सत्यमेव जयते

INDIA DISASTER REPORT

2014-17





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Resilient India - Disaster free India

National Institute of Disaster Management (NIDM)
(Ministry of Home Affairs, Government of India)

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Resilient India - Disaster Free India

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Executive Director

सत्यमेव जयते

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FOREWARD

The geo-climatic conditions of India make it vulnerable to almost all hazards. The frequency and intensity of disasters have shown an increasing trend. Every disaster is different in nature and has its own peculiar way of behaviour. Its handling also is different with every manager who manages it. This brings the importance of documentation, as not only best ways to handle a particular disaster can be brought to fore but also its management will be cost effective. In this regard, in year 2011, National Institute of Disaster Management (NIDM) initiated documentation of disasters that occur in one calendar year in the form of India Disaster Report (IDR). The aim of this documentation is to present consequences and probable causes of the disaster in conjunction with the steps taken for prevention, preparedness, relief and recovery of the disaster. This documentation of disasters every year provides some lessons to be learnt for future and identify the gaps, if any, in the approach towards its management and activities taken for disaster risk reduction.

India Disaster Report –2014-17 deals with major disasters during the period, which needed national intervention in terms of financing and mobilizing resources.

I am thankful to NIDM faculty Shri Shekher Chaturvedi, Assistant Professor, for compiling and bringing out this IDR 2014 to 2017.

The India Disaster Report 2014 to 2017 will be useful for all the researchers, stakeholders and practitioners working on disaster management.

MK Bindal

(Manoj Kumar Bindal)

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National Institute of Disaster Management (NIDM) initiated the documentation of disasters that occur in one calendar year in the form of India Disaster Report (IDR) in year 2011. The compendium of India Disaster Report 2014 to 2017 deals with major disasters, which have national intervention in terms of financing and mobilizing resources that have happened in India during this period.

I am grateful to Maj. Gen. Manoj Kumar Bindal, Executive Director NIDM, for providing directions and guidance in preparation of the document. I am grateful to Dr. Sushma Guleria for her valuable contribution in compilation of India Disaster Report of the year 2014. I would also like to show my gratitude to the two interns Ms. Lucky and Mr. Vikash for compilation and providing support in preparation of the India Disaster Report: 2014 - 2017. I would also like to thank the publication cell of NIDM for providing support in publishing this document.

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INTRODUCTION

The vulnerability of India towards multiple disasters is well known. Every year numerous catastrophes nudge the nation and with changing climatic conditions the frequency and intensity of these events are increasing. India had been responding to disasters for many years and had been assisting cross boundary response also. After 1994 Yokohama convention where India was one of the signatories, Nations decided to shift their focus from reactive approach to proactive approach. Keeping this in mind , India also shifted its focus to disaster risk reduction. This approach led to enactment of Disaster management Act in 2005, which clearly mandates National Institute of Disaster Management (NIDM) with functions such as Capacity Building through training, documentation, research and awareness campaigns. It also mandates NIDM to support Central Ministries, State Governments and UT Administrations in the field of disaster risk reduction.

There is a famous saying *"If It Isn't Written Down, It Doesn't Exist",* this shows the importance of documentation. In year 2011, NIDM initiated a step to document disastrous events of each year in the form of India Disaster Report (IDR). The aim of this documentation is to discuss consequences and probable causes of the disaster in conjunction with the steps taken for prevention, preparedness, relief and recovery of the disaster. This review of disasters every year will provide some lessons to be learnt for future and decipher the present gap in our approach towards disaster risk reduction and address it. It will also help NIDM in the path of capacity building and supporting various government agencies to focus more on disaster risk reduction which will fulfill its mandate given under DM Act 2005.

The major disasters which are documented in this edition of IDR are Jammu & Kashmir Floods, Chennai Floods, Puntingal fire, Cyclone Vardah, Cyclone Hudhud, Malin landslide, Patna Stampede, etc. A brief prologue, consequences, probable causes, response and relief operations are texted for these disasters.

A chapter comprising brief of various other incidents such as road accidents which occurred in the period 2014 to 2017 are also mentioned in the report. The number of deaths in road accidents is matter of great concern. According to Ministry of Road Transport and Highways, Government of India, 4.65 lakh road accidents occurred during 2017 which resulted in deaths of over 1.48 lakh people. The disasters which have been covered in this document are those which have received central assistance in terms of manpower and financial help.

The references of text, figures, and tables are mentioned at the end of each chapter.

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2014

Jammu and Kashmir Floods

Jammu and Kashmir, the northern most state of the country has a long history of natural disasters. Owing to its rugged topography and extreme weather conditions the State has undergone sufferings on account of loss of lives and properties. The state is a multi hazard prone region with natural hazards like earthquakes, floods, fires, droughts, avalanches and landslides which often convert into disasters leading to loss of human lives as well as public and private property due to vulnerability of the region and population.

Floods are one of the disasters which have smashed picturesque terrain of the state frequently in the history. According to Sir Walter Roper Lawrence in his book, The Valley of Kashmir (1895), "Many disastrous floods are noticed in vernacular histories, but the greatest was the terrible inundation which followed the slipping of the Khadanyar mountains below Baramulla in AD 879. The other major flood events that distressed the state happened in 1841, 1893, 1903, 1929, 1948, 1950, 1957, 1959, 1992, 1996, 2006 and 2010.

The major areas of the state affected by flood include low-lying areas of the Kashmir Valley, especially Sonawari, Awantipora and Srinagar, alongwith parts of Jammu. Upper catchments of all the tributaries of the Jhelum, Indus, Chenab and Tawi rivers are also prone to flash floods.

Jammu and Kashmir Floods 2014: An Overview

Jammu and Kashmir faced unprecedented floods of the century in 2014. Incessant rains in the first week of September led to massive floods in state. The Jhelum River and its tributaries were in spate and caused havoc and huge damages to various districts of Kashmir Valley.

The onset of monsoon over J&K region usually takes place by 1st July and the monsoon withdraws by mid-September. In the first week of September (1st Sept. to 6th Sept.), the state experienced catastrophic rainfall which resulted in overflowing of rivers and streams and hence numbers of areas were victimized by flood, flash flood and landslides. The data regarding the rainfall at district level as recorded by the Indian Meteorological Department is given in Table 1.

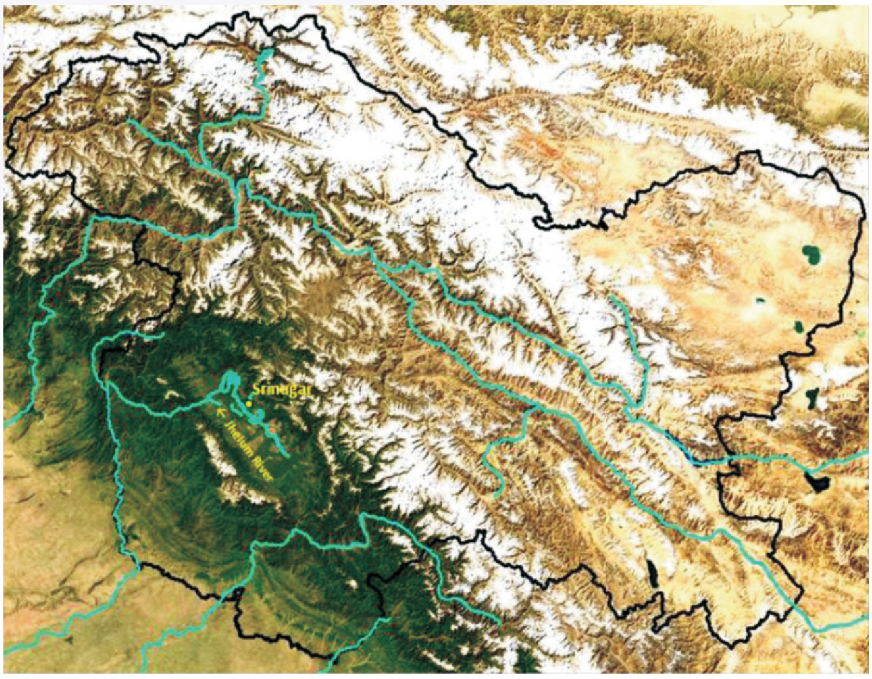


Fig 1: Jammu &Kashmir with stream network

Table 1: Districts rainfall data of the Jammu and Kashmir (1st – 6th Sept. 2014)

District	Actual (in mm)	Normal (in mm)
Jammu	424.2	34.2
Bhaderwah	363.4	6.8
Banihal	491.4	6.7
Batote	532.6	12.0
Katra	625.4	22.6
Anantnag	458.8	10.3
Pahalgam	230	12.3
Kokernag	426.3	9.8
Qazigund	561.3	6.2
Srinagar	157.7	6.5

Table 1 clearly depicts that the amount of rainfall received by different districts were far beyond the normal rainfall. The river Jhelum was flowing much above the danger level at various places. At Sangam, against the danger level of 23 feet, the river Jhelum was flowing at 40 feet. The river was flowing at 29 feet, 11 feet more than the danger level in Srinagar. The data mentioned above points out the severity of the situation.

On September 4th, 2014 J&K experienced 30 hour long rainfall that broke the record of many decades. September was not considered rainy season in the Kashmir and Laddakh region, but this year both these regions recorded moderate to heavy rainfall. In Jammu region such heavy rainfall was earlier recorded in 1903, 1908, 1926, 1942 and 1988. Kashmir valley experienced such intensity of rainfall in 1903,1911,1917,1928 and 1992.



Fig 2: A Scenario of Flood in Jammu and Kashmir

The areas of Southern districts got submerged initially on 3rd and 4th September, 2014 (Fig. 2). The flash floods in overflowing streams trapped number of people by the sudden increase in the level of water. The areas remained submerged for more than a week. By such time there was huge devastation and loss not only to the crops but to the private and public property as well.

Impact

The floods resulted in extensive damage to life, property and crops. A total of 282 people were killed and several others were injured.

The summer capital and business hub of the state, Srinagar got severely affected due to flood. Nearly 70% of the areas remained submerged for 20 days. In Jammu division, the districts of Rajouri, Poonch and Reasi were affected first and later on other districts like Jammu, Ramban, and Samba etc were also affected. Around 5794 villages of 20 districts of the state were affected, out of which 741 villages remained submerged. More than 15 lakh families were affected and around 6.48 lakh hectares of land under various agricultural and

horticultural usage was affected causing huge loss of the crop. Table 2 provides details of affected population in the state.

Table 2 : Details of affected population in the state

S. No.	District	Total villages	Total villages affected	No. of families affected	Deaths	Person injured
1.	Jammu	912	830	33763	10	47
2.	Samba	382	382	34063	0	3
3.	Kathua	512	327	1167	3	5
4.	Udhampur	396	355	9658	45	8
5.	Reasi	259	258	68579	20	8
6.	Rambam	127	127	66751	1	1
7.	Doda	402	402	79636	1	5
8.	Kishtwar	156	155	43783	6	2
9.	Rajouri	385	368	23500	78	9
10.	Poonch	178	172	11504	27	65
11.	Bandipora	123	123	57244	7	57
12.	Anantnag	394	174	142000	10	2
13.	Pulwama	343	343	88600	5	0
14.	Baramulla	538	538	186000	2	1
15.	Kupwara	378	376	158226	5	7
16.	Shopian	238	92	54050	3	1
17.	Ganderbal	139	139	49061	3	0
18.	Budgam	510	224	91414	5	97
19.	Srinagar	137	136	256726	46	50
20.	Kulgam	273	273	72000	5	35
	Total	**6782**	**5794**	**1527725**	**282**	**403**

Links of valley to the rest of the country took about four to five days to open again. 300-km-long national highway was closed to vehicular traffic for five days because of landslides and floods. As many as 60 major and minor roads were cut off and over 30 bridges were washed away, hampering the relief and rescue operations. Except for connectivity between Srinagar and north Kashmir's Ganderbal district, all other districts of the valley - including Anantnag, Pulwama, Kulgam, Shopian, Badgam, Baramulla and Bandipora -were cut off.

In view of huge losses to the public as well as private properties, the Deputy Commissioners had constituted teams for carrying out the assessment of losses to private property, crops,

livestock and also loss to the public infrastructure as per the norms notified by Ministry of Home Affairs under State Disaster Response Fund (SDRF) guidelines. The districts wise details of the losses assessed as per SDRF norms were explained in the *"Memorandum Special Package for rehabilitation of the floods victims of 2014, Department of Revenue, Relief and Rehabilitation, Government of Jammu and Kashmir"*.

Possible Causes of Flood

Devastating floods of Jammu & Kashmir had many reasons such as excessive rain, geographical placement of the state of Jammu & Kashmir, rapid urbanization, unplanned development including construction and few others. In addition to these, impact of climate change cannot be ruled out.

The other reason which can be one of the causes of J&K Floods may be attributed to the lack of early warning. While the three hydrological stations on the Jhelum river, could identify flood like situation few days before, yet this information could not be utilized by the administration for preparing for upcoming flood situation which ravaged Jammu & Kashmir.

Another cause of floods in Jammu & Kashmir is unplanned urbanization, which leads to unplanned construction practices being followed, which hindered the natural drainage of water and hence water logging took place.

Response

In response to heavy monsoon rain, floods, flash floods and landslides in Jammu and Kashmir, the priority of the Government was to ensure no loss to human life and accordingly effectual measures were taken for rescuing the trapped people from the submerged areas. The Indian Armed Forces along with District Disaster Management Authorities and SDRF teams were stimulated to conduct search, rescue, relief, relocation, and humanitarian assistance and rehabilitation missions in Jammu and Kashmir.

Mission Sahayata was launched by the Armed Forces for humanitarian assistance to the victims of the tragedy. Northern Command's humanitarian assistance to Civil authorities was named 'Operation Megh Rahat'. The Indian Army, Air Force, and the Navy, committed large resources to the assistance mission including over 30,000 troops (21,000 in Srinagar, and 9000 in Jammu), 15 engineer task forces, 84 Indian Air Force and Army Aviation Corps fixed wing transport aircraft and helicopters, naval commandos and rescue specialists, and Base Hospital, four field hospitals, over 106 medical detachments. To restore road connectivity, five task forces of Border Roads Organization, which include 5,700 personnel,

had been pressed into service."Operation MeghRahat", ended on 19th September 2014, thereafter "Operation Sadbhavna", the relief and medical assistance support was initiated in "close synergy with the civil administration and the police". Over 2,00,000 people were rescued from the various parts of Jammu and Kashmir.

During the first few days the search and rescue operation were hindered by shortage of boats and bad weather. Boats were airlifted from all corners of India, including from far away Tamil Nadu. In the absence of civil boats the army pressed into service its Boat Assault Universal Type (BAUTS), more appropriate for assault river crossings than rescue assistance during floods.

For those who were stranded on roof tops as flood water menacingly swirled around them, Air Force helicopters with IAF Garud Commandos help winched the stranded people to safe places. Several hundreds were rescued from roof tops. In some cases the Indian Air Force (IAF) commandos had to break through the roof to rescue the trapped people.

The Indian Army, for first time, used social media such as twitter, WhatsApp, , and Face book, in its search and rescue operations, and to collate and feed “Person Finder” provided by Google to the army’s public information office.

19 NDRF teams were deployed in both the divisions along with all necessary equipment required for rescuing the people. Civil Administration and J&K police arranged nearly 400 boats and carried out rescue operations in different areas. Commendable job was done by the local volunteers who need appreciation and point to the need of Community Based Disaster Risk Management (CBDRM).



Rescue Operation by the Army

For medical assistance 311 medical camps were established at various places on rotational basis in Kashmir valley and 58 in Jammu. More than 80 metric tons of medicines were distributed.

Six months free ration was sanctioned in favour of people who suffered losses due to submergence of their houses in floods. Along with 5500 tents and 2.5 lakh blankets, the Government buildings were also made available for temporary shelter.

National Remote Sensing Centre (NRSC) plays vital role during the response stage by providing near real time information of flood inundation in state to MHA, NDMA and Government of Jammu and Kashmir, National Security Council Secretariat and Defense Services. Rapid flood mapping and monitoring was done by the Decision Support Centre (DSC) of NRSC by analyzing the satellite data acquired from Indian Remote Sensing and foreign satellites. In addition, cumulative flood inundation maps, flood progression & recession maps and damage assessment maps were also disseminated by NRSC. NRSC continuously published the flood products and flood layers on Bhuvan and NDEM web portals. Value added satellite images showing the status of flood situation were also published on NRSC website.

Hon'ble Prime Minister Narendra Modi visited J & K on 7th September, 2014 and conducted an aerial survey of flood affected areas. He announced Rs. 1,000 crore of Aid for the state. Compensation was provided to affected (Rs. 2 lakh for the kin of the dead and Rs. 50,000 for those seriously injured) from PM's Relief Fund.

The Jammu and Kashmir flood had put forth many challenges to the state, which undertook following activities to respond.

- First and most important challenge was to rehabilitate those who had lost their houses and were living in shelter. An assessment on war footing basis as per the SDRF norms was carried out by Deputy Commissioners. On other hand departments responsible for restoration of essential public services took necessary steps for restoration of these utilities.

- More than 559 bridges and road length of nearly 6000 kms were damaged partially or severely. The water supplies, Power supplies and damaged roads & bridges were restored by concerned departments.

- 2543 school buildings had suffered damages and in response alternative arrangements were provided to make the schools operational.

- In order to revive the economy and support the business community a package was worked out to help them to revive their business activities again.

