Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 05, May-2019

A Review of Cyclone and its Impact on the Coastal Belts of Odisha

Parna Sarkhel
Lecturer, Department of Architecture and Planning
College of Engineering and Technology
Bhubaneswar, Odisha, India

Debajyoti Biswas
Associate Professor, Department of Architecture
Birla Institute of Technology, Mesra
Ranchi, India

Swapna Sarita Swain
Asst. Professor, Department of Architecture and Planning
College of Engineering and Technology
Bhubaneswar, Odisha, India

***Abstract*:- The preparedness and awareness for cyclonic disaster is the assessment of the degree of various loss or damage due to its manifestation and its given severity. The maximum number of the cyclones that formed near Bay of Bengal which crosses Indian coast line are the next highest in number that dissipated over the sea. Among the highly susceptible country neighboring Bay of Bengal in terms of number of occurrence of cyclonic storm as compared to other countries, India is having maximum number. The eastern state Odisha which is 480 km long and 10 – 100 km wide, is vulnerable to cyclone, flood, and storm surge because of its geographical location. Disaster Preparedness for cyclone prone areas is multi-disciplinary as well as multi-dimensional action, which consist of the vulnerability analysis and risk assessment of the affected area so as to measure the expected loss that is caused by the cyclonic disaster`. The potentials and opportunities of the different zones in coastal area vulnerable to cyclonic disaster have received very less consideration, and the disaster mitigation approaches are seen as a restorative measure rather than shielding one, so both of it raise questions about sustainable coastal belt planning and development of affected areas. Thus a research in terms of planning the preparedness plan for cyclone prone areas need to be formulated and implemented so as to reduce and minimize the effect of cyclone in the coastal areas. Hence, the study help us to understand the impact of different cyclone and its effect on the people which have strain the existing resources and heighten levels of vulnerability.**

Keywords: Disaster Preparedness, Indian Coast-line, Tropical Cyclone, Risk Assessment, Vulnerability.

I. INTRODUCTION

Natural disasters are extensive geological or meteorological events that have cause the potential loss to the lives and properties. Cyclonic storm or winds are characterized by wind movement that revolves near a low pressure zone with inward spiralling wind movement. These cyclonic winds are highly, rapidly rotating spiral storm winds having a low-pressure centre at low-level atmospheric circulation along with thunderstorms leading to the formation of heavy rain. Tropical cyclones formulate over large bodies of relatively warm water and derive their energy from ocean surface through the evaporation process, which ultimately re-condenses into clouds and rain. In addition to very strong winds and rainfall, tropical cyclones are capable of generating high waves, damaging storm surge, and tornadoes. As per its strength, location and magnitude of the wind, a tropical cyclone is known by different names such as typhoon, tropical storm, cyclonic storm, tropical depression, hurricane and also simply cyclone. They typically weaken rapidly over land surface where they are cut off from their primary energy source, for this reason coastal regions are particularly vulnerable to damage caused by the tropical cyclone as compared to inland regions. Disasters, whether natural or man-made, play devastation with the lives of millions of people every year around the globe. The impact of cyclonic hazards is mainly time and location dependent, while vulnerability is dependent on exposure to hazard and it is directly proportional to the magnitude of the risk, duration and intensity of the hazard.

II. THE GLOBAL SCENARIO

Tropical cyclones are the deadliest of all natural disaster worldwide, accounting for about 64% of the total loss of lives. The total of 80-100 tropical cyclones which have occurred worldwide every year cause an average death of 20,000 people and a total economic loss of $6-7 billion. [1] [11]

A. Philippines

Storm surges in Philippines, have caused maximum fatality and have killed in total 14,159 Filipinos who died in the year 1948 to 1990 [1]. Super Typhoon Haiyan's storm surge was the deadliest in the history and which have killed 6300 people and left 1061 missing. [2]

B. China

The most two deadly typhoons that impact coastal East Asia during the twentieth century struck China, killing 50,000 people in 1912 and 60,000 people in 1922, [3] the storm surge events of 1950 have killed between 1000 to 2000 people and in the year 1969, the Typhoon 6903 in Guangdong Province have killed 1554 people. Storm surges cause more economic loss than any other marine hazard in China.

