

## Impact and Analysis of Natural Hazards and Disasters in India

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### Introduction:

Natural hazards are phenomenon which occur suddenly and swiftly and consequently cause harm to the people and their property. They pose a major threat to large parts of the world. Though they are not new to mankind they have been struggled these since time immemorial. In fact; natural hazards are phenomena of nature. The indiscriminate exploitation of nature, in the name of development, has caused and increased the incidence of natural calamities / hazards leading to catastrophe.

Vulnerability of disasters is closely linked to population and economic resources. World Health Organization defines disaster as 'any occurrence that causes damage, economic destructions, loss of human life and deteriorations in health and health services on a scale sufficient to warrant an extraordinary response from outside the affected community or area'. Globally, natural disasters affect nearly 80 percent people and on an average, 200 million people per year.

During last three decades about 8320 disasters were occurred. When Continent wise Proportion of disasters were estimated Asia accounts for 37.35 percent followed by Americas, 23.14 percent, Africa, 19.61 percent, Europe 13.39 percent, and Oceania 6.52 percent. Human losses account for 2.19 million and estimated as 57.19 percent in Asia, followed by 32.01 percent in Africa, 8.25 percent in America, 2.33 percent Europe and 0.22 percent of persons in Oceania. Affected population was about 5342.3 millions, and estimated as 88.87 percent in Asia, 7.24 percent in Africa, 2.95 percent in Americas, 0.57 percent in Europe and 0.37 percent in Oceania. Economic loss estimated accounts for Asia 550.6, Africa followed by 18.79, America as 449.38, Europe 207.52 and Oceania 24.50 million US \$ Dollars respectively.

Phenomenon wise out of 8320 disasters 30.65 percent were floods, 26.08 percent wind storms, 10.0 percent Earthquakes, 7.31 percent droughts, 5.07 percent landslides, 3.68 percent Extreme temperature, 1.74 percent volcano and 15.47 percent other disasters. Human losses accounts for 2.189 millions i.e. 27.89 percent Earthquakes, 25.79 percent Droughts, 13.53 percent Windstorms 10.77 percent Wave surges, 9.11 percent floods, 7.61 percent Epidemics, 2.73 percent Extreme Temperature, 1.17 percent volcano's and 1.4 percent by other persons.

Affected population (53423.24 million), 50.78 percent due to floods, 33.08 percent of the total droughts 11.86 percent due to windstorms, 4.28 percent other phenomena's. Estimated Loss of Damage was, 35.06 percent by wind storms, 28.01 percent by Earthquakes, 27.30 percent due to floods, 4.47 percent by Drought, 2.32 percent through wild fires and 2.84 percent by others disasters value in US \$ 1250.85 million respectively. (Source CRED- EMDT University Catholique de Louvain, Brussels, Belgium, 2005).

The G.D.P (Gross Domestic Product) in hazard zones is subject to potential losses of type of hazard where population exposed and the resources exposed. Out of 89 countries ranking of cyclone 7.608 million estimated as 4th rank and G.D.P was about (billions US\$) 5.78, and estimated as 9th rank were similarly drought was affected to 58.912 million and estimated as 2nd ran out of 184, flood affected with 15.86 million population ranked as 2nd and flood. With 9:39 millions ranked as, 4th Out of 162, landslides affected countries landslides 180,254 2nd and land slide 1.07 9th out of 162, earthquake 3,349,237 persons 8th and earthquake 21.00, 25th out of 153, Tsunami 1,114,388 persons 4th and 0.64, 16th out of 265 countries of world.

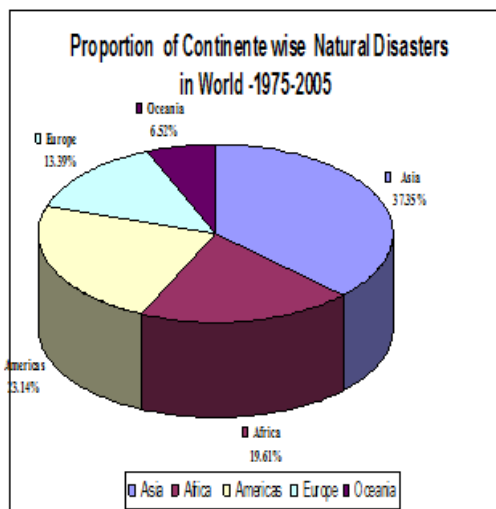
**The Problem Setting:**

The causes of these disasters may be attributed not only to geophysical and hydro-meteorological conditions that are potential sources of hazards, but also to the anthropogenic tampering with the natural phenomena. The role of the natural and human factors responsible for disasters associated with earthquakes, cyclones, floods and droughts etc.

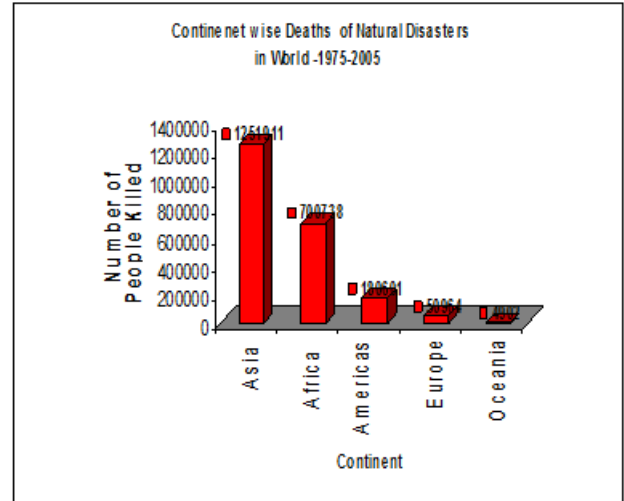
India with its vast territory, large population and geoclimatic conditions, is one of the most disaster prone countries in the world. In the last few decades the country has experienced many extreme hazardous events that have turned into disasters. India suffered enormous loss of lives, livelihoods and damages of public property.

