



Government of Odisha

MEMORANDUM ON VERY SEVERE CYCLONIC STORM "YAAS"

May 2021



SPECIAL RELIEF COMMISSIONER

Revenue & Disaster Management Department
(Disaster Management)
Government of Odisha

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CHAPTER – I

INTRODUCTION

The geographic location makes Odisha Coastal Zone vulnerable to frequent cyclonic disturbances. The high wind, torrential rain and storm surge associated with the cyclone bring damage to the coastal settlements. Generally, two cyclone seasons i.e., one during pre-monsoon period (April, May & June up to onset of monsoon) and another post monsoon (October to December) occur in Odisha. If the disturbances are grouped in terms of pre and post monsoon season, they are more in the post-monsoon season. The cyclones which had affected Odisha coast normally originated in the sea and dissipated on the land.

During the last decade, the State has faced one or other forms of disasters like flood, cyclone, tornado or drought every year.

Cyclone Occurrences in the recent past

The cyclonic events in the Bay of Bengal which had severe impacts on the Odisha coast in the recent past are given in the Table below:

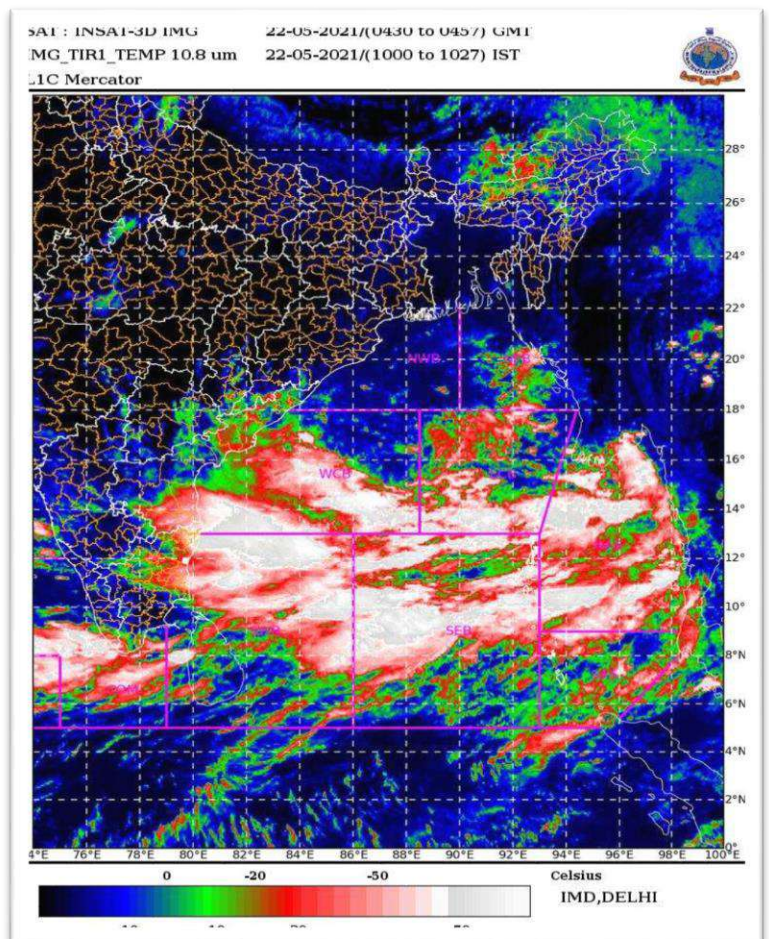
Sl. No.	Date/Year	Category of Cyclone	Landfall place
1	25-31 October, 1999	Super Cyclone	Crossed Odisha Coast near Paradeep at noon of 29 th October
2	12-14 October, 2013	Very Severe Cyclonic Storm 'Phailin'	Crossed Odisha Coast near Gopalpur in the evening of 12 th October
3	12-14 October, 2014	Very Severe Cyclonic Storm 'Hudhud'	Crossed Andhra Pradesh Coast at Vishakapatnam and impacted south Odisha
4	10-12 October, 2018	Very Severe Cyclonic Storm 'Titli'	Crossed Andhra Pradesh Coast at Palasa and severely affected south Odisha
5	3 May, 2019	Extremely Severe Cyclone 'FANI'	Crossed Odisha Coast near Puri
6	8-10 November, 2019	Very Severe Cyclonic Storm 'Bulbul'	Affected the coastal districts of Odisha
7	20 May, 2020	Super Cyclonic Storm "Amphan"	Crossed West Bengal Coasts. Affected the coastal districts of Odisha

