NATURAL HAZARD- CAUSES, DISTRIBUTION PATTERN, CONSEQUENCE AND MITIGATION PROCESS, KERALA CONTEXT

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Abstract

In nature catastrophes such as floods, drought, earthquake, tsunami happens from time to time causing immense damage to life and property. It is important to devise means and methods to manage and minimize natural disasters as far as possible. Disasters are as old as human history but the dramatic increase and the damage caused by them in the recent past have become a cause of national and international concern. A disaster is a result from the combination of hazard, vulnerability and insufficient capacity or measures to reduce the potential ***chances*** *of risk. The main objective of the paper is to have an in-depth and detailed deliberation about the various concepts used in disaster management. The concepts discussed and explained here are disaster, hazard, and vulnerability risk and disaster management. In this paper the causes, effects, prevention and management of natural as well as human made disaster in* ***Kerala*** *were discussed detailed to develop concern about natural calamity and hazards. Such in depth discussion helps to develop among public. The four basic components of disaster management such as preparedness, response, recovery and prevention play an important role in disaster management. Adequate knowledge about understanding of natural hazards and disaster management helps to take measures to prevent disaster.*

Introduction

Disasters are seen as the effect of hazards on vulnerable areas. Hazards that occur in areas with low vulnerability do not result in a disaster. Great damage, loss, destruction and devastation to life and property are the results of disasters. The immeasurable damage caused by disaster varies with the geographical location. Disaster management essentially deals with management of resources and information towards a disastrous event and is measured by how efficiently, effectively and seamlessly one coordinates these resources. The ability to effectively deal with disasters has become a challenge to modern technology. Disaster management is the discipline of dealing with and avoiding risks. A disaster can be defined as "A serious disruption in the functioning of the community or a society causing wide spread material, economic, social or environmental losses which exceed the ability of the affected society to cope using its own resources". A disaster happens when a hazard impacts on the vulnerable population and causes damage, casualties and disruption.

Definition

Disaster

Any occurrence that causes damage, ecological disruption, loss of human life, deterioration of health and health services on a scale, sufficient to warrant an extraordinary response from outside the affected community or area. (WHO)

Hazard

Any phenomenon that has the potential to cause disruption or damage to people and their environment, A hazard is natural event while the disaster is its consequence, A hazard is perceived natural event which threatens both life and property.

Vulnerability

"The extent to which a community, structure, services or geographic area is likely to be damaged or disrupted by the impact of particular hazard, on account of their nature, construction and proximity to hazardous terrains or a disaster prone area."

Classification of disasters

1. Natural hazardsare hazards which arecaused because of natural phenomena (hazards with meteorological, geological oreven biological origin). Examples of naturalhazards are cyclones, tsunamis, earthquakeand volcanic eruption which areexclusively of natural origin. Landslides, floods, drought, fires are socio-naturalhazards since their causes are both natural and manmade. For example flooding maybe caused because of heavy rains, landslideor blocking of drains with human waste.

2. Manmade hazardsare hazards whichare due to human negligence. Manmadehazards are associated with industries orenergy generation facilities and include explosions, leakage of toxic waste, pollution, dam failure, wars or civil strife etc.

To understand the significance and implications of various types of hazards we must have a basic understanding about the nature, causes and effects of each hazard type and mitigation measures that need to be taken up. In this paper we would discuss the following hazards:

- Earth quake
- Tsunami
- Landslide
- Flood
- Cyclone
- Drought

❖ ***Earthquake***

An earthquake is simple words is shaking of the earth. Earthquake is one of the most destructive natural hazard. They occur at any time of the year, day or night, with sudden impact and little warning. Focuses are point where the energy is released.

❖ ***Tsunami***

The term tsunami has been derived from a Japanese term Tsu meaning 'harber' and name meaning 'waves'. Tsunamis are popularly called tidal waves but they actually have nothing to do with the tides. These waves which often affect distant shores, originate by rapid displacement of water from the lake or the sea either by seismic activity, landslides, volcanic eruptions or large meteoroid impacts.