As there is no sufficient organized information system on availability of resources for disasters response at district and national levels Government agencies have faced problem in mobility equipments and skilled human resources to respond immediately to emergencies. Thus there is an immediate need for collection of all resources available starting from village level to national level for better disaster preparedness.

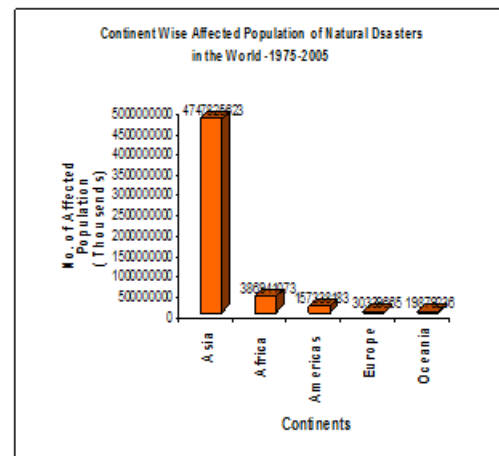
**Fig-1**



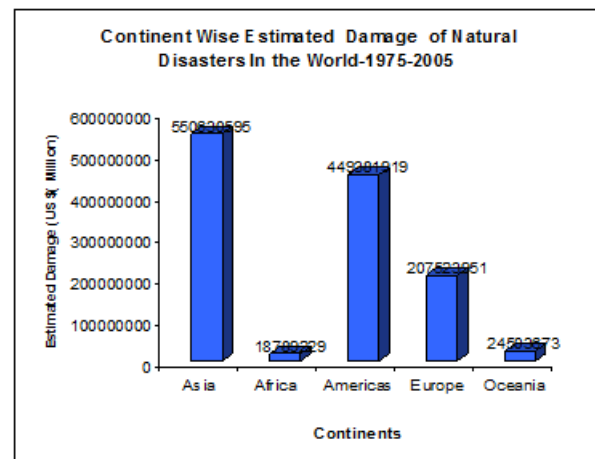
**Fig-2**



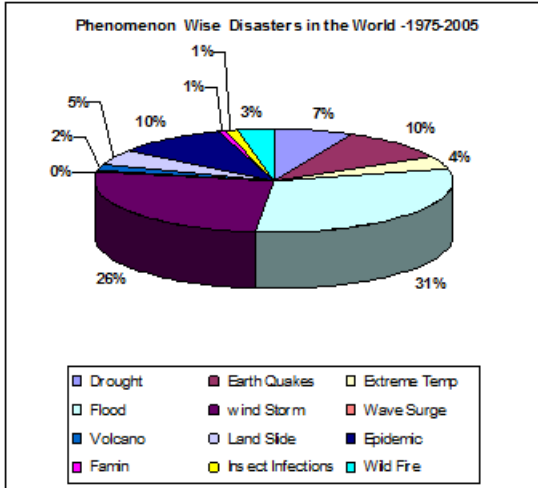
**Fig-3**



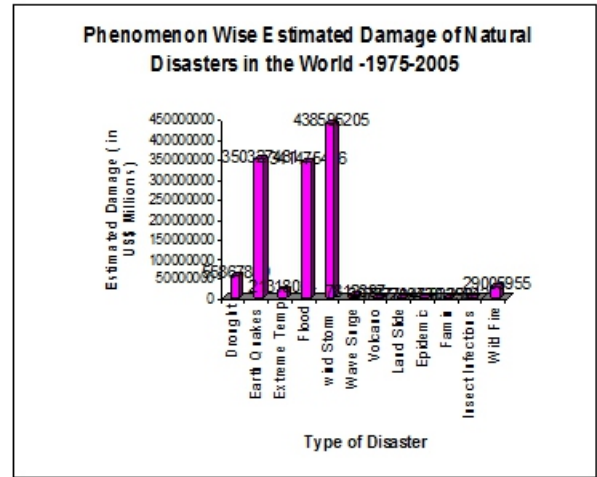
**Fig-4**



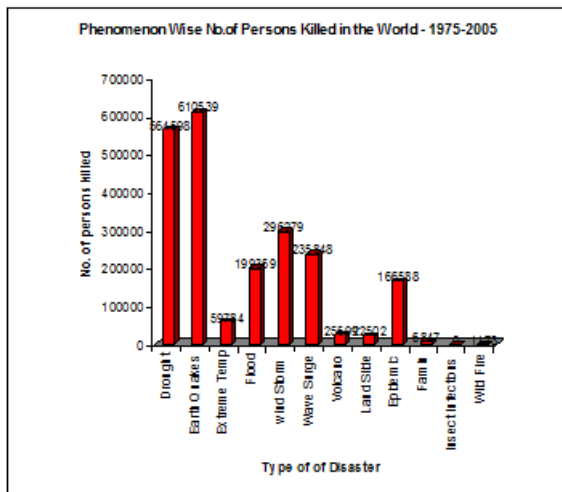
**Fig-5**



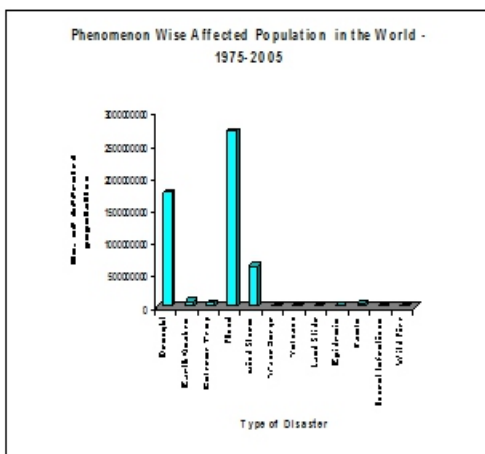
**Fig-8**



**Fig-6**



**Fig-7**



**OBJECTIVES:**

- To examine the trends between 1900-2011 loss of natural Disasters (Cyclones, Floods, Earthquakes, Tsunamies and Droughts) of the country.
- To describe the state wise frequency of occurrence natural disaster in the country
- To identify the causes, measures to minimize in reducing the losses of the country.

**LIMITATIONS:**

1. The analysis of Natural Disasters (cyclones, Floods -1900- August 2006, Earthquakes and Drought1900-2005) weather and geological related disasters were only considered...
2. Frequency of cyclones between 1891-20011 floods 1953-2011 droughts1875-2011, Earth quakes 1900-2014 were included in the analysis.
3. The Analysis of Natural Disasters on the basis of Available data (Human and Economic Losses, Affected population Livestock. And Damage of Crop Area).interpreted.

**Methodology:**

The Present study is based on secondary data at the country level. The data pertains to the century (1900-2011.)

India is highly vulnerable to droughts, floods, cyclones, avalanches, forest fires and landslides. Out of 28 states / 7 union territories, 22 states & 5 Union territories are disaster prone. In India 16 percent of the land is prone to drought, while 12 percent to floods, 57 percent to Earthquakes, 8 Percent to Cyclones, and 3 Percent to landslides. Out of 27 disaster prone states / union territories, 6 states such as Gujarat, Andhra Pradesh, West Bengal, Assam, Tamilnadu, and Himachal Pradesh are prone to four disasters i.e. Earthquakes, cyclones and storms, floods and drought, while nine states (Orissa, Uttar Pradesh, Rajasthan, Maharashtra, Punjab, Delhi, Kerala, Madhya Pradesh and Karnataka) face three types of disasters i.e., droughts, cyclones and floods or droughts, earthquakes and floods. Eleven states (Arunachal Pradesh, Bihar, Haryana, Jammu & Kashmir, Meghalaya, Nagaland, Chattishgarh, Uttaranchal, Sikkim, Pondichery, Manipur, Andaman Nicobar Islands) two types of disasters i.e. droughts and floods or Earthquake, Droughts or Cyclones or Earthquakes and Floods and six states two union territories (Goa, Jharkhand, Mizoram, Tripura, Puducherry, Lakshadweep) are prone to single disaster's cyclones or floods. There has been an increasing trend in life and property loss due to natural catastrophes. The risk is the combination of the probability of an event and its negative consequences. This risk profile is an analysis of the mortality and economic loss risk for three weather-related hazards: Tropical cyclones, floods and landslides. In addition, new insights have been gained into other hazards such as droughts, earthquakes, and tsunamis... Droughts:

Droughts occur in all parts of the world. Due to monsoon failure, it is a natural phenomenon of all the major natural disasters, droughts account for nearly worldwide 22.5% of significant damages though the number of deaths is only 3% (De & Joshi 1998). The earliest history of drought and famine in India was found in the Rig-Veda, the Mahabharata, the Jataka tales of the Buddhists and Chanakya's Arthashastra. Marwar (Jodhpur State) faced drought and famine from 1309 to 1313 AD during the reign of Rao Rajpal. Later in 1570 AD, Emperor Akbar dug the Kukar Talao in Nagaur. Most parts of the country were ravaged by famine in 1783, remembered as Chalisa. The famine of 1812-13 is referred to as Paschal. The 1848 famine led to mass migration from Ajmer in Rajasthan.

The State was struck again in 1868-69, 1877-78, 1891-92, and 1899-1900. India experiences drought every second or third year. In desert areas, droughts are long and sometimes stretch for many years. In the past 106 years (1900-2005) there were 37 drought years, of which 5 were severe (>39.5% area affected) and 4 phenomenal (>47% area affected). Out of 28 states / 7 union territories, 593 districts, 16 states (namely, Andhra Pradesh, Bihar, Jammu & Kashmir, Karnataka, Maharashtra, Madhya Pradesh, Orissa, Gujarat, Haryana, Himachal Pradesh, Tamilnadu, Uttaranchal, Jharkhand, Chattishgarh, Rajasthan, UP) frequently drought faced were 116 districts. At present 208 districts were identified and estimated as 16 percent of the country's total area is drought prone and approximately 50 million people are annually affected by droughts. About 68 percent of total sown area of the country is drought prone and the drought-prone areas identified by government of India lie mostly in the arid, semi-arid and sub-humid area of the country.

On average 28% of the geographical area of India is vulnerable to droughts meteorologically + 19% deviation of rainfall from the long-term mean is considered normal. Deficiency is in the range of 20 to 59% represents "moderate" drought and more than 60% "severe" drought from 1900 to 2002. Out of 37 droughts (Drought India has witnessed 20 major droughts year 1901, 1904, 1905, 1911, 1918, 1920, 1941, 1951, 1965, 1966, 1968, 1972, 1974, 1979, 1982, 1985, 1986, 1987, 2002 and 2009), four of them were severe (1918, 1965, 1987, 2002).