CHAPTER –II

CYCLONE TRACKING

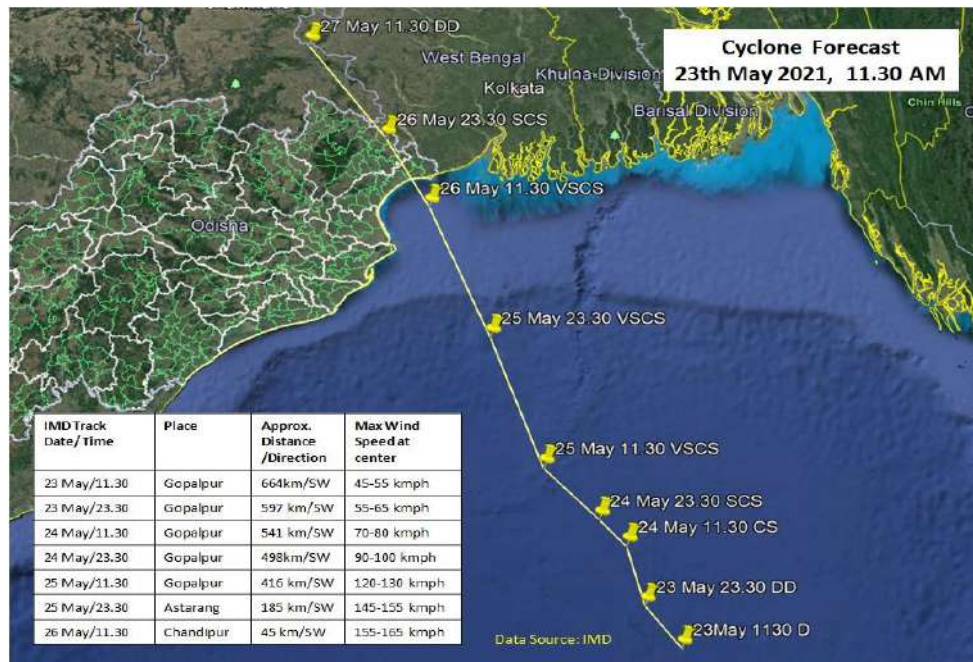
India Meteorological Department (IMD) reported on 20.05.2021 that a low pressure area would very likely to form over north Andaman Sea and adjoining eastcentral Bay of Bengal around 22nd May, 2021. It would very likely to intensify into a Cyclonic Storm by 24th May, 2021. It would move northwestwards and reach near Odisha- West Bengal coasts around 26th May morning. Under this influence, light to moderate rainfall at most places with heavy falls at isolated places would very likely to commence from 25th May over coastal districts of Odisha with significant increase in intensity and also spatial extension subsequently. Squally wind speed reaching 40-50 gusting 60kmph is very likely to prevail over North Bay of Bengal and along and off Odisha – West Bengal coasts from 25th evening and would increase gradually till 26th May, 2021.

On 22.05.2021, IMD informed that a low pressure area formed over eastcentral Bay of Bengal on morning 0830 hrs on the same day. It would very likely to concentrate into a Depression over eastcentral Bay of Bengal by 23rd May morning. It would very likely move north-northwestwards, intensify into a Cyclonic Storm by 24th May and further into a Very Severe Cyclonic Storm during the subsequent 24 hours. It would continue to move north-northwestwards, intensify further and reach North Bay of Bengal near West Bengal and adjoining north Odisha & Bangladesh coasts around 26th May morning. It is very likely to cross West Bengal and adjoining north



Odisha & Bangladesh coasts around evening of 26th May, 2021. IMD issued warning of Heavy to very heavy rainfall for districts of Balasore, Bhadrak, Jajpur, Kendrapada, Jagatsinghpur, Cuttack, Puri, Khordha and Mayurbhanj on 25th May 2021.