❖ ***Landslide***

The term landslide includes all varieties of mass movement of hill slopes and can be defined as the downward and outward movement of slope forming materials composed of rocks, soils, artificial or combination of all these materials along surface of separation by falling, sliding and flowing, either slowly or quickly from one place to another.

Flood

Flood is a state of high water level along a river channel or on the coast that leads to inundation of land, which is not usually submerged. Floods may happen gradually and also may take hours or even happen suddenly without any warning due to breach in the embankment, spill over, heavy rains etc. There are different types of floods namely: flash flood, Riverine flood, urban flood, etc.

Flash foods can be defined as floods, which occur within six hours of the beginning of heavy rainfall, and are usually associated with cloud burst, storms and cyclones requiring rapid localized warning and immediate response to reduce damage. In case of flash floods, warnings for timely evacuation may not always be possible. Riverine flood occurs when excessive rainfall over an extended period of time causes a river to exceed its capacity. Urban flood means inundation of land or property in a built environment, particularly in more densely populated areas, caused by rainfall overwhelming the capacity of drainage systems, such as storm sewers.

Causes

There are several causes of floods and differ from region to region. The causes may vary from a rural area to urban area. Some of the major causes are:

- Heavy rainfall
- Heavy siltation of the river bed reduces the water carrying capacity of the river/stream
- Blockage in the drains leads to flooding of the area.
- Landslides blocking the flow of the stream.
- Construction of dams and reservoirs
- In the areas prone to cyclone, strong winds accompanied by heavy down pour along with storm surge leads to flooding.

The most important consequence of floods is the loss of life and property. The gushing water, landslides triggered on account of water getting saturated, boat and fishing nets get damaged, damages structures like houses, bridges, roads etc. There is huge loss to life and damaged. There is huge loss to life and livestock caused by drowning. Lack of proper drinking water facilities, contamination of water leads to outbreak of epidemics, diarrhea, viral infection, malaria and many other infectious diseases.

Distribution pattern

Floods occur in almost all the river basins of the country. The vulnerability Atlas of India shows periodically the areas liable to floods. Around 12 percent (40 million hectare) of land in India is prone to floods. Most of the floods affected areas lie in the Ganga basin, Brahmaputra basin (comprising of Barak, Tista, Tora, Subansiri, Sankosh, Dilhang, Luhit), the northwestern river basin (comprising Jhelum, Chenab, Ravi, Sutlej, Beas and the Ghargra), peninsular river basin (Tapti, Narmada, Mahanadi, Baitarani, Godavari Krishna, Pennar and the Kaveri) and the coastal regions of Andhra Pradesh , Tamilnadu, Odisa, Kerala . Assam, Utter Pradesh, Bihar and Orissa are some of the states who have been severely prone to floods. Our country receives an annual rainfall of 1200 mm, 85% of which is concentrated in 3-4 months i.e., June to September. Due to intense periodic rain, most of the rivers of the country are fed with huge quantity of water, much beyond their carrying capacity.

Warning

Flood forecasting and warning has been highly developed in the past two decades. With the advancement of technology such as satellite and remote- sensing equipments flood waves can be tracked as the water and water resources department. Central Water Commission maintains close liaison with the administrative and state engineering agencies, local civil authorities to communicate advance warning for appropriate mitigation and preparedness measures.

Possible Risk Reduction Measures:

Mapping of the prone areas is a primary step involved in reducing the risk of the region. Historical records give the indication of the areas and the period of occurrence and the extent of the coverage. Warning can be issued looking into the earlier marked heights of the water levels in case of potential threat. In the coastal areas the tide levels and the land characteristics will determine the submergence areas. Flood hazard mapping will give the proper indication of water flow during floods.

