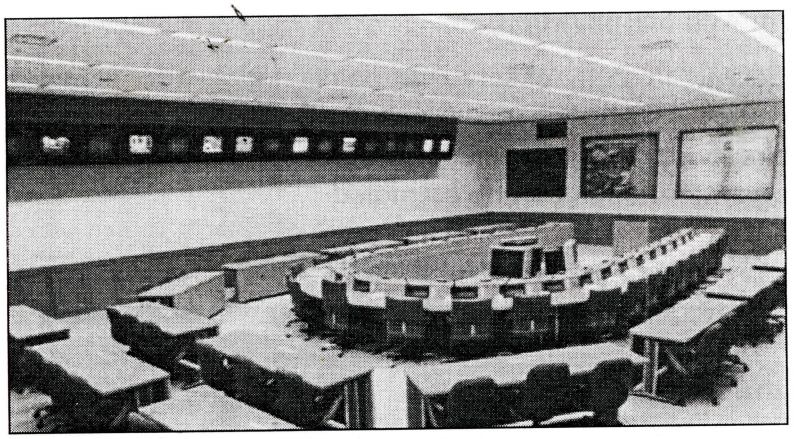


Fig 7 is one example of prefecutre system. A comprehensive disaster information networksystem has been established to assist relief and rescue activities in prefecture level as well.

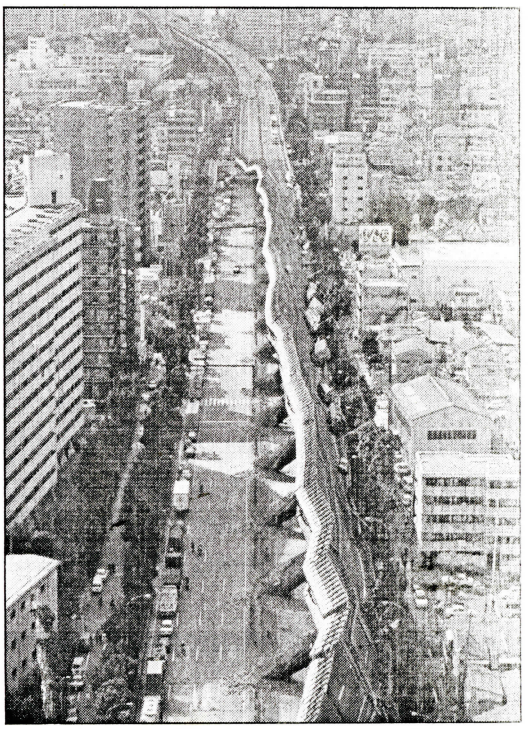
Lesson 3: Confused Logistic

This system functions by gathering and analyzing data from municipal and fire fighting headquaters, appropriate public bodies, seismometers to be newly installed in municipalities, and other sources. This System links to national system.

Like fig. 8 most traffic systems were heavily damaged. And concentration of traffic to remained highway caused heavy congestio. In addirion, lack of information causes confusion carrying aid materials to needed people or needed places.

National Countermeasure 3

Fig.8 Collapsed Highway

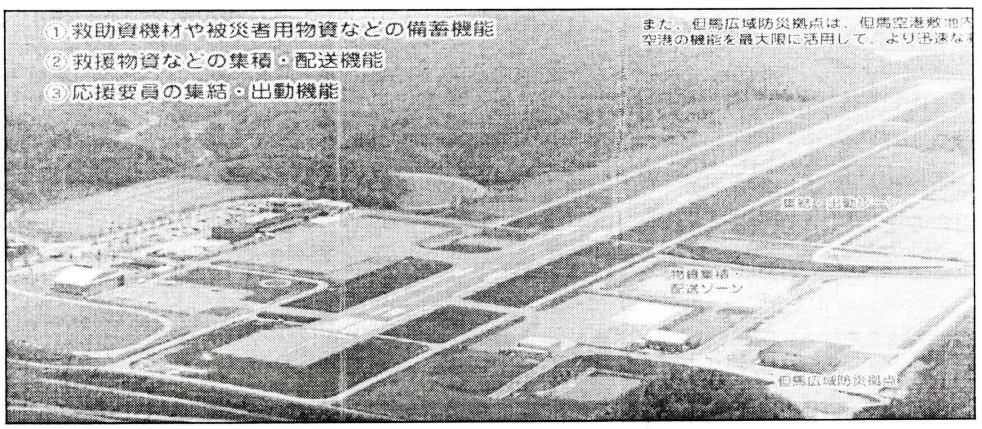


so the national government enactd "Special Measures Act Earthquake Disaster Management", The governmet made "Five-Year Plan for the Emergency Earthquake Disaster Management Plan" "to reconstruct & retrofit "Evacuation route, Emergency trnsport highway", Disaster Management Base, Firefighting faciltities and so on.

As a logisitc base, Disaster Management bases were constructed to secure disaster countermeasure facilities such as stockpile warehouses, delivery facilities and temporary stations to improve disaster management procedures.

Fig.9 shows one example of the base. Beside the local airport, is stockpile warehouse; this is the field for delivery or temporary stations for rescue or support team.

Fig. 9 Regional Disaster Mangement Base



Lesson 4 : Preparedness

Fourth lesson learned was "Lack of Preparedness" especially in field of buildings.

80% were killed by collapsed buildings. And most damaged buildings did not comply with

the building code revised in 1981. Most of them were old building before this revision. And fire broke out spread at those old wooden houses densely built up area.

National Countermeasure 4

Fig.10 Collapsed Houses



As a government's countermeasure, national government enacted "Seismic Building Retrofitting Act" in 1995 to promote seismic retrofitting existing vulnerable buildings.

Government also made subsidy system for retrofitting.

For seismic diagnosis of buildings national and local government shoulders 2/3 of the cost. For retrofitting large buildings 13% of the cost, and houses in dense residential areas 15% of the cost are shouldered by governments.

Lesson 5: Importances of Community and Volunteer

Most people were rescued from rubble of collapsed building by local community people.

And 1.4 million volunters rushed to damaged area to support victims.

Volunteers were really especially in field of medical, architecture, welfare, logistics and so on.

National Countermeasure 5

For support volunteer activity, the governments designated January 17 as "Disaster Management and Volunteer Day". And law to promote specified Nonprofit Activities has passed. Also local governments promoted community self defense organizations.

Fig. 11 Shows a picture of community's self defense organization's drill.

In kobe area more than 90% communities are covered by vthose community self defense organization.

Lesson 5: Needs of Assistance for Vulnerable People

Damaged area was elderly populated area. you may be surprised that 44% death casualty was over 65 years old.

And earthquake hit the small scale industry area. In addition, disperse of the community weakened the mutual aid system of the community. So the area was vulnerable area and they needed assistance.

Fig.11 Community's Self Defense Organization s Drill



National Countermeasure 6

So the government esrablishd several support system.

Those were:

Disaster Recovery Project

Disaster Relief Loans

Disaster Compensation and Insurance

Tax Reduction or Exemption

Tax Allocation to Local Government and Local Bonds

Designation of Extreme Severity Disaster

Assisting the Reconstruction Plan

Assistance for the Recovery of Victims Livelihood

-Disaster Condolence Money

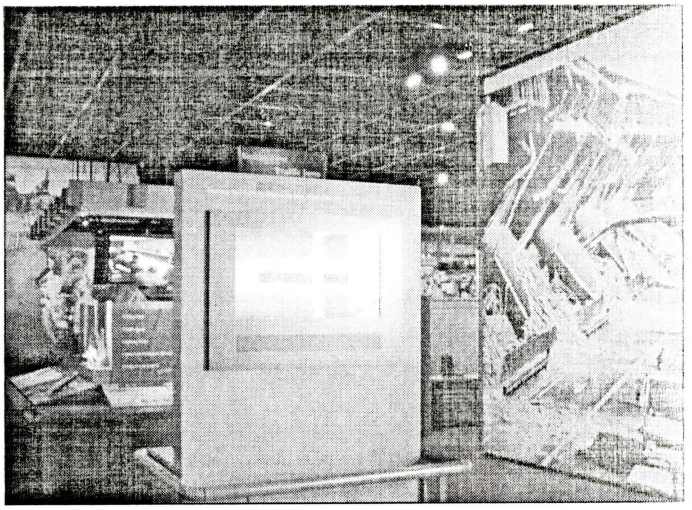
-Disaster Impediment Sympathy Money

-Money for Support of reconstructing of Victims

-Loans from Disaster Support Funds, Livelihood welfare Funds

Dissemination of Lesson learned

Fig.12 Exhibition in the Memorial Center

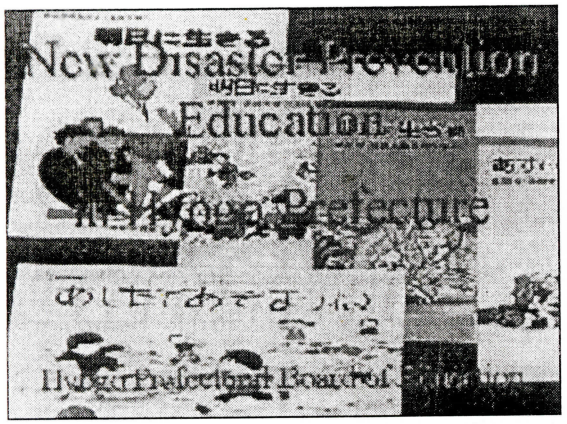


The experiences and lessons from the Earthquake should be communicated widely both within Japan and overseas. The Great Hanshin -Awaji Earthquake Memorial Center opened in kobe in order to pass on as assets belonging to the entire world. After the earthquake, in Kobe, Asian Disaster Reduction Center, UN OCHA Kobe, UNCRD, WHO and JICA International Center were established. Cooperation and networking with these disater prevention organizations and abroad, we should use our experience to contribute to disaster mitigation in the world.

We believe this is the way reward the 6,400 precious life, and reward the support from all over the world. We wish no other country will repeat our sad experience and I hope our lessons learned are usfull and effective to build safer world.

Earthquake Education and Training in School, Training Centre and Community Level

Shinji Itho
Supervisor, Educational Planning Office
Hyogo Prefectural Board of Education.



I an Shinji ito, Supervisor, Educational Planning Office, Hyogo Prefectural Board of Education.

Since English is weak, although I may have an unpleasant, I need your help well. I'd like to talk about something to undertake "New Disaster Prevention Education" in Hyogo prefecture after the Great Hanshin-Awaji Earthquake occurred in 1995.

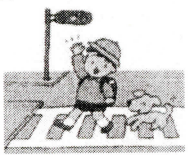
Disaster Prevention Education Before the Great Hanshin-Awaji Earthquake

Disaster Prvention Education as a Part of Safety Education

Traffic Safety

Living Safety

Disaster Safety



Before the Great Hanshin-Awaji Earthquake, the disaster prevention education conducted in Hyogo Prefecture was always a part of safety education, such as traffic safety", living safety" or "disaster safety similar to what was done in other prefectures in Japan. Earthquake disaster drills were also practiced, but with a focus on the potential for fire in the aftermath of an earthquake.

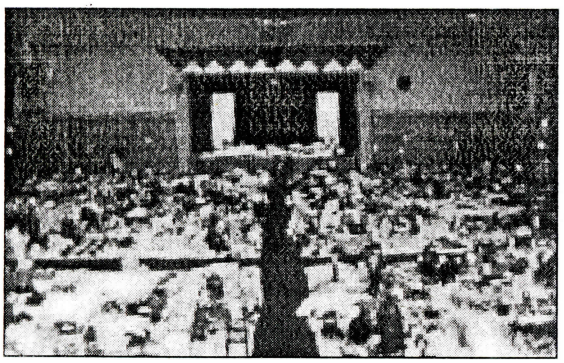
Damages from the Great Hanshin-Awaji Earthquake

* The Number of School chindren Killed	296
* The Number of School children Lost Guardians	231
* The Number of Schools Damaged	1,096
* The Number of Schools that Became Shelters	389
* The Number of Evacuees to Schools	180,227

(Resource: "Living Through the Earthquake"- Recovering in Hyogo Prefectural Board of Education)j

January 17, 1995 (Heisei 7) 5:46 a.m. The Earthquake thatit the southern part of Hyogo Prefecture caused devastating damage to People living in the kobe, Hanshin and Awaji areas.

It took a heavy toll in human lives, including schoolchildren and their guardians. Of the 2,009 school buildings, 389 were used as shelters, to and 180, 227 people were evacuated.



Schools, whether designated as shelters or not were inundated with evacuees.

Without any published guidelines, those schools that were opened to evacuees had to be run completely by improvising according to the demands of each moment.

Post the Great Hanshin-Awaji Earthquake

Establishment of Committee for Inspecting Disaster Management Education

From April 1995 to October 1995

1. Roles of Schools in case of disasters and Enhancement of Disaster Prevention System
1. Disaster Prevention Education ast Schools
1. Mental Health Care for School children

These 3 tasks were discussed in the committee.

In the wake of the experiences born out of the Earthquake, the Hyogo Prefectural Board of Education established a Committee for Inspecting Disaster Management Education, in order to make the most of its experiences to promote this type of education in Hyogo. In the Committee, the following tasks were discussed:

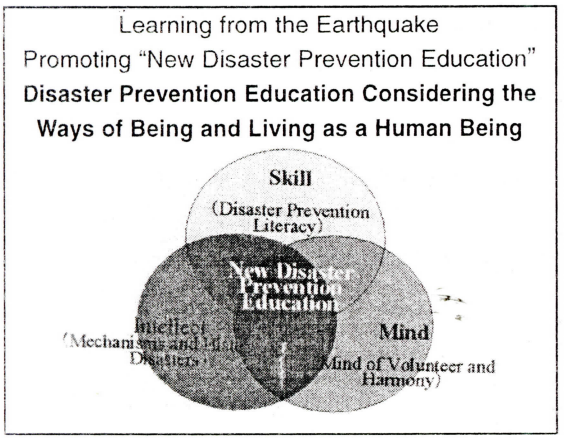
1. Roles of School in the event of disasters and enhancement of disaster prevention system
2. Disaster prevention education at schools.
3. Mental health care for schoolchildren.

Towards Restoring Education in Hyogo Prefecture (Proposal)

1. **Roles of Schools in Case of disasters and Enhancement of Disaster Prevention System**
   * Roles of Schools in Case of Disasters
2. **Dtrengthening of Disaster Prevention Education at Schools**
   * Promotion of "New Disaster Prevention Education"
3. **Mental Health Care**
   * Fulfilment of Mental Health Care

The committee for Inspecting Disaster Management Education presented proposals based on three pillars, each of which has a particular focus:

1. Roles of Schools in the event of disasters
2. Promotion of **"New Disaster Prevention Education"**
3. Expansion of mental health care



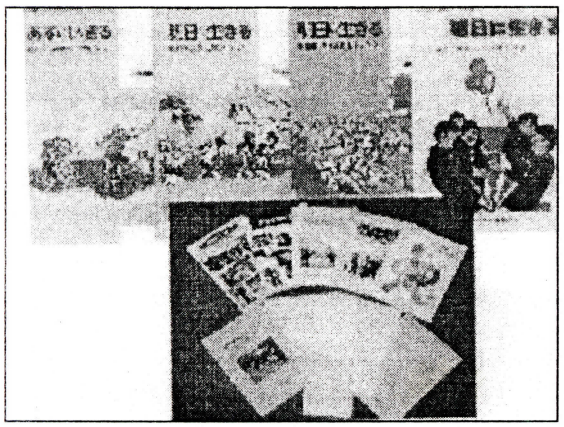
New Disaster Prevention Education is aimed at accomplishing three goals:

- Acquiring disaster prevention literacy to protect oneself against disasters.
- Acquiring knowledge about local disaster history and natural disaster mechanisms.
- Promoting a spirit of volunteerism and harmony with others.

Hyogo Prefecture decided to call this educational program the combination of this information and spirit, the "New Disaster Prevention Education",

Unlike the prequake disaster prevention education, designed and implemented as safety education, we thought any program of education that was to benefit from what we had learned should be aimed at helping children appreciate the beauty of the volunteer activities of the people who spontaneously joined forces at that time, as well as the aspects of life that people share in common.

It is education directed at helping children consider the ways of being and living as a human being a focus we believe, can be applied to all other areas, including school subjects, special activities and moral education.



Hyogo Prefectural Board of Education has developed a series of supplementary reading material for disaster prevention education entitled "Living for Tomorrow" in five versions for kindergarten through high school, to distribute to schools and kindergartens throughout the prefecture. In addition, it has also published every fiscal year since the earthquake various other materials for distribution to school and other institutions.

These include : a summary booklet of New Disaster Prevention Education", a disaster prevention manual for schools an instruction manual to understand and heal the psychological scars of disaster-stricken children, and sample lessons in disaster prevention education.



However, once a disaster occurs, school fill with evacuees, turning into places for living, not education

In such an environment,

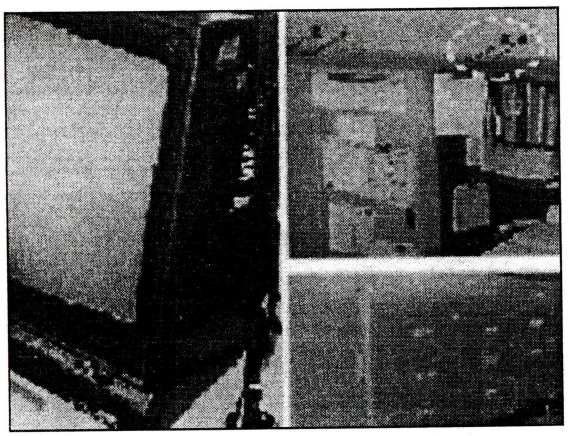
School children learn many things.

Shelter headquaters	Shelter
Distribution of cooked rice	The volunteers are distributing goods

Hyogo Prefectural Board of Education published its Disaster Prevention Manual for Schools in 1998.

The Board has worked on the development of manuals for disaster measures and operation of shelters, based on their reflection on having had to grope their way through action without benefit of any manual.

It is clear from the fact that water reservoirs were built at each school to be used for fire-prevention that school have been positioned as fist-line disaster prevention facilities since early times. Even today, it is mandatory for many primary and junior high schools to keep water in their pools for reasons beyond swimming instruction : it is also intended for water storage for fire prevention.



In order to enhance the disaster-prevention function of schools in light of what we have learned from the Earthquake, and recognizing the role of school as the core of the safety and security of the community during a disaster, we must establish secure places where local residents can evacuate.

Various kinds of disaster prevention equipment are installed in school buildings. We have introduced, for example, belts to prevent TVs From overturning, attachments for securing, and attachments to prevent cabinets from overturning/moving.

In addition to the installation of such equipment, should schools be required to serve as shelters in a disaster, we are currently developing a system to assign faculty members to help with the operation of the shelters for a certain period of time.



Shelters are in principle administered by the local municipalities.

However, in an actual disaster municipal officers cannot handle everything involved in establishing shelters by themselves. This is way we are planning to assign school faculty, who are familiar with the local community and have met its residents, to work at shelters, so that their operation may proceed smoothly.

The group which supports management of shelter	The group which supports resumption school education
The group which supports the eating habits of evaquees	The group which supports the evaquees

Aiming to the best use of our experience and to reciprocate the vast amount of assistance we received from other prefectures at the time of great Hanshin-Awaji Earthquake, in April 2000 we established the "Emergency and Rescue Team by school staff in Hyogo (EARTH)" Members of EARTH have provided support to the school shelters in the area damaged by the eruption of Mount Usu in Hokkaido and psychological care for the children in the quake - Stricken schools in western Tottori Prefecture. They have also participated in seminars for school faculty and local disaster prevention drills to share what we have learned from the Earthquake.

When a school is used as a shelter, various problems arise from using a place for both education and living. While the original function of schools is to provide a healthy place for children to study and play, they also fulfill another capacity. One aspect of the school which has been recognized as the core of the community in Japan, is to be a hub of safety and security for communities. In the hope that local residents as well as children will feel a sense of security in their lives, the members of the school faculties in Hyogo Prefecture are undertaking the expansion of the "New Disaster Prevention Education" program.

Case Presentation on Living with Disasters : A Study on 1991 Cyclone in Bangladesh

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(On Behalf of Research Team)

1. Introduction

a. Background of the study

1.1 Natural disasters have become an integral part of human lives. Floods, cyclones, tidal surge etc. visit almost regularly the vast majority of the world's population living in the disaster prone areas of South Asia, South East Asia, Latin America and Africa. They cause colossal loss of lives and properties and bring in their wake diseases, famines and pauperization. All these frustrate the attempts of many developing countries to break the vicious circle of poverty.

1.2 Bangladesh is a tropical country with the funnel shaped coast touching the Bay of Bengal in the south. Because of its geographical and climactic factors natural calamities such as flood, cyclone, tidal bores etc. are regular phenomena in Bangladesh. Of the cyclones and other disasters that hit Bangladesh so long, the cyclone of 1991 will remain in the sad memory of the people of Bangladesh for years to come. The cyclone of April 29, 1991 with a wind speed of 245 km per hour and tidal surge of over 6 metres hit the coastal areas and off-shore islands of the country. According to available government report, in the Chittagong Zone alone about 1.32 lakh people lost their lives and properties worth US $2.07 billion were destroyed by this cyclone.[1] The cyclone hit 18 coastal districts of the country. The severely affected districts are : (i) Chittagong, (ii) Cox's Bazar, (iii) Bandarban, (iv) Rangamati, (v) Khagrachari, (vi) Feni, (vii) Noakhali, (viii) Bhola and (ix) Patuakhali, Other affected districts include : (i) Barguna, (ii) Bagerhat, (iii) Pirojpur, (iv) Jhalakati, (v) Barisal, (vi) Laxmipur, (vii) Sariatpur, (viii) Chandpur and (ix) Comilla. A map showing the worst affected and affected districts has been given in this report.