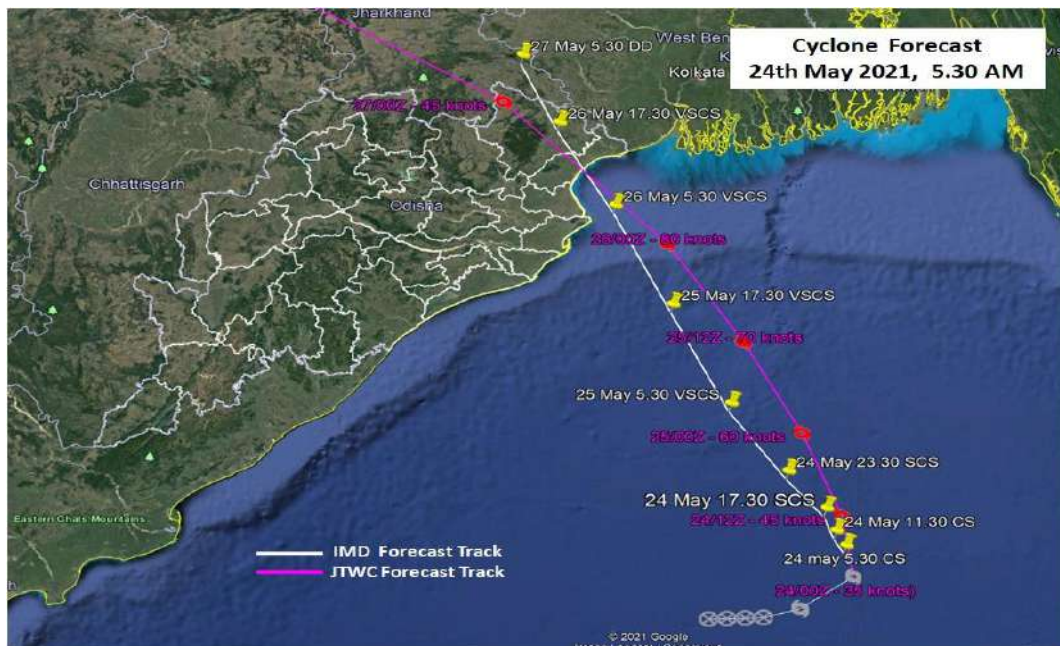
Soon after receiving the meteorological warning, the State Government started closely monitoring the situation. Based on the forecast issued from IMD and other international Agencies like Regional Integrated Multihazard Early Warning Systems (RIMES), Thailand, Joint Typhoon Warning Center (JTWC), USA, the tracking of the system was thoroughly done by the Experts of Odisha State Disaster Management Authority (OSDMA) in GIS platform with regard to possibility of its likely impact over the Odisha.



On 23.5.2021, IMD issued its bulletin saying that the low pressure area which became well-marked over eastcentral Bay of Bengal had concentrated into a Depression over east-central Bay of Bengal and lay centred at 1130 hrs IST of 23rd May, 2021 near latitude 16.1°N and longitude 90.2°E, about 560 km north-northwest of Port Blair (Andaman Islands), 590 km east-southeast of Paradip (Odisha), 690 km south-southeast of Balasore (Odisha) and 670 km south-southeast of Digha (West Bengal). It would very likely to move north-northwestwards and intensify into a Cyclonic Storm by 24th May morning and further into a Very Severe Cyclonic Storm during the subsequent 24 hours. It would continue to move north-northwestwards, intensify further and reach Northwest Bay of Bengal near West Bengal and north Odisha coasts by 26th May morning. It would very likely to cross north Odisha - West Bengal coasts between Paradip and Sagar islands by evening of 26th May as a Very Severe Cyclonic Storm.

As per the Special Bulletin issued by IMD at 8.30 hours 24.05.2021, the Deep Depression over Eastcentral Bay of Bengal remained practically stationary during past 6 hours, intensified into Cyclonic Storm 'Yaas' (pronounced as 'Yass') and located at 0530 hrs IST of today, the 24th May, 2021 over Eastcentral Bay of Bengal near latitude 16.3°N and longitude 89.7°E, about 600 km north-northwest of Port Blair (Andaman Islands), 540 km

south-southeast of Paradip (Odisha), 650 km south-southeast of Balasore (Odisha) and 630 km south-southeast of Digha (West Bengal). It would very likely to move slowly north-northwestwards, intensify further into a Severe Cyclonic Storm during next 24 hours and into a Very Severe Cyclonic Storm during subsequent 24 hours. It would continue to move north-northwestwards, intensify further and reach Northwest Bay of Bengal near north Odisha and West Bengal coasts by 26th May early morning. It would very likely to cross north Odisha-West Bengal coasts between Paradip and Sagar islands around noon of 26th May as a Very Severe Cyclonic Storm.



