

Climate Change and Extreme Events in Weather

Extreme events in weather have disastrous effect on environment. Intergovernmental Panel on Climate Change had reported that the climate based extreme weather event is increasing throughout the world. One of the major challenges before the scientists is to determine whether the observed change in extreme weather events exceeds the variability expected through natural causes, and to attribute the significant changes to greenhouse gases or aerosols. As far India is concerned by far the two most important meteorological events which occur over the Indian sub-continent are a) south west monsoon or summer monsoon and b) tropical cyclones. Basically the climate of India is dominated by the south west monsoon season which accounts for about 75% of the annual rainfall. The extreme weather events occur over India are: Floods, Droughts, Tropical Cyclones, Heat Waves and Cold Waves, Storms Surges, Hail Storms, Thunderstorms, Dust Storms. Floods, droughts and tropical cyclones have specific significance as far as India is concerned.

Floods and droughts are the two sides of the weather phenomena. The floods have affected India in the same manner as droughts and have similar frequency. The worst flood year according to ranking is 1961, when 57% of the country was affected. In October 1924, floods in upper Ganga and Yamuna caused serious damage to Uttar Pradesh and Punjab affecting 13,080 sq. Km of area. About 110 persons and 1 Lakh cattle were drowned and 242,400 houses were washed away. An Intense Rainfall Event (Rainfall > 10 cms in day is called an Intense Rainfall Event) of 50 inches was recorded in July 1943 on the hills of Mewar and Merwara. Unprecedented flood in Ajmer and Merwara devastated 50 villages and took a toll of 5000 lives (De et al., 2005). Severe Floods occurred to Godavari and Tungabhadra rivers in the last week of August 2000. During this flood, 131 persons died in Andhra Pradesh, 5368 cattle lost, and around 1 Lakh people were rendered homeless. During July 2003 severe floods occurred to Brahmaputra and its tributaries. In Assam state alone, 38 persons died, 52, 35, 092 people in 4962 villages were affected. Standing crops in 2,13,184 hectares of land were badly affected.

Of all the major natural disasters, droughts account for significant damages even though the number of deaths is insignificant. An analysis of monsoon droughts by Sikka (1999) has brought out the following facts. The droughts exhibit an epochal nature. During the period 1921-1964,

there were only two moderate droughts in the years 1941 and 1951. Droughts were more frequent during the epochs 1890 to 1920 and also from 1960 to 1990. During the past 125 years phenomenal droughts on the all India scale were only four. These years were 1877, 1899, 1918 and 1972, when the seasonal rainfall deficiencies were more than -26% below the seasonal mean rainfall. .

During the early years droughts were associated with considerable loss of life and property. During 1877, 1899 and 1918 the occurrence of famine and scarcity conditions prevailed over most parts which resulted in deaths of thousands of persons. In recent years, better distribution system and buffer stocks have helped in reducing the adverse effects of drought. The management of drought have been quite systematic and mitigation measures taken in the years 1982 and 1987 have saved many lives. The estimated loss of crops and live stock in the country in 1982 and 1987 were Rs 5,000 and Rs 110 crores respectively (De et al., 2005).

One important phenomena which we feel can contribute to the drought conditions can be the break in monsoon conditions. During the monsoon season, it does not rain the same way throughout the monsoon season (1 June to 30 September), some days it rains heavily, some days the rainfall over the Indian subcontinent is quite weak and some days, the rainfall over the Indian subcontinent is below 9 mm/day for 3 consecutive days or more in the peak monsoon months of July and August. We call these events as break in monsoon conditions. During the break in monsoon conditions the rainfall over Indian subcontinent decreases substantially

Ramesh Kumar (2009) has found that there is an increasing trend in prolonged break in monsoon conditions over the Indian subcontinent during recent decades. Their study found that the vertically Integrated moisture transport into the peninsular India decreasing during recent decades. The sea surface temperature (SST) over the Eastern Equatorial Indian Ocean (EEIO) was found to have increased by about 1^o C from 1951 to 2008, indicating the significant rise in SST over this region. This substantial rise over the EEIO has weakened the Monsoon Hadley Cell circulation and also weakened the Tropical Easterly Jet at 150 hPa and the low level Jet stream at 850 hPa over the tropical Indian Ocean. Thus they feel that is the Ocean Atmosphere processes over the Indian Ocean play an important role in the break in monsoon conditions over the Indian subcontinent.

