II. OVERVIEW OF NATURAL DISASTERS IN INDIA - TYPES, OCCURRENCES AND IMPACT

Today, it is not only believed that natural disasters are recurring more frequently but with greater intensity. Before we go into the further details as to why natural disasters are increasing in India, the statistics available show that

: The number of disasters per year is increasing.

: The number of people affected every year is increasing.

: The number of people killed in natural disasters every year is increasing.

: The natural disasters invariably become social disasters affecting mainly the poor living on marginal areas lands and underdeveloped areas

: In India, now all states demand central assistance for relief while only 8-10 states demanded disaster relief in the past.

: The amount of money sought for relief assistance is becoming disproportionate with planned expenditure thus reducing the finances available for planned disaster management and control.

: Disaster events have now become disaster processes. India is a major disaster prone country in the South East Asia Region.

It is important to have a relief overview of the Magnitude of natural disasters before giving the details and identification of the present areas of concern and state of disaster preparedness in this country. The dossier's focus is however on the 4 major forms of natural disasters, viz, droughts, floods, cyclones and earthquakes.

Droughts :

According to the National Commission of Agriculture (1976), droughts are of three types :

1) **Meterological Drought**: When there is a significant decrease (more than 25%) of rainfall from the normal rainfall in an area.

2) **Hydrological Drought** : When Metrological drought is prolonged resulting in marked depletion of surface water, consequent drying up of reservoirs, lakes, streams and rivers and also fall in ground water level.

3) **Agricultural Drought** : When soil moisture and rainfall are inadequate during the cropping season leading to stress, crop wilting and failure.

Out of the total geographical area of 329.3 million hectares, the arable land constitutes about 140 million hectares. The distribution of sown area under various ranges of rainfall is as given below :

(a) 33%	-	Low Rainfall Region	- 750 mm.
(b) 35%	-	Medium Rainfall Region	- 750-1125 mm
(c) 24%	-	High Rainfall region	- 1125-2000 mm
(d) 8%	-	Very High Rainfall Region	- 2000 mm

: **About 33 percent of the country which gets less than 750 mm of rainfall is severely drought prone.**

: **Another 35 percent which gets between 750-1125 mm. rainfall are in the transitional zone.**

: **About 68 percent of the country's cultivable area is drought prone because of the erratic distribution of rainfall.**

: **The district covered under the Drought Prone Area Programme cover a third of the country's land area and slightly less than one-third of the country's population.**

: **New districts are being added to the Drought Prone Area Programme mainly from semi humid and humid areas.**

: **1960s and 1970s witnessed an unusally large number of droughts and 1980s shows an even higher incidence of drought years according to Indian Meterological Department. The details are depicted in Table I below**

TABLE - I

DROUGHT YEARS IN SPECIFIC REGIONS

No. of Drought Years

Region	1951-60	1961-70	1971-80	1981-90	Total
Bihar Plateau	0	1	1	5	7
Bihar Plains	2	1	1	4	8
Western Rajasthan	1	3	3	7	14
Gujarat Region	3	1	2	5	11
Saurashtra & Kutch	1	2	2	5	10
Maharthwada	0	0	2	3	5
Orissa	2	2	5	6	15
Total	9	10	16	35	70

Shortage of rainfall should not solely be considered as the only basis of information for assessment of drought intensities. Several other factors such as temperature, wind velocity, soil texture, evapotranspiration, stage of crop growth and antecedent rainfall interact to produce the drought situation.

: **The data available indicates that there is practically no organisation which considers all the above-mentioned contributory factors while assessing the extent of drought intensity or adopting plans for intervention in drought-prone areas. Rainfall, as the only parameter of analysis of drought intensities, has yielded incorrect and incomplete information and thus a partial plan for drought intervention.**

As compared to other areas, the drought-prone tracts are more vulnerable to ecological degradation. leading to an increasing economic and social dependence.

: **Expenditure in Central Assistance to States for drought relief showed a marked increase especially after 1966-67.**

: **The Central assistance for some States for drought relief has far exceeded the assistance for the Plans.**

: **As the fluctuation in crop production in drought-prone areas is high due to irregular rainfall and other factors, it has a substantial impact on the country's food economy.**

The drought-prone areas, as identififed by the Government of India, lie in the arid, semi-arid and sub-humid areas of the country.

