

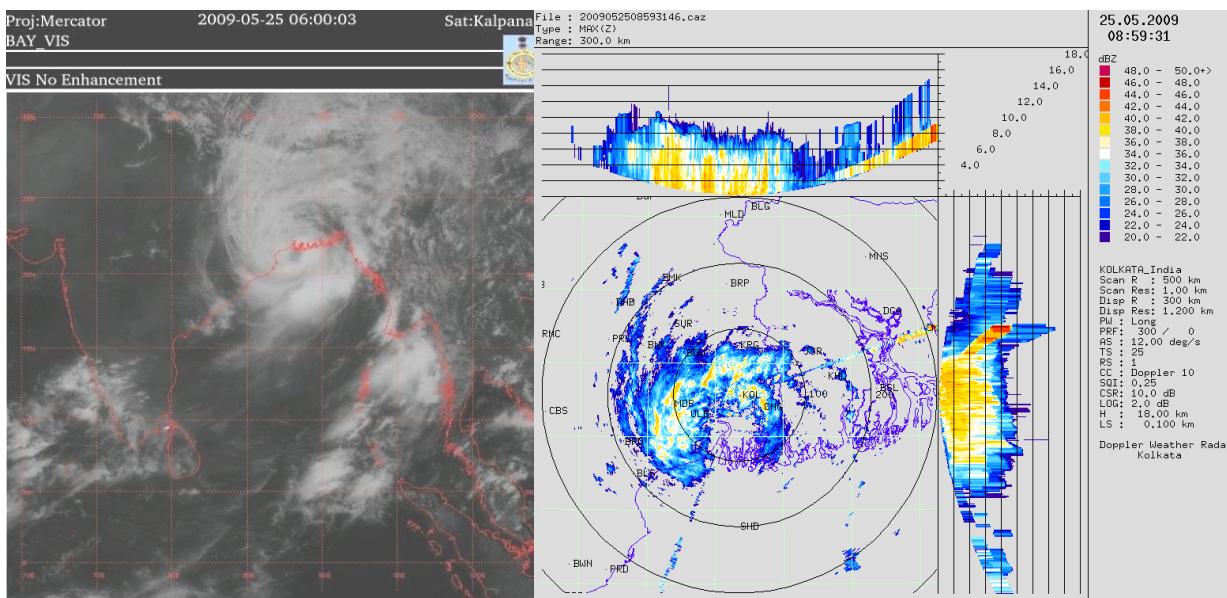
Development of Upgraded Hazard Profile Map of India (Cyclone)

The expert members of Steering Committee (constituted by NDMA) felt that the existing vulnerability maps (cyclone) need to be upgraded and the job was assigned to expert sub-committee to carry out the necessary upgradation. The expert subcommittee have since met on number of occasions to carry out the upgradation task and have prepared a list of cyclone prone districts by adopting Hazard Criteria.

The upgraded hazard profile of the Indian Landmass with reference to cyclone is reproduced under here for comments/ suggestions, if any, from the experts in this area (including those already members of NDMA Steering Committee/Sub-committee) for NDMA's consideration of their inclusion before preparing the upgraded hazard profile maps with reference to cyclone. We shall be grateful if the comments/suggestions requested for are received latest by 30th April 2010.

This is in continuation to the upgraded hazard profile maps (earthquake) already uploaded in NDMA website.

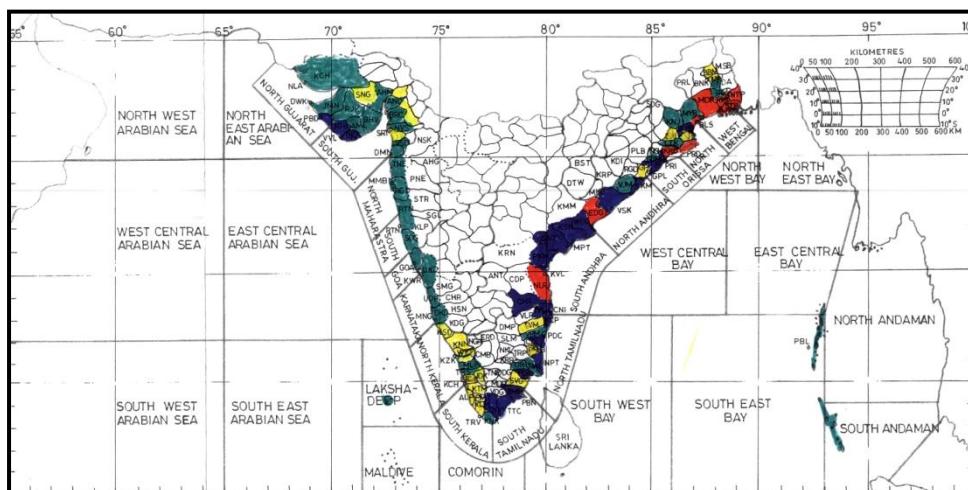
Cyclone Hazard Prone Districts of India: A Report



INSAT (Kalpana) visible imagery

AILA

Doppler Weather Radar, Kolkata of cyclone, imagery of cyclone, AILA



Cyclone Hazard Prone Districts of India

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Cyclone Hazard Prone Districts of India : A Report

1. Introduction

Cyclones are one of the natural hazards that affect India almost every year causing large loss of lives and properties. Tropical Cyclone (TC), also known as ‘Cyclone’, is the term used globally to cover tropical weather systems in which winds equal or exceed the minimum of 34 knot (62 kmph). These are intense low pressure areas of the earth atmosphere coupled system and are extreme weather events of the tropics. Hazards associated with tropical cyclones are long duration rotatory high velocity winds, very heavy rain and storm tide (the combined effect of storm-surge and astronomical tide). Out of these, the storm surge is the greatest killer hazard associated with cyclone.

India has a coastline of about 7,516 km of which 5,400 km is along the mainland. The entire coast is affected by cyclones with varying frequency and intensity. Although the North Indian Ocean (the Bay of Bengal and Arabian Sea) generates only about 7% of the world’s cyclones (5 to 6 TC’s per year) 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 (UTs) in the country are affected by tropical cyclones. Four states (Tamil Nadu, Andhra Pradesh, Orissa and West Bengal) and one UT (Puducherry) on the east coast and one state (Gujarat) on the west coast are more vulnerable to cyclone hazards.

The India Meteorological Department (IMD) is the nodal government agency that provides weather services related to cyclones in India. However, IMD has not identified cyclone prone districts following any specific definition though the districts for which cyclone warnings are issued have been identified. On the other hand, for the purpose of better cyclone disaster management in the country, it is necessary to define cyclone proneness and identify cyclone prone coastal districts. It is also necessary to decide degree of hazard proneness of a district by considering cyclone parameters so that mitigation measures are prioritized.

2. Classification

Cyclones are known by many names the world over like tropical cyclones, typhoons, hurricanes etc. Though TCs differ by name across regions, they are classified according to their wind speed. The classification, however, varies from region to region. The Indian classification of these intense low pressure systems (cyclonic disturbances) is shown in the Table 1 below:

3. Earlier Study

The Building Material Technology Promotion Council (BMTPC) of Ministry of Urban Development, based on Hazard Vulnerability of India identified cyclone prone districts of India taking into consideration cyclone hazards of the coastal districts. These districts are also listed in cyclone guidelines published by NDMA. These lists have included some inland districts of a few states in northeast India which do not experience full impact of cyclone. Also, while preparing such list it appears that no weightage was given for the number as well as intensity of cyclones crossing coast. It is in this context an attempt has been made to prepare a list of cyclone prone districts by adopting hazard criteria.

4. Data:

For the above purpose, the following lists of districts have been taken into consideration.

- (i) Districts touching the Indian seas.
- (ii) Coastal districts as per the Vulnerability Atlas of India (BMTPC).
- (iii) Districts considered as coastal districts for the issue of cyclone warning by India Meteorological Department (IMD).
- (iv) District close to the coast (within a few km from the coast) but not touching the sea.

The lists of above districts are shown in Table 2-5.

The data on cyclones for the period 1891-2008 have been collected from the electronic atlas of cyclonic disturbances published by IMD during 2008.

Cyclones have been grouped in two categories:

- (i) Cyclonic storms and
- (ii) Severe cyclonic storms & above categories.

The severe cyclonic storm includes very severe cyclonic storms and super cyclonic storm. This categorization has been adopted as official data of IMD is available only in these two categories in the e-Atlas.

5. Methodology:

5.1 Cyclones parameters considered

The frequencies of cyclonic storms and severe cyclonic storms and hence total number of cyclones crossing different coastal districts of the country during 1891-2008 have been tabulated. A district has been considered as cyclone prone if at least one cyclone in the past had crossed that district or its neighbouring one on its both sides during the period 1891-2008. As discussed earlier, the cyclone itself is a multi hazard weather system. Therefore, only the frequency of landfalling cyclones cannot determine the degree of proneness. Therefore to determine the degree of proneness the following parameters have been considered.

