INEVITABILITY OF CIVIL ENGINEERING IN A PERFECTLY PREPLANNED DISASTER MANAGEMENT

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ABSTRACT

A disaster is an unexpected extreme event, which results in the loss of property and life. This article is presented to describe the necessity of perfectly pre-planned disaster management. Here, various types of disasters are described with an explicit focus on hydro-meteorological disasters with their impact and influence zone. The historical data of the disaster occurrences in the world, India, and Gujarat state are discussed in brief. The influence of the disasters in terms of population affected and damaged to the properties is presented.

The disaster, natural or manmade, is responsible for the severe disturbance of the functioning of a society, causing widespread (human, material and environmental) damages, losses of property and lives, which exceeds the ability of the affected society to deal with using only its resources. This much description reveals why perfectly planned and fool-proof disaster management is inevitable. What are the roles of different fields of civil engineering in disaster management is also described in detail.

KEYWORDS: Natural and Manmade disasters, Vulnerability, Disaster management

1. INTRODUCTION

There are two types of disasters: natural disasters and man-made disasters. Natural disasters include earthquake produced by sudden tectonic movements, volcanic eruptions, continued drought conditions, heavy floods, cyclones, etc. Man-made disasters include fire accident, road accident, terrorism, nuclear disasters, chemical accidents, biological disasters etc. A disaster of any kind, manmade or natural, is a combined effect of threats and hazards like floods, cyclone, drought, etc. and vulnerabilities of society, cities or villages. There are no disasters without vulnerability or hazard. A hazard is defined as a phenomenon that poses a risk to the community or system which may cause disaster. Vulnerability is the ability of a society or a system to resist the forces and impacts of hazard [1].The disaster is a product of hazards and vulnerability. The major categories of disasters are as follows.

1. Hydro-meteorological disasters like flood, cyclone, and drought.
2. Geological disasters like earthquake, landslide, and volcanoes.
3. Technological disasters like nuclear and chemical accidents.
4. The word ‘disaster’ originated from the Old Italian word disaster. In Latin and Greek meaning of disaster is “bad star” which means the destruction of the star.

The geo-climatic conditions, a high scale of socioeconomic vulnerability, large population below the poverty line (BPL) etc. altogether make India one of the most disasters facing nation in the world. Every year, India is facing destructive effects of the cyclone, flood, drought, cloudburst, which results in the damage of the properties and losses of life.

2. DEFINITIONS OF DISASTERS

Certain definition of disaster or calamity is given hereunder.

- A sudden occurrence of an accident that causes an enormous loss of life and property is called a calamity or a disaster.
- An unexpected natural or man-made catastrophe of substantial extent causing significant physical damage or destruction, loss of life or sometimes permanent change to the natural environment is known to be a disaster.
- Disaster is also sometimes described as a catastrophic situation in which the usual pattern of life or ecosystem is disrupted and extraordinary emergency interventions are required to save and preserve lives and the environment [2].
- A catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or man-made causes, or by accident or negligence which results in substantial loss of life or human suffering or damage and destruction of property, or degradation of the environment, and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area [3].
- The occurrence of sudden or significant misfortune event which disrupts the basic fabric and normal functioning of the society or community [4].

3. NATURAL DISASTERS

The number of deaths from natural disasters has been varying from year to year; some years pass with very few deaths before a large disaster event takes many lives away. For many decades,~60,000 people globally died from natural disasters each year, i.e. only ~0.1% of global deaths. In many years, the number of deaths can be very low, often less than 10,000, and accounting for as low as ~0.01% of total deaths. But we also see some distressing impact of shock events: famine and drought (Ethiopia, 1983-85), Gujarat Earthquake (Katchchh, Saurashtra and Gujarat, 2001), Indian Ocean earthquake and tsunami (2004); Nargis Cyclone (Myanmar 2008), Port-au-Prince earthquake (Haiti, 2010). These and many such events pushed global disasters deaths to over ~200,000 lives which is more than ~0.4% of deaths in these years. Low-frequency, high-impact events (earthquakes or tsunamis) are unpreventable. The world has seen a significant reduction in disaster deaths through earlier prediction, more robustly resistant infrastructure, emergency preparedness and response systems with proper tactfully predesigned disaster management [5].

Those low-income groups(LIGs) are often the most vulnerable to disaster happenings, so improving living standards, infrastructure and response systems in these regions is the key to preventing deaths from natural disasters in the upcoming decades. Globally, over the past decade, natural disasters accounted for an average of ≅0.1% of total deaths. This was, however, highly variable to high-impact events and ranged from ≈0.01% to 0.4% of total deaths. What we see is that in the early-to-mid 20thcentury, the annual death toll from disasters was high, often reaching over one million per year. In recent decades we have seen a substantial decline in deaths. In most years fewer than ~20,000 dies (and in the most recent decade, this has often been ≤10,000). Even in peak years with high-impact disasters, the death toll has not exceeded ~500,000 since the mid-1960s. This decline is even more significant when the population growth rate over this period is considered. When it is corrected for population, showing this data in terms of death rates (per 100,000 people), even more decline over the past century is seen. A significant decline in deaths from almost all types of disasters with exception of earthquakes and extreme weather is also observed [5].

The reduction in the death rate is even more impressive. When the world population has grown rapidly over this period; one of the major successes over the past century has been the dramatic decline in global deaths from natural disasters. Behind this improvement has been the improvement in living standards; access to and growth of strong infrastructure; and effective response systems. These factors have been driven by an upsurge in incomes across the world. Today, the populations in low-income countries, those where a large percentage of the population is still in extreme poverty and mark low on the social or Human Development Index, have been more vulnerable to the effects of natural disasters.

Highly developed countries are much more resilient to disasters and so have a consistently low death rate from natural disasters. This does not mean that low-income countries have high death rates by disasters every year. In most years they also have very low death rates. But in the low-frequency, high-impact disasters, they are particularly vulnerable to its effects. Overall development, poverty lessening, and knowledge-sharing of how to increase resilience to natural disasters will therefore be the key to reducing the disasters-toll in the years to come [5].

4. TYPES OF DISASTERS

The disasters identified by the high power committee on disaster management constituted in 1999 under National Disaster Management Authority (NMDA) [3, 6] is identified in **Table 1.**

Table 1: Different Types of Disasters *[6].*

Sr.	Type Of Disasters	Examples
01	Climatical Disasters	Floods, Cyclones, Tornadoes, Cloud Burst, Droughts, Heat Wave and Cold Wave
02	Geological Disasters	Earthquakes, Landslides and Mudflows, Dam Break/Dam Bursts, Minor Fires
03	Chemical, Industrial and Nuclear Disasters	Chemical Disasters, Industrial Disasters, Nuclear Reactor Disasters
04	Accidental Disasters	Forest Fires, Oil Spills, Mine Flooding, Urban Fires, Village Fire, Electrical Disasters, Road/Rail/Air Accidents, Boat Capsizing, Bomb Blasts.
05	Biological Disasters	Epidemics, Pandemics, Pest Attacks, Food Poisoning, Cattle Epidemics

5. DISASTERS WORLDWIDE

During the 2nd half of the 20thcentury, more than 200 horrific natural disasters were happened in different countries of the world and caused a loss of lives of ~1.4 million. Losses due to natural disasters are ~20 times more in developing countries. Asia is having a topmost in causalities and loss of lives due to natural disasters.

5.1 Major Disasters Worldwide

During 1991-2005, the world was heavily affected by natural disasters like flood, windstorm, epidemic, earthquake, tsunami, drought, wildfires, high temperatures, landslides, volcano, etc. According to the centre for research on the epidemiology of disaster (CRED)[7], the contribution of different factors is given in **table 2.**

Table 2: Different Elements / Factors Responsible for Disasters Worldwide *[7]*.

No	Disaster Type	World (~%)	Africa (~%)	Asia (~%)	Europe (~%)	U.S.A. (~%)	Lands of Pacific Ocean
1	Flood	32	33	34	40	30	20
2	Wind Storm	25	09	26	20	34	46
3	Epidemic	13	38	10	06	06	05
4	Earthquake/ Tsunami	08	03	13	06	06	06
5	Drought	06	14	04	03	05	06
6	Land Slide	05	01	07	03	05	04
7	Wild Fire	04	01	02	08	07	05
8	Extreme Temperature	04	*	03	14	04	02
9	Volcanic Irruption	02	*	01	*	03	05
10	Insect Infestation	01	01	*	*	*	01

Results*< ~ 0.5% are not shown and the box left blank.