The present analyses are based on an average of nearly 76.35 million hectares of area and 124.266 million populations which are affected in earlier drought years in the country. In India, frequency of drought occurrence over different meteorological subdivisions are observed and according to in Assam & NE region occur roughly i.e. once in 15 years, West Bengal, West Madhya Pradesh, Coastal Andhra Pradesh, Konkani, Maharashtra, Kerala, Bihar & Orissa are once in many years, while in Sikkim, East Rajasthan, Vidarbha, Gujarat, East & West UP occur once in 4 years, in Tamilnadu & Jammu & Kashmir occur once in 3 years, where as in Rayalaseema, Telangana, West Rajasthan occur in every alternative year. Average frequency of occurrence of drought has been recorded once in 3 years in earlier years in India.



During The 136 years (1875- 2011) major drought and no. of minor droughts of occurred in the country. Among the states and union territories , highest frequency of occurrence drought situations was recorded in Rajasthan ( 34) followed by Gujarat, Jammu & Kashmir(27) Andhra Pradesh ,(23) Punjab , Haryana ,Himachal Pradesh , Delhi(22) Maharashtra ,(19) Uttaranchal , Andaman Nicobar Islands (17) Uttar Pradesh , Madhya Pradesh ,(14) Manipur , Nagaland Lakshadweep (13) Tamilnadu, Mizoram , Pandicherry , Tripura(12) Karnataka (11) Bihar , Kerala Chattishgarh(10 ) West Bengal , and Goa (9) Orissa, Jharkhand ( 6) Assam (3) and Meghalaya(2) respectively, other remaining states are prone free activity of droughts .

A Study of Droughts during the last 111 years in India shows that all kinds of lossless , Human losses 28.004 lakh persons dead , 1988.26 million people are affected , Live stock 792.02 millions are affected , 1499 million hectors cropped area damaged . The economic losses 7194. 25 crores , Average drought loss 783.59 lakh hectors of crop land , 124.27 million people , 15.84 million livestock , 7441 thousand persons are dead in the Country. Probability of Occurrence of Droughts, Cyclone flood, earth quake Risk Map

Fig-10

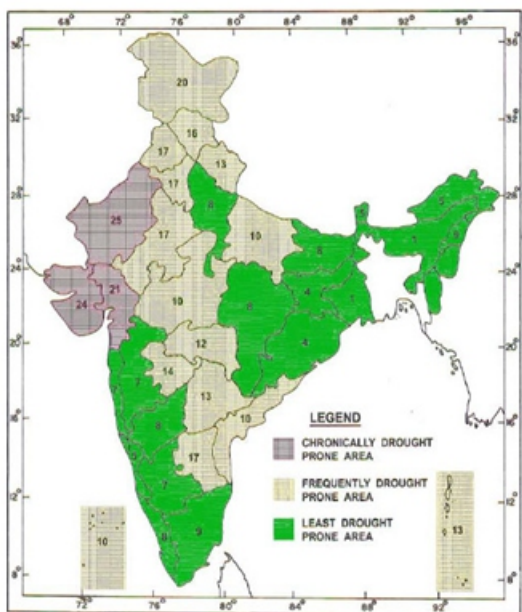
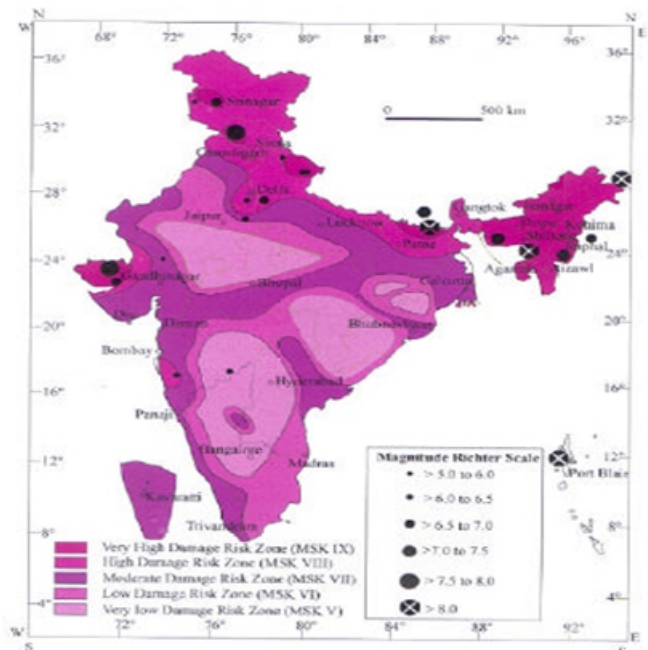


Fig-11



Source: Surinder Kaur Drought (India)(IMD)

Fig-12



**Fig-13**



**Source :** Fig-11,12,13 From Financing Disaster Management In India,(13th Finance Commission)National Institute of Disaster management-2009

### Cyclone:

A cyclone is a non-frontal storm system that is characterized by a low pressure centre, spiral rain bands and strong winds. Usually it originates over tropical or subtropical waters and rotates clockwise in the southern hemisphere and counter-clockwise in the northern hemisphere. (Source: CRED). Cyclones are very frequent in various parts of the World. Cyclones occur most frequently over the Northwest Pacific, over the southern end of the Bay of Bengal, east of India and south of Bangladesh (UNESCAP and ADB 1995, Ali 1999, Huang 1999, Kelly and Adger 2000).