1.3 Not only the people of Bangladesh but the entire international community were grieved by such an unprecedented destruction of human lives and properties. To get a first hand idea about how the people survived the onslaught of the cyclone, about the preparedness of the authorities concerned regrading the cyclone, the roles played by the people and about the post-cyclone activities, Bangladesh Public Administration Training Centre decided to undertake the study.

1. *Zonal Relief Co-ordinator, GOB, Operation SHEBA, Relief & Rehabilitation plan for district of Chittagong, Cox's Bazar, Noakhali, Feni, Laxmipur, Rangamati, Khagrachhari and Bandarban. (Chittagong, June 1991), pp 4-5*

b. Review of literature

1.4 Based on the review of available literature on the 1991 cyclone, the following issues have relevance to this study : (i) nature and extent of damage, (ii) relief and rehabilitation measures and (iii) effect of the cyclone on class structure. These issues have been discussed at length.

b.1 Nature and extent of damage :

1.5 The Cyclone of 1991 caused severe damage to life, property and physical infrastructure of the coastal area of Bangladesh. A perceptional study was undertaken by BCAS (Bangladesh Centre for Advanced Studies) to assess the damage caused by the cyclone for the country as a whole. In the estimate of the visiting team, human causalities in the unprotected islands were on the average between 40-50 percent of the total population of the areas affected by the storm surge, in the islands protected by embankments, it could be between 30-50 percent while on the mainland coast, that faced the fury of the surge, deaths were probably upto 20-30 percent of the existing population.[2] The news media informed that 85 percent of the deaths were of women and children.[3]

1.6 The Government of Bangladesh estimate of the human death toll runs as high as 1,38,000 lives. Dr. Mahabub Hossain attempted to make an informed guess by compiling information from censuses and surveys carried out earlier. Informed guess about the loss of income and capital stock due to the cyclone is as follows :

Items	Tk. (crores)
Food grains	300
Fisheries	106
Livestock	163
Housing	254
Industry	1456
Total	2309

This amounted to about 3.3% of the National income.[4]

1.7 According to the study of BCAS, some 50,625 hectors of agricultural land and dwelling areas were submerged in the Cox s Bazar region under saline water, the calamity washed away shrimp-beds prown hatcheries, embankments and infrastructures of shrimp cultivation, most of the salt beds damaged, all the katchha houses were demolished, more than 50 percent of houses with wooden pillars, tin walls and roofing were also destroyed.

1.8 In the districts of Chittagong, Cox's Bazar, Noakhali, Feni, Laxmipur, Rangmati, Khagrachari and Bandarban, out of total area of 26,406 sq. km. 2,326 sq. km. were

2. *BCAS : Cyclone '91 An Environmental and Perceptional Study (Dhaka : BCAS, 1991), p,35*

3. *Hasna Hena, "Why Women Appear Vulnerable" in Hameeda Hossain, Cole P. Dodgeand F. H. Abed (ed.) From Crisis to Development : Coping with Disasters in Bangladesh (Dhaka : University Press Limited, 1992). p.67*

4. *Mahabub Hossain, The April Cyclone and Economic Loss : An informed Guess from Secondary Data. (Dhaka :BIDS, 1991,pp. 5_6.*

worst affected, 4,150 sq. km were badly damaged and 5,920 sq. km were partially damaged. Nearly 7,000 educational institutions and 3,000 mosques and places of worship were also damaged. Industries suffered the worst blow and the estimated loss in this sector alone is Tk. 13.57 billion. Total loss is estimated at US$ 2.07 billion for all Sectors.[5]

b.2 Relief and rehabilitation measures

1.9 The extent of deaths, damages and destruction left affected people entirely dependent on relief provisions and services for succour and survival. As part of preparedness measures, Standing Orders for Cyclones have been prepared by the Ministry of Relief and Rehabilitation which lay down actions by all concerned during the various stages of disaster. Various actions under these Standing Orders generally fall into the following stages : (a) Pre-disaster stage (2) After stage (3) Warning stage (4) Disaster stage and (5) Post disaster stage.[6]

1.10 After the cyclone 1991, the office of Zonal Relief Coordinator prepared a relief and rehabilitation plan for the distressed people and the area within the districts of greater Chittagong and Noakhali. The relief and rehabilitation plan was outlined in four phases : (a) survival relief, (b) emergency relief, (c) emergency relief and rehabilitation, (d) short, medium and long-term rehabilitation. Total estimated budget for this relief and rehabilitation plan was calculated to be Tk. 57,150 million.[7]

b.3 Effect on the structure :

1.11 In the immediate aftermath of the cyclone, there was an equalizing effect of the disaster on the class structure of the affected people. The devastation cut across all classes. However, inequality will persist and increase on the basis of type of housing. Those having pucca buildings survived the disaster, will continue to form the dominant class. The upper class based on land ownership or salt trade will decrease in size. The middle class will dwindle and the lower class will be pauperized. Rehabilitation into their former status will depend on the ability of each to regain their former sources of income. In this way, class inequality will intensify in future.[8]

c. Rationale of the Study

1.12 Bangladesh has one of the lowest per capita incomes in the world (US$ 210 in 1990) and ranks eighth in terms of population (about 110 million people in 1991). Because of its geographical and climatic factors, Bangladesh is tormented and devastated by natural calamities such as flood, cyclone, tidal waves etc. almost every year. The people of Bangladesh have become habituated to these disasters for a long time. April 29, 1991 was particularly distressful since very few people have heard or seen the cyclone

5. *Zonal Relief Co-ordinator, GOB, Operation SHEBA, Relief & Rehabilitation Plan for districts of Chittagong, Cox's Bazar, Noakhali, Feni, Laxmipur, Rangamati, Khagrachhari and Bandarban. (Chittagong : June 1991) Ibid.pp 4-5.*

6. *Ministry of Relief and Rehabilitation, GOB, Standing Orders for Cyclone (Dhaka : 1985).*

7. *Zonal Relief Coordinator, GOB : Ibid,p.26.*

8. *BCAS : Ibid, p.60*

accompanied by tidal bores of such a devastating magnitude before.

1.13 Because of the cyclone, the government has to divert money from development projects and programmes to relief and rehabilitation measures. It is a fact of life that we have to live with these natural calamities. We have heard the stories of survival. We need to find out how the individual and the community struggled for survival with their limited resources, at time supplemented by assistance of both government and NGOs. While the stories of devastation loss of lives and properties should be the basis for designing plans and programmes for coping with the disaster, the stories of survival are no less important in this exercise. Therefore, an attempt has been made to study the behavior of the affected people as they struggled for survival in 1991 cyclone.

1.14 It is hoped that the findings of the study will provide some ideas and information to the policy makers; planners and administrators for designing and implementing effective disaster management plans and programmes in Bangladesh.

d. Objectives of the study

The broad objective of The study is to see how the affected people survived the onslaught of cyclone 1991 and to give some recommendations for coping with the cyclone efficiently in future. The specific objectives of the study are as follows:

(i) To examine the level of preparedness of the people before the cyclone

(ii) To study how the affected people responded to the cyclone

(iii) To examine the nature of assistance received from different organizations in post cyclone situation and.

(iv) To give some recommendations for living with the cyclone efficiently in future.

2. Cyclone Warning and Forecasting System and Preparation and Precautions taken by the Respondents

a. Cyclone Warning and Forecasting System:

2.1 Cyclone warning and forecasting system is very important to face cyclones and other natural disasters. Right forecasting and proper signaling can help the people take preparation to face disasters and help reduce loss of lives and properties caused by cyclones. When the respondents were asked as to whether they had prior knowledge about the possible occurrence of the cyclone, 89.23% of the respondents replied in the affirmative and 10.77% replied in the negative. On the other hand, 77.68% of the respondents knew about the cyclone with tidal bore, 22.32% of the respondents did not know about the impending cyclone with tidal bore. This information has been presented in table-2.1 districtwice. It is evident from table 2.1 that the number of respondents (77.68%) who knew about the probable occurance cyclone with tidal bore was less than those (89.23%) who knew about the occurrence of cyclone only.

Table - 2.1
Prior knowledge of the respondents about the cyclone and tidal bore

Description	Nature of Response	No. of respondents								Total	%
		Bag.	Bar	Bhol	Ctg.	Cox's	Feni	Noa	Patua		
Only Cyclone	Known	91	345	774	922	1205	177	535	609	4658	89.23
	Not Known	09	15	66	78	275	3	65	51	562	10.77
Total		100	360	840	1000	1480	180	600	660	5220	100
Cyclone+ Tidal bore	Known	83	321	743	680	949	175	524	580	4055	77.68
	Not known	17	39	97	320	531	5	76	80	1165	22.32
Total		100	360	840	1000	1480	180	600	660	5220	100

N=5220

Table - 2.2
Respondents' sources of information about the cyclone and tidal bore

Sources of Information	No. of responses								Total	%
	Bag.	Bar	Bhol	Ctg.	Cox's	Feni	Noa	Patua		
Radio	88	308	714	708	846	147	422	495	3728	80.03
Television	2	1	42	59	48	8	35	7	202	4.34
Local Administration	7	8	126	223	218	9	52	111	754	16.19
UP Chairman/Member	8	32	84	181	209	24	38	37	613	13.16
Mohral/Matbar	1	27	17	88	113	6	35	11	298	6.40
School Teacher	2	6	15	5	51	5	20	10	114	2.45
Neighbour	27	119	210	259	313	58	105	97	1188	25.50
NGO Worker	7	0	252	27	19	18	15	2	340	7.3
Mowlana/Imam	2	0	10	1	51	0	10	0	74	1.51
CPP	55	196	504	277	474	62	320	304	2192	47.06
Discussion with the people	17	59	336	430	392	21	40	218	1513	32.48
Others	9	4	42	2	72	0	0	0	129	2.78

N=4658

N. B. : Multiple responses were recorded.

Table - 2.3
Information received no. of days before and belief about the occurance of the cyclone

No. of days information Received	Nature of Response	No. of respondents								Total	%
		Bag.	Bar	Bhol	Ctg.	Cox's	Feni	Noa	Patua		
In the day of Cyclone	Believed	0	75	0	155	252	0	0	126	608	13.05
	Not belived	0	0	0	284	320	0	0	5	609	13.07
1 day before	Believed	54	163	468	156	183	101	320	253	1698	36.45
	Not believed	7	18	50	183	225	25	50	44	602	12.92
2 day before	Believed	21	76	206	68	78	26	114	142	731	15.69
	Not believed	0	1	0	45	78	0	0	17	141	3.03
3 day before	Believed	9	12	47	15	33	25	34	21	196	4.22
	Not believed	0	0	0	13	26	0	0	1	40	0.86
4 days before	Believed	0	0	3	2	5	0	17	0	27	0.58
	Not believed	0	0	0	1	5	0	0	0	6	0.13
Total	Believed	84	326	724	396	551	152	485	542	3260	69.99
	Not believed	7	19	50	526	654	25	50	67	1398	30.01
Total		91	345	774	922	1205	177	535	609	4658	100%

N=4658

Table - 2.4
Reasons for not believing that the cyclone would hit the respondents

Reasons	No. of respondents								Total	%
	Bag.	Bar	Bhol	Ctg.	Cox's	Feni	Noa	Patua		
Generally the information did not come true in the past	6	13	40	138	423	19	34	52	725	51.86
They did not think that the cyclone would be so strong	4	7	24	172	314	12	17	39	589	42.13
They did not think that the cyclone would be accompanied by tidal bore	3	6	26	165	249	4	18	15	486	34.76
They had doubt that the Cyclone with the tidal bore would be so strong	5	0	43	0	247	14	35	50	374	26.75
They had completely surrendered themselves to Almighty Allah	4	0	22	0	0	5	16	0	47	3.36
Others	0	0	0	0	46	0	0	0	46	3.29

N=1398

N. B. Multiple responses were recorded.

Only 25.34% of the respondents left their houses and took shelter in cyclone shelters and neighbours strong houses. The respondents who did not lave their houses stated some reasons for this. The largest number i.e. about 48% of the respondents stated absence of nearby cyclone shelters. Other factors for not leaving teir respective houses were (i) shortage of time (15.95%) and (ii) they though that thier houses were good enough of face the cyclone (23.89%) and (iii) not beleving the information abut the cyclone (14.98%). 13.10% of the respondents did not leave their houses for other reasons, i.e. (i) fear of theft in their houses and (ii) not believing the intensity of the cyclone (Table 2.5)

Table - 2.5
Reasons for not moving their own homesteads

Reasons	No. of responses								Total	%
	Bag.	Bar	Bhol	Ctg.	Cox's	Feni	Noa	Patua		
Due to shortage of time	20	15	84	113	36	16	75	67	426	15.95
Did not believe	13	9	8	227	96	17	11	19	400	14.98
Absence of my nearby cyclone shelter	54	132	313	147	97	81	300	153	1271	47.81
Own houses were good enough to protect cyclone	14	46	260	36	71	0	90	128	638	23.89
Did not ready to leave parental house	10	0	0	0	0	15	0	0	25	0.94
Others	0	97	0	105	95	0	0	52	350	13.10
Cyclone shelter was very near to house	0	0	18	0	0	0	15	0	33	1.24

N=2671 N.B. : Multiple responses were recorded.

2.2 For taking necessary preparations and also for making the people aware, some organizations played important roles to face the cyclone. Of different concerned organizations in the study areas, CPP played a very significant role. Most of the respondents appreciated the role played by the CPP. Other organizations like Union Parishad, school teachers, local leaders, Thana Parishad, and NGOs also played a role in making necessary preparations and making the people aware of the disaster in the study areas (Table 2.6).

Table - 2.6
Name of the organizations/individuals came foreward to provide different services for cyclone preparedness

Organizations/ Individuals	No. of responses								Total	%
	Bag.	Bar	Bhol	Ctg.	Cox's	Feni	Noa	Patua		
Upazila Parishad/ Municipal Corporation	54	417	121	290	490	26	11	96	1505	28.83
NGOs	46	11	234	52	98	24	109	48	622	11.92
Students & Youth	29	4	7	25	66	25	8	36	200	3.83
Union Parishad	74	87	238	237	334	32	92	119	1213	23.24
CPP	181	417	753	234	493	102	332	475	2987	57.22
Neighbour	12	0	0	0	0	25	0	0	37	0.71
Others	0	45	0	0	70	0	0	2	117	2.24
School Teachers	0	44	0	12	41	0	0	9	106	2.03
Farmers/Landless	0	2	0	0	8	0	0	17	27	0.52
Local Leaders	0	27	10	12	109	0	12	52	222	4.25
District Administration	0	0	318	0	0	0	36	0	354	6.78

N-5220

N. B. : Multiple responses were recorded.

Table - 2.7
Nature of services rendered by different organizations

Nature of Services	No. of responses								Total	%
	Bag.	Bar	Bhol	Ctg.	Cox's	Feni	Noa	Patua		
Gave Information about Cyclone	90	32	726	602	694	150	314	525	3133	60.02
Advised to take shelter	91	150	614	208	527	175	286	456	2507	48.03
Advised to preserve food and drinking water underground	16	125	150	153	186	51	82	338	1101	21.09
Helped to shif people in Safe place	42	21	53	66	137	0	20	237	582	11.15
Advised to set free their livestock	86	44	0	86	291	82	0	281	870	16.67

N-5220

N. B. : Multiple responses were recorded.

Table - 2.8
Reasons for not taking shelters by the respondents

Reasons	No. of responses								Total	%
	Bag.	Bar	Bhol	Ctg.	Cox's	Feni	Noa	Patua		
Absence of any cyclone shelter or safe places	25	60	425	92	-	81	186	-	869	38.54
Cyclone shelter was far away	45	85	175	142	-	62	232	-	741	32.86
Own house was good enough for safety	19	35	212	55	-	14	37	-	372	16.50
Shortgage of time	20	16	125	143	-	28	33	-	365	16.19
Not possible to leave the houses unprotected	18	87	85	113	-	18	152	-	473	20.98
Cyclone shelter was very close to the house	8	0	65	0	-	0	22	-	95	4.21
Did not belive the cyclone forecasting	11	0	0	0	-	27	0	-	38	1.69
Others	0	61	0	105	-	0	0	-	166	7.36

N=2255 N. B. Multiple responses were recorded.

Table - 2.9
Distance of cyclone shelters

Distance (km.)	No. of responses								Total	%
	Bag.	Bar	Bhol	Ctg.	Cox's	Feni	Noa	Patua		
1	3	61	215	359	615	12	35	276	1576	30.19
2	2	34	385	203	293	18	35	236	1206	23.10
3	2	45	95	120	72	0	63	66	463	8.87
4	2	47	70	46	47	7	35	28	282	5.40
5	31	45	34	12	38	21	14	20	215	4.12
6	48	47	19	5	51	102	82	10	364	6.97
7+	12	64	12	145	364	20	100	24	741	14.20
No response	0	17	10	110	0	0	236	0	373	7.15
Total	100	360	840	1000	1480	180	600	660	5220	100

N=5220

Table - 2.10
Reasons for not preserving food, water and medicine underground

Reasons	No. of responses								Total	%
	Bag.	Bar	Bhol	Ctg.	Cox s	Feni	Noa	Patua		
Did not know at all	32	128	552	340	487	49	400	239	2227	49.51
Did not belive cyclone forecasting	18	0	42	224	318	24	10	30	666	14.81
Shortage of time	20	22	60	103	90	0	31	27	353	7.85
Did not think to preserve them underground	22	160	30	264	410	99	63	232	1280	28.46
Others	0	25	0	31	91	0	0	37	184	4.09
No reply	0	0	0	0	0	0	96	0	96	2.13

N=4498 N. B. : Multiple responses were recorded.

Table - 2.11
Resons for not taking livestock to safe places

Reasons	No. of responses								Total	%
	Bag.	Bar	Bhol	Ctg.	Cox s	Feni	Noa	Patua		
Lack of safe places	39	83	435	252	212	64	335	97	1517	39.29
Did not think necessary	12	94	75	140	352	29	74	79	855	22.14
Shortage of time	16	13	175	120	180	14	109	90	717	18.58
Dependence on Alah	12	0	64	0	0	17	40	0	133	3.44
Did not believe the forecast	18	0	0	90	0	27	0	0	135	3.50
Own houses were safe	0	17	0	3	0	0	0	0	20	0.52
It was not possible to take livestock with them	0	25	0	13	0	0	0	0	38	0.98
Afraid of being stolen and missing	0	8	0	0	0	0	0	0	8	0.21
To safe own lives	0	0	0	0	254	0	0	125	379	9.82
No reply	0	0	125	0	0	0	88	0	213	5.52

N=3861 N. B. : Multiple resposes were recorded.

Table - 2.12
No. of Dead Persons of Eight Districts

Name of the districts	Number of dead persons as reported by the respondents		
	Male	Female	Total
Bagherhat	1	0	1
Barguna	1	1	2
Bhola	4	2	6
Chittagong	261	341	602
Cox's Bazar	481	542	1023
Feni	0	0	0
Noakhali	0	0	0
Patuakhali	1	0	1
Total	749	886	1635

b. Post-Cyclone Situation

b. 1. Losses of lives and properties caused by the cyclone :

2.3 Cyclone with tidal bore occurred in most of the affected areas. As a consequence people suffered loss of lives and properties. None was reported dead in the study areas of Feni and Noakhali. In the districts of Bagherhat, Barguna, Bhola and Patuakhali a few persons died (10 persons). But 1625 persons died in the districts of Chittagong and Cox's Bazar and most of the dead persons were female. Districtwise death information is presented in table-2.12. As reported by the respondents the major causes of their death were failure to take shelter due to absence of any nearby cyclone shelter, and lack of sufficient accommodation in the cyclone shelters. Other important causes of death are sudden occurrrence of tidal bore, trapped under fallen trees and houses. No death incidence was reported among those who took themselves in the cyclone shelters.

Only a few respondents' families took shelter in the cyclone shelter nearby. According to their observation, people varying from 200 to 6000 took shelter in a cyclone shelter. The cyclone shelters were reported to be overcrowded by two to four times the normal capacity.

2.4 The respondets suffered not only in terms of demise of their near and dear ones but also in terms of damage of their houses and other properties and loss of livestock. However, no attempt has been made to assess the extent of loss of livestock and other properties in the study. The dead persons were burried by their relatives ad neighbours. Most of the dead animals were thrown into ponds, rivers and canals.

b. 2. Activities Immediately After the Cyclone

2.5 An attempt has been made to know how the respondents faced the situation with the activities immediately after the cyclone. According to the respondents, the following actions were taken by them immediately after the cyclone :

(i) Assessed their own losses

(ii) Repaired their damaged and fallen houses

(iii) Damages of roads, bridges and culverts

(iv) Roads were submerged under water because of tidal bore

(v) Severe damage of coastal embankments

2.6 In the areas where transport and communication system had been affected, different organizations and individuals namely, Union Parishad, launch owners, different government organizations, and local people took initiatives to restore transport and communication facilities, though it was very difficult in some areas due to submerged water.

