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Recent floods related natural hazards over West coast and Northeast India

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ABSTRACT
The severity of the weather, which manifest in the form of floods and landslides on account of rainfall, has a substantial impact on life and properties. In view of these, an attempt is made in this paper to study the economic damage and human casualties associated with floods that occurred during the period 1971-2005 over two specific zones i.e. northeast and the west coast regions of India. For this study, data from Disastrous Weather Events, Weekly Weather Reports and "Weather in India" published by Indian Meteorology Department during the above mentioned period have been analyzed. The study reveals that flood frequencies and associated human casualties and economic losses have increased in the recent decade.

INTRODUCTION

We live in a world that is exposed to the vagaries of severe and unusual weather. Natural disaster and severe weather events have a close link because all severe weather events, due to climate change or otherwise could and often lead to natural disasters that occur on varying time and space scales. Disaster may strike any country but the greatest burden falls on less developed countries and their highly populated regions. Despite developments in all fields of socio-economic activity we have not succeeded in insulating the population from their effects (De 2004). The severity of the weather, which manifests in the form of floods and landslides on account of rainfall, has a substantial impact on life and property.

Northeast India and west coast are the two major disaster prone regions of India because of their unique geographical locations and physical features, witnessing the fury of monsoon. The summer (southwest) monsoon influences both these region from June to September contributing more than 80% of the annual rainfall. During this season major floods occur that often lead to disaster. A flood is an extreme event, having major impact on humanity and also on the environment. As extreme events deviate beyond the threshold of tolerance, they create a progressively greater potential for disaster. The physical and socio-economic impacts of disaster are complex, depending upon the vulnerability of the place of occurrence as well as the mitigation strategies. The vulnerability of the people to the extreme weather events seems to be increasing every year in terms of change in frequency and adversely affecting the people. And therefore, the studies related to climatic change and extreme weather events have received increased attention in the last few years. Several researchers (Sharma 1997; Dhar & Nandargi, 2000; Pielke & Downton Mary 2000, Szlafsztan 2001; De 2004) reported the genesis of flood hazards and attributed it to the social, natural, climatological and synoptic factors. Historically, floods have produced the greatest death tolls than any other natural hazards (Bryant and Allen Perry, 1997).

The two regions under study receive copious rainfall during the monsoon season that might cause not only deaths but also destructions to the properties. Therefore, an attempt has been made to take a closer look at the facts if flood related deaths and destructions have increased in the recent decade along with the trend/ variability that associated with synoptic system.

DATA AND METHODOLOGY

In order to study disaster caused by floods, 6 meteorological sub-divisions; 3 each in the northeast region (Arunachal Pradesh; Assam and Meghalaya; Nagaland, Manipur, Mizoram and Tripura) and in the west coast region (Konkan and Goa; Coastal Karnataka and Kerala) were selected. The data are collected from the report on Natural hazards in the Disastrous Weather Events, Weekly Weather Reports and "Weather in India" published in Mausam, (1971-2005) IMD. Though the study considers the disaster in all the seasons, the main focus is during the rainy season. The sub-divisional monsoon rainfall from 1971-2006 provided by IMD, was used to find out the trend in rainfall of each sub-divisions.

RESULT AND DISCUSSION

The below table indicates that there is an increase in the flood frequency, causalities and economic losses during the last three decade over both the regions. It was observed that in the northeast region June recorded highest floods while for the west coast it was July (Table.2).

Table 1. Flood frequency, casualties and economic damages for the period 1971-2005 are reported.

Northeast region				West coast region					
Decade	Assam (flood freq)	causalities	Economic losses (Rupees in Crores)	Konkan /Goa (flood freq)	Coastal Karnataka (flood freq)	Kerala (flood freq)	Total (flood freq)	causalities	Economic losses (Rupees in Crores)
1971-1980	47	572	6.3	26	15	32	73	571	1.7
1981-1990	50	1152	165.1	49	10	41	100	827	319.21
1991-2000	76	3251	55.1	60	23	82	165	2486	675.7
2000-2005	38	1174	*NA	15	7	23	45	1468	601

*NA-Not available

Table 2. Monthly frequencies of flood during the southwest monsoon.