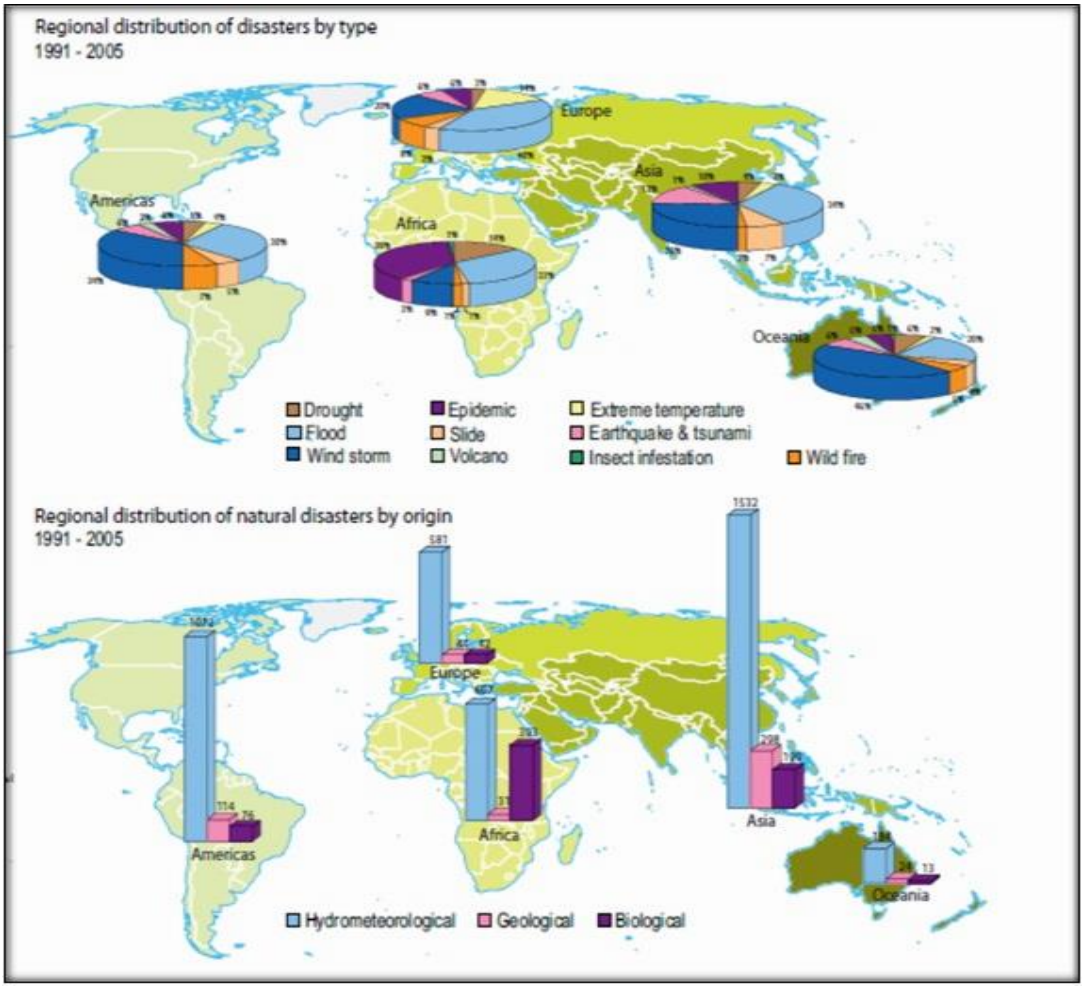

Figure 1: Regional Distributions of Disasters *[8]*.

A close look at **figure 1** reveals the regional distributions of the disasters worldwide [8]. **Figure 2** to **15**[9-10] show different graphs and charts presenting global data concerning disasters. **Figure 2** shows an Annual number of weather and non-weather types of natural disaster events globally from 2000 to the recent time, categorized by type. Due to the natural disaster from 1990-2017, **figure 3** shows the global estimates of the number of deaths from the natural disasters differentiated by the disaster type. **Figure 4** describes the global estimates of the number of deaths from natural disasters differentiated by disaster type. **Figure 5** provides an insight into the weather and nonweather related global disaster losses in economic terms expressed as a share of global gross domestic product (G-GDP). **Figure 6** brings awareness about the year wise total economic cost of damages as a result of global natural disasters, and the same due to flood only is shown in **figure 7**. **Figure 8** describes the absolute or annual number of deaths or death rate from all forms of natural disasters and the same due to the flood only is shown in **figure 9**. **Figure 10** shows the global natural disaster death rates due to all-natural disasters, while the same due to flood is given in **figure 11**. **Figure 12** is the graph of the number of natural disaster events from 1900 to 2019 and the same for flood is shown in **figure 13. Figure 14** describes the total number of deaths due to natural disasters worldwide**. Figure 15** showsglobal economic losses from disasters as a share of GDP**.** All figures [9-10] comprise the data of all types of naturaldisasters including drought, flood, extreme weather, extreme temperature, landslides, dry mass movement, wildfires, volcanic activities and earthquakes; except where specifically flood is not considered.

Table 3 [11] describes the world's deadliest disasters in the last century. According to the presented statistics, the Asian countries profoundly affected by the natural disaster than USA and other regions. China is profoundly affected by flood in the last century, while Bangladesh is affected by the cyclone. Heavy earthquake is affected by Japan, China, and Turkey. If individual disasters are considered, then the world has been heavily affected by flood and windstorm compared to other disasters [7].

Table 3: World Deadliest Disasters in the Last Century *[11].*

Sr.	Name of Event	Year	Country and Area
1	China Floods	1931	China
2	China Floods	1954	China
3	Bangladesh Cyclone	1970	Bangladesh, Chittagong, Khulna
4	Bangladesh Cyclone	1991	Bangladesh
5	Earthquake	1999	Turkey
6	Tsunami	2004	Indonesia, Srilanka, Malaysia, Somalia, Bangladesh, Thailand
7	Hurricane Katrina	2005	United States of America
8	Sichuan Earthquake	2008	China
10	Cyclone Nargis	2008	Myanmar
11	Haiti Earthquake	2010	Haiti

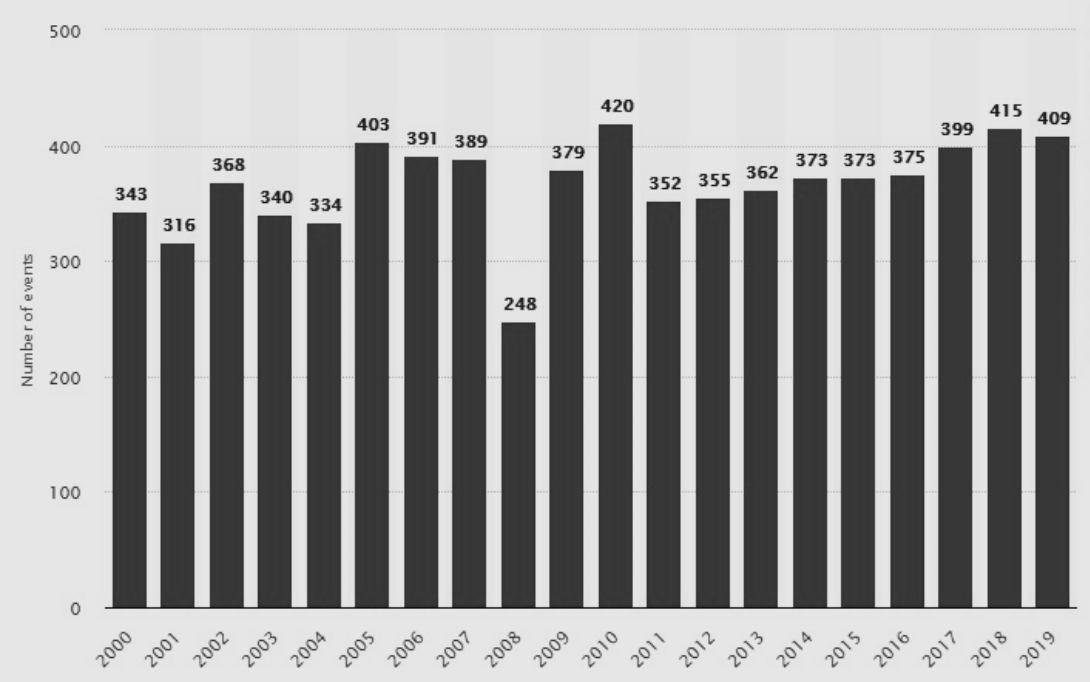

Figure 2: Global Data of Annual Number of Natural Disasters *[9, 10].*

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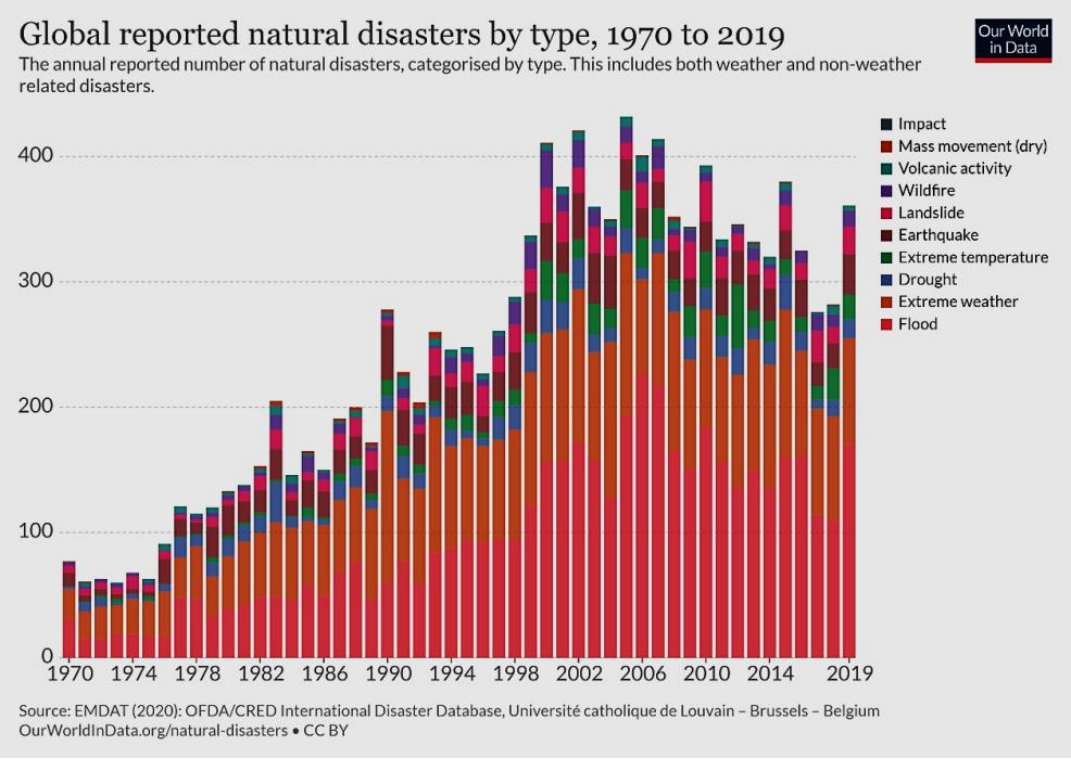