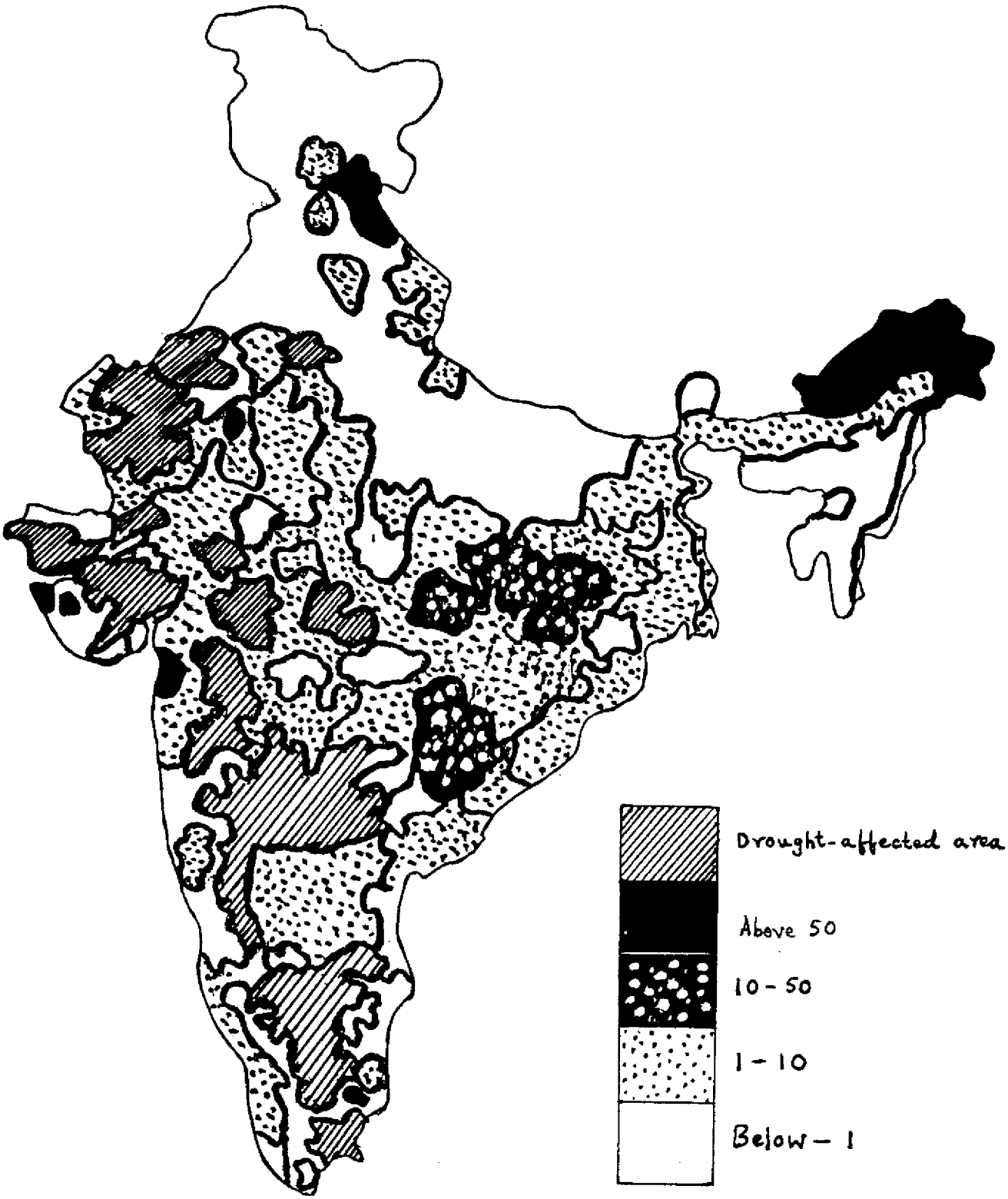
Table II below gives the periodic distribution of number of drought years according to intensity.

TABLE - II

NO. OF DROUGHT YEARS

Period	SLIGHT	MODERATE	SEVERE	CALAMITOUS	TOTAL
1876 - 1900	4	2	0	2	8
1901 - 1920	4	5	0	1	10
1921 - 1940	3	0	0	0	3
1941 - 1960	1	2	0	0	3
1961 - 1980	3	4	1	0	8
1981 - 1990	1	2	1	0	4
TOTAL	16	15	2	3	36

DROUGHT - PRONE AREAS



The map gives the distribution of drought-prone areas in the country.

The main characteristics of the drought-prone areas in the country are as follows :

: The number of small and marginal farmers and agricultural labourers in drought prone areas is estimated to be 9 million households, constituting the poorest segments of the rural population.

: The drought-prone areas are economically low potential areas.

: The soil condition of most of the drought-prone areas has deteriorated.

: Increasing pressure of human and livestock population has led to the cultivation of marginal lands unsuitable for agriculture.

: Forests have been practically denuded and the top soil in the agricultural land have been increasingly eroded due to bad management practices.

: Inadequate and uncertain moisture conditions, uncertain and erratic rainfall, predominance of small holdings, large incidence of agricultrual labourers, non-availability of suitable drought resistant varieties of crops and an overall low-level economic development-all combine to aggravate unemployment and low income.

: Economic disparities in the living standards of those living in drought-prone areas as compared to irrigated and high and assured rainfall areas are on the increase.

: Drought-prone areas represent a major factor contributing towards regional imblances.

: Disparities in income and living standards between the dry and drought-prone areas, on the one hand, and the better rainfall and irrigated areas, on the other, have been further accentuated as a result of the advances in the present agricultural technology which are more suited to irrigated agricultural areas.

: Drought affect most severly the poor and marginal farmers, the agricultural labourers and especially the women leading to increasing indebtedness, land alienation, bondage and other forms of social oppression and accompanying large-scale migration.

: The number of drought victims today is estimated to be 200 million in 21 states as against the drought in 1950s which affected only around 25 million in 8 states.

The other factors which should be noted are

: A few studies in the country indicate some relationship between deforestation and rainfall, especially in humid areas. There is however no study undertaken in arid or semi-arid regions of the country.

: Studies have indicated changes in the micro-climatic situation leading to reduction in afternoon showers and drier and hotter pre-monsoon months due to deforestation.

: Studies have indicated a correlation between the area under forest cover and rainfall and also a decrease in the number of rainy days.

: Studies indicate that higher the deforested area, the larger is the number of climatic criteria showing a diminishing trend in rainfall.

: The number of climatic criteria showing a decreasing trend has taken a sudden leap from the decemical period 1956-65 to 1966-75.

: The evergreen forest belts are more prone to diminishing trends of precipitation than the dry desiduous forest areas.

: Studies indicate that forest reduction does not lead to a reduction in the total amount of rainfall but in the reduction of number of rainy days leading to increase in the intensity of tropical rainfall resulting in enhancing run-off and soil erosion, erratic rainfall, longer spells of dryness and accompanying agricultural drought.

