IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 9, Issue 3 Ver. III (Mar. 2015), PP 27-32
www.iosrjournals.org

Typhoon in India and Taiwan

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I. Introduction

Tropical Cyclone is defined as a cyclonically rotating atmospheric vortex that ranges in diameter from a few hundred miles up to one or two thousand miles. It is associated with the central core of low pressure and convective clouds that are organized into spiral bands, with a sustained convective clouds mass at or near the centre. These are storms that originate in tropical latitudes; they include tropical depressions, tropical storms, hurricanes, typhoons and cyclones.

Natural disasters cannot be controlled but they can be regulated and predicted to some extent. Similarly the origin and formation of Typhoons cannot be stopped, so the only way to handle this kind of disaster is through warning systems. A warning system can reduce the impact of the disaster and help to mitigate the impact. The devastation caused by tropical cyclones in terms of loss of lives and damage to the economics of all countries affected by these storms can be enormous. Damage estimates collected by the Typhoon Committee of the World Meteorological Organization (WMO) have documented typhoon related economic losses exceeding 4 billion US dollars annually to the countries along the rim of the western north pacific (Chen 1995). Indian Meteorological Department (IMD) provides the Cyclone Warning System in India from the Area Cyclone Warning Centres (ACWC's) at Kolkata, Chennai and Mumbai, and Cyclone Warning Centres (CWCs) at Bhubaneshwar, Vishakhapatnam and Ahmedabad. IMD has developed the necessary infrastructure to originate and disseminate the cyclone warnings at appropriate levels.

Similar conditions prevail in China, Taiwan and surrounding areas. This area is one of the regions most intensely affected by typhoons. The memory of the terrible Taiwan typhoons in 2004 and again in 2005 is still fresh. Taiwan and India both should join the joint warning system operated at International Levels. The fury of nature can only be minimized by cooperation and joint efforts.

II. Tropical Cyclone As A Disaster

A tropical cyclone is an intense storm with wind speed of over 118 kilometers per hour (13 mph) – force 12 on the Beaufort scale of wind force. Cyclones usually tear away anemometers (wind gauges), so their speed is rarely measured accurately. But most of them are thought capable of sustained speed of 200 kph (125 mph) over large areas, with gusts up to 400 kph (250 mph). It is a vast, violent whirl in the atmosphere, which moves from the high seas to towards the coastal areas, its occurrence be confined to defined regions of the earth usually, in the tropical portion of the oceans. The havoc caused by cyclones is mostly due to strong minds, accompanied by torrential rains, tidal waves and the resultant inundation.

The term cyclone is used to denote all tropical storms although Hurricane in the Atlantic and Eastern Pacific, Typhoon in Western Pacific, Willy-Willy in Australian sea, Baguis, in the Philippines etc. There are many more names depending upon their time period and occurrence site.

III. Science Of Typhoons

A cyclone begins to form when moist air heated by the sun rises from the surface of the warm tropical seas and is funneled upwards in a natural updraft. As this moist air rises, it cools and condenses into rain. This condensation feeds back into the air large amounts of heat, which add to the force of the storm's updraft and which stokes the power of the cyclone. Air continues to go spiraling up, and hot moist air rushes in from all sides to replace it and feed the updraft. The winds spiral around an 'eye', an area of calm light rains a few kilometers across. The cyclones may be between 100 and 200 km in diameter with a vertical depth of 11-9 km. But the diameter varies. Winds are accompanied by torrential rains and can push ocean water high onto beaches, which are called the Storm Surges.

Atmospherically, just north of the equator, the southeast trade winds of the southern hemisphere meet the northeast trade winds of the northern hemisphere at the Inter-Tropical Convergence Zone (ITCZ) – the area commonly referred to as the Doldrums – because there is little wind. As these trade winds collide, the earth's rotation causes the air to move in an anti-clockwise direction. In the southern hemisphere, this movement is clockwise. Despite intense research, it is not known why some storms become hurricanes.

IV. Warming, Prevention And Building

No two tropical cyclones take the same route, and their erratic nature makes warming both more difficult and necessary. In the Caribbean countries, routine monitoring of tropical low-pressure areas that may precede hurricanes has increased the probability of early warming to almost 100%. More forecasts can give 24 hours warming of the expected arrival time and the force of the storm.

Elsewhere, forecasting and tracking has also improved. Warming has been more successful than prevention. Cyclones cause an average of 10% loss among buildings, according to the Munich Reinsurance Company[1].

V. Description Of Cyclonic Phenomenon

Cyclones are low-pressure systems or depressions around which the air circulates in an anti-clockwise direction in the northern hemisphere, but in clockwise direction in the southern hemisphere. When we say disastrous cyclone, the speed of circulating air (the blowing wind) exceeds 33 meters per second near the earth's surface.