- (a) Total number of cyclones crossing the district
- (b) Total no. of severe cyclones crossing the district
- (c) Probable maximum winds (mps) over the district
- (d) Probable maximum storm surge over the district (m)
- (e) Probable maximum precipitation (1 day) in cms over any station in the district

While the inputs for (a) and (b) have been collected from officially published data of IMD as discussed in previous section, inputs for (c), (d) and (e) have been taken from the Vulnerability Atlas published by BMTPC, Ministry of Urban Affairs, Govt. of India (Latest Edition; 2006) for which data source is again the publications of IMD.

5.2 Overall Ratings

For the purpose of deciding degree of proneness, different districts have been rated in a 10 point scale as per the following four categories (Table 6) with the above parameters. The degree of proneness has been decided accordingly.

5.3 Ratings of Parameters

Different ratings used for different cyclone parameters are in Table 7. The same scale has been used as that in Vulnerability Atlas for the rating purpose to maintain conformity. The scale is non-linear.

The rating scale is same for maximum wind as used in vulnerability atlas. The new scales have been proposed for the other parameters.

5.4 Composite Score/Ratings.

Finally, a composite score/rating has been calculated taking the arithmetic mean of all ratings. The composite score has been further been divided into four categories like low (≤ 3), moderate (>3 and ≤ 5), high (>5 and ≤ 7) and very high (>7) to find out the intensity (degree) of proneness of districts.

It may be clarified that for the classification of districts along the west coast, the Probable Maximum Precipitation (PMP) has not been considered as the PMP over this region can also be due to orographically enhanced rainfall in association with monsoon systems like off-shore troughs, low level cyclonic circulations, lows and depressions. Therefore, for the west coast remaining four parameters have been used to calculate composite rate of a district. Similarly, for the islands and some districts for which Probable Maximum Storm Surge (PMSS) information is not available, the composite rating has been computed using the remaining parameters.

As hazard due to TC depends on the associated adverse weather, an attempt has also been made to calculate the composite score based on weighted score and hence to classify the districts based on degree of proneness like low (≤ 3), moderate (> 3 and ≤ 5), high (> 5 and ≤ 7) and very high (> 7). The weights considered for this purpose are given below

Total number of cyclones crossing districts (w1)	= 1
Total number of severe cyclones crossing districts (w2)	= 2
PMP for the district (w3)	= 2
Strong wind affecting the district (w4)	= 3
PMSS for the district	= 5

Maximum weight is given to storm surge followed by wind, as the maximum hazard is associated with storm surge followed by wind.

6. Results

6.1. Hazard proneness based on frequency of total severe cyclone, total severe cyclones, hazardous weather based on BMTPC Atlas

From the frequency analysis it is found that most of the districts are cyclone prone. Therefore, it is imperative to find out intensity of proneness of a district for prioritising mitigation measures. The consolidated lists of districts touching the coast with different intensity of proneness, like very high (P1), high (P2) , moderate (P3) and low (P4) are shown in Table 8 and Table 9. In general, the coastal districts of West Bengal, Orissa, Andhra Pradesh and Tamil Nadu are more prone and are in the high to very high category. The Proneness factor is very high for the districts of Nellore, East godawari, Srikakulam & Guntur in Andhra Pradesh; Balasore, Kendrapada , Bhadrak, Jagatsinghpur and Ganjam in Orissa; Kanchipuram in Tamil Nadu; and South 24 Parganas and Midnapore in West Bengal.

The consolidated lists of districts not touching the sea (but close to the coast) with different degree of proneness are shown in Table 10 and 11. In this list the interior districts of West Bengal, like north 24 Praganas and Howrah have been classified as very high cyclone hazard prone followed by Hoogly and Kolkata as high cyclone hazard prone districts.

Mayurbhanj, Cuttack and Nayagarh, the interior districts of Orissa, are categorized as high cyclone prone districts. All other districts in this list are categorized as moderate or low cyclone hazard prone.

While considering the weighted mean scores of the districts, it is found that the rating usually decreases and becomes unrealistic in many cases like districts of Kerala and Karnataka. Therefore it is proposed that list of cyclone hazard prone districts may be considered by assigning equal weights to different cyclone parameters. A composite list of cyclone hazard prone districts based on equal weights to hazard criteria and intensity of cyclones is given in Table 12. The pictorial presentation of the cyclone hazard prone districts of the country is shown in Figure 1.

6.2. Hazard proneness based on frequency of total Severe Cyclonic Storm (SCS), total Very Severe Cyclonic Storm (VSCS) and hazardous weather based on BMTPC Atlas, but with higher threshold of PMP

A composite list of cyclone hazard prone districts based on higher threshold of PMP was also attempted to avoid the impact of lows and depressions, as rainfall of 10, 20, 30 cm etc can occur along east coast with the low pressure area and depression. For this purpose, the PMP was categorised as below.

PMP (cm)	Rating
1-20	3
21-30	5
31-40	7
>40	10

In this case, only the hazard proneness of Kanyakumari district changed from P2 to P3. It remained same for other districts (not shown).

6.3. Hazard proneness based on frequency of total SCS, total VSCS, maximum wind and storm surge, based on BMTPC Atlas

The exercise was also conducted without considering the rainfall as a parameter for both east and west coast. It was found that the results yield the inconsistent and incoherent cyclone hazard prone districts (not shown). Hence above two propositions are not accepted.

6.4. Hazard proneness based on frequency of total SCS, total VSCS, actual/estimated maximum wind and storm surge due to cyclone

All the above classifications have the limitations as, they do not distinguish between the maximum wind due to squall and that due to cyclone. As a result, it gives almost uniform weight to all districts in east coast. Similarly, the PMP is weighted equally for all the districts. As a result more weight is attached to rating due to PMP. To avoid all the above, the following procedure was also attempted.

- (i) The PMP is not considered at all for all districts.
- (ii) Actual wind is collected from the reports published by IMD for the period 1971-2008 in MAUSAM. The data for the above period is considered, as these data are more reliable. The estimated maximum wind is the estimate based on satellite observations. Prior to satellite era, the wind estimation is subject to error.
- (iii) Weight to wind is given based on Damage Potential published by IMD. According to damage potential, wind has been classified in this study into four categories.
- (iv) The ratings based on actual/estimated wind are as follows

System	Wind speed	Rating
Cyclonic Storm:	34-47 Knots 62-87 Kmph	03
Severe Cyclonic Storm	48-63 Knots (88-117 Kmph)	05
Very severe Cyclonic Storm	64-90 knots (118-167 kmph)	07
Very Severe Cyclonic Storm	91-119 knots (168-221 kmph)	10
Super Cyclonic Storm	120 knots and more	10

(222 kmph or more)

Based on above categorization, the consolidated lists of districts touching the coast with different intensity of proneness, like very high (P1), high (P2), moderate (P3) and low (P4) are shown in Table 13 and Table 14. In general, the coastal districts of West Bengal, Orissa, Andhra Pradesh and Tamil Nadu are more prone and are in the high to very high category. The Proneness factor is very high for the districts of Nellore, East godawari, in Andhra Pradesh; Balasore, Kendrapara, in Orissa; and South 24 Parganas and Midnapore, in West Bengal.

The consolidated lists of districts not touching the sea (but close to the coast) with different degree of proneness are shown in Table 15 and 16. In this list the interior districts of West Bengal, like north 24 Praganas and Howrah and Kolkata have been classified as very high cyclone hazard prone districts.

A composite list of cyclone hazard prone districts based on equal weights to hazard criteria and intensity of cyclones based on the criteria mentioned in the beginning of this section is given in Table 17. The pictorial presentation of these cyclone hazard prone districts of the country is shown in Figure 2.

Comparing Fig.1 with Fig.2 or Table 12 with Table 17, the results in Table 17/ Fig.2 seems to be more logical and representative of the hazard proneness due to cyclones. Hence this categorization as shown in Table 17/ Fig.2 is recommended for classification of cyclone hazard prone districts.

7. Conclusion:

The results give a realistic picture of degree of cyclone hazard proneness of districts, as they represent the frequency and intensity of landfalling cyclones alongwith all other hazards like rainfall, wind and storm surge. The categorization of districts with degree of proneness also

tallies with observed pictures. Therefore, it is proposed that this classification of coastal districts based on hazard (Table 17/ Fig.2) may be considered.

In this connection, it may be stated that this classification is only based on hazard criteria. Vulnerability of the place has not been taken into consideration. Therefore, composite cyclone risk of a district, which is the product of hazard and vulnerability, needs to be assessed separately through detailed study.

In the list of cyclone hazard prone districts of the country, some of the districts of north-east India appearing in the list prepared by BMTPC have not appeared here. This is because those districts are away from the coast and no parts of these districts were affected by storm surge requiring large scale evacuation of population. These districts are mostly affected by depressions also interior districts of coastal states were not considered though some of these may be affected by storm wind and very heavy rainfall causing damage and destruction to life and properties.

The result of the report was also presented in the thematic session on cyclone of the second India Disaster Management Congress (IDMC) held in New Delhi during 4-6 November 2009 and the work was appreciated by the participants.

