International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 4 Issue 02, February-2015

Cyclone Prone Areas in Tamil Nadu State - A Geospatial Approach

A. Priya, Research Scholar[1] N. D. Mani, Professor[2]
Department of Rural Development, The Gandhigram Rural Institute-Deemed University,
Gandhigram-624302, Dindigul District, Tamil Nadu

Abstract :- **Cyclone, one of the most detrimental natural hazard, affects human lives, property, livestock, agricultural produce, infrastructure and communication facilities. In the case of India, cyclones originate in the Bay of Bengal have more frequency than the cyclones those are having their origin from Arabian Sea. The state of Tamil Nadu in India is taken as the study area because it also one of the most affected states by cyclone originating in the Bay of Bengal. Arc GIS software is used in the study for analysis. The past cyclone tracks from Cyclone e-Atlas provided by Indian Meteorological Department (IMD) is taken as the source of data. The aim of the study is to delineate the cyclone prone zones in the study area, which will surely help in disaster management planning, research and development.**

Keywords: Natural hazard; Disaster; Cyclone prone area; GIS; Mapping of cyclone prone area.

INTRODUCTION

Cyclone is a natural hazard, which mainly affects the coastal regions in the globe. The occurrence of cyclone, can neither be prevented nor controlled. It can only be predicted in advance. Timely warning and evacuation of people from coastal areas can reduce the loss of life and property. The high winds, heavy rainfall and storm surge associated with the cyclone result in loss of life, property, belongings, disruption of communication facilities and damages to agricultural and plantation crops. The normal life comes standstill during the cyclone. It takes a few more days for the administration to restore the basic amenities to the people. The mental trauma caused by the cyclone due to the loss of their kith and kin, their property and livelihood is immeasurable.

In the past four decades, due to rapid increase in population growth and urbanization, many new cities have emerged along the coastal regions all over the world. According to the UN 1992 estimates more than half of the world's population live within 60 km of a shoreline.[1] The people living in the coastal regions are directly exposed to the coastal hazards like cyclones, tsunami and coastal erosion etc.

The term "cyclone" can be defined as "the centres of low pressure surrounded by closed isobars having increasing pressure outward, and closed air circulation from outside towards the central low pressure in such a way that air blows inward in anti-clockwise in the northern hemisphere and clockwise in the southern hemisphere".[2] According to World Meteorological Organization (WMO, 1976) definition, the term "tropical cyclone" which covers the weather system in which wind speed exceeds the 'gale force' (67 km/hr). Cyclone is called by different names in different parts of the world. It is known as 'typhoon' in China, 'willy willy' in Australia, 'cyclone' in Indian Ocean, 'baguio' in Philippines, 'taifu' in Japan and 'hurricane' in USA.

The damages caused by the cyclone increase with the increase in its velocity. Low pressure area, depression and deep depression cause very minimum damage when compared to the other four categories given in the Table 1.

The effect of cyclone is not uniform in all parts of the globe. It varies from place to place. It depends on the latitude, wind direction, atmospheric circulation, coriolis force, shape of the coastline, the formation of El-Nino etc. At the same time, all the people living in the coastal regions are not affected by cyclone equally. It varies from person to person. The socio, economic, political conditions, education, health and income status are the determining factors which can minimize or maximize the impact of cyclone on people. The recovery rate immediately after the cyclone also depends on these factors.

CLASSIFICATION OF CYCLONES

Indian Meteorological Department (IMD) has categorized the cyclone based on the wind speed as presented in Table 1.

Table 1
Classification of Cyclones

Type of Disturbance	Wind Speed in Km/hr
Low Pressure Area	<32
Depression	32 to 50
Deep Depression	51 to 59
Cyclonic Storm	60 to 90
Severe Cyclonic Storm	90 to119
Very Severe Cyclonic Storm	119 to 220
Super Cyclone	>220

Source : Indian Meteorological Department (IMD), Chennai.

The International Disaster Database has been created by Centre for Research on the Epidemiology of Disasters (CRED). From the database, it is understood that the most severe cyclonic storms occurred in the world, in terms of number of people affected from the year 1900 to 2014 around the globe (Table 2).

