MANAGING NATURAL DISASTERS IN BANGLADESH

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ABSTRACT

Bangladesh currently ranks as one of the world's foremost disaster-prone country. The situation is aggravated, all the more by its being the most densely populated country in the world. Environmental disasters like tropical cyclones, storm surges, floods, norwesters, tornadoes and droughts ravage the country almost every year. During the last forty years, the country was devastated by forty severe cyclones of varying intensities. One of the severe ones in recent times was that of 29 April 1991, when material damage was to the tune of about 2.4 billion US dollars and human casualty of about 1,40,000 lives. On a previous occasion of a similar catastrophe in 1970, about half a million lives were lost. The Bangladesh flood of 1988 caused economic loss to the extent of about one billion dollar. The loss due to the current 1998 flood of Bangladesh has exceeded that due to any previous flood and may be around two billion dollars. And flooding in Bangladesh is a perennial problem. Every year Bangladesh is also affected by norwesters and tornadoes causing loss of lives and immense damage to property. Though Bangladesh is affected by floods frequently it is not spared from drought which occurs in Bangladesh occasionally causing extensive damage to crops. Bangladesh also lies in the seismic zone and hence comes under the risk of earthquakes.

All these natural disasters pose a great threat to sustainable development of the country. Disasters cause immense loss of crops which could affect the food security of the country unless adequate measures are taken to replenish the loss. This puts lot of stress in the society and affect the National Security also. For example, during the cyclone of 1991, many of our Air Force aircrafts were damaged and many naval ships were sunk thus creating direct national security problem. Disastrous weather is always a problem in operational activities. Thus proper monitoring of disasters and adequate measures for disaster management are of utmost importance for sustainable development.

In this paper losses due to various natural disasters and measures to deal with them are discussed. It may be mentioned that disaster management has improved considerably in Bangladesh in recent times with the exception of earthquake disaster.

IMPACT OF NATURAL DISASTERS SUSTAINABLEECONOMICDEVELOPMENT

Exact knowledge of weather condition is essential for sustainability of economic development. A disastrous weather condition like a tropical cyclone can severely affected the economy of the country.

POLITICAL

Failure to deal with a disaster adequately can endanger the political security of a country.

It is thought that successive crop failure due to repeated droughts forced the Union of Scotland with England.

ECONOMIC

It is the economic aspect that will be emphasized most in this paper. Economy of a country is of great concern and worsening of the general economic condition can be a great threat to national security. Given below is a statistics of the economic growth rate of Bangladesh from 1973/74-1993/94.

TABLE - I

Year	Percentage Growth Rate of GDP at Constant Market Price.
1973-1974	11.6
1974-1975	3.5
1975-1976	9.6
1976-1977	1.6
1977-1978	6.9
1978-1979	4.3
1979-1980	1.2
1980-1981	6.2
1981-1982	1.4
1982-1983	3.4
1983-1984	4.2
1984-1985	3.9
1985-1986	4.4
1986-1987	3.9
1987-1988	2.9
1988-1989	2.5
1989-1990	6.6
1990-1991	3.4
1991-1992	4.2
1992-1993	4.5
1993-1994	4.6

TABLE-II

Years of Lesser Growth Rate and Disaster Associations

Year	Growth rate	Disaster
1974-1975	3.5	Flood
1976-1977	1.6	El-nino
1979-1980	1.2	Drought
1981-1982	1.4	El-nino
1984-1985	3.9	Flood
1987-1988	2.9	El-nino/Flood
1988-1989	2.5	La-nina/Flood/ Drought
1990-1991	3.4	Cyclone

The statistics shows that a lesser growth rate year is associated with flood, cyclone or drought or El-nino/La-nina phenomena. Thus association of a natural disaster with national security is clearly established. Here I take indulgence in the work of the great economist the Nobel Laureate Amartya Sen who in his took "Poverty and Famines'' has expressed the opinion that famines can occur in a region even when the available food stock is equal to that of any normal previous year's stock. Thus if famine can occur in normal year, it is more probable that it can occur in a disaster striken year. Let us examine this in the most famous famines of this region.