Figure 3: Globally Reported Worldwide Natural Disasters by Type *[9, 10].*

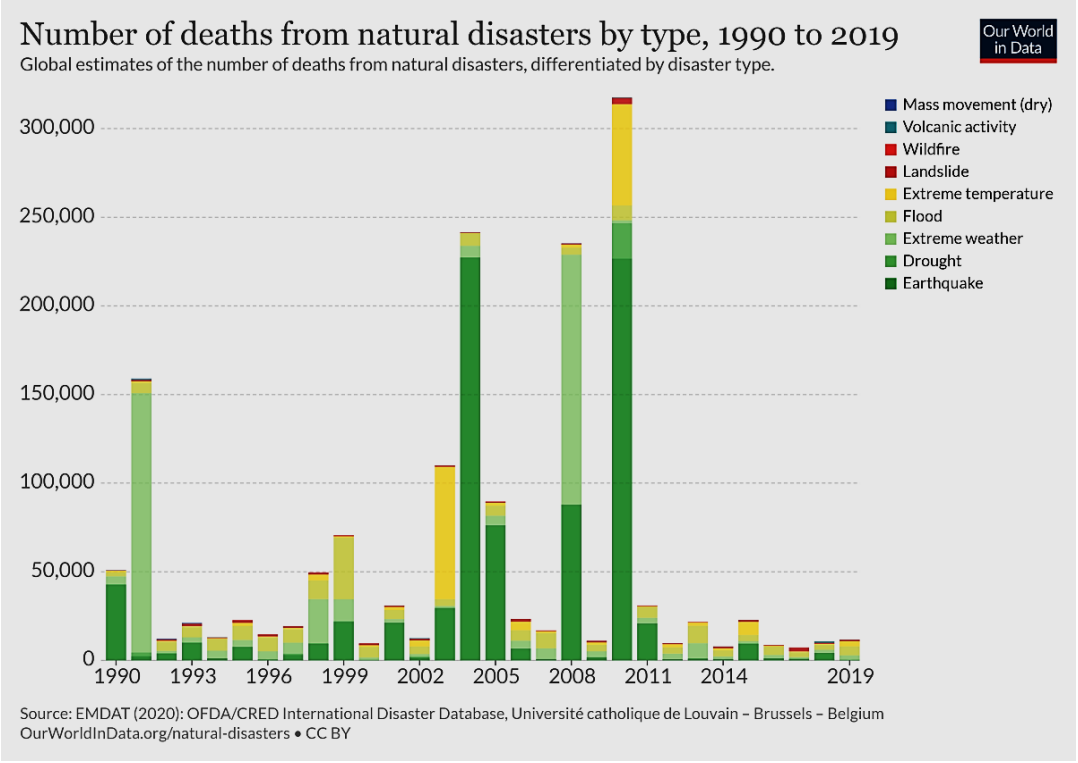

Figure 4: Number of Deaths from the Natural Disasters by Type World –Wide *[9, 10].*