2.7 The above mentioned activities were undertaken by the respondents themselves at their own inititatives. This shows their strong community felings for fighting the survival battle.

2.8 Immediately after the cyclone some items become essential for survival of the affected people. The respondents were asked about their immediate needs. Table - 2.13 persents the food and other essentials needed by the respondents immediately after the cyclone. It is revealed from the table that the largest number of respondents (84.46%) considerd food to be the most essential item immediately after the cyclone. Drinking water (68.28%), fire wood/fuel (31.90%), wearing clothes (40.65%), dry land (20.02%), house building materials (1.21%) and cash money (3.22%) were also items needed by the respondents immediately after the cyclone. Before receiving any external assistance, the respondents themselves made attempts to collect food mainly from their relatives, neighbours and markets. It appears from table - 2.14 that 77.11% of the respondents were able to collect food and 22.89% were unable to collect food. Those who were unable to collect food passed their days in starvation till receipt of outside assistance. In case of drinking water 81.19% of the respondents were able to collect food. Those who wrer unable to collect food passed their days in starvation till receipt of outside assistance. In case of drinking water 81.19% of the respondents were able to collect water and 18.81% were unable to collect. Those who could not collect safe water mainly because the sources of drinking water were submerged under water were compelled to drink impure water.

Table - 2.13
Items urgently needed by the respondents immediately after the cyclone

Items	No. of responses								Total	%
	Bag.	Bar	Bhol	Ctg.	Cox's	Feni	Noa	Patua		
Drinking water	72	223	440	895	1124	135	424	251	3564	68.28
Food	82	323	560	850	1352	140	530	572	4409	84.46
Fire Wood/Fuel	43	100	60	377	775	74	89	147	1665	31.90
Dry land	28	11	40	197	624	52	90	3	1045	20.02
Wearing clothes	58	73	20	570	975	87	159	180	2122	40.65
Drug	12	0	80	64	242	26	89	15	528	10.11
House building materials	0	38	0	25	0	0	0	0	63.	1.21
Cash Money	0	38	30	10	0	19	0	0	97	1.86
Others	0	32	0	6	345	0	18	60	461	8.83

N=5220 N. B. : Multiple responses were recorded.

Table - 2.14
Information as to whether the respondents were able to collect food and drinking water

Items	Responses	No. of responses								Total	%
		Bag.	Bar	Bhol	Ctg.	Cox's	Feni	Noa	Patua		
	Yes	65	350	812	577	917	114	577	613	4025	77.11
Food											
	No	35	10	28	432	563	66	23	47	1195	22.89
Total		100	360	840	1000	1480	180	600	660	5220	100
	Yes	94	342	790	668	1092	130	488	634	4238	81.19
Drinking											
	No	6	18	50	332	388	50	112	26	982	18.81
Total		100	360	840	1000	1480	180	600	660	5220	1000

N=5220

Table - 2.15
Number of days after the cyclone respondents received relief goods

Days after the Cyclone	No. of respondents								Total	%
	Bag.	Bar	Bhol	Ctg.	Cox's	Feni	Noa	Patua		
1	14	33	69	175	161	14	38	10	524	14.08
2 - 6	6	54	132	587	552	61	87	87	1566	42.07
7 - 15	47	74	309	205	322	40	62	252	1311	35.23
30	8	41	75	3	115	9	70	0	321	8.62
Total	35	202	585	970	1150	124	267	349	3722	100

N=5220

Table - 2.16
Opinion of the respondents regarding distribution of relief goods

Option	No. of respondents								Total	%
	Bag.	Bar	Bhol	Ctg.	Cox's	Feni	Noa	Patua		
properly distrbuted	19	117	402	531	938	25	300	392	2724	52.18
Not properly distributed	76	121	344	469	542	155	123	268	2098	40.19
No response	5	122	94	0	0	0	177	0	398	7.63
Total	100	360	840	1000	1480	180	600	660	5220	100

N=5220

Table - 2.17
Reason for improper distribution of relief goods.

Reasons	No. of responses								Total	%
	Bag.	Bar	Bhol	Ctg.	Cox's	Feni	Noa	Patua		
Wastage	6	13	58	167	106	15	18	39	422	20.11
Misappropriation	84	74	119	301	300	136	36	135	1185	56.48
Misuse	0	84	0	174	163	0	0	196	617	29.41
Others	0	4	0	10	118	0	0	51	180	8.58
No respose	10	0	167	0	0	4	69	0	250	11.92

N=2098 N.B. : Multiple responses were recorded.

Table - 2.18
Persons/organizations responsible for improper distribution of relief good

Responsible person/ Organization	No. of responses								Total	%
	Bag.	Bar	Bhol	Ctg.	Cox's	Feni	Noa	Patua		
Local elected respersentatives	-	103	-	310	419	-	-	168	1000	71.43
Relief distribution committee	-	12	-	120	72	-	-	35	240	17.14
Govt. officials	-	4	-	43	69	-	-	39	155	11.07
Others	-	2	-	24	99	-	-	42	167	11.93

N=1400 (Excluding the districts of Bgherhat, Bhola, Feni and Noakhali)

' ' informations were not compiled accordingly.

N.B. : Multiple responses were recorded.

Table - 2.19
Opinion of the respondents regarding organizations/ individuals for proper distribution of relief goods in future

Organizations/ Individuals	No. of responses								Total	%
	Bag.	Bar	Bhol	Ctg.	Cox's	Feni	Noa	Patua		
Armed Forces	15	120	150	167	316	82	130	87	1067	50.86
Govt. Officials	12	40	198	148	167	74	140	157	936	44.61
Honest and Sincere Local People	6	29	161	82	88	36	125	41	568	27.93
Red Crescent Society	9	17	102	0	29	21	100	37	315	15.01
NGOs	0	0	0	92	128	0	0	35	255	12.15
Local Relief Committee	0	6	0	0	0	0	0	0	6	0.29
Local Elected Representative	3	18	0	8	0	0	0	0	29	1.38
Political Party Workers	0	1	0	3	4	0	0	0	8	0.38
Others (Cooperatives)	0	4	0	53	59	0	0	0	116	5.53
No response	2	0	78	0	12	15	60	7	174	8.28

N=2098 N. B.: Multiple responses were recorded.

Table - 2.20
Whether members of the respondents family were affected by discases in the post cyclone period

Response	No. of responses								Total	%
	Bag.	Bar	Bhol	Ctg.	Cox's	Feni	Noa	Patua		
Yes	46	58	306	777	1151	154	310	321	3123	59.83
No	42	302	420	223	329	26	195	339	1876	35.94
No response	12	0	114	0	0	0	95	0	221	4.23
Total	100	360	840	1000	1480	180	600	660	5220	100

N=5220

Table - 2.21
Medical service received from different organizations/indivduals

Organizations/ Individuals	No. of responses								Total	%
	Bag.	Bar	Bhol	Ctg.	Cox's	Feni	Noa	Patua		
Government	37	22	78	463	661	102	52	133	1545	49.47
Red Crescent Society	27	3	26	420	507	68	18	54	1123	35.96
NGOs	27	3	26	420	507	68	18	54	1123	35.96
Personal Initiative	32	10	184	8	0	12	155	0	401	12.84
Armed Forces	13	0	61	0	0	42	55	0	171	5.48
Others	0	0	0	0	96	0	101	0	197	6.31
No medical facility received	0	23	0	99	161	24	0	46	353	11.30
No responses	9	0	49	0	0	0	50	0	108	3.46

N=3123 N. B. : Multiple responses were recorded.

b.3 Respondents Views for Future Survival Strategies :

Table - 2.22
The respondents willingness to be shifted permanently or not.

Response	No. of responses								Total	%
	Bag.	Bar	Bhol	Ctg.	Cox's	Feni	Noa	Patua		
Yes	32	112	359	420	714	77	388	151	2253	43.16
No	68	248	481	580	766	103	212	509	2967	56.84
Total	100	360	840	1000	1480	180	600	660	5220	100

N = 5220

2.9 Natural calamities are almost regular visitors to the areas studied. Over the years the cyclone caused colossal loss of lives and properties. In order to avoid the onslaught of the cyclone in future the respondents might like to be shifted to safe places. The respondents were asked if they were willing to be shifted permanently to safe places, majority (57%) responded 'no' and 43% pesponded 'yes' (table 2.22). These who pesponded 'no' stated some reasons why they were not willing to be shifted permanently. The reasons are: (i) most of the respondents were not willing to be displaced from their ancestral homesteads, (ii) affection of relatives and local people and (iii) they were not sure about sources of livelihood elsewhere. This indicates their willingness to live will disasters.

2.10 In almost every year disasters take place in the study areas. The respondents gave their opinions regarding how they would survive disaster in future .Their opinions have been stated in the following lines:

(i) Due to lack of cyclone shelters nearby and also negligence to take cyclone warning signals seriously, they suffered a lot. So they opined that in future they would go to cyclone shelters if the govt. constructed shelters for them.

(ii) They would repair their houses strongly and would try to construct pacca houses so that they could stay in their own houses safely.

(iii) Some people would try to take shelter in their neighbors strong houses.

(iv) They thought that trees could lessen the wind speed and tidal surge. So they expressed their views for planting more trees surrounding their homesteads.

(v) In the previous cyclones and the cyclone studied some of them saved their lives by climbing big trees. So they would climb the trees in future as well.

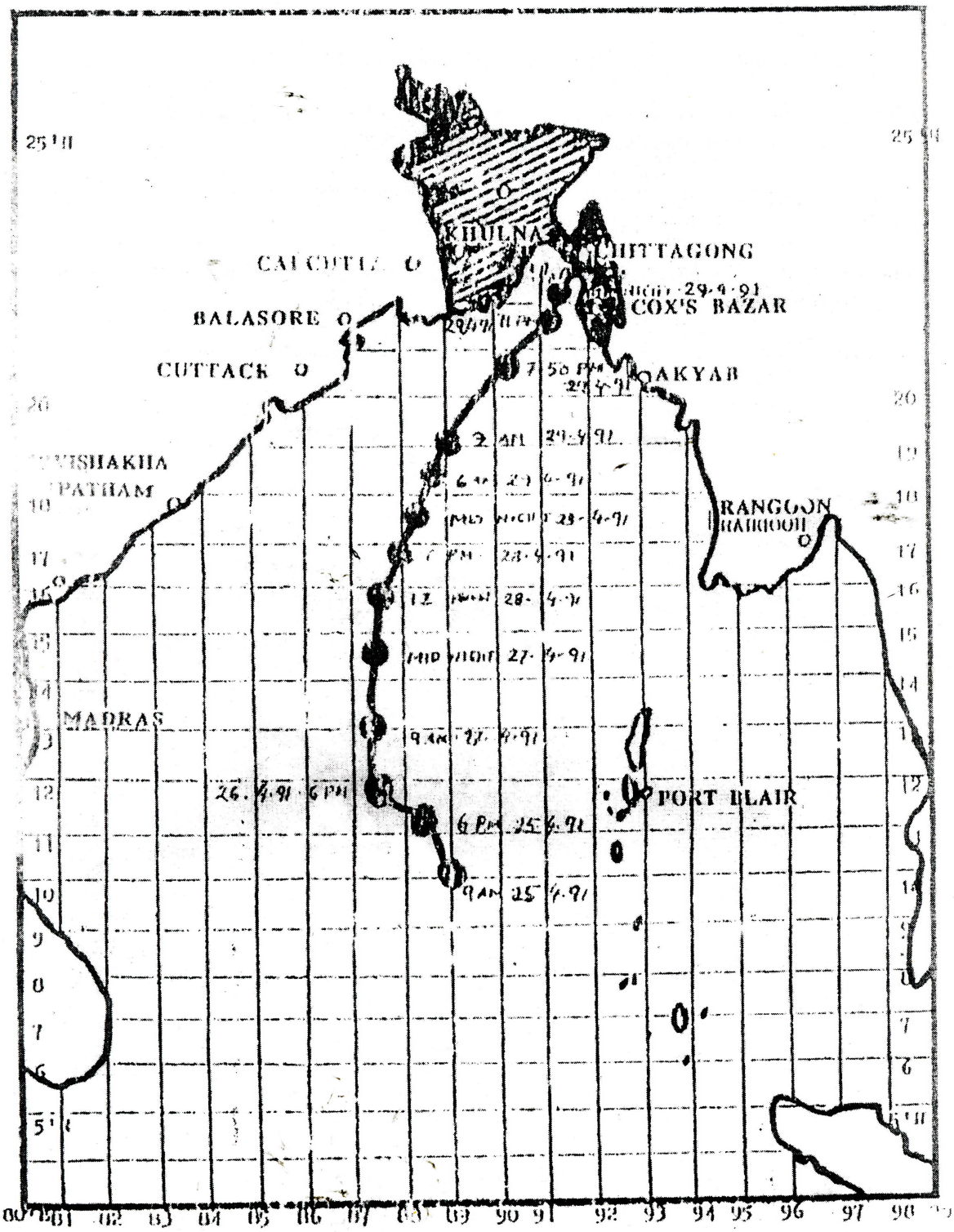
(vi) Some respondents would try to build their houses on embankments nearby mainly to protect themselves from tidal surge.

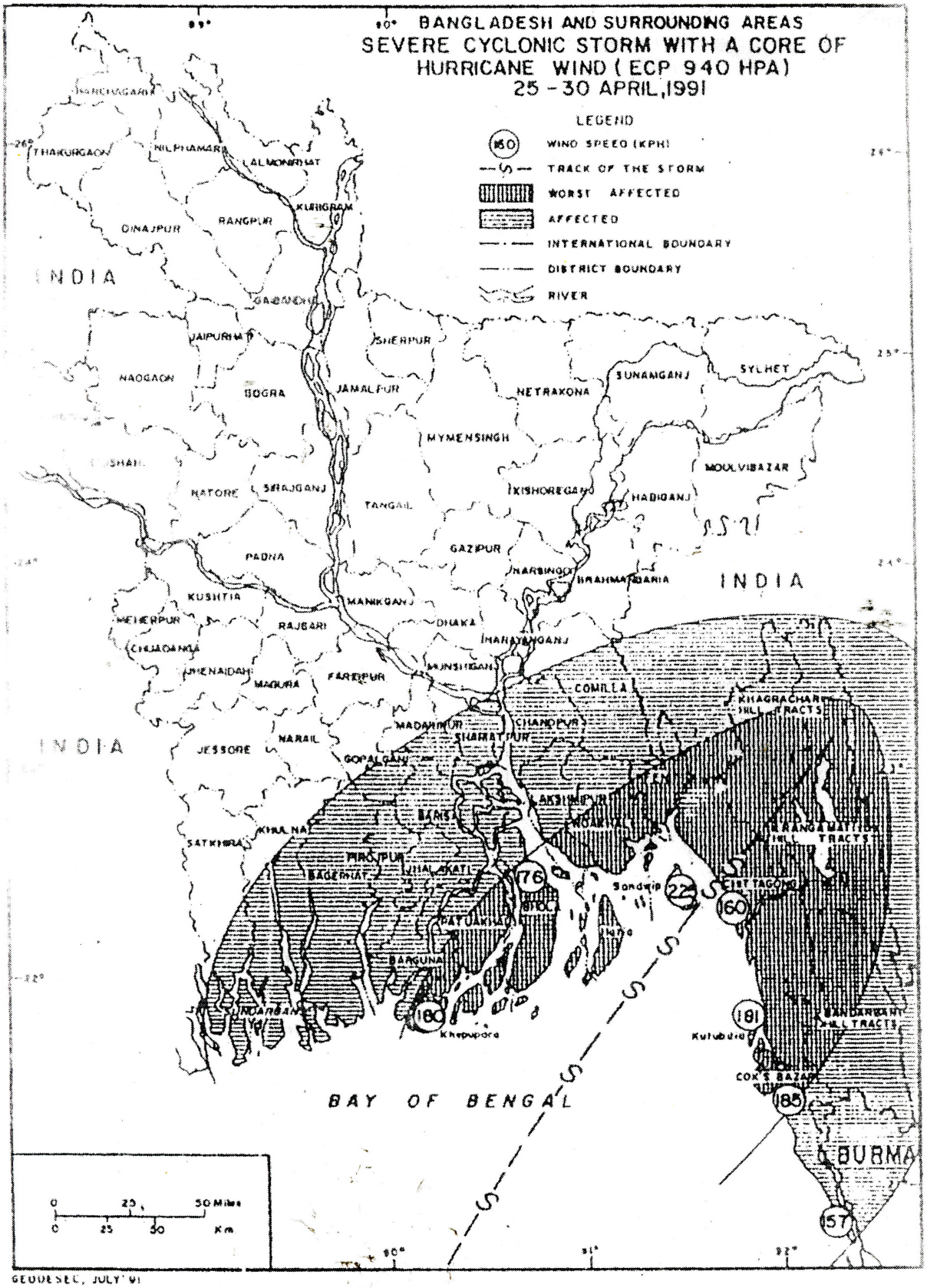
(vii) Some would depend on Allah. Because they thought that only Allah could save them from the scourge of the disasters.

CYCLONE OF 29 - 30 APRIL -91

DEPRESSION TRACKING MAP

CYCLONE PREPAREDNESS PROGRAMME




BANGLADESH AND SURROUNDING AREAS
SEVERE CYCLONIC STORM WITH A CORE OF HURRICANE WIND (ECP 940 HPA)
25 - 30 APRIL,1991
LEGEND
WIND SPEED (KPH)
TRACK OF THE STORM
WORST AFFECTED
AFFECTED
INTERNATIONAL BOUNDARY
DISTRICT BOUNDARY
RIVER
INDIA
INDIA
INDIA
BURMA
BAY OF BENGAL
THAKURGAON
NILPHAMARI
LALMONIRHAT
KURIGRAM
DINAJPUR
RANGPUR
GAIBANDHA
JAIPURHAT
SHERPUR
NAOGAON
BOGRA
JAMALPUR
NETRAKONA
SUNAMGANJ
SYLHET
MYMENSINGH
MOULVIBAZAR
NATORE
SIRAJGANJ
TANGAIL
KISHOREGANJ
HABIGANJ
PABNA
GAZIPUR
NARSINGDI
BRAHMANBARIA
KUSHTIA
MANIKGANJ
DHAKA
MEHERPUR
RAJBARI
NARAYANGANJ
CHUADANGA
JHENAIDAH
MAGURA
FARIDPUR
MUNSHIGANJ
COMILLA
KHAGRACHARI HILL TRACTS
MADARIPUR
CHANDPUR
SHARIATPUR
NARAIL
JESSORE
GOPALGANJ
BARISAL
LAKSHMIPUR
NOAKHALI
KHULNA
SATKHIRA
PIROJPUR
BAGERHAT
JHALAKATI
RANGAMATIYA HILL TRACTS
BHOLA
PATUAKHALI
BARGUNA
Khepupara
Kutubdia
BANDARBAN HILL TRACTS
COX'S BAZAR
0 25 50 Miles
0 25 50 Km
GEODESEC, JULY '91

Cyclone Prediction, Forecasting, Weather Warning System and Dissemination Methods : Bangladesh Perspective

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1. Introduction

Bangladesh is a deltaic land of area about 1,44,000 sq. kms. The Himalayas is on the north and the Bay of Bengal is on the south. Due to the concave shape of the Bangladesh coast and peculiar geographic location, the weather system has become complicated over country. Bangladesh is the most disaster prone area of the world of course, most of the disasters are meteorological. Sometimes, it occupies new headlines in terms of the extreme weather events e.g. the great Backerganj cyclone of 1876, the killer of November cyclone, 1970, The Urirchar cyclone 1985, the worst killer cyclone in human history, 1991 & floods of 1954, 1987, 1988 and 1998; tornadoes of 1969 (Demra, Dhaka) 1974 (Manikganj), 1977 (Madaripur), 1989 (Saturia of manikganj), 1995 (Laohajong), and 1996 (Tangail).

2. Tropical Cyclone

A tropical cyclone is a warm-core low-pressure system around which the air circulates in an anti-clockwise direction in the Northern Hemisphere. A tropical cyclone consists of a rotating mass of warm and humid air, normally between 300 and 1500 kms is diameter. The strongest winds, which may approach 200 knots, blow around the eye of a tropical cyclone, a central region of light winds and lightly clouded sky ranging from a few kilometer to over 100 kilometer in diameter.

The life span of tropical cyclones with full hurricane intensity averages at about six days from the time they form until the time of landfall. Some storms last only a few hours and a few as long as two weeks or even a month.

2.1 Nomenclature :

The nomenclature of cyclones are different in different parts of ocean/ seas. It is called "cyclone" in the Bay of Bengal and the Arabian Sea, "hurricane" in the Atlantic Ocean, "typhoon" in the northern and southwestern Pacific Ocean, "baggio" in the Philippines Sea "willie wille" in the Pacific near Australia.