: Increase in drought period leads to less release of water from forests, increase dust problems and greater desertification of the humid and sub-humid zones.

: Drought is the result of neglect and over-exploitation of common environmental resources which provide a cushion during dry periods to the people in the area.

: There is an increasing fodder shortage, especially green fodder shortages in all drought prone areas, leading to crisis proportions during drought years.

: No attention has been paid to fodder production and development and protection of grazing lands leading to increasing amount of grazing lands being converted into wastelands.

- : **Drought areas have been characterised by large charges in land-use pattern-expansion of crop lands onto grazing and forest lands, reduction in the area under grazing lands and their over-exploitation, heavy grazing of forest areas, decline in tree cover, adverse effect on the marginal cropland, increase in wastelands and higher percentage of area being affected by floods and droughts.**
- : **As wastelands increase, people tend to keep more goats than cattle leading to greater pressure on environment.**
- : **Because of heavy animal pressure, the soial forestry programmes have concentrated on incrasing plantations on non-browsable spacies like encalyputs, acacia, etc. leading to further environmental degradation.**
- : **Drinking water problems have reached acute proportions during drought years and the number of villages affected by drinking water problems have increased from 1749 "problem villages" in 1983 to 4778 villages in 1985.**
- : **Wells which have never gone dry in the past are drying up in hundreds and inspite of drinking water supply programmes, "problem villages" are increasing rather than decreasing in recent years, urban drought has also become widespread and increasing problem.**
- : **The Central Ground Water Board (CGWB) has indentified 645 blocks were groundwater use must be strictly controlled because of increasing depletion of groundwater. But controlling this has proved to be politically very difficult.**

Table III shows the details of blocks where ground water is already being over-exploited of nearing over-exploitation.

Table - III

	Level of Utilisation of ground as % of available groundwater	No. of Blocks	Blocks covered by DPAD/DDP
Dark Block	Above 80%	369	21
Grey Block	60% - 80%	276	21
Total		**645**	**42**

Result of heavy and continued concentration in irrigated areas and neglect of dryland agriculture is leading to depletion of foodgrain production along with reduction in rainfall crop productivity and area.

FLOODS :

As assesed by the RBA, Rashtriya Barh Ayog (National Commission on floods) set up by the Government in 1976, an area of about 40 million hectres in the country is prone to floods. According to the data published by RBA, the flood-prone area increased from 6.48 mha in 1950s to over 9 mha in the 1970s and 1980s. The Commission's report is now over a decade old. According to a report of the Centre for Science & Environment (CSE) whose source of data are the RBA and the Central Water Commission (CWC), both government agencies, the flood prone area has risen even further from nearly 19 mha in 1959, to 23 mha in 1969, 43 mha in 1979 and in 1984 it was 58 5 mha. Since RBA understimates the flood prone area as large portions of flood protected areas which are liable to get flooded are not counted, therefore the total flood-prone area in the country at present will be over 60 mha, which is about one-fifth of the country's land area.

According to RBA data, the average annual area affected during 1980s is 9.02 mha, which has risen from 6.48 mha in 1950s. During the worst decade of floods in 1970s, average annual area affected was 9.54 mha. According to the unpublished CWC sources, the average annual area affected has risen from 6.86 mha in 1950s to 16.57 mha in 1980s. According to CWC, the percentage of crop area affected by floods has risen from 29% in 1950s to 51% in 1980s and the average annual damage from 60 crores in 1950s to Rs 307 crores in 1980s. Areas in the states of Andhra Pradesh, Rajasthan, Haryana and Gujrat which are not usually affected by floods, were also affected

The RBA's report also states that floods have increased more because of human factors like deforestation, drainage congestion caused by badly planned construction of roads, bridges, railway tracts and other developmental activities, reduction in infiltration because of increased occupation of land by industries and large scale urbanistion and construction of embankments along rivers and extension of human occupation in flood-prone plains.

The following factors/data should be highlighted for an understanding of the overall flood situation in the country.

: **India is one of the world's richest countries in terms of water resources.**

: **The average annual precipitation in India is higher than that of every other continent in the world except that of South America and twice that of the average annual precipitation of the continent of Asia.**

: **India receives an annual precipitation (rain and snow) of about 400 million hectare metres (mham). In addition, rivers flowing in from countries situated in the Himalayan watershed bring in another 20 mham.**

: **Of this 420 mham, 70 mham evaporates immediately. The remaining 350 mham gets converted into 165 mham of soil moisture, 135 mham of surface water in rivers, ponds and 50 mham of ground water.**

: **Finally, these 350 mham gets transferred into 200 mham of moisture which is lost to the atmosphere through evapotranspiration and another 150 mham of water flows into the sea.**

: **India today uses only about a tenth of the precipitation it receives annually.**

: **Today with environmental destruction, we find the country's water balance is being badly distrubed. As a result, the water availability is becoming extremely uneven.**

: **India's annual expenditure on natural disaster relief has been increasing at an alarming rate. Table IV shows the details of Central Assistance to States for Floods, Droughts and other Natural Calamities.**

Table IV

	Period	Average Assistance per year (Rs. crores) in current prices
I	Five Year Plan (1951-56)	5.64
II	Five Year Plan (1956-61)	7.71
III	Five Year Plan (1961-66)	6.41
	Annual Plans (1966-69)	87.96
IV	Five Year Plans (1969-74)	239.59
V	Five Year Plan(1974-79)	130.28
	Annual Plan (1979-80)	341.43
VI	Five Year Plan(1980-85)	558.39
VII	Five Year Plan (1985-86)	1027.25
	1986-87	Approx. 1100-1200

: The flood-prone area in the country has been increasing from 23 mha at the end of 1960s to about 40 mha by mid 1970s to over 60 mha at present.