The central area around which the air circulates is called the 'eye' of the storm. The atmospheric pressure in this area is extremely low (below 1000 millibar). In the eye area, weather conditions are relatively quiet with light winds and small amounts of cloud.

In the ring from the perimeter of the eye to the storm's outer boundary (or wall), violent winds and torrential rains are to be found. These strong, winds may persist for many hours. The depth of a cyclone from its top to sea level ranges between 10 and 20 cm. When the eye of a storm passes over an area, strong winds from one direction and followed by the quiet conditions of the central area, where after strong winds from the other direction will have their devastating effect. The damaging effects of the wind are produced by a combination of their strength, their gustiness and their persistence. The tropical cyclone is described as the most devastating of all natural phenomenon's. Most tropical cyclones originate between 5 and 30-degree latitude both sides of the equator. On an average 80 cyclones are formed year. Two third of those are in northern hemisphere. Most cyclones develop in the Western Pacific. Other important areas are east and west of Central America and the Indian Ocean, Basically, high energy build up by continuous sum radiation over the ocean in responsible for the development of cyclones. Cyclones form a sort of value to release the accumulated energy. After its formation, the cyclones move within the zone of trade winds at speeds of 10-50 km/hour. The course and direction of cyclone is determined by the distribution of the ocean water temperature, the lower atmospheric strata, pressure distribution etc. The average direction of a cyclone is nine days. During this period it may travel a distance of 10,000 km. Due to much lower energy supply, it will subside over land. The friction of the earth's surface will also destroy the cyclone gradually by allowing more air to penetrate the eye of the cyclone.

VI. Measurement Level

The most important determinant of a cyclone is the wind. When speed of wind exceeds 120 km/h they are referred to as destructive winds. Apart from the direction damage caused by powerful winds, death and injury can he cause by solid objects, large and small, flying through the air. The force of tropical cyclone also produces a destructive effect by lowering the atmospheric pressure outside a closed structure sufficiently for normal pressure inside to cause the building to explode outward and collapse.

VII. Classification Of Depression And Cyclones

Classification	Range of Max. Wind speed	Range of mp
Depression	28-31 mph	3.0 – 3.4 mb
Deep Depression	32-38 mph	3.5 – 5.9 mb
Cyclonic storm	39 – 54 mph	6.0 – 8.9 mb
Severe Cyclonic storm	55 – 73 mph	9.0 – 15.9 mb
Severe cyclone storm of hurricane intensity	> 74 mph	> 16 mb

VIII. Cyclones Warnings System In India

The government of India has tried to put responsibility for handling various disasters in the hands of different nodal Ministries.

8.1 Nodal Ministries for different types of Disaster

Disaster	Nodal Ministry
Air Accidents	Ministry of Civil Aviation
Civil strife	Ministry of Home Affairs
Railway Accidents	Ministry of Railways
Chemical Disasters	Ministry of Environment and forests
Biological Disasters	Ministry of Health
Natural Disasters	Ministry of Agriculture
Nuclear Accident inside or outside the country which poses health	Department of Atomic Energy.

[1] Encyclopedia of Disaster Management, Vol – VII, Wind & Water Driven Disasters, Edited by P.C. Sinha.