Abnormal monsoon occurred during the year 2009 requires specific attention. The onset of summer monsoon of 2009 took place on 23rd May over Kerala almost 8 days ahead of schedule (1st June, being the normal onset date). But, the amount of monsoon rainfall received over the Indian subcontinent, was one of lowest in recent decades a deficiency of 23% — making it the worst season since 1972, when the deficiency was 24%. During the monsoon 2009 season (1st June to 30th September), out of the 533 meteorological districts, 8 % (41 districts) recorded “scanty” rainfall (deficiency of over 60 per cent), and 51% (270 districts) recorded “deficient” rainfall (deficiency of rainfall between 20 and 59 per cent). The northwest homogenous region comprising Delhi, Haryana, Punjab, Chandigarh, Uttar Pradesh, Uttarakhand, Himachal Pradesh, Jammu and Kashmir and Rajasthan top with a deficiency of 36%, followed by the northeast region — which includes Bihar, West Bengal, Sikkim, and Jharkhand, apart from the northeastern States — with a deficiency of 27%. Central India, which comprises Maharashtra, Gujarat, Goa, Madhya Pradesh, Orissa and Chhattisgarh, occupies the third place with a deficiency of 20%. The south peninsular region, comprising Tamil Nadu, Pondicherry, Andhra Pradesh, Karnataka, Kerala, Lakshadweep, and Andaman and Nicobar, brings up the rear with a deficiency of four per cent from the normal.

Tropical cyclones (TC) are among the most destructive natural disasters of the world. About 7% of the global tropical cyclones form in the north Indian Ocean. Further, more number of cyclones form in the Bay of Bengal (about three to four times higher) than in the Arabian Sea. In the north Indian Ocean, there are two important seasons for their formation, namely, a) Pre-monsoon (March- May) and b) Post monsoon (October- December). There have been conflicting reports on the role of climate change on the frequency, intensity and tracks of Tropical Cyclones (TC) over different ocean basins, namely, Atlantic, Pacific and Indian Ocean.

The complex societal structure and socio – economic issues in the developing countries make the impacts of the TC’s far more disastrous than the developed countries. Strong winds, heavy rainfall and storm surge associated with TC’s are responsible for the devastating damages. The damage and destruction caused by TC do not seem to decrease over the years. However, loss of life has decreased substantially as a result of improved weather forecasts and

warnings, their effective and timely dissemination and disaster management strategies put in place. Owing to the improved weather forecasting ability there has been a gradual decline in the number of human casualties. E.g. the human toll during the Chirala cyclone in 1977 was 10,000 while that during the Kakinada cyclone in 1996 was only 978 (De et al., 2005).

Some of the most disastrous tropical cyclones of the 20th Century include the Orissa Super cyclone (October, 1999), Kandla Cyclone (1998), Porbandar Cyclone (1976) and Bombay cyclone (1948). The super cyclone of 1999 and Bangladesh cyclone of 1970 are the most well documented of all the tropical storms. The super cyclone of 1999 was one of the most disastrous ones in recent years. The storm hit the Orissa coast 20 km east of Paradip on 29th October, 1999. The storm surge recorded at Paradip was 8-10 m high. The inundation due to tidal waves extended up to 60 Km in the coastal belt from Paradip to Balasore, causing devastating destruction. The storm remained stationary for nearly 24 hours northeast of Bhubaneswar. It caused wide spread damage to property worth crores of rupees (De et al., 2004).

Recent study of Ramesh Kumar and Syam (2010) shows that the relationship between the SST and the maximum wind speed is quite complex and there is no preferred range for the formation of cyclonic or severe cyclonic storms over the north Indian Ocean. Results clearly indicate that warm SST’s alone are not sufficient for the initiation of convective systems over the Arabian Sea and the Bay of Bengal. However, other environmental parameters, such as the low-level vorticity, the mid tropospheric humidity and the vertical wind shear between lower (850 hPa) and upper troposphere (200 hPa), all play an equally important role in their genesis and intensification.

Natural hazards are inevitably increasing throughout the world. Part of the increase in the number of reported extreme climatic based disaster may be due to better techniques of reporting and communication mechanism developed by modern science. However, according to the report of United Nations Environment Program (UNEP 2008) the fact remains that analogous increases in reports has not been taken place in relation to other types of disasters like the number of reported earthquakes.

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