

METEOROLOGICAL AND HYDROLOGICAL DISASTERS BANGLADESH EXPERIENCES EVERY YEAR MONITORED THROUGH SPACE TECHNOLOGY

Suraiya Begum¹ --- Md. Shah Alam² --- Mehrun Nessa³ --- Md. Shajahan Ali⁴ --- Md. Firoz Molla⁵

^{1,2}Principal Scientific Officer, Bangladesh

³Chief Scientific Officer, Bangladesh

⁴Sr. Scientific Officer, Bangladesh

⁵Asstt. Engr. Bangladesh Space Research & Remote Sensing Organization (SPARRSO), Bangladesh

ABSTRACT

The physical cause of this disaster is embodied in law of science and hence proper scientific research is necessary to deal with them. Bangladesh is one of the disaster prone country faces Cyclones, Floods, draught, Norwesters/Tornadoes, Earthquake etc. almost every year. The Role of Remote Sensing in the monitoring such natural disasters has been described in this paper.

Keywords: Disaster, Monitoring, Neccessry, Proper, Remote sensing, Research, Role.

Contribution/ Originality

SPARRSO, has been engaged with monitoring of different natural disasters using remote sensing technology since early seventies'. This type dealing is necessary to study the nature of the events useful for awareness and disaster management towards sustainable development of the country.

1. INTRODUCTION

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 during the monsoon period i.e. June to October. About 5% rainfall occurs November to February and about 15% rainfall occurs throughout the year [1]. Most of the rainfall i.e. about 80% 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 forms 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 variation of rainfall at different places from year to year. Specially, during the pre-monsoon 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 climate 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 of the time. Some of the droughts in Bangladesh seem to be related to El-Nino phenomenon.

2. TROPICAL CYCLONES

The tropics can be regarded as the region of the earth lying between 30N latitude and 30S latitude. All the tropical of the earth with the exception of the south Atlantic and east south Pacific give birth to deadly atmospheric phenomena known as tropical cyclones [2]. On the average, nearly 80 tropical cyclones are formed every year all over the globe. Bangladesh is a part of humid, 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, nor'easter's, tornadoes and flood. The Bay of Bengal is an ideal breeding ground for tropical cyclones(Fig-1.a & Fig-1.b).

Fig-1a. LEHAR On 25 Nov' 2013

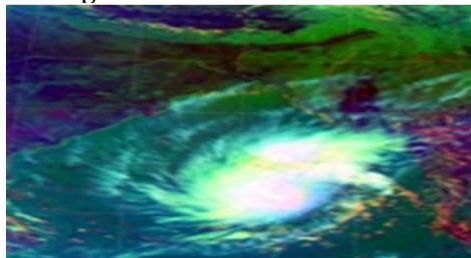
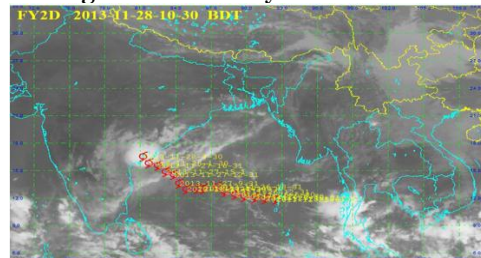


Fig-1b. Track of Cyclone LEHAR



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 opposite sign on entire side of this system. The difference between the wind vectors between two vertical wind shear (ii) Presence of low pressure region with cyclonic vorticity (iii) Warm Ocean temperatures. A tropical storm does not form if the sea temperature is less than 27C. Such a high surface temperature is necessary to produce a steep lapse rate for maintaining the vertical circulation in a cyclone [3]. This condition is met throughout the year in regions of the Bay of Bengal where cyclone are formed. All the low

pressure system may not develop into cyclones. A cyclone can turned into very sever cyclonic storm. Some just die out whereas others intensify into cyclones [4]. A list of the major cyclones affecting Bangladesh is given in table-1.