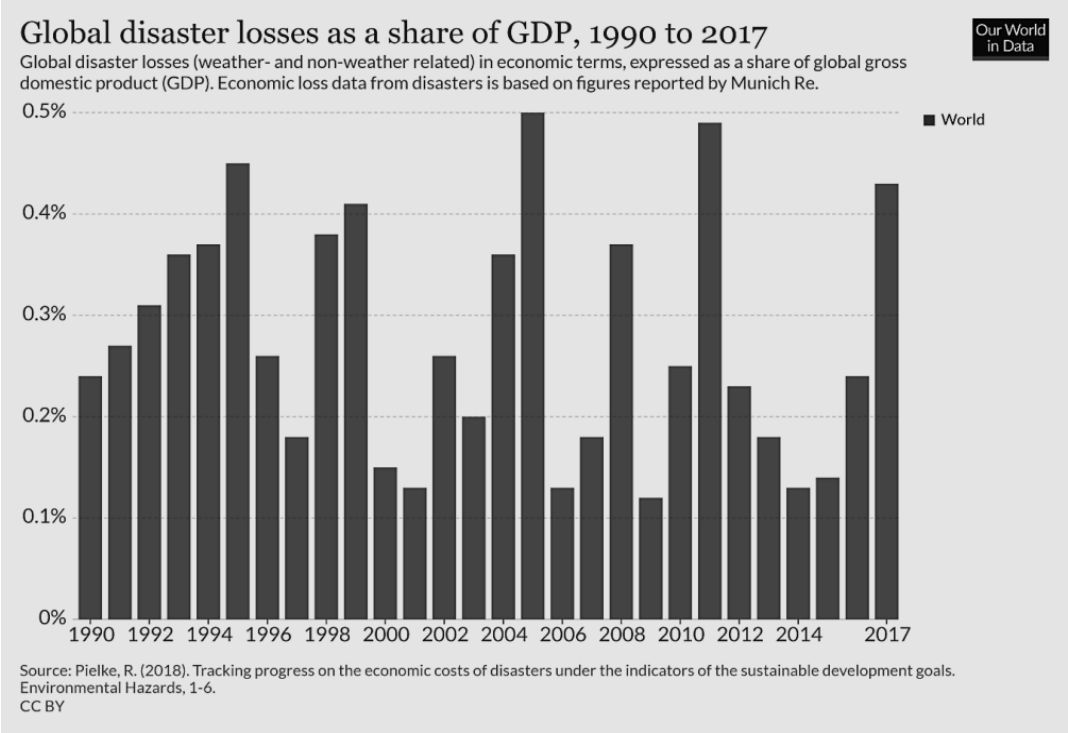

Figure 5: Global Disaster Losses as a Share of GDP *[9, 10].*

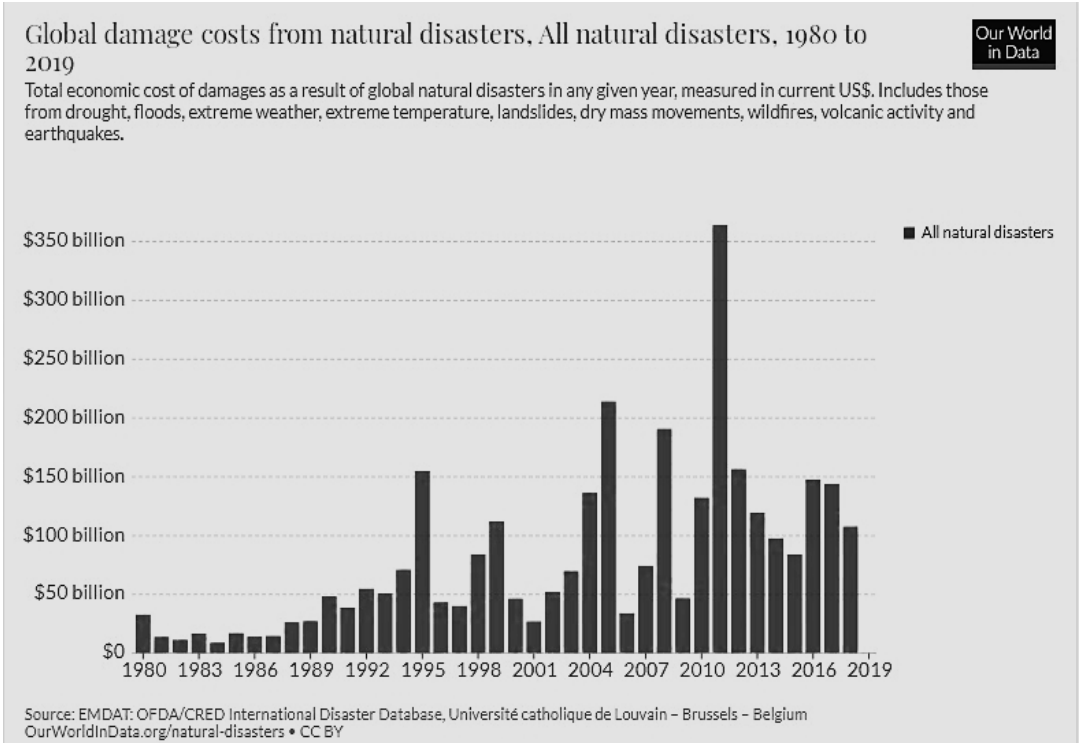

Figure 6: Global Damage Costs from All Natural Disasters *[9, 10].*

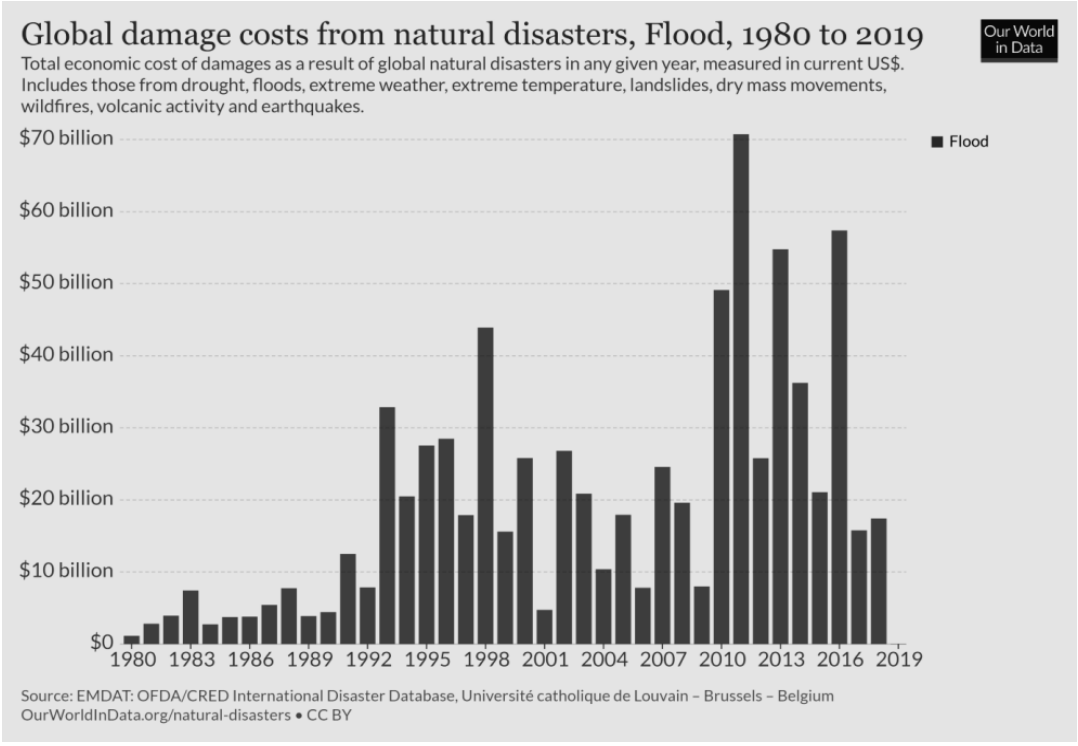

Figure 7: Global Damage Costs from the Flood *[9, 10].*

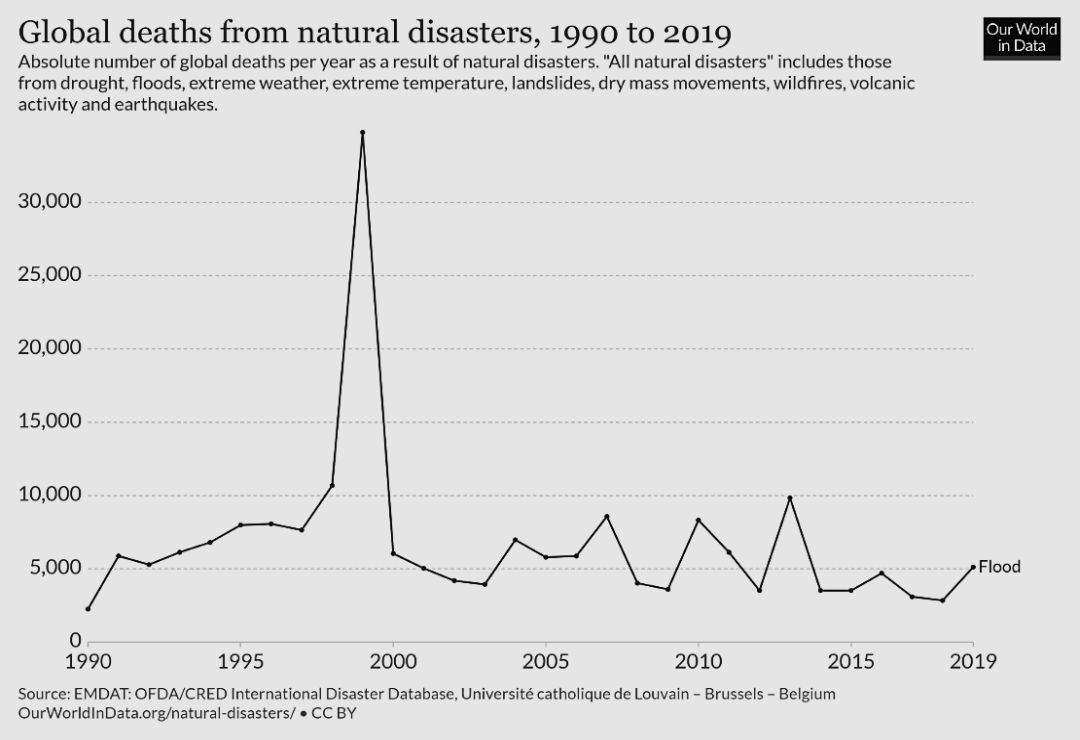

Figure 8: **Deaths from the Natural Disasters Worldwide** [9, 10].