Table 1. Indian Classification of Cyclonic Disturbances in the North Indian Ocean (The Bay of Bengal and Arabian Sea)

Type	Wind Speed in km/h	Wind Speed in knot
Low pressure area(L)	Less than 31	Less than 17
Depression (D)	31-49	17-27
Deep Depression(DD)	50-61	28-33
Cyclonic Storm(CS)	62-88	34-47
Severe Cyclonic Storm(SCS)	89-118	48-63
Very Severe Cyclonic Storm(VSCS)	119-221	64-119
Super Cyclonic Storm (Sup. CS)	222 or more	120 or more

(Generic name like Tropical cyclone or cyclone is used to represent CS, SCS, VSCS and Sup.
CS as a whole)

Table 2: Coastal Districts touching Ocean

S. No.	Name of coastal state	Name of districts
1.	Andhra Pradesh	East Godavari Guntur Krishna Nellore Prakasam Srikakulam Visakhapatnam Vizianagaram West Godavari
2.	Gujarat	Ahmedabad Anand Amreli Bhavnagar Bharuch Jamnagar Junagadh Kachchh Navsari Porbandar Rajkot Surat

		Vadodara Valsad
3.	Karnataka	Dakshin Kannada Udupi Uttar Kannada
4.	Kerala	Alappuzha Ernakulam Kannur Kasargod Kollam Kottayam Kozhikode Malappuram Thrissur Thiruvananthapuram
5	Maharastra	Raigarh Ratnagiri Sindhudurg Thane
6.	Orissa	Baleshwar Bhadrak Ganjam Jagatsinghpur Kendrapara Khordha Puri
7.	Tamil Nadu	Chennai Cuddalore Kanchipuram Kanniyakumari Nagappattinam

		Pudukkottai Ramanathapuram Tiruvallur Thanjavur Tiruvalur Tuticorin Tirunelveli Viluppuram
8.	West Bengal	Haora Midnapore North 24-pargana South 24-pargana
9.	Goa	North goa South goa
10.	Puduchery (UT)	Puducheri
11.	Daman &Diu (UT)	Daman Diu
12.	Dadra & Nagar Haveli (UT)	Dadra & Nagar Haveli
Total		66

Table 3: Coastal Districts not touching Ocean, but within about 100 km from the coast

State	Districts
AP	Chittor
Gujarat	Rajkot
	Sunder Nagar
	Kheda
	Vadodara
Kerala	Wayand
	Palakkad
	Kottayam
	Idukki
	Pathanamthitta
Orissa	Mayurbhanj
	Jajpur
	Keonjhar
	Dhenkanal
	Cuttack
	Nayagarh
	Gajapati
Tamil Nadu	Tiruvannamalai
	Ariyalur
	Sivaganga
West Bengal	North 24 Pargana
	Howrah
	Hogli
	Bardhaman
	Kolkata
Total	25

Table 4: coastal districts as per warning bulletins issued by IMD

S. No.	Name of coastal state	Name of districts
1.	Andhra pradesh	East Godavari Guntur Krishna Nellore Prakasam Srikakulam Visakhapatnam Vizianagaram West Godavari
2.	Gujarat	Ahmedabad Anand Amreli Bhavnagar Bharuch Jamnagar Junagadh Kachchh Navsari Porbandar Rajkot Surat Vadodara Valsad
3.	Karnataka	Dakshin Kannada Udupi Uttar Kannada
4.	Kerala	Alappuzha Ernakulam

		Kannur Kasargod Kollam Kottayam Kozhikode Malappuram Thrissur Thiruvananthapuram
5	Maharastra	Raigarh Ratnagiri Sindhudurg Thane
6.	Orissa	Baleshwar Bhadrak Gajapati Ganjam Jagatsinghpur Kendrapara Khordha Puri
7.	Tamil Nadu	Chennai Cuddalore Kanchipuram Kanniyakumari Nagappattinam pudukkottai Ramanathapuram Tiruvallur Thanjavur Tiruvalur Tuticorin

		Tirunelveli Viluppuram
8.	West Bengal	Haora Hugli Midnapore North 24-pargana South 24-pargana
9.	Goa	North Goa South Goa
10.	Puduchery (UT)	Puduchery
11.	Daman &diu (UT)	Daman Diu
12.	Dadra & Nagar Haveli (UT)	Dadra & Nagar Haveli
Total		72

**Table 5. List of Vulnerable Districts for Cyclone Wind and
Coastal/Inland Flooding**

S. No.	District	Wind and Cyclone	Coastal/ Inland Flooding
Andhra Pradesh			
1	East Godavari	VH	FLZ
2	Krishna	VH	FLZ
3	Guntur	VH	FLZ
4	West Godavari	H	FLZ
5	Prakasam	VH	FLZ
6	Vizianagaram	VH	FLZ
7	Nellore	VH	FLZ
8	Visakhapatnam	VH	FLZ
9	Srikakulam	VH	FLZ
Goa			
10	North Goa	M	-
11	South Goa	M	-
Gujarat			
12	Ahmadabad	M	FLZ
13	Bharuch	M	FLZ
14	Kachchh	VH	FLZ
15	Kheda	M	FLZ
16	Surat	M	FLZ
17	Vadodara	M	FLZ
18	Valsad	M	FLZ
19	Bhavanagar	M	-
20	Junagadh	VH	FLZ
21	Jamnagar	M	FLZ
22	Narmada	H	FLZ
23	Navsari	M	FLZ
24	Anand	M	FLZ
25	Amreli	M	FLZ
26	Rajkot	M	FLZ
27	Porbandar	H	FLZ

Karnataka			
28	Udupi	M	-
29	Uttara Kannada	M	-
30	Dakshina Kannada	M	-
Kerala			
31	Ernakulam	M	FLZ
32	Idukki	M	FLZ
33	Kannur	M	FLZ
34	Kasaragod	M	FLZ
35	Kollam	M	FLZ
36	Kottayam	M	FLZ
37	Kozhikode	M	FLZ
38	Malappuram	M	FLZ
39	Palakkad	M	FLZ
40	Thiruvananthapuram	M	FLZ
41	Thrissur	M	FLZ
42	Kasargod	M	-
43	Alappuzha	M	FLZ
43	Wayanad	M	-
44	Pathanamthitta	M	-
Maharashtra			
45	Mumbai	H	FLZ
46	Sindhudurg	M	-
47	Raigadh	M	-
48	Ratnagiri	M	-
49	Thane	H	FLZ
Orissa			
50	Cuttack	VH	FLZ
51	Ganjam	VH	FLZ
52	Jagatsinghpur	VH	FLZ
53	Kendrapara	VH	FLZ
54	Khordha	VH	FLZ
55	Puri	VH	FLZ
56	Baleshwar	VH	FLZ
57	Bhadrak	VH	FLZ
58	Jajpur	VH	FLZ
59	Navagadh	H	-

60	Dhenkanal	H	-
Tamilnadu			
61	Thanjavur	VH	FLZ
62	Cuddalore	VH	FLZ
63	Kanchipuram	VH	-
64	Thiruvallur	VH	-
65	Tiruvanamalai	VH	-
66	Viluppuram	VH	-
67	Ramanathapuram	VH	-
68	Puducherry and Karaikal	H	-
69	Nagapattinam	VH	FLZ
70	Pudukkottai	H	-
71	Sivaganga	H	-
72	Thoothookodi	VH	FLZ
73	Tirunelveli	VH	-
74	Kanyakumari	H	-
West Bengal			
75	Barddaman	H	FLZ
76	kolkata	H	FLZ
77	Hugli	VH	FLZ
78	North Twenty Four Parganas	VH	FLZ
79	South Twenty Four Parganas	VH	FLZ
80	Midnapur	VH	FLZ
Union Territories			
81	Andaman & Nicobar	H	FLZ
82	Dadra & Nagarhaveli	H	FLZ
83	Daman & Diu	H	FLZ
84	Lakshadweep	H	FLZ

M : Moderate, H : High, VH : Very high, FLZ : Flood Zone

Table 6. Categorisation of districts based on degree of proneness

Category	Rating
Low (P4)	≤ 3.0
Moderate (P3)	3.1 – 5.0
High (P2)	5.1 – 7.0
Very high (P1)	7.1 – 10.0

Table 7(i). Rating of districts based on total number of cyclones crossing the district

Total number of cyclones	Rating
1-5	3
6-10	5
11-15	7
>15	10

Table 7(ii). Rating of districts based on total no. of severe cyclones crossing the district

Total number of severe cyclones	Rating
1-3	3
4-6	5
7-10	7
>10	10

Table 7(iii). Rating of districts based on Probable Maximum Winds (PMW) in knot over the district

PMW (knot)	Rating
No. CS	0
34-47	3
48-63	5
64-90	7
≥ 90	10

Table 7(iv). Rating of districts based on Probable Maximum Storm Surge (PMSS) over the district

PMSS (metre)	Rating
0-2.0	3
2.1-4.0	5
4.1-6.0	7
>6	10

Table 7(v). Rating of district based on Probable Maximum Precipitation (PMP) for a day in cms in the district