IMD warned that Light to moderate rainfall would occur at many places with heavy falls at isolated places over south Coastal Odisha on 24th, heavy to very heavy rainfall in the north coastal districts on 25th, heavy to very heavy rains at a few places with extremely heavy falls in Balasore, Bhadrak, Kendrapara, Mayurbhanj and heavy to very heavy falls at a few places in Jagatsinghpur, Cuttack, Jajpur, Keonjhar on 26th May and heavy to very heavy rainfall at isolated places in north interior Odisha on 27th. Isolated heavy to very heavy rainfall would likely over south coastal districts of Odisha during 25th and 26th May. Squally wind speed reaching 40-50 kmph gusting 60 kmph would very likely to prevail over North Bay of Bengal and adjoining west central Bay of Bengal along and off north Andhra Pradesh-Odisha-West Bengal-Bangladesh coasts from 24th afternoon. It would increase gradually becoming 50-60 kmph gusting to 70 kmph from 25th evening. It would further increase becoming gale wind speed 60-70 kmph gusting to 80 kmph from 26th early hours over northwest Bay of Bengal and along and off West Bengal & north Odisha and Bangladesh coasts. It would gradually increase further becoming 90-100 gusting to 110 kmph from 26th

morning and increase thereafter becoming 155-165 kmph gusting to 180 kmph at the time of landfall.

On 25.05.2021 at 2.30 hrs, IMD issued bulleting mentioning that the Cyclonic Storm 'Yaas' over Eastcentral Bay of Bengal moved north-northwestwards with a speed of about 10 kmph during past 6 hours, intensified into a Severe Cyclonic Storm and lay centred at 2330 hrs IST of the 24th May, 2021 over Eastcentral Bay of Bengal near latitude 17.6°N and longitude 89.0°E, about 390 km south-southeast of Paradip (Odisha), 490



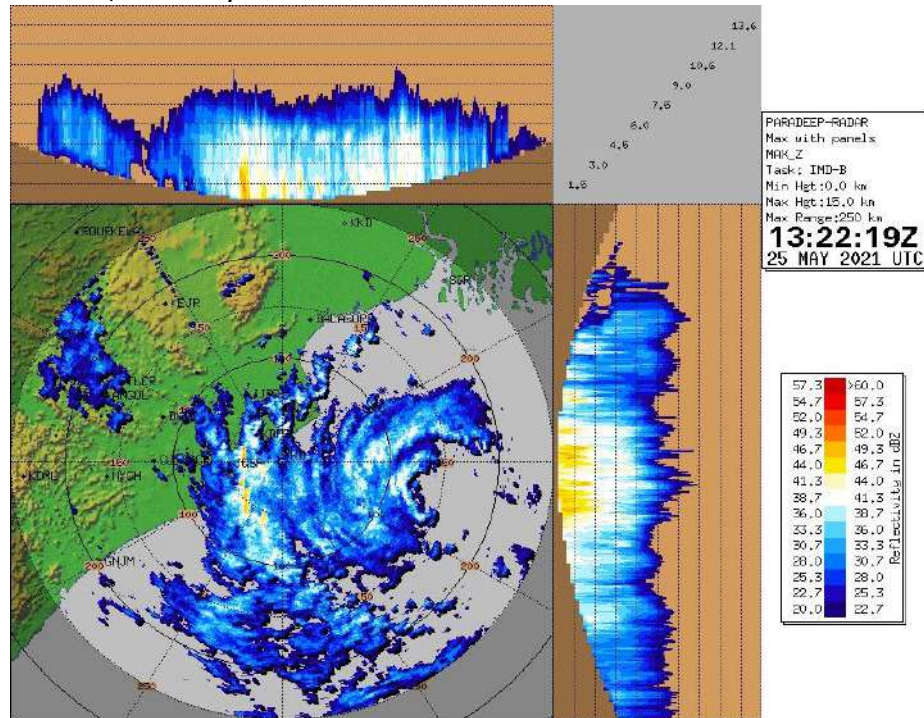
km south-southeast of Balasore (Odisha), 470 km south-southeast of Digha (West Bengal) and 500 kms south-southwest of Khepupara (Bangladesh). It would very likely to move north-northwestwards, intensify further into a Very Severe Cyclonic Storm during next 12 hours. It would continue to move north-northwestwards, intensify further and reach Northwest Bay of Bengal near north Odisha and West Bengal coasts by 26th May early morning. It would very likely to cross north Odisha-West Bengal coasts between Paradip and Sagar Island around Balasore, during noon of 26th May as a Very Severe Cyclonic Storm.

IMD issued red warning with Heavy to very heavy rainfall over the districts of Balasore, Bhadrak, Jajpur, Kendrapada, Jagatsinghpur, Cuttack, Mayurbhanj, Keonjhar and Dhenkanal and Yellow Warning with Heavy rainfall over the districts of Anugul, Deogarh, Khurda, Puri and Sundergarh from 0830 Hrs of 26.05.21 to 0830 Hrs of 27.05.21.