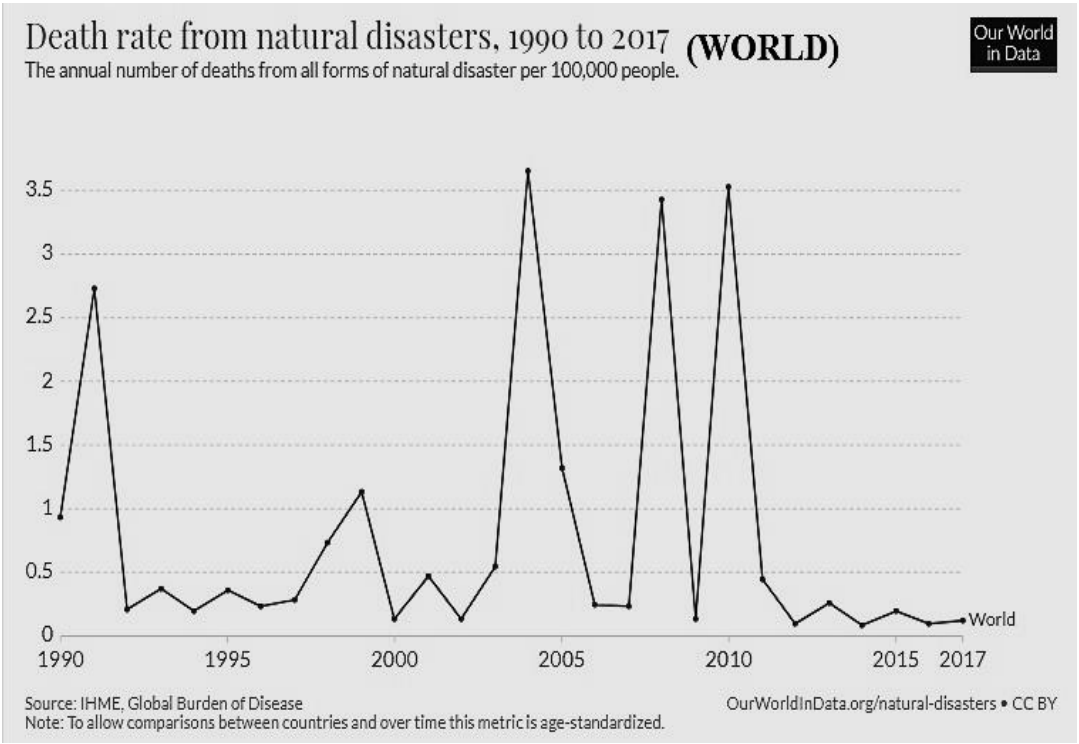

Figure 9: Worldwide Death Rate from Natural Disasters *[9, 10].*

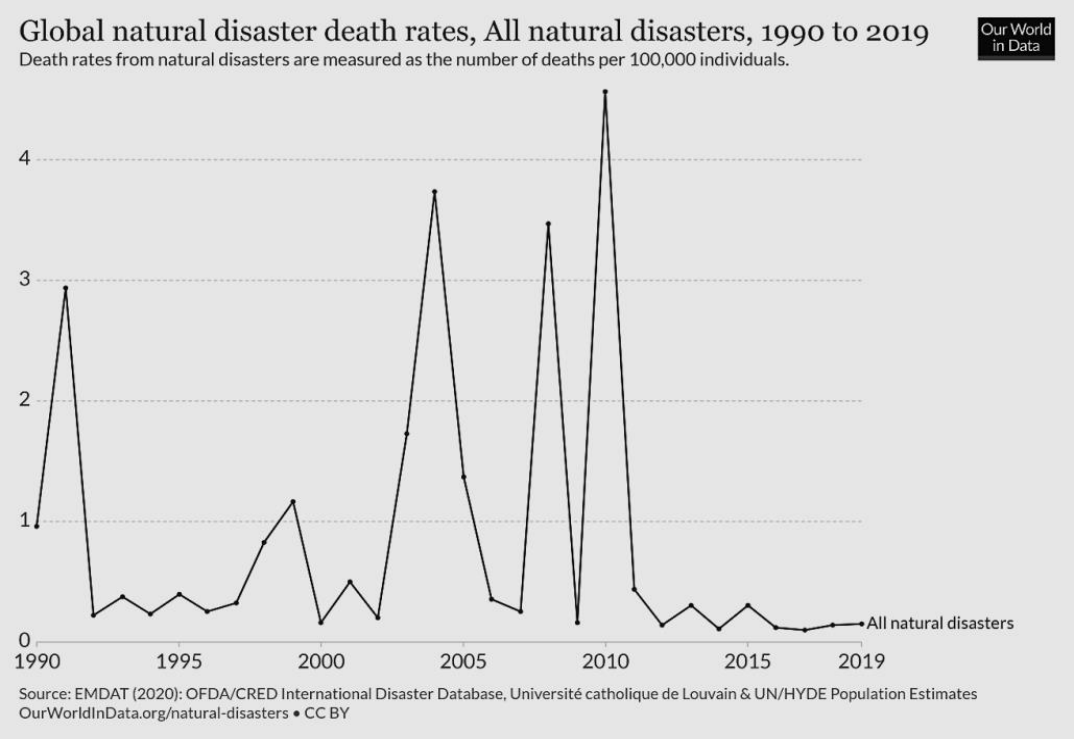

Figure 10: Global Death Rates due to all Natural Disasters *[9, 10].*

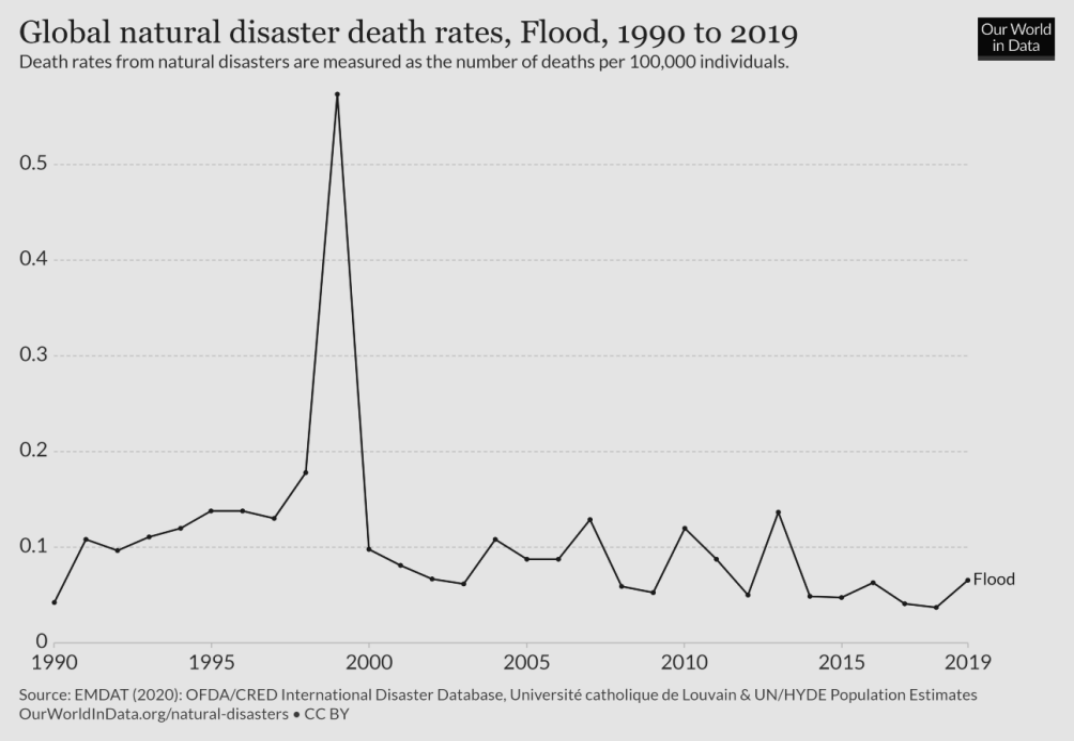

Figure 11: Global Death Rates due to Flood *[9, 10].*

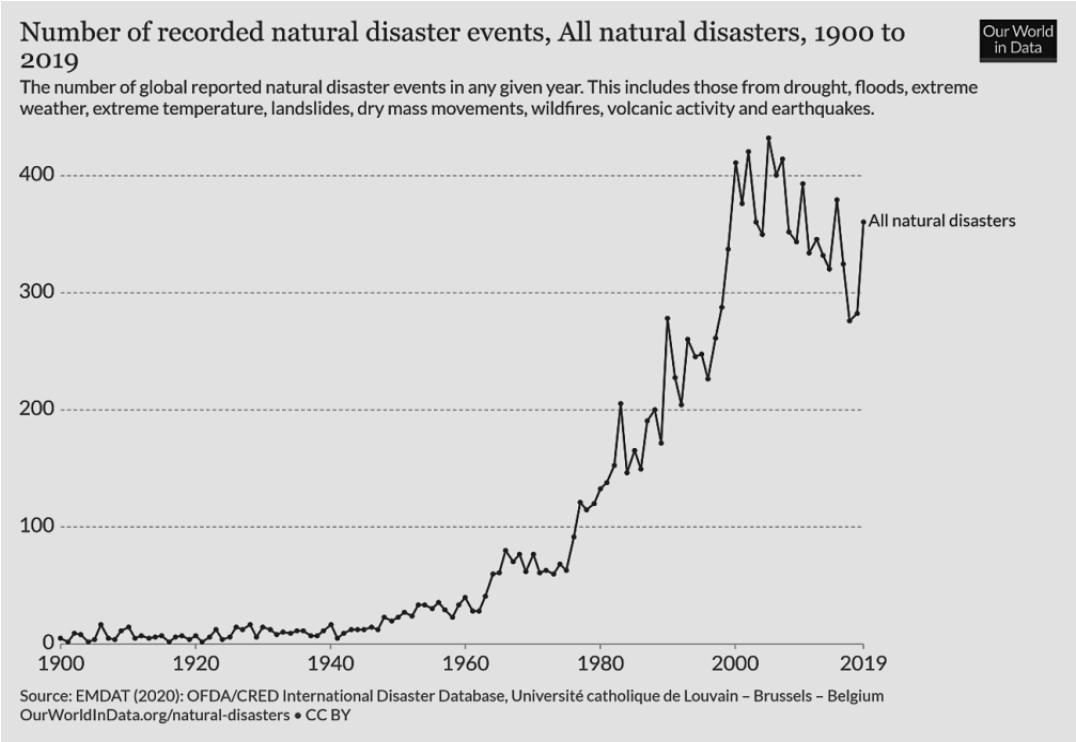

Figure 12: Number of Natural Disaster Events Year Wise-World Wide [9, 10].

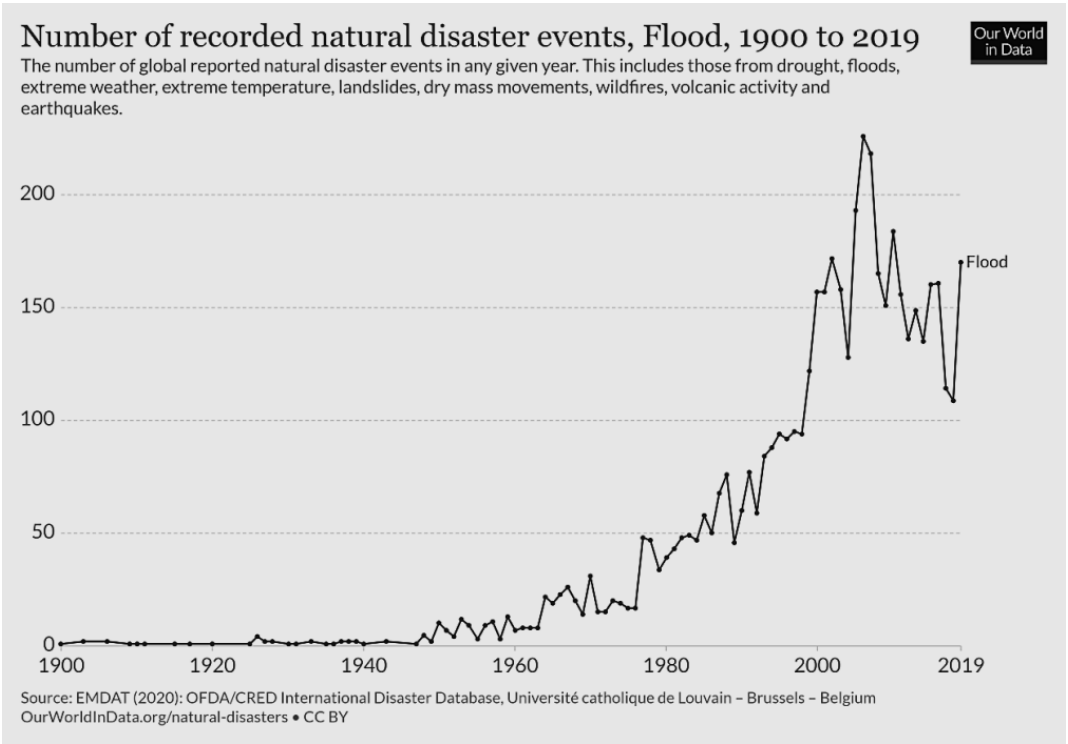

Figure 13: Number of floods Yearwise World Wide *[9, 10]*.