2.2 Formation of cyclones:

The following conditions are essential for the formation of the tropical cyclone (cyclogenesis).

i) Sea Surface Temperature (SST) should not be below 27°C

ii) There should be little or no vertical wind shear for vertical growth

iii) There should be baroclinic zone i.e. inter -section of pressure surface and density surface

iv) The sea- surface region should be beyond 6° latitude (for more Coriolis force and hence for more spinning)

The cyclones have tendency to move initially in a west or northwesterly direction. Then they move northeastwards and sometimes they may recurve northwards. In the Bay of Bengal, cyclonic storms generally form in the months of April- May and mid September to mid December periods.

2.3 Different stages of tropical cyclones

The evolution of the average storm from birth to death has been divided into four stages (Chessman, 1951):

a. **Baby or formative stage :** This stage when the circulation develops along the equatorial front, in easterly wave. In this stage, the cyclone shows a falling pressure tendency. Winds remain below hurricane force in the formative stage and the surface pressure drops to about 1000 hPa

b. **The developing or immature stage :** This stage lasts up to the time when it reaches into cyclonic storm. In this stage, the cyclone attains lower central pressure below 1000 hPa. Winds are well organized in a narrow band and spiral inward the centre. Only a small area is as yet involved, though there may be a large outer envelope.

c. **The mature stage :** This stage lasts from the time of attaining maximum intensity up to the time it weakens below 64 knots. It attains lowest central pressure, maximum intensity up to hurricane wind, maximum wind around centre and formed eye, which attain maximum temperature. In this stage, the surface pressure is no longer falling at the centre and maximum wind speed is no longer increasing. Instead the circulation expands during the mature stage, which may lasts a full week.

d. **The decaying stage :** Decay stage of cyclones appear when the cyclone makes landfall or sometime, cyclone has been observed to die over sea, for instance when moving over cold ocean currents.

Characteristics of Tropical Disturbances in the Bay of Bengal :

Stages of Disturbances	Radius of Disturbances	Maximum sustained wind
Low pressure are or Low	-	Less than or equal to 31 Kph (17 kts)
Well marked Low	-	32 Kph -39 Kph (18 Kts-21 Kts)
Despression	44Kms (24 NM)	40Kph-50 Kph (22 Kts-27 Kts)
Deep Despression	48Kms (26 NM)	51Kph-60 Kph (28 Kts-33 Kts)
Cyclonic Storm	54 Kms (30 NM)	61 Kph-88 Kph (34 kts -47 kts)
Severe Cyclonic Storm	64 kms (35 NM)	89 Kph-117 Kph (48 Kts-63Kts)
Severe Cyclonic Storm with a Core of Hurricane wind	74 kms (40 NM)	118 Kph-219 Kph (64 Kts-118Kts)
Super Cyclone	84 kms (45NM)	220 Kph or more (119 Kts or more)

2.4 Cyclone season of Bangladesh.

Climatalogically Bangladesh may be grouped into four seasons:

Seasons	Period	Weather events	Rainfall
Summer season Pre-Monsoon	March-May	Nor' wester, Tornado Hail, Cyclone	370 mm 17%
Rainy season (Monsoon)	June September	Heavy Precipitation Monsoon Depression, Flood	1625 mm 72.5%
Auturmn season (Post-Monsoon)	October-November	Cyclone, Tornado	208 mm 90%
Winter season (NE- Monsoon)	December-February	Abnormal dryness, Cold	33mm 15%

3. Cyclone Warning System in Bangladesh

3.1 Prediction of cyclone and issue of warning :

Prediction of cyclonic storm in the Bay of Bengal and issuance of timely warning is the task of Storm Warning Centre (National Weather Forecasting Centre) Dhaka. The cyclone information issued by the storm Warning Centre requires detection and monitoring of cyclone from the formation till its landfall and forecast the cyclone's future track. Modern technology has provided the means of early detection and constant tracking.

3.2 Data and weather charts used for cyclone forecasting :

Data from all sources, ground based and space based are utilized in weather forecasting. The following types of weather data are utilized :

i) Surface observations at different synoptic hours .

ii) Upper air observations at 6 or 12 hours intervals (pilot balloon and Rawinsonde).

iii) Ships observations and observations available from automatic platforms (if any)

iv) Aircraft report (if any)

v) Satellite observations of various types, such as clouds, wind sea surface temperature, etc.
vi) Radar observations
vii) NWP Products.

3.3 Cyclone warning system of Bangladesh

Cyclone warning system is the well-known warning system in Bangladesh. This warning includes the following information :

a) Position of storm centre.
b) Direction and rate of movement.
c) Area likely to be affected specifying upazillas of the district if possible :
d) Approximate time of commencement of gale winds (speed more than 32 mph or 52 kms/hrs).
e) Maximum wind speed expected.
f) Storm surge/ tide of approximate height and the areas likely to be affected.

3.4 Cyclone prediction methods

In order to fulfil the tropical cyclone warning, predictions of the followings are required:

- Tropical cyclone location motion
- Tropical cyclone wind field.
- Storm surge

Now -a -days, forecasting offices all over the world are equipped with a large number of track prediction techniques. These techniques can broadly be divided under the following categories:

(a) Climatological techniques
(b) Persistence techniques
(c) Climatological-cum-persistence technique (CLIPER)
(d) Synoptic techniques:
  (i) Surface geostrophic steering technique ,
  (ii) Upper air steering technique.
(e) Satellite techniques
(f) Statistical techniques using climatology, Persistence, synoptic data (actual or forecast) as predictors.
(g) Analogue techniques
(h) Dynamical techniques.

Besides these, Debsarma (STP Modelk 1994 & STEEPER Model 1998) developed one regression model and one steering-cum-persistence model for the track prediction of cyclones, which operates well in the Storm Warning Centre of BMD. It has been found that the upper air steering method plays an important role in the track prediction cyclones in the Bay of Bengal. For this purpose. 200 hPa or 150 hPa level chart is carefully analyzed to obtain the circulation pattern and the movement of a cyclone is guided by the anticyclonic flow pattern at 200 hPa ar 150 hPa level.

3.5 Warning signals :

Warning signal is classified in two: i) For Maritime Port and ii) River Ports.

i) Warning Signal for Maritinme Ports:

Signals	Meanings	Remarks
1. Distant cautionary signal No I	There is region of squally weather in which a storm may form (well Marked low or Depression with wind speed up to 61 Kph)	These signals indicate that ships may be exposed to danger after leaving/ coming to the harbour.
2. Distant Warning Signal No. II	A storm has formed (cyclonic storm) with winds speed 62-88 kph.	
3. Local Cautionary Signal No. III	III) The port is likely to be threatened by squally weather. It may experience servere weather from a squally wind of 40-50 kph	These signals indicate that the port itself and the ships in it are in danger. All fishing boats and trawlers over North Bay and deep Sea are advised to take shelter immediately.
4.Local Warning Signal No. IV	IV) The port is likely to be threatened by a Storm but it doesn t appear that the danger is as yet sufficiently great to justify extreme precautionary measures of precaution (Cyclonic circulation with surface wind 51-61kph).	
5. Danger Signal no. V	V) The port will experience sever weather from a storm of moderate intensity that is expected to cross the coast to the south of the port (Cyclonic circulation with wind speed 62-88kph).	These signals indicate that the port itself and the ships in it are in danger. All fishing boats and trawlers over North Bay are advised to remain in shelter till further notice.
6. Danger Signal No. VI	VI) The port will experience severe weather from a storm of moderate intensity that is expected to cross the coast to the north of the port (Cyclonic circulation with wind speed 62-88kph).	
7. Danger Signal No. VII	VII) The port will experience severe weather from a storm of moderate intensity that is expected to cross over or near the port (Cyclonic circulation with wind speed 62-88kph).	
8. Danger Signal No. VIII	VIII) The port will experience severe weather from a storm of great intensity that is expected to cross the coast to the south of the port (Severe cyclonic storm with wind speed 89-117 kph or more).	
9. Great Danger signal No. IX	IX) The port will experience severe weather from a storm of great intensity that is expected to cross the coast to the north of the port (Sever cyclonic storm with wind speed 89-117 kph or more).	These signals indicate that the port itself and the ships in it are in great danger. All fishing boats and trawlers over North Bay are advised to remain in shelter till further notice.
10. Great Danger signal No.X	X) The port will experience severe weather from a storm of great intensity that is expected to cross over or near the port (Severe cyclonic storm with wind speed 89-117kph or more).	
11. Great Danger signal No. XI	XI) Communications with the Meteorological Warning Centre have broken down and local officers consider that a devastating cyclone is following	Since the storm Warning Centre (SWC) is now in Dhaka, this Signal has become ineffective.

ii) Signals for Inland River Ports:

Signals	Meanings	Remarks
1. Cantionary Signal No. I	I) The area is threatened by squally winds of trasient nature with the kalbaishakhi wind of about 60 kph	This signal is hoisted in case of gusty wind. The river crafts are advised to proceed with caution.
2. Warning Signal No.II	II) A storm is likely to strike the area (Vessels of 65 feet and under in length are to seek shelter immediately). The area is threatened by squally winds ot transient nature with the kalbaishakhi wind of about 61 kph or more	This signal is hoisted in case of squally weather expected from nor' westers. The river crafts of length more than 65 feet may proceed with caution but small river crafts are advised to remain in shelter.
3. Danger Singal No. III	III) A storm will strike the area (all vessels will seek shelter immediately). The are is threatened by squally winds of transient nature with the wind of about 62-88 kph.	This signal is hoisted in case of weak/ moderate cyclones. when there are Danger Signals for Maritime Ports. The river crafts are advised to remain in shelter till further notice.
4. Great Danger Signal No. IV	IV) A violent storm will soon strike the area (all vessels will take sheller immediately). The area is threatened by squally winds of transient nature with the wind speed of about 89 kph or more.	This signal is hoisted in case of strong cyclones. When there are Great Danger Signals for Maritime Ports. The river crafts are advised to remain in shelter till further notice.

3.6 Standing orders for cyclone warning

As per the Standing Order of the Govt, Cyclone Warning messages are issued as follows :

a) Warning Stage : 24 hours in advance

b) Danger Stage : Minimum 18 hours in advance

c) Great Danger Stage : Minimum 10 hours in advance.

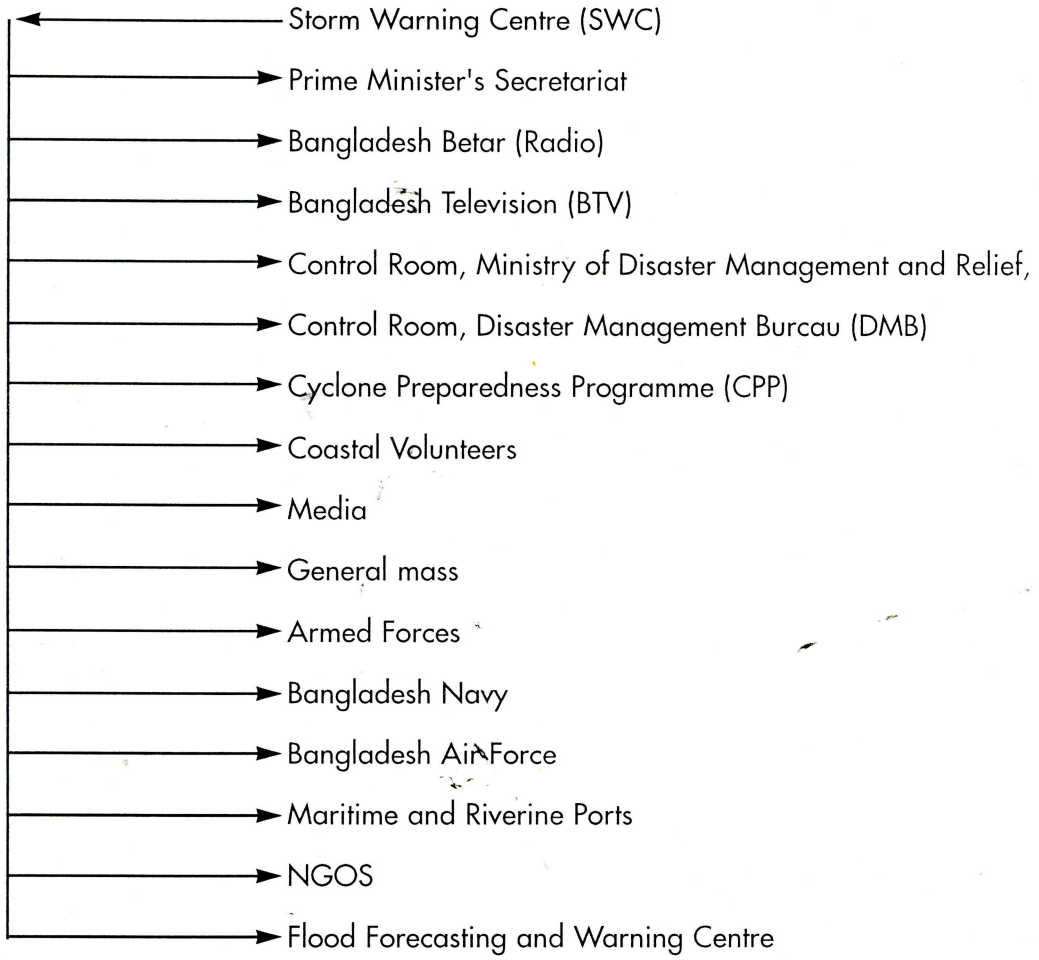
There are standing order for cyclones to be disseminated to all concerned Ministries/ Divisions/Department/Non-govt. agencies and also to press for public to enable to discharge their duties in a speedy and systematic manner to handle the situation efficiently. More frequent contact is maintained between Bangladesh Meteorological Department (BMD) and Betar (Radio), Television for extension of transmission hour beyond normal hours as and when Danger Signal and Great Danger Signal are hoisted.

Only 5% cyclone forms in the Bay of Bengal but loss of lives and property is about 85% of the Global total. Cyclone of 1970 took lives of 3,00,000 people but the cyclone of the same intensity of 1991 took lives of 1,38,000 people, cyclones of 1997 and 1998 took lives of only 127 and 6-7 respectively. This is surely a development for saving the lives of people and properties. A short table in this regard is shown here.

Sl.No.	Cyclone Time	Land fall	Wind speed (max)	Storm surge	People killed
1.	8-13 Novermber 1970	Between Noakhali & Chittagong	a) Chittagong=224Kph	3.0-10.0m (10-33ft)	People killed = 3,00,000
2.	22-25 May, 1985 The Urirchar cyclone	Near Chittagong	a) Chittagong=154Kph b) Sandwip=139 Kph c) Cox's Bazar=104 Kph	4.55m (15ft)	People killed=4,264, Affected population= 13,10,935
3.	24-30 November 1988	Khulna coast near Raimangal river	a) Khulna & Satkhira =157 Kph b) Pathargata=161 Kph	4.4m (14.5fl)	In Bangladesh People killed = 5,683, People Missing = 6,000 In India People killed=532
4.	25-30 April, 1991	A little Noth of Chittagong	a) Sandwip-225 Kph b) Chittagong-218 Kph c) Cox s Bazar = 185 Kph	6-7.6m (20-25 ft)	Affected Population = 1,07,98257, No. of people killed - 1,38,882
5.	24-27 September, 1997	Near Sitakunda	a) Sandwip=150 Kph b) Char Tazumuddin =150 Kph c) Barguna=90-135 Kph d) Bhola=120-140 Kph e) Hatiya=120 Kph	4.55m (15 ft)	People killed = 67
6.	17-20 May, 1998	Between Chittagong and Sitakunda	a) Chittagong= 174 kph b) Rangamati = 101 Kph	3m (10 ft)	There was no report of death but believe 6 or 7 people were killed

This was due to timely and correct weather forecast and effective preparedness programme. We have a long coastal belt of 710 kms at any point of which cyclonic landfall may occur. Cyclone Preparedness Programme (CPP) has about 35,000 volunteers of which 3,000 are female. They are playing a tremendous role to combat disasters arising out from cyclonic landfall over coastal and island areas. These efforts have been appreciated and the International Award "Smith tumsaroch" was jointly given to Bangladesh Meteorological Department and Cyclone Preparedness Programme in 1998. Despite this development in terms of disaster mitigation, we are not satisfied. We are still trying to reduce the loss of lives and properties.

3.7 Warning message dissemination system of SWC, the national weather forecasting centre is as follows :



4. Conclusion :

Weather forecasting was challenging is challenging and will remain as challenging jobs. The BMD has proposed a new unified (maritime and riverine): warning signals system based on wind speed is still awaiting for approval from the highest authority. With the inception of new equipment and modern technologies and the new warning system in Bangladesh, The BMD in collaboration with the CPP and other organizations related to disaster management will hopefully be in a position to handle the natural disasters more efficiently and easily in near future. That is our great expectation.

Flood Forecasting, Warning System and Flood Preparedness and Management in Bangladesh

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Introduction :

Floods are natural phenomena and Bangladesh is a flood prone country. After the floods of 1954 and 1955, Bangladesh experienced disastrous floods in two successive years in 1987 and 1988. Thus questions are being raised whether there will be be flood in 1999. Debates are going on whether we should "live with flood" and be at the mercy of nature or we should execute "flood control projects" and protect all lands from flooding. Questions are being asked what happens to the beneficial aspects of "flooding" when we construct embankments for "flood control" projects. Fundamental questions are being raised about the causes of floods and the options that are available for "flood control" Should we go for "structural options" or we should opt for "non-structural options". Questions are also being raised about the impact of floods on food security, communication, overall economy, environment and ecosystem.

During the 1998 floods a number of other issue have come up. Some of these are the role of El-Nino and La-Nina, global warming as the cause of flood. The role of Tsunamirs in the Bangladesh coast reportedly to have been originated from the earthquakes in the Bay of Bengal, meeting of glacial ice in the Himalayas etc. There are speculation about the role of flood control infrastructures in increasing the flood intensity. The Farakka Barrage, constructed and operated by India just across the border, is often blamed for floods in Bangladesh. We have to seek answers to these questions for understanding the possible approaches for flood management in Bangladesh. It is very important to find scientific explanations to all the speculations about 1998 flood and remove confusions about the causes of the flood.

Let us define "flood" at first: If an are a goes under water and even remains so for sometime we call it inundation. But when this inundation causes damage to property and life, disrupts communication and brings harmful effects to not only human beings but also to flora and fauna, we will call it flood. Flood not only causes damages to economy by disrupting normal activities, it brings in their trail serious health hazards. It causes dislocation to public health, renders thousands homeless, damages crops in the field and disrupts normal agricultural cycle, causes death to livestock, poses serious threat of nutrition, and results into hunger and famines. The poor and downtrodden group of the society suffer the most from flood.

Causes of Flood in Bangladesh

To understand the phenomenon of flooding in Bangladesh. Let us imagine the country as a bowl into which water is in-flowing from across the border and from which water is out-flowing into the Bay of Bengal. Water is added, as inflow, into the bowl, by rains as they

occur over the country. The in-flow rate is dependent mainly on quantity and intensity of rainfall that occurs in the north, north eastern and north western areas of Bangladesh, in India, Bhutan and Nepal. The out-flow rate is dependent on the gradient in which the rivers discharge water into the Bay. If the outflow is equal to inflow then water level in the bowl remains static. When the inflow rate is higher than the outflow rate then the water level goes up. If the water level goes up too high it may cause floods. Similarly when the outflow rate is higher than the inflow rate, then the water level in the bowl goes down. The gradient of out-flowing water becomes much flatter in monsoon months due to prevailing southern wind and with the reversal of wind direction in post monsoon period and in dry season the gradient becomes steeper resulting in faster rate of outflow. Thus the outflow rate is slower in the period when the inflow rate is also high.

It is the inflow rate and the outflow rate which control process of inundation and flooding of all lands of the country. There are some other factors which complicate this physical process. They are deterioration of drainage channel by natural siltation, shoal formation, or obstructions; drainage congestion due to faulty development programs and encroachment on flood plains effect of construction of embankments and polders, causing increase in flooding elsewhere; deforestation in upper catchment areas; flat topography of the country which slows drainage rate; tidal surges and sea waves; and global climate change.

However, the main causes of floods in Bangladesh are excessive rainfall leading to excess run -of in excess of safe channel conveyance capacity and rise in sea level due to monsoon wind. As such whether there will be floods in 1999 will depend on the rainfall pattern of next year. As of now, we have no way of forecasting whether there will beexcessive rainfall in 1999 and hence it can not be stated whether there will or will not be floods next But in the long run, as a result of global warming, intensity as well as quantity of monsoon rains are going to be of higher level and as such more frequent events are apprehended.

In 1998, after 10 years of 1988 flood, Bangladesh has been overtaken by a flood that has shattered the 100 year record of the Ganges flood, almost equaled the 1988 flood in the Brahmaputra and Meghna and has surpassed all past records of flood in terms of duration. About 47 districts out of 64 has been affected and the most hard hit areas are the central area of Bangladesh including the capital city of Dhaka. The flood dike protecting the capital city was seriously endangered and a continuous flood fighting for days have saved the protected part of the city. But many of the sub-urban areas and the less vulnerable posh areas and the diplomatic enclave, Gulshan was flooded to knee deep water areas. Therefore we must prepare for future with a long term vision. Flood management very often consists of crisis-driven responses. Floods may or may occur regularly. Further the level, duration, extent and timing of their occurrence vary from event to event. Where floods occur after long intervals, the occurrence of a flood may provoke an immediate crisis. However, as the memory of the crisis fades away, the preparations of flood management also disappears. Most of the developing countries respond to flood with ad hoc measures.