(1) Famine of 1770 (Chiattarer monnonthor) Monsoon failed in that year. there was no rain till August. People could not cultivate their land which was abandoned. There must have been serious shortfall in agricultural production. One crore people died in the then Bengal of starvation. Of course, the occupation of Bengal by the East India company under Robert Clive and his ruthless exploitation must have accelerated this famine. But had there been no shortfall of food, famine might not have occurred.

(2) Bengal Famine of 1943 (Panchasher monnonthor). The year 1940 and 1941 were Elnino yeas and so was 1943. This occurrence of continuous Elnino might have caused continuous drought and continuous shortfall in the agricultural production, which ultimately must have caused this great famine in which another crore people died. Without any severe shortage of food, the famine might not have occurred by war procurement and hoarding by the traders alone.

(3) 1974 FAMINE :

1972 and 1973 were El-nino years where there could have been drought and consequent loss of crops. Thereafter there was the great flood of 1974 which must have destroyed lot of crops which is reflected in the 1974/1975 GDP growth rate which dropped to 3.5% from 11.6% in the previous year.

(4) Now let us look at another historical famine of 1866, which occurred in different parts of the then Bengal due to a severe drought in 1865. W.W. Hunter in his Statistical Account of Bengal (1876) states the rainfall in Bogra that year. The rain commenced early as far as 11.7 inches in May, rainfall in June and July was excessive, that of August insufficient, By 15 Sept. rains entirely ceased except for one light shower in October.

That is a situation very similar to 1997, when the rainfall for the whole year was more or loss normal, but the rain ceased by the first week of October which was only 18% of the normal and there was no subsequent rain in November as well. There was no adequate rain during the flowering of the Aman crop and consequently the loss of crop was 2.8 million tons and this was compensated by massive procurement. It may be mentioned that it is not the absolute value of the rain for the whole year but adequate rain at the appropriate time that matters. Had there been just one inch of rain during late October or early November, in 1997 loss of crops would not have occurred to that extent.

Let us come to 1998. We have some 4 million tons of food shortage during this year due to the prolonged flood and to avert a famine this much of food has to be imported. But the fear is that GDP growth rate will come down to some 3.6% from 5.6% last year (Ref).

Thus to avert a famine and ensure national security is to assess the food shortage timely and correctly procure the same from wherever we can. There is no other alternative.

Bangladesh Govt. has learnt this lesson over the years. A reserve stock of about a million ton of food is always kept and in case of shortage, arrangement is made for the procurement of the shortfall amount. Arrangement like VGF makes it available to the poor, what Sen calls ensuring their entitlement.

TROPICAL CYCLONES

The tropics can be regarded as the region of the earth lying between 30°N latitude and 30°S latitude. All the tropical seas of the earth with the exception of the south Atlantic and east south Pacific give birth to deadly atmospheric phenomena known as tropical cyclones. On the average, 80 tropical cyclones are formed every year all over the globe. Bangladesh is a part of humid tropics, with the Himalayas in the north and the funnel shaped coast touching the Bay of Bengal in the south. This peculiar geography of Bangladesh causes not only the life giving monsoons but also catastrophic ravages of cyclones, norwesters, tornadoes and floods. The Bay of Bengal is an ideal breeding ground for tropical cyclones.

Though solar energy ultimately controls the terrestrial weather, the following environmental conditions have been found to be prerequisites for the development of cyclones (i) Absence of strong vertical wind shear of the horizontal wind near the cyclone centre and presence of strong vertical shear of opposite sign on either side of this system. The difference between the wind vectors between two vertical levels is known as the vertical wind shear (ii) Presence of low pressure region with cyclonic voracity (iii)

Warm ocean temperatures. A tropical storm does not form if the sea temperature is less than 27^0C. Such a high surface temperature is necessary to produce a steep lapse rate for maintaining the vertical circulation in a cyclone. This condition is met throughout the year in regions of the Bay of Bengal where cyclones are formed. A cyclone can extend upto a height of 15 kms. All the low pressure systems may not develop into cyclones. Some just die out whereas others intensify into cyclones. A list of the major cyclones affecting Bangladesh is given in Table-III.