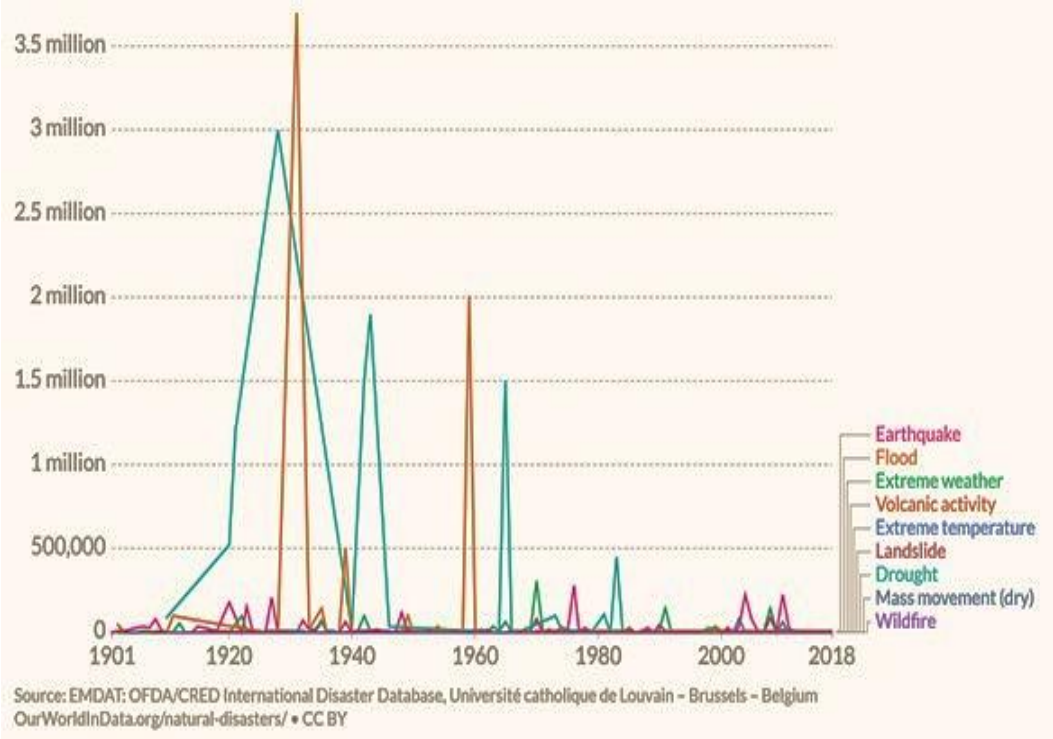

Figure 14: Total Number of Deaths in the World Due to Natural Disasters *[9, 10].*

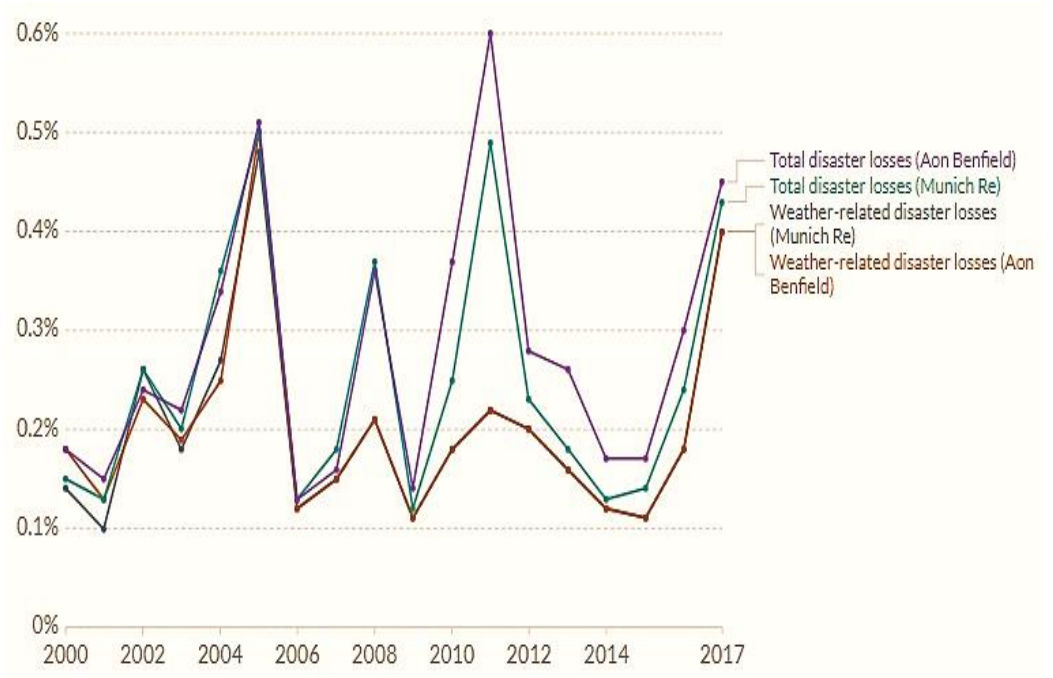

Figure 15: Global Economic Losses from Disasters as a Share of GDP *[9, 10].*

5.1 Impact of Disasters

Natural disasters like flood, cyclone, and earthquake are resulting in substantial loss of human lives and property. **Table 4** shows the total loss of properties and human during various kinds of disaster in 2005-14 and the average data of the last 30 years.

***Table 4: Impact of Natural Disaster in World** [11]*

Time Span → Disasters and Loss ↓	During 2015	During 2014	Last 10 Years (2005-14)	Last 30 Years (1985-2014)
Number of Disasters	377	341	4,042	10,322
Property Loss (Approx.) M US$	70,960	97,770	14,30,551	25,61,999
Loss of Human Lives	23,774	20,809	8,22,325	19,47,947

6. DISASTERS AT INDIA LEVEL

In India due to geo-climatic and socio-economic conditions and large populations are responsible for various disasters. During the time of the last thirty years, India has been struck by 431 natural and man-made disasters resulting in vast losses of life and property. In the last three decades, almost ~1.43 lakh people have lost their lives and 150 crore were affected due to various natural and man-made disasters. The total estimation of properties and other infrastructures loss is more than 4800 crore US$ according to the prevention of web statistics. The number of deaths and the death rate in India are shown in **figures 16** and **17**[9, 10] respectively.

6.1 Major Disastersin India

The hazard vulnerability map of India [12] is displayed in **figure 18**. During 1980-2010, the majority of 25 major disasters took place. Also, drought, heat-wave, cold-wave, coastal erosion and storm surge are affecting some of the areas of the country. In the world, India is one of the ten disasters prone country. This is due to manmade reasons like population growth, urbanization, rapid industrialization, non-scientific development practices etc. and natural factors like different geo-climatic conditions, topographic features, pollution, degradation of natural sources, etc.

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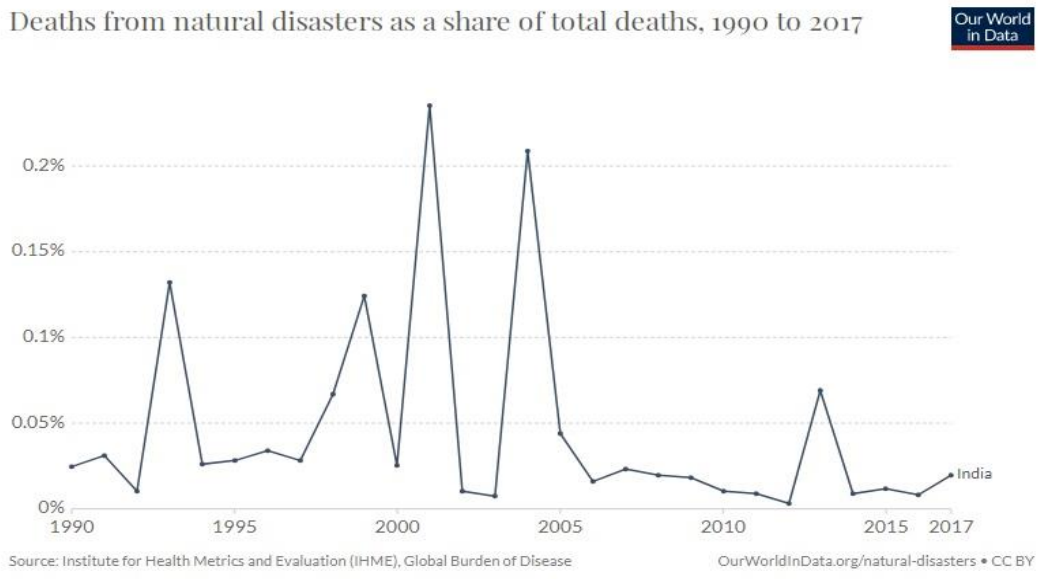

Figure 16: Figure 16: Deaths in INDIA due to Natural Disasters [9, 10].