*Land Use Control*will reduce danger of life and property when waters inundate the flood plains and the coastal areas. The number of casualties is related to the population in the area at risk. In areas where people already have built their settlements, measures should be taken to relocate to better sites so as to reduce vulnerability. No major development should be permitted in the areas which are subjected to high flooding. Important facilities like hospitals, schools should be built in safe areas. In urban areas, water holding areas can be created like ponds, lakes low-lying areas.

Construction of Engineered Structures in the flood plains and strengthening of structures to withstand flood forces and seepage. The building should be constructed on an elevated area. If necessary build on stilts or platform.

Flood Control aims to reduce flood damage. This can be done by decreasing the amount of runoff with the help of reforestation (to increase abortion could be a mitigation strategy in certain areas), protection of vegetation, clearing of debris from streams and other water holding areas, conservation of ponds and lakes etc. flood diversion include leaves, embankments, dams and channel improvement.

Flood Management in India, systematic planning for flood management commenced with the five year plans, particularly with the launching of national programme of flood management in 1954. During the last 48 years, different methods of flood protection structural as well as non- structural have been adopted in different states depending upon the nature of the problem and local conditions. Structural measures include storage reservoirs, flood embankments, drainage channels, anti erosion works, channel improvement works, detention basins etc. and non-structural measures include flood forecasting, flood plain zoning, flood proofing, disaster preparedness etc. the flood management measures undertaken so far have provides reasonable degree of protection to an area of 15.81 million hectares throughout the country.

FLOOD IN KERALA 2018

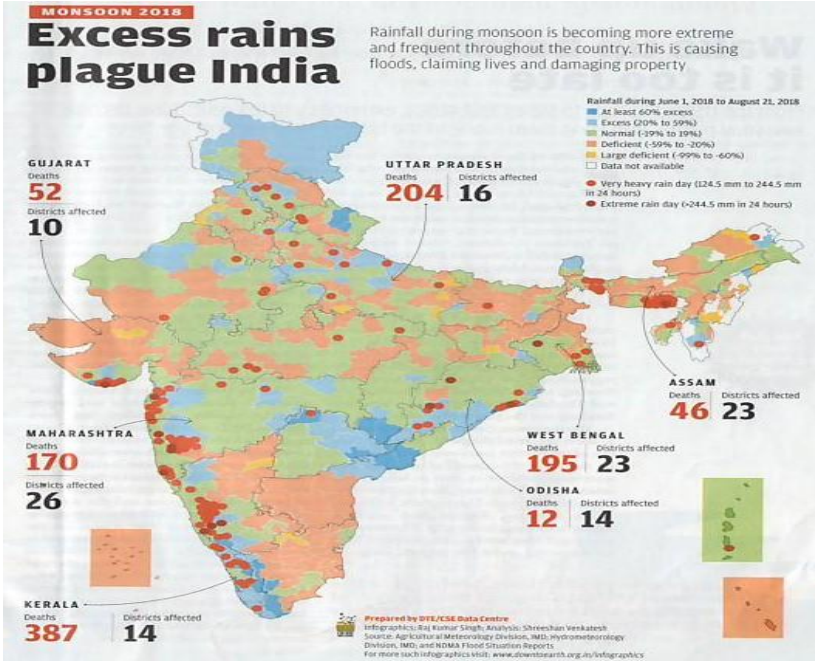
DELUGE OF THE CENTURY

*Kerala's worst flood since 1924 reinforces how local environment degradation and lack of disaster preparedness can make extreme weather events deadly. Amid accusations that the Kerala floods were a man-made disaster, it is important to take a close look at the structural limitations of the state's river basins and other issues such as topography, water and power needs, and extreme event predictions***.**

Year	Intensity of rain
1878	292.54
1924	311.53
1961	294.34
2018	237.87

Source: Mathrubhumi Malayalam sept 2018

Kerala experienced its worst floods in recent history during the third week of August 2018. It was similar to the one that occurred in 1924, known as the 'great delgue of 99", the figure "99" denoting the year 1099 as per the Malayalam calendar. In the latest instance, extreme flooding affected 13 of Kerala's 14 districts. The state has1,564 villages, and just about 3.48 core, more than 54 lakh people- or one sixth of the population- were affected by this deluge.