The Severe Cyclonic Storm Yaas over northwest & Bay of Bengal moved north-northwestwards with a speed of about 15 kmph during past 6 hours, and intensified into a Very Severe Cyclonic Storm over northwest Bay of Bengal lay centred at 1730 hrs IST of the 25th May, 2021 over northwest Bay of Bengal near latitude 19.5°N and longitude 88.0°E, about 160 km east-southeast of Paradip (Odisha), 250 km south-southeast of Balasore (Odisha), 240 km south-southeast of Digha (West Bengal) and 230 km south of Sagar Islands (West Bengal). As per the bulletin issued by IMD, cyclone Yaas would very likely to move north-northwestwards, intensify further and reach near north Odisha coast close to

Dhamra port by the early morning of Wednesday, the 26th May. It would very likely to cross north Odisha-West Bengal coasts between Paradip and Sagar Islands close to north of Dhamra and south of Balasore, during noon of



Wednesday, the 26th May as a Very Severe Cyclonic Storm. Red Warning was issued by IMD for Odisha West Bengal coasts.

The Very Severe Cyclonic Storm "Yaas" crossed north Odisha coast around Latitude 21.35°N and Longitude 86.95°E, about 20 km to the south of Balasore as a Very Severe Cyclonic Storm with a maximum sustained wind speed of 130 -140 kmph gusting to 155 kmph between 1030 & 1130 hrs IST of 26th May 2021. It, then, moved northwestwards and entered to the Mayurbhanj district and weakened gradually.