Some Recommendations and Preventive Measures

Following measures were recommended to be taken up to minimize the risks associated with flood:

- Construction of an alternate flood spill channel for Jhelum.
- Undertaking of feasibility study for construction of flood channel from Sangam/Kandizal to Whular.
- Widening of the spill channel running across Peerbagh and Nambali-Narkur to receive the waters of Doodhganga Nallah. Strengthening of the bunds and embankments and at places raising their levels to make low lying areas around them safe.
- Improving the river flood channels to hold water beyond 35000 cusecs with current capacity of 15000 cusecs by a comprehensive de-siltation programme both for river Jhelum and its tributaries.
- De-siltation in Valley Floor Lakes and revival of flood basin of Khushalsar, Gilsar, Anchar, Hokharsar, Shalabugh, and Haigam.
- Raising and strengthening of the low lying bunds (earthen ones) along the Nallah as these are always prone to breach.
- Developing a flood risk/hazard zonation map for Jammu and Kashmir in terms of assessment of physical and socio-economical vulnerability including making existing natural drainage networks (inlets and outlets) viable.
- Monitoring of sediment loads from catchments.
- Monitoring of Land use/Land cover of river basin.
- Having river monitoring and flood fore-warning system.
- Coming out with preparedness plan (evacuation strategy, optimum locations for SDRF teams/stores, relief/rehabilitation camp sites etc.), required policy institution and capacity building.
- Inventorization and reconstruction of dangerous buildings, flood zoning, relocation of buildings very close to the river banks, strict regulations to check future interferences with drainage system, restoration of wetlands and river training works.

- Capacity Building of all the stake holders including first responders and youth of the state to reduce the impact and provide local help to the victims.

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Cyclone Hudhud

India, world's seventh largest country in area, with a coastline stretch of 7516 Km is exposed to nearly 10 percent of the world's tropical cyclones. About 71 percent of this area is in ten states& UTs (Gujarat, Maharashtra, Goa, Karnataka, Kerala, TamilNadu, Puducherry, Andhra Pradesh, Orissa and West Bengal). The islands of Andaman, Nicobar and Lakshadweep are also prone to cyclones. On an average, about five or six tropical cyclones form in the Bay of Bengal and Arabian sea hit the coast every year. Out of these, two or three are severe.

Although cyclones affect the entire coast of India, the East Coast is more prone compared to the West Coast. Analysis of the frequencies of cyclones on the East and West coasts of India for the period 1891-2000, show that nearly 308 cyclones (out of which 103 were severe) affected the East Coast. During the same period 48 tropical cyclones crossed the West Coast, of which 24 were severe cyclonic storms.

Recurring cyclones account for large number of deaths, loss of livelihood opportunities, loss of public and private property and severe damage to infrastructure, thus seriously reversing the developmental gains at regular intervals. Broad scale assessment of population at risk suggests that an estimated 32 crore people, which accounts for almost third of the country's total population, are vulnerable to cyclone related hazards.

In the year 2014, the eastern coastline of India was jolted by a Very Severe Cyclonic Storm (VSCS) "Hudhud" which caused extensive damage and loss of life in the region.

Overview of Cyclone Hudhud

Hudhud, a very severe cyclonic storm was formed on 6th October, 2014 from a low pressure area which lay over Tenasserim coast and adjoining North Andaman Sea. It continued to intensify while moving northwestwards and crossed north Andhra Pradesh coast over Visakhapatnam (VSK) between 1200 and 1300 hrs IST of 12th October with the maximum sustained wind speed (MSW) of 180 kmph.

Hudhud was the first cyclone that crossed Visakhapatnam coast in the month of October, after 1985 and it made landfall on the same day as VSCS Phailin did in 2013. It caused very heavy to extremely heavy rainfall over North Andhra Pradesh and South Odisha, strong gale winds leading to large scale structural damage over North Andhra Pradesh and adjoining districts of South Odisha and storm surge over North Andhra Pradesh coast. Maximum 24 hour cumulative rainfall of 38 cm ending at 0830hrs IST of 13th October was reported from Gantyada (dist. Vizianagaram) in Andhra Pradesh.

Consequences of Cyclone Hudhud

The states of Andhra Pradesh and Odisha experienced severe consequences due to Hudhud cyclone.

Andhra Pradesh

In AP, about 9.2 million people in over 7285 villages in 4 coastal districts were affected resulting in 61 human causalities. Although the human causalities were relatively low, there was massive loss of livelihood in the affected areas. About 1,12,850 houses were partially or fully damaged in the coastal areas of Vishakhapatnam district alone. More than 7,52,540 households living on agriculture, horticulture, livestock, fisheries and handlooms, were severely affected. Agricultural and horticultural crops were severely damaged on account of cyclonic storm and floods due to heavy rains. A rapid damage needs assessment team of the World Bank estimated the total damages to the tune of about Rs. 13,263 Crores (US $ 2155 million) due to Hudhud.

Odisha

A large part of the State was affected and huge damages occurred in various sectors due heavy cyclonic wind, torrential rainfall and consequent flooding. Around 33.44 lakh people in 9657 villages were affected due to the cyclone. Three persons lost their lives due to cyclone. About 2,47,557 hectare of agriculture area was affected out of which an area of 40,484.50 hectare sustained crop-loss of more than 50% due to cyclonic storms. 198 large animals and 472 small animals were lost and 39350 more livestock and poultry were affected.

Due to cyclone, standing mulberry crop in 210.8 hectare and eri silkworm crop in 40.6 hectare of land belonging to 747 sericulture farmers sustained loss to the extent of 50% and above. Massive damage was caused to public properties like electrical installations, water supply works, roads, bridges, culverts, embankments, drains, tubewells, Lift Irrigation points, telecommunications infrastructure, Government buildings, etc as reported by government of Odisha.

Preparedness and Response

The VSCS Hudhud was monitored & predicted continuously since its inception by the IMD. The forecast of its genesis on 7th Oct., its track, intensity, point & time of landfall, as well as associated adverse weather like heavy rain, gale wind & storm surge were predicted exceedingly well with sufficient lead time which helped the administration to maximize the management of cyclone in an exemplary manner.

The Union Ministry of Home Affairs and State authorities of Odisha and Andhra Pradesh closely coordinated preparedness measures. The Air Force was kept in readiness to help in rescue and relief operations in case of requirement.

Reponses by Odisha

- Control rooms in different departments and district offices were activated and functioned round the clock. The Departments ensured their Field Officers remained in their respective positions.
- With a Mission to achieve `zero casualty', collectors of each district likely to be affected prepared the evacuation plan in respect of their districts giving highest priority to most vulnerable villages/ habitations.
- All cyclone and flood shelters were kept in readiness for the evacuees. The water supply, lighting and sanitation arrangements in the shelters were checked and curative measures taken.

- Required arrangements (especially food, water, light, medicine) were made at the shelters for the evacuees.
- As flood is always associated with cyclone, necessary boat arrangements were made in advance to take up rescue and relief operations for the likely flood.
- Water level of Dams and Minor Irrigation Projects (MIPs) was carefully monitored.
- Arrangements were made for pre-positioning adequate food materials including baby food for the affected people.
- Availability of sufficient food stuff in hostels of all residential schools of ST & SC Development Department and other Departments in the cyclone prone areas, was ensured by the Collectors and the Departments concerned.
- Adequate stock of POL was ensured by Food Supplies and Consumer Welfare (FS&CW) Department in the districts likely to be affected by the cyclone.
- Advance arrangements for supply of safe drinking water were made. Concerned departments made arrangements to run the pumps with generators in absence of electricity to pump water. Further, arrangements were made for supply of adequate potable water through tankers and in pouches in affected areas including the shelter places.
- Stocking of required medicines and arrangements for deployment of mobile medical teams was ensured.
- Advance arrangements for cattle health care and supply of cattle feed was made for the affected cattle population.
- Works, Rural Development, Panchayati Raj and Housing & Urban Departments made necessary advance arrangements for immediate restoration of road communication to facilitate movement of relief materials to the affected areas. Similar advance arrangements were made for restoration of power supply in-case of breakdown.
- The Fishermen were called back from the sea and advised not to venture into the sea.
- Police arrangement was made for maintenance of law and order to check stealing/ loot of public properties and relief materials which are usually on rise in the immediate aftermath of a disaster.

Responses by Andhra Pradesh

The timely action of Govt. of India and State Government after the Cyclone warning resulted in minimum causalities.

- Over 2,22,000 people were evacuated from low lying and vulnerable areas to 310 relief camps.
- In addition, 1688 medical camps were opened.
- About 2.9 million food packets and 6.5 million water packets were distributed over a period of 15 days.

This was made possible with the efforts of the Govt. of AP in close collaboration with district authorities, local self Government, National Disaster Response Force (NDRF), Indian Army and Navy.

NRSC role during Cyclone Hudhud

Satellite Data Analysis

NRSC carried out rapid cyclone inundation mapping and monitoring on daily basis from the satellite data acquired through Indian Remote Sensing (IRS) and Foreign satellites. In addition to inundation information, cumulative inundation maps and progression & recession maps were also disseminated to MHA, NDMA and government of AP to help in relief and rescue operations. These informations were continuously published on NRSC-Bhuvan and National Database for Emergency Management (NDEM) web portals.

HUDHUD mobile App, opened to public was launched by Bhuvan so that people could upload the information regarding the damage observed by them through their mobile phones. SMS was sent to more than 9000 users (officials) to download the App and share the field data. Automated field photographs were shared by AP government through quick mobile survey.

Aerial Data Analysis

High resolution photographs of Vishakhapatnam district covering about 600 sq. km from Venkatapuram to Bheemunipatnam were acquired by NRSC, ISRO during 13th-17th Oct. 2014. The aerial data was processed, analyzed and a rapid assessment was carried out to identify the infrastructure damage caused due to the cyclone Hudhud.

Crowd Sourced Data for Damage Assessment

An Android based mobile application was developed and uploaded on NRSC-Bhuvan portal to facilitate crowd sourcing. Crowd sourcing information on cell tower location, affected cell towers, total electrical sub stations, affected sub stations, damaged roads, crops, houses etc were published on Bhuvan portal to help the government of AP in providing relief. To assess the damage, many State and Central organizations came forward with new applications accessible through mobile phones, internet and File Transfer Protocol (FTP). The access to these applications was given to the organizations and public through crowd sourcing.

The field data for HUDHUD cyclone with 10 different categories through web interface towards crowd sourcing with moderation control was enabled by NRSC to bring the crowd sourced data, live.

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Malin Landslide

Landslides with cosmopolitan distribution affect 22 states and 2 union territories of India. The most sensitive areas are the Himalayan belt, the Nilgiris, the Western and Eastern Ghats. Landslides constitute a serious hazard that causes substantial human and financial losses in

the country. It is estimated that annually on an average about 300 human lives are lost and approximately Rs. 300 Crores are lost every year.

The worst part associated with landslide disaster is its multi-hazard nature. It also strikes along with or as a consequence of other disasters like earthquakes, floods, cyclones, cloudburst, dam / lake bursts etc. In such cases, landslide losses are normally included within the primary disaster and hence, are not dealt separately. Thus, most of the reported estimates on landslides losses are found to be quite lower than the actual impacts of landslides on the society as a whole.

With growing population, urbanization and human interventions in terms of developmental activities over unstable slopes, landslides pose increasing risk to human lives, buildings, structures, infrastructure and environment. Changing climatic conditions manifesting in the form of global warming, glacial melting, erratic and uneven rains, extreme temperature conditions etc. are also extending these risks to even unexpected areas. Large scale deforestation along with faulty management has led to increased vulnerability to landslides in many regions of the country. Human activities relating to expansion on unsafe locations, unscientific mining, unsafe construction of roads, dams and river training works ignoring natural features contribute to increased intensity of landslides.

Malin Landslide: An Overview



A View of Malin Landslide
Resource: http://blogs.agu.org/landslideblog/2014/07/31/malin-landslide-1/

On 30th July, 2014 the Malin village in the Pune district of Maharashtra witnessed catastrophic mud avalanche of the year. The village Malin is located approximately 45km NW of Ghorhegaon, and 120km NNW of Pune at latitude of about 19o9'41.58'N and Longitude of 73o41'19'E, at approximate elevation of 796 m. The village is about 20-25 km from the multi-purpose Dimbhe Dam site, forming a part of the foothills of Sahyadri Mountain range of the Western Ghats and is occupied by tribal population that depends on agriculture over terraced fields. The cloudburst that followed the two days incessant rains triggered the landslide that engulfed more than 150 persons. More than 40 houses got amalgamated in the landslide debris after these were hit by the landslide. The landslide got initiated from the top of the hillock and moved up to the river level, thereby blocking the road with debris.

Causes of Malin Landslide

The Northern Western Ghats region of the country receives heavy rainfall in the monsoons. During the last week of July, especially 25th – 31st July, the area receives very heavy rainfall. Cumulative rainfall in the week as recorded by NASA's TRMM (Tropical Rainfall Measuring Mission) was more than 600 mm. In fact on the 29th July, the region including Malin was shown purple in 24 hr rainfall map, which signifies the highest range of rainfall, exceeding 175 mm.

According to the Geological Survey of India (GSI), along with heavy rainfall, flattening of the ground around the halfway mark of the hill for cultivation and excessive deforestation are responsible for the landslide in Malin village of Ambegaon taluka.

The GSI experts also blame use of heavy machinery over the past two years to level the land for cultivation. They noticed cracks in the ground in places where soil had eroded and was washed away downhill. These cracks were a result of improper drainage system of rainwater. The flattening of land would have affected the water drainage resulting in the cracks.

Rescue and Response

For the rescue operation, around 378 personnel of the National Disaster Response Force (NDRF) were deputed to the landslide area. Seven NDRF teams rushed to Malin gaon soon after the district administration sent in a request. Two more teams of the NDRF pre-positioned at Andheri Sports Complex, Mumbai, left for Malin gaon in the afternoon.

All the nine teams assigned for the rescue operations comprised doctors and paramedics, besides personnel trained as medical first responders. These teams were carrying state-of-the-art rescue equipment and communication sets. In addition, two unmanned aerial vehicles (UAVs) were helping the forces with the rescue work.



Rescuers using excavators battle through heavy rains in their search for survivors
Resource:http://www.scmp.com/news/asia/article/1563537/rescuers-race-find-survivors-india-landslide-death-toll-rises

After working day in and day out constantly for a week and extracting 151 bodies from debris, the officials of National Disaster Response Force (NDRF) announced that the rescue operation at Malin village was over. The rescue teams found total 146 bodies which were intact while they found ten body parts like hands and legs. The medical teams counted these body parts as five bodies and therefore the figure had reached to 151 bodies. Since the numbers were matching with the number given by the district administration, the operation was called off.

Way forward

The episode of Malin landslide once again drew attention to our failure in recognizing such disasters and to take proper steps to mitigate them. Northern Western Ghats which are characterized by heavy rainfall, rich biodiversity and predominant tribal population need more sensitive management approach than what it is subjected to. Such incidences give an idea about the vulnerability and complex inter-linkages that affect the region, which require a long term planning vision integrating a number of components.

The foremost responsibility is to usher the culture of safety in a way that progress is seen on the ground and touch the imagination of the people. Whenever landslide disasters strike, we rush to lean on fixed ideas in our minds. It has almost become ritualistic to name rainfall to explain away cataclysmic floods and devastating landslide events, without even attempting to understand the slope dynamics. We can understand landslides only by systematic geotechnical, geomorphologic, hydro geological and seismic characterization of slopes, and study of the environmental impact of urbanization.

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PATNA STAMPEDE

Stampede delineates an abrupt sprint with no clear direction or purpose of an impulsive mob of people, usually resulting in many fatalities and injuries from suffocation and trampling. The most salient features of stampede include homogeneity of thought and action among its participants and their impulsive and irrational actions. In recent time human stampedes have been identified as a major disaster that could occur during any mass gathering. In India, religious gatherings and pilgrimages have been venue for 79% of the stampede.

The disaster (stampede) can occur in any place where huge mass of people assemble in absence of quality crowd management strategies. A simple model with the acronym "FIST" provides a basic understanding of stampede. The acronym elements are defined as the crowd Force (F); the Information (I) upon which the crowd acts; the physical Space (S) involved, both in terms of individual density and larger scale architectural features; and Time (T), the duration of the incident. The model is used to illustrate crowd characteristics and to develop guidelines for the prevention of crowd disasters. The real time information and communication are key factors in preventing stampede.

Patna Stampede

On 3rd October, 2014 tens of thousands of people had gathered at Gandhi Maidan in Patna for Dussehra celebration. The celebration turned into a tragedy as a consequence of stampede in which 33 people were killed and 29 others injured. Amongst the dead, there were 5-6 children and around 20 women. The post mortem examination of the victims bodies identified asphyxia as the main cause of the deaths. According to eyewitnesses the misfortune struck at around 7 pm at the south east corner of the ground near the Exhibition Road when people who were returning after watching the "RavanaVadh" event jostled with each other to move ahead.



A view of the crowd gathered during the Dussehra celebrations at Gandhi maidan in Patna
Source: http://indianexpress.com/article/india/india-others/32-people-killed-15-injured-in-stampede-in-patna/99/

Causes of the Stampede

Some eyewitnesses claimed that the stampede was triggered by rumors that some people had come in contact with a live wire. There was such a rush towards the exit gate that several women and children were run over.

There was inadequate street lighting on the south-east side of the Gandhi Maidan as a result of which several people fell on each other in the darkness as the crowd ran in panic, said an eyewitnesses. However, the two-member committee comprising principle secretary (Home) and ADG (Headquarters) found that a rumour of electric current in a telephone cable at the southern gate led to the stampede. They also blamed poor lighting near the gate, broken cowcatcher, non-functional high-mast, lax magistrates and police force on duty and non-availability of public address system for so many deaths.

Many blamed the district police for keeping most exit gates shut at the massive ground, forcing the crowds to leave from the same gate.

This was the second such tragedy in Patna in less than two years. During the Chhath festival in November 2012, 21 people had died in a similar stampede.

Compensation

The state government announced ex-gratia of Rs. 3 lakh each for the next of kin of the dead. The Centre also announced an ex-gratia of Rs. 2 lakh to the next of kin of the deceased and a compensation of Rs. 50,000 for the critically injured.