Details of the flood damages in India during 1953 to 1987 are given in Table V

Table V

Flood damages in India during 1953 to 1987 (using published sources)

Year	Area affected	Population affected	Damage to crops		Damage to houses		Cattle lost Nos.	Human lives lost nos.	Damage to public utilities	Total damage to crops, houses & public utilities (Rs. crore)
			Area	Value	Nos.	Value				
	(mha)	(m)	(mha)	(Rs. crore)	(m)	(Rs. crore)	(m)		(Rs. crore)	
1954	7.49	12.92	2.61	40.52	0.20	6.56	0.02	279	10.16	57.24
1953	2.29	24.28	0.93	42.08	0.27	7.24	0.05	37	2.90	52.40
1954	7.49	12.92	2.61	40.52	0.20	6.56	0.02	279	10.16	57.24
1955	9.44	25.27	5.31	77.80	1.70	20.95	0.07	865	3.98	102.73
1956	9.24	14.57	1.11	44.44	0.73	8.05	0.02	462	1.15	53.64
1957	4.86	6.76	0.45	14.12	0.32	4.98	0.01	352	4.28	23.38
1958	6.26	10.98	1.40	38.28	0.38	3.90	0.02	389	1.80	43.97
1959	5.77	14.52	1.54	56.76	0.65	9.42	0.07	619	20.02	86.20
1960	7.53	8.35	2.27	42.55	0.61	14.31	0.01	510	6.32	63.17
1961	6.56	9.26	1.97	20.04	0.53	0.89	0.02	1374	6.44	31.37
1962	6.12	15.46	3.39	83.18	0.51	10.66	0.04	348	1.06	94.89
1963	3.49	10.93	2.05	30.17	0.42	3.70	0.00	432	2.75	36.62
1964	4.90	13.78	2.49	56.87	0.26	4.59	0.00	690	5.15	66.61
1965	1.46	3.61	0.27	5.87	0.11	0.20	0.01	79	1.07	7.13
1966	4.74	14.40	2.16	80.15	0.22	2.54	0.01	180	5.74	88.43
1967	7.12	20.46	3.27	133.31	0.57	14.26	0.01	355	7.86	155.43
1968	7.15	21.17	2.62	144.61	0.68	41.11	0.13	3497	25.37	211.09
1969	6.20	33.22	2.91	281.89	1.27	54.42	0.27	1408	68.11	404.43
1970	8.46	31.83	4.91	162.78	1.43	48.61	0.02	1076	76.44	287.83
1971	13.25	59.74	6.24	423.13	2.43	80.24	0.01	994	129.11	632.48
1972	4.10	26.69	2.45	98.56	0.90	12.46	0.06	544	47.17	158.19
1973	11.79	64.08	3.73	428.03	0.87	52.48	0.26	1349	88.49	569.00
1974	6.70	29.45	3.33	411.64	0.75	72.43	0.02	387	84.94	569.01
1975	6.17	31.36	3.85	271.49	0.81	34.09	0.02	686	166.05	471.63
1976	11.91	50.46	6.04	595.03	1.75	92.16	0.08	1373	201.50	888.68
1977	11.46	49.43	6.48	720.61	1.66	152.29	0.56	11316	328.95	1201.84
1978	17.53	70.45	9.96	911.08	3.51	167.57	0.24	3396	376.10	1454.76
1979	3.99	19.52	2.17	169.97	1.33	210.61	0.62	3637	233.63	614.21
1980	11.46	54.12	5.55	366.37	2.53	170.85	0.06	1913	303.28	840.50
1981	6.02	32.49	3.27	524.56	0.91	159.63	0.09	1376	513.31	1196.51
1982	8.87	56.01	5.00	589.40	2.40	383.87	0.25	1573	671.61	1644.87
1983	9.02	61.03	3.29	1285.85	2.39	332.33	0.15	2378	873.43	2491.60
1984	10.71	54.55	5.19	906.09	1.76	181.31	0.14	1661	818.16	1905.56
1985	8.38	59.59	4.65	1425.37	2.45	583.86	0.04	1804	2050.03	4059.25
1986	8.81	55.52	4.58	1331.58	2.05	543.41	0.06	1200	1982.54	3748.52
1987	8.88	48.34	4.94	1154.64	2.92	464.49	0.13	1835	950.59	2569.72
Worst	**17.53**	**70.45**	**9.96**	**1425.37**	**3.51**	**283.86**	**0.62**	**11316**	**2050.03**	**4059.25**
Year	**(1978)**	**(1978)**	**(1978)**	**(1985)**	**(1978)**	**(1985)**	**(1979)**	**(1977)**	**(1985)**	**(1985)**
Annual Average	**7.66**	**31.84**	**3.51**	**367.79**	**1.21**	**112.62**	**0.10**	**1439**	**287.67**	**768.08**

Source : 2

Details of victims affected by Floods and Droughts in the country are given in Table VI

Table VI

	Period	Percentage of World's victims living in India
Droughts	1970s	80
Floods	1960-81	70*

* India and Bangladesh combined

: **India faces a massive soil erosion problem - 5,344 million tonnes of soil every year.**

: **Of the 5,344 million tonnes of soil eroded every year :**

. 29 percent goes to the sea.

. 10 percent are deposited in dams reducing storage capacity by 1-2 percent every year.