TABLE- III
Cyclones affecting Bangladesh since 1960

Date	Max. wind speed in kms/hr	Storms surge ht. (in ft.)	Deaths
09 Oct. 1960	162	10	3,000
30 Oct. 1960	210	15-20	5,149
09 May 1961	146	8-10	11,466
30 May 1961	146	20-29	-
28 May 1963	203	14-17	11,520
11 April 1964	-	-	196
11 May 1965	162	12	19,279
31 May 1965	-	20-25	-
14 Dec. 1965	210	15-20	873
01 Oct. 1966	146	15-30	850
11 Oct. 1967	-	6-28	-
24 Oct. 1967	-	5-25	-
10 May 1968	-	9-15	-
17 April 1969	-	-	75
10 Oct. 1969	-	8-24	-
07 May 1970	-	10-16	-
23 Oct. 1970	-	-	300
12 Nov. 1970	223	20-30	,00,000
08 May 1971	-	8-14	-
30 Sep. 1971	-	8-14	-
06 Nov. 1971	-	8-18	-
18 Nov. 1973	-	8-13	-
09 Dec. 1973	122	5-15	183
15 Aug. 1974	97	5-22	-
28 Nov. 1974	162	7-16	a few
21 Oct. 1976	105	8-16	-
13 May 1977	122	-	-
10 Dec. 1981	97	06	02
15 Oct. 1983	97	-	-
09 Nov. 1983	122	-	-
03 June 1984	89	-	-
25 May 1985	154	10-15	11,069
29 Nov. 1988	162	5-10	2,000
29 April 1991	140	20-25	1,38,000
02 June 1991	100	06	-
02 May 1994	200	-	170
19 May 1997	225	15	126
26 Sept. 1997	150	10	70
20 May 1998	120	0.0	03

Determination of the Cyclone Track : The precise forces responsible for the motion of tropical cyclones is not understood clearly and hence determination of the path of the cyclone in advance is one of the most difficult tasks in meteorology.

Recently various statistical and numerical dynamical methods have also been introduced for the forecast of cyclone paths.

(1) Steering Principle was first applied by H. Mohn in 1870. Until 1950 forecasts of tropical cyclones were made by subjective methods based on synoptic maps and climatological behaviour. Following are some of the objective methods applied in modern times for cyclone forecasting. (2) Statistical methods relate predicted movement to one or more parameters in an empirical way. (3) Dynamical techniques, on the other hand make use of some forms of the equation of motion to predict numerically the motion of cyclone from an observed initial state of the atmosphere. (4) Hybrid model in which output parameters from a dynamical model are used in a statistical model. SPARRSO has installed a model named TYAN for predicting the track of a cyclone based on climatology of Bay of Bengal Cyclones for the last one hundred years. The model has shown promising results for the forecast of cyclone movement twenty four hour ahead of landfall. In Bangladesh, Meteorology Directorate is, responsible for the issue of cyclone warning.

Protection Against Cyclones : What can be done to protect ourselves from the cyclones ? A cyclone is a natural phenomenon like an earthquake or a volcanic eruption. We have to learn to live with it. We have to strengthen the cyclone warning system and adopt protective and relief measures to minimize their onslaught. SPARRSO monitors the tropical cyclones on an hourly basis with the help of the remote sensing equipment installed and passes the information to all concerned agencies including Bangladesh Meteorological Dept., Bangladesh Air Force, Honourable Prime Minister's Office, Ministry of Disaster and Relief and so on. With the help of the facilities at SPARRSO, we can determine the location, the intensity and the future course of motions of the cyclone. As a matter of fact no cyclone in the Bay of Bengal can escape the notice of the remote sensing equipment of SPARRSO. An integrated computerised method of Cyclone warning system needs to be developed.