Crowd Management Strategies and Arrangement

To avoid stampede like tragedy, a proper crowd management strategy and arrangements are required during the arrival of crowds; during the event at the venue and during the departure. Various elements of crowd management strategy are: a) Capacity Planning (long and short term), b) Understanding Crowd Behaviour, c) Crowd Control, and d) Stakeholder approach. National Disaster Management Authority (NDMA) came up with a document "Managing Crowd at Events and Venues of Mass Gathering, A Guide for State Government, Local Authorities, Administrators and Organizers" in 2014, which illustrates the crowd management in detail.

Do's and Dont's for Stampede

- It is advisable to move in groups from the camps with the assistance of the controlling authority or group leader or police person.
- Do not try to go against the direction of the crowd.
- Do not lose temper and do not fight with others.
- Understand the evacuation routes, emergency exits and layout of the place of event.

- Keep calm. Don't panic.
- In case of emergency do not run.
- Think before you do. Do not just blindly follow others.
- Follow instructions given by the authorities, public address system etc.
- Do not spread rumors.
- Assist and collaborate with the organizers, authorities, fire services. Police etc.

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ACUTE ENCEPHALITIS SYNDROME and JAPANESE ENCEPHALITIS EPIDEMIC

Acute encephalitis syndrome (AES) is a multi-factorial clinical condition, the most common cause being **Japanese Encephalitis (JE)**. JE is a vector-borne viral disease caused by the JE virus of group B arbovirus (Flavivirus) and is transmitted to humans by the Culicine mosquito. The outbreak of Japanese encephalitis (JE) in some regions of India in

year 2014 created a havoc. The most affected parts of country were Assam, West Bengal, Uttar Pradesh and Bihar.

Countries with proven epidemics of JE include India, Pakistan, Nepal, Sri Lanka, Burma, Laos, Vietnam, Malaysia, Singapore, Philippines, Indonesia, China, Siberia, Korea, and Japan. In year 1955, JE was first time recognized in Tamil Nadu, India. Since then many major outbreaks have been witnessed by different parts of the country.

After the year 1972, Japanese Encephalitis (JE) extended to newer regions of the India and its outbreaks were reported from West Bengal, Uttar Pradesh, Assam, Manipur, Bihar, Andhra Pradesh, Pondicherry, Karnataka, Goa, Kerala and Maharashtra.

Signs and symptoms

Most JE virus infections are mild (fever and headache) or without apparent symptoms, but approximately 1 in 250 infections results in severe disease characterized by rapid onset of high fever, headache, neck stiffness, disorientation, coma, seizures, spastic paralysis and death.

Of those who survive, 20%–30% suffer permanent intellectual, behavioral or neurological problems such as paralysis, recurrent seizures or the inability to speak.

Mortality and morbidity

The disease has mortality rate of approximately 25% to 30%, but it can be reduced by intensive care support. Patients often suffer significant long-term morbidity. Some effects, such as learning difficulties and behavioral problems, can be subtle and may remain undetected for several years. More than half percentages of the people who recover from the JE suffer from neurological deficit.

JAPANESE ENCEPHALITIS

Japanese Encephalitis in Assam

The deadly outbreak of Japanese Encephalitis (JE) and Acute Encephalitis Syndrome (AES) claimed 388 lives in Assam. According to health officials estimate, over 2,170 cases were detected in the region. Almost all 27 districts in the state were affected. The worst hit districts in Lower Assam were Sonitpur, Barpeta, Nalbari, Darrang, Kamrup (Rural) and Kamrup (Metro), while in the Upper Assam these were Tinsukia, North Lakhimpur, Jorhat, Dibrugarh, Dhemaji and Golaghat.

The moist climate, deep forests and dense network of water streams make Assam favorable place for such viral disease. Mosquitoes, the principal vectors, are prolific in rural areas where their larvae breed in ground pools, especially in flooded rice fields.

Japanese Encephalitis in West Bengal

254 people lost their life due to encephalitis outbreak in West Bengal in 2014. According to state health services, out of 254 deaths, Acute Encephalitis Syndrome (AES) claimed 209 while 45 plunged prey to Japanese Encephalitis (JE). The worst affected areas in the state were Malda, Jalpaiguri, Coochbehar, Darjeeling, Uttar and Dakshin Dinajpur.

Japanese Encephalitis in Bihar

In 2014,857 cases of Acute Encephalitis Syndrome (AES) were reported in Bihar out of which 159 people succumbed. Muzaffarpur, East Champaran, Vaishali and Sitamarhi region of the state were severely affected by the viral disease.

Japanese Encephalitis in Uttar Pradesh

In 2014, 510 cases of Acute Encephalitis Syndrome (AES) and Japanese Encephalitis (JE) were reported in the State of Uttar Pradesh. The number of death due to AES and JE were 123 and 9 respectively. The major affected areas for the disease in the state were Gorakhpur, Kushi Nagar, Siddharth Nagar, Maharajganj, Deoria, Basti and Sant Kabir Nagar.

Management of Japanese Encephalitis

The severe morbidity and mortality due to Japanese encephalitis can be reduced by simply identifying its early warning signs and referring patient to health facility and educating the health workers about the first line of management at the grass root level 9.

Treatment of patients at health facility depends upon the condition in which he is received. Exclusion of other causes of Central Nervous System (CNS) affliction like meningitis or cerebral malaria is done. The treatment of the patients may require:-

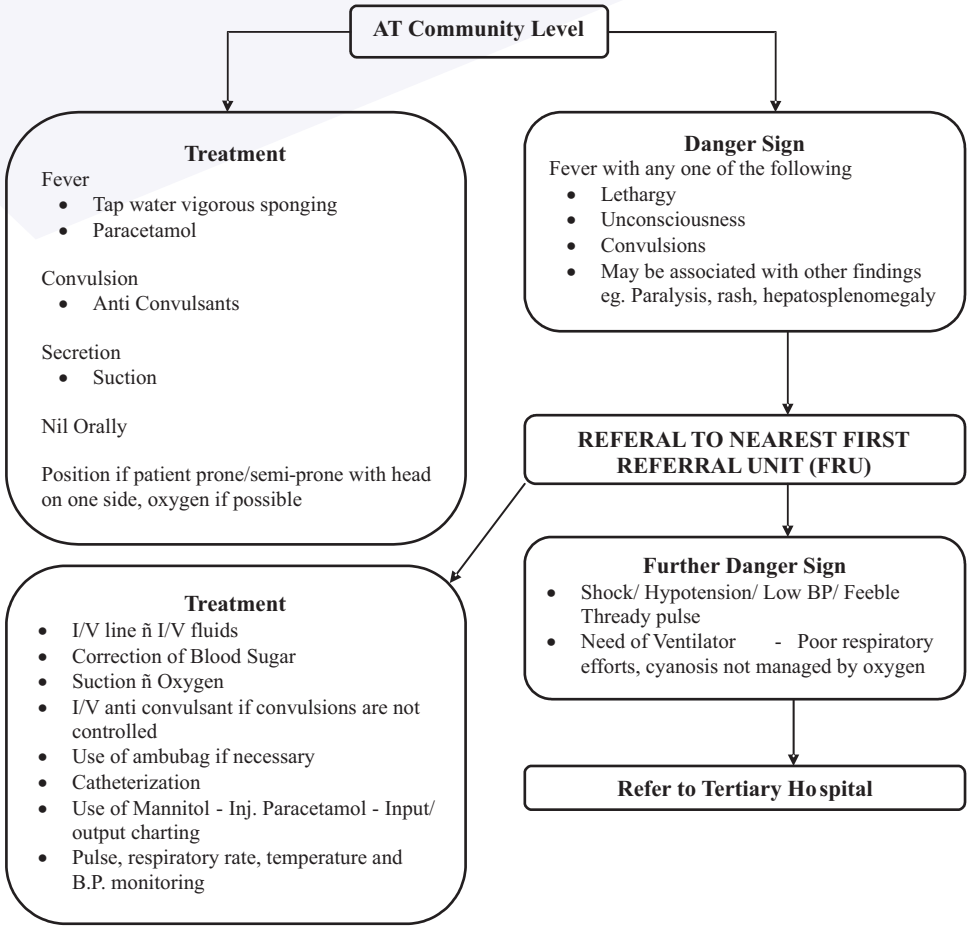
1) Management of Airways and Breathing and Circulation

2) Control of Convulsions and Intracranial pressure

3) Temperature monitoring

4) Fluid and Electrolytes and Calories/ Nutrition

5) Investigations, Samples Collection & Transportation



Management of AES including Japanese Encephalitis

Source:http://nvbdcp.gov.in/Doc/Revised%20guidelines%20on%20AES_JE.pdf

Detailed management of Japanese Encephalitis is given in "Guidelines- Clinical management of acute encephalitis syndrome including Japanese Encephalitis".

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Road Accidents and Other Incidents

During the year 2014, 489400 road accidents occurred and these resulted in 139671 deaths. The following table denotes the State/UT wise data of persons killed and injured in road accidents.

Table: Total number of accidents, persons killed and injured during the calendar year 2014

Sl. No	States/UTs	Total Accidents	Killed	Injured
1	Andhra Pradesh	24440	7908	29931
2	Arunachal Pradesh	205	119	308
3	Assam	7144	2522	6499
4	Bihar	9556	4913	6640
5	Chhattisgarh	13821	4022	13157
6	Goa	4229	290	1879
7	Gujarat	23712	7955	22493
8	Haryana	10676	4483	8944
9	Himachal Pradesh	3058	1199	5576
10	Jammu & Kashmir	5861	992	8043
11	Jharkhand	5201	2628	4356
12	Karnataka	43713	10452	56831
13	Kerala	36282	4049	41096

14	Madhya Pradesh	53472	8569	55335
15	Maharashtra	61627	12803	40455
16	Manipur	743	168	1295
17	Meghalaya	542	141	311
18	Mizoram	132	103	234
19	Nagaland	305	81	230
20	Odisha	9648	3931	11087
21	Punjab	6391	4621	4127
22	Rajasthan	24628	10289	27453
23	Sikkim	203	59	352
24	Tamil Nadu	67250	15190	77725
25	Telangana	20078	6906	21636
26	Tripura	716	188	1225
27	Uttarakhand	1410	878	1531
28	Uttar Pradesh	31034	16287	22337
29	West Bengal	12875	5875	12018
30	Andaman & Nicobar Islands	218	23	283
31	Chandigarh	369	131	335
32	Dadra & Nagar Haveli	87	59	96
33	Daman & Diu	39	15	49
34	Delhi	8623	1671	8283
35	Lakshadweep	1	0	1
36	Puducherry	1111	151	1323
	Total	**489400**	**139671**	**493474**

Source: Ministry of Road Transport & Highways, Government of India

In addition to the road accidents, various other incidences occurred during the year 2014. These have been tabulated below by obtaining data from various media reports.

Table: Other incidents

Sl. No.	Month	Place	Description	Source
1.	January	Goa	31 workers were killed and 30 injured when an under-construction five-storeyed building at Chaudi in Canacona collapsed	The Hindu
2.	January	Maharashtra	At least 18 persons were killed in a stampede in South Mumbai area	PTI
3.	January	Andaman and Nicobar Islands	Twenty-two tourists were drowned when a private tourist boat capsized in the seaoff Port Blair.	The Hindu
4.	February	Odisha	In a major tragedy in Odisha, at least 29 persons died when a motor boat carrying over 110 passengers capsized near Pitapali inside the Hirakud reservoir, about 20 km from Sambalpur.	News on air
5.	February	Andaman and Nicobar Islands	22 persons were killed as their boat capsized in the sea in the Andaman & Nicobar Islands. More than 29 people were rescued by district administration.	PIB, GoI
6.	March	Maharashtra	Heavy rain accompanied by hailstorms in 28 districts of Maharashtra claimed the lives of at least 12 people and caused widespread damage to crops, affecting nearly five million farmers	IANS
7.	March	Jammu and Kashmir	At least 11 people, including two army jawans, were killed while over 100 others were evacuated to safety as the unprecedented snowfall triggered avalanches and damaged over 150 structures including dozens of houses in Jammu and Kashmir	PTI
8.	March	Maharashtra	Unseasonal rains accompanied by severe hailstorms left at least 28 people dead and over 100 others injured across Maharashtra	IANS
9.	March	Jammu and Kashmir	The untimely snowfall in Jammu and Kashmir claimed 17 lives and left nearly 2,000 houses damaged in Kashmir division	Zee News

10.	March	Odisha	At least fifteen people drowned while taking bath in rivers and ponds after the Holi celebrations.	News on air
11.	March	Rajasthan	As many as 10 women drowned when the boat they were boarding capsized in Bisalpur Dam in Tonk district.	PTI
12.	April	Uttar Pradesh	At least 27 persons were killed and more than 30 injured in a strong duststorm that lashed Uttar Pradesh. Ten persons were killed in Farukhabad, six including two children in Barabanki, three each in state capital Lucknow and Sitapur, two each in Hardoi and Jalaun and one in Faizabad.	Zee News
13.	April	Madhya Pradesh	Twenty people were feared drowned in Sindhu River near Datiya in Madhya Pradesh. The incident took place in Sewra where 40 members of a family were going to attend a marriage ceremony in a boat which capsized during a storm.	The Times of India
14.	May	Madhya Pradesh	17 lives were lost due to fire at a cracker factory in Badnagar town of Ujjain district.	Hindustan Times
15.	May	West Bengal	In West Bengal, at least 14 people were killed and several others injured in lightening at various parts.	News on air
16.	June	Bihar	Lightning claimed ten lives and injured several others when a thunderstorm swept the north-eastern part of Bihar.	Zee News
17.	June	Himachal Pradesh	24 students from Hyderabad drowned in Beas river at Thalout in Mandi district.	Times of India
18.	June	Andhra Pradesh	The deadly fire-blast caused by leakage from a GAIL gas pipeline killed 19 people	Zee News
19.	June	New Delhi	Ten people including five children and three women were killed while two others injured when a 50-year-old dilapidated four-storey building collapsed in a congested area in north Delhi.	The Indian Express

20.	June	Tamil Nadu	61 people were killed when a portion of a 12-storey building under construction near Porur in Chennai collapsed in heavy rain	The Times of India
21.	July	Tamil Nadu	11 construction workers from Andhra Pradesh were crushed to death after a newly built compound wall adjacent to their huts collapsed near Uttarapalayam in Tiruvallur district.	News on air
22.	July	Tripura	67 people died from the malaria disease and many fell ill within the month of July	The Times of India
23.	July	Bihar	A total of 156 deaths due to encephalitis were reported from Bihar's Muzaffarpur district and other adjoining districts from January to July	Zee News
24.	August	Uttar Pradesh	The boat carrying over 42 persons capsized in the Ganga River between Varanasi and Mirzapur in Betawar-ghat killing 12 people.	Zee News
25.	August	Odisha	Vast areas in the delta region of Mahanadi river system were inundated by flood waters killing 45 people and affecting over 17.8 lakh people.	DD News
26.	August	West Bengal	The total of 212 deaths occurred in the entire state due to different types of encephalitis since January	News on Air
27.	August	Uttarakhand	52 people lost their lives due to floods and landslides in Uttarakhand.	Zee News
28.	August	Madhya Pradesh	Ten people were killed and dozens more injured in a stampede at a temple in Chitrakoot area, which falls in the northern Vindhya range of mountains spread over the states of Uttar Pradesh and Madhya Pradesh	News on Air
29.	Septem-ber	Assam & Meghalaya	Floods wreak havoc in the states of Assam and Meghalaya in the month of September 2014. A total of 85 people were killed due to heavy floods and inundation in both the states. While 39 people were	Hindustan Times

			killed in Assam, 46 deaths were reported from Meghalaya.	
30.	December	Uttarakhand	Intense cold wave conditions accompanied by snowfall left 24 people dead in Uttarakhand	Zee News
31.	December	Uttar Pradesh	The dense fog and extreme cold claimed at least 125 lives in Uttar Pradesh	News on AIR

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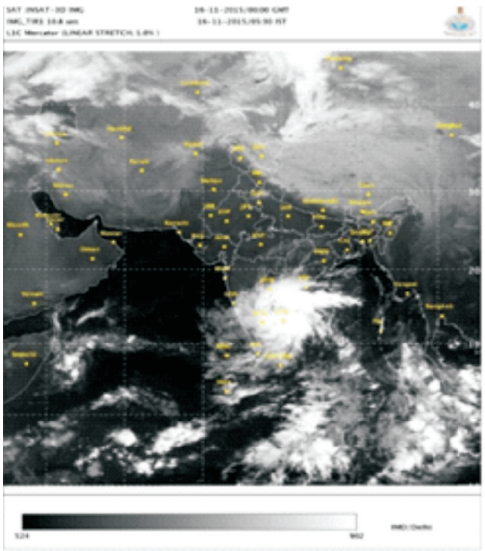
2015

CHENNAI FLOODS

Chennai, the capital of Tamil Nadu, one of the biggest metropolitan cities of India, and sixth-most populous city, has a long history of natural disasters. During the months of October, November and December, the North-East monsoon mainly contributes to rainfall for the city. In November and December 2015, floods in Tamil Nadu, Andhra Pradesh and Puducherry brought in horrific devastation. Chennai was most affected by the floods. The floods were a result of poor urban planning and some other factors. About 470 people were killed, 12,000 cattle died, and millions of people were displaced in the state. In addition to the huge loss of public property, about 4.92 lakh houses were destroyed. The crop area which got damaged, was 3.83 lakh hectares. Overall estimated loss was Rupees 20 thousand to 1 lakh crores.

The Chennai flood: An Overview

Indian state Tamil Nadu experienced devastating floods in November and December, 2015.Incessant rains in November led to massive floods in Chennai city and other parts of Tamil Nadu.