C. Japan

The Typhoon Vera in 1959 caused the greatest losses of any Japanese storm surge, which killed 4687 people [8] , and

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 05, May-2019

surge inflicted heavy losses on the city of Nagoya, turning the harbor into a "sea of dead" [5], while enormous waves killed 300 people and destroyed 250 homes in the town of Handa, southeast of Nagoya. [5]

III. INDIAN SCENARIO

The Indian subcontinent is the worst affected part of the world as per the death toll statistics. Out of 9-recorded cases of heavy loss of human lives accounting to 40,000 or more by cyclones during the past 300 years, 7 cases (77%) occurred in Indian subcontinent [5]. The tropical cyclones affects this region in two seasons: Pre-monsoon (April-May), Post-monsoon (October-December). The casualty associated with major Bay of Bengal cyclones in the recent past are 3,00,000 and 1,31,000 in Bangladesh in 1970 and 1991 respectively; 10,000 and 1000 in 1977 and 1990 respectively in Andhra Pradesh [6]. The super cyclone that crossed Odisha (India) coast on 29th November 1999 affected 129.66 lakhs people (about 10,000 people killed) and caused huge damage to properties. [7]

A. Cause of cyclonic event

Cyclonic winds usually rotates towards the west, northwest and north and some of them re-curve towards northeast after initial north-westward movement, though consider to be much weaker in the intensity and smaller in magnitude in comparison to the cyclones of other regions, the cyclones of post monsoon seasons which cross over the east coast of India or Bangladesh are highly devastating. The reason behind this damage and destruction is due to densely populated coastal belts that are having shallow bathymetry approximately forming a funnel shape of the coastline and the long stretch of the low-lying delta region embedded with various number of river systems.

B. Cyclone prone coastline around Bay of Bengal

The Figure 1, shows the cyclones crossing Indian coast-line and coast-line of other countries like Bangladesh (14.5%), Myanmar (7%), and Sri Lanka (1.2%) shows that most of the cyclones developed over the Bay of Bengal crosses Indian coast line accounts to 60.8%, which is the next highest number of cyclones dissipated over the sea. Thus in terms of frequency, among the countries bordering Bay of Bengal, India is most vulnerable and it must be noted here that the vulnerability due tropical cyclones cannot be determined solely by its frequency of occurrence, but also depends on associated storm surge, coastal inundation / flooding and socio-economy of the possible affected region.

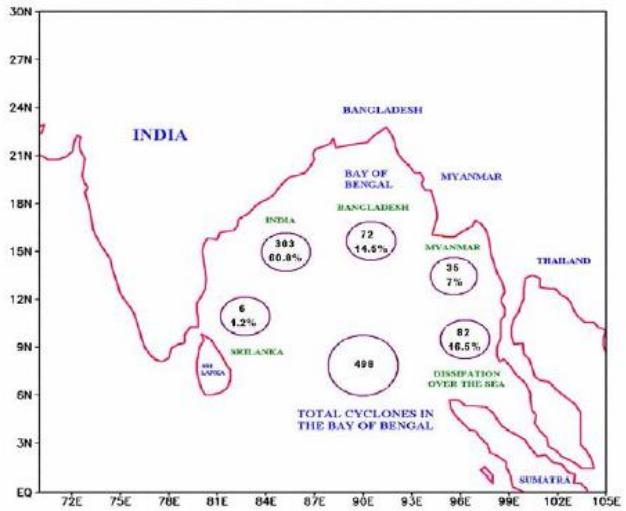

Fig. 1: tropical cyclones crossing the coastline of India, Bangladesh, Myanmar, Sri Lanka