PMP (cm)	Rating
1-10	3
11-20	5
21-30	7
>30	10

Table 8. Cyclone parameters for districts of India touching the coast

State	Districts	Cyclone Parameters				
		No. of severe cyclones	Total no. of cyclones	Wind speed (mps)	PMSS (metre)	PMP (cm)
A&N Island	A & N Islands	2	2	44	-	N/A
Andhra Pradesh	Nellore	8	18	44-50	4.5	60
Andhra Pradesh	East Godavari	4	17	44-50	4.5	52
Andhra Pradesh	Srikakulam	5	12	44-50	4	56
Andhra Pradesh	Guntur	0	0	44-50	7.5	56
Andhra Pradesh	Visakhapatnam	4	7	44-50	4	52
Andhra Pradesh	Krishna	3	10	44-50	5.5	56
Andhra Pradesh	West Godavari	1	3	44-50	5	52
Andhra Pradesh	Prakasam	3	5	44-50	6	52
Andhra Pradesh	Vizianagaram	0	2	44-50	4	52
Dadra & Nagar	Dadra & Nagar Haveli	1	1	44	-	80
Daman	Daman	1	1	50	5	80
Diu	Diu	4	8	50	3.5	80
Goa	North Goa	0	0	39	4.5	64
Goa	South Goa	0	0	39	4.5	64
Gujarat	Junagadh	4	8	44-50	3.5	84
Gujarat	Kachchh	3	7	44-50	3.5	60
Gujarat	Bhavnagar	1	1	44-50	4.5	56
Gujarat	Jamnagar	1	2	44-50	3.5	72
Gujarat	Porbandar	2	2	50	3.5	84
Gujarat	Amreli	1	1	44-50	4	56
Gujarat	Ahmedabad	0	0	44-50	-	60
Gujarat	Anand	1	1	44-47	-	52
Gujarat	Surat	0	0	44-47	4.5	88
Gujarat	Navsari	0	1	44-47	4.5	88
Gujarat	Valsad	0	0	44-47	5	104
Gujarat	Bharuch	0	3	44-47	-	72
Karnataka	Udupi	0	0	33-39	4.5	84
Karnataka	Uttar Kannada	0	0	33-39	4.5	68
Karnataka	Dakshin Kannada	0	0	33-39	4.5	92
Kerala	Kozhikode	1	1	39	4.5	60
Kerala	Malappuram	0	1	33-39	4.5	60
Kerala	Thrissur	0	0	39	4.5	52
Kerala	Kasargod	0	0	39	4	48
Kerala	Kannur	0	0	39	4	60
Kerala	Ernakulam	0	0	39	4	44
Kerala	Alappuzha	0	0	39	4	40
Kerala	Kollam	0	0	39	3.5	44
Kerala	Thiruvananthapuram	0	0	39	3	48
Lakshadweep	Lakshadweep	1	2	39	-	N/A
Maharastra	Thane	1	1	39-44	5	72

Maharastra	Mumbai suburban	1	1	44	5	95
Maharastra	Ratnagiri	1	1	39-44	4	64
Maharastra	Raigarh	0	1	39-44	5	72
Maharastra	Sindhudurg	1	1	39	4	72
Orissa	Balasore	5	28	50	11	60
Orissa	Kendrapara	4	16	50	8.5	60
Orissa	Bhadrak	3	15	50	9.5	60
Orissa	Jagatsinghpur	3	14	50	6.5	60
Orissa	Ganjam	5	11	39-50	4	48
Orissa	Puri	1	6	50	4	60
Orissa	Khordha	0	4	44-50	4	52
Puducheri	Pudukkottai	1	1	47	7	52
Puducheri	Karaikal	0	0	50	3.5	52
Tamilnadu	Kanchipuram	8	13	39-50	3.5	68
Tamilnadu	Cuddalore	4	6	39-50	3.5	68
Tamilnadu	Tiruvarur	3	6	47	5.5	60
Tamilnadu	Nagappattinam	3	10	39-47	4.5	68
Tamilnadu	Chennai	0	0	50	3.5	52
Tamilnadu	Viluppuram	3	3	39-50	3.5	68
Tamilnadu	Ramanathapuram	1	2	39	12	48
Tamilnadu	Toothukudi	1	1	39	7	52
Tamilnadu	Tirunelveli	3	3	39	7	48
Tamilnadu	Thanjavur	1	2	47	5.5	48
Tamilnadu	Tiruvalur	0	5	39-50	4.0	56
Tamilnadu	Kanyakumari	0	0	39	3	40
West Bengal	South 24-pargana	16	29	50	12	52
West Bengal	Medinipur	8	16	47-50	13	56
Total		69				

Table 9. Proposed cyclone prone districts of India touching the coast

State	Districts	Ratings based on						Mean rating	Category of Proneness
		No. of severe cyclones	Total no. of cyclones	Wind speed	PMSS	PMP			
AP	Nellore	7	10	10	7	10	8.8	P1	
AP	East Godavari	5	10	10	7	10	8.4	P1	
AP	Srikakulam	5	7	10	5	10	7.4	P1	
AP	Guntur	3	3	10	10	10	7.2	P1	
Orissa	Balasore	5	10	10	10	10	9	P1	
Orissa	Kendrapara	5	10	10	10	10	9	P1	
Orissa	Bhadrak	3	7	10	10	10	8	P1	
Orissa	Jagatsinghpur	3	7	10	7	10	7.4	P1	
Orissa	Ganjam	5	7	10	5	10	7.4	P1	
Tamilnadu	Kanchipuram	7	7	10	5	10	7.8	P1	
West Bengal	South 24-pargana	10	10	10	10	10	10	P1	
West Bengal	Medinipur	7	10	10	10	10	9.4	P1	
AP	Visakhapatnam	5	5	10	5	10	7	P2	
AP	Krishna	3	5	10	7	10	7	P2	
AP	West Godavari	3	3	10	7	10	6.6	P2	
AP	Prakasam	3	3	10	7	10	6.6	P2	
AP	Vizianagaram	0	3	10	5	10	5.6	P2	
Daman & Diu	Daman	3	3	10	7	-	5.7	P2	
Daman & Diu	Diу	5	5	10	5	-	6.3	P2	
Gujarat	Junagadh	5	5	10	5	-	6.3	P2	
Gujarat	Kachchh	3	5	10	5	-	5.7	P2	
Gujarat	Bhavnagar	3	3	10	7	-	5.7	P2	
Gujarat	Jamnagar	3	3	10	5	-	5.3	P2	
Gujarat	Porbandar	3	3	10	5	-	5.3	P2	
Gujarat	Amreli	3	3	10	5	-	5.3	P2	
Orissa	Puri	3	5	10	5	10	6.6	P2	
Orissa	Khordha	0	3	10	5	10	5.6	P2	
Puduchcheri	Pudukkottai	3	3	7	10	10	6.6	P2	
Puduchcheri	Karaikal	3	3	10	5	10	6.2	P2	
Tamilnadu	Cuddalore	5	5	10	5	10	7	P2	
Tamilnadu	Tiruvarur	3	5	7	7	10	6.4	P2	
Tamilnadu	Nagappattinam	3	5	7	7	10	6.4	P2	

Tamilnadu	Chennai	3	3	10	5	10	6.2	P2
Tamilnadu	Viluppuram	3	3	10	5	10	6.2	P2
Tamilnadu	Ramanathapuram	3	3	5	10	10	6.2	P2
Tamilnadu	Toothukudi	3	3	5	10	10	6.2	P2
Tamilnadu	Tirunelveli	3	3	5	10	10	6.2	P2
Tamilnadu	Thanjavur	3	3	7	7	10	6	P2
Tamilnadu	Tiruvalur	0	3	10	5	10	5.6	P2
Tamilnadu	Kanyakumari	3	3	5	5	10	5.2	P2
A&N Island	A & N islands	3	3	7	-	-	4.3	P3
Dadra &Nagar Haveli	Dadra & Nagar Haveli				0	-	3.3	P3
Gujarat	Ahmedabad	0	3	10	-	-	4.3	P3
Gujarat	Anand	3	3	7	-	-	4.3	P3
Gujarat	Surat	0	3	7	7	-	4.3	P3
Gujarat	Navsari	0	3	7	7	-	4.3	P3
Gujarat	Valsad	0	3	7	7	-	4.3	P3
Gujarat	Bharuch	0	3	7	-	-	3.3	P3
Goa	North Goa	3	3	5	7	-	4.5	P3
Goa	South Goa	3	3	5	7	-	4.5	P3
Karnataka	Udupi	0	3	5	7	-	37	P3
Karnataka	Uttar Kannada	0	3	5	7	-	3.7	P3
Karnataka	Dakshin Kannada	0	3	5	7	-	3.7	P3
Kerala	Kozhikode	3	3	5	7	-	4.5	P3
Kerala	Malappuram	0	3	5	7	-	3.7	P3
Kerala	Thrissur	0	3	5	7	-	3.7	P3
Kerala	Kasargod	0	3	5	5	-	3.3	P3
Kerala	Kannur	0	3	5	5	-	3.3	P3
Kerala	Ernakulam	0	3	5	5	-	3.3	P3
Kerala	Alappuzha	0	3	5	5	-	3.3	P3
Kerala	Kollam	0	3	5	5	-	3.3	P3
Kerala	Thiruvananthapuram	0	3	5	5	-	3.3	P3
Lakshadweep	Lakshadweep	3	3	5	-	-	3.7	P3
Maharastra	Thane	3	3	7	7	-	5	P3
Maharastra	Mumbai suburban	3	3	7	7	-	5	P3
Maharastra	Ratnagiri	3	3	7	5	-	4.5	P3
Maharastra	Raigarh	0	3	7	7	-	4.3	P3
Maharastra	Sindhudurg	3	3	5	4	-	3.7	P3