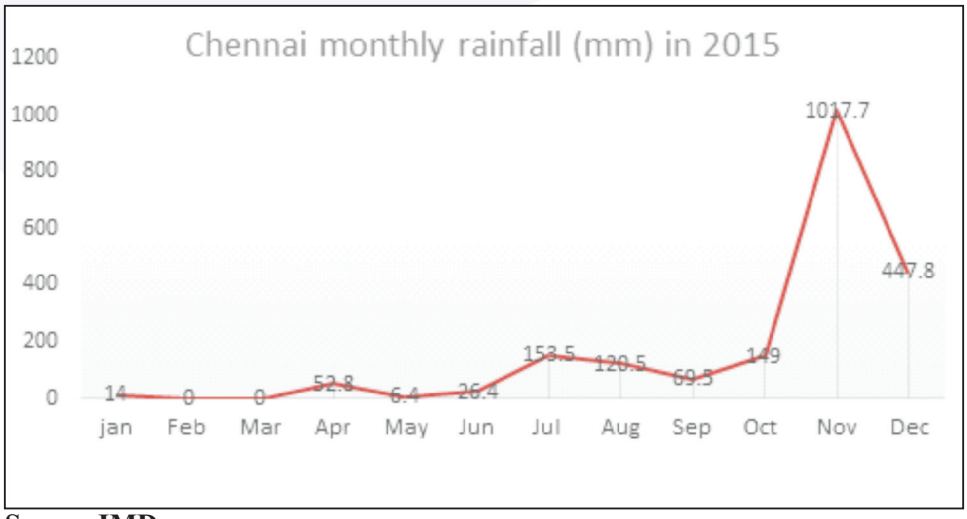


Source: IMD

The El-Nino of 2015 was one of the strongest reported, which had impact on North-East Monsoon. This brought incessant rains in parts of Tamil Nadu including Chennai.

Chennai received 1,017.7 mm of rainfall in November, 2015, the highest recorded since November, 1918, when 1088 mm rainfall was recorded. There has been heavy rainfall in every 10 years 1969, 1976, 1985, 1996, 1998, and 2005. Chennai city alone has experienced five major floods from 1943 to 2005. The chart given below denotes the monthly rainfall (in mm) in Chennai during 2015.

Chart-1



Source IMD

Chart-1 clearly shows that chennai received the heighest rainfall in November, which was excessive in any measure. As per the Indian Meterological department (IMD) Chennai received 1017.7 mm rains in november, which was nearly 177 per cent above the normal observation of 407.2 mm.

Table 1 – Rainfall Pattern of the most affected Districts during North East Monsoons, 2015

Sl. No.	District	Actual Rainfall for 5 Days (in mm)	Normal Rainfall for 5 Days (in mm)	Excess %
1.	Chennai	399.0	40.6	+883 %
2.	Kancheepuram	467.2	34.5	+1254 %
3.	Tiruvallur	335.2	34.8	+863 %
4.	Cuddalore	274.8	49.9	+451%
5.	Nagapattinam	263.1	73.9	+256 %
6.	Vilippuram	240.0	27.8	+764 %

(Source: Tamil Nadu Floods: Lessons Learnt & Best Practices – A report of NDMA)

Table-1 clearly shows the districts which received heavy rainfall. The incessant downpour rapidly filled the Chembarabakkam Dam (located on the outskirts of chennai) that forced authorities to release 29,000 cusecs water from the Chembarambakkam reservoir into the Adyar river for over two days causing floodswhich submerged neighborhoods on both sides.

Areas south of Chennai experienced heavy rainfall between 29th November and 2nd December. Between 1st and 2nd of December Chennai itself received more rainfall in 24 hours than it had on any day since 1901. This caused widespread flooding throughout Chennai, however areas which faced the worst flooding include Jaffarkhanpet, Saidapet, kottupuram, Adyar and Chennai airport.

Consequences of the Chennai floods

The outcome of this unprecedented level of downpour was immediate and disastrous with major water bodies getting filled and flowing into major rivers, Adayar, Coovum and Kosathalaiar coupled with the heavy downpours in the city, which could not drain into the Adayar river.

Chennai & Tamil Nadu

The floods filled the rods and streets of the densely populated areas of Chennai City. This flood put a large number of urban population of the affected areas in great difficulty and caused severe damage to public and private property. Flood waters entered into a large numbers of houses in many areas of Chennai and other districts, forcing the inhabitants to evacuate from lower floors of their houses and move to upper floors for safety. The loss of life on account of these floods in the State was 470 upto 31.12.2015, and it also caused severe damages to roads, bridges, electrical and other public infrastructure.

There was shortage of necessary supplies, drinking water and communication. In various parts school and colleges were closed. At the MIOT Hospital, 14 patients died due to power and oxygen failure. Chennai airport was shut till 6th December, 2015 and many people were struck at the airport. Image-3 below shows submerged Chennai airport on 2nd December.



(Image-3) Ariel view of Chennai airport on 2nd December, 2015 (source- CNN)



Image-4 (source-cnbc.com)

Image-4 People sitting on the wooden trough in flood plains on Chennai on December 3



Image-5 (source- ndtv.com)

Image-5 the lower parts of the city and the areas near the Adyar River were badly affected by the flood

POSSIBLE CAUSES

Impact of climate change:

Global warming played a large role in the rains of 2015. The 2015 EL-NIÑO together with strong upper air divergence and high moisture content at lower level had affected northeast monsoon in India and had caused heavy precipitation over Chennai.

Lack of awareness about pre warning:

On December 1st 2015 Chennai was facing heavy rains and at the same time Chennai authority released 25,000 cusecs of water from Chembarbakkam Dam. Although the flood warning was given before releasing the water, but large population of Chennai was not aware of it.

There were many other reasons for the flood, like lack of awareness, illegal construction, encroachment etc. However, CAG Report highlighted few other reasons for such situation. It said lack of mainstreaming flood mitigation in Master Plan of Greater Chennai, lack of legislation for flood plain zoning, lack of modernized flood forecasting equipment using real time data, lack of emergency action plan for management of reservoirs were main reasons for devastation in Chennai.

Illegal Constructions and Encroachment

- Over 650 water bodies had been encroached or land use had been switched to make space for IT parks, residential colonies etc. and the number of water bodies came down to less than 30. This reduced city's natural holding capacity of water drastically.

- Chennai's infrastructure and residential construction had increased nearly 13 times since 1991, while the flood plains and open areas reduced by a quarter. Northwest and southwest zones of Chennai had the most unplanned growth.

Role of Government of India

The Central Government supported the Tamil Nadu Government in the relief and evacuation operations by providing assistance of the Indian Army, Navy, Air-force and NDRF. The National Crisis Management Committee chaired by cabinet Secretary Shri P.K. Sinha, met daily between 2nd to 5th December and again on 7th December to ensure that necessary relief and assistance was provided for the rescue & relief operations. Apart from this, for the coordination of various operational matters, the national executive committee met daily with various ministries of the Government of India, from 2nd to 5th December and again from 7th to 11th December.

On 4th December, 500 liters of milk, 1 lakh bottled water and other food items were sent to Tamil Nadu state. Despite heavy downpour, BSNL kept its services operational and provided free services for a week in the state. Government of India also released financial assistance to the affected state in two phases. In the first phase, it released assistance of Rs. 388.42 crores in advance and also released Rs. 1000 crores from National Disaster Response Fund for immediate relief operations in the second phase.

Role of the State Government

In the first phase of the crisis, Tamil Nadu government had made all reasonable efforts to save the state from the huge havoc of disaster. The state government sought the services of NDRF, Army, Navy and Air-force from the central government

Relief and Rehabilitation

In order to handle the situation arising out of the disaster, more than 80,000 personnel comprising of six teams of State Disaster Response Force, 6 teams of Coastal Security Group, 1400 personnel of the fire and rescue department, 30,000 personnel of Tamil Nadu police and 45,000 personnel from municipal administration, rural development department and local volunteers were deployed in rescue and relief operations round the clock from the state government's side.

In all, 19,37,593 persons were rescued, evacuated or moved to safer places throughout the State and put up in 7,069 relief camps. Food, milk and safe drinking water were provided to all these persons. As on 15.12.2015, a total of 1,34,32,953 food packets had been distributed to persons in relief centres as well as others affected by the floods. 695 metric tonnes of milk powder had been distributed to the families with young children in the relief camps.

As on 15.12.2015, 31,320 Medical Camps had been conducted and about 32.46 lakhs had been treated in these camps. Nearly 5 lakh sanitary napkins were distributed to women in the flood affected areas including in relief centres.

The problem of inundation was addressed on a war footing. 470 heavy duty pumps of capacities ranging from 10 hp to 200 hp were deployed at various locations to pump out the water. Pumps of the Corporation of Chennai, Chennai Metrorail Limited, Neyveli Lignite Corporation and from various other private sources both from within and outside the State had been deployed. Heavy duty pump sets were also airlifted from New Delhi. In addition, 71 super sucker machines, 49 Fire and Rescue Department vehicles, 82 JCBs/Poclains, 111 jet-rodding machines and 200 desilting machines were deployed to pump out the water or to cut open channels to dewater flooded areas.

In Chennai city, Electricity was restored by the night of 6th December, 2015 in 95% of the areas, except in areas which still had some residual inundation. With the cooperation of telecommunication department 75% telephone connectivity was restored by December 5.

People of the affected areas had lost their valuable belongings in the floods, which included important records such as patta, educational certificates, Aadhar card, voter ID cards, bank pass books, RC books, driving licences etc. The State Government had taken a special initiative to expeditiously provide duplicate copies of these important documents. Special camps were organised at Taluk level for two weeks, beginning 14th December, 2015, for issue of certificates to persons who had lost them in the floods. Arrangements were also made to receive applications for replacement of such documents at Common Service Centres.

On 17th November 2015, Tamil Nadu Government initially raised Rs. 500 crore for relief and restoration works from SDRF (State Disaster Response Fund). On 15th December, 2015, the State Government raised Rs. 1000 crores for payment of pre-relief amount to affected families and Rs. 300 Crore for immediate restoration of roads, drains, tap water pipes and sewers in urban localities. 4159 people were appointed for the enumeration and identification of the affected families. In compensation, in addition to Rs. 5000, 10 Kg rice, a dhoti, and a saree were given to those affected families which lost their clothes, and other household goods. An extra amount of Rs. 5000 was provided to those who had lost their huts. Compensation money was deposited into bank account while aid assistance including rice, dhoti, and saree was distributed through PDS (Public distribution system) stores. The loss of livestock was compensated with Rs. 10,000 for cows and buffalos, Rs. 3000 for loss of pigs and goats, and poultry was compensated at Rs. 100. The state government arranged special camps at Taluk level for two weeks for people who lost their important records such as educational certificate, aadhar, voter ID card, bank passbook, vehicle RC, driving license, etc. 37,707 students who had lost their study material during the disaster, were issued textbooks, notebooks and one set of school uniform.

Social Media

Government officials also provided updates on Facebook and Twitter that were giving information about the situation. Social media became an important tool of communication and a way to reach out to loved ones.

Rescue Operations

A massive rescue operation was set and the priority of the Government was to ensure no loss to human life. 50 teams of NDRF were deployed with 194 boats. Indian Army, Navy and Air Force with 2 Inflatable Geminicrafts, 4 helicopters and 4 remote piloted air-crafts all were pressed in action.

National Disaster Response Force (NDRF)

50 teams (1700 personnel) of National Disaster Response Force (NDRF) along with 194 boats, 1571 life jackets, 1071 life buoy, 40 diving sets, 100 divers and other flood rescue equipment were deployed in Tamil Nadu as follows:-



(Image-6) National disaster response force carried an elderly women and a dog from floodwaters(source-wbur.org)

- Chennai - 32 teams,
- Kanchipuram - 06 teams,
- Thrivallur - 02 teams,
- Nagapattnam - 05 teams,

- Thoothukudi - 03 teams,
- Tirunelveli - 02 teams.

During 14th-27th November, 11 teams of National disaster response (NDRF) rescued over 10,000 people in Tamil Nadu and safely shifted them to relief camps.



(Image -7) NDRF team carrying out relief works in Velachery, one of the worst flood-hit areas in Chennai (source- Indian express)

Table- 2 Shows the Details of rescue work done and relief material distribution by National Disaster Response Force (NDRF) in Tamil Nadu

Rescue work done by NDRF	Number
Persons rescued	22450
Livestock rescued	30
Dead bodies retrieved	13
Medical Help	359 persons
Medicine	46 Boxes
Relief material distribution by NDRF	Number
Food Packets distributed	2,41,904
Water Packets distributed	2,10,372
Milk Pouches	22,186
Atta	2800 Kg
Rice	5150 Kg
Misc. Food Pkt.	8581
Misc. Items	16030

Cloths/Blanket	56,965
No of food material trucks	4

Indian Air Force Operations



(Image-8) Air Force Station at Tambaram, soldiers load food supplies onto a chopper (source- wbur.org)

After incessant rains that affected many parts of Tamil Nadu and Andhra Pradesh, Indian Air Force (IAF) was pressed into service for rescue operations. IAF conducted 25 sorties for the rescue and relief operations. It rescued 25 stranded people including six women and twelve infants, who were airlifted from inundated parts of Chennai by chetak/cheetah helicopter. It also air dropped 5000 kgs of supplies. Air-bridges were established by IAF between Arokonnam and Tambaram Air Base on 4th December to rescue over 200 people.

The Indian Navy Operations

Indian Navy also took up rescue operations and pressed into action itsteams including INS Airavat, Geminis, as well as a fleet tanker to rescue stranded people from remote locations and carried out operation "MADAD"



(Image-8) Indian Navy's amphibious ship INS Airavat rushed to Chennai to participate in relief operation (source-The Hindu)

Chennai airport was shut due to floodwater and no air craft could take off. INS RAJALI which is based at Arakkonam was activated and all the relief material as well as the civil flights started operating from Arakkonam.

On 4th December, Eastern Naval command had dispatched two more ships INS Shakti and INS Sahyadri to Tamil Nadu carrying 18 Gemini boats, 105 divers, 3000 towels, 200 tents, 10 field kitchens, milk packets & milk powder,



(Image-9 & 10) Indian Navy forces rescuing people and distribute relief materials (source- indiannavy.nic.in)

food, medicines, generators, 5000 liters of portable water.700 tons of fresh water and many other essential items for marooned people.

Indian Army operations

1200 personnel of Indian army from different units and regiments engaged in relief and rescue operation across Chennai and Tamil Nadu. Army shifted people from flood hit areas to relief camps. Relief materials were provided to people in relief camps. Army also made available food items to those who were stranded.



(Image-11) Indian Army saving people from submerged area (source-ssbcrack.com)

Indian Army saved more than 4000 stranded people till 4th December, and several lakh food packets and relief materials were provided.



(Image-12) An Indian army soldier distributes relief material to flood affected people (source: news113)

Challenges

Due to excessive rainfall and flood, many challenges were there in front of the administration and people of state. Some of the major challenges are listed below:

- Expected outbreak of water-borne diseases caused by ingestion of water contaminated by human or animal faeces, which contain pathogenic microorganisms, such as Typhoid, Fever, Cholera, Dysentery, Hepatitis A and E etc.
- A lot of garbage had gathered on the roads after the flood, creating blockages in traffic movement.
- Almost total breakdown of telecommunications.

With the timely action by the State Government and able support of central ministries and agencies, the above mentioned challenges could be addressed.

Lessons Learnt

The disastrous flood of November and December 2015 had exposed many lacunae in preparedness and mitigation activities undertaken. The lessons learnt from management of such a disaster are;-

- Establishing effective coordination mechanism between various stakeholders specially different departments.
- Development of Action Plan for management of Reservoirs and its strict implementation.
- Awareness drives for enhancing the capacity of the community.
- Installation of modernized equipment for flood monitoring which can use real time data effectively.
- Effective use of funds under Corporate Social Responsibility (CSR) for various mitigation activities.

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GUJARAT FLOODS

Gujarat, a state on the western coast of India, is rich in resources as well as its production contribution. It is located near the Thar Desert; hence most of the land is dry and arid in nature. Further to it, out of total 33 districts of Gujarat, 15 districts are on the sea shore. Gujarat has faced various major disasters, such as 1989 cyclone, the 2001 Kutch earthquake, the 2005 floods.

The chapter deals with 2015 floods that hit Gujarat. Major cause of this flood was the low pressure depression on the Arabian Sea, which gradually changed into the deep depression and coupled with the monsoon season to cause more than normal rainfall. Amreli district of Saurashtra region of Gujarat was the most affected. This flood took away precious lives and damaged property. Government of Gujarat and Government of India immediately swung

into action and did their best to manage the disaster. All necessary supplies like food, drinking water, medicines, kerosene etc. were provided in the areas affected by floods. Soon after the disaster, massive rescue and evacuation operations were launched by various central and state government agencies (NDRF, IAF, and SRP).

Gujarat Floods: An Overview

The low pressure depression formed over the northeast Arabian Sea turned into "deep depression", escalated eastward and crossed the Saurashtra coast, which brought heavy rains in some parts of Saurashtra region of Gujarat and flooded many low lying areas.

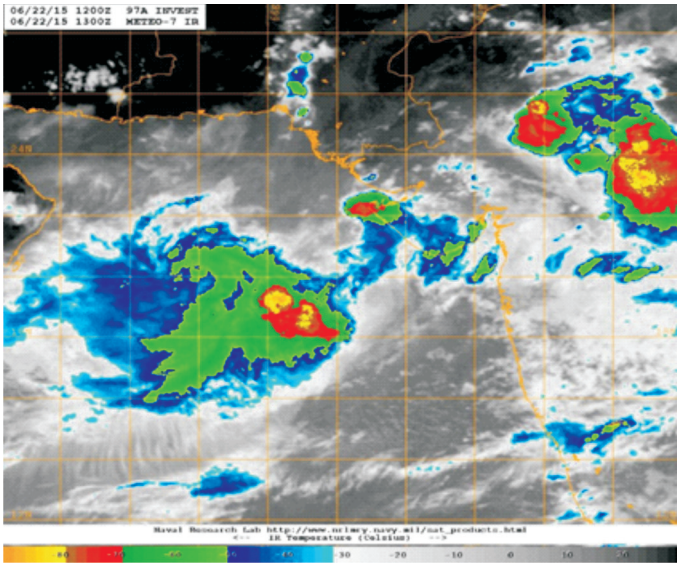


Fig-1 Naval satellite imagery of depression on June 22nd 2015

The winds of 55 to 75 mph per hour blew along the shores of Gujarat and North Maharashtra. Fishermen were warned not to venture into the sea of the Gujarat coast. Some parts of Amreli received very heavy rains which resulted in flood situation in many parts. Several other districts of the Saurashtra region, which include Rajkot, Gir-Somnath, Bhavnagar, Junagadh and the Devbhoomi Dwarka, also received heavy rains.