: **61 percent gets transported from one place to another, quite a high percentage of it settling down on river beds.**

: **Careless road building in the Himalayas leads to enormous soil erosions and has made the area soil erosion prone.**

: **Silted river beds necessiates that the embankments are raised every year resulting in land being protected by embankments becoming lower and lower and increasing area becoming flood prone.**

: **Increasing siltation of barrages and flash floods due to heavy landlides cause increasing floods causing widespread destraction life and property.**

The details of the flood prone area of India are given in the Map enclosed.

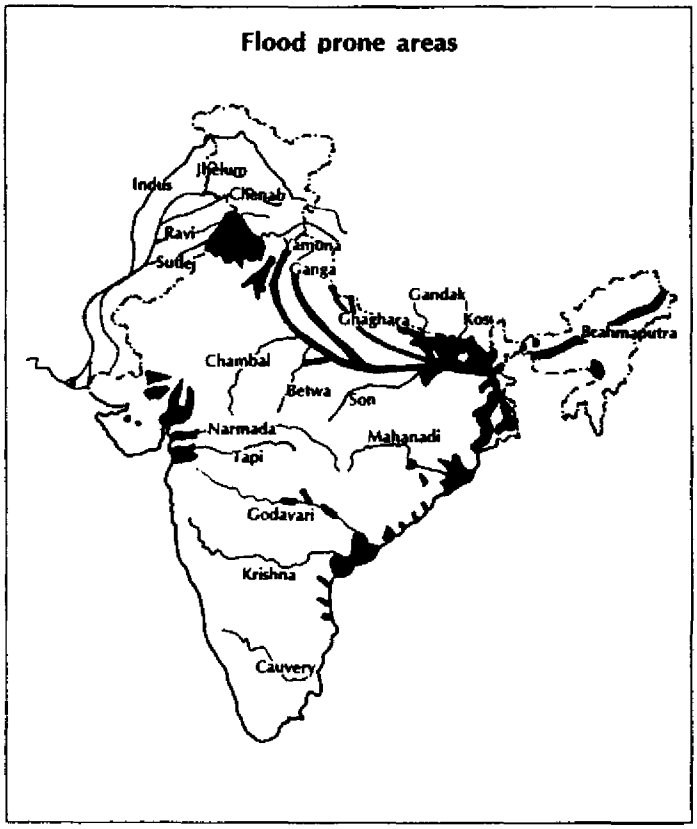
: **Flood control measures have rarely gone beyond the construction of dams and embankments. The expenditure has also grown increasingly.**

: **Upto March, 1987, total length of embankments is 14.511 kms and expected area to be protected is 13.36 mha.**

Table VII

Decade	Number of dams constructed
Before 1950	28
1950s (1950-59)	32
1960s (1960-69)	64
1970s (1970-79)	85
1980s (1980-86)	47
Under construction in 1986	154

The details for flood control expenditure are given in Table VIII



The Rashtriya Barh Ayog estimates the country's flood prone area at 40 mha. But it may be even higher.

Table VIII

Plan Period	Expenditure (Rs. crores)	Cumulative area protected (mha)
First Plan (1954-56)	13.21	1.00
Second Plan (1956-61)	48.06	3.24
Third Plan (1961-66)	82.09	5.43
Annual Plans (1966-69)	41.96	5.83
Fourth Plan (1969-74)	162 04	8 04
Fifth Plan (1974-78)	298.60	9 98
Annual Plans (1978-80)	329.96	11.21
Six Plan (1980-85)	786.85	13.01
Seventh Plan (1985-90)		
(1985-86)	166.30	13.18
(1986-87)	186.77	13.35
(1987-88)	181.55	13.48
(1988-89)	211.99	N.A.
(anticipated)	2509.38	
Seventh Plan Outlay	947.39	14.10

: **However, inspite of increasing expenditure on flood control the area affected by floods have increased.**

: **Degradation of watersheds of the rivers, deforestation of the hilly and mountainous portions of their catchment area have caused increasing floods**

: **due to increasing siltation, soil erosion**

: **Till date, the environment aspects of flood protection are not taken into account by the water resources establishment who still rely mainly on engineering solution inspite of increasing floods in the country.**

CYCLONES :

India has a long coastal line of 5700 kms. which is exposed to the hazards of tropical cyclones arising in the Bay of Bengal and Arabian Sea. On an average 2-3 out of 6 tropical cyclones in this region have been found to hit India. Cyclones are characterised by winds, torrential rains, high tides and assoicated flooding which cause extensive damage in the coastal areas.

Of all the cyclones in the recent past, the cyclone of 1977 is considered to be the worst. The approximate estimate of the loss of lives varies from a few thousands to hundred thousands alongwith loss of thirty thousand acres of paddy crop.

Despite 52 radio warnings transmitted from All India Radio Vijaywade extending upto 1.30 a.m. on 19th November 1977 and two relay transmissions from Hyderabad, there is very little indication that radio listeners of the affected villages acted upon the cyclone warnings. The ultimate result as witnessed was death, destruction and destitution.

Since then and perhaps even before, cyclone on the east and west coast are an annual feature, cyclones develop in the Bay of Bengal as well as in the Arabian Sea every year before or during both monsoons. The coastal population experience the cyclones almost every year.

The following is an Anonymous quotation dated 1963: **Between 1891 and 1960, 408 storms crossed Bay of Bengal. Fifty six cyclones crossed the coast of Andhra Pradesh in the eight coastal districts between 1892 and 1977.**

Of this as stated earlier the two cyclones of November 1977 were the worst in recent times.

Despite all attempts to communicate warnings, the death toll was enormous and the loss of properly great.