The most damaging oceanographic episode that coastal residents can face is a cyclone with a combination of wind, waves, surge and rain. Tropical Cyclones are among the most destructive natural disasters of the world. In India metrological information shows that more than 1000 cyclonic disturbances occurred in the bay Bengal during the last century<sup>1</sup> among which over 500 were either depressions or deep depressions and over 400 were either cyclonic storms or severe.

The east coast of India has been affected by a minimum of four high intensity cyclones every year for the past hundred years Ex: Orissa super cyclones 1999. India with a long coastline of 8041km is exposed to on average 5-6 tropical cyclones annually from the Bay of Bengal and Arabian Sea. About half of the Indian Boundary is surrounded by ocean and approximately 40 % of total Population Lives within 100 km ocean coast. Nearly 10 million peoples are affected in the country. The people living in the coastal regions of India are highly vulnerable to such cyclones.

Cyclones are usually located approximately 30 degrees above and below the equator. They vary in diameter from 50 km to 320km, but their effects dominate thousands of Square kilometers of ocean surface and the lower atmosphere. Cyclones in the coastal area of the country are the most disastrous natural calamity, claiming huge loss of life and property damage. These cyclones are created by intense low- pressure areas in the atmosphere, due to which wind blows with a very high speed in circular motion resulting into cyclones. Horizontally this area extends from 500-1000 km and vertically from surface to 12-14 km above.

The north Indian Ocean accounts for 7 % of global tropical cyclones<sup>1</sup> and due to this more cyclones form in the Bay of Bengal than the Arabian Sea; and the ratio of their respective frequencies is about 4:1. This is evident from the fact that in the last 270 years, 21 of the 23 major cyclones (with a loss of about 10,000 lives or more) worldwide occurred over the area surrounding the Indian subcontinent (India and Bangladesh). This is primarily due to the serious storm tide affected in the area. Thirteen coastal states and Union Territories (UTs) in the country, encompassing 84 coastal districts, are affected by tropical cyclones.

Four states (Tamil Nadu, Andhra Pradesh, Orissa and West Bengal) and one UT (Pondicherry) on the east coast and one state (Gujarat) on the west coast are more vulnerable to hazards associated with cyclones. According to the world meteorological organization, India accounts for 6 percent of the total number of cyclones world –wide. There are two cyclone seasons in the north Indian Ocean, Viz. Pre-monsoon (especially May) and Post monsoon (especially October and November) A few Cyclones from in transitional monsoon months June and September also.



On an average about 5-6 tropical cyclones (maximum sustained wind of 34 Knots or more) form in Bay of Bengal and the Arabian sea every year, of which 2-3 reach sever stage (maximum sustained wind of 48 knots or more) The Bay of Bengal accounts for 90 percent of cyclones with cyclones originating from Arabian sea surging themselves to Gujarat coast only. Over 58 per cent of the cyclonic storms that develop in the Bay of Bengal approach or cross the east coast in October and November.

Only 25 per cent of the storms that develop over the Arabian Sea approach west coast. In the pre-monsoon season, corresponding figures are 25 per cent over the Arabian Sea and 30 percent over the Bay of Bengal. In India Cyclone prone area covering 9 states namely Gujarat, Maharashtra, Goa, Karnataka, Kerala, Tamilnadu, Andhra Pradesh, Orissa and West Bengal and Union territory of Pondicherry besides islands of Lakshadweep and Andaman and Nicobar Islands and Die & Daman covers 8 percent of the total geographical area.

During the 120 years 179 cyclones and storms events recorded. In India states and Union Territories with highest frequency of occurrence of cyclones and storms situations was Andhra Pradesh ( 70) Orissa (53) Tamilnadu (40) West Bengal (35) Gujarat (20 ) Kerala (7) Maharashtra (6) Madhya Pradesh and Punjab (4) Assam , Karnataka and Pondicherry ( 3) Himachal Pradesh (2) respectively.

Some of the past and recent major Cyclones accrued in the century are 1935 Tropical Cyclone deaths 30,000 people , 1942 , Tropical Storm In Orissa and West Bengal killed 40,000 people, 1943 Rajputana tropical storm 5000 people were killed, 1971 tropical storm eastern coast of Orissa killed 9658 people, 1977 cyclone in Tamilnadu , Andhra Pradesh and Kerala 14204 People were killed, 29th October 1999 Orissa super cyclone 10,000 people were killed , 2003 cyclone storm deaths 44 persons, August and November 2006 cyclone storm and Ogni deaths 206 persons, 2008 Nisha, Khaimuk tropical Cyclone deaths 180 persons , 2009 Phyan, 2010 Jal, Laila , and 2011 Thane tropical cyclones. In India between 1891 – 2011 losses due to cyclones include 139121 persons dead , 1328.49008 million population affected 129.13 lakhs population homeless . 54.63 lakhs of livestock , 124.42568 thousands of houses damaged , 143.46 million hectars damage of crop land , 1367.98 crores Estimated Economic loss, .

## Earthquakes:

Earthquake is one of the most dangerous and destructive natural hazards. It occurs due to movements along faults that have evolved through geologic and tectonic processes. Often they occur without any prior warning and are therefore unpredictable. Among all the natural calamities, earthquakes are the most disastrous since their impacts can cover large areas causing deaths, injuries and destruction on a massive scale. The extent of the impact of an earthquake depends on its magnitude, location and time of occurrence.

