

## Environment

## Living with wrath of nature

by DR. A. M. Choudhury

BANGLADESH CURRENTLY RANKS as one of the world's foremost disaster-prone countries. 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, Bangladesh was devastated, on an average, by one severe cyclone every year. One of the severe ones in recent times was that of April 29, 1991. Material damage was to the tune of about 2.4 billion US dollars and human casualty of about 140,000 lives. A similar catastrophe in 1970 snatched away about half a million lives. The flood in 1988 caused economic loss to the extent of about one billion dollars. The loss due to the flood exceeded that due to any previous floods. And flooding is a perennial problem for the country. Every year, norwesters and tornadoes cause loss of lives and immense damage to property. Also, drought occurs quite frequently to cause extensive damage to crops. Besides, being in the seismic zone, the country is susceptible to earthquakes.

Natural disasters pose a great threat to our national economy. Disasters cause immense loss of crops which could affect food security of the country unless adequate measures are taken to replenish the loss. Thus proper monitoring of disasters and adequate measures to deal with them are of utmost importance for national economy.

In this paper causes of various natural disasters and measures to deal with them will be discussed. Finally disaster preparedness measures in Bangladesh will be highlighted.

## Tropical cyclones

The tropics can be regarded as the region of the earth lying between  $30^{\circ}\text{N}$  latitude and  $30^{\circ}\text{S}$  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:

1. 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.

## 2. presence of low pressure region with cyclonic vorticity; and

## 3. warm ocean temperatures.

A tropical storm does not form if the sea temperature is less than  $27^{\circ}\text{C}$ . 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 up to a height of 15 kilometres. All the low pressure systems may not develop into cyclones. Some just die out whereas others intensify into cyclones.

**Determination of the cyclone track:** 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 tracks.

**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. **Statistical methods** relate predicted movement to

shown promising results for the forecast of cyclone movement twenty-four hours ahead of landfall. In Bangladesh, Meteorology Department 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 minimise 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 Department, Bangladesh Air Force, 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.

• snow melting in the Himalayas.

• hydrographic changes in the Brahmaputra basin.

• 2.4 billion tonnes of sediments carried by the river system of Bangladesh every year reduces the water carrying capacity of the rivers, which worsens

western part of the country to about 200 inches in the north-eastern part. At Cherapunji in Assam very near to the Sylhet border the average annual rainfall is about 500 inches, the highest in the world. But the average rainfall in Bangladesh generates annually only 100 million acre feet of water whereas 1.1 billion acre feet of water comes from outside the country. Thus about 90 per cent 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 square miles of which only 7.5 per cent 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.

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

• deforestation in the catchment area tends to aggravate the flood.

• construction of unplanned roads, railways, barrages, embankments etc. also create obstacles to the flow of water and aggravate the flood.

**Flood forecasting and warning:** The government has taken up both structural and non-structural measures for flood mitigation. In this respect researchers 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

one or more parameters in an empirical way. **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. **Hybrid model**, in which output parameters from a dynamical model are used in a statistical model.

Plantation of trees along the coastal area can also diminish the fury of the storm surges.

## Floods

The primary cause of flood is rainfall in the catchment areas of the rivers in Bangladesh. Situated in the monsoon belt with the Himalayas in the north, Bangladesh falls in the region of very heavy rainfall. About 80 per cent of the rainfall occurs during the five-month period from June to October. The annual rainfall varies from about 60 inches in the

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