Flood management or flood damage mitigation measures are aimed at reduction of level of damage and harmful effects, and creation of an environment for enhanced economic activity. Inundation has beneficial effects such as it allows additional ground water recharge, help flood plain fisheries and navigation, rejuvenates flora and ecosystem, cleans up the wastes

and helps agriculture. On the other hand floods may have different levels in different year having different return periods. Thus elimination of all floods or total flood control is neither feasible nor desirable.

The modern day approaches on flood loss management were based on the optimistic assumption that floods are not nature's order, something that has to be endured as a part of life. The concept of "live with flood" does not foster any economic growth. The technical expertise for reduction of flood levels are readily available. However, adequate resources and appropriate institutional set up for effective management of all levels of hazards are still lacking. Flood management approaches therefore, emphasizes the need for decreasing flood losses by comprehensive structural and non-structural precautions and by organization of emergency services, including expanding the hydrological services to aid in forecasting flood and related events."

Planning for Flood Management

Damages from a flood event depend on the following factors location (urban and rural arears must be treated separately): depth (growth stage crops is to be considered); duration (paddy can tolerate submergence for few days); timing (crop calendar is important here): and extent of flooding. In fact every flood prone area has its special and particular characteristics. Before drawing up any flood management scheme, it is of utmost importance to investigate in details the various factors responsible for flood in a given area. Any negligence or half-hearted investigation is bound to be reflected later on in complete or partial failure of the scheme.

For proper planning and management against flood disaster a systematic and well organized program is necessary. These are four stages to a national flood management program : 1) Pre disaster mitigation : This includes measures to reduce the impact of or prevent a flood event. Examples range from structural measures to public education. 2) Pre-disaster preparedness : At this stage a response plan for the flood is developed in advance; a warning system for flood is installed and the people responsible for implementation of preparedness are trained; the institutional mechanism for implementation is specified. 3) Response to disaster: This includes activities which are undertaken during and immediately after flood, such as emergency aid, evacuation to pre-designated shelters, flood fighting, and assistance and taking measures for minimizing secondary damage and recovery operations. And 4) Post-Flood recovery : At this stage support is provided for a return to vital life-support system to minimum operation levels, which is continued until the community returns to normal life. These stages are however, inter-related. For example, recovery programs may be related to per-disaster mitigation in the future.

Options for Flood Management

Now let us look into the options available for flood damage mitigation. Measures that can be adopted for flood damage mitigation can be classified into two categories: Direct or structural measures, and indirect or non-structural measures.

Structural measures aim at protecting an area up to certain level of flooding and non-

structural measures are aimed at reduction of loss due to flood by administrative or managerial measures. Construction of structural measures for flood management are always carried out in parallel with non-structural measures including flood -forecasting and warning, flood preparedness and disaster management. Till structural protection is available effective disaster management measures are only mechanism to reduce loss and damage. Even when structural measures are available, it should be borne in mind that they provide protection up to a certain level of flooding, and failure of structural measures are frequent and common unless properly designed and constructed.

Thus floods pose complex challenges to engineers, administrators and planners. Effective flood management must take into account not only technical and economic, but also social, administrative, environmental, political and legal factors. These considerations are important for disaster management programs as well as for planning of structural options.

Historically, structural measures for altering flood patterns were known as "flood control project". However, it is now realized that absolute control over floods is not feasible, both physically and economically. There is now a growing understanding that "zero risk" is not a possibility and "safe" is not the equivalent or "risk-free" Structural options are therefore now described as flood damage mitigation measures or "flood management measures."

Structural measures can be divided into six categories : storage reservoir or detention basins for impounding of excess runoff; retarding basin to lower the level of flooding downstream; embankments and flood walls to confine flood waters within areas immediately adjacent to the rivers or sea; improvement of channel capacity by channel improvement and dredging and removing obstructions to flow; flood-way or flood diversion through by passes aimed at diversion of excess flows causing flood; and catchment management and afforestation.

The most popular method of flood mitigation in Bangladesh is the construction of embankments or levees. The main attraction of embankments is that they are cheap and easy to build. The embankments often provide reasonable protection against flood. However, embankments are mixed blessings. However, they tend to produce a number of undesirable side effects. The confining of flood flows within embankments lead to a rise of flood levels in the channel. The river channels have to transport more sediments compared to pre-embankments situation leading to rise of the river bed. Embanking may produce an increased meandering or shifting of the river channels because of increased flood velocities in embanked channels. If adequate measures are not planned in advance embankments may lead to the problem of interior drainage congestion Embankments obstruct the flow of sits into field. Embankments may adversely affect the production of fish and dislocate the traditional navigational routes. The change in natural hydrology in certain areas also create health hazards to the human as well as the livestock population. And finally, the embankment fosters increased flood plain occupancy. When a flood of greater magnitude than the design flood occurs much greater damage is done than if no Embankment had been constructed at al Embankments and polders require regular inspection and continuous maintenance.

Embankments are often supplemented by channel improvement. Watershed management can play a significant role in flood abatement.

Broadly, there are seven types of non structural measures : flood forecasting and warnings; flood-fighting; flood proofing; flood plain zoning; rescheduling of reservoir operation; evacuation and shelter management; and flood insurance.

In some communities evacuation from affected area is the most effective means for minimizing flood losses. Evacuations are usually made on the basis of flood forecasts. Flood-fighting involves both collective and individual actin. Collectively existing levees may be guarded or new temporary dikes may be built. Individuals may remove goods and equipment to higher ground. Flood-proofing is based on the adoption of certain measures that can be taken as soon as a flood warning is received. Among the various methods of flood-proofing are the installation of removable covers over equipment, doors or windows, and the installation of sump pumps and elevated outlet pipes to remove water which seeps into buildings. Moreover, in flood- prone zones activities may be rescheduled to avoid flood losses. For example, goods which would be damaged may be moved from the flood- prone areas at the time when flooding is expected. Relief operations including life-saving operations, the provision of temporary shelter and the necessities of life, health care facilities and water supply, as well as rehabilitation and reconstruction.

Concluding Remarks

Floods cause loss of lives, damage property and crops, and bring in their wake diseases and famine. In Bangladesh it is a difficult obstacle to modernization of traditional agriculture. Two lessons can be drawn from mankind's protracted fight against floods. First no dramatic solution for the problem of flood is available. Floods will continue to be problems for a long time to come. They cannot be tamed by ad hoc or short-term measures. It is therefore necessary to draw up long-term plans for the mitigation of floods. Second, the problems of floods are compounded by short sighted human action. We always want a quick and immediate solution. We may plan our steps in phases and implement them in an integrated way. To minimize flood losses in coming years, the following steps may be taken urgently:

- Setting up an efficient system for the dissemination of flood warning. Forecasts produced by BWDB is accurate enough and they are doing a good job but it is time to take steps to convert them into warnings so that users can comprehend the technical messages.
- Encouraging the introduction of zoning laws, especially in urban areas and areas covered by newly-built water-control structures; education of the public about flood hazards, especially through the development of flood-risk maps;
- Where embankments/ polders have been constructed, its maintenance is essential to have it effective during flood events. This is only possible with effective participation of beneficiaries in flood fighting.
- Increase usage of modern tools such as satellite imageries and weather radar for increasing the lead time of flood forecasts.

Community -Based Approach for Disaster Preparedness and Mitigation: Bangladesh Perspective

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1.0 Introduction

1.1 Since the introduction of modern Government the 'management of disaster' has been exclusively looked after by the Government personnel. When an event of disaster be it man made or natural, occurs in a country, it is the Government machinery who immediately rush to the spot in order to provide necessary logistic support to the victims of the disaster. Rendering this type of services from the Government is mandatory in one hand and to some extent, a routing work in general. As a result, a tradition has by now been developed that it is the Government who is to exclusively provide necessary services and logistics to the victims of the disasters and no other organizations or parties have got any other duties to render any type of cooperation or services to the victims. Providing this type of post-disaster services both in developed and developing countries is mainly administered and controlled centrally by the government. Experiences demonstrate that in most cases, government services do not reach in time to the right place and fail to provide right benefit to the right people. This system is still dominating and occupying principal approach of disaster management practice for more than several decades.

1.2. With the emergence of changing role of the Government and with the increasing participation of public in socio-polictical activities of the Government, the increasing unusual trend of various natural disasters are posing a fundamental question as to the role of government and how it would manage the disaster and what would be the more rationale and effect way of management. A common consensus is emerging amongst the policy makers, experts and professionals that the Government alone can not and will not properly manage and handle all types of disasters with its machinery which require active participation by the people in any given region of a country. In line with this philosophy, involving local level people, leaders and community to provide necessary services and logistics to their victims during and after disaster has been encouraged both in the developed and developing country. And in recognition to this philosophy a new approach of managing disasters has been evolved known as Community-Based Approach (CBA) which emphasises the total participation of all people facing any hazard or disaster and makes sure to render all possible services to the community. But as of today this approach in Bangladesh does not get the legal status and recognition

as an institution.

1.3. The purpose of this paper is to address the need for institutionalizing the Community- Based Approach(CBA) and the social network of local communities in order to develop a comprehensive disaster management in Bangladesh. To establish and prove the importance and effectiveness of CBA, an attempt has also been made to highlight the activities of two success stories of community-based approaches in preparing, planning and managing their disaster problems at the community level. More specifically the objectives of the paper would be as follows:

(a) to highlight the importance and role of community-based approach in managing disaster;

(b) to propose a conceptual framework for developing a standard coping mechanism in order to institutionalize the community approach and

(c) to provide suggestions to integrate the community-based approach into planning process for developing comprehensive and efficient disaster management system in Bangladesh.

1.4. To discuss these above objectives the paper has been divided into four major sections. First section deals with importance and role of community-based approach in terms of its changing scenario in managing disaster at the local level. The second part attempts to identify the process through which the concept of community-based approach can be effectively institutionalized in Bangladesh context, while in the third part an attempt has been made to provide suggestions and recommendations as to how the Community-Based Approach (CBA) could be integrated in our development plan.

Section-I

2.0 Paradigm Shift and Importance of CBA

2.1 In the context of the opening statement, made in the introductory part, it is appropriate to briefly trace the paradigm shift occurred over the last several decades in disaster management theory and practice. In the past, most decision-makers tend to consider the hierarchical top-down governmental disaster planning approach as the only legal institution and viable means through which post-disaster management should be implemented. In fact disasters were viewed as one-off events and responded by the governments and relief agencies without taking in to account the role of community people. It used to provide mainly recovery services and logistics followed by distribution of relief goods and repairs

to essential services such as bridge, culvert and telephone network. It may be worth mentioning that government does not have any policy for public awareness, training and preparedness program. It has theoretically only a set of prevention and mitigational rules and regulations covering both structural and non-structural measures. It employs sets of disaster warning system and reporting systems, hierarchical model of control, and a variety of disaster mitigation/response tools (e.g., regulations, seismic building codes, land use control, checking lists, and detailed hazard response plans). While, the policy makers and planners often think that the community-based approach can only play a minor role in disaster planning, due to its limitations such as a lack of compulsory power and the limited scope and ability in mobilizing citizens as well as resources.

2.2 The traditional top-down hierarchical governmental disaster planning suffer from the problem of "organizational lag", in the post-disaster response stage (especially in the critical response period) due to the lack of correct information regarding local condition, the fragmented dispersion of responsibility across different government agencies, and the difficulties in conducting effective communications between communities and government agencies and thus limits theirs ability in making immediate response and in mobilizing resources to assist the affected communities. Therefore, many scholars argue for a local-oriented community-based disaster management institution to fill the gap and to achieve the goals of community disaster planning (Turner, et al. 1986, Comfort 1988, Simpson 1992).

2.3 Disaster mitigation using government alone is insufficient because it pays little attention to addressing the community dynamics, perceptions, or priorities. At the same time, local communities are often either unaware of these formal disaster management interventions or they find the interventions inappropriate due to the lack of recognition of community's vulnerabilities and capacities, or they lack the external resources or technical support to supplement their own initiatives and capacity.

2.4 This understanding convinced the policy makers that effective disaster management is not possible without the active participation of local community. The important role of CBA can not be ignored. For the last two decades there has been a growing realization that disaster management is most effective at the community level where specific local needs, resources, and capacities are met. Moreover, studies of community participation in the planning process have shown that citizens at the neighborhood and community levels can, under supportive conditions, manage lanes, waterways, and waste collection and disposal systems, and are capable of developing and enforcing access rules and reciprocal obligations among community members. The communal system of exchange is

based on the principles of reciprocity and redistribution, community organisations will spontaneously arise and undertake collective actions to reverse environmental deterioration common in most low-income neighborhoods. (Douglass, M. 1992) .

2.5 This frustrating scenario and the experiences of many recent hazards events, both decision-makers and the general public have started to ask questions such as: why the formal top-down governmental disaster planning system fail did to respond to the immediate needs of the affected communities after a disaster, and why this approach cannot satisfy the true demands of the victims?. Many developed countries, such as US, UK, Canada, and Japan have began to realize and recognize the importance of the role of community-based institutions in implementing disaster planning system.

3.0 Role of Community-Based Approach (CBA)

3.1 The community-based disaster management approach is a bottom-up, process-oriented approach, focusing on promoting the idea of community self-help and the involvement of volunteers, community-based organizations, and communities residents in the disaster planning process (Yodmani, S 2001). Community based approaches are aimed to reduce vulnerability of the communities and to increase their capacity to withstand the damaging effects of disasters.

3.2 This approach is based on a number of principles, which must be followed and observed by all members of the community. There should be number of teams assigned to look after major responsibilities at the time of disaster. Team members are trained to understand the disaster management to acquire basic knowledge and skill to handle and tackle the specific type of disaster in particular and emphasize the importance of public awareness in coping with crisis situation in general. Moreover there should be very good cooperation amongst the various teams and with government agencies as well as NGOs and civil society. Over the last one decade Community-Based Approach has been used both in develop and developing countries in managing not only disaster but also many other situations and found to be yielding very positive result and benefit to the community.

3.3 A Community-Based Approach, on the other hand, include a public information campaign to encourage citizens to fasten tall pieces of furniture to the walls of their homes and offices, to store heavy items on shelves near the floor, and to keep a small fire extinguisher near at hand. This program might also teach citizens where to take cover during an earthquake (in an open area, for example, or under a bed or valves and electricity, extinguish small fires, and so on). Program might also provide Medical First Responder (that is, advanced First Aid) training to members o community groups such as Red Cross Volunteers, Boy Scouts and Girl Scouts, policemen and others.

In line with above role the community-based measures can actually save more lives than the Top-down measures because: -

- ❒ The family members and neighbors who survive would start their rescue program immediately after the disaster than by official search and rescue teams using sophisticated equipment;

- ❒ Survivors are capable to locate and identify the people who sustain injuries during an earthquake or any other disaster and can render best possible services, such as stabilize them, and safely transport them to medical care facilities as they are familiar within local environment know how to assess their injuries;

- ❒ Community members are also in position to provide temporary shelter to the victims who needed most and assist in getting necessary services from government and NGO's; and

- ❒ It is at the local level that the physical, economic, and social risks faced by the poor can be adequately assessed and managed. Some initiatives in this direction have come up in recent years.

3.4 These positive results with the increased awareness of the relation between development and disasters are replacing traditional reactionary and relief approaches with more developmental approaches. This view has been further endorsed by a number of regional and international initiatives including the IDNDR [International Decade for Natural Disaster Reduction] 1994 meeting for Asia, in February '99 at Bangkok. The Community-Based Approach has the following advantages:

(i) It utilizes various community networks to integrate resources from public and private sectors.

(ii) It focuses on community needs and local demand,

(iii) It promotes the idea of community self-help and community self-learning,

(iv) It fosters better communications between planners and community residents,

(v) It gives community residents the feeling that they have some control over the disaster planning tasks that they are involved, and

(vi) It utilizes community networks to manage the dissemination of hazard information and planning information.

Section-II

4.0 Framework of Total Disaster Management

4.1 Strengthening people's capacity to cope with hazards is a critical starting point for disaster reduction programs. A community develops specific adjustment mechanisms through a process of trial and error, generally over a long period of time. They adapted relationship and arrangements that allow them to adjust and managed periodic stress. The society also deliberately fosters a wide range of long-term strategies to bring them greater security and vulnerable environment (Wood and Knight 1985).

4.2 Given this situation, framework of a standard adjustment or coping mechanism has been felt by the experts and professionals so that it could be a model for design and develop an appropriate framework on the basis of the local need and demand by the people. This framework would not only help to avert and buffer the impact but also survive and it gives the people a greater responsibility in coping both before and after a disaster occurs.

4.3 Through this framework communities would develop adjustment mechanisms in response to recurrent exposure to a hazard, such as periodic hurricanes or flooding. The mechanisms also help them to prepare an action plan according to their situation and need in order to avert and buffer the impact, as well as survive and recover from these crisis events. Adjustment mechanisms include a wide range of social, economic, cultural, and technological relationships and arrangements. Similarly, participation in mutual help associations may provide capital to speed recovery.

4.4 A simple framework is developed here which specifics four general categories of adjustment mechanisms (social organization, economic relationships, technology use, and cultural arrangements) and three disaster intervention phases of the disaster life cycle (prevention, emergency/response, and recovery). A particular community's adjustment mechanisms can be mapped onto this conceptual structure according to how they allow it to avert, mitigate, survive, and recover from disasters. (See figure 1). This framework and mapping exercise are the first step in operationalizing the concept of hazard-related adjustment mechanisms.

Figure-1: The Framework hazard-related Adjustment Mechanisms

Adjustment and coping mechanisms	Disaster intervention phases (disaster life cycle)		
	Prevention	Emergency	Recovery
Categories	**Hazard-related functions**		
1. Social organization 2. Economic relationships 3. Technology use 4. Cultural arrangements Hazard-related functions	◆ prevention ◆ early warning ◆ mitigation ◆ preparedness ◆ risk sharing or spreading risk ◆ hazard assessment ◆ vulnerability analysis ◆ physical vulnerability ◆ resource requirement ◆ decision making	◆ rescue ◆ evacuation ◆ relief ◆ shelter ◆ food ◆ treatment & care of victims	◆ reconstruction/ rehabilitation ◆ Social recovery ◆ economic recovery ◆ material recovery ◆ mitigation ◆ development

Source : Adapted from Caroline. C.G. Living with Hazards, Communities Adjustment Mechanisms in Developing Countries, World Bank Report, 1998.

4.5 The above statement gives an indication of the importance of using framework for preparing an effective disaster management plan of a given localities for a community. There is no doubt that the experience and the lessons gained from this framework would help us to understand the disaster intervention phases and help us to plan accordingly. By using the life cycle of the disaster as the organizing model, the entire spectrum of hazard-related functions that adjustment mechanisms can be kept in mind. The framework matches the way that disaster reduction decisions are made, offering alternatives for supporting indigenous adjustment mechanisms at any one or all stages. Finally, the framework stresses the inter relatedness of the disaster response process and encourage decision makers to formulate the long-term, as well as short-term plan for hazard related adjustment mechanisms.

5.0 Institutional Arrangements for Disaster Management

5.1 This community-based approach can not sustain and be able to provide positive impact until and unless it receives government recognition and cooperation. It is encouraging to note that in the mean time a number of the developed and developing countries governments have not only encouraged operating the community-based approach but also interested to institutionalize the CBA.

5.2 Experience in two Community-based Approach

5.3 An attempt has been made in the following sections to highlight the experiences of two community-based approaches of disaster management in Bangladesh, which have not only been recognized as the pioneer of this approach but also at the forefront in developing community-based disaster initiatives in disaster management in South Asian region.

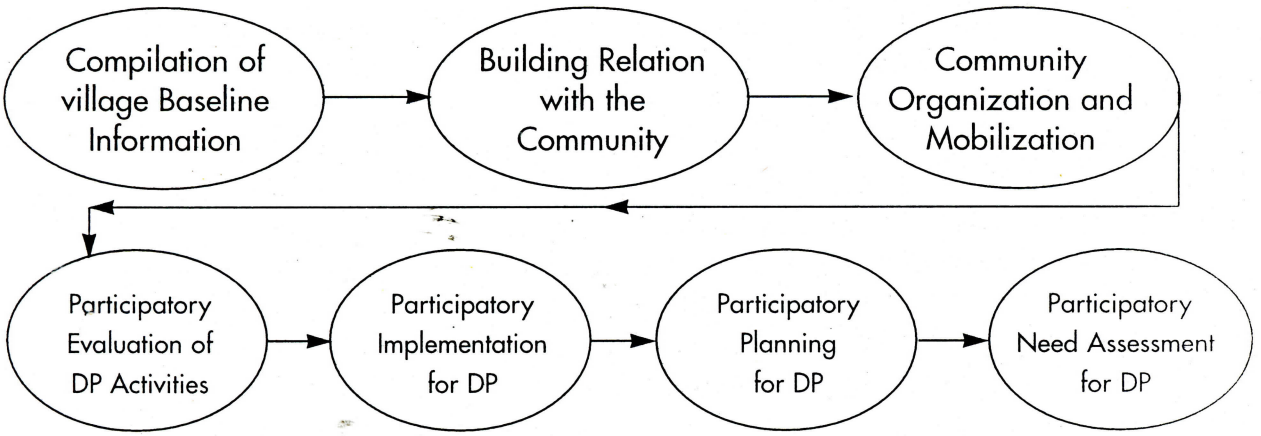
5.4 Bangladesh Red Crescent Society has a Community Based Disaster Preparedness Program in Cox's Bazar. The program is mainly designed to enable vulnerable communities to withstand and cope effectively disasters by collective participation on self-help basis. The program presently covers 28 districts, benefiting 2.5 million vulnerable people and is planned to expand to 50 disaster-prone districts of the country by the year 2003. Over five million vulnerable people will eventually be benefited from the program.