Source: Down to Earth

July 16-18, 1924, rainfall

Source: Frontline Sept 2018

According to the Indian meteorological department (IMD), Kerala received 2,34.66 millimeters of rainfall between June 1(traditionally the date of onset of the monsoon in Kerala) and August 19. This is 42 percent above the normal rainfall of 1,649.5mm. Further, the rainfall over Kerala during June, July and between August1 and 9 was 15 percent, 18 percent and 164 per cent above normal, respectively. But this comparison will not suffice to understand why this extreme precipitation created the kind of flooding Kerala witnessed during August 15-17.

We must understand how heavy rainfall. Very heavy rainfall and extreme rainfall events test, in varying degree, the resilience of Kerala's reservoirs, river channels, riverbanks, backwaters lakes and the exit mechanisms that discharge the freshet, or flood from rivers, to the sea and lead to different flooding intensities. As the outside world tracked news of heavy rains for more than a week after August 8, the response was just a habitual disclaimer.

For a state living with two monsoons and fighting drought for the last three years with a monsoon deficit ranging up to 34 percent, it was a respite. Day after day over 11 days, floods gripped all the state's 14 districts with an unheard of ferocity. on August 19, for the first time in the preceding 11 days, satellite images of Keralacaptured fractures in the cloud cover. The state govt lifted the red alert consequently.Thirty-five out of the fifty-four dams within the state were opened, for the first time in history. All five overflow gates of the Idukki Damwere opened at the same time, and for the first time in 26 years 5 gates of the Malampuzhadam of Palakkad were opened. Heavy rains in Wayanad and Idukki have caused severe landslides and have left the hilly districts isolated. The Prime Minister regularly monitored the situation, and the National Crisis Management Committee coordinated the rescue and relief operations.

Intensity of rainfall

Descriptive term used	**Rainfall (in mm)**
No rain	0
Very light rain	0.1-2.4
Light rain	2.5-7.5
Moderate rain	7.6-35.5
Rather heavy	35.6-64.4
Heavy rain	64.5-124.4
Very heavy rain	124.5-244.5
Extremely heavy rain	≥ 244.5
Exceptionally heavy rain	#

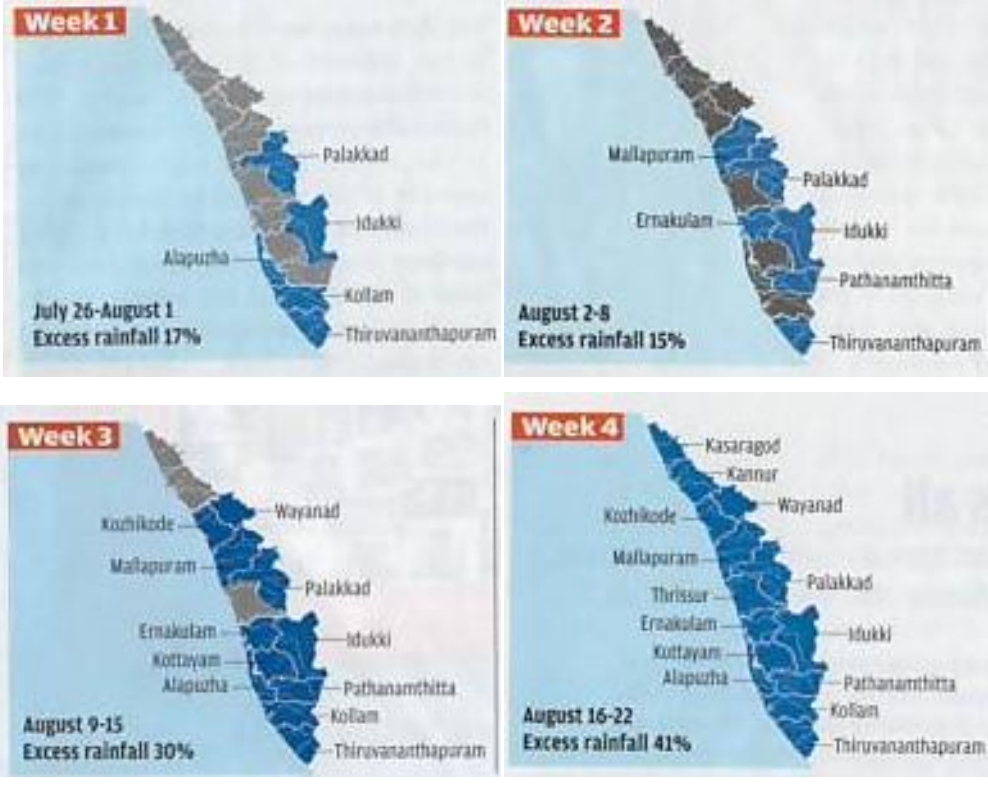
when the amount is near the highest recorded rainfall at or near the station for the month or season. However, this term will be used only when the actual rainfall amount exceeds 1,200mm. ***Source: Frontline magazine Sept 2018***