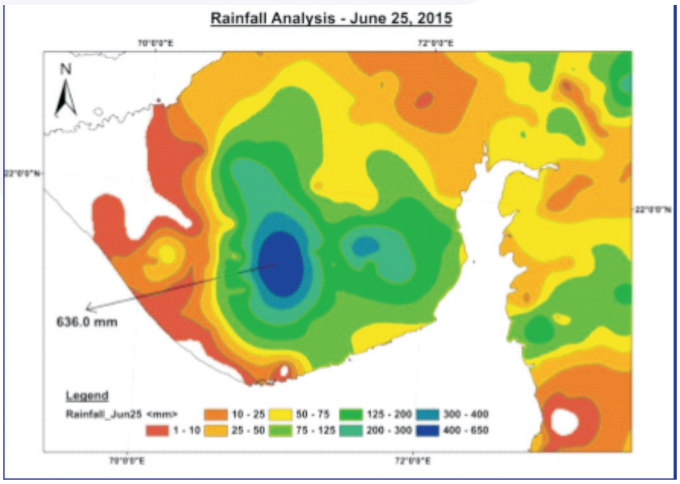


Fig-2 Rainfall analysis of Saurashtra & Kutch region 25 June 2015 (Source-IMD)

Maximum rainfall of 636 mm was recorded at Bagasra station of the Amreli district of Saurashtra and Kutch division, while 511 mm in Dhari and 400 mm rainfall was recorded in Variyav. Machhundari, Raval, Malan, Shahi rivers were on the bust. Thunderstorms also hit at isolated places over the Saurashtra & Kutch region during the impact period as per the State Emergency Operation Center, Department of Revenue, Government of the Gujarat.Table-1 below shows the areas with highest rainfall in the Gujarat between 8 a.m. on 23rd June to 8:00 am of 24th June.

Districts	Taluks	Rainfall In MM
Girsomnath	Una	324
Junagadh	Malia	279
Amreli	Amreli town	203
Girsomnath	Kodninar	225
Girsomnath	Talala	288
Amreli	Rajula	192
Amreli	Jafrabad	132
Junagadh	Manglore	120
Bhavnagar	Khambha	119
Junagadh	Keshod	115
Amreli	Sarvakundla	113
Porbandar	Renavav	107
Gir Somnath	Veraval	107
Rajkot	Gondal	98

Girsomnath	Sutrapada	97
Bhavnagar	Palitana	96
Surrender Nagar	Chotila	90

Table-1 **(source: Gujarat state flood control room)**

Various dams of the affected areas were overflowing and added on to misery of areas already reeling under floods. From 1st June to June 26, Gujarat region had received 635% more rains, and rain in Saurashtra and Kutch was 812% higher than normal, which led to devastating floods. The figure below denotes normal seasonal rainfall and the actual rainfall which led to flood situation.

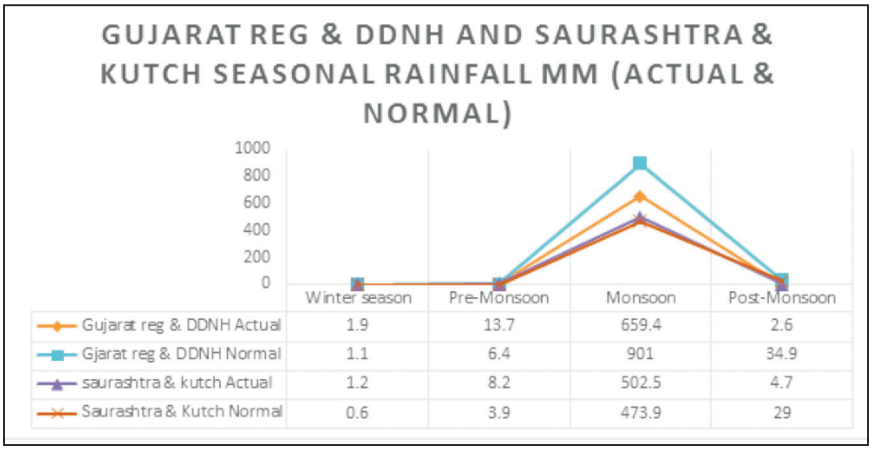


Fig. 3: Source: Gujarat State Flood Control Room

Impact

33 districts of Gujarat state were affected by the floods. Amreli district was worst affected and faced its worst flood in ninety years, where almost 600 of its 838 villages were flooded. About 400 villages were inaccessible as roads and rail connections were destroyed due to floods and the people were also deprived of electricity. More than 1700 houses sustained damage. Schools and colleges remained closed in flood affected districts. Table 2 depicts the casualties due to floods in various affected districts of Gujarat.

District	No. of Casualties
Amreli	26
Bharuch	5
Bhavnagar	3
Dahod	2

Devbhumi Dwarka	4
Jamnagar	5
Junagadh	3
Kheda	1
Kutch	5
Jamnagar	5
Mahesana	2
Morabi	2
Porbandar	1
Rajkot	5
Surat	2
Valsad	1
Surendranagar	3

Table-2 (Source: Gujarat state control room)

In all there were 75 deaths due to floods in different parts of the state till 25th June, 2015, which went upto 81 on 28th June. Over 455 cattle and livestock were washed away in the flood. The carcasses of 10 Asiatic lions including a three-month-old female cub were recovered from overflowing river Shetrunji, which flows through Gir wildlife sanctuary.1670 blue bulls (Nilgai), 87 Cheetals (spotted deers), 9 black bucks, 6 wild boars and some porcupines were also recovered in the Gir Forest National Park and the surrounding area.



Fig-4. The flood washed away a railway track over river Shetrunji. (source-Deshgujarat)

Railway tracks were badly damaged and many trains had to be canceled. A total of 112,217 farmers suffered damages, while 134,007 hectares of farm land were battered. The damages estimated by the government were at Rs. 1650



Fig.-5 one of the worst affected area of the Amreli District (source-IAF)

Possible Causes

Impact of climate change: Climate change may be one of the leading causes of 2015 floods of Gujarat.

Deforestation: Deforestation also is a major cause of floods. Trees prevent soil erosion and runoff. Cutting of trees may lead to soil erosion and could be a reason of the flash floods as according to the statistics of the forest department, in the first four months of the fiscal year 2014 - 2015, about 61,009 trees were cut for the development projects and road widening.

Absence of early warning: It was seen that at the local level, dissemination of early warning was missing. People of lowlying areas should have been warned to move to safer places, as soon as the information of formation of depression was received .Further, an alternate information dissemination methodology to the people residing in surrounding areas of Varsan barrage and downstream of Sabarmati river could have been thought of before releasing water from Sabarmati river.

This could have avoided further distress to already struggling people .

Government of India initiatives

Government of India, Ministry of Home Affairs offered full support of the central government to tackle the situation. The Central agencies, including National Disaster Response Force (NDRF), were monitoring the situation. The central government was committed to provide all assistance to the state. Understanding the urgency of the disaster, the Air Force and NDRF were deployed in the state on 24th June by the Government of India.

Government of Gujarat Initiatives

In the flood review meeting held in Gandhinagar on 24th June, hon'ble Chief Minister of Gujarat asked the cabinet ministers to be in constant touch with the district administration of affected districts and provide help in their disaster management activities. The Chief Minister asked the district collectors to set up a network of mobile numbers of Sarpanchs, Talati, Sakhimandal-Aanganwadi women, and get details of the local situation once in every two hours.

The Ministers and officials in-charge of the affected district, worked closely together in management of the flood. Several animal husbandry teams were sent for survey of cattle and affected animals due to heavy rains and fodder depots were opened in the taluka centers for animals. Affected farmers and farm lands were surveyed by 60 teams engaged by the State Government to provide all kinds of assistance to the affected farmers. Thousand tons of clear bottled drinking water was provided by airdrop and 34,699 chlorine tablets were distributed for pure drinking water in the affected districts. 200 health teams with mobile laboratories from district headquarters reached every affected village. They established 11 medical treatment camps, in which 499 patients were treated. 7 Sanjivani teams, 17 Rashtriya Bal Swasthya Karyakram (RBSK) teams and 6 mobile medical teams were deployed in Amreli alone and over 261 packets of ORS were also distributed. The medical teams surveyed 128 villages, while the teams of Rajkot and Bhavnagar also cleaned the affected villages and towns so that the outbreak of diseases could be avoided.

The Government of Gujarat had deputed 10 senior class-1 officers to the Amreli district administration in order to tackle the flood situation in the district. Due to heavy rainfall flood like situation had emerged in the Saurashtra region. Over 584 villages were short of power supply. 216 teams of state run Paschim Gujarat Vijli Company Ltd. (PGVCL) restored power supply in 366 villages including 188 out 239 villages of Amreli district within 48 hours of their deployment. Road connectivity was also restored to flood affected villages with the help of 50 JCB machines, tractors and dumpers. Mobile network was also restored within shortest possible time.

Due to heavy rains and floods, water supply in Gujarat's Amreli district was also severely affected. The same was made available to the affected community through generator sets and about 80 tankers and trucks.

After heavy rains and floods in Amreli district of Gujarat, many rural roads and state highways were damaged and state transport (ST) bus services were partially halted. On evening of 27th June in Amreli district, 23 out of 26 roads were made functional. 53 dumpers, 37 tractors and 35 JCB machines were active in road repair work. Gujarat Pipavav Port

(APM Terminals Pipavav) also resumed its operations on 28th June after the improvement in weather conditions.

On 14th July, 2015, the state government announced a total package of Rs. 300 crore including Rs. 150 crore from the NCRF (National Calamity Relief Fund)

Rescue Operations

The National Disaster Response Force (NDRF), Indian Air-force, State Reserve Police Force (SRPF) and local authorities were prepared and worked in close coordination wherever rescue operations were carried out. Around 4,000 people were evacuated from 17 badly affected villages downstream of Bhadar dam and over 200 people were rescued from different places affected by the flood.



Fig-6 Relief materials being loaded in IAF helicopter for flood affected people.(Source-IAF)

National Disaster Response Force

Overall, 5 teams consisting of 180 personnel of 6th battalion of National Disaster Response Force were deployed to execute rescue operations in flood affected areas. NDRF went to the areas which were badly affected by the flood and saved the flood victims and provided all necessary help.

Indian Air-force

The Indian Air force started its massive rescue operations in the flood affected areas of Gavadka and Khari villages of Amreli district with two MI-17V5 helicopters.87 people were evacuated and moved to safer places and almost 120 kg of food was distributed by air-drop.

The figure below depicts people stranded on a damaged road in Jamnagar in Saurashtra desperately waiting for the IAF's rescuers. They were rescued by IAF's MI17V5 copter.





Fig-7 **source: IAF**

Lesson Learnt & Some Recommendation

Major lessons learnt in management of this flood were :-

- Need for early warning and its dissemination in local language for community to understand better.
- Importance of coordination amongst stakeholders.
- Need for constant monitoring of rains in catchment areas and planning according to changing situations.

Few recommendations which may lead to better management of such situations in future are:

- Check dams should be constructed on rivers, Sabarmati, Narmada, Mahi and Shetrunji to control flow of water. The check dams should be checked periodically in order to prevent any breach and flow of water regulated based on situations in the catchment areas of rivers. This will not only help in preventing, controlling and minimizing erosion of fertile land but also help in increasing the ground water table by reclamation of underground water sources.
- Further, people should also be made aware of affects of residing in low lying, downstream and river bed areas in order to mitigate the effect of disaster and also safeguard the environment.

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Road Accidents and Other Incidents

Road accidents have been considered as one of the disasters by the High Powered Committee constituted by Government of India in 1999. Ministry of Road Transport and Highways compile such accidents. The list below is sourced from report of Ministry of Road Transport and Highways Government of India.

State/UT –Wise total number of accidents, persons killed and injured during the calendar year 2015

Sl.No	States/UTs	Total Accidents	Killed	Injured
1	Andhra Pradesh	24258	8297	29439
2	Arunachal Pradesh	284	127	359
3	Assam	6959	2397	7068
4	Bihar	9555	5421	6835
5	Chhattisgarh	14446	4082	13426
6	Goa	4338	311	2055
7	Gujarat	23183	8119	21448
8	Haryana	11174	4879	10794
9	Himachal Pradesh	3010	1096	5108
10	Jammu & Kashmir	5836	917	8142
11	Jharkhand	5162	2893	4038
12	Karnataka	44011	10856	56971
13	Kerala	39014	4196	43735
14	Madhya Pradesh	54947	9314	55815
15	Maharashtra	63805	13212	39606
16	Manipur	671	139	1201
17	Meghalaya	606	183	319
18	Mizoram	70	72	103
19	Nagaland	54	30	74
20	Odisha	10542	4303	11825
21	Punjab	6702	4893	4414
22	Rajasthan	24072	10510	26153
23	Sikkim	219	70	337
24	Tamil Nadu	69059	15642	79746
25	Telangana	21252	7110	22948
26	Tripura	647	158	1028

27	Uttarakhand	1523	913	1657
28	Uttar Pradesh	32385	17666	23205
29	West Bengal	13208	6234	11794
30	Andaman & Nicobar Islands	258	23	331
31	Chandigarh	416	129	331
32	Dadra & Nagar Haveli	69	42	97
33	Daman & Diu	70	42	64
34	Delhi	8085	1622	8258
35	Lakshadweep	3	0	3
36	Puducherry	1530	235	1552
	Total	**501423**	**146133**	**500279**

Source: Ministry of Road Transport & Highways

In addition to the Road accidents, States and UTs face many other incidences which result in loss of life. Few of them have been sourced from various media reports and compiled below.

S.No	Month	State/ UT	Description	Source
1	March	Karnataka	Nine bogies of Bangalore to Ernakulam intercity express were derailed killing 10 people and injuring more than one hundred and fifty	Zee news
2	March	Uttar Pradesh	Janta express from Dehradun to Varanasi derailed that caused death of fifty eight people and injuries to nearly one hundred and fifty people. Driver reported by radio that the break had failed.	Times of India
3	April	Bihar	A severe thunderstorm ravaged 12 districts of Bihar killing 42 people.	IndiaTV News.com
4	May to June	Many regions of India	As many as 2081 deaths occurred due to heat wave in many parts of the country.	Various media reports
5	June	Maharashtra	103 people died and 46 people hospitalized in critical condition after drinking toxic alcohol. The accident occurred due to Methanol adulteration in alcohol	Indian express. com
6	July	Rajasthan	Due to the heavy rainfall in isolated places over Rajasthan, 38 people died.	Media reports

7	June-July	Sikkim	41 persons died due to heavy to very heavy rainfall Which occurred at isolated places over Sikkim, 4 districts were severely affected	Media reports
8	August	Madhya Pradesh	At 11:30 pm, Eleven bogies of Kamyani-express and nine bogies of Janta-express trains were derailed. Trains derailed due to waterlogging on the track. At least 30 people died and 100 people were seriously injured	The Hindu
9	April – August	Odisha	Lightning strike over many parts of Odisha, which resulted in at least 240 deaths	Media reports
10	Septe-mber	Madhya Pradesh	Due to explosion in a restaurant, at least One hundred five people were killed and more than one hundred fifty people were severely injured. Explosion was caused by Gas cylinder and stored mining explosives	Hindustan times
11	Septe-mber	Chhattisgarh	A tunnel collapsed in Bilaspur, Chhattisgarh during the construction and three workers were trapped in the tunnel. 9days later, 2 workers were rescued by teams of Army, NDRF, and local police. But one worker could not be traced and was declared missing.	The Hindu
12	August – Septe-mber	Assam	Very heavy rainfall occurred at isolated places of Assam and led to overflow of River Brahmaputra at Neamatighat, District. Jorhat (Assam) . At least 41 persons died.	Media reports

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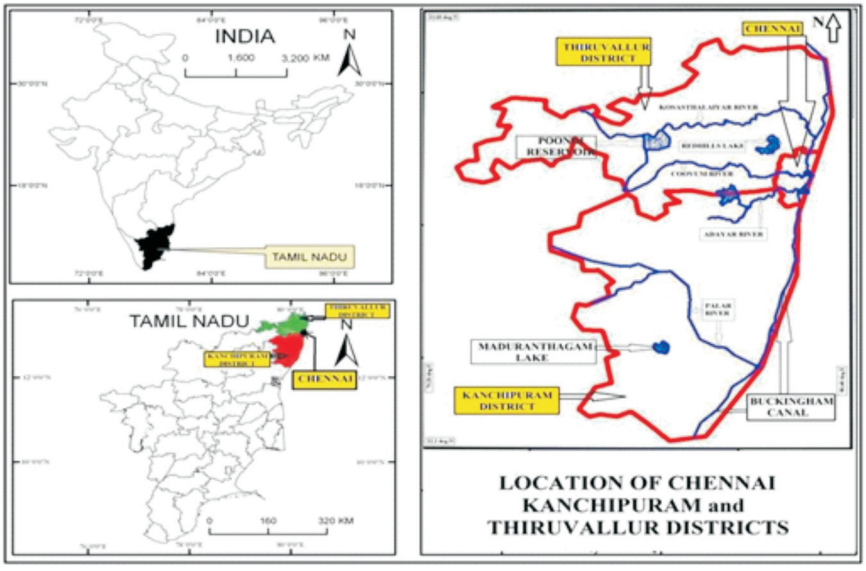
2016

Cyclone Vardah

Cyclone Vardah hit the Tamil Nadu capital on12th December, 2016. Its impact was so severe that it uprooted trees, boards, hoardings, damaged compound walls and resulted in disruption of power supply. Chennai's green cover faced a considerable loss as thousands of trees were uprooted by the cyclone. The uprooted trees blocked the roads and many vehicles were caught under fallen trees. Atleast10 persons, including a three-year-old child and four women, died in rain-related incidents in Chennai on 12th December. The rain and winds had uprooted at least 258 trees across several places in Chennai.