**ODISHA STATE
Cyclone Yaas Track
(May 2021)**



CHAPTER – III

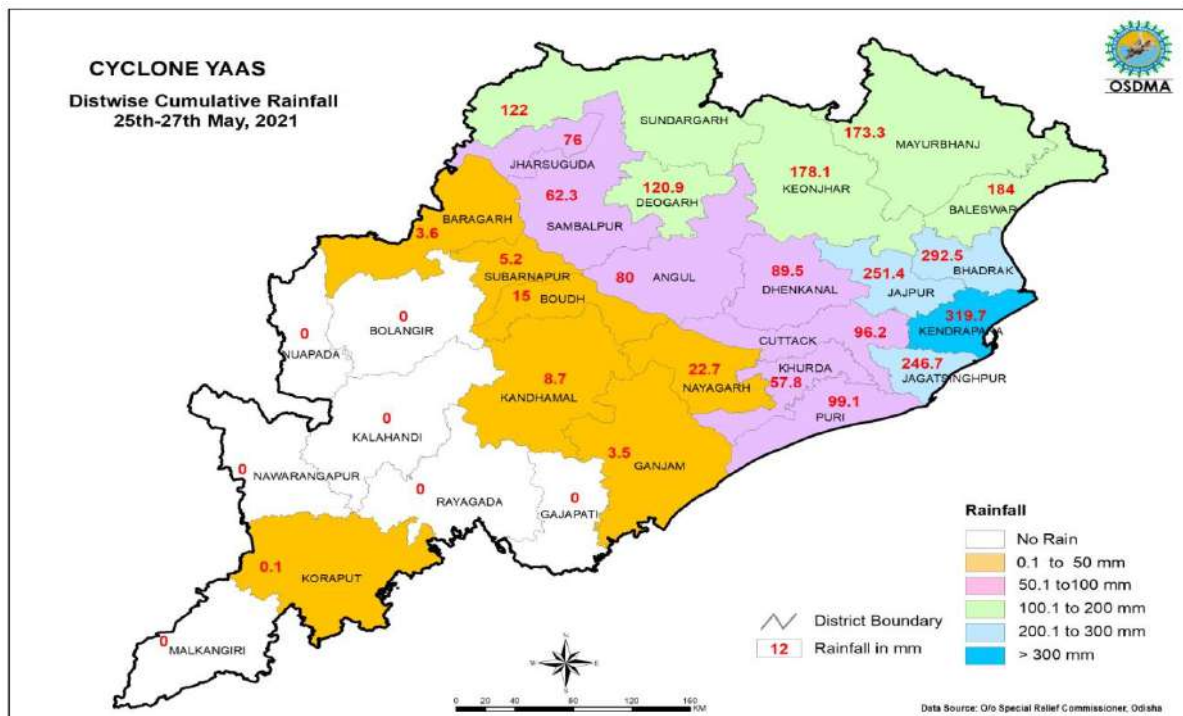
OCCURRENCE & INTENSITY

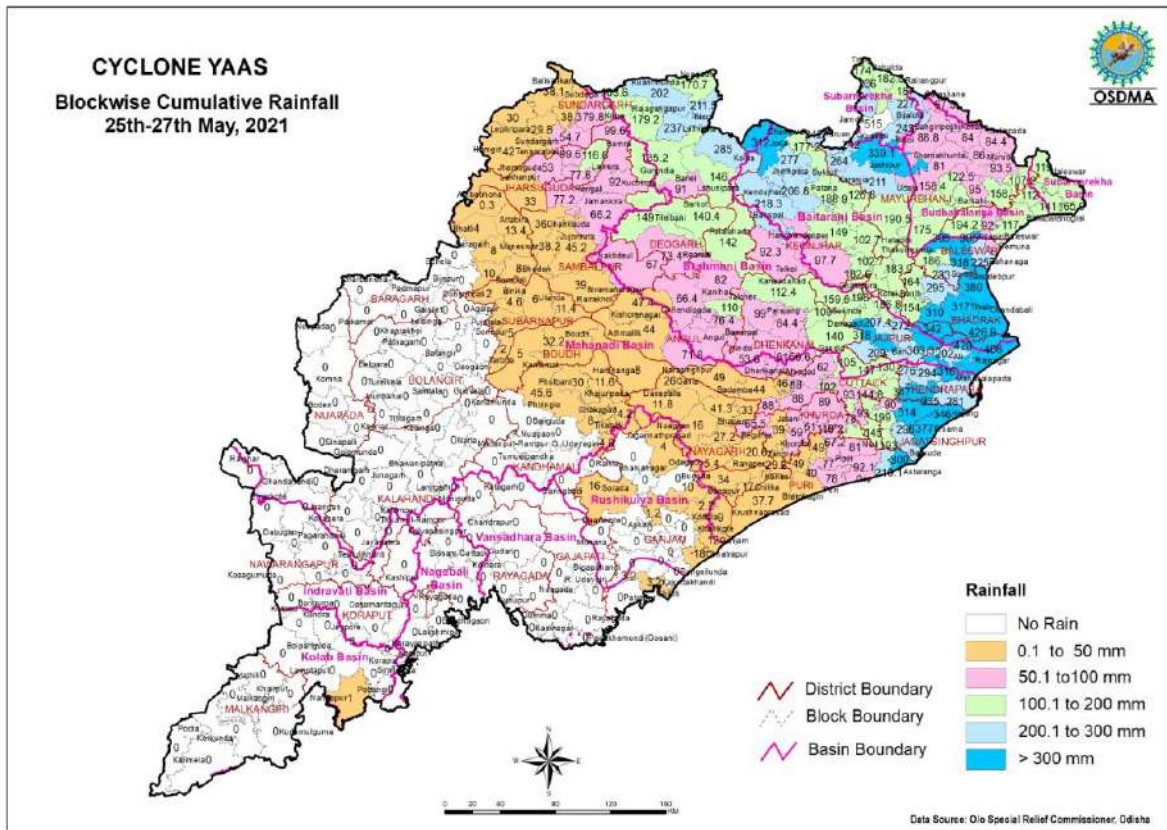
Wind:

Due to the cyclone, wind speed of 130-140 kmph gusting to 155 kmph was prevailing along & off Balasore district on 26.05.2021. Gale wind speed reaching 120-130 kmph gusting 145 kmph prevailed over Jagatsinghpur, Kendrapara, Bhadrak, Balasore districts of Odisha. The wind gradually reduced to 90-100 kmph gusting to 110 kmph from evening of 26th May. Gale wind speed reaching 80-90 kmph gusting 100 kmph prevailed over Jajpur & Mayurbhanj Districts till 26th May afternoon and reduced gradually. Squally wind speed reaching 50-60 kmph gusting to 70 kmph prevailed over Ganjam, Cutack, Khurda Angul, Deogarh, Dhenkanal, Keonjhar & Sundergarh districts of Odisha and reduced gradually.

Rainfall:

Under the impacts of cyclone heavy rain experienced in Balasore, Bhadrak, Kendrapara, Jagatsinghpur, Mayurbhanj & Keonjhar districts.





DISTRICT AVERAGE RAINFALL					
From 25.05.2021 to 27.05.2021					
(Rainfall in mm.)					
Sl. No.	District	25	26	27	Total
1	Kendrapara	70.1	209.7	39.9	319.7
2	Bhadrak	62.3	154.8	75.4	292.5
3	Jajpur	45.6	129.2	76.6	251.4
4	Jagatsinghpur	74.6	159.1	13.0	246.7
5	Balasore	41.7	100.9	41.4	184.0
6	Keonjhar	6.4	44.7	127.0	178.1
7	Mayurbhanj	14.5	62.7	96.1	173.3
8	Sundargarh	0.0	20.7	101.3	122.0
9	Deogarh	0.0	29.1	91.8	120.9
10	Puri	45.2	49.0	4.9	99.1
11	Cuttack	36.3	45.3	14.6	96.2
12	Dhenkanal	13.7	30.0	45.8	89.5
13	Angul	1.4	20.8	57.8	80.0
14	Jharsuguda	0.0	7.7	68.3	76.0
15	Sambalpur	0.0	6.8	55.5	62.3
16	Khordha	33.5	20.9	3.2	57.6