Strongly built houses have to be constructed high above the sea level to serve as shelter places. People from the low lying areas in the coastal region can be evacuated into these shelters in the event of a cyclonic hit. Coastal embankments have to be made to protect life and property from the onslaught of storm surges. Plantation of trees along the coastal area can also diminish the fury of the storm surges.

FLOODS

The primary cause of flood in Bangladesh is rainfall in the catchment areas of the rivers of Bangladesh. Situated in the monsoon belt with the Himalayas in the north, Bangladesh falls in the region of very heavy rainfall. About 80 percent of the rainfall occurs during the 5 month period from May to September. The annual rainfall varies from about 60

inches in the western part of the country to about 200 inches in the north eastern part. At Cherapunjee in Assam very near our Sylhet Border the average annual rainfall is about 500 inches which is the highest in the world. But the average rainfall in Bangladesh generates annually only 100 million acre feet of water whereas 1100 million acre feet of water comes from outside Bangladesh. Thus about 90 percent of the water carried by our river system, the Brahmaputra, the Ganges, the Meghna and other smaller rivers is brought from outside the country. These rivers carry water from an area of about 600,000 sq. miles of which only 7.5 percent lies in Bangladesh. Water enters in Bangladesh through three major channels but the discharge takes place through one major channel. The river system has evolved to carry the normal flow of water generated in the catchment area. Whenever the inflow of water is greater than the carrying capacity of the rivers (and this happens very often) flood results. The magnitude of the flood depends on the magnitude of excess water that is generated. A list of area flooded in different years is shown in Table-IV.

Table -IV

Area affected by flood in Bangladesh

Year	(Thousand Sq. Km.)
1954	36.4
1955	49.9
1956	35.1
1960	28.2
1961	28.4
1962	36.9
1963	42.5
1964	30.7
1965	28.2
1966	33.0
1967	25.3
1968	36.3
1969	41.0
1970	42.0
1971	35.8
1972	20.5
1973	29.4
1974	52.0
1975	16.4
1976	27.9
1977	12.3
1978	10.8
1980	32.5
1982	3.1
1983	11.0
1984	27.9
1985	11.3
1986	3.1
1987	56.6
1988	81.8
1989	6.1
1990	3.5
1991	28.6
1992	2.0
1993	28.7
1994	0.42
1998	85.0

Besides the primary cause, namely rainfall in the catchment area, there are other factors which may aggravate the floods. They are :

(1) Snow melting in the Himalayas.

(2) Hydrographic changes in the Brahmaputra basin.

(3) 2.4 billion tons of sediments carried by the river system of Bangladesh every year reduces the water carrying capacity of the rivers, which worsens the flood.

(4) Deforestation in the catchment area tends to aggravate the flood.

(5) Construction of unplanned roads, railways, barrages, embankments etc. also create obstacles to the flow of water and aggravate the flood.

Flood Forecasting and Warning : Bangladesh Govt. has taken up both the structural and non-structural measures of flood mitigation. In this respect regional and international cooperation has been sought. A Flood Action Plan with 26 components with the assistance of World Bank has been undertaken. Structural measures of flood control like storage reservoirs, embankments or levees, channel improvements and bypasses or floodways are costly and time consuming. For immediate benefit to public, non structural measures are accomplished at a much smaller cost and time. For flood forecasting a network of hydrological stations connected with telemetering gauges or by telecommunication or teleprinter links with the forecasting centre has been established by the Water Development Board. Available hydrological data consist of discharge, water level and rainfall records. Historical records of data have been analysed to prepare forecasting procedure. For major rivers, correlation of water levels or discharges between upstream and downstream stations are utilized in preparing forecasting procedure. For rivers with smaller catchments rainfall-runoff relation, flood routing, co-axial graphical correlation methods are used. Extensive modeling of flood in our river system is necessary for effective forecasting. The Flood Forecasting Cell of Bangladesh Water Development Board has considerably improved its facility for the issuance of flood forecasting. It uses the remote sensing data along with ground data. The methods need further automation. Remote Sensing data have been used to delineate the flood affected areas.