Table 10. Different cyclone parameters for districts of India not touching the coast

State	District	No. of severe cyclones	Total no. of cyclones	Wind speed	PMSS	PMP
Gujarat	Rajkot	1	3	44-50	0	72
	Sunder Nagar	2	2	39-50	0	56
	Kheda	0	0	44-47	0	52
	Vadodara	0	0	44-47	0	64
Kerala	Wayand	0	0	33-39	0	52
	Palakkad	0	0	39	0	52
	Kottayam	0	0	39	0	48
	Idukki	1	1	39	0	52
	Pathanamthita	1	1	39	0	48
	Mayurbhanj	1	10	47-50	0	56
Orissa	Jajpur	0	2	50	0	60
	Keonjhar	0	5	47-50	0	52
	Dhenkanal	0	3	44-50	0	44
	Cuttack	1	4	44-50	0	52
	Nayagarh	1	7	44-50	0	52
	Gajapati	0	1	39-50	0	52
Tamil Nadu	Tiruvannamalai	0	2	39-50	0	40
	Ariyalur	0	4	44	0	52
	Sivaganga	0	3	39-44	0	40
West Bengal	North 24 Pargana	11	23	50	0	52
	Howrah	12	23	50	0	50
	Hoogli	3	11	47	0	52
	Bardhaman	0	10	47	0	56
	Kolkata	12	23	50	0	52
Total			24			

Table 11. Proposed cyclone prone districts of India not touching the coast

State	Districts	Ratings based on					Mean rating	Category of Proneness
		No. of severe cyclones	Total no. of cyclones	Wind speed	PMSS	PMP		
West Bengal	North 24 Pargana	10	10	10	10	10	10	P1
West Bengal	Howrah	10	10	10	7	10	9.4	P1
West Bengal	Kolkata	10	10	10	0	10	8.0	P1
Orissa	Mayurbhanj	3	7	10	0	10	6	P2
Orissa	Cuttack	3	3	10	0	10	5.2	P2
Orissa	Nayagarh	3	5	10	0	10	5.6	P2
Orissa	Keonjhar	3	10	10	0	10	6.6	P2
West Bengal	Hoogli	3	7	10	0	10	6	P2
Gujarat	Rajkot	3	3	10	0	-	4	P3
Orissa	Jajpur	0	3	10	0	10	4.6	P3
Orissa	Dhenkanal	0	3	10	0	10	4.6	P3
Orissa	Gajapati	0	3	7	0	10	4	P3
Tamilnadu	Tiruvannamalai	0	3	5	0	10	3.6	P3
Tamilnadu	Ariyalur	0	3	5	0	10	3.6	P3
Tamilnadu	Sivaganga	0	3	5	0	10	3.6	P3
West Bengal	Bardhaman	0	5	7	0	10	4.4	P3
Gujarat	Sunder Nagar	0	3	7	0	-	2.5	P4
Gujarat	Kheda	0	0	7	0	-	1.7	P4
Gujarat	Vadodara	0	0	7	0	-	1.7	P4
Kerala	Wayand	0	0	3	0	-	0.7	P4
Kerala	Palakkad	0	0	5	0	-	1.3	P4
Kerala	Kottayam	0	0	5	0	-	1.3	P4
Kerala	Idukki	0	3	5	0	-	2	P4
Kerala	Pathanamthitta	0	3	5	0	-	2	P4

Table 12. Proposed cyclone prone districts of India

State	Districts	Ratings based on						Mean rating	Category of Proneness
		No. of severe cyclones	Total no. of cyclones	Wind speed	PMSS	PMP			
AP	Nellore	7	10	10	7	10	8.8	P1	
AP	East Godavari	5	10	10	7	10	8.4	P1	
AP	Srikakulam	5	7	10	5	10	7.4	P1	
AP	Guntur	3	3	10	10	10	7.2	P1	
Orissa	Balasore	5	10	10	10	10	9	P1	
Orissa	Kendrapara	5	10	10	10	10	9	P1	
Orissa	Bhadrak	3	7	10	10	10	8	P1	
Orissa	Jagatsinghpur	3	7	10	7	10	7.4	P1	
Orissa	Ganjam	5	7	10	5	10	7.4	P1	
Tamilnadu	Kanchipuram	7	7	10	5	10	7.8	P1	
West Bengal	South 24-pargana	10	10	10	10	10	10	P1	
West Bengal	Medinipur	7	10	10	10	10	9.4	P1	
West Bengal	North 24 Pargana	10	10	10	10	10	10	P1	
West Bengal	Howrah	10	10	10	7	10	9.4	P1	
West Bengal	Kolkata	10	10	10	0	10	8.0	P1	
AP	Visakhapatnam	5	5	10	5	10	7	P2	
AP	Krishna	3	5	10	7	10	7	P2	
AP	West godavari	3	3	10	7	10	6.6	P2	
AP	Prakasam	3	3	10	7	10	6.6	P2	
AP	Vizianagaram	0	3	10	5	10	5.6	P2	
DAMAN	Daman	3	3	10	7	-	5.7	P2	
DIU	Diu	5	5	10	5	-	6.3	P2	
Gujarat	Junagadh	5	5	10	5	-	6.3	P2	
Gujarat	Kachchh	3	5	10	5	-	5.7	P2	
Gujarat	Bhavnagar	3	3	10	7	-	5.7	P2	
Gujarat	Jamnagar	3	3	10	5	-	5.3	P2	
Gujarat	Porbandar	3	3	10	5	-	5.3	P2	
Gujarat	Amreli	3	3	10	5	-	5.3	P2	
Orissa	Puri	3	5	10	5	10	6.6	P2	
Orissa	Khordha	0	3	10	5	10	5.6	P2	
Orissa	Keonjhar	3	10	0	10	10	6.6	P2	
Puduchcheri	Pudukkottai	3	3	7	10	10	6.6	P2	
Puduchcheri	Karaikal	3	3	10	5	10	6.2	P2	

Tamilnadu	Cuddalore	5	5	10	5	10	7	P2
Tamilnadu	Tiruvarur	3	5	7	7	10	6.4	P2
Tamilnadu	Nagappattinam	3	5	7	7	10	6.4	P2
Tamilnadu	Chennai	3	3	10	5	10	6.2	P2
Tamilnadu	Viluppuram	3	3	10	5	10	6.2	P2
Tamilnadu	Ramanathapuram	3	3	5	10	10	6.2	P2
Tamilnadu	Toothukudi	3	3	5	10	10	6.2	P2
Tamilnadu	Tirunelveli	3	3	5	10	10	6.2	P2
Tamilnadu	Thanjavur	3	3	7	7	10	6	P2
Tamilnadu	Tiruvalur	0	3	10	5	10	5.6	P2
Tamilnadu	Kanyakumari	3	3	5	5	10	5.2	P2
Orissa	Mayurbhanj	3	7	10	0	10	6	P2
Orissa	Cuttack	3	3	10	0	10	5.2	P2
Orissa	Nayagarh	3	5	10	0	10	5.6	P2
West Bengal	Hoogli	3	7	10	0	10	6	P2
A&N Island	A & N islands	3	3	7	-	-	4.3	P3
Dadra &Nagar	Dadra & Nagar Haveli	3	3	7	0	-	3.3	P3
Gujarat	Ahmedabad	0	3	10	-	-	4.3	P3
Gujarat	Anand	3	3	7	-	-	4.3	P3
Gujarat	Surat	0	3	7	7	-	4.3	P3
Gujarat	Navsari	0	3	7	7	-	4.3	P3
Gujarat	Valsad	0	3	7	7	-	4.3	P3
Gujarat	Bharuch	0	3	7	-	-	3.3	P3
Goa	North Goa	3	3	5	7	-	4.5	P3
Goa	South Goa	3	3	5	7	-	4.5	P3
Karnataka	Udupi	0	3	5	7	-	37	P3
Karnataka	Uttar kannada	0	3	5	7	-	3.7	P3
Karnataka	Dakshin kannada	0	3	5	7	-	3.7	P3
Kerala	Kozhikode	3	3	5	7	-	4.5	P3
Kerala	Malappuram	0	3	5	7	-	3.7	P3
Kerala	Thrissur	0	3	5	7	-	3.7	P3
Kerala	Kasargod	0	3	5	5	-	3.3	P3
Kerala	Kannur	0	3	5	5	-	3.3	P3
Kerala	Ernakulam	0	3	5	5	-	3.3	P3
Kerala	Alappuzha	0	3	5	5	-	3.3	P3
Kerala	Kollam	0	3	5	5	-	3.3	P3
Kerala	Thiruvananthapuram	0	3	5	5	-	3.3	P3
Lakshadweep	Lakshadweep	3	3	5	-	-	3.7	P3
Maharastra	Thane	3	3	7	7	-	5	P3