However, the November, 1977 disaster that swept coastal Andhra was neither the first nor the last. Some of the major cyclonic storms to hit the Andhra Coast in the past are.

a) The 1864 cyclone - one of the worst in recorded history struck Machilipatnam reported killing 35,000 people.

b) The 1927 Nellore cyclone caused considerable loss of life and destroyed thousands of acres of crop.

c) The 1949 cyclone hit Machilipatnam killing 800 people and destroyed millions of acres of crops.

d) The twin cyclones of May 1969 took a toll of 900 lives along the Andhra Coast and caused property damage worth Rs. 200 crores.

e) The November, 1977 killed and also destroyed millions of houses and millions more acres of crops.

f) The May, 1990 cyclone, caused wide spread loss of property and crops in districts of East and West Godavari, Krishna, Guntur and Pracasan districts of coastal Andhra Pradesh.

Note : Between 1691 and 1990 nearly 600 cyclones were born in Bay of Bengal. Off those, the Calcutta Cylone of 1737 took 3 lakh lives. The Machilipatnam cyclone of 1779 took 20,000 lives. Bengal cyclone of 1789 took 20,000 lines and 1864 Bengal cyclone took away 1 lakh lines.

The extent of unpreparedness for cyclones can perhaps be guaged by the following case study done by Dr. Binod C. Agarwal and a team of eight social scientists from the Development Education and Communication Unit (DECU), ISRO, SAC, Ahmedabad.

I FOUND MYSELF NUDE :

Shri Vendatrayalu, 70 Male, Agriculturist,
Pallekaru Jati, Sripuram,
Interviewed on the way to Dwaraka on 9.12.1977.

"I lost my wife, two daughters, son-in-law, two grand children and a son in cyclone and tidal wave. I also lost one bullack cart, 8 buffalowes, two bags of rice, 4 brass pitchers, Rs. 400/- cash and new clothes worth Rs. 200/-."

"On Thursday morning (November 17,1977) I had been to Keduru village which is about 5 kilometers. I purchased clothes for all my household members worth of Rs 200/- and returned home in the evening. Till them I did not hear anybody either talking or discussing in the market places of Koduru about impending cyclone. Next day, as I had planned few days back I harvested paddy of two acres and gathered at a place for thrashing on the next day - of course it is lost now. As usual we talked and discussed about paddy procurement of labouers, harvest and others. We did not talk about cyclone."

"I don't have a transistor but my neighbour was having one. On Thursday returning from Koduru I had my evening meal and came out of my house. I heard the cyclone warning on transistor. It was announced that there would be heavy rains in coastal Andhra Pradesh due to the formation of depression in Bay of Bengal All those residing in low lying places should vacate and go to safe places. I heard similar radio accouncements till Saturday noon several times. I received the information of cyclone only through transistor but not from any other source. All the radio stations of Hyderabad, Vijayawada and Visakhapatnam gave the same news. The final announcement, I heard was that the cyclone centered 3 kilometers from Bandar, and the waves of the sea would rise upto 2 meters."

"We have been experiencing heavy winds and rain for many years so I took it casually. I did not believe that the devastation would be this much (he showed the devasted area by hand). The cyclones hit this place severely on three occassions. In 1925 May when I got married and in 1953 and also in October 1960. On these three occassions, except damage to crops and houses there was no loss of life."

"On Saturday, it was drizlling since the morning. There was a chilly wind. But the intensity of the wind gradually increased, I think before noon, my neighbours who were having a transistor, came out of their houses. They felt that their house might collapse as it was very weak and old. My house was also had mudwalls and thatched roof, but it was in better condition than my neighbour's. The transistor was put on now and then. There was similar warnings. We took it casually and were discussing other matters expecting gradual decline of cyclone's intensity."

"May be around the noon, the wind grew very wild We feared that the roof might be blown off. My wife wanted to go out and see whether the roof was intact. When she stepped out two feet out of the door she was pushed by the wind about ten feet, I quickly went out and brought her back into hut. We heard the radio announcing that the cyclone has crossed the coast. Within an hour of that announcement we found water in the house. In the beginning we thought it was rain water. We were busy in keeping some of the materials on the top or an elevated place so that the water will not spoil it. But within a few minutes water level increased surprisingly upto our knees and was gradually rising. We did not know what to do next. There was heavy wind and downpouring, and the water level in the hut was rising rapidly.

"While we were helplessly thinking, the walls of the house collapsed. There were shouts, crying and lot of noise in the hut for help. The roof of the house fell on us. Some of us shouted advising every body to remain calm my wife asked not to cry. I dragged her close to me. No sooner she said so, there was another big wave which upturned the roof again. This time, I could not catch my wife. She was drowned in water and carried away."

"I tried myself to float and find out a support. A palmyrah tree felt by my hands. So, I caught hold of the palmyrah tree tightly. There were several waves hitting me and I was hanging from the tree and I do not know how much height I was from the ground. After some time I did not feel waves and the water slowly receeded.

After some time I glided for few feet and lent on the palmyrah tree. After a long time, I realised that I am at the bottom of the palmyrah trees on an elevated place. I was shivering as it was very cold. Except chilly weather there was no rain or wind. The ground was very muddy and damp, so I gathered some hay which got stuck up to the tree and spread on the ground. I was very tired and wanted to take some rest. I sat for a long time. I do not know when the day broke. I could not properly see as the eyes were bruning and there was uncontrollable flow of tears. I found myself nude. I did not know what to do next. I also could not think what had happened "

"One woman was passing that side. She pitied me and threw a piece of cloth and asked me to cover. It was about 7 a m., as sun was up in the sky. I realised, the roof and come on to the top of another roof. Every body tried to save themselves while helping others. Then I felt the waves were hitting the roof, my wife was sitting beside me. Within a short time there was a big wave which hit the hut. As a result, the roof was carried away for some distance. Every body was crying helplessly. Another big wave hit the roof again. This time, the roof was torn and split into pieces. Luckily myself and my wife were together on one big rafter and hay of the roof. At the moment, I though of saving myself and my wife. Next wave carried us to some distance Now I felt that we are above the ground may be at the height of palmyrah trees and thorny bushes."