Cox's Bazar: Example-A

5.5 Cyclone and tidal bore frequently affect the coastal areas and offshore islands of Bangladesh. In order to cope and develop adjustment mechanism to live with this recurrent disaster Bangladesh Red Crescent Society has introduced community based approach first of its kind in Bangladesh. The objective of the program is to enable the community to deal with the impact of cyclone-related disaster using participatory methods aimed at strengthening the self-help capacities of the people. The Bangladesh Red Crescent Society has-with the help of the German Red Cross and other donors-constructed 30 cyclone shelters in the most vulnerable areas of the district, mainly off-shore islands. It is around these cyclone shelters that the activities of the Community Based Disaster Preparedness Program (CBDPP, BDRCS, CXB) are being implemented.

5.5 The objective of the program is to facilitate a process which aims at strengthening the self-help capacity of the vulnerable communities. In order to achieve this, the project has developed an approach for community based disaster preparedness which is best described by the following process cycle graph.

Process Cycle Graph



Source: BRCSGRC Report, 2000

5.6 Subsequently, community organizations have been formed, which carry out a range of disaster preparedness activities before, during and after the cyclone occurs.

- Community-level disaster preparedness measures, such as shelter maintenance and utilization, an intensive multi-media awareness campaign and community training on disaster preparedness, community based first aid, diarrhea management, cyclone warning and rescue operations, as well as collection of DP-Fund for future sustainability.
- Family-level disaster preparedness measures, such as cyclone strengthening of houses, plantation of life-saving trees, storage of food and drinking water, and protection measures for cattle and poultry.

5.7 In addition, the project presently supports 11 primary schools (with more than 2,750 students) located in cyclone shelters. Primary education is still a luxury in this backward district, where only about one fourth of the population is literate, and specially village girls have no access to schooling.

5.8 Surveys conducted after major cyclones revealed, that about 90% of the victims were women and children. Therefore, the project focuses on improving the status of women in the extremely conservative field areas through training on gender related issues as well as on small-scale entrepreneurship for women.

5.9 Minor cyclones, which occurred after the onset of the program, proved that the capacities of the communities in the intervention areas to deal with disaster are considerably enhanced. At the same time, the cyclone shelters are maintained and

utilized in a proper fashion, which makes them ready for use in the event of a cyclone. This leads to an improved disaster preparedness at the community-as well as family-level, better organized evacuation during cyclone warnings, and to a general reduction of loss of lives, properties and sufferings of the people (Pl. note Annex-I).

5.10 Examples of some community-based initiatives include: the formation of Village Disaster Preparedness Committees; development of an extensive awareness raising campaign, training of the community in disaster preparedness, community first aid, and cyclone warning signals; shelter maintenance; and implementation of disaster preparedness, measures such as installation of drinking water and food storage facilities and construction of raised poultry sheds. (Annex-II).

5.11 There is also the well-known Cyclone Preparedness Program (CPP) of the Bangladesh Red Crescent Society. CPP demonstrates the importance of usable and understandable information and a good network to disseminate this information. The Bangladesh Red Crescent Society has developed a comprehensive system of passing on special weather bulletins containing cyclone warming signals from the Bangladesh meteorological Department to households. Other CPP activities include training of volunteers, public awareness campaigns, and cyclone drills and demonstrations.

CARE Bangladesh: Example-B

5.12 CARE Bangladesh also implements a number of community-based initiatives. CARE Bangladesh used food-for-work to help communities with community "flood-proofing" after the 1998 floods. This includes raising of house plinth to a 5-year flood level, schools and community centers to a 20-year flood level, raising hand pumps and building foot paths, as well as village-level saving schemes that are used as a safety net in a disaster to meet immediate relief needs.

5.13 Under the Asian Urban Disaster Mitigation Program of ADPC, CARE Bangladesh is implementing the Bangladesh Urban Disaster Mitigation Project. The project will begin with the establishment of community-based flood mitigation and disaster preparedness system in the two demonstration project sites, the municipalities of Gaibandha and Tongi. Through this process, the project aims to improve the capacity and skills of the communities to manage risk and apply mitigation skills in the urban areas. It is expected that the best practices and lessons learned from the two demonstration project sites will be replicated to other municipal areas of Bangladesh.

Section-III

6.0 Recommendations and Conclusion

6.1 From the above discussions, it is clear that government alone can not manage the disaster effectively, unless various community participation are encouraged and ensured. Thus local level communities should be mobilized and empowered to plan and prepare themselves so that they can not only develop the coping mechanism of the disaster but also respond rapidly and effectively to face the disasters situation. This section of the paper therefore presents a few recommendations on the basis of the findings of the discussions made in previous sections. Following recommendations are appears to be pertinent for the effective community-based disaster management.

(a) Integrate the CBA into Planning for Development

Government should not only encourage the idea of CBA for managing any disaster but also integrate as a policy issue into plan document. This initiative would help the concerned agencies to initiate development projects at the community level through which CBA would subsequently take the form of institutions.

(b) Promoting the Idea of Community Development

The idea of CBA could be popularized among to the local communities when government agencies and NGO's would lead to promote the concept by taking various-projects. It would be possible only when the community approach issue would provide real benefit to a certain region and to a certain group of people. In order to promote the idea, it needs to introduce the true meaning of community and community development through public education, radio, television and newspapers. Secondly, suitable organizational units for community disaster management must be identified.

(c) Developing Community Based Disaster Model

As we know model is a idea of framework tested and accepted by the people for reviewing real benefit. A model of similar nature has been used in the present paper which could be utilized as a basic reference in planning and developing communities own framework for effective disaster management. This type of model framework should be made available to each and every group of community members in order to understand the concept and basic idea as well as guidelines for taking primary initiative.

To accomplish this task, communities could be classified into several specific categories based on factors such as location, degree of urbanization, demographic structure, socio-economic characteristics and local economic base. Several prototypes of community-based disaster management model could then be developed based on the characteristics of each community category.

(d) Motivate Local People

The community people normally motivate themselves in any activities when they found it would provide some benefit to them. Keeping this view in mind, concerned agencies and NGOs could easily motivate the community by explaining the real benefit of the CBA. In order to popularize the idea an endless process should not only continue but also its plan and program must be continuously expanded.

(e) Conduct an Inventory of Community

The inventory should be designed to get an overall picture of the disaster mitigation skills of community residents and special needs of the community as well as the existing and potential available resources for community disaster planning. The inventory should include the information of spatial location, environmental, geo-physical, socio-economic and educational background. These information would help the agencies to identify their strength and weakness and the nature and type of intervention needed.

(f) Hazards and Vulnerability Analysis

Disaster result from vulnerable conditions being exposed to a potential hazard. Therefore, first step in taking any mitigation measures is to assess the hazard in terms of nature, severity, frequency and impact. Having established the dimensions of hazard incidence, the next step is to initiate vulnerability analysis, which mainly focused on physical, social and economic risk in order to identify the level of exposure of person and property of a given locality.

(g) Training and Public Awareness

Findings of the inventory and hazard vulnerability analysis would be the basis of training and intervention required making the community aware. Moreover, the training program should also be designed according to the need of the members of the community. The program should introduce the concept of community self-help and consensus building, and teach community residents the skills needed for disaster planning. The development of such a program should use a bottom-up and local oriented approach. This can be accomplished by training the interested individuals within the community, and then encourage these trained individuals to

serve as lecturers for next terms of the class. However, creation of public awareness would always be the central theme of all the training program.

(h) Establish Community-based Networks

The community-based network is being conceived as a powerful instrument to store, retrieve, disseminate and manage disaster information. It has by now earned a solid reputation in South Asian region and in the world as well. It should be local oriented, but be able to connect to other useful external networks. The community should use these networks to attract external resources, develop partnership, and manage the dissemination of information regarding the situation of community redevelopment and community disaster planning

6.2 Finally, Bangladesh as a one of the disaster prone countries of the world, with extremely limited resources, its real development is not possible without the integration of disaster mitigation projects. Our planning thrust should be diverted towards disaster management as a major consideration in regional development planning. But people's welfare depends not only on development activities but also on the ability of the community to protect lives, properties and development infrastructure from disaster. Hence for any meaningful and lasting contribution towards economic growth and people's welfare, there has to be community integration in the development plan in terms of disaster management. Therefore, establishing priority between various economic development and disaster management measures should be taken from the viewpoints of institutionalizing the community-based approach for the real benefit of the country. Unless these issues are not taken care for developing an institutional culture no comprehensive disaster preparedness and mitigation plan would be successful.

Annex-I

Achievement of the Approach (as of November 1999)

Community Organizations	16 Village Disaster Preparedness Committees (VDPCs) 11 Shelter School Committees 147 Male Micro Group, 119 Female Micro Group 16 First Aid Group, 16 Rescue Group and 3 Evacuation Group
Community Volunteers	5082 Volunteers: Male-2940, Female-2142 First Aides: Male-114, Female-51 Rescue: Male-64, Female-20 Evacuation: Male-24, Female-12
Community Training	5082 Persons have been provided with basic orientation on DP, cyclone warning signals, community organization & group formation. 1150 persons received specialized training on Disaster Preparedness, Community Based First Aid, Rescue, Gender and DP, etc.
Multi-Media Awareness Campaign	Dissemination of information regarding DP-related issues through training booklets, calendars, posters, billboards, film show, drama, mass gatherings and rallies. Approx. 100.000 people reached through awareness campaign. One study conducted on cyclone-strengthening of houses
Disaster Preparedness Fund	Taka 300.000-deposited by 16 VDPCs in bank accounts
Equipment for Shelters & Volunteers	16 nos. of shelter areas provided with first aid, evacuation and rescue equipment, etc.
Gender Awareness	About 2750 Students (almost 50% female) One study conducted on Gender and DP.
Red Crescent Youth Program	800 RCY Volunteers, 3 RCY Camps and 21 Training Courses on Basic DP and Red Cross/Red Crescent Movement

Source: CBDP At a Glance, 2002

Annex-II

CBDPP, BDRCS, COX'S BAZAR AT A GLANCE

Objective	To enable the community in the target areas to deal with the impact of cyclone related disasters on their lives in order to reduce loss of lives and properties and to mitigate the suffering of the people.
Duration	Phase I- 1996-1998 Phase II-1999-2002
Location	Cox's Bazar district
Project area	Field areas in high risk cyclone prone coastal villages & islands (based around 30 cyclone shelters and 1 service station)
Population covered	Approximately 80.000 direct beneficiaries (about 450 families around each shelter)
Shelter schools	11 Red Crescent Cyclone Shelter Primary Schools
Co-operation with	Cox's Bazar District Red Crescent Unit Cyclone Preparedness Program, BDRCS
Technical & financial assistance provided by	German Red Cross
International recognition	Official EXPO 2000 World Exposition Project

Source: CBDP At a Glance, 2002

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Concluding Session

Concluding Remarks

by Seminar Director
Syed Shamsul Alam
BPATC, Savar, Dhaka

Honourable Chief Guest, Secretary-in-charge, BMM Mozharul Huq, ndc, Respected Chairperson, Dr. Md. Omar Faruque Khan,MDS, BPATC
Respected Director General from DMB and Representative from Ministry of Disaster Management and Relief
Faculty Members of BPATC
Distinguished Participants

Ladies and Gentlemen

Assalamu Alaikum,

It is my pleasure to welcome you all again in the concluding ceremony of six day long international seminar on "Improvement of Early Warning Systems and Responses in Bangladesh towards Total Disaster Risk Management Approach " jointly organised by BPATC & DMB Bangladesh in collaboration with ADRC & UN OCHA Japan.

At the very outset, let me express our deep gratitude to the Honourable Chief Guest, Secretary-in-charge, BMM Mozharul Huq, ndc, for kindly consents to preside over the function and distribute the certificates among the participants. The objective of the seminar is to improve the existing capacity of early warning systems of various disasters practiced in advanced countries with particular reference to Japanese context.

To achieve these objectives seminar program was designed on the three major themes such as earthquake, cyclone and flood where Japanese and Bangladeshi eminent scholars were invited. They have in the last six days presented their papers and share their professional knowledge and skills on earthquake, cyclone and flood. These scholars presented their papers and shared their professional knowledge and skills with the distinguished 37 participants. Moreover, participants were request to provide their opinions and suggestions as to how our existing warning system could be improved and developed on the basis of three themes. After threadbare discussion and brainstorming session each and every group presented their findings to the floor in order to identify the most relevant and appropriate issues on the theme of the disaster.

During this six day long seminar the following major issues emerges from the floor:

(a) There is a scope for improving our early warning system of various disasters and it deserves special attention to be understandable to all stakeholders and general mass.

(b) To meet this requirement an appropriate signal and warning system with simple guidelines

are to be disseminated taking in to the account of our local cultural and economic values.

(c) To foster scientific and engineering endeavours aimed at closing the gaps in knowledge a related measure for prediction, prevention and mitigation of natural disasters through cooperation with a professional organisations like ADRC and UN OCHA is needed.

Members of the Seminar Management express their thanks to the all MDSs for providing necessary guidance in conducting this seminar. I would like to express my sincere gratitude and thank to them for providing valuable advice, constant cooperation and operational freedom in conducting and running the seminar.

Thanks are also due to Dr. Md. Omar Faruque Khan, MDS(Project) and Chairperson of this session and Mr. Mosharraf Hossain, AKM Nashirul Huq, Dr. Mir Obaidur Rahman, who have informally advised me on the various aspects of the seminar, especially Dr. Md. Omar Faruque Khan for taking a personal interest in making the seminar a success.

I am also thankful to the officers and staffs of the centre, for their sincere cooperation, particularly to the Director, Deputy Director (Finance/Admn.), Deputy Director (Service), Librarian(AVR), Cafeteria and Dormitory. In fact their joint cooperation and valuable service was instrumental factor in successful completion of the seminar.

We must thank our distinguished participants of "Improvement of Early Warning Systems and Responses in Bangladesh towards Total Disaster Risk Management Approach " who have, inspite of our limitations, participated the program very seriously and extended all cooperation. The seminar would not have been so enjoyable and lovely without having their sincere participation and cooperation.

Last but not least, I must thank Banik Gour Sundar and Jesmin Ara Begum for their untiring effort to conduct the seminar as smoothly as possible. In fact their sincere labour and effort have make this seminar meaningful.

Thank you Hon'ble Chief Guest and Chairperson, Thank you all.

Allah Fafez.

Closing Speech of the Chief Guest

BMM Mozharul Huq, ndc, Secretary-in-charge,
Ministry of Disaster Management and Relief.

Mr. Chairperson,
Distinguished Members of the Directing Staff,
My colleagues from various agencies of the government.

I am extremely happy to be here today. First of all, let me congratulate all of you on the successful completion of this six-day long seminar. I am particularly happy to see that some of our armed forces colleagues are here in this seminar. At the same time, I should like to take the opportunity to impress upon my civilian colleagues because you are the officials who have been drawn carefully from various agencies responsible for disaster management.

As I was informed earlier, I would like to say that the purpose for which the seminar was organized had been achieved from different papers those were presented during the working sessions. One of my colleagues told me that a good number of questions was raised and had quick responses. It indicates that the seminar was able to generate a great deal of interests among the participants. However, it is not worthy to see that there is no female participant, which is very unusual and unlikely of the present social context. Well, anyway, the participants who have taken part in this seminar are directly or indirectly responsible for managing disaster.

You are here to represent different agencies at the national, local and the regional levels. You need to carry this experience with you and apply whatever knowledge and skills you have acquired regarding your particular work situations. I always compare the job of disaster managers with those of the armed forces managers. The armed forces should remain prepared irrespective of the real or perceived treat. Similarly, the disaster managers should remain ever prepared to face any challenge because this is a very sensitive issue. If we cannot reach to the affected people the image of the country, the image of the government and the image of the organizational responsibilities for managing disasters will be at stake. As a Relief Secretary, I feel proud of serving the real affected people of the country. I would like you to have that kind of feelings in you so that we can really serve people. Relief work is something that cannot be forced. It should be spontaneous and self-motivated.

The present government is kind to shift the relief culture and switchover to a comprehensive disaster management bureau. Disaster management is not a single-agency responsibility. It is a multi-agency responsibility. What we can do is that we can coordinate activities. We are to embark upon a $16 million comprehensive disaster management programme involving various stakeholders: government and non-government. Particularly, we are to involve the apex training institutions of the country like BPATC, National Institute of Local Government

(NILG), the armed forces and other training institutions. This should be integrated not only in the planning process but also in the regular curriculum up to the various levels. We do collaborate with the armed forces.

I would not like to burden you with advices. I would like to thank you very much on behalf of the Ministry of Disaster Management and Relief. I would also like to take this opportunity to thank the BPATC authority for giving us this opportunity for working together and I can assure you that from now on we would like to avail any of such opportunities, which the BPATC authority would like to share with us. Thank you very much for your participation and thanks to the Members of the Directing Staff for their hard work and other officials who have worked behind the screen.

I thank you all.

Allah Hafez.

Closing Speech of the Cahirperson

Dr. Omar Faruque Khan,
Member of the Directing Staff, BPATC
Savar, Dhaka

Respected Chief Guest,
Distinguished participants from various organizations and armed forces.
Respected Members of the Directing Staff,
Other faculty members,
Ladies and gentlemen.

It is indeed a great pleasure for me to chair this closing session of this seminar. We all know that Bangladesh is a disaster prone area. Every year we are facing flood, cyclone and other natural disasters. We never faced devastating earthquake. Very recently, we are experiencing frequent earthquake of low intensity particularly in the north and eastern part of Bangladesh. The situation is alarming and extremely vulnerable to massive earthquake, which may occur at any time. We need to take comprehensive measures and create awareness among people so that in case of such occurrence we could minimize the loss of lives and property. This seminar in collaboration with ADRC and UN OCHA and the Ministry of Disaster Management and Relief and DMB marks the beginning of such initiatives to improve our early warning system and will help develop a comprehensive risk management system, a total disaster management approach.

Distinguished participants,

As we all know that in Bangladesh we don't have early warning system for monitoring earthquake except one in Chittagong, which is not in a good shape. We need to establish at least 3/4 earthquake observatory centers preferably in Sylhet, Rangpur and around Mymensing depending upon the seismic map of Bangladesh. We need to have a network between these observatory centers for uninterrupted flow of information through various mode and media. I believe that this seminar will help draw attention of the concern authority to take necessary action plans in this regard. During the working sessions of the seminar the experts from Japan have shown their keen interests to help develop a comprehensive early warning system for Bangladesh to meet the challenges and to minimize the risks of losses of lives and property in Bangladesh. We are happy to know that through this seminar BPATC and DMB in collaboration with ADRC and UN OCHA, has been able to create awareness among the officials who are actively engaged in disaster management process in Bangladesh.

Dear participants,

You have shared your thoughts and ideas through active participation in the seminar. The recommendations made by you are quite sensible and remarkable. We must confess that through this seminar we have learnt many aspects about the present status of disaster preparedness in Bangladesh. We became closure to each other and quite confident that the outcome of the seminar will help the planners and the policy makers to develop a comprehensive workable plan for disaster management in line with the earthquake. I thank all of you for enormous contributions that you have made to the seminar. Actually, while negotiating with the Japanese counterparts for holding this seminar they have expressed their reservation about the timing of the seminar. So we could not get sufficient time to arrange the seminar up to our satisfaction.

I know some lapses are there in conducting the seminar. I hope, you will appreciate our sincere efforts. Finally, I thank the participants for their sincere efforts and hard work to make this seminar a success. The seminar management also worked hard. They deserve appreciation. In order to make this seminar fruitful the senior faculty members of the BPATC have given their wholehearted cooperation and support. I sincerely convey my thanks and gratitude to them. Our honorable Rector gave us guidance and necessary instructions. These have inspired us to conduct this seminar. We are very much indebted to our honorable Rector. The Ministry of Disaster Management and Relief and DMB who played pioneer roles to conduct this type of seminar, ADRC and UN OCHA, who have extended the full cooperation and support for the programme deserve a lot of thanks. On behalf of the BPATC, I thank the respected chief guest for his valuable and wholehearted support. I thank the press media for the wide publicity of the seminar in the daily newspapers.

Thank you all.

Allah Hafez.

Recap of the Working Sessions

Recap of the Program on 19 December 2002

Theme: Earthquake management

Session Chairperson: Mr. Mosharraf Hossain, MDS (R&C), BPATC, Savar, Dhaka.

Topic 1: Geophysical Structure of Bangladesh with Special Reference to Earthquake.

Paper Presenter: Dr. Shamsul Alam, Professor, Jahangirnagar University, Bangladesh

The presenter mainly focused on the relation between geographical structure and earthquake. He told that an earthquake is the vibration of the earth produced by the rapid release of energy. This energy radiates in all directions from its source, and thus focus in the form of seismic wave. This seismic wave dissipates energy rapidly with increasing distance from the focus and the instrument used to record the event is called seismograph. The Richter scale of magnitude is logarithmic, in each unit measures a ten-fold increase in the amplitude of major earthquake waves and a nearly thirty-fold increase in energy. He informed the house that a few research works had been done on the issue.