Typically, Kerala receives strong monsoon showers in June and July as the southwest monsoon gains strength, after which there is a lull in the latter two months saw slightly above normal rains this year, the normalcy did not extend into August, within the first three weeks of the month, the state received close to 500mm of rain over and above the normal rainfall received by the state since the beginning of the month, close to 75 percent was received in the eight days between August 9 and 17, representing a departure from normal by around 300 per cent for the time period. Between August 8 and August 16, Kerala received two spells of widespread intense rains. The first spell of heavy rains prior to August 10 was heralded by just such a system and was anticipated by monsoon trackers. What came as asurprise though was the second spell of rainfall after August 14. The western end of the trough at the time was not stable.

Month wise actual rainfall, normal rainfall and percentage departure from normal

Period	Normal Rainfall	Actual rainfall	Departure from normal
	(mm)	(mm)	(%)
June,2018	649.8	749.6	15
July,2018	726.1	857.4	18
1-9, August,2018	287.6	758.6	164
Total	1649.5	2346.6	42

Source: Central Water Commission 2018



Source: Down to Earth 1-15 Sept 2018

Due to the heavy rainfall, the first onset of flooding occurred towards the end of July. A severe spell of rainfall was experienced at several places on 8th and 9th of August 2018. The 1 day rainfall of 398 mm, 305mm, 255mm,254mm, 211mm,214mm were recorded at Nilabur in Malappuram district, Mananthavadi in Wayanad district, Peermade, Munnar KSEB and Myladumpara in Idukki district and Palakkad district respectively on 9 August 2018. This led to further flooding at several places in Mananthavadi and Vythiri in Wayanad district during 8-10 August 2018. Water released from several dams due to heavy rainfall in their catchments. The water levels in several reservoirs were almost near their full reservoir level due to continuous rainfall from 1st of June. Another severe their spell of rainfall started from the 14th of August and continued till the 19th of August, resulting in disastrous flooding in 13 out of 14 districts.

District wise rainfall realized during 1 June 2018 to 22 August 2018

Districts wise rainfall realized in Kerala as per IMD records is presented in this table, where it can be seen that the rainfall departure in Idukki is the highest viz.92%

Districts	**Normal rainfall(mm)**	**Actual rainfall(mm)**	**Departure from Normal (%)**	
Kerala State	*1701.4*	*2394.1*	*41*	*Excess*
Alappuzha	1380.6	1784	29	Excess
Kannur	2333.2	2573.3	10	Normal
Ernakulam	1680.4	2477.8	47	Excess
Idukki	1851.7	3555.5	92	Large excess
Kasaragod	2609.8	2287.1	-12	Normal
Kollam	1038.9	1579.3	52	Excess
Kottayam	1531.1	2307	51	Excess
Kozhikode	2250.4	2898	29	Excess
Malappuram	1761.9	2637.2	50	Excess
Palakkad	1321.7	2285.6	73	Large excess
Pathanamthitta	1357.5	1968	45	Excess
Thiruvanathapuram	672.1	966.7	44	Excess
Thrissur	1824.2	2077.6	14	Normal
Wayanad	2281.3	2884.5	26	excess