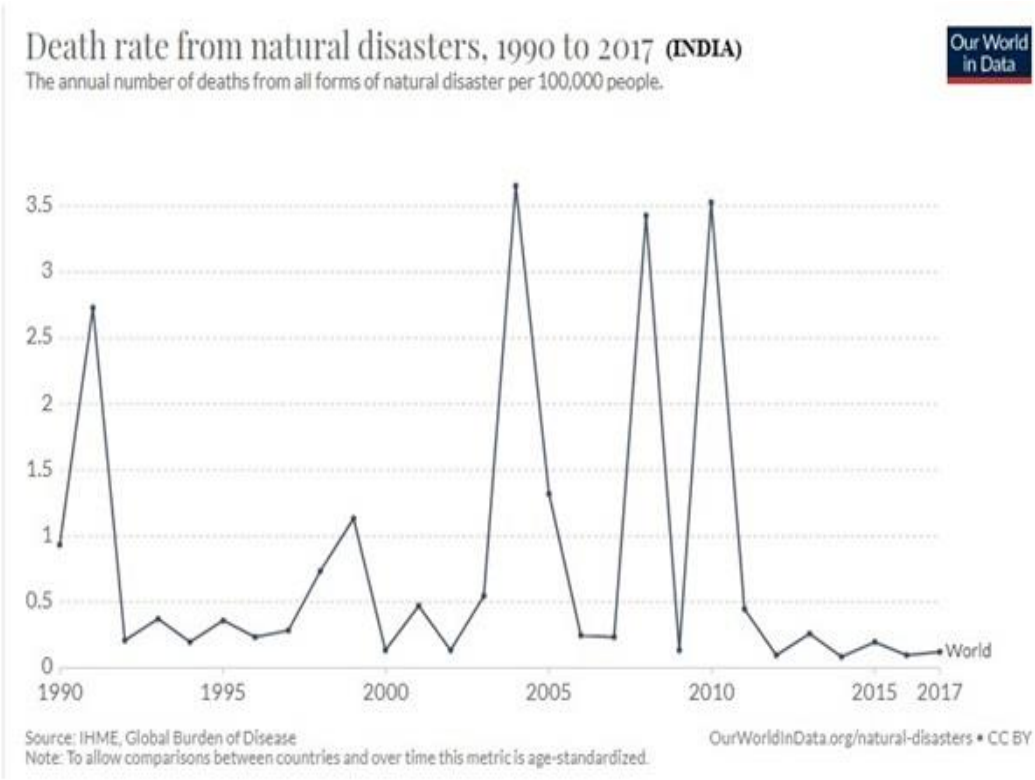

Figure 17: Death Rate in India due to Natural Disasters [9, 10].

Due to geological as well as geographical situations, India is highly vulnerable to natural disasters. The Himalayan region is prone to landslides and earthquakes. Every year, the plain area is affected by massive floods, a significant desert area in Kachchh-Gujarat and Rajasthan are prone to drought. While the sizeable coastal area is susceptible to storms and cyclones. Details about India's major deadliest disasters of the last century has been given in **Table 5** [11].

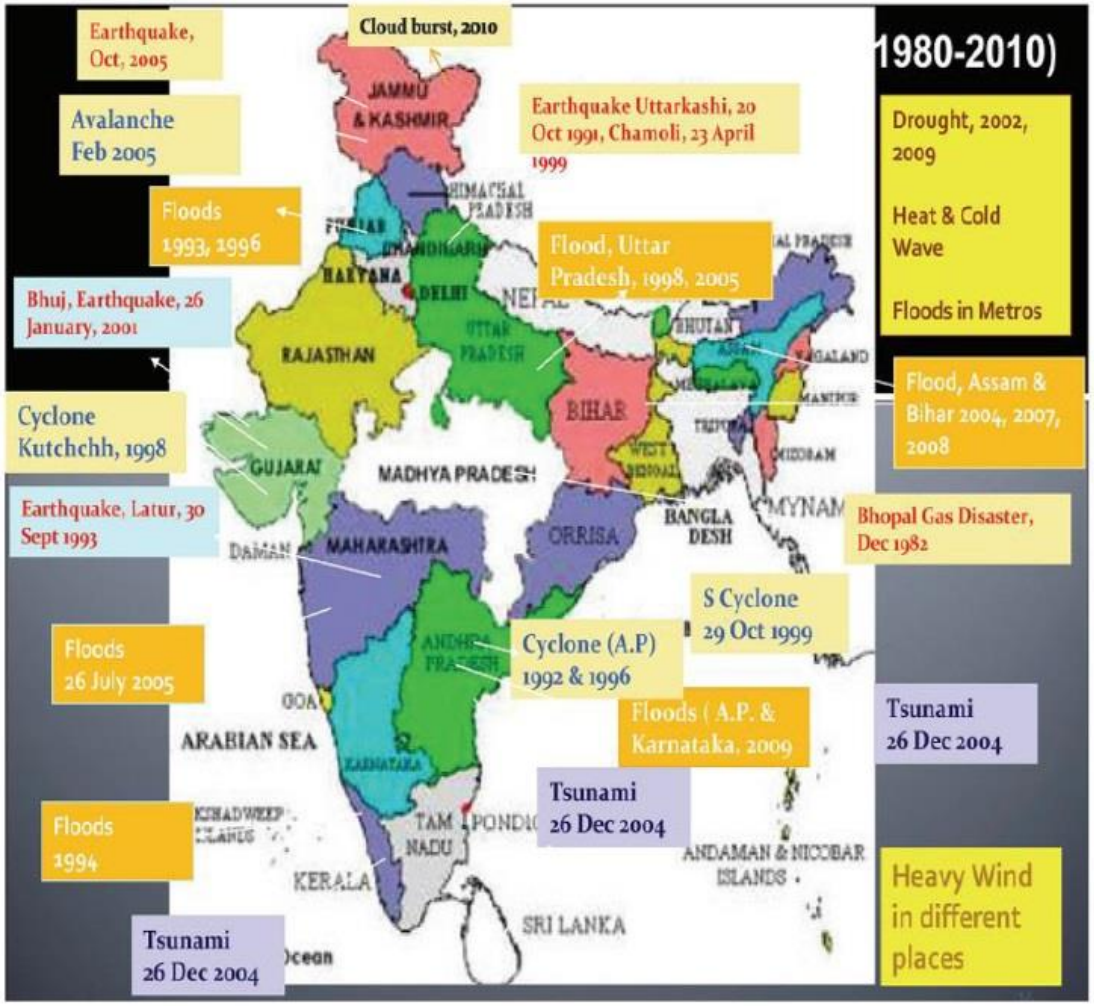

Figure 18: Scenario of Major Disasters in India from 1980-2010 *[12].*

Table 5: India's Deadliest Disasters in the Last Century [11].

Sr.	Name of Event	Year	State and Area
1	Earthquake	1905	Kangra, Himachal Pradesh.
2	Cyclone	1977	Andhra Pradesh.
3	Latur Earthquake	1993	Latur, Marathwada, Regions of Maharashtra.
4	Orissa Super Cyclone	1999	Orissa.
5	Gujarat Earthquake	2001	Bhuj, Bhachau, Anjar, Ahmedabad, Surat and all major areas of Saurashtra-Katchchh in Gujarat State.
6	Tsunami	2004	The coastline of Kerala, Tamil Nadu, Andhra Pradesh and Pondicherry, Andaman and Nicobar Islands.
7	Maharashtra Floods	2005	Maharashtra.
8	Kashmir Earthquake	2005	Kashmir.
9	Bihar Floods	2008	Tamil Nadu.
10	Nisha Cyclone	2008	Tamil Nadu.

Most natural disasters in India are related to the climate of India and cause massive losses of life in addition to properties. Natural disasters like Droughts, floods, flash-floods (Cloudbursts), cyclones, hurricanes, avalanches, land-slides by torrential rains, snowstorms, earthquakes, etc. pose extreme threats. To be classified as a disaster it should have a profound environmental effect and/or human loss and frequently incurs monetary loss. Other dangers include frequent summer dust storms, which generally track from north to south, cause extensive property damage in Northern India [13, 14] and deposit a huge amount of dirt-dust from dry and waterlessbarren regions. In some parts of India, Hail causes severe damage to standing crops such as rice and wheat and many more crops.

6.2 Impacts of Disasters

Table 6: Impact of Natural Disasters in India [11].

Time Span → Disasters and Loss↓	During 2015	During 2014	Last 10 years (2005-14)	Last 30 years (1985-2014)
Number of Events	21	16	168	429
Approximate loss of Property in Million US$	3,949	23,263	43,975	75,420
Loss of Human Lives	3,391	1,064	23,840	1,37,160

Table 6 [11] provides the effect of natural disasters in India regarding the loss of property and human lives. From this data, it is clear that during the last 30 years ~1.38 lakh people have lost their lives besides the estimated property loss of 76 billion US$.