or other hazards to people in India	

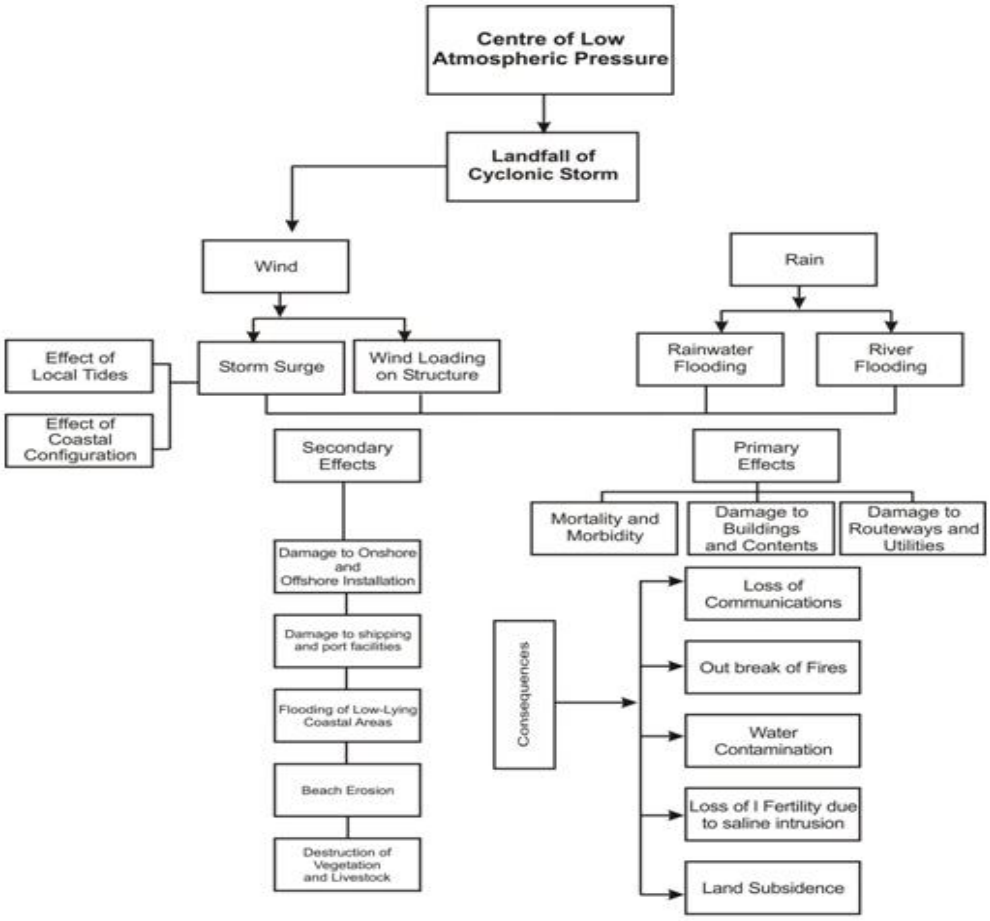
[Source: Journal: India, IDNDR and Beyond. NIDM, IIPA, 2000]

More and more people are now becoming vulnerable. It has also become apparent that while on the one hand particular communities are periodically exposed to the same hazard, on the other, hazards are striking areas where they are not expected. Direct monetary losses in terms of damage to transportation systems, communication facilities, electricity networks, lost crops, loss of animal stocks etc are phenomenal increase with time. This increase in damage due to disasters is being brought about by concentration of people in disaster prove areas. In terms of disasters, what it translates is INCREASED VULNERABILITY.

The death toll in India during the IDNDR was primarily because of floods and secondly by cyclonic flood except 1993-94 where Earthquake leads.

Year	Floods	Cyclone/flood	Earthquake
1990-91	1,320	979	–
1991-92	1,185	304	768
1992-93	1,193	497	–
1993-94	1,690	318	7938
1994-95	2,038	247	–
1995-96	2,072	361	–
1996-97	2,069	1,719	–
1997-98	1,560	216	39

Fig.: Human lives lost in India due to Natural Disaster during IDNDR
Source: National Institute of Disaster Management (NIDM) New Delhi



IX. Methodology For Use Of Cyclonic Data:

The recent methodology for the Mortality Risk Index[2] has been developed by UNEP Grid Initiative. This is represented with the help of X and Y axis (Fig 1). The X axis shows the absolute number of people

[2] In GAR 2009 the MRI included risk from tropical cyclones, floods, landslides and Earthquakes. MRI is mostly used for understanding underlying factors of risk and the share of hazard, exposure and vulnerability in characterizing risk in the different Countries.

killed in the typhoon incident or says any other natural hazard. The number of people is in relation to the population of the country. In case if we case India which has the second highest number of fatalities. The Y-axis has the absolute number of fatalities divided by the total population i.e. it displays the risk of any person living in that country of getting killed due to a cyclone. The only difference between the x-axis and the y-axis is that on the y-axis that number of x-axis is divided by the population of the respective country.