Source: Central Water Commission 2018

Rescue

During floods the heroic efforts of the fishermen who rescued more than 65,000 marooned people from some of the worst affected districts and the efforts of the rescue teams from the National Disaster Response Force (NDRF), Indian Army, Navy and the Air Force who evacuated marooned people using boats and aircrafts along with the Government officials, elected representatives and women and youth volunteers showed the resilience of the communities to come together to help each other. The self organizing, self driven innovative solutions using inter operable technology platforms, mobile applications, web portals and virtual army of IT savvy youth who designed, developed and implemented innovative solutions to fast track search and rescue, evacuation and monitor rehabilitation and relief distribution etc. showcased several good practices. The structured efforts of the state government under the leadership of the Chief Minister has been able to mobilise Rs. 1620.51 Cr in CMDRF through donations from individuals and groups. Indian Army, Indian Navy and Indian Air Force have led and contributed to the largest disaster recovery operation. This operation spanned over 16 days and rescued more than 50000 people all over the state. The Indian army also restored temporary access to 26 bridges and many inaccessible roads. The Southern Naval Command dispatched four diving teams with dinghies and one Sea King helicopter to Wayanad district to render assistance to the local population. Teams have been augmented by Gemini boats, divers and other resources from both Eastern and Western Naval Commands of the Indian Navy. 92 diving teams have been deployed at various locations across the affected districts. Social media platforms were used to reach out to the people, to spread awareness, and also to curb the spreading of fake news. Social media platforms became control rooms overnight for relief coordination needs of the state. NIMHANS, Bangalore has already deployed a 40-member psycho-social team (Psychiatrists, Psychologists and Psycho-social workers), one team for each of the 14 districts for rapid psycho-social assessment and community -based psycho-social care.

Rebuild Kerala

- Repair of damaged shelters through provision of material, cash and labour support. Relocation of vulnerable houses which are at risk
- Prepare & encourage community to build flood resilient houses with available local resources.
- For families who have lost their homestead, identifying possibilities of rental support, & construction of transitional

Shelters

- All reconstruction should consider resilience and environmental impact/ carbon footprint. Local resources should be mobilised as much as possible.
- In Landslide prone zone, reconstruction should be carried out post study of land based on the stability & identified safe zones.
- Joint planning for shelter recovery should be done with the affected people who have lost their house, with contribution from the owners of the house.

Conclusion

Natural hazards are result of climatic imbalance and can not be prevented but we can develop effective warning system and minimize loss by reducing vulnerability and increasing capacity. We need to more pro active than reactive. Very poor awareness level among community. Common belief among people that managing disaster or protecting their life is responsibility of government only. Also disaster is given priority only after occurrence, no efforts are done for reducing vulnerability or discussing, creating awareness as ongoing process. Community is major stakeholder in Disaster Management .It plays important role at each stage of Disaster Management Cycle .We can reduce vulnerability by creating awareness, giving them proper training which can help in disaster preparedness and response. We can provide trained manpower by giving training to informal groups .There is need to bring change in perception of people from Disaster response to Disaster Risk Management. Disaster is a serious disruption of the functioning of a society, causing widespread human, material, or environmental losses which exceed the ability of the affected society to cope using its own resources. Insuranceisstill the gap between Economic loss and insured property is more. Our system doesn't have compulsion for it. Present system works more on Disaster response than preparedness and mitigation. Absence of Strict laws and many times poor implementation of laws is a major drawback of system as we know if houses are made as per norms then causalities and economic losses will be minimum for disasters like flood.

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