Maharastra	Mumbai suburban	3	3	7	7	-	5	P3
Maharastra	Ratnagiri	3	3	7	5	-	4.5	P3
Maharastra	Raigarh	0	3	7	7	-	4.3	P3
Maharastra	Sindhudurg	3	3	5	4	-	3.7	P3
Gujarat	Rajkot	3	3	10	0	-	4	P3
Orissa	Jajpur	0	3	10	0	10	4.6	P3
Orissa	Dhenkanal	0	3	10	0	10	4.6	P3
Orissa	Gajapati	0	3	7	0	10	4	P3
Tamilnadu	Tiruvannamalai	0	3	5	0	10	3.6	P3
Tamilnadu	Ariyalur	0	3	5	0	10	3.6	P3
Tamilnadu	Sivaganga	0	3	5	0	10	3.6	P3
West Bengal	Bardhaman	0	5	7	0	10	4.4	P3
Gujarat	Sunder Nagar	0	3	7	0	-	2.5	P4
Gujarat	Kheda	0	0	7	0	-	2.3	P4
Gujarat	Vadodara	0	0	7	0	-	2.3	P4
Kerala	Wayand	0	0	3	0	-	0.75	P4
Kerala	Palakkad	0	0	5	0	-	1.3	P4
Kerala	Kottayam	0	0	5	0	-	1.3	P4
Kerala	Idukki	0	3	5	0	-	2	P4
Kerala	Pathanamthita	0	3	5	0	-	2	P4
Total						93		

Table 13. Cyclone parameters for districts of India touching the coast

State	Districts	Cyclone Parameters				
		No. of severe cyclones	Total no. of cyclones	Wind speed (knot)	PMSS (metre)	PMP (cm)
A&N Island	A & N Islands	2	2	90	-	N/A
Andhra Pradesh	Nellore	8	18	110	4.5	60
Andhra Pradesh	East Godavari	4	17	125	4.5	52
Andhra Pradesh	Srikakulam	5	12	100	4	56
Andhra Pradesh	Guntur	0	0	127	7.5	56
Andhra Pradesh	Visakhapatnam	4	7	125	4	52
Andhra Pradesh	Krishna	3	10	127	5.5	56
Andhra Pradesh	West Godavari	1	3	127	5	52
Andhra Pradesh	Prakasam	3	5	115	6	52
Andhra Pradesh	Vizianagaram	0	2	94	4	52
Dadra & Nagar	Dadra & Nagar Haveli	1	1	55	-	80
Daman	Daman	1	1	55	5	80
Diu	Diu	4	8	90	3.5	80
Goa	North Goa	0	0	55	4.5	64
Goa	South Goa	0	0	55	4.5	64
Gujarat	Junagadh	4	8	90	3.5	84
Gujarat	Kachchh	3	7	90	3.5	60
Gujarat	Bhavnagar	1	1	90	4.5	56
Gujarat	Jamnagar	1	2	90	3.5	72
Gujarat	Porbandar	2	2	90	3.5	84
Gujarat	Amreli	1	1	90	4	56
Gujarat	Ahmedabad	0	0	90	-	60
Gujarat	Anand	1	1	70	-	52
Gujarat	Surat	0	0	45	4.5	88
Gujarat	Navsari	0	1	70	4.5	88
Gujarat	Valsad	0	0	45	5	104
Gujarat	Bharuch	0	3	70	-	72
Karnataka	Udupi	0	0	45	4.5	84
Karnataka	Uttar Kannada	0	0	45	4.5	68
Karnataka	Dakshin Kannada	0	0	45	4.5	92
Kerala	Kozhikode	1	1	55	4.5	60
Kerala	Malappuram	0	1	45	4.5	60
Kerala	Thrissur	0	0	45	4.5	52
Kerala	Kasargod	0	0	45	4	48
Kerala	Kannur	0	0	45	4	60
Kerala	Ernakulam	0	0	45	4	44
Kerala	Alappuzha	0	0	45	4	40
Kerala	Kollam	0	0	45	3.5	44
Kerala	Thiruvananthapuram	0	0	45	3	48
Lakshadweep	Lakshadweep	1	2	90	-	N/A
Maharastra	Thane	1	1	55	5	72

Maharastra	Mumbai suburban	1	1	55	5	95
Maharastra	Ratnagiri	1	1	55	4	64
Maharastra	Raigarh	0	1	55	5	72
Maharastra	Sindhudurg	1	1	55	4	72
Orissa	Balasore	5	28	75	11	60
Orissa	Kendrapara	4	16	140	8.5	60
Orissa	Bhadrak	3	15	65	9.5	60
Orissa	Jagatsinghpur	4	14	140	6.5	60
Orissa	Ganjam	5	11	100	4	48
Orissa	Puri	1	6	140	4	60
Orissa	Khordha	0	4	100	4	52
Puducheri	Pudukkottai	1	1	55	7	52
Puducheri	Karaikal	0	0	90	3.5	52
Tamilnadu	Kanchipuram	8	13	55	3.5	68
Tamilnadu	Cuddalore	4	6	90	3.5	68
Tamilnadu	Tiruvarur	3	6	90	5.5	60
Tamilnadu	Nagappattinam	3	10	90	4.5	68
Tamilnadu	Chennai	0	0	95	3.5	52
Tamilnadu	Viluppuram	3	3	77	3.5	68
Tamilnadu	Ramanathapuram	1	2	55	12	48
Tamilnadu	Toothukudi	1	1	55	7	52
Tamilnadu	Tirunelveli	3	3	55	7	48
Tamilnadu	Thanjavur	1	2	90	5.5	48
Tamilnadu	Tiruvalur	0	5	95	4.0	56
Tamilnadu	Kanyakumari	0	0	45	3	40
West Bengal	South 24-pargana	16	29	115	12	52
West Bengal	Medinipur	8	16	115	13	56
Total		69				

Table 14. Proposed cyclone prone districts of India touching the coast without taking PMP into consideration and actual wind speed

State	Districts	Ratings based on					Mean rating	Category of Proneness
		No. of severe cyclones	Total no. of cyclones	Wind speed	PMSS			
AP	Nellore	7	10	10	7	8.5	P1	
AP	East Godavari	5	10	10	7	8.0	P1	
Orissa	Balasore	5	10	7	10	8	P1	
Orissa	Kendrapara	5	10	10	10	8.7	P1	
Orissa	Jagatsinghpur	5	7	10	7	7.1	P1	
West Bengal	South 24-pargana	10	10	10	10	10	P1	
West Bengal	Medinipur	7	10	10	10	9.3	P1	
AP	Srikakulam	5	7	10	5	6.7	P2	
AP	Guntur	3	3	10	10	6.5	P2	
AP	Visakhapatnam	5	5	10	5	6.3	P2	
AP	Krishna	3	5	10	7	6.3	P2	
AP	West Godavari	3	3	10	7	5.7	P2	
AP	Prakasam	3	3	10	7	5.7	P2	
Daman & Diu	Diu	5	5	7	5	5.5	P2	
Gujarat	Junagadh	5	5	7	5	5.5	P2	
Gujarat	Porbandar	3	3	7	5	5.5	P2	
Orissa	Bhadrak	3	7	7	10	6.7	P2	
Orissa	Ganjam	5	7	10	5	6.7	P2	
Orissa	Puri	3	5	10	5	5.7	P2	
Puduchcheri	Pudukkottai	3	3	5	10	5.3	P2	
Tamilnadu	Cuddalore	5	5	7	5	5.5	P2	
Tamilnadu	Kanchipuram	7	7	5	5	6	P2	
Tamilnadu	Tiruvarur	3	5	7	7	5.5	P2	
Tamilnadu	Nagappattinam	3	5	7	7	5.5	P2	
Tamilnadu	Chennai	3	3	10	5	5.3	P2	
Tamilnadu	Ramanathapuram	3	3	5	10	5.3	P2	
Tamilnadu	Toothukudi	3	3	5	10	5.3	P2	
Tamilnadu	Tirunelveli	3	3	10	10	5.3	P2	
AP	Vizianagaram	0	3	10	5	4.5	P3	
A&N Island	A & N islands	3	3	7	-	4.3	P3	
Gujarat	Ahmedabad	0	3	7	-	3.3	P3	
Goa	North goa	3	3	5	7	4.5	P3	