In response to some questions, the presenter informed the participants that earthquakes are shallow, moderate and powerful. If rocks cannot sustain the quake, they are broken. High-rise buildings can expand the damage of earthquake because there is no safety measure. It was informed at that time that houses built at the delta area namly Jessore and Khulna, are less vulnerable and it should be taken into consideration.

In addition, he said that the young generation is coming forward to work on geographical information systems. Though the Indian scientists are working on the issue of locating fault lines in their country, the Bangladeshi scientists are yet to conduct such activities. However, he informed that there are six fault lines around the Dhaka city.

Topic-2: Earthquake Prediction, Forecasting, Preparedness and Peoples Awareness: Bangladesh Perspective

Presenter: Dr. Md. Hossain Ali, Professor, Bangladesh University of Engineering and Technology.

The presenter of this paper said that hazards we face are different in nature. The worldwide network of seismic stations records each year more than 1,50,000 earthquakes. It is difficult for us to have an idea about earthquake because the last major earthquake occurred in our country in 1918. Two earthquakes having magnitudes greater than eight have occurred in the northeastern and northern seismic belts in 1897 and 1934 causing widespread damage

to the country. The plates of the earth are moving. Mountains, oceans and lakes can be created as a result of the movement of the plates. We have to share our knowledge regarding earthquake with other countries because the earthquake centers are outside Bangladesh. He told that only the relevant data available is not sufficient.

In addition, the presenter informed that the Japanese use building technology to minimize the damage caused by earthquake. He further added that people of Bangladesh are unprepared about any possible earthquake, though there is an organizational set up for disaster management in Bangladesh. It was suggested that Bangladesh should begin seismic research before going for the construction of Padma Bridge. In response to this, the presenter said that many stations are needed to do this. Intensity scale and magnitude scale are different. Historical data are also important to predict earthquake at the same time.

In reference to the earthquakes that took place in the country, he informed that earthquake generally continued for less than one minute. However, there was one with three minutes duration. It depends.

The Chairperson's comments:

The Chairperson observed that little progress has been achieved in respect of earthquake. We must share our knowledge with neighboring countries. Because most earthquake centers are outside our country. We need many stations. We cannot predict earthquake. But we can assume that it may occur any time and get ourselves prepared. Preparedness and post earthquake activities are very important. He thanked the presenters and the audience for making the session a success.

Chairperson: Dr. Md. Omar Faruque Khan, MDS (Project) BPATC, Savar, Dhaka

Topic 3: Seismic Observation, Earthquake Information, Tsunami Warning and Earthquake prediction in Japan

Paper Presenter: Mr. Yuji Nishimae, Japan Meteorological Agency (JMA)

The presenter described a number of earthquakes took place in Japan elaborately. He also stated the responsibilities of the Japan Meteorological Agency (JMA). He mentioned that the following bodies work for fighting earthquake:

- Cabinet Research Office
- Cabinet Office
- Defense Agency
- Coast Guard
- NHK

Time schedule, as informed by him, for issuance of earthquake information is as follows:

- Two minutes: Seismic Intensity Information
- Three minutes: Tsunami Warning
- Five minutes: Earthquake information location

Japanese people get information from radio and television. Now a days, they get information from website too. He informed that there are 180 seismic observation sites and 3000 seismic intensity meters.

Replying some questions, he said that a computer collects information within two minutes after the quake occurs in Japan. He further added that in Tokai, earthquake takes place after every one hundred years. So only Tokai regions earthquake can be predicted. Replying a question about networking system of Tsunami he told that when earthquake occurs NHK stops all regular program and telecast information within two minutes. There is coordination between JMA and NHK. The Pacific region will be covered by Tsunami warning system. He added that there are many stations in Japan. Telephone system and electricity may be disrupted. But all the areas are not hit at a time. When one area is hit, message can be sent from another place.

Topic-4: Earthquake Risk and Vulnerability Analysis: Japanese Practices and Lessons

Paper Presenter: Mr. Toshiaki Udono, PASCO Co.

Mr. Hidetoshi Kakiuchi, PASCO Co.

The speaker informed the house that a disaster occurs at the point of contact between human activities and natural phenomena of unusual scale. Earthquake often occurs in Japan because of subduction of cold (heavy) oceanic plate. There are intra plate earthquake and inter plate earthquake. Japan is situated at the most seismically active areas of the world. The Japan Meteorological Agency (JMA) conducts seismic and Tsunami observation, and issues on those phenomena and tsunami warning in order to mitigate disaster. JMA constructed new earthquake monitoring network and is processing system in order to provide tsunami warning in about three minutes after an earthquake occurs. New network consists of 150 seismic stations. Tsunami warning system commenced in 1999. Tokai is considered as the area where the occurrence of the Tokai earthquake is imminent.

He also told that seismic information is needed for hazard map. It is the result of long time research works by many researchers. There are many parameters such as intensity area and location. Surface is given weightage, its intensity is measured. Regarding the development of warning system of Bangladesh he opined that Bangladesh should use database. However,

the people of Bangladesh should determine what to do. It was suggested that Bangladesh lacks in developed software. Cooperation from Japan can help the country a lot.

The Chairperson's comments:

The Chairperson called the seminar a learning one and said that some ground works have been done. Bangladesh is a vulnerable area regarding disaster. We should develop a system to reduce the loss caused by disasters. He thanked the presenters for delivering a nice presentation and the audience for asking a number of good questions.

Recap of the Program on 20 December 2002

Theme: Cyclone Forecasting and Management

Session Chairperson: Dr. Mohammad Mahbubur Rahman, MDS (P&S), BPATC, Savar, Dhaka.

Topic 5: Cyclone and Flood: Prediction, Forecasting, Warning Systems and Dissemination Methods of Japan (How to make the warnings Lead to Action)

Paper Presenter: Mr. Hiroaki Nakaya, Japan Metropolotical Agency (JMA)

Before starting his presentation, the presenter gathered some information regarding disaster and its management in Bangladesh because he thinks that each country has its own definition and situation of disaster. What he came to know were as follows:

- It takes 18 hours from the capital city to reach coastal areas if disaster can be predicted 24 hours before.
- There are urban and rural local governments in Bangladesh. Urban local governments get news from media earlier. Problem arises with rural local governments.
- There is a standing order and a standing committee about disaster management headed by the Prime Minister.
- There are thirty thousand volunteers to evacuate people in coastal areas.

He informed the participants that JMA can issue warning independently. He wanted to know the warning system of Bangladesh. He was informed that Bangladesh maintains international standard weather forecasting system. Around 93% of rainfalls come from outside the border only 7% come from within the country. Regarding flood, we have to depend on international bodies. Bangladesh flood warning center has no local project. There are special weather bulletin and warning.

The speakers described the role of flood fighters in Japan. Then the following information about Bangladesh came from the floor:

There are evacuating teams consisting of various bodies. There are 30-90 flood shelters. Bangladesh Red Crescent Society is active in every district. From each district 3 villages are selected. In each village there are 35 volunteers. District administration always remains alert to fight disaster. There are 250 evacuating boats throughout the country. Coast guards have 50 boats. These are borrowed from them by the district administration. Government takes all precautions to evacuate people. Four stages namely pre, during, after and rehabilitation activities are stated in the standing order. It is clearly spelled out who will do what. The

concerned agencies use radio, television, wireless, and teleprinter for forecasting disaster.

During the devastating and prolonged flood in 1998, the entire Dhaka city was under water. Telecommunication was disrupted. Then Prime Ministers Office, Airport and the Rangpur Radar were taken under computerized telecommunication system with the help of Japan. Every year fishermen are trained to fight cyclone. In relation to this, the speaker elaborately described the warning system of Japan. He concluded that the best knowledge lies in the minds of local folk.

Replying a number of questions, he opined that unless we use the same data, we could not communicate with all. In Japan, local bodies warn people in case of landslide. It is difficult for the tropical region to forecast disasters. But in the case of Japan, it is possible. Japan belongs to the monsoon region. There is a similarity between Bangladesh and Japan. The situation is not the same but similar. In Japan, there are 10-12 TV channels providing information about disaster. But the source of information is same.

Topic-6: Hazard Mapping and Vulnerability Assessment : Japanese Experience

Paper Presenter: Mr. Toshiaki Udono, PASCO Co.

Mr. Hidetoshi Kakiuchi, PASCO Co.

The speakers said that Hazard Map cannot stop disaster but it can reduce the loss caused by disaster. Around 70 percent of Japan's land consists of mountains. There are 86 active volcanoes. In 1995 Kobe suffered a devastating earthquake. Every year many people are killed by earthquake in Japan. Disaster history and data set are important for Hazard Mapping. Hazard Map is one of the most important needs for fighting disaster. According to their opinions, a total disaster prevention system is necessary.

While answering questions, they added that in Japan, Ministry of Construction and provincial governments are responsible for preparing and providing hazard map. There is a standard system of disaster prevention. Both national and provincial governments are responsible for legalizing Hazard Map. Consumers have access to disaster prevention activities through local governments. For preparing the Hazard Maps, consequences of 5-10 years are considered. Global warming by emission of CFC is a long-term affect, though it is not considered yet.

Ministry of Infrastructure and Transport is responsible for training people to fight disaster. There is a cabinet body called Ministry of Disaster Management. There are public committees at local level for mitigating disaster. Seismic strength is the intensity of earthquake. Nearly all people of Japan are vulnerable to the disaster like earthquake.

The Chairperson's comments:

The Chairperson observed that the problem has a lot of faces. Only the human face has been discussed but not the technological face. There are social (community participation) economic

(migrant workers, fishermen's income) legal and legislative aspects of the problem. There are around 200 environment related rules without any enforcement. An integrated land use plan is required so that the loss caused by disaster can be minimized. Enclaves, townships, zones are necessary to reduce the pressure of population on mega cities. Discrimination in providing shelter in urban areas should be brought to an end. Existing communication system needs to be developed. Institutional arrangements should be enhanced. User-friendly tools and techniques should be explored so that all people can understand the impact of earthquake. Local governments should be strengthened in both urban and rural areas. Database is essential. People's language should be understood. The issue should be incorporated in the education curricula. Continuos cooperation with Japan and other countries will bring about positive result in this field. He concluded by saying that both the presenters and the audience had contributed a lot for making the session a success.

Chairperson: Dr. Mir Obaidur Rahman, MDS (D&E) BPATC, Savar, Dhaka.

Topic7: Total Disaster, Risk Management Approach: Japan's Lesson Learned

Paper Presenter: Ms. Takako Izumi, UN OCHA

The presenter described the activities of UN OCHA. She informed that it has two headquarters. One is located in New York and another is in Geneva. Response Coordination Branch (RCB) is an important part of UN OCHA. She told that natural disasters are not natural , but rather man-made. Human societies have the capacity to recognize the risks and factors that would lead to or cause disasters and appropriate interventions to control or manage them. Disasters can be prevented, or at least their destructiveness can be minimized.

Regarding UN OCHA, she said that it is not an implementing body. If any disaster takes place assistance is given upon concerned governments request (up to US$ 50,000). UN OCHA has the Secretariat of Internal Rescue and Relief. Its mandate is to mobilize and coordinate relief. Among other disasters, it deals with drought and famine. However, as she informed, an international workshop/meeting was held at Kobe. No delegation from Bangladesh could attend due to devastating flood.

Bangladesh, India and Sri Lanka are eager to establish the regional office of UN OCHA. The higher authority will decide where the proposed regional office will be situated. UN OCHA's mandate is disaster assistance. It focuses mainly on Community participation, which is important in disaster management. She further said that it is not possible to provide fund for preparing hazard map. However, arrangement can be made to help a country to organize related seminar or workshops.

Topic-8: Cyclone Preparedness and Management in Bangladesh

Paper Presenter: Mr. MH Khan Chowdhury, Consultant, Disaster Management Bureau (DMB), Bangladesh.

The presenter divided his lecture into four phases, such as, geographical features of Bangladesh, warning, cyclone and evolution. As he said, Bangladesh is a country with 230 rivers where people face pre-monsoon and post monsoon cyclones. He informed the house that every year the country is hit by one or two cyclones, which covers 80 to 90 percent of the global devastation. From 1964 to 1996, we lost 400,000 people due to cyclone. We have to take care of our 710 km coastal areas to encounter the consequences of cyclone. According to him, the reasons of cyclone are: (i) the location of the Bay of Bengal, (ii) Shallow sea and (iii) difference in water level which is related to full moon and full dark. He cited an example of Barisal, a district of the southern part of the country, which was hit by a cyclone of 200 miles per hour and 13 meters tidal surge in 1876. He further added that cyclone might occur at any time during full moon or deep moon. However, it is devastating at the full moon.

He stated that number of signal has no relation with intensity. It is related to the change of direction. In the existing signal system of Bangladesh, more emphasize is given to ports but not to human aspects. A committee, as he reported, has already submitted its recommendations to the Government of Bangladesh regarding the rearrangement of the existing signal system. The presenter said that the signal number varies with distance from the cyclone centre. All areas are not equally affected by cyclone. He opined that because of the location of the Bay of Bengal cyclone move from south to north. Malaysia and Indonesia belong to the Equatorial Region. Therefore, they do not face any cyclone.

He informed the participants that Bangladesh has direct satellite link with UK Met Office. The country uses mainly British equipments though equipments are also borrowed from other countries.

The Chairperson's comments:

The Chairperson said that the topics discussed in last two sessions are a guideline for pre and post disaster activities. We need comprehensive and holistic approach to fight disaster. A lot of technical events and institutional arrangements have been covered during the two sessions. A lot of disaster preparedness devices had been developed. The type of presentation, questions and answers were analytical. He hoped that the program would help extending future cooperation between Bangladesh and Japan. He expressed heartiest thanks to both the presenters and the audience for making the session lively and successful.

Recap of the Program on 21 December 2002

Theme: Earthquake Management

Session Chairperson: Mr. Mosharraf Hossain, MDS (R&C), BPATC, Savar, Dhaka.

Topic 9: Japan s Countermeasure for the Earthquake: Lesson Learned from the Great Hanshin Awaji Earthquake

Paper Presenter: Mr. Fumiaki Yoshimura, Asian Disaster Reduction Center (ADRC)

The presenter mainly focused on the lessons learnt from the great Hanshin-Awaji (KOBE) Earthquake. That was really a severe earthquake, which occurred on 17 January 1995 at 05:46 hours causing loss of 6,432 lives and injured 43,792 persons. The magnitude of the earthquake was 7.3, 7th degree Japan's intensity scale. The total loss of property was 85 billion US dollar.

During the presentation, the speaker mentioned the lessons learnt and their countermeasures. There were 5 lessons and some countermeasures for each of the lessons. The five lessons were regarding: (a) Delay of first response (b) Coordination among organizations (c) Confused logistics (d) Lack of preparedness and (e) Importance of community and volunteers.

The presenter informed that most of the buildings were old and constructed before 1970. These buildings were not constructed according to the building code. As a result, they collapsed. Now a memorial center has been established to gather the information from the KOBE earthquake and to share the experiences of the victims so that people can encounter same kind of disaster in future. The speaker added that there are 1.4 million volunteers in Japan.

Regarding countermeasures, he told if there were a lack of preparedness, the damage would be devastating. Japan would not go back to past. Some old buildings might collapse. For this reason Seismic Building Retrofitting Act (1995) was approved to promote seismic retrofitting of existing vulnerable buildings.

He made no comment regarding the issue of anticipated earthquake that may occur in Dhaka. Rather he commented that this is a problem of Bangladesh. So he is looking forward to hear the answer from the people of Bangladesh. However, JICA, USAID and other international agencies can help Bangladesh in this regard, as he informed.

Though density of population is always considered as a reason for vulnerability, the presenter differed a little with this view and said that densely populated areas are not always vulnerable. However, if the city is decentralized in sub-cities and centers then less people will be affected. At the same time, he made a comment that it is absolutely impossible to evacuate

all the people before earthquake because there is no forecasting system of earthquake. There is no success story about forecasting earthquake in Japan because it starts all on a sudden. However, in Tokai, the Japan Government is trying to give some prior information.

Regarding the post earthquake situation in Japan, he stated that fire accidents take place after the earthquake because of the wooden buildings though gas supply and train commutations stop automatically after the earthquake. He further stated that they try to supply water by truck and ship. The high school children help in distributing water and cleaning toilets. They suggest people to use plastic bags for using in toilets for some days.

The Chairperson s comments:

The chairperson thanked the presenter for his nice deliberation. He said that the participants have gathered much information from the presentation. Now how to get prepared is a very important issue. He opined that information and scientific research are required for Dhaka city. The countermeasures and the role of government and local community are very important. Bangladesh can follow Japan's survey and structural plan and preparedness program and learn how community participation may be more effective.

Session Chairperson: Mr. AKM Nashirul Huq, MDS (M&PA) BPATC, Savar, Dhaka.

Topic 10: Earthquake Education and training in school, training center and community level.

Paper Presenter: Mr. Shinji Itho, HPBE

The presenter emphasized on training for evacuating the earthquake victims. This training is the part and parcel of the school curriculum. These training are conducted in the schools, training centers, memorial centers and at the community level. Volunteers at the community level play a very significant role in imparting this kind of preparedness training in Japan.

The Chairperson's comments:

The chairperson praised the presenter for his nice presentation. He emphasized on the need of exchanging knowledge and information between Japan and Bangladesh regarding earthquake. He said as Bangladesh is a disaster prone country, the government and concerned agencies must take initiatives to introduce disaster preparedness related curriculum for the school and college students.

Plenary Session for Developing Earthquake Warning and Management System in Bangladesh

Session Chairperson: Mr. AKM Nashirul Huq, MDS (M & PA), BPATC, Savar, Dhaka.

The participants were divided into three groups for discussion. After the discussion they prepared and presented the following recommendations:

Recommendations of Group A:

- Bangladesh is located adjacent to an active seismic belt. It is inevitable that there would be earthquakes in the future but it is difficult to predict the time and place of next occurrence. Therefore we should be ready to face an earthquake of maximum magnitude and increase public awareness and response to minimize the possible losses of lives and properties;
- Formation of advance response team with proper training for damage assessment and response;
- Institutionalization of the organogram to coordinate among different concerned departments and agencies;
- Awareness building;
- Training for rescue team and necessary logistic supports;
- Media training and coordination;
- For building up Earthquake Hazard Awareness the first and successful essential step is to continue research and monitoring activity on earthquake and ground motion characteristics as yet this has not taken reasonable shape and understanding;
- The country is in need of a standard seismic hazard map to provide appropriate data in the context of engineering design that generally define the prediction level of ground acceleration, attenuation relation and probability of occurrence of an earthquake during any specific time;
- As seismic hazard estimation involves a complex geological perception and analytical modeling, development of modern research facilities and professional developments in multidisciplinary approach are fundamental requirements;
- The country requires at least 10 seismic observatory stations for monitoring the seismic activity of the country. High-speed computer expert services for installation of seismic data center at Dhaka;
- Training program for maintenance of seismic equipment;
- Data exchange with neighboring countries should be enhanced;
- The Government, NGO and other agencies should play active roles in earthquake hazard reduction preparedness and awareness. The people of the country should be aware of what

to do and not to do before, during and after an earthquake including different aspects of fire safety and medical emergency services. The Services of armed forces, medical and police department shall be given appropriate training and facilities to work in the earthquake damaged urban environment;

- For effective earthquake preparedness and building of preparedness the government and non-government agencies have a great deal to complement of the public awareness development system;
- The Government policy-makers awareness in seismic hazard management would be best judged for overall national earthquake disaster preparedness and awareness development.

Recommendations of Group B:

Pre Earthquake:

- Preparation and updating of seismic zoning and Earthquake Hazard Map;
- Establishment of seismic stations and observatory network;
- Vulnerability Assessment;
- Institutions, various organizations (GOB/NGO) involved in earthquake operations and family and community level awareness building including volunteers formations;
- Procurement of equipments and monitoring assistance;
- Setting up of structural monitoring cell;
- Stockpiling;
- Directives for adopting existing Codes and Specifications;
- Establishment of well-equipped requisite number of earthquake observatory centers, having good computer/network facilities;
- Preparation of medical services action plan;
- Organized siren warning system.

Post Earthquake:

- Rescue operation in coordination among all relevant organizations;
- Installation information center;
- Execution of medical services action plan;
- Evacuation;
- Disposal of dead bodies;
- Reinstallation of different essential lifeline services;

- Relief and Rehabilitation operations;
- Early post-damage assessment;
- Assistance from foreign countries, if required.

WHAT ADRC CAN DO?

ADRC can cooperate in the following field:

- Capacity building;
- Transfer of latest technology;
- Training of trainers;
- Fund for continuous research;
- Development of regional cooperation.

Recommendation of Group C:

- More Seismic observatories with modern equipments;
- Network between observatories;
- Central Monitoring System;
- Search & Rescue operations;
- Monitoring system utilities, life line services and management;
- Seismic Assessment;
- Retrofitting;
- BNBC updated;
- Earthquake part of BNBC should be enacted through legislation;
- Micro Zonation Hazard Map with recent aerial photograph;

Recap of the Program on 22 December 2002

Theme: Cyclone Forecasting and Management

Session Chairperson: Dr. Mohammad Mahbubur Rahman, MDS (P&S) BPATC, Savar, Dhaka.