It has been found that Southern Oscillation Index (SOI) can be used to came advance forecast of floods and droughts.

NORWESTERS AND TORNADOES

Though cyclones are the most devastating storms affecting Bangladesh, there are other kinds of storms which affect Bangladesh. Of these, mention may be made of Norwesters and Tornadoes which cause lot of destruction of lives and property.

Norwesters come mainly from the north westerly direction (and hence the name) and are land based. They are a very common phenomenon in Bangladesh during late Chaitra and Baishak months and are known in Bengali as Kalbaishaki.

Another kind of storm very similar to a tropical cyclone but is of much smaller dimensions and very destructive is known as a Tornado. A tornado is also a low pressure region where strong winds blow around a centre in an anticlockwise direction in the northern hemisphere and clockwise direction in the southern hemisphere. But unlike a cyclone a tornado develops on land. A cyclone lasts for days whereas a tornado lasts for a very short duration.

A tornado is formed because of the interaction of two air masses, one moist and warm air and the other dry and cold air resulting in extreme form of instability. Tornadoes often form a series and travel in almost parallel paths. The whole tornado moves at a speed of 25-30 miles an hour, whereas the maximum wind in a tornado could be 300 miles/hr.

Since the horizontal diameter of a tornado is so small and it forms so suddenly that it is difficult to recognise a tornado either in the surface weather map or in the satellite picture and hence forecasting of a tornado well ahead of occurrence becomes very difficult. We have observed that certain cloud features as obtained from satellite pictures and some other meteordogical parameters like the Showalter or Total Total Stability Index may indicate the occurrence of a tornado but again it is very difficult to pinpoint the place, time and severity of a tornado occurrence. Surface meteorological observations are taken usually at certain specified towns whereas a tornado can occur anywhere. A network of radars and frequent satellite observations may be very helpful in the early detection of tornadoes. Extensive research is needed on tornadoes to make any forecast possible.

DROUGHT

Though Bangladesh is a land of abundant rainfall, drought is very familiar to us. It is difficult to define the term drought precisely and hence any definition is rather subjective. It simply means lack of water and may be defined as lack of sufficient water to meet requirements. Thus drought can be of various kinds according to various requirements.

Drought History : The scourge of drought may be regarded as an integral part of the world climate. Wherever there is rainfall, there is drought also. Just like there is excess of rain causing floods, there is inadequate rain causing drought. Drought is by no means an isolated phenomenon or a purely local phenomenon. Sometimes drought occurs in large part of the globe and sometimes in many parts of the earth simultaneously. Excess rainfall may occur in some parts of the earth and drought may occur in another part. This may be due to the atmospheric teleconnections. Drought is again a recurrent phenomenon. There are records of severe droughts in history. In Bangladesh, drought of 1979 is the severest in living memory. In the seventeenth century, repeated drought and consequent crop failures occurred in Scotland which in the opinion of some forced the union of Scotland with England. In the 19th century repeated drought occurred in many

parts of USA and Canada . In the sixties, drought occurred in various parts of India and in the late sixties and early seventies, there was drought in the Sahel region of Africa.