Goa	South goa	3	3	5	7	4.5	P3
Gujarat	Kachchh	3	5	7	5	5	P3
Gujarat	Bhavnagar	3	3	7	7	5	P3
Gujarat	Amreli	3	3	7	5	4.5	P3
Gujarat	Jamnagar	3	3	7	5	4.5	P3
Gujarat	Anand	3	3	7	-	4.3	P3
Gujarat	Navsari	0	3	7	7	4.3	P3
Gujarat	Valsad	0	3	3	7	3.3	P3
Gujarat	Bharuch	0	3	7	-	3.3	P3
Daman & Diu	Daman	3	3	5	7	4.5	P3
Karnataka	Udupi	0	3	3	7	3.3	P3
Karnataka	Uttar Kannada	0	3	3	7	3.3	P3
Karnataka	Dakshin Kannada	0	3	3	7	3.3	P3
Kerala	Kozhikode	3	3	5	7	4.5	P3
Kerala	Malappuram	0	3	3	7	3.3	P3
Kerala	Thrissur	0	3	3	7	3.3	P3
Lakshadweep	Lakshadweep	3	3	7	-	4.3	P3
Maharastra	Thane	3	3	5	7	4.5	P3
Maharastra	Mumbai suburban	3	3	5	7	4.5	P3
Maharastra	Ratnagiri	3	3	5	5	4	P3
Maharastra	Raigarh	0	3	5	7	3.7	P3
Maharastra	Sindhudurg	3	3	5	4	3.7	P3
Orissa	Khordha	0	3	10	5	4.5	P3
Puduchcheri	Karaikal	3	3	7	5	4.5	P3
Tamilnadu	Viluppuram	3	3	7	5	4.5	P3
Tamilnadu	Thanjavur	3	3	7	7	5	P3
Tamilnadu	Tiruvalur	0	3	7	5	3.7	P3
Tamilnadu	Kanyakumari	3	3	3	5	3.5	P3
Dadra &Nagar Haveli	Dadra & Nagar Haveli	3	3	5	0	2.7	P4
Gujarat	Surat	0	3	3	7	2.5	P4
Kerala	Kasargod	0	3	3	5	2.7	P4
Kerala	Kannur	0	3	3	5	2.7	P4
Kerala	Ernakulam	0	3	3	5	2.7	P4
Kerala	Alappuzha	0	3	3	5	2.7	P4
Kerala	Kollam	0	3	3	5	2.7	P4
Kerala	Thiruvananthapuram	0	3	3	5	2.7	P4
Total		69					

Table 15. Different cyclone parameters for districts of India not touching the coast

State	District	No. of severe cyclones	Total no. of cyclones	Wind speed	PMSS	PMP
AP	Chittor	8	15	95	0	
Gujarat	Rajkot	1	3	90	0	72
	Sunder Nagar	2	2	55	0	56
	Kheda	0	0	45	0	52
	Vadodara	0	0	45	0	64
Kerala	Wayand	0	0	55	0	52
	Palakkad	0	0	55	0	52
	Kottayam	0	0	45	0	48
	Idukki	1	1	45	0	52
	Pathanamthita	1	1	45	0	48
Orissa	Mayurbhanj	1	10	55	0	56
	Jajpur	0	2	65	0	60
	Keonjhar	0	5	45	0	52
	Dhenkanal	0	3	45	0	44
	Cuttack	1	4	140	0	52
	Nayagarh	1	7	65	0	52
	Gajapati	0	1	100	0	52
Tamil Nadu	Tiruvannamalai	0	2	55	0	40
	Ariyalur	0	4	45	0	52
	Sivaganga	0	3	55	0	40
West Bengal	North 24 Pargana	11	23	115	0	52
	Howrah	12	23	115	0	50
	Hoogli	3	11	65	0	52
	Bardhaman	0	10	45	0	56
	Kolkata	12	23	115	0	52
	Total			25		

Table 16. Proposed cyclone prone districts of India not touching the coast

State	Districts	Ratings based on				Mean rating	Category of Proneness
		No. of severe cyclones	Total no. of cyclones	Wind speed	PMSS		
West Bengal	North 24 Pargana	10	10	10	10	10	P1
West Bengal	Howrah	10	10	10	7	9.3	P1
West Bengal	Kolkata	10	10	10	0	7.5	P1
AP	Chittor	7	7	10	0	6	P2
Orissa	Mayurbhanj	3	7	5	0	3.7	P3
Orissa	Cuttack	3	3	10	0	4	P3
Orissa	Nayagarh	3	5	7	0	3.7	P3
Orissa	Keonjhar	3	10	3	0	4	P3
West Bengal	Hoogli	3	7	7	0	4.3	P3
Gujarat	Rajkot	3	3	7	0	3.3	P3
Orissa	Jajpur	0	3	7	0	2.5	P4
Orissa	Dhenkanal	0	3	3	0	1.5	P4
Orissa	Gajapati	0	3	10	0	2.5	P4
Tamilnadu	Tiruvannamalai	0	3	5	0	2	P4
Tamilnadu	Ariyalur	0	3	3	0	1.5	P4
Tamilnadu	Sivaganga	0	3	5	0	2	P4
West Bengal	Bardhaman	0	5	3	0	2	P4
Gujarat	Sunder Nagar	0	3	5	0	2	P4
Gujarat	Kheda	0	0	3	0	0.7	P4
Gujarat	Vadodara	0	0	3	0	0.7	P4
Kerala	Wayand	0	0	5	0	1.3	P4
Kerala	Palakkad	0	0	5	0	1.3	P4
Kerala	Kottayam	0	0	3	0	0.7	P4
Kerala	Idukki	0	3	3	0	1.5	P4
Kerala	Pathanamthitta	0	3	3	0	1.5	P4
Total		25					

Table 17. Proposed cyclone prone districts of India without and actual wind

		Ratings based on						
State	Districts	No. of severe cyclones	Total no. of cyclones	Wind speed	PMSS	Mean rating	Category of Proneness	
AP	Nellore	7	10	10	7	8.5	P1	
AP	East Godavari	5	10	10	7	8.0	P1	
Orissa	Balasore	5	10	7	10	8	P1	
Orissa	Kendrapara	5	10	10	10	8.7	P1	
Orissa	Jagatsinghpur	5	7	10	7	7.1	P1	
West Bengal	South 24-pargana	10	10	10	10	10	P1	
West Bengal	Medinipur	7	10	10	10	9.3	P1	
West Bengal	North 24 Pargana	10	10	10	10	10	P1	
West Bengal	Howrah	10	10	10	7	9.3	P1	
West Bengal	Kolkata	10	10	10	0	7.5	P1	
AP	Srikakulam	5	7	10	5	6.7	P2	
AP	Guntur	3	3	10	10	6.5	P2	
AP	Visakhapatnam	5	5	10	5	6.3	P2	
AP	Krishna	3	5	10	7	6.3	P2	
AP	West Godavari	3	3	10	7	5.7	P2	
AP	Prakasam	3	3	10	7	5.7	P2	
AP	Chittor	7	7	10	0	6	P2	
Daman & Diu	Diu	5	5	7	5	5.5	P2	
Gujarat	Junagadh	5	5	7	5	5.5	P2	
Gujarat	Porbandar	3	3	7	5	5.5	P2	
Orissa	Bhadrak	3	7	7	10	6.7	P2	
Orissa	Ganjam	5	7	10	5	6.7	P2	
Orissa	Puri	3	5	10	5	5.7	P2	
Puduchery	Pudukkottai	3	3	5	10	5.3	P2	
Tamilnadu	Cuddalore	5	5	7	5	5.5	P2	
Tamilnadu	Kanchipuram	7	7	5	5	6	P2	
Tamilnadu	Tiruvarur	3	5	7	7	5.5	P2	
Tamilnadu	Nagappattinam	3	5	7	7	5.5	P2	
Tamilnadu	Chennai	3	3	10	5	5.3	P2	
Tamilnadu	Ramanathapuram	3	3	5	10	5.3	P2	
Tamilnadu	Toothukudi	3	3	5	10	5.3	P2	
Tamilnadu	Tirunelveli	3	3	10	10	5.3	P2	