17	Nayagarh	12.3	7.0	3.4	22.7
18	Boudh	0.0	5.9	9.1	15.0
19	Kandhamal	0.0	6.7	2.0	8.7
20	Subarnapur	0.0	2.2	3.0	5.2
21	Ganjam	1.2	2.3	0.0	3.5
22	Bargarh	0.0	0.8	2.0	2.8
23	Koraput	0.0	0.1	0.0	0.1
24	Balangir	0.0	0.0	0.0	0.0
25	Gajapati	0.0	0.0	0.0	0.0
26	Kalahandi	0.0	0.0	0.0	0.0
27	Malkanagiri	0.0	0.0	0.0	0.0
28	Nawarangpur	0.0	0.0	0.0	0.0
29	Nuapada	0.0	0.0	0.0	0.0
30	Rayagada	0.0	0.0	0.0	0.0
State Average		15.3	37.2	31.1	83.6

Block Rainfall:

RAINFALL REPORTS OF DIFFERENT BLOCKS FROM 25.5.2021 TO 27.5.2021(in mm.)						
Sl.	District	Block	25.05.2021	26.05.2021	27.05.2021	Total
Rainfall above 500 mm						
1	Mayurbhanj	Kusumi	0.0	304.0	211.0	515.0
Rainfall between 400 mm and 500 mm						
1	Bhadrak	Chandbali	104.9	288.3	33.7	426.9
2	Kendrapara	Rajnagar	115.0	275.0	30.0	420.0
3		Rajkanika	97.0	251.0	58.0	406.0
Rainfall between 300 mm and 400 mm						
1	Balasore	Soro	59.0	160.0	99.0	318.0
2		Oupada	12.0	95.0	198.0	305.0
3	Bhadrak	Basudevpur	60.0	125.0	195.0	380.0
4		Tihidi	63.0	142.0	112.0	317.0
5		Dhamnagar	90.0	160.0	60.0	310.0
6	Jagatsinghpur	Erasama	88.0	271.0	18.0	377.0
7		Kujanga	110.0	226.0	10.0	346.0
8		Tirtol	92.0	207.0	15.0	314.0
9	Jajpur	Binjharpur	62.0	206.0	95.3	363.3
10		Dasarathpur	82.0	205.0	55.0	342.0
11		Dharmasala	22.0	121.0	175.0	318.0
12	Kendrapara	Garadapur	46.0	245.0	56.0	347.0
13		Marshaghai	64.0	229.0	42.0	335.0

14		Pattamundai	55.0	195.0	66.0	316.0
15	Keonjhar	Joda	0.0	43.4	268.6	312.0
16	Mayurbhanj	Joshiapur	9.2	75.1	254.8	339.1
17	Puri	Astarang	115.0	180.0	14.0	309.0
Rainfall between 200 mm and 300 mm						
1	Balasore	Simulia	48.0	147.0	38.0	233.0
2		Bahanaga	56.0	134.0	35.0	225.0
3	Bhadrak	Bhadrak	63.0	167.0	65.0	295.0
4	Jagatsinghpur	Balikuda	96.0	193.0	7.0	296.0
5	Jajpur	Jajpur	45.0	135.0	92.0	272.0
6		Bari	75.0	140.8	44.5	260.3
7		Badachana	52.0	117.0	40.0	209.0
8		Rasulpur	28.6	110.8	68.0	207.4
9	Kendrapara	Kendrapara	104.0	164.0	26.0	294.0
10		Mohakalpara	52.0	220.0	9.0	281.0
11		Derabis	56.0	185.0	35.0	276.0
12		Aul	42.0	123.0	37.0	202.0
13	Keonjhar	Jhumpura	0.0	64.8	212.2	277.0
14		Banspal	0.0	58.2	160.1	218.3
15		Keonjhar	0.0	28.2	178.6	206.8
16	Mayurbhanj	Sukuruli	0.0	45.0	219.0	264.0
17		Besoi	7.0	70.0	166.0	243.0
18		Raruana	0.0	34.0	208.0	242.0
19		Bijatata	4.0	68.0	155.0	227.0
20		Karanjia	0.0	43.0	168.0	211.0
21		Jamda	0.0	66.0	140.0	206.0
22	Puri	Kakatpur	97.0	110.1	3.0	210.1
23	Sundargarh	Koira	0.0	53.0	232.0	285.0
24		Lathikata	0.0	24.0	213.0	237.0
25		Bisra	0.0	31.5	180.0	211.5
26		Kuarmunda	0.0	32.4	169.6	202.0
Rainfall between 100 mm and 200 mm						
1	Angul	Pallahara	2.0	28.0	112.0	142.0
2		Talcher	0.0	20.0	90.0	110.0
3	Balasore	Nilagiri	53.0	128.0	13.2	194.2
4		Khaira	5.0	128.0	53.0	186.0
5		Bhograi	65.2	86.3	14.4	165.9
6		Baliapal	58.0	61.0	22.0	141.0