Bangladesh Climate : Bangladesh is situated in the active monsoon regions of the world with an average rainfall of about 90" per year. But the rainfall distribution is not uniform throughout the year. Most of the rainfall i.e. about 80% occurs during the monsoon period i.e. June to October. About 5% rainfall occurs during November to February and about 15% rainfall occurs during March to May. This shows that the months November to February are very dry and may be regarded as permanent drought months. But this does not mean that Bangladesh has an arid climate because aridity in these four months is amply compensated by abundant rainfall during the rest of the year. However, the amount of rainfall varies considerably from year to year and from region to region. In some areas in the northwestern part of the country, the amount of annual average rainfall may be as low as 50" whereas in the north-eastern part, average annual rainfall may be as high as 200". There is a lot of variation of rainfall at different places from year to year. Specially during the premonsoon period, decrease of rainfall may seriously affect various crops. For example in 1979 rainfall during January to May was about one third of the normal though for the whole year, rainfall was only about 10% short of the normal. As people have adapted their crop to average climatic conditions, substantial decrease of rainfall may seriously affect the crops and other activities. Though a severe drought like the one that occurred in 1979 is not very frequent a study has shown that milder droughts occur in Bangladesh after an interval of 5-10 years. The years 1950, 1951, 1957, 1958, 1966, 1967, 1972 and 1979 were years of less rainfall in Bangladesh. We have witnessed severe drought in 1989 also. Some drought occurred during the post-monsoon season in 1997. Drought condition prevails in some part of the country almost every year for some of the time. Some of the droughts in Bangladesh seem to be related to El-Nino phenomenon.

THE GREENHOUSE EFFECT

Man through his activities has started acting as an agent of climatic change. He is releasing enormous quantities of CO_2 (carbon dioxide) by burning both fossil fuels and non-fossil fuels (including burning wood). Part of the CO_2 is absorbed in the ocean and part is released in the air. It is estimated that since 1860, the CO_2 content in the atmosphere has risen by about 20% and will continue to rise further in future and may double by the middle of the next century. CO_2 and other greenhouse gases can increase the temperature of the lower atmosphere by re-emitting back part of the radiation emitted by the earth. Thus this can definitely change the earth's climate. Large scale increase of the earth's temperature and the consequent rise of sea level has been predicted because of the increased amount of CO_2 and other gases in the atmosphere in future. Even there could be damaging change in the regional climate because of the global warming. For example, Bangladesh could face increasing floods because of this effect. Thus the disaster situation in Bangladesh will multiply manifold because of the greenhouse effect. If the prediction of the greenhouse effect comes true then low lying deltaic countries like Bangladesh will be faced with the worst kinds of disaster in human history.

Here again various space platforms under Mission to Planet Earth are being launched by US and other countries. These space platforms will help in understanding the greenhouse effect and adopting remedial measures.

EARTHQUAKES

There is ample evidence from various geological studies that the earth's crust is in motion both horizontally and vertically. The modern theory of this aspect of the earth's surface is called plate tectonics.

Earthquakes occur in regions of the earth's crust which are undergoing deformation. As the region is deformed, energy is stored in the rock in the form of elastic strain. This continues until at some point the accumulated strain exceeds the strength of the rock. Then fracture or faulting occurs. Of the theories of earthquakes, perhaps the elastic rebound theory is the most successful one. This states that opposite sides of the fault rebound to a position of equilibrium and the energy is released in the form of heat, in the crushing of rock and in the vibration of elastic waves. The waves or vibrations which are generated at the moment of fracture produce the shaking which is experienced in earthquake.

The major earthquakes that have affected Bangladesh since the middle of the last century are the Cachar Earthquake of January 10, 1869, the Bengal Earthquake of July 14, 1885, the Great Earthquake of July 12, 1897, the Srimangal Earthquake of 8th July, 1918, the Dhubri Earthquake of July 3, 1930, the Bihar-Nepal Earthquake of January 15, 1934 and the Assam Earthquake of August 15, 1950. Of these, only the Bengal Earthquake of 1885 and the Srimangal Earthquake of 1918 had their epicentres in Bangladesh.

The damages caused by these shallow focus earthquakes however were restricted to narrow zones surrounding the epicentres. The greatest damage was caused by the 1897 earthquake. The tremors were felt all over the country and severe damages were caused in the northern parts of Sylhet and Mymensingh districts and in the eastern part of Rangpur district. The 1950 earthquake was also felt all over the country though no damage was reported.

Thus we see that Bangladesh is not entirely free from the menace of earthquakes. Specially the northern belt of greater Sylhet, Mymensingh and the eastern part of Rangpur Districts could be vulnerable. Bangladesh should develop adequate facilities for detection and study of earthquakes.