The most affected areas were the north coastal areas of Chennai, Tiruvallur and Kancheepuram districts. People were evacuated to safety and educational institutions were closed due to the severity of the cyclonic storm. Life was disrupted due to heavy rains. National Disaster Response force (NDRF) was called to assist the administration in responding to the cyclone. People in low lying areas were asked to move to safer zones. Puducherry also experienced intermittent drizzle. The figure below depicts the districts which were badly affected by Cyclone `Vardah'

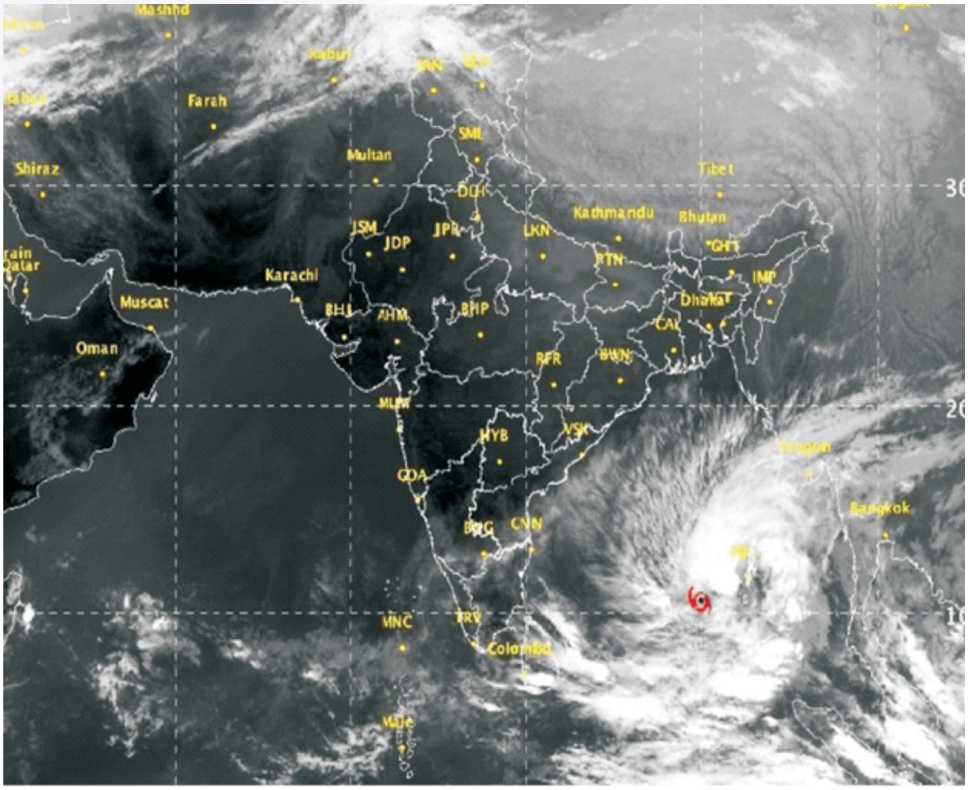
Fig. 1 Districts affected by Cyclone Vardah



Causes of Cyclone Vardah

The depression over north interior Tamil Nadu moved westwards and weakened into a well marked low pressure area over north interior Tamil Nadu & adjoining South Interior Karnataka at 8:30AM on 13th December. India Meteorological Department (IMD) had issued

a warning of heavy to very heavy rainfall at many places over north interior Tamil Nadu and adjoining areas of south interior Karnataka & north Kerala by 13th December midnight.



Picture above depicts formation and eye of cyclone Vardah Source: India Meteorological Department(IMD)



NDRF teams clear up damage after Cyclone Vardah. Photo: NDRF

The cyclonic storm Vardah made landfall near Chennai resulting in heavy rainfall which left the city drenched. But most people, aware of the nature's fury, remained indoors, leaving the roads across the city virtually deserted.

Response

The government undertook massive evacuation in low-lying areas and around the shores of Tamil Nadu and neighboring Andhra Pradesh, where Vardah was initially predicted to make landfall. About 10,000 people were evacuated from areas near the sea in Tamil Nadu and over 9,400 persons moved to relief camps in Andhra Pradesh. Government had moved fifteen teams of the National Disaster Response Force (NDRF) to various parts of Tamil Nadu, including Chennai, Tiruvallur and Kancheepuram, for rescue operations.

The Tamil Nadu Electricity Board had deployed 4,000 personnel to restore powerlines, which supplied 1850mw of power to the city, but had been damaged due to high speed winds that blew at a speed of 130kmph. The NCTPS Unit1 was hand tripped due to heavy winds on 2nd December. The two 220MW units at Madras Atomic Power Station (MAPS) too, stopped operating due to tripping of power evacuation lines.

The armed forces were asked to be on stand by with the army, navy and airforce prepared to be deployed anytime, as and when required.

CONCLUSION

The devastation caused by Cyclone Vardah again highlighted the importance of the strict implementation of Coastal Zone regulations. Even though the coasts currently support a large population, yet in order to restore at least some of the ecosystems that have provided natural flood control and other protections from time to time, it is necessary to implement CZ regulations. Cyclone Vardah also highlighted the importance of early warning and its dissemination in order to reduce the impact of cyclones.

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PUTTINGAL TEMPLE FIRE

The Incident

Kerala, also known as 'God's own country", is a state filled with natural beauty, and is situated in the south western region of India. On 10th April, 2016, competitive fireworks held during a festival at the Puttingal temple in Paravur had turned into a major disaster. The Puttingal Temple in Paravur, Kollam, Kerala, was witnessing a huge crowd of pilgrims to the tune of about 15000 on 10th April, 2016, the last day of a seven-day festival of the goddess Bhadrakali, to mark local Hindu celebrations. The temple was devastated by fire which was caused due to firework celebrations on 10th April, 2016 at approximately 03:30 AM . As a result of the fire, 111 people died and more than 350 were injured, including some with severe burns. The blast was so severe that the temple and at least 150 houses in the area of the temple were damaged. According to local reports and eyewitnesses, the explosion and fire were caused by sparks from a firecracker being used in a competitive fireworks display igniting fireworks in a concrete storehouse. On 13th April, in the aftermath of the event, the Kerala High Court banned the display of sound-emitting firecrackers in all places of worship in the state after sunset.



The ground looked like a war zone with bodies and concrete chunks strewn all over source deccanchronicle.com

Brief of Puttingal Temple Fire and its Causes

Every year, temple celebrated the Hindu new-year festival with lots of fire-works witnessed by many people. In 2016 also, the same ritual was being followed and a load of fire-crackers were stockpiled for fire-works in the temple. On the night of 10th April, 2016, fire crackers were lit to celebrate the festival. One of the shots fell on the stockpile of fire crackers and it exploded causing widespread deaths and damages to temple. Firefighters and police battled to douse the fire that broke out after the explosion and to rescue those trapped at the complex. The deaths that took place in the tragic event were mainly of men as it was night time and those witnessing the event were mostly men. Major causes of this fire tragedy were the storage of huge amount of explosives for fire display and lack of space around the display place for people to run for safety.



Fire broke out in the temple due to fire crackers
Source: TimesofIndia.Indiatimes.com



A man walks past damaged structures at the spot where a massive fire broke out
Source:Zeenews.india.com

Impact

An entire dump of fire crackers meant to be burst to mark the conclusion of the meena-bharani festival exploded, killing over 40 persons instantly, injuring many more and causing extensive damage to nearby buildings. A large number of people died when concrete chunks and iron grills from the structures fell on those who had gathered to watch the festivities. The sound of the explosion was heard over a radius of 1km and the whole area plunged into darkness as the power supply went off and people ran helter-skelter.



The pictures above also denote the kind of devastation caused by the fire.
Source: Indiatoday.in

Response

Measures taken by District Administration

Although display of fireworks had been a regular feature of such festivals in Puttingal, yet this time the Kerala Fire and Rescue Services had not given clearance for the fireworks display at the Puttingal Devi Temple in Kollam. It was denied due to insufficient space for organizing firework displays as the temple area was occupied by makeshift shops, stage and the crowd that throngs the venue. The DM and ADM too had denied permission for the pyrotechnics at site on a petition filed by senior citizen Pankajak shyamma, who lives in the vicinity of temple. The ADM issued an order banning pyrotechnics after information that the temple committee was planning competitive pyrotechnic display (the best performer being given the rolling trophy with the name of a pyrotechnic master called Govindan Asan) which posed threat to the lives and property of people in the area.

The police and fire & rescue services personnel reached the site of incident and shifted all the injured and dead to hospitals. Experts of the Petroleum and Explosives Safety Organization defused the remaining fireworks.

Response from Central Government

The centre deployed 6 helicopters (4 from IAF and 2 from Navy) besides two AN-32 transport aircrafts alongwith 2 teams of NDRF to assist in relief for those affected by fire.

The Army dispatched 2 teams from Thiruvananthpuram to Kollam to provide immediate medical relief while the Navy helicopters carrying 3 doctors and 6 medical personnel reached the site next day. The Navy deputed 3 ships–Kalpeni, Kabra and Sunayana (carrying 200kg of medical supplies on each ship). Some of the injured were evacuated and taken to the naval hospital in Kochi.

NDRF sent a team of 50 doctors, paramedics and nurses.

The two AN-32 transport aircraft rushed 2 NDRF teams from Arakkomnam.

Relief

- The centre announced a relief of Rs. 2 Lakh to the kin of the deceased and Rs. 50,000/-to the injured.
- Kerala Cabinet announced Rs. 10 lakh ex-gratia for next of kin of those killed in firework disaster; Rs. 2 lakh for the injured.

- Judicial probe was ordered into the Kollam temple fire tragedy.
- Hon'ble Prime Minister Shri Narendra Modi took stock of the situation in Kollam and promised all support from Centre to State government.

Recommendation

Kerala's temple festivals often include fireworks displays that draw thousands of locals and tourists. The fire permission rules must be made stringent and implemented with full conviction as the rituals may not be stopped due to sentiments

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Road Accidents and Other Incidents

The chapter discusses about the road accidents and other incidents which resulted in loss of life during the year 2016. The data of road accidents has been taken from Statistics of Ministry of Road Transport and Highways while that of other incidents has been taken from various media reports.

Total number of accidents, persons killed and injured during the year 2016

Sl. No	States/UTs	Accidents	Killed	Injured
1	Andhra Pradesh	24888	8541	30051
2	Arunachal Pradesh	249	149	391
3	Assam	7435	2572	6127
4	Bihar	8222	4901	5651
5	Chhattisgarh	13580	3908	12955
6	Goa	4304	336	2026
7	Gujarat	21859	8136	19949
8	Haryana	11234	5024	10531

9	Himachal Pradesh	3168	1271	5764
10	Jammu & Kashmir	5501	958	7692
11	Jharkhand	4932	3027	3793
12	Karnataka	44403	11133	54556
13	Kerala	39420	4287	44108
14	Madhya Pradesh	53972	9646	57873
15	Maharashtra	39878	12935	35884
16	Manipur	538	81	955
17	Meghalaya	620	150	354
18	Mizoram	83	70	68
19	Nagaland	75	46	120
20	Odisha	10532	4463	11312
21	Punjab	6952	5077	4351
22	Rajasthan	23066	10465	24103
23	Sikkim	210	85	263
24	Tamil Nadu	71431	17218	82163
25	Telangana	22811	7219	24217
26	Tripura	557	173	853
27	Uttarakhand	1591	962	1735
28	Uttar Pradesh	35612	19320	25096
29	West Bengal	13580	6544	11859
30	Andaman & Nicobar Islands	238	17	323
31	Chandigarh	428	151	329
32	Dadra & Nagar Haveli	70	46	130
33	Daman & Diu	71	38	102
34	Delhi	7375	1591	7154
35	Lakshadweep	1	1	0
36	Puducherry	1766	244	1786
	Total	**480652**	**150785**	**494624**

Source: Ministry of Road Transport & Highways, Government of India

Other incidents

S. No	Date	States/ UTs	Description	Source
1	January	Northern parts of India	Numerous buildings were damaged. Eleven people were killed, injured: 200 due to earthquake	BBC news
2	February	J&k	An avalanche hit the Army post in Siachen. 10 soldiers were killed in this.	India Today
3	March	West Bengal	The Majerhat Bridge, one of the main connectors between south and southwest Kolkata, caved in under the weight of early evening traffic, killing three and leaving at least 20 people injured	India Today
5	April	North-West states and UTs	Nine people were killed and 20 Injured due to earthquake in India. People fled buildings in panic when the tremor struck.	BBC News
8	August	Bihar and UP	On the night of 15th August, 2016, some people in Khajur Vani locality in Gopalganj town consumed country-made liquor and began suffering from stomach pain and vomiting. After being rushed to hospital for treatment, 13people died and Three people had lost their vision	Scorll.ina
9	Novem-ber	Uttar Pradesh	142 passengers died and more than 200 were injured in a train derailment in Uttar Pradesh. It was India's deadliest train crash since 2010 and has renewed concern about the poor safety standard of the state-run network, which is a lifeline for millions of Indians but has suffered from chronic under investment	Livemint
10	February to May	Uttarakhand	Uttrakhand forest severly affected districts Pauri, Nainital, Rudraprayag, Chammoli, Almora and Uttarkashi, where neighboring 1500 villages and the forest ecosystem had been affected. Nearly 3,000 acres of forest cover had been destroyed	Media reports

11	May-June	MP, Rajasthan, Gujarat	According to newspaper report at least 17 heat-related deaths occurred in the Gujarat state, seven in Madhya Pradesh and 16 in the state of Rajasthan, where the highest temperatures were recorded during the heat wave around 19th May, 2016. More than hundred people were admitted to hospitals in western India with signs of heat-related illness. In addition, many people were affected by the Failure of crop due to the excessive heat.	Media reports

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2017

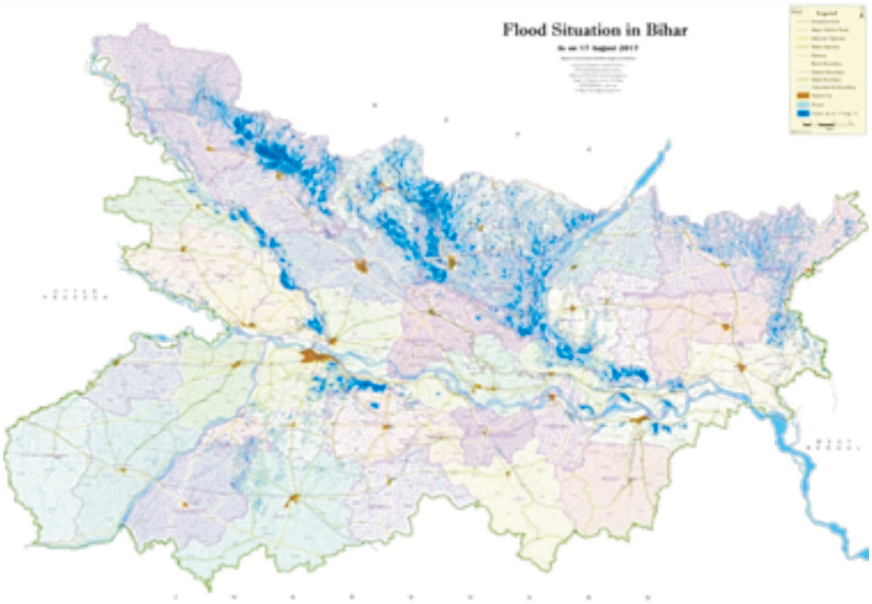
Bihar Floods -2017

Bihar is located in the east of India and approximately 85 per cent of its land is under cultivation. Major floods hit the state in 1993, 1995, 1999, 2002, 2004, 2007, 2008, and 2011. Bihar faces the brunt of floods through heavy rains in its own catchment area and Nepal.

In the mid of August, 2017,when nation was planning to celebrate its 70th Independence Day, the State of Bihar faced severe floods due to deep depression over Bay of Bengal. This deep depression brought heavy rains in many parts of Bihar from 10th to14th of August and life was stranded. This was one of the worst floods in the history of Bihar.

This flood was the result of a sudden increase in water discharge from the Kosi dam of Nepal due to torrential rains in the Nepal and Himalayan foothills. The floods mostly affected the districts of North Bihar. The calamity engulfed 19 districts of Bihar namely, Kishanganj, Araria , Purnea, Katihar , West Champaran , East Champaran , Darbhanga , Madhubani , Sithamarhi , Shivhar, Supaul, Madhepura , Muzaffarpur , Gopalganj , Saharsa , Khagaria , Saran and Samastipur.

The Central Water Commission of India (CWC) stated that Kosi, Gandak and Mahananda rivers were flowing above warning levels at 21 different locations



(source-http://www.fmis.bih.nic.in/FloodMap17/State-flood-17Aug17.jpg)

Fig-1 Map showing the flooded areas (in darker blue) in Bihar, as of 17th August, 2017

The map above shows the flooded areas of state. According to Water Resources Department, Bihar Government, 16 districts of the state were affected by the flood by 17th August, 2017. 1.75 feet of water level was recorded in Kishanganj district due to the unprecedented rainfall in Nepal and Himalayan catchment areas and the Kankai River, which did not have any water for the last 50 years, was also in spate in Kishanganj.

Impact

The floods in Bihar during 2017 had caused widespread damages in many districts of the state. The damage ranged from displacement of people, deaths, crop loss and livestock loss.