Table 2
Storm Disasters - 1900 - 2014

Country	Date	No. of People Affected
Bangladesh, Tropical cyclone	11/5/1965	15600000
China, Convective storm	20/04/1989	30007500
Bangladesh, Tropical cyclone	29/04/1991	15438849
China, Tropical cyclone	8/9/1996	15005000
China, Tropical cyclone	1/7/2001	14998298
China, Convective storm	14/03/2002	100000000
China, Tropical cyclone	1/9/2005	19624000
China , Tropical cyclone	16/07/2006	29622000
China, Convective storm	17/04/2011	22000150
Philippines, Tropical cyclone	8/11/2013	16106870

Source: "EM-DAT: The OFDA/CRED International Disaster Database

It can be inferred from Table 2 that China is the most affected country by the cyclone in terms of frequency of cyclones and number of people affected. Bangladesh and Philippines occupy second and third positions respectively. Among the most severe cyclonic storm shown in Table 2, the convective storm which occurred in China in 2002, was the very severe one when compared to others. The frequency of occurrence of cyclone has increased in China.

CYCLONE IN INDIA

In India, cyclone mainly occurs during South-west monsoon (June to September) and North-east monsoon (October to December). Table 3 shows the number of cyclones, which originated in the Bay of Bengal and Arabian Sea between the year 1891 and 2012. Eight percent of the coastal regions in India are vulnerable to cyclone.[3] East coast of India is more prone to cyclones when compared to west coast.

Table 3
Frequency of Cyclones - India - 1891 - 2012

	Cyclonic Disturbances (32 to 59 Km/hr)	Cyclones (60 to 90 Km/hr)	Severe Cyclones (>90 Km/hr)
Bay of Bengal	1173	499	221
Arabian Sea	210	119	69

Source : Indian Meteorological Department (IMD), Chennai.

It is clear from Table 3 that the cyclonic disturbances, cyclones and severe cyclones originated in Bay of Bengal are almost four times higher than those which originated in the Arabian Sea. Every year around 5 to 6 cyclones form in the Arabian Sea and Bay of Bengal, out of which 2 or 3 are intensive cyclones. The entire stretch of east coast of India is vulnerable to cyclone with varying intensity. In the case of west coast, Gujarat and Maharashtra states are the most vulnerable to cyclone when compared to southern part of the west coast. [4]

The deadliest cyclone which hit the east coast of India in the recent years is the Orissa Super Cyclone, which had taken away the lives of more than 9000 people, with the wind speed of 250 mph and surge height of 5.5 m. More than 19 lakh houses damaged and two lakh cattle perished during the cyclone. In total, it affected 120 blocks in 14 districts in Orissa.[5]

CYCLONE IN TAMIL NADU STATE

The State of Tamil Nadu has a long coastline of 1076 km, which is about 15 percent of the country's total length of the coastline. It is frequently subjected to overwhelming devastation by cyclonic storms and flooding due to its location in a highly vulnerable part of peninsular India.[6] On an average, Tamil Nadu faces one or two severe cyclones during North-east monsoon period.

The physiographic location of Tamil Nadu state and its shape of the coastline increase the exposure of coastal communities to the direct impact of cyclones. Because almost 50 per cent of the coastal communities are living within two kms from the coastline.[7] In 2008, cyclone 'Nisha' brought heavy rainfall and widespread damages to infrastructure. Cyclone 'Thane' occurred in December 2011, which resulted in heavy precipitation, storm surge and consequent flooding of the coastal areas resulted in extensive loss to both public and private infrastructure. Cuddalore and Villupuram districts of Tamil Nadu state and Puducherry Union Territory were the most affected during 2011 cyclone.