Satellite Remote Sensing can easily identify earth’s fault zones where the earthquake mainly occurs. Very high resolution satellites are being used for the detection of tectonic movement of the earth.

EARTHQUAKE PREDICTION IN CHINA

People's Republic of China is perhaps the only country in the world where there is an operational programme on Earthquake Prediction. The success of their programme lies in the employment of large number of people's observatories in addition to their regular established observatories. The people's observatories are run by volunteers say school children or factory workers. In this way they get large number of observations which help in the interpretation very much. What they look for is some anomaly in the earth parameters known as precursors. Some of the precursors are 91) Land deformation (2) Tilt and Strain (3) Geomagnetic field (4) Earth currents (5) Radon (6) Underground water (7) Animal behaviour etc. It has been reported that since 1975, Chinese successfully predicted 4 earthquakes out of 5. In all the four successful cases both the short term and the intermediate term alarms were issued. The unsuccessful case was the famous Tengshan earthquake of 1976.

IMPACT OF NATURAL DISASTERS ON NATIONAL SECURITY

National Security is three dimensional. It has military, political and economic aspects. Natural disasters can affect all the three aspects of national security namely military, political and economic.

MILITARY

Exact knowledge of weather condition is essential for military operations. A disastrous weather condition like a tropical cyclone can severely hamper the military operation. Hence all military services maintain their own weather forecasting services. United states, for example has its own Defence Meteorological Satellite of higher capability even though they have quite a few civilian meteorological satellites.

Bangladesh for example lost few of its aircraft's and ships during the catastrophic tropical cyclone of 1991 due to lack of adequate preparedness measures.

Thus for national security purposes a high standard of weather service is essential.

CLIMATE CHANGE

Another great disaster mankind is facing is the climate change chiefly due to greenhouse effect being caused by manmade activities like burning of fossil fuels. Climate is largely responsible for the prosperity of people and nations. Rise and fall of civilizations also depend very much on climate. Mighty Mesopotemian or Indus Valley civilizations might have been destroyed by adverse climate. Mankind must take advance precaution to face the alarming threat of an impending climate change. If the threatened sea level rise to the

extent of a meter occurs due to greenhouse effect some 17% of Bangladesh is threatened to go under water affecting some 20-30 million people. This could be the most terrible disaster of all times. Bangladesh must take steps to raise its coastal area by a metre by massive afforestation and various engineering devices.

BANGLADESH DISASTER MANAGEMENT BUREAU

Bangladesh Disaster Management is doing a nice job in undertaking various training programmes on disasters, bringing awareness of people and their various publications. However, it is necessary that it consists of professional people and the organisation needs to be strengthened.

INSTITUTIONAL ARRANGEMENT FORDISASTER MANAGEMENT IN BANGLADESH

The Government have constituted various Disaster Management Committees at the National and field levels.

a) The National levels committees are :

i) National Disaster Management Council headed by the Hon'ble Prime Minister to formulate and review the Disaster management policies and to issue directives to all concerns.

ii) Inter-Ministerial Disaster Management Coordination Committee headed by Hon'ble Minister-in Charge of the Ministry of Disaster Management & Relief. This Committee is responsible for implementation of Disaster management policies and decisions of National Disaster ManagementCouncil/Government.

iii) Cyclone Preparedness programme Implementation Board headed by the Secretary, Ministry of Disaster Management & Relief to decide issues on Cyclone.

CONCLUSION

National Economy can be adversely affected by the occurrence of natural disasters and adequate measures should be taken well in advance to deal with related problems. It is heartening to note that the Government and the various concerns agencies are taking part side by side with the people to ameliorate the sufferings of the people struck by natural disasters. But adequate facilities should be provided to all those participating in the disaster mitigation activities (e.f. Sea Angels of US Army Operation during 1991 Cyclone).

Above all, economic condition of the country needs to be strengthened so that there is enough resources to face the disasters. We should aim to achieve something like 10% growth rate annually.

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