Table-1. Tropical cyclone

Date	Max. Wind speed	storms surge ht.	Deaths
	In Kms/hr.	(in ft.)	
12 Nov. 1970	223	20-30	5, 00,000
09 Dec. 1973	122	5-15	183
28 Nov. 1974	162	7-16	a few
10 Dec. 1981	97	6	02
25 May 1985	154	10-15	11,069
29 Nov. 1988	162	5-10	2,000
29 April, 1991	225	20-25	1, 40,000
19 May 1997	225	5	126
02 June, 1991	100	6	-
02 June, 1991	100	6	-
19 May 1997	225	5	126

3. FLOODS

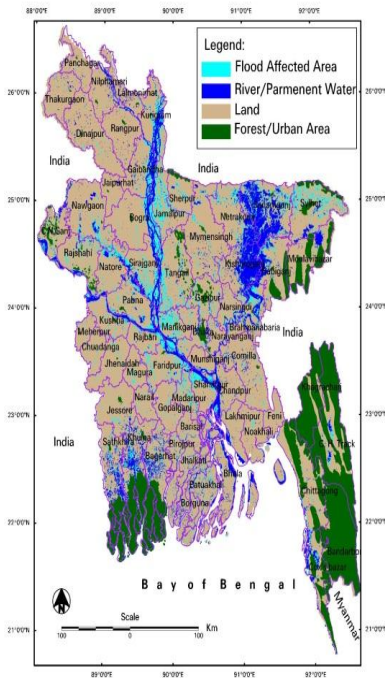
The primary cause of flood in Bangladesh is rainfall in the catchment areas of the rivers of Bangladesh. Situated in monsoon belt with the Himalayas in the north, Bangladesh falls in the region of very heavy rainfall. About 80 percent of the rainfall occurs during the 5 month period from May to September [5]. 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 Cheraunjee in Assam 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 [6]. Thus about 90 percent of the water carried by our river system, the Brahmaputra, the Ganges, the Meghan 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 water generated than the carrying capacity of the river catchment area. Whenever the inflow of the water is greater than the carrying capacity of the rivers (and this happened very often) flood result (Fig-2). 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 2.

Table-2.

Area affected by flood in Bangladesh	
Year	(thousand Sq. Km.)
1954	36.4
1955	49.9
1956	35.1
1970	42
1974	52
1980	32.5
1987	56.6
1988	81.8
1991	28.7
1998	85

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

Fig-2. Map of flood affected areas 2008



- (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 water and aggravate the flood.

4. NORWESTERS AND TORNADOES

Though cyclones are the most devastating storm affecting Bangladesh, there are other kinds of storm which affect Bangladesh. Of these, mention may be made of Norwesters and Tornadoes which causes lot 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 month and are known in Bengali as Kalbaishaki.

Fig-3a. FY-2D Satellite image (22-03-2013)

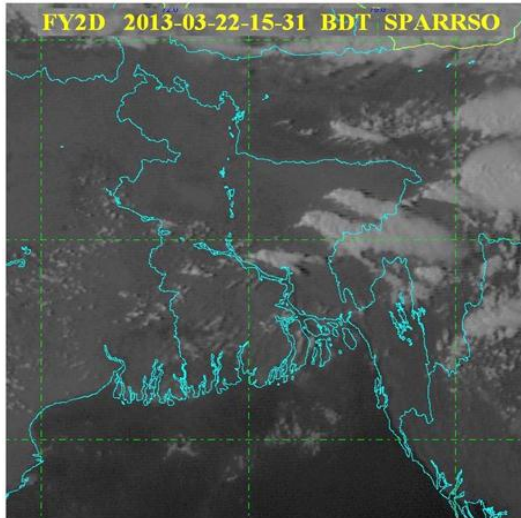
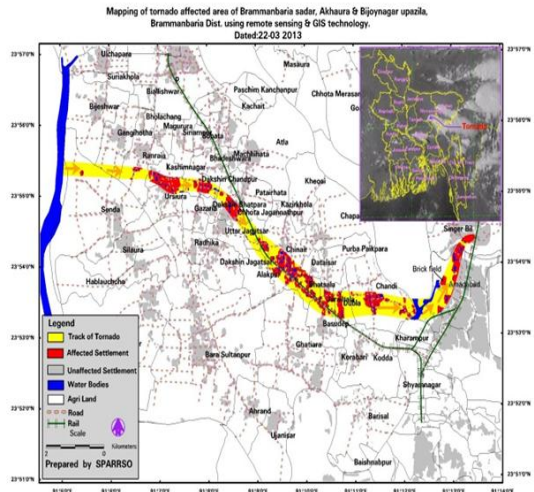