"There were many waves which carried us for a long distance. I did not know which direction we were being carried away. Every time I had to adjust myself to remain on the top of the roof which was tilting. There was heavy rain and wind, which I had never seen earlier. I could not understand from which direction the wind was blowing. I thought that I would die soon. Then suddenly the roof which was carrying us upturned. My wife cried loudly that she was dying. I caught her arm immediately and luckily caught hold another roof with the other hand. We crawled on the another roof. We drank plenty of sea water. My wife was sobing that she would not survive. I could say nothing elevated place but we were near Government hospital in Koduru. My knees became very stiff so I could not walk properly. Somehow, I reached **the hospital. There was a known person who gave me a lungi.** I did not talk much to him I slowly walked to a soda shop and asked for a drink, because I was feeling very thirsty. There, I met another known person. I asked him to give me something to eat, so that I may not die of hunger. I had no food since last day. He gave me half a dozen palantains. I sat there like a mad man. The same man carried the news about me to my son who is in Koduru. My son and daughter-in-law came to me. We all wept bitterly. They took me to their home which was also collapsed."

The warning of cyclone reached Venkatrayalu through transistor. He took it as usual cyclone. He thought of his paddy, which was prone to damage. He tired to save it but in vain. He never understood that his life was at danger.

The various recommendations of the Union Govt. appointed Cyclone Distress Mitigation Committee (CDMC) following the 1969 Andhra Cyclone are as follows :-

a) **Installation of high power storm detection Radars at Calcutta, Madras, Visakhapatnam and a network of 50 wind observations along the AP coast.**

b) **upgrading the AIR Radio Stations of Hyderabad, Vizag and Vijaywada for rapid dissemination of weather data.**

c) **Construction of storm shelters.**

d) **Providing wind breaks along the coast**

e) **Building dyces and bunds**

f) **Afforestation along coastal belts**

g) **Construction of paved roads in vulnerable areas, to enable evacuation as well as quick relief and rescue.**

The report recognising that advance warnings are ineffective without the people's cooperation, suggested an elaborate community preparedness programme. A model cyclone plan for Andhra was drawn up by the CDMC which spelt out in detail the steps to be taken by various agencies of Govt. before, during and after the cyclones.

In this plan its was envisaged that adequate financial assistance, installation of early warning systems and

rapid transmission of information would be the Central Government's main cointribution while the other aspects of ground execution would be the areas of responsibility of State Government. Each District was to have a high powered CDMC unit with the District Collector as its head.

As of today, even after 15 years of 1977, what has been pointed out is a series of steps, whereby the population gets out of the area fast, certain construction are made to mitigate the distress and an organisational system is developed to rush relief and assistance after the disaster.

a) **A proper system of motorable roads to the vulnerable villages and settlements**

b) **A judicious use of AIR, Door Darshan, Indian Metrological Department and local authorities would enable wide publicity and create awareness of impending disasters.**

c) **Adequate number of disaster shelters with propr designs for withstanding the worst cyclones and effects of salinity.**

d) **A system of dykeo and bundhs which would enable quick dissipation of flood waters and reduce the damage to crop land due to salinity.**

e) **Planting of the right species of trees for wind breaks as well as for ecological and economic help.**

However, a review shows that more than 30% of the cyclone prone villages do not have shelters. Most of the shelters and houses built after 1977 are inadequate and badly designed and many have broken down or are not in use. Other preventive measures for environmental upgradation for reducing the impact of the cyclones like dykes, embankments and tree plantations are far below the needs. However, the main task of economic rehabiliation of those affected and reduction of wastelands affected by the saline water is yet to be undertaken making the population still dependent primarily on external aid.

EARTHQUAKES :

The country has about 50-60% of its total area vulnerable to seismic activities of varying intensities. The vulnerable areas are located essentially in the Himalayan regions of country besides the Unioin Territories of Andaman & Nicobar Islands.

As the Himalayan mountains constitute a region where two drifting earth plates meet and the Earth's crust is undergoing a change, it is a region with high seismic activity. The junctions, marked by a gently inclined thrust plane, is called the Main Central Thrust (MCT) and the sliding of the Indian Plate below the Asian Plates have caused widespread splitting, shattering and crushing of lesser Himalayan rocks leading to innumerable landslides. The junction of the lesser Himalaya and the outer Himalayas, the Main Bounday thrust (MBT), and its geological conditions is even worse.

These areas have been rocked by both moderate and large earthquakes ranging from 6 to over 8 on the Richter Scale. Seismicity is high along both the MBT and MCT. Earth quakes have taken place along the MCT in Nepal and Himachal Pradesh. Earthquakes, in the proximity of the MBT, though less frequent, have larger magnitude. Seismicity maps show that the Indo-Nepal border registers the largest number of earthquakes per year. Large earthquakes have caused considerable damage to life and property and destructive landslides over extensive areas. There are strong and recurrent movements also along the many transverse faults which tear the Himalayan front into differentialy moving blocks and segments. Transverse faults are seismically more active than the thrusts.