Northeast region				
Sub-division	June	July	August	September
Assam	45	41	39	30
West coast region				
Konkan/Goa	43	48	22	14
Coastal Karnataka	13	21	14	2
Kerala	43	47	27	9

However, the sub-divisional monsoon rainfall data for these two regions do not indicate significant increase in rainfall. Since intensity of rainfall plays crucial role in the occurrence of floods particularly flash floods, monthly extreme rainfall for these regions were analyzed. The analysis reveals significant increase in the extreme rainfall (Fig 1).

The paper also attempts to find out the synoptic component associated with heavy rainfall occasions accordingly major flood events for those two regions have been indentified (Table 3).

Aizawl from the northeast region reported a loss of 106 lives from landslide that occurred on 9-10th August 1992. This was not only due to the heavy rains of this period, but also as a consequence of another heavy spell that happened in the preceding week on 1st and 5th of August with 370 mm and 320 mm of rain respectively. The month average rainfall (304 mm) took place in a single day creating favorable condition for landslide.

The severe flood over Kerala with a death toll of 250 was due to the recorded rainfall of 130 mm and 110 mm at Kottayam and nearby area on 3rd and 9th October respectively. This was due to the influence of a well marked low pressure over Madhya Pradesh with its extended trough running till Kerala coast extending up to mid-tropospheric level.

Dakshin Kannad which lies mid-way between Konkan and Kerala coast within the west coast region reported the loss of 34 people and economic damage worth of 11.35 Crores on 2nd week of October 1993 (Table 3). During the 1st week of October there was heavy rain with stations Kollam reporting 110 mm while Bajpe recorded 350 mm of rains, this was due to the combined effect of a trough extending from south Maharashtra to Karnataka coast with a cyclonic circulation extending up to mid-tropospheric levels over Maldives, this in turn supported a low pressure over coastal Karnataka.

The heaviest devastation in terms of loss of life

and economic damages due to landslide was reported from Arunachal Pradesh in the northeast region. During the period 11-16th June 2000, 2,026 people lost their lives and extensive economic damages amounting to 1.5 crores was reported in East Siang, Upper Siang, lower Subansiri and Lohit (Table 3). About 146 mm of rain was received at Pasighat on 9th June followed by another spell of 88 mm on the next day. This catastrophe was due to the combined effect of cyclonic circulation extending up to 0.9 km a.s.l over Bangladesh and its neighborhood with a sea level trough that extended from Himachal Pradesh to