C. Indian coastline prone to cyclone

The coastline of India is about 7,516 km of which 5,400 km is along the mainland and the entire coast is affected by cyclones with varying frequencies and intensities. Although the North Indian Ocean (the Bay of Bengal and Arabian Sea) generates only about 7% of the world's cyclones that is 5 to 6 tropical cyclone per year, but their impact is comparatively high and devastating, especially when they strike the coasts bordering the North Bay of Bengal. Thirteen coastal states and Union Territories in the country are affected by tropical cyclones, the major four states which are more vulnerable to cyclone hazards are Tamil Nadu, Andhra Pradesh, Odisha and West Bengal along with one UT which is Pondicherry on the east coast and one state Gujarat on the west coast.

For a country like India, where nearly one-third of the population lives in the coastal area are at a risk of cyclones, storms, heavy rainfalls etc. The west coast of India is less vulnerable to storm surges than east coast of India in terms of both the height of storms as well as the frequency of occurrences. The strong winds associated with a cyclone may destroy infrastructure including dwelling houses especially for the weaker section of the society, have also hit agricultural production, fallow lands, leading to widespread malnutrition and posing a significant threat to food security in the state.

IV. CYCLONE IN ODISHA

Floods, droughts and cyclones are regular occurrences in the coastal districts of Odisha. These natural disasters have led to the loss of human lives and caused major damage to household and livelihood assets.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 05, May-2019

Fig. 2: cyclone prone zone of Odisha according to Vulnerability Atlas of India

From 1891 to 2019, the numbers of cyclones, severe cyclones and super cyclones that crossed the Odisha coast were 98, which is the highest among all the East Coast States. Annually, Odisha is susceptible to cyclone twice as compared to the other eastern region States. The latest report of the State Government on 'Vulnerability to Cyclone' reveals that Odisha is 17 per cent vulnerable of the total Indian east coast affected by and nearly 35 per cent of all cyclone and Severe Cyclones that have crossed the east coast. Cyclonic storms associated with storm surges that have crossed and hit the eastern coast often inundate large tracts of Odisha causing huge damage to life and properties.

The state had the first impact by a super cyclone in the year 1737 in the month of October, another super cyclone crossed the state's coast in the year 1885 at the false point on September 22 which took a toll of 5,000 lives. The state faced its first very severe cyclone on 31st October, 1831 which crossed the coast near Baleshwar and the loss of life was whopping to 50,000 in numbers. In year 1864, on the month of October and November, another cyclone that crossed West Bengal near Contai and Andhra Pradesh near Machlipatnam have also impacted Odisha. During 1967, on the month of October, a cyclone with higher intensity crossed the Odisha coast between Puri and Paradip resulting to a loss of total 10.000 lives. [9]

In the year 1999, Odisha faced devastating Super Cyclone from 29th -31st October that crossed Paradip with a wind speed of more than 300 km/h, made landfall near Ersama (Jagatsinghpur) killing over 10,000 people. The cyclone affected 1.89 crores people in 14 districts of Odisha with loss of 4.45 lakh livestock, crops of 18.43 lakh hectare land and 75% of the standing trees of coastal area. Cyclone destroyed almost 90% of the coastal vegetation, mangroves of Kendrapara and Jagatsinghpur districts and casuarina forest from Paradip to Konark.

In the year 2013 from October 12th -14^{th,} cyclone naming *Phailin* crossed the Odisha coast near Gopalpur, having average wind speed of 250 km/h and the total death toll was 44. In the year 2014, another cyclone naming *Hudhud* crossed Andhra Pradesh at Visakhapatnam also impacted southern Odisha between October 8th -14th. *Titli*, another cyclone that crossed near Palasa in Andhra Pradesh on October 11, 2018 also had serious impact on Ganjam, Gajapati, Rayagada and Kandhamal districts of Odisha.