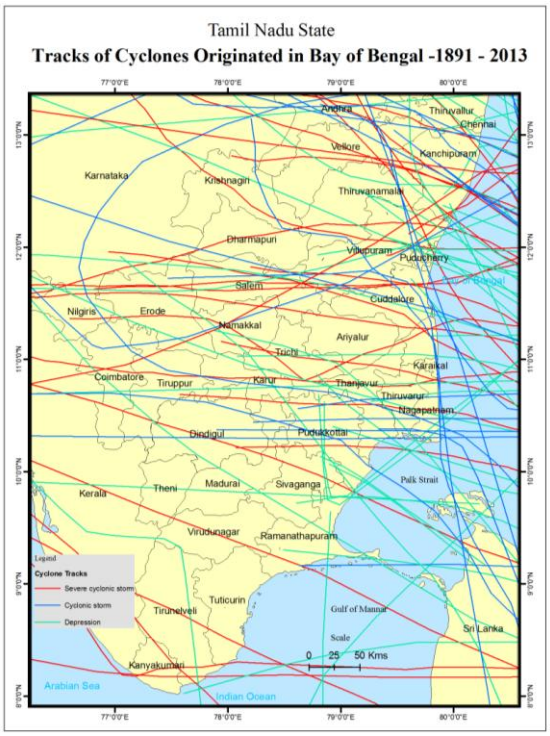
METHODOLOGY

The coastal districts of the Tamil Nadu state are considered for the present study. Arc GIS software was used in the present study for digitization and further analysis. District-wise Tamil Nadu state map was digitized. Blocks in the coastal districts were also digitized. Tracks of past cyclones which occurred from the year 1891 to 2013 were generated from the cyclone e-atlas of Indian Meteorological Department (IMD). Based on the wind speed of each cyclone, these tracks were classified into three categories namely, depression, cyclonic storm and severe cyclonic storm. The tracks, which were originating from Bay of Bengal and moving over towards the coast of Tamil Nadu state were considered for the analysis. All the images were individually downloaded, rectified, geo-referenced and digitized using Arc GIS software. Cyclone track density

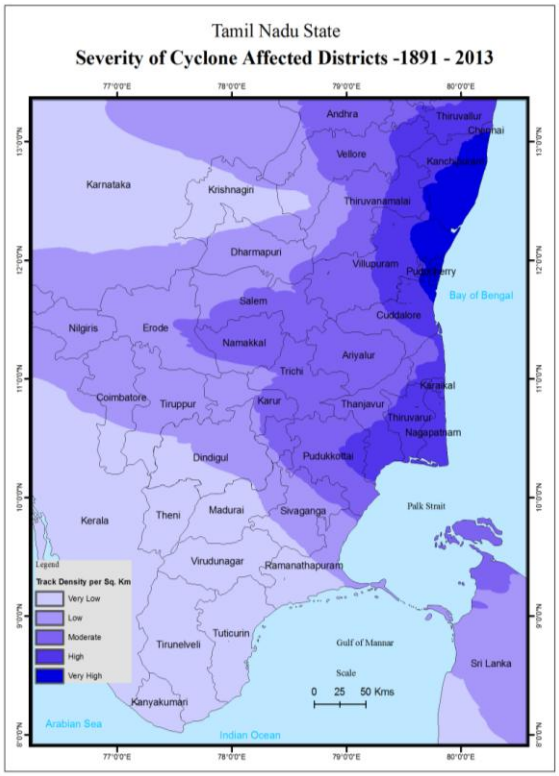
per sq-km was calculated to demarcate the cyclone prone zones in Tamil Nadu state.

ANALYSIS

The tracks of past cyclones, which crossed the Tamil Nadu coast from the year 1891 to 2013 were digitized and shown in the Map.1. IMD has broadly classified these tracks as depression, cyclonic storm and severe cyclonic storm. Out of total 98 tracks, 44 are depressions, 25 are cyclonic storms and 29 are severe cyclonic storms. It can be inferred from the Map.1 that, the northern Tamil Nadu coast (from Vedaranniyam to Pulicat Lake), is more cyclone prone when compared to the southern part (from Kanniyakumari to Vedaranniyam). These tracks are further classified into two groups based on their landfall in Tamil Nadu state. There are 34 depressions, 24 cyclonic storms and 23 severe cyclonic storms which made a landfall in northern Tamil Nadu coast but only 10 depressions, a cyclonic storm and six severe cyclonic storms crossed the southern Tamil Nadu coast.



Map.1



Map.2

The cyclone track density per sq.km was calculated. It shows the cyclone prone zones in the coastal districts of Tamil Nadu. It can be inferred from the map that the northern part of Tamil Nadu is more affected by cyclones than the southern part. It is due to the physiographic location of Sri Lanka. Most of the cyclones formed in Bay of Bengal are deflected towards north because of Sri Lanka. As a result, northern Tamil Nadu coast becomes more cyclone prone than its southern counterpart.

Cyclonic tracks running parallel to the coast of Tamil Nadu normally are not crossing the coast of Tamil Nadu. They either cross the coast in Andhra Pradesh or Orissa. But even these cyclones yield precipitation in the coastal areas of northern Tamil Nadu state as they are moving close to the coast.