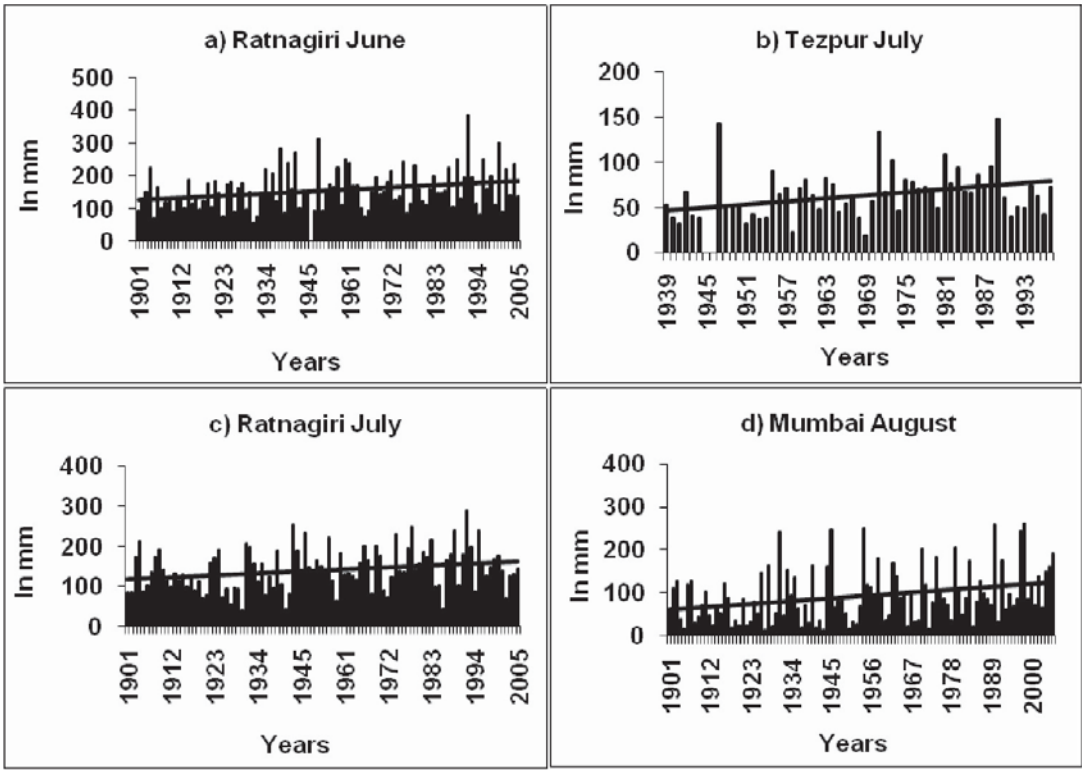

Figure 1. Yearly march of extreme rainfalls at selected stations during the monsoon period.

Table 3. Occurrence of major flood events.

Sub-divisions	Year	Rainfall in mm	Deaths	Amount of properties destroyed
Aizawl (Nagaland, Manipur, Mizoram, Tripura)	9-10th Aug 1992	690 mm	106	*NA
Allapuzha, Kollam & Trivandrum (Kerela)	10-11th Oct 1992	240 mm	250	*NA
Dakshin Kannad (Coastal Karnataka)	1st week Oct, 1993	460 mm	34	11.35 Crores
East Siang, upper Siang, and Lohit (Arunachal Pradesh)	11-16th June 2000	234 mm	2,026	1.5 Crores
Assam (Assam/Meghalaya)	1st week Oct 2004	722 mm	500	*NA
Mumbai & neighborhood (Konkan/Goa)	25-27th July 2005	944 mm	927	450 Crores

*NA-not available

northeast Assam.

Even though monsoon season of 2004 was deficient for northeast region, 500 people were washed away by flash floods in the 1st week of October in the state of Assam. The disaster was due to the formation of an upper air cyclonic circulation extending up to 2.1 km over Assam and its neighborhood. This has resulted in heavy rainfall of 258 mm on 7th and 464 mm on 8th at Guwahati and Shillong respectively.

At Mumbai on 25-27th July 2005, 927 people perished and total amount of properties damage worth of 450 crores was reported. The synoptic causes for Mumbai deluge were the development of low pressure over the northwest Bay of Bengal, intensification of monsoon trough, presence of embedded convective vortices over central India, accompanied with a strong monsoon current from Arabian Sea, strong vertical circulation anomalies over Maharashtra and Gujarat regions along with the meso-scale off-shore vortex over Mumbai and its neighboring areas. This caused highest ever recorded rainfall of 944 mm at Santa Cruz on 27th July.

Generally chances of prevalence of high floods were observed when monsoon rainfall was high in the country viz., 1988, 1989, 1993, 1995 and 1998. However, there were occasions of floods even during the drought years e.g., 1972, 1974, 1979, 1982, 1985, 1987, 2000 and 2002. This might be due to the spatio-temporal variations in southwest monsoon in India. The present study reveals that the rise in casualties and economic losses are related to increase in flood frequency. This result is similar to that obtained by Dutta (2003) indicating that economic loss and human casualties from flood events have shown increasing trend in Asia. The increase in flood frequency during the recent years is associated with heavy rain spell from cyclonic circulations, sea level troughs, off shore troughs, active to vigorous monsoon conditions, low-pressure areas, low-level troughs, mid-tropospheric cyclonic circulations and east–west oriented troughs.

CONCLUSIONS

The above study reveals that meteorological conditions and physiography of the study areas make them vulnerable to floods during the summer monsoon season. Further, unsustainable land use such as rapid urbanization and deforestation may be responsible for increasing floods damage and related death (De et al, 2005). The analysis presented in this paper leads to the following conclusions:

Synoptic factors and physiographic features are significantly related to death and damages in the northeast and west coast regions of India.

Extreme rainfall during the monsoon months might be responsible for increasing the flood frequencies.

The study suggests that much of the flood related damages in recent decades might be due to the increased frequency of extreme weather events, for which measures are to be taken to reduce flood vulnerability, through proper land use planning following a sustainable development strategy.

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