Sl No	District	Blocks	Panchayats	Population affected in Lakh	Deaths
1.	Kishanganj	7	126	10.10	24
2.	Araria	9	188	17.50	95
3.	Purnea	13	148	12.31	44
4.	Katihar	15	189	20.08	40
5.	East Champaran	22	261	24.08	32
6.	West Champaran	16	211	7.19	42
7.	Darbhanga	14	231	21.21	37
8.	Madhubani	15	201	7.65	28
9.	Sitamarhi	10	243	22.74	47
10.	Shivhar	5	41	1.62	6
11	Supaul	8	77	3.98	16
12	Madhepura	10	89	3.38	29
13	Muzaffarpur	12	140	8.69	21
14	Gopalganj	6	47	3.44	20
15	Saharsa	7	72	3.37	8
16	Khagaria	6	35	1.62	10
17	Saran	6	36	1.68	13
19	Samastipur	5	32	0.50	2
19	Sivan	1	4	0.50	0
Total		**187**	**2371**	**171.64**	**514**

Table-1 http://disastermgmt.bih.nic.in/press%20notes/PR18092017Evening.pdf

The table above depicts the number of deaths and population affected by the Bihar flood.

As reported by the Government of Bihar, the disaster affected 19 districts of North Bihar causing death of 514 people and affecting 2,371 panchayats (settlement councils) under 187 blocks of 19 districts. Approximately 1.71 crore (17.1 million) people and 8394 villages were hit by the floods. More than 8.5 lakh people lost their homes. Araria district was worst affected by the flood and 2.2 million people were rendered homeless in the district. 25,425 houses were damaged by the flood till 28th August, 2017, to include 24,350 severely damaged and 1075 partially damaged houses. 63,67,000 hectare Crop had been affected, and 351 animals had died.

Few of the areas were cut off due to floods and several trains were either cancelled or diverted. Due to the severity of floods, a bridge in Araria district collapsed and three persons including a woman and a child were swept away immediately.



Fig-2.The Bihar Floods damaged property as well as disrupted normal human life source-www.googleimages.com)



Fig-3 An aerial view of a flood-hit region of Motihari district in Bihar. (source-.newindianexpress.com)

Possible Causes

A dam had been constructed over Kosi river in Nepal in 1956. There is a treaty between both the countries in terms of release of excess water in the river after providing advance information.

Due to increase in soil erosion (due to deforestation), the silt brought by tributaries have made the problem even more grave. Because of this, the carrying capacity of the rivers has been reduced and water spreads in the surrounding areas. During the monsoon season in 2017, a deep depression had developed on the Bay of Bengal. When it coupled with heavy rains in Nepal, it caused severe floods in Bihar. Another reason for the flood damage is that people, due to the poverty, increasingly occupy the flood plains thus exposing themselves to flood risk.

Response from Government of India

Government of India, on seeing the disastrous situation of Bihar, immediately swung into action and provided all assistance in terms of NDRF and army immediately. Based on his assessment through an aerial survey, the hon'ble Prime Minister Shri Narendra Modi announced Rs. 500 crore central assistance for flood hit areas of Bihar and ex gratia of Rs. 2 Lakh to the next of kin of each of the deceased from the PM Relief Fund. Madhya Pradesh, Gujarat and Jharkhand donated Rs. 5 crore each to Bihar flood relief fund.

Bihar Government Response

The Government of Bihar was proactive in dealing with the disastrous flood, and commenced preparatory activities by immediately dispatching emergency assistance and evacuating people.

Bihar cabinet sanctioned an amount of Rs. 6,000 as gratuitous relief to every flood-affected person to be deposited in the beneficiaries' bank account.

On 29th August, 2017, Bihar cabinet sanctioned Rs. 1,935 crore under Bihar Contingency Fund for relief and restoration work in the flood-hit districts in the state.

Rescue operations

Total number of 52 teams which includes 28 teams of NDRF and 16 teams of SDRF along with 7 teams of army consisting of 2248 personnel were deployed for rescue and evacuation of flood affected population. Number of People evacuated was 85,49,363 and number of people in relief camps was 4,21,824. Total Number of 280 boats were provided to evacuate flood affected population. Air dropping of 1,60,840 kg. of ration was done through 31,908 sorties. Dry food packets were distributed in areas which were disconnected due to floods. Ready to eat Chana, Chura, Ghur and Poly sheets were also distributed by the central agencies. 18,977 persons & 141 livestock were evacuated by NDRF till 17th August 2017, and 5,100 food packets, 9,975 Kg. dry ration and 500 water bottles were distributed to flood victims. An army column and an Engineer Task Force (ETF) were deployed in six districts of Bihar, which successfully rescued more than 300 people from flood-affected areas.

Units	No. of Teams	No. of Persons	No. of Boats
NDRF	28	1172	118
SDRF	16	466	92
ARMY	7	630	70

Fig-4 Army personnel rescue marooned people



(source-catchnews.com)

Lessons Learnt and Some Recommendation

As Bihar faces floods every year its population has reconciled in living with floods. Furthermore Bihar is hit mainly by heavy rains in Nepal and hence it is necessary that the existing bilateral or regional agreement must be adhered to tackle such situations. Some other recommendations are as follows :-

- Due to rapid pace of human encroachment on forest and wetlands, the forest cover has declined significantly. The state can start a survey of such wetlands and set a target for each block to mark out certain percentage of area for these.
- States can engage with the insurance and banking industry to provide insurance cover to the affected population in order to mitigate the loss they suffer.
- All main highways should be constructed in such a way so that to the extent possible they are not inundated in flood waters. Rescue on the road is a lot more efficient than boats. The state may also ask the railways to consider construction of tracks on some important routes also to be safe from flood waters, so that the railways can run relief trains in the affected areas.

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CYCLONE OCKHI

Introduction

Cyclone Ockhi was one of the severe natural disasters of 2017.It left a deep impact on India as well as Sri Lanka. The severe cyclone took place on 29th November, 2017 and dissipated on 06th December, 2017. About 55,000 people were affected by the cyclone. Cyclone Ockhi affected the southern states and UTs of India including Tamil Nadu, Kerala, Lakshadweep and Gujarat. This severe disaster in its entire journey left a trail of massive destruction. It was reported as the most intense cyclone in Arabic sea since cyclone of 2015. Cyclone Ockhi was caused by the emergence of low pressure developed in southeast of Sri Lanka.

Cyclone Ockhi: An Overview

The severe cyclone Ockhi's journey began with the development of a low pressure system in the southern part of the Bay of Bengal which moved westwards. It brought isolated heavy rains over South Tamil Nadu on 28th and 29th November. Moving northwest, Ockhi cyclonic storm intensified. It caused extensive damages over Kanyakumari and adjoining areas of south coastal Tamil nadu as well as Thiruvananthapuram and adjoining areas of south Kerala. "Very heavy" to "extremely heavy" rainfall occurred over Tamil Nadu and Kerala on 30th November and 01st December. After this, it continued to move north-northeast and gradually weakened.

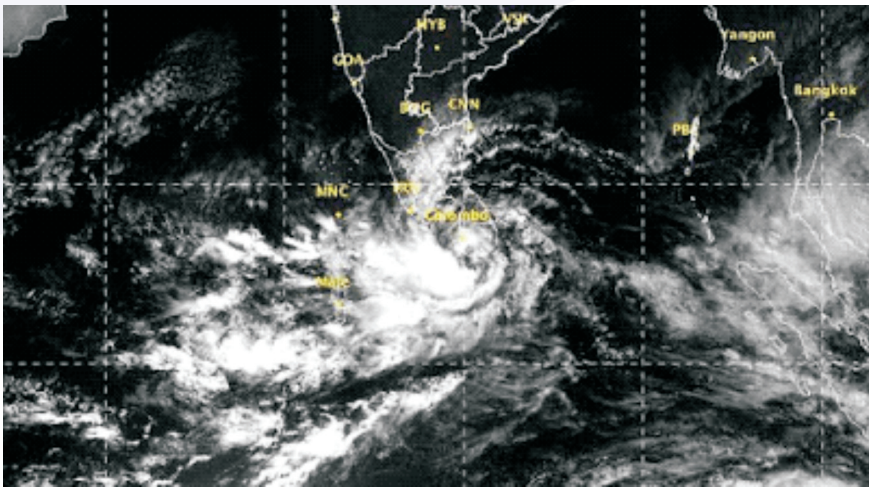


Figure-1 The arrival of the first tropical storm of the season, cyclone "Ockhi" on 29th November. (source: indianexpress.com)

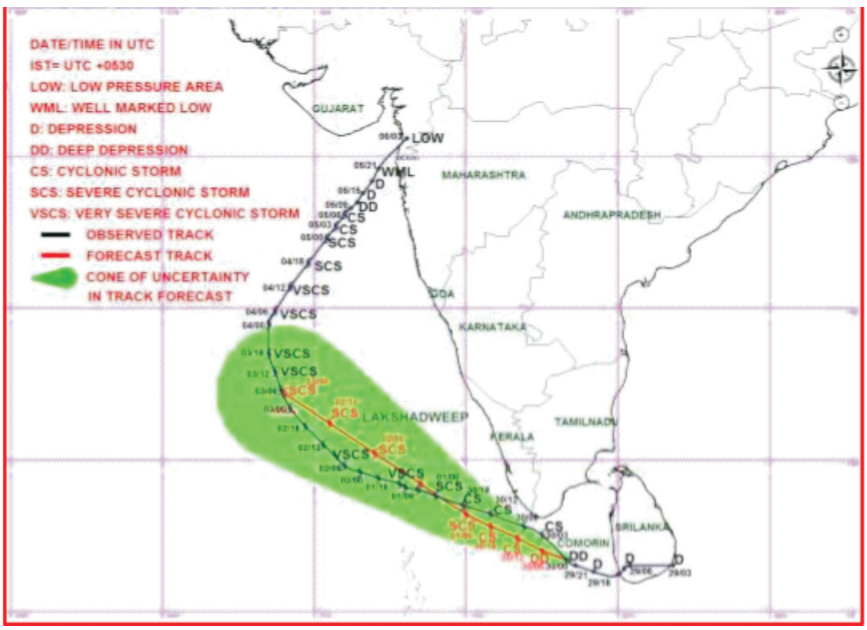


Figure-2 Observed and forecast track with cone of uncertainty (issued for Kerala, Tamil Nadu, and Lakshadweep) (source: IMD)

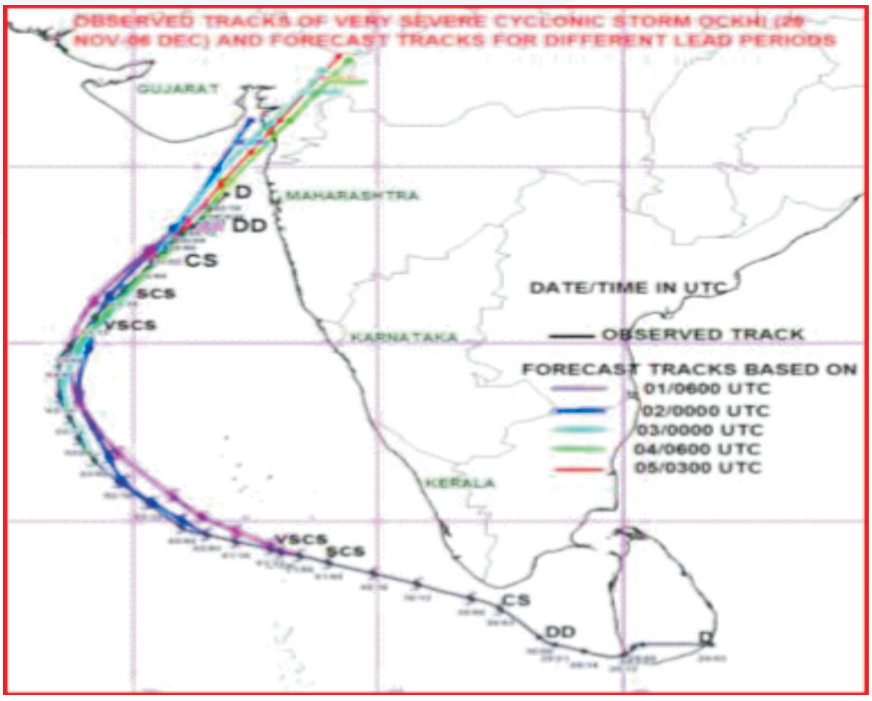


Figure-3 Typical graphical products displaying observed and forecast track for movement towards Gujarat coast. (source: IMD)

Heavy rainfall occurred over Tamil Nadu, Kerala and Lakshadweep in association with constantly intensifying of cyclone Ockhi. Many areas of south coastal Tamil Nadu experienced inland flooding due to heavy to very heavy rainfall on 30th November and 01st December, 2017. Heavy rainfall was recorded in Papanasam (450 mm) and Manimutharu (380 mm) in Tirunelveli district of South Tamil Nadu and Aryankavu (260 mm) in Kollam district, Kerala, ending 24 hours on 08:30 December, 2017.

Heavy rainfall occurrences ≥ 70mm/day over Tamil Nadu, Puducherry, Kerala and Lakshadweep during 30th November - 03rd December, 2017 (Table-1)

Table-1

http://www.imdchennai.gov.in/NEM2017.pdf

Date	State	District	Station	Rainfall MM	State	District	Station	Rainfall MM
30.11. 2017	TAMIL NADU & PUDUC HERRY	Thanjavur Kanyakumari	Vallam	70	KERALA	Kollam	Aryankavu	450
			Thuckalay	70			Papanasam	380
		Puducherry UT	Pondicherry	70			Manimutharu	170
							Thenkas	150
01.12. 2017	TAMIL NADU	Tirunelveli	Shencottah	120		Kanyakumari	Mylaudy	190
			Aryankavu	450			Thuckalay	160
			Papanasam	380			Pechiparai	160
			Manimutharu	170			Bhoothapandy	160
			Thenkas	150			Eraniel	140
			Ayikudi	120			Colachel	140
			Radhapuram	90			Nagercoil	1130
			Sankarankoil	90			Kuzhithurai	120
			Ambasamu dram	100			Kanyakumari	100
			Sivagiri	80		Virudhunagar	Watrap	150
			Nanguneri	70			Srivilliputhur	120
		Theni	Gudalur	160			Sattur	90
			Uttamapal ayam	100			Rajapalayam	80
			Periyakulam	70		Dindigul	Kodaikanal	130
		Toothukudi	Maniyachi	140		Nilgiris	CoonoorPTO	130
			Satankulam	120			Coonoor	120
			Srivaikuntam	120			Uthagam andalam	80
			Ottapadiram	110			K bridge	70
			Tiruchendur	110		Trichy	Samayapuram	120
			Kovilpatti AWS	110			Lalgudi	70
			Tuticorin	100			Musiri	70
			Kovilpatti	90		Tiruvannamalai	Polur	90
			Kalugumalai	70			Arani	80
		Sivaganga	Sivaganga	80		Tiruvallur	Madavaram AWS	90
			Kancheepu ram	80			Cholavaram	70
		Chennai	Anna University	80			Chembar abakkam	80
			DGP office	80			Thamara ipakkam	70
			Anna University	70	KERALA	Kollam	Aryankavu	260
			ARG					
			Chennai(N)	70			Punalur	90

		Madurai	Vadipatti	70		Idukki	Myladumpara _AGRI	120
							Thiruvanan thapuram AP	80
		Karur	K.paramathi	70				
			Karur	70				
			Neyyattinkara	80				
			Mayanur	70				
			Panchapatti	70				
		Perambalur	Padalur	70				
		Vellore	Ambur	70				
02.12. 2017	TAMIL NADU & PUDUC HERRY	Tiruvannamalai	Sathanur Dam	230		CuddaloreDist	Cuddalore	120
			Chengam				Sethiathope	120
			Arani	70		Villupuram	Gingee	150
		Nagapattinam	Sirkali	190			Mylam AWS	140
			Anaikaran chatram	180			Tirukoilur	130
			Nagapattinam	90			Vilupuram	130
			Mayiladu thurai	90			Kallakurichi	90
		Cuddalore	Chidambaram	180			Vanur	90
			Chidambaram AWS	170			Sankarapuram	90
			Virudachalam	150			Tindivanam	90
			K.m.koil	40			Ulundurpet	80
			Parangipettai	90		Nilgiris	CoonoorPTO	130
			Neyveli AWS	90		Karur	Mayanur	90
			Tozhudur	80		Namakkal	Paramathivelur	90
			Srimushnam	80		Kanyakumari	Nagercoil	70
			Panruti	70			Kuzhithurai	80
	KERALA	Malappuram	Angadippuram	70				
			Perinthalmanna	70				
03.12. 2017	TAMIL NADU& PUDUC HERRY	Tiruvarur	Tiruvarur	140		Nagapattinam	Nagapattinam	110
			Pandavaiyar head	130		Thanjavur, Karaikal (Puducherry UT)	Kumbakonam	90
			Kodavasal	130				
			Needaman galam	90				
			Valangaiman	120		Ramanathapuram	Tiruvadanai	80
			Nannilam	120		Thanjavu	Thiruvida imaruthur	70
			Thiruthurai poond	80				

On 5th December, north coastal Maharashtra and adjoining south coastal Gujarat also received heavy rainfall.

Impact

Cyclone Ockhi caused wide spread damage and destruction .Table 2 denotes the devastation caused by Cyclone Ockhi in Tamil Nadu, Kerala and Lakshadweep.