Topic 11: Case Presentation on the Responses in 1991 Cyclone

Paper Presenter: Mr. Md. Monjurul Hoque, Deputy Director, BPATC

This paper was a case study report. A Research Team of 7 members worked on preparing this report after the 1991 cyclone. The presenter was one of the team members. The report was published in October 1992.

As the presenter stated, the case study report mainly focused on the cyclone that occurred on 29 April 1991 with a wind speed of 224 km per hour and tidal surge of over 6 meters. It hited the coastal areas and offshore islands of the country. The cyclone affected 18 coastal districts of the country. The severely affected districts were Chittagong, Cox's Bazar, Bandarban, Khagrachari, Feny, Noakhali, Bhola and Patuakhali. According to the available government report, in the Chittagong Zone alone about 1.32 lakh (0.132 million) people lost their lives and property loss was worth 2.07 billion US dollars, nearly 7000 educational institutions and 3000 mosques and places of worship were also damaged. The presenter informed that the research started in June 1991 and it ended in November 1991.

The presenter briefly highlighted the findings of the research, which were as follows:

1. About 89.23% of the respondents had prior knowledge about the cyclone and about 77.68% of the respondents had prior knowledge of both the cyclone and the tidal bore.

2. It was recorded that about 80% of the respondents received the information about the cyclone and tidal bore through radio message, local administration also played a significant role.

3. Most of the respondents did not believe that a cyclone would really hit the coastal areas because 51% of the respondents said that the information did not come true in the past.

4. Cyclone Preparedness Program (CPP) topped the list of the organizations and individuals came forward to provide different services for cyclone preparedness. 57% respondents admitted the role of CPP. The other important organizations and individuals were adjacent Upazilla Parishads and Municipal Corporations.

5. Different kinds of services were rendered by different organizations. In most of the cases the organizations gave information about cyclone and advised to take shelter and to preserve food and drinking water underground. However, 49.51% of the respondents did not know at all about preserving food, water and medicine underground, while 28.46% of the respondents did not think to preserve them underground and 14.81% did not believe cyclone forecasting.

6. The reasons for not taking shelters by the respondents were (a) absence of any cyclone shelter or safe places, (b) cyclone shelters were far away and (c) not possible to leave the house unprotected.

7. The respondents said that the urgent requirement after the cyclone was drinking water, food, wearing clothes. In response to this, 14.08% of the respondents said that they received food after 1 day of the cyclone, 42.07% got food after 2-6 days, 35.23% got food after 7-15 days.

8. 52.18% respondents said that relief goods were distributed properly, while 40.19% said reliefs were not distributed properly. The important causes of improper distribution of relief materials were misappropriation, misuse and wastage. The majority of the respondents said that local elected representatives were liable for improper distribution of relief goods, while 17.14% said the relief distribution committee was liable for improper distribution. It was suggested by the respondents that in future, the armed forces and the government officials should distribute relief goods.

9. Regarding the post cyclone effect, 59.83% of the respondents said that diseases affected their family members in the post cyclone period. They also reported that medical services were received from different government departments, Red Crescent Society and the NGOs.

10. 43% of the respondents said that they would like to be shifted from the affected areas whereas 56.84% said they would never be shifted.

The presenter informed that the Upazilla Parishad, Municipal Corporation and Local Government of the affected and coastal districts came forward to help the people. The affected people were just given some relief goods and nothing else. The total loss was worth about 2.07 billion US dollar. It was revealed by the research that people had superstitions and did not want to believe the cyclone forecasting. The Presenter suggested that superstitions should be ruled out. If the people were educated, they would have believed the forecasting messages.

The Chairperson's Comments:

The Chairperson thanked the presenter and the participants for their enthusiastic participation. He observed that the main problem is the credibility of the events and how can we take these forecasting messages. Once people did not believe that man can reach to the moon. But it was true. We must have the mobilization of information. Those who are alive, we should save them. But there is no clear assessment of the loss and extent of damage. We delay in this procedure. We must have training of managing stress and trauma. For this emergency counseling system and psychological training is very important.

Session Chairperson: Major General Jibon Kanai Das, Commandant, National Defense College, Dhaka.

Topic 12: Cyclone prediction, Forecasting, Warning Systems and Dissemination Methods: Bangladesh Perspective.

Paper Presenter: Mr. Akram Hossain, Director, Bangladesh Meteorological Department (BMD)

In the introductory part of the lecture the presenter told that due to the concave shape of Bangladesh coast and peculiar geographical location, the weather system has become complicated over the country. Bangladesh is the most disaster prone area of the world. Of course, disasters are meteorological. Sometimes, it occupies news headlines in terms of the extreme weather events, for example, the great Bakherganj Cyclone in 1876, the killer November Cyclone 1970 and the Urirchar Cyclone 1985 were of great significance.

The presenter explained the conditions that are responsible for the formation of the tropical cyclone. He also described the evolution of the average storm from birth to death that has been divided into four stages such as, baby or formative stage, the developing or immature stage, the mature stage and the decaying stage.

Regarding the warning and prediction system of disaster like cyclone in Bangladesh, he said that the prediction of cyclone storm in the Bay of Bengal and issuance of timely warning is the task of Storm Warning Center (SWC) which is known as the national weather forecasting center in Dhaka. As he informed, the modern technology has provided the means of early detection and constant tracking. According to him, data and weather charts are used for cyclone forecasting which are as follows:

- Surface observation at different synoptic hours
- Upper air observation at 6 to 12 hours interval
- Ships observations and observations available from automatic platforms
- Aircraft reports
- Satellite observations of various types, such as clouds, wind, sea surface temperature
- Radar observation
- NWP products

He further informed the participants that the warning signal in Bangladesh is classified into two groups such as, (i) signal for maritime ports and (ii) signal for river ports. There are 11 signals for the maritime ports and 4 signals for the river ports. As per the standing order of the government, cyclone-warning messages are issued as follows:

- Warning stage: 24 hours in advance
- Danger stage: minimum 18 hours in advance
- Great danger stage: minimum 10 hours in advance

In addition, he said that the existing idea of maritime signals that are only for the maritime ports were borrowed from the British rulers. They used their ships and boats for importing goods. For that reason, they laid emphasis on the maritime ports for safe communication.

It was surprising to know from his presentation that only 5% cyclone forms in the Bay of Bengal but loss of lives and property equals to about 85% of the total global loss. He cited an example of the cyclone in 1970 that took lives of 300,000 people but the cyclone of the same intensity in 1991 took lives of 1,38,000 people, cyclone of 1997 and 1998 took lives of only 127 and 67 respectively. This is surely a development of saving the lives of people and properties. This was due to timely and correct weather forecast and effective preparedness program. He said that Bangladesh has a long coastal belt of 710 km at any point of which cyclonic landfall may occur.

The presenter ended his presentation with the comment that weather forecasting was challenging, is challenging and will remain a challenging job . The Bangladesh Meteorological Department has already proposed a new unified maritime and riverine warning signals system based on wind speed, which is still waiting for the approval of the highest authority. The presenter expected that with the inception of new equipments, modern technologies and new warning system in Bangladesh, the BMD in collaboration with the CPP and other organizations related to disaster management would hopefully be in a position to handle the natural disasters more efficiently and easily in near future.

Regarding the effect of full moon, he informed that there are no significant relations with the full moon and the cyclone. The wave of the Ocean and the Sea depends on the full moon. The cyclone depends somehow on the temperature of the seabed. The temperature is related with the cyclone. He revealed that it is a matter of observation that most of the time cyclone hit in the full moon or in the full dark. However, he commented that there is no specific signal at night in Bangladesh. The flags can be hoisted but they may not be visible from everywhere. So there may be some light signals at night. The local community can communicate the warning signals by hearing the weather bulletin from radio or television.

The Chairperson's Comments:

The Chairperson thanked the presenter for presenting a nice paper. He said that cyclone and flood are the two most vulnerable disasters for Bangladesh. He added that in comparison to some past experiences of cyclone, the loss of lives and property had been reduced for taking appropriate measures of preparedness and motivation. The armed forces along with the government agencies, the local community, non-government organizations and various national and international organizations had come forward to evacuate the affected people and to distribute relief materials among the victims. He requested the meteorological department to be equipped with modern and sophisticated forecasting system. Finally, the Chairperson thanked the presenter and the participants for their cooperation in conducting the session smoothly.

Recap of the Program on 23 December 2002

Theme: Flood Forecasting and Management

Session Chairperson: Major General Jibon Kanai Das

Topic 13: Flood Forecasting, Warning System and Flood Preparedness and Management in Bangladesh

Paper Presenter: Dr. Ainun Nishat, Country Representative, IUCN

Dr. Nishat began with the definition of flood. He agreed that a shift in options and strategies is going on all over the world as to how to manage flood. He put some questions to the audience, "Is flood a disaster or a fact of life? Should we live with flood? How much is flood good and how much is it bad? Is it a natural disaster? Should we bring it under control? Should we manage it or live with it?

He said that when inundation causes damage it is called flood. All inundations are not flood. Inundation is necessary for soil fertility, supporting fish, navigation, ecosystem and ground water recharge. He mentioned flood control and flood mitigation as essential ingredients of flood management. He also said that flood management has two aspects: urban floods and rural floods. Timing, extent, duration and depth of inundation are important in rural areas. In contrast, duration and extent of inundation are important in urban areas. He also talked about four types of flood such as, flash flood, monsoon flood, drainage congestion and tidal flood. For management of these floods, as he explained, different approaches are needed for each flood. He also discussed the causes of flood.

In discussing options for flood management he suggested structural measures and non-structural measures. Building of embankments and shelters are structural measures. Embankment has merits and demerits. While considering shelter management, sanitation and security of the shelters must be taken care of. About flood forecasting and warning, lead-time and dissemination of forecasting are important. He criticized the cyclone warning dissemination in the country, which is age-old and is directed to the captain of the ship. Our warning dissemination system should be changed so that people may easily understand what the message contains and what to do. Planning for flood management must include pre-disaster mitigation, pre-disaster preparedness, response to disaster, and post flood recovery. He finished his deliberation with an imperative of moving our approach of relief distribution to disaster management.

In relation to some precautionary measures, the speaker suggested that embankments must be checked. During or after floods sometimes embankments are cut or the embankments may be destroyed otherwise. So embankments must be repaired. Flood management approach has to be rectified. He also focused on the importance of water movement and suggested that

while constructing roads, the water movement need to be taken into consideration.

Regarding the prediction of rainfall, he emphasized on the effectiveness rather than accuracy. He further said what can be gathered from the existing system, must be disseminated to the people, though the weather satellite is required for an accurate prediction. He concluded by saying that the maximum utilization of gathered information must be ensured.

The Chairperson's Comments:

The chairperson of the seminar said a few words to the audience. He thanked the paper presenter for his excellent presentation. He mentioned that the presenter addressed many issues and his personal experiences. The chairperson commented that warnings must be effective to the people. Flood management should focus the poor. Preparedness should be taken to save lives.

Session Chairperson: Dr. Md. Omar Faruque Khan, MDS (Project) BPATC, Savar, Dhaka.

Topic 14: Community Based Approach for Disaster Preparedness and Mitigation: Bangladesh Perspective

Paper Presenters: AKM Nasirul Huq, MDS (M & PA) BPATC and Syed Shamsul Alam, Director, BPATC

The presenters introduced before the seminar participants the background of and necessity for Community Based Approach (CBA) to mitigate the damage of disasters in Bangladesh. They said that services are not given to the right people at right time and at the right direction by various government agencies. So there arises a question of what would be the right approach to reach the affected people. There is a common consensus emerging among the policy makers, experts and professionals that the government alone cannot and will not properly manage and handle all types of disasters with its machinery because it requires active participation of the local people. The local people can best help themselves during and after the disaster if they are provided with adequate logistic and other necessary supports. This approach is getting popularity in both the developed and developing countries of the world. The speakers addressed many things including objectives of the paper, role of CBA, and successful experiences of two Community Based Approaches in Bangladesh. Finally, they made some suggestions.

It was suggested that the age for membership in the groups comprising community people should be limited. The speakers added that the group members are not elected representatives and they do not get any incentive from anybody. But the group members are provided training free of cost and some equipment very much related to disaster

management. It was also suggested that the government could institutionalize the community-based approach and set up inter-community linkages.

As the participants observed, it was suggested that the paper could have focused on the possible relationship between the local government and the local community and incorporated the relationships between the Union Parishad and the CBA since it dealt with the community based approach to disaster management. The presenters admitted the limitations and assured the participants that the suggestions would be incorporated later in the paper.

The Chairperson's Comments:

The Chairperson thanked both the paper presenters for presenting a new approach to disaster management but the paper had some limitations. It would require a cost-benefit analysis before going to take a final decision on Recap of the Program on 24 December 2002.

Recap of the Program on 24 December 2002

Concluding Function

Chairperson: Dr. Md. Omar Faruque Khan, MDS (Project) BPATC, Savar, Dhaka.

**Chief Guest: BMM Mozharul Huq, ndc, Secretary-in-charge,
Ministry of Disaster Management and Relief, Bangladesh**

After recitation from the Holy Quran the seminar Director delivered his speech. Recommedations of the participants towards total disaster risk management approach were tabled, discussed and adopted by the seminar. Then certificates were awarded among the participants. The Chief Guest delivered his closing speech. The seminar met a successful completion with the distribution of certificates, as he mentioned. He was happy to see the civilian and armed personnel interactions in the seminar. Participants for the seminar were carefully selected. The purpose of the seminar was achieved. But he felt sorry, as there was no female participant in the seminar. Finally, he thanked the BPATC authority for working together with the Ministry of Disaster Management and Relief and he wished to see further cooperation.

The Chairperson in his closing speech commented that Bangladesh frequently experiences earthquakes of low intensity. So, there is a possibility of occurance of a big one. The UN-OCHA, ADRC, DMB and BPATC jointly organized the seminar. This is a beginning and we hope further collaboration with them. He thanked the seminar management team who worked hard for the seminar. He also thanked the Rector for giving needful suggestions and inspirations to conduct the seminar.

Seminar Schedule

Day-1

Theme: Earthquake Management

Date 19.12.2002

Time Event

08:30 Registration

09:00 Inauguration of the Seminar

10:30 Tea Break

11:00 First Working Session

Session Chairperson: Mosharraf Hossain, MDS, BPATC
Topic-1: *Geophysical Structure of Bangladesh with special reference to Earthquake*
Paper Presenter: Dr. Shamsul Alam, Professor, JU

11:45 Floor Discussion
Question and Answer

12:00 **Topic-2:** *Earthquake Prediction, Forecasting, Preparedness and Peoples Awareness: Bangladesh Perspectives*
Paper Presenter: Dr. Md. Hossain Ali, Professor, BUET

12:45 Floor Discussion
Question and Answer

01:00 Remarks by the Session Chairperson

01:10 Lunch Break

02:15 Second Working Session
Session Chairperson: Dr. Md. Omar Faruque Khan, MDS, BPATC
Topic-3: *Seismic Observation, Earthquake Information, Tsunami Warning and Earthquake Prediction in Japan*
Paper Presenter: Mr. Yuji Nishimae,JMA

03:30 Floor Discussion
Question and Answer

03:45 **Topic-4:** *Earthquake Risk and Vulnerability Analysis: Japanese Practices and Lessons*
Paper Presenter : Mr. Toshiaki Udono, PASCO Co.
Mr. Hidetoshi Kakiuchi, PASCO Co.

04:30 Floor Discussion
Question & Answer

04:45 Remarks by the Chairperson

05:00 Tea and end of the Day One

Day-2

Theme : Cyclone Forecasting and Management

Date 20.12.2002

Time Event

09:30 Third Working Session

Session Chairperson: Dr. Mohammad Mahbubur Rahman, MDS, BPATC

Topic-5 : *Cyclone and Flood: Prediction, Forecasting, Warning Systems and Dissemination Methods of Japan*

Paper presenter: Mr. Hiroaki Nakaya, JMA

11:00 Floor Discussion
Question & Answer

11:15 Tea Break

11:45 **Topic-6:** *Hazard Mapping, Risk and Vulnerability Analysis: Japanese Experience*
Paper Presenter: Mr. Toshiaki Udono, PASCO Co.
Mr. Hidetoshi Kakiuclhi, PASCO Co.

12:30 Floor Discussion
Question & Answer

12:45 Lunch Break

02:30 Fourth Working Session

Session Chairperson: Dr. Mir Obaidur Rahman, MDS, BPATC

Topic-7: *Total Disaster Risk, Management Approach: Japan's Lesson Learned*
Paper Presenter: Ms. Takako Izumi, UN OCHA

03:15 Floor Discussion
Question & Answer

03:30 **Topic-8:** *Cyclone Preparedness and Management in Bangladesh*
Paper Presenter: M. H. Khan Chowdhury, Consultant, DMB

04:15 Floor Discussion
Question & Answer

04:30 Remarks by the Chairperson

04:45 Tea and end of Day Two

Day-3

Theme: Earthquake Management

Date 21.12.2002

Time Event

09:30 Fifth Working Session

Session Chairperson: Mosharraf Hossain, MDS, BPATC
Topic-9: *Japan's Countermeasure for the Earthquake: Lesson Learned from the Great Hanshin Awaji Earthquake*
Paper Presenter: Mr. Fumiaki Yoshimura, ADRC

10:15 Floor Discussion
Question & Answer

10:45 Remarks by the Session Chairperson

11:00 Tea Break

11:30 **Topic-10:** *Earthquake Education and Training in School, Training Centre and Community Level*
Paper Presenter: Mr. Shinji Itho, HPBE

12:15 Floor Discussion
Question & Answer

12:45 Remarks by the Chairperson

01:00 Lunch Break

02:00 Sixth Working Session

Session Chairperson: AKM Nashirul Huq, MDS, BPATC
Plenary Session for Developing Earthquake Warning and Management System in Bangladesh

03:30 Remarks by the Chairperson

03:45 Tea and end of Day Three

Day-4

Theme: Cyclone Forecasting and Management

Date 22.12.2002

Time Event

09:30 Seventh Working Session

Session Chairperson: Dr. Mohammad Mahbubur Rahman, MDS, BPATC
Topic-11: *Case Presentation on the Responses in 1991 Cyclone*
Paper Presenter: Md. Monjurul Hoque, Deputy Director, BPATC

11:00 Tea Break

11:30 Floor Discussion
Question & Answer

12:00 Remarks by the Session Chairperson

01:00 Lunch Break

02:00 Eighth Working Session
Session Chairperson: Golam Mowla, Director General, DMB
Topic-12: *Cyclone Prediction, Forecasting, Warning Systems and Dissemination Methods: Bangladesh Perspective*
Paper Presenter: Mr. Akram Hossain, Director, BMD

02:45 Floor Discussion, Question & Answer

03:00 Remarks by the Session Chairperson

03:15 Plenary Session on Developing Cyclone Warning Management Systems in Bangladesh

04:00 Tea and end of the Day Four

Day-5

Theme: Flood Forecasting and Management

Date 23.12.2002

Time Event

09:30 Ninth Working Session
Session Chairperson: AKM Nashirul Huq, MDS, BPATC
Topic-13: *Flood Forecasting, Warning System and Flood Preparedness and Management in Bangladesh*
Paper Presenter: Dr. Ainun Nishat, Country Representative, IUCN

11:00 Tea Break

11:30 **Topic-13:** *Flood Forecasting, Warning System and Flood Preparedness and Management in Bangladesh* (continued)

12:15 Floor Discussion
Question & Answer

12:45 Remarks by the Chairperson

01:00 Lunch Break

02:15 Tenth Working Session
Session Chairperson: Dr. Md. Omar Faruque Khan, MDS, BPATC
Topic-14: *Community Based Approach for Disaster Preparedness and Mitigation: Bangladesh Perspective*
Paper Presenter: AKM Nashirul Huq, MDS and Syed Shamsul Alam, Director, BPATC

03:00 Floor Discussion, Question & Answer

03:30 Remarks by the Session Chairperson

03:45 Tea and end of the Day Five

Day-6

Time Event

Theme: Flood Forecasting and Management

Date 24.12.2002

09:30 Eleventh Working Session
Session Chairperson: M. Mujibul Haque, Former Secretary, GOB
Plenary Session on Developing Flood Forecasting, Warning, Preparedness and Management in Bangladesh

10:45 Remarks by the Chairperson

11:00 Tea Break

11:30 Session Chairperson: Dr. Kamal Uddin Siddiqui, Rector, BPATC
Wrap-up Session: Finalization of Comprehensive Disaster Management Strategies and Approaches (Earthquake Cyclone and Flood) for Bangladesh

12:30 Closing session

01:00 Lunch Break

02:30 End of the Training Seminar and Departure

Senior Researcher :
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Seminar Director :
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Seminar Co-ordinators :
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Jesmin Ara Begum, Assistant Director (PPR), BPATC Savar, Dhaka

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Seminar on

"Improvement of Early Warning System and Responses in Bangladesh towards Total Disaster Risk Management Approach"

Duration : 19-24 December, 2002 (Held at BPATC, Saver, Dhaka)

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