Recently, an extremely severe cyclonic Storm '*Fani*' made landfall on the Odisha coast south of Puri on 3rd May, 2019 and the eye of the storm was completely moved into land by 1000 hours at the wind speed of 175-185, raising to 205 km/h. However, the strong wind of more than 200 km/h has caused extensive damage to the infrastructure, people's assets and vegetation with a total death toll of 64 people. The internal road blockades are still a major challenge to fasten the relief and rehabilitation operations. The devastating cyclone has shaken the backbone of coastal Odisha and killed the hope and dreams of people in rural as well as urban areas. The cyclone has damaged the housing condition in major parts of the coastal region including the smart city Bhubaneswar and made more than 60% families homeless. The most vulnerable section of the affected community includes the women, children, elderly people and the persons with disability. [10]

V. DISCUSSIONS

In terms of cyclone occurrence, six districts namely Balasore, Bhadrak, Kendrapara, Jagatsinghpur, Puri and Ganjam stretching over a 480 kilometre coastline have been categorized as a high risk zone according to the Vulnerability Atlas of India. The state has been declared as vulnerable to cyclonic disaster and the level of poverty has further aggravated the population's vulnerability to natural disasters, in particular for those living in the high-risk coastal belts. Vulnerability of the population living along the coastline is further worsening by the lack of safe shelter, effective early warning systems and insufficient community awareness on how to prepare for disasters. Disaster response, including evacuations, is often hindered due to underdeveloped transport and infrastructure facilities. The impact of climate change will continue further to strain the existing resources and heighten levels of vulnerability.