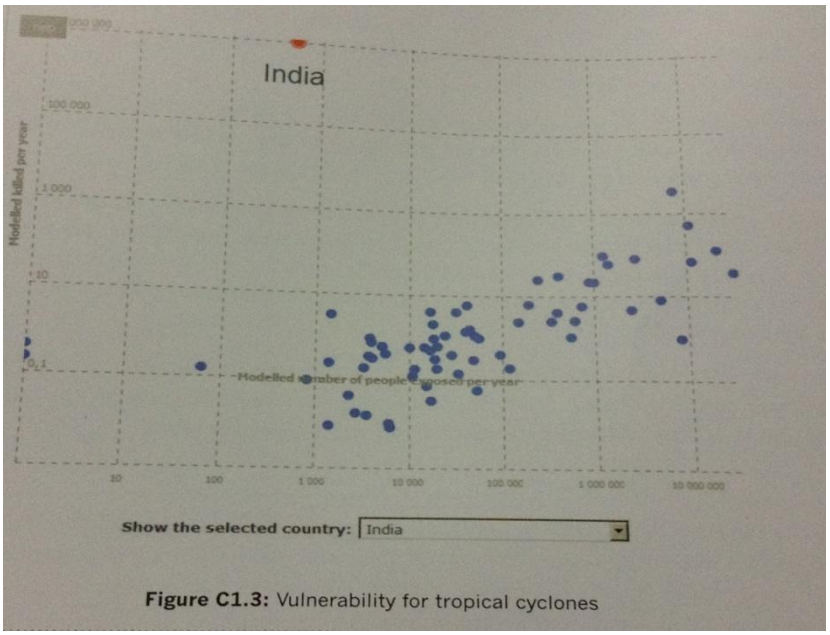


Fig 1: Mortality Risk Index (MRI) for tropical cyclones.

Taiwan

X. Geography

Taiwan is situated in the western Pacific between temperate Japan to the north, subtropical southern Japan to the west, and the tropical Philippines to the south. It lies on major air and sea transportation routes in the region. The island of Taiwan is 394 km long and 144 km at the widest-point. It has a land area of 36,179 sq km and a total of 1,566 km of coastline (including the Pengu Island. Lush green hills and mountains occupy two-third of the island, with the highest elevation of 3,952 m at Jade Mountains. Other topographic features include dormant volcanic mountains, foothills, tablelands, terraces, coastal plains and basins.

Taiwan has an oceanic and subtropical monsoon climate. Summers are usually hot and humid, while winters are short and mild. Taiwan is situated in the path of tropical storms and typhoons. In 2004, five typhoons landed on Taiwan.

The most special thing about the geography of Taiwan is its coastal area. The mountains rise steeply from the Pacific. In the western side, sediments lie just below the surface of the sea. This is because of the fact that river deposits have filled the shallow waters and extended the land to 15 to 30 km westward from the foothills. This increases the arable land area even than the island of Japan and Philippines. Natural resources and agricultural potentiality is also being facilitated by it. When the typhoon hits the land area the coastal area gets devastated the most.

10.1 CLIMATE OF TAIWAN

The climate of Taiwan is influenced by its topography. It lies in the path of warm ocean currents. Summers are long here with high humidity. Winters are short and mild with snow on the peaks of high mountains during the coldest months.

In the planetary wind system, Taiwan lies in the Trade Wind belt and is greatly affected by the seasonal exchange of air masses between the continent and the ocean. In the month of May and June the annual precipitation starts which is called as the 'Plum Rain'. During this period, southern Taiwan usually has wet weather, while northern Taiwan is relatively dry. The moisture carried by the southwest monsoon and local terrestrial winds, falls largely in convectional form. Usually summer month is the season for typhoons and thundershowers in Taiwan.

When typhoons hit this very country these cause severe storms which leads to damage. An average of three to four typhoons hit Taiwan every year usually in July, August and September. In the period between 2003 and 2004, eight typhoons occurred.

All these typhoons were very strong but Dujuan brought heaviest rainfall, especially at Maobitou in Southern Taiwan i.e. 282 mm of rainfall in one hour similarly, mindulle also brought heavy rainfall which occurred in mountainous areas of central and southern Taiwan. This much of rainfall in any area will cause debris flow and catastrophic landslides. Even tropical cyclone Aere brought more than 1000 mm of rainfall within 48 hours and caused widespread damage. The year 2004 was the Typhoon year in the Pacific Ocean.

Case Study Of Nock-Ten Typhoons

This particular typhoon was localized in Northeast of the country including the capital Taipei. It occurred on 25th October 2004. The hardest hit portion was the northeastern port. The heavy flood triggered by this typhoon made the situation worse. The eye of this typhoon was almost 80 kilometers north of Taipei at 0800 GMT and the spinning speed was 20 kilometers per hour towards Japan. The speed as well as its spin was capable enough to engulf many people. The television reporter of the Taiwan's Central Weather Bureau was drowned in a flash flood in Taipei County, and many rescue workers were also swept away by raging waters. Taiwan's second largest part, Keelung port faced the waves of at least 14 meters (46 feet) high.