AP	Vizianagaram	0	3	10	5	4.5	P3
A&N Island	A & N islands	3	3	7	-	4.3	P3
Gujarat	Ahmedabad	0	3	7	-	3.3	P3
Goa	North Goa	3	3	5	7	4.5	P3
Goa	South Goa	3	3	5	7	4.5	P3
Gujarat	Kachchh	3	5	7	5	5	P3
Gujarat	Bhavnagar	3	3	7	7	5	P3
Gujarat	Amreli	3	3	7	5	4.5	P3
Gujarat	Jamnagar	3	3	7	5	4.5	P3
Gujarat	Anand	3	3	7	-	4.3	P3
Gujarat	Navsari	0	3	7	7	4.3	P3
Gujarat	Valsad	0	3	3	7	3.3	P3
Gujarat	Bharuch	0	3	7	-	3.3	P3
Daman & Diu	Daman	3	3	5	7	4.5	P3
Karnataka	Udupi	0	3	3	7	3.3	P3
Karnataka	Uttar Kannada	0	3	3	7	3.3	P3
Karnataka	Dakshin Kannada	0	3	3	7	3.3	P3
Kerala	Kozhikode	3	3	5	7	4.5	P3
Kerala	Malappuram	0	3	3	7	3.3	P3
Kerala	Thrissur	0	3	3	7	3.3	P3
Lakshadweep	Lakshadweep	3	3	7	-	4.3	P3
Maharastra	Thane	3	3	5	7	4.5	P3
Maharastra	Mumbai suburban	3	3	5	7	4.5	P3
Maharastra	Ratnagiri	3	3	5	5	4	P3
Maharastra	Raigarh	0	3	5	7	3.7	P3
Maharastra	Sindhudurg	3	3	5	4	3.7	P3
Orissa	Khordha	0	3	10	5	4.5	P3
Puduchcheri	Karaikal	3	3	7	5	4.5	P3
Tamilnadu	Viluppuram	3	3	7	5	4.5	P3
Tamilnadu	Thanjavur	3	3	7	7	5	P3
Tamilnadu	Tiruvalur	0	3	7	5	3.7	P3
Tamilnadu	Kanyakumari	3	3	3	5	3.5	P3
Orissa	Mayurbhanj	3	7	5	0	3.7	P3
Orissa	Cuttack	3	3	10	0	4	P3
Orissa	Nayagarh	3	5	7	0	3.7	P3
Orissa	Keonjhar	3	10	3	0	4	P3
West Bengal	Hoogli	3	7	7	0	4.3	P3
Gujarat	Rajkot	3	3	7	0	3.3	P3
Dadra	Dadra & Nagar	3	3	5	0	2.7	P4

&Nagar Haveli	Haveli						
Gujarat	Surat	0	3	3	7	2.5	P4
Kerala	Kasargod	0	3	3	5	2.7	P4
Kerala	Kannur	0	3	3	5	2.7	P4
Kerala	Ernakulam	0	3	3	5	2.7	P4
Kerala	Alappuzha	0	3	3	5	2.7	P4
Kerala	Kollam	0	3	3	5	2.7	P4
Kerala	Thiruvananthapuram	0	3	3	5	2.7	P4
Orissa	Jajpur	0	3	7	0	2.5	P4
Orissa	Dhenkanal	0	3	3	0	1.5	P4
Orissa	Gajapati	0	3	10	0	2.5	P4
Tamilnadu	Tiruvannamalai	0	3	5	0	2	P4
Tamilnadu	Ariyalur	0	3	3	0	1.5	P4
Tamilnadu	Sivaganga	0	3	5	0	2	P4
West Bengal	Bardhaman	0	5	3	0	2	P4
Gujarat	Surendra Nagar	0	3	5	0	2	P4
Gujarat	Kheda	0	0	3	0	0.7	P4
Gujarat	Vadodara	0	0	3	0	0.7	P4
Kerala	Wayand	0	0	5	0	1.3	P4
Kerala	Palakkad	0	0	5	0	1.3	P4
Kerala	Kottayam	0	0	3	0	0.7	P4
Kerala	Idukki	0	3	3	0	1.5	P4
Kerala	Pathanamthitta	0	3	3	0	1.5	P4
Total		94					

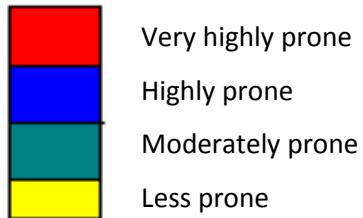
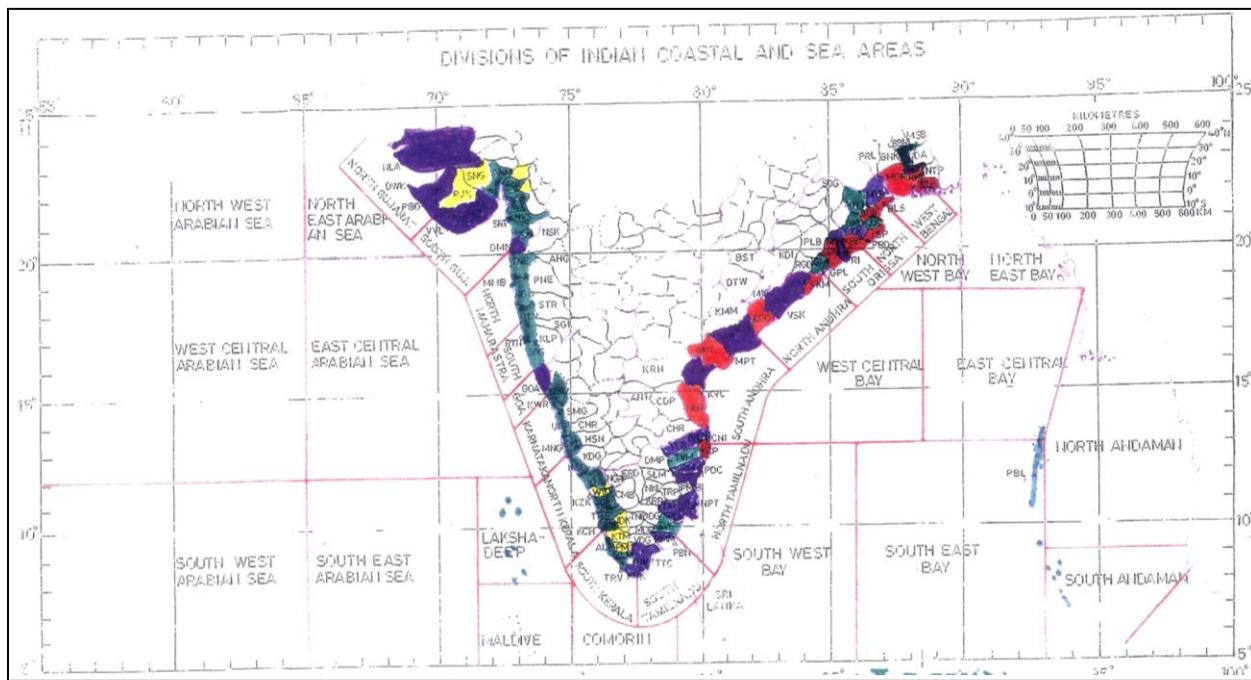


Fig.1. Cyclone hazard prone districts of India considering all the parameters and wind based on BMTPC Atlas

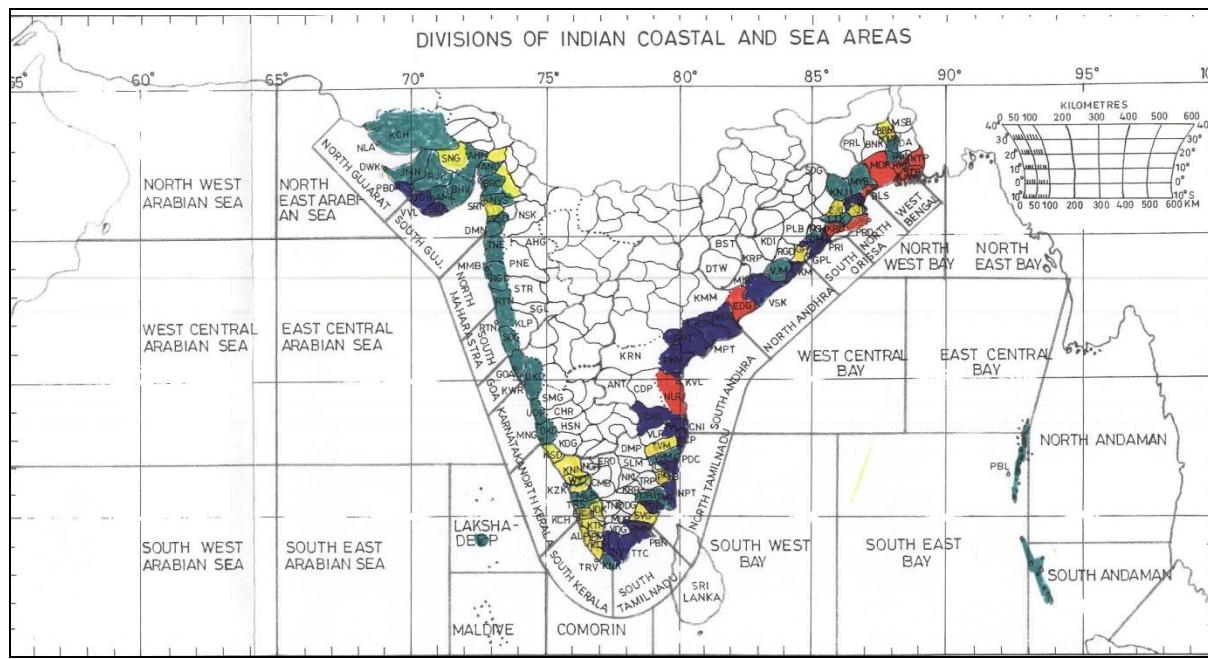


Fig.2. Cyclone hazard prone districts of India based on frequency of total cyclones, total severe cyclones, actual/estimated maximum wind and PMSS associated with the cyclones