Fig-3b. Map showing of Track of Tornado

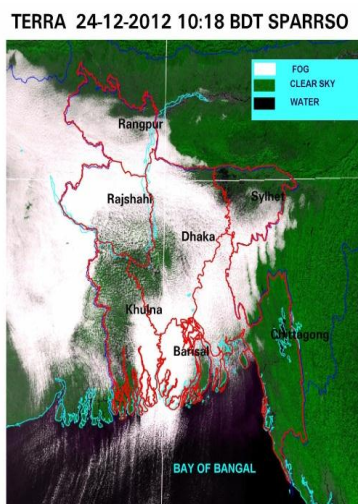


Another kind of storm very similar to a tropical cyclone but is of much smaller dimensions and very destructive is known as a Tornado (Fig-3.a&Fig-3.b). A tornado is also a low pressure region hemisphere and clockwise direction in the southern hemisphere. But unlike a cyclone a tornado develop on land. A cyclone lasts for days whereas a tornado lasts for a very short duration. A tornado is formed because 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 mile an hour, whereas the maximum wind in a tornado could be 300 mile/hr [1].

Since the diameter of a tornado is so small and it form so suddenly that it is difficult to recognize a tornado either in the surface weather map or in the satellite picture and hence forecasting of a tornado well ahead of occurrence become very difficult. We have observed that certain cloud features as obtained from satellite picture and some other meteorological 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.

5. COLD WAVE/FOG

Fig-4. Cold Wave and Fog spread over Bangladesh (TERRA Satellite Image of 24 December, 2012)



Cold wave and Fog is the natural and common weather event that found in winter season as air temperature drops down significantly and the atmosphere remains foggy. Cold wave passes over Bangladesh every year and usually occurs at the end of December and beginning of January. The space based data are very useful for monitoring the formation, duration and movement of such phenomena. Satellite images acquired in the visible and infrared regions of the solar spectrum showed appreciable sensitivity to the presence, properties and spatial distribution of fog.

The shape of the wave and its directional movement are very much visible on the satellite images. SPARRSO monitors the characteristics of these events using Space Technology and GIS on real time basis. The images received at SPARRSO ground station from FY-2D/E, MTSAT-1 and NOAA-series satellites are helpful in this regards.

6. CONCLUSION

Climate sensible issues must be taken into account in the physical design, disaster management and planning. Despite significant improvement in the prediction and monitoring of climate on a wide of scale in last decade, extreme weather and climate events continue to cause much distraction and losses to lives and properties. Timely information and early warning can mitigate the losses and damages to be caused by the cyclones. It helps in bringing immense benefit to the development of the country. The study and researches on such meteorological events thus is useful to warn people much ahead of time about the occurrence of the weather calamities like cyclone. Monitoring of cyclones as well as early warning and information provided by SPARRSO on time using remote sensing and GIS helped the Government and its organizations to take necessary actions and preparedness program in the respective areas for the sustainable development of the country.

REFERENCES

- [1] A. M. Choudhry and A. Anwar, "Prediction of the maximum wind speed in cyclones in the bay of bangle- a preliminary investigation," *Nuclear Science and Application*, vol. 7, p. 109, 1974.

- [2] A. M. Choudhury, "Movement of a tropical cyclone in the presence of inclined plane boundaries and an azimuthal wind," *Journal Bangladesh Math. Soc.*, vol. 2, pp. 27-30, 1982.
- [3] A. M. Choudhury, "Rose petals for tropical nuclei," *Sc. and Appl.*, vol. 11B, pp. 1-7, 1978.
- [4] A. M. Choudhury, *About cyclones*. London: Space Education, 1983.
- [5] A. M. Choudhury, *Study of floods in Bangladesh and India with the help of meteorological satellite in advances in space exploration* vol. 9. London: Pergamon Press, 1980.
- [6] A. M. Choudhury, "Monsoon flood boundary delineation damage assessment using space borne imaging radar and landsat data," *In Photogrammetric Engineering and Remote Sensing, USA*, vol. 53, pp. 405-413, 1987.

Views and opinions expressed in this article are the views and opinions of the author(s), International Journal of Mathematical Research shall not be responsible or answerable for any loss, damage or liability etc. caused in relation to/arising out of the use of the content.