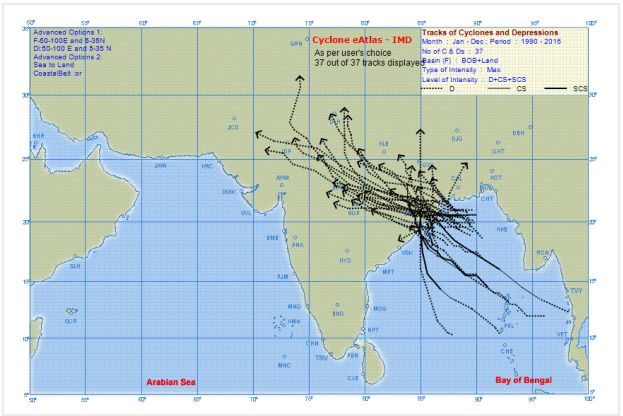

Fig. 3: Tracks of cyclones and depression along coastal belt of Odisha

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 05, May-2019

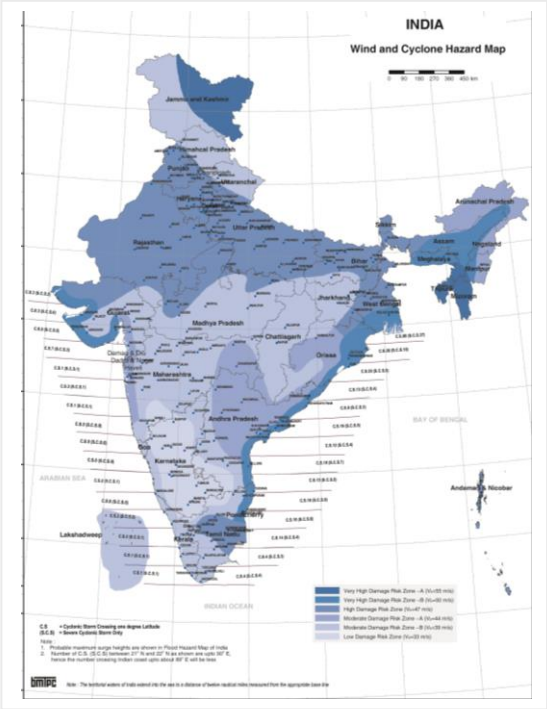

Fig. 4: Wind and Cyclone Hazard Map

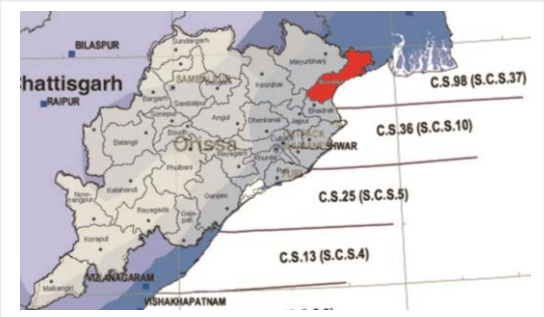

Fig. 5: cyclones crossing the vulnerable districts of Odisha

Odisha is more prone to cyclone where nearly one third of cyclones of east coast hit the states coastal belt. Most of the major cyclones have occurred in the month of October and November that is in post monsoonal season but it must be noted that the cyclone *Fani* that occurred recently in the pre monsoon season impacted both Puri and smart city Bhubaneswar with a very high intensity.

Figure 5 shows the vulnerable wind and cyclone hazard map, it can be illustrious that the number of cyclones, super cyclones and severe super cyclones mainly impact the six coastal districts of Odisha which are being categorized as "Very High Damage Risk Zone-A", among which Balasore district is highly affected cyclone prone district of Odisha.

VI. CONCLUSION

Odisha cyclonic storm exposes to the impact of three types of hazards that is high speed wind, storm and tidal surge and heavy torrential rainfall which leads to physical destruction, saline inundation of low-lying area and flooding respectively. The severe storms of 1942, 1967, 1971, 1977, 1999 Super Cyclone, *Phailin* of 2013, *Hudhud* of 2014, *Titli* of 2018 and the recently occurred *Fani* in 2019 have led to devastation of public life, property and high death toll.

Cyclone is a natural phenomenon which cannot be ignored but with preparedness, proper mitigation strategy and proper disaster management, we can considerably reduce the devastation of public life, property and other disastrous consequences of cyclone to a great extent. The recent cyclone Fani is a burning example of this.

REFERENCES

[1] Soriano, B. (1992), Tropical cyclone, statistics in the Bicol Region, Ang Tagamasid, 20, 15.

[2] Lagmay, A. M. F., et al. (2015), Devastating storm surges of Typhoon Haiyan, Int. J. Disaster Reduct., 11, 1–12.

[3] Han, M., J. Hou, and L. Wu (1995), Potential impacts of sea-level rise on China's coastal environment and cities: A national assessment, J. Coastal Res., 14, 79–95.

[4] Joint Typhoon Warning Center (1959), 1959 annual typhoon report, U.S. Navy: JTWC Annual Tropical Cyclone Reports. [Available at http://metocph.nmci.navy.mil/jtwc/atcr/1959atcr/pdf/1959complete.pd.]

[5] Frank, N. L., and S. A. Husain (1971), Deadliest tropical cyclone in history, Bull. Am. Meteorol. Soc., 52, 438–444

[6] Smith, D. K. (1989), Natural disaster reduction: How meteorological and hydrological services can help, Pub. No. 722, World Meteorological Organisation, Geneva, Switzerland.

[7] Kalsi, S. R., and M. Gupta (2003), Success and failure of early warning systems: A case study of the Gujarat cyclone of June, 1998, published in Zschau, J., and A.N. Kuppers, 2003, in Early Warning Systems for Natural Disaster Reduction, 837 pp., published by Springer, Printed in Italy.

[8] Needham, H. F., B. D. Keim, and D. Sathiaraj (2015), A review of tropical cyclone-generated storm surges: Global data sources, observations, and impacts, Rev. Geophys., 53, 545–591, doi:10.1002/2014RG000477.

[9] International Fedretion of Red Cross and Red Crescent Socirties, Case Study Building safer Communities in south Asia.

[10] Humanitarian Aid International report 2019, Cylone Fani response in Odisha.

[11] Southern, R. L. 1979. "The Global Socio-Economic Impact of Tropical Cyclones."Australian Meteorological Monographs 27: 175–195.