Historically earthquakes have been recorded as early as 1177 B.C. in China. Of course earthquakes have been a part of myth and legend since the dawn of man. In Greek Mythology, Poseidon (Neptune in the Roman pantheon) was “God of the Sea”. Yet one of his powers was thought to be that of “earth shaker”. As a tsunami is often the result of an earthquake, this was an appropriate power for a sea god. Europe in 580 B.C, America 1811-1812 occurred near New Madrid, Missouri, San Francisco. In 1906, and great Alaskan earthquake of 1964, The Chilean quake of 1960. In India 1618 earth quake in Mumbai in which 2000 people lost lives , 1737 earth quake in Bengal ( That time Bangladesh was part of Bengal estimated loss 300,000. 16th January 1819 Kutch earth quake was of 8.0 on the Richer scale ( XI intensity on modified mercalli Scale ) Razed to the ground chief towns of Tera , Kathara, Mothala , 10th January 1869 Assam Earthquake of 7.5 richer scale ., affected area 250,000 square miles, 12th June 1897 Shilling earthquake was 8.7 richer scale, 4th April 1905 kanga earth quake in Himachal Pradesh was 8.0 richer scale human loss estimated 20,000 people , 1934 earth quake Bihar India ( near the Nepal Border ) was 8.3 Richer Scale, human loss 6000 people . other earth quake in Quetta ( Now part of Pakistan ) was 7.5 Richer scale and IX Modified Mercalli intensity ) human loss 25000 people, 1941 Earth Quake in the Andaman Islands was 8.1 on the Richer scale ( ix Modified Mercalli scale ), 1950 huge earth quake in Assam was 8.6 richer Scale earlier earthquake in Assam were in 1869( neighboring Shilling ) in 1897 and 1918 ) human loss 1500 people , 21st August 1988 in Assam was 7.2 Richer Scale ( I Modified Mercalli Scale Intensity ) 20 million people are affected , 1956 earth quake in Anjur in Gujarat was 7.0 richer scale XII Modified Mercalli Intensity.

The Asia – Pacific region alone has recorded 70 percent of World’s earthquakes measuring 7 or more on the Richter scale ,and at an average rate of 15 events per year(ESCAP<1995a) The countries of the region which are badly affected by earthquakes includes Japan , the Philippines, India , Nepal , Afghanistan, the Islamic Republic of Iran and the Pacific Islands. Many of the countries in the region are located along, or adjacent to the Pacific Ocean Seismic activities of varying Intensity (ESCAP1995a).

India has a large part of its land area liable to wide range of probable maximum seismic intensities where shallow earthquakes of magnitudes of 5.0 or more on Richter scale, have been known to occur in the historical past or recorded in the last 100 years. A catalogue prepared by the India Meteorological department (IMD) lists about 1200known earthquakes. According to this catalogue there are 8 earthquakes of  $M > 8.00$ , 43 of  $M 7.0-7.9$ , 312 of  $M 6.0-6.9$ , the rest of  $M 5.0-5.9$ .

About 56% of the total areas in the country are vulnerable to seismic activities of varying intensity. Approximately 400 million Populations are affected in the country. Most of the vulnerable area generally located in Himalayan and sub- Himalayan regions, Cambay, Ran of Kutch of western Gujarat, parts of peninsular India and the islands of Lakshadweep and Andaman Nicobar Islands.

Based on the available data on epicentres and years of occurrence of earthquakes ( $>5.0$  intensity) as per IMD catalogue of earthquakes, and expected maximum intensity of earthquake related seismo-tectonic features in different parts of the country as per studies conducted by the Geological Survey of India and the Department of Earthquake Engineering of IIT Roorkee, a seismic zone map of India has been standardized as per IS: 1893 -1984. As per this map the entire country has been divided into four seismic zones II to V, as below:

**Table: 1 Classification of States According to Seismic Zones**

Seismic Zone	Risk Zone	Intensity			States
		MSK	Rescale	Area	
V	Very High Damage Risk Zone	IX	8+	10.9%	Entire North East and parts of J&K, HP, Uttaranchal, Gujarat, Bihar and Andaman & Nicobar
IV	High Damage Risk Zone	VIII	7 – 7.9	17.3%	Parts of J&K, HP, Punjab, Haryana, Uttaranchal, UP, Bihar, Jharkhand, West Bengal, Gujarat and Maharashtra
III	Moderate Damage Risk Zone	VII	5 – 6.9	30.4%	Parts of Punjab, Haryana, UP, Bihar, Jharkhand, West Bengal, Orissa, MP, Chhattisgarh, AP, TN, Rajasthan, Gujarat, Maharashtra, Karnataka, Kerala, Lakshadweep.
II	Low Damage Risk Zone	VI	< 4.9	41.4%	Parts of Rajasthan, MP, Orissa, Chhattisgarh, Jharkhand, AP, TN, Maharashtra, Karnataka, Kerala.

Source: Financing Disaster Management in India a Study for the Thirteenth Finance Commission



Some of the recent major earthquakes occurred in the country are: 1991- Uttarkashi- Uttaranchal Pradesh, 6.6 Richter scale: 1993-Lathur – Maharashtra , 6.4; 1997 – Jabalpur - Madhya Pradesh, 6.0; 1999 Chamoli- Uttaranchal Pradesh 6.8; and 2001 Bhuj-Gujarat, 6.9 Richter scale., 8th October 2005 earth quake in Kashmir was 7.6 Richer scale human loss 1309 persons .