7. DISASTERS AT GUJARAT LEVEL

Because of climatic conditions, geological features and physical features, 1600 km coastal area Gujarat, which is the longest in India, is highly vulnerable to all significant and major natural hazards like drought, flood, cyclone, earthquake, tsunami, etc. Natural disasters in Gujarat is tabularized in **table 6.** Because of the development of chemical and pharmaceutical industries, Gujarat state is also vulnerable to chemical disasters and industrial disasters. Major Accident Hazard (MAH) units are located Vapi, Hazira, Ankleshwar, Dahej, Jamnagar etc in Gujarat. The incidences of biological disasters are man-made disasters such as transportation accidents, terror attacks, radiological leakage is most probable in the state.

Table 7: Deadliest Disasters Gujarat in the Last Century *[12].*

Sr. No.	Name of Event	Year	Area
1	Earthquake MW 6.1	1945	Anjar (Kachchh)
2	Flood	1979	Morbi.
3	Cyclone 125 KM/Hr.	1981	West Veraval and Porbandar.
4	Cyclone 200 KM/Hr.	1982	Saurashtra region.
5	Drought	1984 to 1987	A different region of the state-Saurashtra and Kachchh regions are more affected.
6	Cyclone	1998	Porbandar.
7	Earth quake MW 7.9	2001	Kachchh.
8	Drought	2001&2002	A different region of the State-Saurashtra and Kachchh regions were more affected.

9	Flood	2006	Surat city and south and central Gujarat.
10	Flood	2013&14	Bharuch, Narmada and Vadodara districts.

7.1 Major Disasters in Gujarat

Look at **table 7.** Gujarat is highly vulnerable to natural hazards like earthquake, flood, cyclone, tsunami, drought and man-made hazards like industrial (chemical) accidents. The vulnerability to the Gujarat state for these natural hazards is described above [15].

***Table 8: Impact of Natural Disaster in Gujarat** [15].*

Time Span → Disasters and Loss ↓	**During 2015**	**During 2014**	**Last 10 years (2005-14)**	**Last 30 years (1985-2014)**
Number of Events	2	2	6	14
Approx. Property Loss MUS$	604	904	3,000	9,580
Loss of Human Lives	156	27	302	14,991

8. CIVIL ENGINEERING IN DISASTER MANAGEMENT

Disaster management is the creation of plans through which people reduce vulnerability to hazards and cope with disasters. Apart from the old concept, occasionally disaster management prevent or eliminate the threats instead, as mostly found, it focuses on creating plans to decrease the effect of disasters, save people, property and reestablishment of environment and ecosystem. When a natural catastrophe or man-made disaster happens on a large scale, a disaster management team of trained and skilled persons come to rescue the people trapped in the calamity and successfully handle situations in difficult times. A well-proper planning and careful execution of technical support can decrease the tangible destruction in disasters. With a strong team of engineers, onecan reduce the magnitude of damage and save thousands of lives. Engineers;and especially civil engineers play a key role in this disaster and emergency management. The majority of disasters are due to improper town-planning, structural design failure, insufficient infrastructural facilities, unawareness of building construction and maintenance norms, substandard building materials and lack of site survey investigations. All different specialist civil engineers like surveyors, cityplanners, construction managers, structural engineers, geotechnical engineers, marine engineers etc. have their active role in disaster management and mitigation.

For a disaster-prone country like India, disaster management is essentially a crucial subject.Due to the topography and the climate-change, every year, on average 50 million Indians are affected by disasters besides massive property-loss in millions. Annual droughts, flash floods, avalanches, landslides make 24 to 26 of the 35 states and Union territories, disaster-prone. India loses about ~2% of our GDP on an average to disasters [16]. So, disaster management is a very crucial issue wherein civil engineering with each branch has its own vital role to play.

For successful planning and implementation of disaster management, capacity building, the topography of the land, city planning are vital factors. Though the Nonstructural elements help in preparedness, the significance of structural elements must not be overlooked. The role of a civil engineer comes in when the structural aspect of disaster management is considered. The study of modern technologies such as base isolation methods and stress on forensic and earthquake engineering can reduce the damage. Studies on geotechnical and hydraulic engineering reduce the occurrence of landslides. Civil engineers made ensure that damaged roads can be constructed immediately. A strong building foundation

prevents the risk of its collapsing. A geotechnical engineer can construct such high earthquake-resistant buildings enhancing the infrastructure. A hydraulic engineer provides information regarding dams and bridges; and advanced designs for flood control and prevention of destruction of dams. A City planner and project manager can study the vulnerabilities providing proper guidelines required during calamities and disasters. A structural engineer can successfully carry out rescue operations and safety-escape routes in every building along with possible reconstructions. An environmental engineer handles hazardous wastes, toxic wastes, air pollution control, drainage development and radiation protection, which are needed once the disaster has struck in order to control the after-effects. A geotechnical engineer is responsible for the construction of such a high earthquake-resistant buildingwith a strong foundation. The hydraulic engineer gives all the essential information about the various bridges and dams and high-level designs for blocking flood control and destruction of dams. A project supervisor and City administrator study the vulnerabilities presenting proper guidelines required for infrastructures to withstand anything.

The disasters mostly we face other than flood, are earthquake and fire. In earthquake-prone regions, the building should be designed considering all the earthquake load combinations instead of designing buildings for only gravity loads. Even after an earthquake also by making use of civil engineering knowledge, the lives of those who are stuck in collapsed buildings can be saved. For fire, while designing it is needed to provide required access to people to escape.

The versatility of civil engineers according to their specialisation is useful in disaster management and post-disaster rescue and reestablishment steps. Each one plays a vital role as per one's expertise. They are policymaker planner, structural engineer, geotechnical engineer, hydrological / irrigation engineer, environmental engineer, public health and sanitary engineer, surveyor transportation engineer, marine engineer, infrastructure -construction and project manager, services (plumbing, fire-fighting, lift, electrical) consultant, surveyor, site-engineer/ supervisor/ builder/ contractor, research and development; academician etc. A Structural engineer plays an active role in preparing the development plan of an area. All specifications should be followed, the structural analysis should be done using the latest techniques and advanced methods like performance-based designs must be followed rather than simple code based approaches. A Geotechnical engineer study of ground behaviour and examines subsoil ensuring the structure will not betray while calamity. A hydraulic engineer provides information about bridges and dam construction and also suggest flood control measures. A City planner keeps in mind the vulnerability of a specific area to disasters and issues specifications and guidelines for construction activities in these areas. An Environmental engineer maintains an optimum level of the ecosystem during pre and post-disaster time by taking measure for air pollution control, industrial hygiene, radiation protection, hazardous waste management, toxic materials control, water supply, wastewater management, stormwater management, solid waste disposal, public health, land manage etc. An Infrastructural engineer mind for the development of technologies for enhancement of infrastructure, Construction of infrastructures with high natural disaster resistance, Involvement in the rescue operation and reconstruction works after natural disasters. The geotechnical engineer builds high earthquake-resistant buildings enhancing the infrastructure so that the collapsing of any building can be prevented by a strong foundation. For flood control and dams safety, the hydraulic engineer provides all the required information about the various bridges and dams and advanced designs for prevention.City planners and project managers study the vulnerabilities. A structural engineer establishes the rescue operations and safety-escape routes in every building along with possible reconstruction of the entire building. The building construction should be based on NBC (National Building Code) and the vulnerability of that area to various disasters. The building should withstand the maximum possible intensity of the disaster.

Though the design is the primary responsibility of an architect, an engineer must ensure maintaining all kinds of standards of construction [16].

9. CONCLUSION

In any given disaster situation the basic duty of the local government is to provide immediate relief to the affected community in form of emergency shelters, emergency watersupply and sanitation provisions along with medical facilities for preventing epidemics. The planning, setting up and maintenance of emergency relief camps, provision of adequate potable water supply adequately hygienic sanitation facilities are the main responsibilities of a Civil Engineer who is associated with the Disaster Management team. In disaster management and mitigation, not only the planning, setting up and maintenance are the core responsibilities of the Civil Engineers but also they have to ensure that the provisions are as per standard norms laid down by various relief organisations like Red Cross etc.

In the mitigation works, structural mitigation (eg. Retrofitting, embankments etc.) must be made properly. In post-disaster situations, the relief camp, proper arrangement of water, sanitation, hygiene must be arranged properly. Since infrastructure facilities are severely damaged in disasters, the reconstruction of these basic infra-services as the post-disaster work eg. roads, bridges, railways, etc are most important to provide relief to affected communities. Assessing damaged structures being fit or unfit to use is also one of the jobs in post disasters.

The damage and destruction due to natural disasters can be minimized if proper and timely information about the disaster is made available. The GIS and RS are essential tools for forecasting and evaluating the effects of disasters and also used to prepare pre and post-disaster management plans with rescue plans for relief operations. Information of multi-hazard maps provides the extent of the geographical effect, risk-level and geographical details like affected human settlements and infrastructural resources. Such details are very helpful to estimate the vulnerability of the area concerning various hazards and to take protective measures. It is challenging and next to impossible to deal with disasters without such details. The matter and data, strongly appeal that a perfect pre-and-post disaster management plan with a disaster forecasting system is inevitable at state as well as national levels.

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