Tropical Storms/ Typhoons of 2004			
Duration	**Typhoon**	**Category**	**Vmax (Kt)**
Jan 28 – July 3	Mindulle	Typhoon	90
August 23-26	Aere	Typhoon	75
September 11-13	Haima	Tropical Storm	35
October 23-26	Nock-ten	Typhoon	85
December 3-4	Nanmadol	Typhoon	90

Vmax is vorticity maximum tropical storm is $\geq$34~<50 knots per hour (kt) severe tropical storm is $\geq$50~<64 kt. Typhoon is $\geq$64 kt

Source: Central Weather Bureau, Ministry of Transportation and Communication

When the Typhoon started making storm the gust was at the speed of 180 kilometers per hour and it was whipping very high around the capital city Taipei. Earlier the people felt as if the earthquake had struck the country. Taipei is also prone to seismicity as it lies on the active stretch of pacific basin. Due to its vulnerability to earthquakes, typhoons, landslides and debris flows, Taiwan has made efforts to increase emergency response capability. Now the government of Taiwan is trying to reform its policy towards empowering the community to take actions in hazard mitigation, emergency preparedness and emergency responses. ICBDM i.e. Integrated

Community – Based Disaster Management Program was a new initiative launched in 2001 by the Executive Yuan to achieve the goal of strengthening community resistance. This program is an area approach particularly in Shang village. Through this participatory process the people are spreading awareness towards a particular disaster. They are learning how to analyze vulnerable conditions, discover new emerging problems, develop their solutions and establish firmly to implement various disaster management tasks. May be in future the same programme can to be generalized and applied in the entire country.

10.2 Different Types Of Typhoons In Taiwan

- Typhoon Talim was observed in Taiwan in 2005, which intensified on 27th August. This made a landfall near Fuzhou, China. From there, the cyclone crossed the Taiwan Strait.
- Typhoon Omar occurred on August 20. It had a depression near Marshall Island in the pacific region.
- Typhoon Longuang was known as the super typhoon of 2005 pacific typhoon season with the speed of 130 knots at its peak intensity. It made landfall twice killing more than hundred people. This typhoon gets its strength as it moved towards northwestern side of Taiwan.
- Super Typhoon Herb: It was the strongest and the largest storm of 1996. Herb hit Ryukyu Islands, Taiwan and Mainland China. The western pacific name list was renewed in 1996 and the name Herb was used for the first time in 1996.
- Typhoon Haitang: It was one of the major typhoons of 2005 in the pacific. It started from the Philippine (Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA). This is a Warning Centre. From Philippines this moved towards Taiwan and Sakishima Island of Japan. Because of this typhoon in China even more than 7,50,000 people evacuated in China anticipating the arrival of Haitang. In Taiwan, more than 1500 people had been evacuated, mostly from northern Taiwan.

People make boundaries. Natural elements make no boundaries. The maximum number of typhoons occurred in 2004 between the month of May and November mostly north of equator and west of international date time. To classify the typhoons occurring east of International Date Line are called Hurricanes. The common names that hit Taiwan are Conson (Tropical depression in South China Sea), Aere (also known by Marce) that hit Gaogiao town, Yinzhou district, Ningbo city. Other is tropical storm Haima (also known as Ofel) that is a Chinese word for the sea horse. This typhoon basically hit the southwest of Taipei.

- Typhoon Muifa (Unding) is another one, which hit Taiwan.
- Regarding typhoon Aere, it had an impact on Shihmen Reservoir. It was having concentration of suspended sediment in the reservoir and water treatment plants were shut down. So the government of Taiwan has enacted a National Land Protection Act (NGPA) to ban the development above 1500 m in the mountainous area.
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XI. Major Recommendations

Some of the major recommendations for the areas hit by cyclone can the very helpful if seriously taken into consideration. These are all follows: -

1. There should be an integrated approach to cyclonic disaster with national requirements and global perspectives in the context of IDNDR (International Decade for Natural Disaster Reduction).
2. There should be an integrated coordination between the inter ministerial group at the central and state level along with appropriate research community and professional organization with principal objectives of developing a common approach to future natural disaster management.
3. There should be a commonality in the legislative policies and common cyclonic management agenda, the Indian variant of IDNDR so as to serve the proper methods during a cyclone.
4. Disasters summits emphasizing particularly on cyclone should take the following purpose as the basic platform in mitigating the impact.

XII. Conclusion

India and Taiwan the two separate geographical entity affected by one common natural phenomenon i.e. Typhoon. Both countries are trying hard to deal with this disaster. Their approach and methods are very different. India has more developed Pre –Warning systems while Taiwan has more developed Post-Warning systems. The impact and intensity of cyclone could be mitigated only when pre and post warning systems together give an effective response. So both the countries can come on a common platform to be familiar with this natural event. We must walk together to understand the complexity of typhoon and implement pragmatic measures in order to regulate and balance the ecology of socio-geographical aspects.

Nature has linked both the nations through disaster. Let us take our turn to link both the countries by countering it with effective disaster management jointly.

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