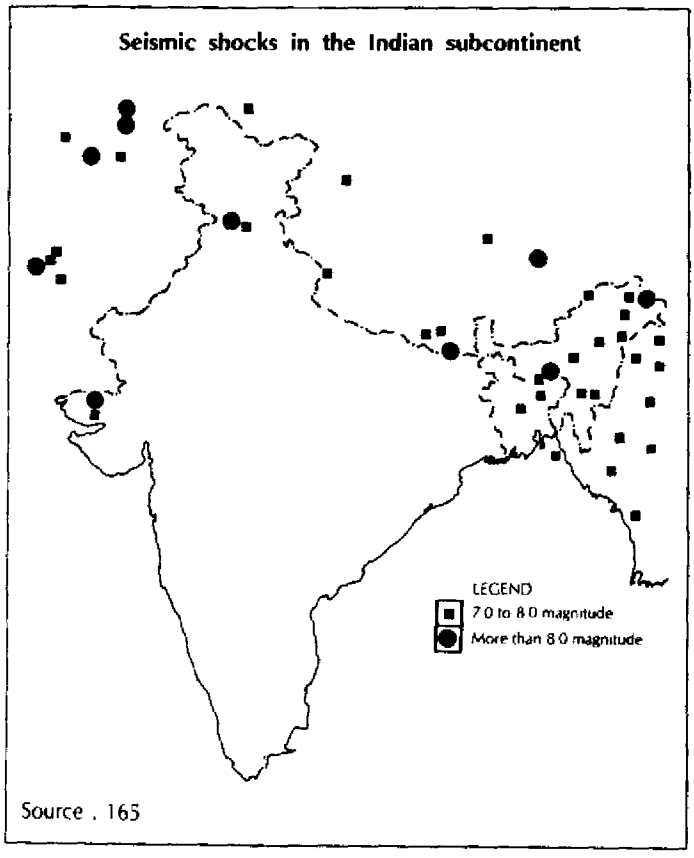
The magnitude of the recent earthquake in October, 1991, which rocked the hilly regions, of Uttar Kashi of Uttar Pradsh killing more than 1500 people and causing widespread destruction to house and property and accompanying landslides have raised serious questions on the state of preparedness against earthquakes in one of the most earthquake prome regions in the world.

According to Prof. Ramesh, Head of Department of Agriculture, Administrative Staff College of India, Hyderabad, even post Uttar Kashi there is still no definite policy of the Government regarding earthquakes.

Details of the major earthquakes in India since the 19th Century upto the Uttar Kashi earthquake are as follows

MAJOR EARTHQUAKES THAT ROCKED INDIA SINCE 19TH CENTURY :

Sept., 1.1803	**Mathura, intensity 6.5. The shock was felt upto Calcutta.**
1803	Kumaon region in UP; intensity 6.5.200-300 people killed at Barabal.
June 16,1891	Kutch (Gujarat); intensity 8. Chief towns of Tera, Kathara and Mothala razed to the ground.
June 6,1828	Near Srinagar; intensity 6,1,000 people killed.
Jan. 10,1869	Near Cachar (Assam); intensity 7.5. Affected an area of 250,000 sq. miles.
May 30,1885	Near Srinagar; intesity 7. Kamiaray area destroyed.
June 12, 1885	Shillong plateau, intensity 8.7. Widespread destruction in Shillong, Goalpara, Guwahati, Nowgong, Sylhet.
Apr. 4,1905	Kangra (Himachal); intensity 7.6. Heavy damage in Dhubri, Cooch Bihar, Lalmuniarath and Rangpur.
Jan. 15,1934	Bihar - Nepal border; intensity 8.25. It ruined Motihari, Darbhanga, Patna dn Kathmandu.
Mar. 14,1938	Madhya Pradesh; intensity 6.5.
June 26,1941	Near the Andamans; intensity 8.1
Aug. 15,1950	Assam; seven minutes duration.
Dec. 10,1967	Maharashtra, intensity 6.1 Ikoyna Nagar razed.
Aprl. 13,1969	Bhadrachalam; intensity 6.5
Jan. 19,1975	Himachal; intensity 7.5 Rocked parts of Kinnaur and Lahaul Spiti.
Aug. 21,1988	At least 900 people killed in Bihar and Nepal.



It is surprising that even after recurrent major earthquakes and being vulnerable to seismic activities of various interensities, neither the Central nor State Governments even have a policy for earthquake management till date.

LANDSLIDES:

Landslides are frequent and recurrent in the various regions of the country. They are triggered off by natural causes like heavy rainfall, cloud bursts, land and soil degradation caused by human interference. The Himalayan region has a very high incidence of landslides. Catastrophic events like heavy rainfall, earthquakes, etc. bring frighteningly high quantity of sedements in a very short period thus negating resorting to annual averages which are relatively meaningless in the Himalayan context and increase average denudation rates several fold.

Landslides in the Western Himalaya have affected vital roads, river valley projects, urban and rural settlements. They have caused extensive damage to life and property through landslide dams on the rivers caused by stones and rock brought down by the landslides and blocking the rivers and causing devastating floods.

Landslides are common in the North-East and large parts of Arunachal Pradesh, Nagaland, Manipur and Mizoram are severaly susceptible to landslides.

AVALANCHES :

About 25,000 ha of the country, mostly in the Himalayan region fall in the Alpine Region. The snow avalanches of the Himalayan regioins are massive and have great destructive potential. An area of about 2000,000 sq. mts. of Northern India is exposed to avalanches. Most of these occur during the period of heavy snowfall or immediately after. Wet snow avalanches during spring are also frequent. Destruction due to avalanches of life and property is also extensive and also the consequent floods in the plains