Table-2

http://rajyasabha.nic.in/https://mha.gov.in/MHA1/Par2017/pdfs/par2018-pdfs/ls-20032018/LSQ.4065.pdf

Items	Tamil Nadu	Kerala	Lakshadweep
(i) Human lives lost	42	60	Nil
(ii) Livestock	7654	Nil	1691
(iii) No. of missing fishermen	102	161	Nil
(iv) Houses damaged	Huts damaged- 6262	-	-
	Pucca/ kutcha houses partly damaged-101	Fully-3600, Severely-3253	Fully -87, Partially -935
(v) Infrastructure Damage	Mechanized boats partially-640	Boats- fully damaged/ lost-384	Boats- fully damaged/lost-12
	Mechanized boats fully- 60	Loss of road- 41 km.	Boats partially damaged-25
	Fiber Reinforced Plastic (FRP) Vallams partially-3407	Damage to Pumps – 180	Houses - fully damaged-87
		Damage to Supply Tanks – 430	Houses partially damaged-935
	Fiber Reinforced (FRP) Vallams fully-3407		Government building-340
	Electricity Board Poles-15,858		Coconut trees – 32747
	Transformers-95		
	Fallen Trees -25,526		Other trees – 5514
	38 Breaches in tanks and 31 Breaches in channels/canals		NIOT drinking water plant was also damaged to some extent
	103 Government buildings damaged		
	Damage to 75.046 km State Highways, 98.93 km. National Highways, 417.18 km. Rural/Urban Roads.		
(vi) Coconut trees	-	-	32747
(vii) Total crop area	6625 hectares	7817.43 hectares	-

http://rajyasabha.nic.in / https://mha.gov.in/MHA1/Par2017/pdfs/par2018-pdfs/ls-20032018/LSQ.4065.pdf



Figure-4 Damages due to gale winds associated with the passage of cyclone Ockhi over Thiruvananthapuram. (Source:IMD)

Tamil Nadu

As on 27th February, 2018, in Tamil Nadu 42 people lost their lives, 7400 houses were destroyed and 4207 boats and 4027 nets were damaged. In addition, 102 missing persons were construed as dead by State Government. Kanyakumari, Tirunelveli and Tuticorin districts were worst affected in Tamil Nadu.

Tamil Nadu's Kanyakumari district, one of the worst affected had more than 4,000 power lines in the district damaged by the cyclone and it took almost a week for the entire power supply to be restored.1408 hectares, out of an area of 27,407 hectares of Rubber cultivation in Kanyakumari district was affected due to Ockhi. The worst affected was the low-lying area of Suchindram where water entered the villages.



Figure-5 A washed-away road in Suchindram at flood-hit Kanyakumari. Source: rediff.com

Water had also entered the popular 17th century Thanumalayan Temple. Palayar Rivers flow impacted some low lying areas in Oluginaseri area in Therur Panchayat of Thovalai Block. The Hanuman River in Ppanagudi also overflew and some impact was felt in the lowlying areas. 620 houses were fully damaged and around 240 were partly damaged. Highways were blocked, schools and shops were closed due to the impact of cyclone. Agricultural crops were affected over a diameter of more than 2 kms. Many trees, estimated approx. 20,000, alongside the roads and fields were uprooted. Approx. 4,00,000 banana trees and approx. 50,000 rubber trees were damaged. Many coconut trees were damaged. Approx. 3000 electricity poles were uprooted.



Figure-6 Minicoy Island in the aftermath of Cyclone Ockhi, Lakshadweep. (Source- The Hindu)

Lakshadweep

There was considerable loss of basic structures due to the cyclone. However, no fisherman from Lakshadweep was reported missing as a result of cyclone Ockhi, but all the drinking water sources were disrupted and contaminated by the cyclone. As on 27th February, 2018, 1022 houses/huts were damaged and 37 boats were lost. Many government department offices were damaged. Most of the smaller as well as larger jetties were damaged. A desalination plant at Kavaratti was also badly damaged. There was no communication available. The main port in Kalpeni was also damaged.

Kerala

60 people had lost lives in Kerala primarily due to trees uprooted by destructive winds. 3600 houses were severely damaged and 384boats and 446 nets were destroyed. 91 people were reported missing while additional 161 missing persons had been construed as dead by State Government. About 33,000 people were affected by the flood in the state.

Maharashtra & Goa

After wreaking havoc in South India, Cyclone Ockhi arrived in Maharashtra on the evening of 4th December. But Maharashtra was already on high alert to deal with the side effects of stormy weather. However, Cyclone Ockhi impacted Thane, Raigad and Navi Mumbai. Heavy rains were recorded in Borivali, Kandivali and Dahisar, which caused water logging on the roads and disrupted life of common people. On 5th December, a precautionary holiday was granted for all schools in the coastal districts of Palghar, Thane, Mumbai, Raigad, Ratnagiri and Sindhudurg. Cyclone Ockhi had also dumped out about 80,000 kilograms of waste on the beaches of Mumbai. In Goa, the sudden entry of water and strong winds affected many major beaches of the state, resulting in inundation of huts.

Response

Government of India

Government of India, The Ministry of Home Affairs, in close coordination with the Ministry of Defence and other Central Ministries / Departments, provided all necessary support to Tamil Nadu, Kerala and Lakshadweep during the search and rescue (SAR) operations.

The Government of India provided full support, including deployment of Indian Navy and Coast Guard ships & personnel, IAF helicopters and aeroplanes, Coast Guard helicopters and National Disaster Response Force (NDRF) teams with the necessary logistics equipment, for immediate rescue, search and relief measures to the victims of Cyclone Ockhi.

In order to help the affected people of the States of Kerala and Tamil Nadu, Central Government dispatched immediate financial assistance of Rs. 280.50 crore to Tamil Nadu and Rs. 76.50 crore to Kerala from State Disaster Response Fund (SDRF) on 8th December 2017 and 11th December 2017 respectively.. The Hon'ble Prime minister visited the affected areas and after his visit he announced Rs. 21 crores for providing assistance for repair of fully damaged houses under Pradhan Mantri Awas Yojana (PMAY).The Families of the bereaved fishermen were provided Rs. 2 lakh from Prime Minister National Relief Fund (PMNRF). In addition the State Government of Tamil Nadu and Kerala had taken various steps for rehabilitation of the families of missing fishermen. The Department of Animal Husbandry, Dairying and Fisheries in the Ministry of Agriculture and Farmers Welfare released Central Financial Assistance of Rs. 94.40 Lakh including 3% administrative expenditure to the Government of Kerala to provide assistance to the traditional fishermen affected by the Cyclone.

An amount of Rs. 1500 crores was sanctioned to Lakshadweep from the budget of UT for providing relief to the affected people and rebuilding of damaged infrastructure.

Tamil Nadu Government

- The state government provided assistance of 10 lakhs to family members of bereaved fishermen while Rs. five lakh solatium to those fishermen who were affected by the cyclone and unable to pursue their profession and an assistance of Rs. 50,000 to the injured fishermen. The state government sanctioned an amount of Rs. 42,50,000 to provide special livelihood support of Rs. 5,000 per family to the families of fishermen missing due to the cyclone.
- The State Government also initiated special schemes :-
    - o To meet the educational expenditure to pursue / continue higher studies (vocational, technical and educational) by the children of fishermen, which was implemented by the Fisheries Department.
    - o To provide training in an alternate livelihood to the families of the missing / deceased fishermen.

Government of Kerala

- The state government provided ex-gratia amount of Rs. 20 lakh to the dependents of all the missing fishermen.
- A disbursement of Rs. 33.95 crores was made to provide Rs. 2000/head relief to all active fishermen after cyclone Ockhi for livelihood.
- Rations worth Rs. 8.31 crores were provided to families of active fishermen registered in Kerala coast.
- Relief meal kits worth Rs. 4.61 lakhs were distributed immediately to the affected families in Thiruvananthapuram.
- An amount of Rs. 58.86 lakhs was disbursed to farmers in Thiruvananthapuram district as crop loss assistance.
- A disbursement of Rs. 5.82 crores was done to repair the damage to the houses in Thiruvananthapuram district.
- Fisheries Department provided free education for the children of the deceased fishermen.

- Apart from this, Government of Kerala recruited 200 fishermen under a recruitment drive in coastal police .

Reconstruction & Rehabilitation

State Government provided:-

1. Special assistance to the dependents of the deceased fishermen. Pension to fishermen for fishing and special assistance to educate the children of deceased fishermen.
2. Upgradation of educational infrastructure facilities in coastal areas
3. Reorganizing the coastal police with adequate facilities and establishing a community-centric digital early warning system

Search and Rescue Operations

The response, rescue and relief operations during the Ockhi cyclone were exemplary and historic in the country's disaster management. The central government immediately deployed Indian Air Force, Navy and Coast Guard for search and rescue operations. Teams of the National Disaster Response Force (NDRF) were already deployed in the cyclone affected areas of Tamil Nadu and Kerala to assist the local administration.

Five Indian Navy (IN) ships and two aircrafts were deployed for SAR operations in Kochi. This number was later expanded to ten ships and eight Indian Navy aircraft. Apart from the Indian Navy, the Indian Coast Guard (ICG) undertook a large-scale SAR operation to rescue fishing boats and fishermen.



(Source:DNA.com)

Figure-7 Stranded fishermen in mid-sea were brought safely to the shore through active coordination of various agencies including the Navy, the Air Force and the Coast Guard

By the night of 30 November and the early hours of 1st December, 2017, ten surface platforms of the ICG were immediately deployed to the cyclone-affected areas. Dornier aircraft and helicopters were engaged since the morning of 1st December, 2017, for extended aerial search of marine areas. The ICG coordinated the rescue of twelve boats and seventy-one fishermen with the assistance of Tamil Nadu fisheries officials till the night of 30th November 2017.The track and progress of the cyclone was constantly being monitored by various ICG operation centers. Based on inputs and requirements proposed by the Department of Fisheries, the ICG took up the search and rescue missions.

In Kerala, 155 fishermen were rescued and another 150 fishermen managed to return to safety on their own. Over 1,000 people were evacuated from the low-lying areas of Kanyakumari and placed in the relief camps



source-ndtv.com,outlookindia.com

Figure-8 Search and rescue operation by Indian Air Force

Use of Fishermen App developed by ISRO for Fishermen safety

To address the concerns of fishermen safety at sea, ISRO has developed an indigenous solution based on satellite communication and navigation systems. This, user-friendly app, also works on basic smartphones with compact Bluetooth enabled devices. This system enables fishermen to receive alerts in emergency situations such as cyclones, high waves, tsunamis, etc. It provides information on potential fishing areas and can also be used for geo-fencing applications. Inputs provided by agencies such as INCOIS/MoES can be transmitted to fishermen through the indigenous NAVIC system covering a distance of 1500 km. on the Indian mainland.

- Inputs from satellites may be received and integrated into cyclone forecasting models to make forecasting of cyclones such as Okhi more accurate.
- Security standards with a worldwide safety benchmark require continuous monitoring of critical infrastructures and should strengthen where there is a shortage.

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WEST BENGAL FLOODS

Introduction

The state of West Bengal has extensive network of rivers, their tributaries, rivulets, jhoras, canals, tanks and low lying pockets of water bodies, which are life line for the state.

Flood season in West Bengal is from the month of June to September. Due to excessive rainfall, all the river systems, under Brahamaputra basin in Alipurduar, Coochbehar, Darjeeling and Jalpaigui districts of North Bengal experienced one flood spell during the period from 10th to 13th August.

Impact

This flood caused considerable damages to the embankments and protection works.

This is due to the fact that high quantum of run-off flushed out from theadjacent State of Bihar into Malda district thereby raising the flood peak,1.73 m above Estimated Danger Level on 22nd August. Important branch channels of Mahananda like Fulhar, Dahuk, Pitani, Nagar, Tangon, Punarbhaba also flowed at higher than danger levels because of which large areas were inundated and the aforesaid districts were water logged for a considerable duration.

Due to heavy rainfall in the basin area of Atreyee within the neighbouring Country Bangladesh, the large areas of South Dinajpur district also experienced waterlogging and drainage congestion during this floodspell.

The rainfall within catchment area of Ganga basin in North Bengal during flood spell of August, 2017 were not so significant but still the water levels in the rivers were above Danger level and Extreme danger level. This is due to the fact that the whole system received considerable run-offs from the adjacent state of Bihar as well as from neighbouring country Bangladesh.

The disaster caused heavy loss of precious lives and extensive damage to private properties and public infrastructure. Over 52 lakh people were hit by the floods in six north Bengal districts of Coochbehar, South Dinajpur, North Dinajpur, Jalpaiguri, Alipurduar and Malda.

Assistance provided by Government of India:

National Disaster Response Force (NDRF):

During heavy rains in the region and rise of water level in most of the rivers, there was flood like situation in several districts of the state. As per the request of state government to manage the flood like situation, NDRF airlifted 07 teams from Rajali Airbase, Tamil Nadu. As such 19 teams of NDRF were deployed at Rajarhat (Kolkata), Jalpaiguri, Alipurduar, Birbhum, Medinipur, Malda, South Dinajpur & North Dinajpur for flood rescue operations and distribution of relief material in consultation with state government. This was the highest ever deployment of NDRF in West Bengal.

NDRF teams conducted a number of flood rescue operations, in which they rescued 1,267 persons, evacuated 6062 persons and retrieved 09 dead bodies. Medical assistance was also provided to flood affected people

Many of the rescues were carried out in the districts of Hooghly, East Medinipur, West Medinipur, Burdwan, North 24 Parganas and South 24 Parganas. NDRF teams, along with police and local authorities distributed relief materials to flood victims.

Deployment of State Forces:

i.	SDRF	8 Teams
ii.	Boats	48

(Source: MHA)



Distribution of food and other essential commodities in flood affected areas of Udaynarayanpur by Howrah Rural Police. Photo: West Bengal Police.

EMERGENCY RESCUE AND RELIEF OPERATIONS:

Various Central and State level government and non-government agencies played a significant role in making this operation successful, despite difficult terrain, adverse weather conditions, disrupted roads and lack of telecom connectivity. Several ministries/agencies of the Central Government, departments/agencies of the State Government, governments of

other states, NGOs, and corporate sector, all helped in the evacuation/relief operations. The efforts of the Indian Air Force, the Aviation Corps of the Indian Army and the civil helicopters engaged by the Civil Aviation Department of the State Government played a stellar role in the rescue operations. More than 27,00,000 people in 106 blocks of 14 districts of West Bengal were affected by the flood. Around 311 relief camps were opened for them by the state government. Hon'ble Chief Minister Ms. Mamata Banerjee visited flood-hit areas in Amta and Udaynarayanpur in Howrah.

Conclusion:

The West Bengal is basically recipient of run-off generated outside the state. The state has typical basin characteristics. In the north the rainfall is high and the ground slope is steep mainly in the Sub-Himalayan region. The rivers in the Terai region are wide with shallow depth. Due to continuous denudation of forest cover and dolomite mining in the hills, the silt loads are continuously deposited in the river beds, reducing the carrying capacity of the rivers causing the flood.

Reference:

Annual Flood report for the year 2017 by Irrigation and Waterways Directorate, Government of West Bengal.

Road Accidents and Other Incidents

This chapter discusses about major disaster such as road accidents and also other incidents which occurred in the country during 2017. The data of road accidents has been taken from Minstry of Road Transport & Highways, Government of India, and other incidents have been compiled from various media reports.

Total number of accidents, persons killed and injured during the year 2017

Sl. No	States/UTs	Total Accidents	Persons Killed	Persons Injured
1	Andhra Pradesh	25727	8060	27475
2	Arunachal Pradesh	241	110	316
3	Assam	7170	2783	6163
4	Bihar	8855	5554	6014
5	Chhattisgarh	13563	4136	12550
6	Goa	3917	328	1922
7	Gujarat	19081	7289	16802
8	Haryana	11258	5120	10339
9	Himachal Pradesh	3114	1203	5452
10	Jammu & Kashmir	5624	926	7419
11	Jharkhand	5198	3256	3918
12	Karnataka	42542	10609	52961
13	Kerala	38470	4131	42671
14	Madhya Pradesh	53399	10177	57532
15	Maharashtra	35853	12264	32128
16	Manipur	578	136	1027
17	Meghalaya	675	182	354
18	Mizoram	68	60	55
19	Nagaland	531	41	375
20	Odisha	10855	4790	11198
21	Punjab	6273	4463	4218
22	Rajasthan	22112	10444	22071
23	Sikkim	196	78	479
24	Tamil Nadu	65562	16157	74571
25	Telangana	22484	6596	23990
26	Tripura	503	161	718
27	Uttarakhand	1603	942	1631
28	Uttar Pradesh	38783	20124	27494

29	West Bengal	11631	5769	10091
30	Andaman & Nicobar Islands	189	21	263
31	Chandigarh	342	107	302
32	Dadra & Nagar Haveli	67	43	60
33	Daman & Diu	79	36	70
34	Delhi	6673	1584	6604
35	Lakshadweep	1	0	1
36	Puducherry	1693	233	1741
	Total	**464910**	**147913**	**470975**

Source: Ministry of Road Transport and Highways, Government of India

Other Incidents

S.No	Month	State/ UT	Description	Source
1	January	Andhra Pradesh	The Hirakhand Express, plying from Jagdalpur in Chhattisgarh to Bhubaneswar in Odisha, derailed near Kuneru railway station in Andhra Pradesh's Vizianagaram district This accident left 39 dead and 67 injured	The Hindustan times
2	January	Kashmir	More than 20 persons, including 15 army personnel died in avalanches caused by fresh snowfall across Kashmir.	Business Standards
4	June	Gujarat	Due to the heavy to very heavy rainfall at isolated places of Gujarat, several damages to infrastructure and death of 22 people were reported. In addition 59 livestock were lost.	NDMA
5	August	Uttar Pradesh	24people were killed and 154 others were injured in a train derailment accident	The Hindu

6	September	Uttar Pradesh	NTPC power plant explosion left 35 dead and over 90 injured,The accident occurred in the ash-handling section of the plant and ash gushed out at high-temperature, burying several workers.	Hindustan times
7	September	Uttar Pradesh	1318 children died due to Acute encephalitis syndrome (AES) at BRD medical college in Gorakhpur	The Hindu
8	September	Uttar Pradesh	75 people were severely injured in derailment of Kaifiyat Express.	Zee news
10	December	Mumbai	Fire broke out at the Kamala Mills Compound, located above the Mojo's Bistro Pub in the Lower Parel area of Mumbai. 14 persons were feared dead while many were injured	The Hindustan Times

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