During the 113 years (1900-2014) 113 recorded, many no. of mailed earthquakes occurred in the country. Among the states and Union territories highest frequency of Earthquakes was Gujarat (22) Assam (13) Maharashtra (12) New Delhi (11maild ) Andaman Nicobar Islands (8) Uttar Pradesh and Sikkim (4) West Bengal , Bihar , Rajasthan Uttaranchal (3) Andhra Pradesh , Manipur (2) Arunachal Pradesh , Tamilnadu , Meghalaya and Himachal Pradesh (1) and Un identified areas (8) other remaining States are prone free activity of earthquakes.

The Country Experience an earthquakes in Average once in every year. Between 1900 – 2014 , 38 Earth Quakes were recorded Human Losses were estimated at 61724 persons and 201.03 million population are affected , 76, 600 persons becoming homeless and 161 634 livestock's loss , total economic losses estimated 4747 .00crores Tsunami :

Tsunamis are large waves generated by sudden movements of the ocean floor that displace a large volume of water. Although usually associated with earthquakes, tsunamis can also be triggered by many other types of phenomenon, including submarine or terrestrial landslides, volcanic eruptions, explosions or even bolides (e.g., asteroid, meteor, and comet) impacts. Tsunamis have potential to strip beaches, uproot plantations, inundate large inland tract, damaging life and property in coastal areas.

Indian coastal belt had not recorded many tsunamis in the past. The earthquakes of 1881 and 1941 over the Bay of Bengal had caused some damages in Andaman region. The earthquakes of 1819 and 1845 near the Ran of Kutch created rapid movements of water on Arabian Sea. The 1945 Mekran earthquake (Magnitude 8.1) generated tsunami of 12 to 15 meters height causing some damages in Gulf of Cambay and Mumbai. he Sumatra earthquake of December 2004 (Magnitude 9.1) caused widespread damages in large parts of Andaman & Nicobar, Tamil Nadu, Pondicherry, Andhra TPradesh and Kerala;

recorded human losses were estimated 16389 persons, 6, 55 Lakh population are affected, total economic losses estimated 1022800 thousands USD( Source.EMDATA).

### **Floods:**

After earthquakes, flood is the second most severe natural hazard affecting a large part of our country. India is the worst flood-affected country in the world after Bangladesh and accounts for one-fifth of the global death count due to floods. About 40 million hectares or nearly 1/8th of India's geographical area is flood-prone. River floods are most frequent and often most devastating and 12 percent of the country is prone to floods. 85 percent of country's average rainfall of 1200mm takes places within four months of monsoons. It's most frequent in the Gang- Brahmaputra- Meghan basin, which carry 60 percent of nations total river flow.

An estimated 8 million hectares of land are affected annually. The cropped area affected annually ranges from 3.5 million ha during normal floods to 10 million ha during worst flood. In India floods affect 21 States / union territories namely Andhra Pradesh , Arunachal Pradesh, Assam, Bihar, Gujarat, Himachal Pradesh Jammu & Kashmir , Karnataka, Madhya Pradesh, Punjab , Uttar Pradesh, West Bengal , Orissa , Maharashtra, Rajasthan , Tamilnadu Manipur , Meghalaya, Mizoram , Nagaland, and Andaman & Nicobar islands(U.T). Most flood prone spread 116 districts 11 States in the Country are most flood prone (Reported by Ashtray Bar Agog (RBA). Flood control measures consist mainly of construction of new embankments, drainage channels and afforestation to save 546 towns and 4700 villages.

During 1980 and 2011 about 235 flood situations occurred in various states of the country. Among the States and Union territories with highest frequency of occurrence of flood situation was Assam ( 38) Followed by Andhra Pradesh (33) Uttar Pradesh ( 32) Gujarat and Bihar (21) Himachal Pradesh and Tamilnadu (18) West Bengal (16) Jammu and Kashmir and Kerala ( 10) Punjab (9) Orissa (8) Madhya Pradesh (6) Tripura, Haryana , Karnataka and Rajasthan (5) Delhi and Sikkim (2) and Manipur , Chhattisgarh and Nagaland (1) respectively . The Country faces Annual Average Floods 4 Times in every Year.

**Table -2 Losses Due to Natural Disasters in India – 1900 -2011**

S.No	Particulars	Cyclones	Floods	Droughts	Earthquakes	Total
1	No. of Events	179	238	21	11361724	551
2	No. of Persons Dead	139121	97551	2800430	201.03	231.401
3	Affected Population ( millions)	1328.49028	1912.86	1988,675,000	76,600	5230.78
4	Homeless ( In Lakhs)	129,13500	N.A	----	---	12913500
	Loss of Livestock(lakhs)	54,63129	5699	7920,25000	161634	803187129
5	Damage of Crops ( Million hectares)	143,45 683	223.23	1499.01511	N.A	1865,70194
6	Damage Of Houses (000)	12442568	74034	-----	86816	12603418
7	Damage of Public Utilities( crores)	N.A	1101442.80	-----	N.A	110144280
8	Estimated Loss of Economic Cost ( In Crores)	1367.98	2129592.90 (million) 21295.93 Rupees	15487,22430 (USD) 7194.25(INR)	3321( million USD) 14944.5(INR)	44;802.65(IN R)

**Source:**

1. Central Water Commission,
- 2.www. Indian environ.stat com.: Environment Statistics, Central Statistical Organization.