An in-depth analysis on the tracks of the cyclone indicates that, after crossing the coast, tracks are converging in certain zones. This is due to obstruction of mountains which are located near to the coast of Tamil Nadu. For example, tracks are almost absent in the central part of Thiruvannamalai and Ariyalur districts. But more number of tracks are converging in Kanchipuram, Villupuram and Thanjavur districts. Javadi hills, Chervarayan hills, Pachaimalai and Kollimalai are located discontinuously in the coast of Tamil Nadu state. Hence they obstruct and deflect these cyclone winds, either towards north or south of these hills. Alternative pattern of convergence and divergence of the paths of cyclones is due to the discontinuous arrangement of these hills. It results in

making Ariyalur as drought prone district, even though it is located closer to the coast of Tamil Nadu.

The entire Tamil Nadu state can be divided into five zones namely very high, high, medium, low and very low cyclone prone zones (Map.2) based on the density of the past 123 years of cyclone tracks. The map portrays that southern part of Chennai, eastern part of Kanchipuram, eastern part of Villupuram, north-eastern part of Cuddalore and Puducherry Union Territory fall under the very high cyclone prone zone.

Nagapattinam, Thiruvallur, Thiruvarur (except north-western part), southern part of Thanjavur, eastern part of Pudukkottai, eastern part of Cuddalore, middle portion of Villupuram, eastern part of Thiruvannamalai, western part of Kanchipuram, north-eastern part of Vellore and northern part of Chennai districts were included in the high cyclone prone zone.

Medium cyclone prone zone comprises of Ariyalur, Pudukkottai (except eastern part), Trichi(except central-western part), northern part of Thanjavur, north-western part of Thiruvarur, western part of Cuddalore, western part of Villupuram, central part of Thiruvannamalai, central part of Vellore, southern part of Salem, south-eastern part of Dharmapuri, Namakkal (except south-western part) and eastern part of Karur districts.

Nilgris, northern part of Coimbatore, northern part of Tiruppur, northern part of Dindigul, north-eastern part of Madurai, northern part of Ramanathapuram, Sivaganga (except south-eastern part), Erode (except central-eastern part), northern part of Salem, Dharmapuri (except central-eastern part), north-western part of Vellore and north-western part of Thiruvannamalai districts form part of the low cyclone prone zone.

Kanyakumari, Tirunelveli, Tuticurin, Theni, Virudunagar, southern part of Coimbatore, southern part of Tiruppur, southern part of Dindigul, southern part of Ramanathapuram, southern part of Madurai, south-western part of Sivaganga and Krishnagiri districts were covered in very low cyclone prone zone.

Cyclone prone blocks in various districts were identified by superimposing block level map over the layer having different cyclone prone zones. The study reveals that following blocks fall under very high cyclone prone zone. They are Cuddalore block in Cuddalore district, Ollakur, Marakanam, Vanur and Mailam blocks in Villupuram district, St. Thomas Mount, Thiruporur, Tirukalukkundram, Lattur, Chitamur, Maduranthagam, Acharapakkam, Uttiramerur and Kattankolathur blocks in Kanchipuram district, southern part of Chennai and Puducherry Union Territory.

CONCLUSION

The study concludes that based on the historical analysis of cyclone tracks Kanchipuram, Cuddalore, Villupuram and Nagapattinam districts of Tamil Nadu state are identified as the most cyclone prone districts along the coast of Tamil Nadu state. The most cyclone prone blocks are located in these districts. These districts need to be given special attention in both pre and post cyclone period for effective and efficient management.

REFERENCES

1. Kumar, T.S. et al. (2010). Coastal Vulnerability Assessment for Orissa Coast, East Coast of India. *Journal of Coastal Research*, 26(3), Pp. 523–534.
2. Singh, S. (1998). Physical Geography. Prayag Pustak Bhavan: Allahabad, p. 495.
3. Kullar, D. R. (2006). India - A Comprehensive Geography. Kalyani Publishers: New Delhi, p. 187.
4. The Report of High Powered Committee on Disaster Management. National Centre for Disaster Management. New Delhi, p. 62.
5. Kalsi, S. R. (2006). Orissa Super Cyclone- A Synopsis. *Mausam*, 15(1), p. 14
6. Annual Report on Natural Calamities: 2010-2011. Government of Tamil Nadu, Pp. 1-2.
7. Kuppuswamy, S. & Rajarathnam, S. (2009). Disasters in Tamil Nadu, India: Use of Media to Create Health Epidemic Awareness. *Estudos em Comunição* , 6, Pp. 19-36.