**Note:**1 USD =45 rupees based Calculated , Drought Estimated Economic Losses were reported in the years1972,1973,2000 and 2002

**Table-3: State wise Frequency of Natural Disasters (Cyclones, Floods, Droughts, and Earth Quakes) in India**

sno w	Name of the State or Union Territory	Cyclones 1891 to2011	Floods 1953 to2011	Droughts 1875 to 2011	Earth Quakes 1900 to 2014	Total	Occurrence of Disasters type Each State
1.	Andhra Pradesh	75	33	23	2	128	4
2.	Arunachal Pradesh.	_	15	7	--	22	2
3	Assam	3	38	3	13	57	4
4	Bihar	---	21	10	--	31	2
5	Chattish Garh	---	1	10	--	11	2
6	Delhi	--	2	22	11(mailed)	35	3
7	Goa	---	---	9	---	9	1
8	Gujarat	20	21	27	22	90	4
9	Haryana	---	5	22	---	27	2
10	Himachal Pr.	2	18	22	1	43	4
11	Jharkhand	---	---	6	---	6	1
12	J & K	---	10	27	---	37	2
13	Karnataka	3	5	11	--	19	3
14	Kerala	7	10	10	---	27	3
15	Madhya Pradesh	4	6	14	---	24	3
16	Maharashtra	6	--	19	12	37	3
18	Meghalaya	--	---	2	2	4	2
17	Mizoram	==	---	12	--	12	1
20	Manipur	---	1	13	--	14	2
21	Nagaland	---	1	13	--	14	2
	Odessa	53	8	6	---	67	3
22	Punjab	4	9	22	--	35	3

	Rajasthan	---	5	34	3	42	3
23	Sikkim	---	2	---	4	6	2
24	Tamil Nadu	40	18	12	2	72	4
25	Tripura	---	---	12	---	12	1
26	Uttar Pradesh	---	32	14	4	50	3
27	Uttaranchal	---	---	17	3	20	2
28	West Bengal	35	16	9	3	63	4
29	A & N Island	N.A	N.A	17	8	25	2
30	Pondicherry	3	N.A	12	—	15	2
31	Lakshadweep	N.A	N.A	13	---	13	1
32	Others ( Un Identified)	---	---	--	8	8	1

**Source:** 1. climatologically features of Drought incidences in India, Climatology No: 21/2005  
2. Financing Disaster Management India, 13th finance commission.

In India between 1950 – 2011 losses Due to floods include 97,551 persons dead. 1912.86 million population affected, 5699 thousands of livestock loss 223.23 million s of hectares of crop land , 74034 thousands off Houses damaged , 1101442.80 million rupees of public utilities damaged , 2129592.90 million rupees estimated economic loss . annual average of losses 1653 persons human 3.68 million hectares of crop land area , 32.42 million population are affected 97 thousands of live stock loss , 1255 thousands houses are damaged economic losses estimated 36094.80 million rupees.

### Factors contributing vulnerability Cyclones:

- (i) Settlement located in low-lying coastal areas
- (ii) Poor Communication warning System

### Floods :

1. Excessive rainfall in catchments areas.
2. Intensive rainfall.
3. Poor natural drainage and interference of drainage system.
4. Cyclones and very severe rainfall.
5. River bank erosion and silt of river beds
6. In adequate capacity which in bank of the river to contain high flow.
7. Flash floods and mismanagement of the Traditional Tank System.

### Droughts:

- (i) Lack of seed and fodder reserves
- (ii) Low soil moisture retention
- (iii) Lack of water resources/ reserves
- (iv) Lack of alternative livelihoods

### Earthquakes :

- (i) Lack of proper warning System about Earth quakes.
- (ii) Structures which are not resistant to earth quakes.

### Risk reduction Measures:

The following risk reduction measures are suggested  
Cyclones

- (i) Improvement of vegetation cover along with coast line
- (ii) Identification and assessment of risk and hazard mapping.
- (iii) Land use control and flood plain management.
- (iv) Implementation of building codes

### Floods :

1. Improved hydro meteorological studies
2. Improvement of flood forestry and communication system
3. Maintenance & strengthening of embankments
4. Capacity building & training for personal of state and districts multi-hazard preparedness of response plan.
5. Identification of hazard prone region on the basis of historical & technical knowledge
6. Design of Engineering Technologies / specifications for various kinds of structures.
7. Conserving catchments areas is one of the most crucial aspects of water management.
8. More dams or the inter- linkage of rivers
9. Improving of water management and management of river areas.

### Droughts:

1. Soil – moisture conservation measures,
2. Water harvesting practices,
3. Minimization of evaporation losses



4. Development of the ground water potential including recharging and the transfer of surface water from surplus areas where feasible and appropriate.
5. Develop Pastures, forestry or other modes for increase of vegetation
6. Planning of water resources Development irrigation projects should be Priority of drought prone areas.
7. Implementation of Micro irrigation systems in Agriculture Sector.
8. Minimize the exploitation of Ground water.
9. Implement less water consumption and increase drought resistant crops cultivation
10. Development of drought & famine Early Warning System State / District / Manual and Village level.
11. Development of mitigation plans.
12. Skill development training programmers for youth in nonfarm sectors.
13. Encouragement to off farm & nonfarm sectors

### Earth Quakes:

- (i) Hazard mapping and zoning Identification of vulnerable areas.
- (ii) Creation of awareness among community and people in particular to enhance capacity building.
- (iii) Strict Implementation of Bureau of Indian standards to reduce structural Vulnerability.
- (iv) Proper land use control
- (v) Compulsory Insurance
- (vi) Best of earthquake warning and proper communication system.

### Conclusion:

India is prone to cyclones floods, droughts, earthquakes, and Tsunami disasters, and the damage and impacts are complex. These risks can be minimized with the integrated approach and disaster mitigation which can form an important segment of Planning for future action with timely taking preventive measures.

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