7		Jaleswar	36.0	71.0	12.0	119.0
8		Balasore	39.0	74.0	4.0	117.0
9		Basta	38.0	69.0	5.0	112.0
10	Bhadrak	Bonth	25.0	117.0	22.0	164.0
11		Bhandaripokhari	30.0	84.0	40.0	154.0
12	Cuttack	Salepur	73.0	70.0	4.0	147.0
13		Niali	51.0	84.0	10.0	145.0
14		Nischintakoili	46.3	89.3	9.2	144.8
15		Mahanga	38.0	70.0	22.0	130.0
16		Tangi-Choudwar	30.0	60.0	15.0	105.0
17		Barang	34.0	48.0	20.0	102.0
18	Deogarh	Deogarh	0.0	18.0	131.0	149.0
19		Barkote	0.0	27.2	113.2	140.4
20	Dhenkanal	Gondia	21.0	74.0	45.0	140.0
21		Kankadahad	12.2	28.4	71.8	112.4
22		Bhuban	18.0	27.0	64.0	109.0
23	Jagatsinghpur	Jagatsinghpur	49.0	150.0	0.0	199.0
24		Naugaon	99.0	90.0	4.0	193.0
25		Biridi	42.0	84.0	33.0	159.0
26	Jajpur	Danagadi	30.0	96.0	70.0	196.0
27		Korei	29.2	114.4	43.2	186.8
28		Sukinda	30.0	46.4	83.2	159.6
29	Jharsuguda	Laikera	0.0	21.4	95.2	116.6
30	Keonjhar	Patna	2.3	36.8	149.8	188.9
31		Hatadihi	21.1	50.4	112.4	183.9
32		Ghasipura	33.2	87.3	62.1	182.6
33		Champua	0.0	50.0	127.2	177.2
34		Ghatgaon	7.2	38.6	103.2	149.0
35		Saharpada	4.2	23.0	99.6	126.8
36		Anandapur	15.5	40.5	46.7	102.7
37		Khordha	Balipatna	62.0	46.2	8.0
38	Mayurbhanj	Thakurmunda	7.0	43.5	140.0	190.5
39		Rairangapur	0.0	63.0	124.0	187.0
40		Bahalda	0.0	60.0	122.8	182.8
41		Kaptipada	22.0	78.0	75.0	175.0
42		Tiring	0.0	58.4	115.6	174.0
43		Udala	14.6	30.4	113.4	158.4
44		Betanati	82.0	66.0	10.0	158.0

45		Khunta	19.1	82.4	21.0	122.5
46		Gopabandhunagar	19.1	82.4	21.0	122.5
47		Rasgovindapur	38.6	58.6	10.0	107.2
48	Sundargarh	Rajgangpur	0.0	38.6	140.6	179.2
49		Nuagaon	0.0	38.0	132.7	170.7
50		Lahunipara	0.0	44.0	102.0	146.0
51		Gurundia	0.0	22.0	113.2	135.2
52		Kutra	0.0	16.2	87.4	103.6
Rainfall between 50 mm and 100 mm						
1	Angul	Kaniha	0.0	18.0	64.0	82.0
2		Banarpal	5.4	22.6	48.4	76.4
3		Angul	4.0	21.0	46.8	71.8
4		Chhendipada	0.0	15.4	51.0	66.4
5	Balasore	Remuna	31.0	58.0	3.0	92.0
6	Cuttack	Cuttack Sadar	36.0	39.0	18.0	93.0
7		Kantapada	55.0	33.0	5.0	93.0
8		Banki-Dampada	47.0	22.0	19.0	88.0
9		Athagarh	21.0	22.0	19.0	62.0
10	Deogarh	Reamal	0.0	42.2	31.2	73.4
11	Dhenkanal	Parjang	10.0	28.0	61.0	99.0
12		Kamakhyanagar	14.1	19.1	51.2	84.4
13		Odapada	4.0	14.0	43.0	61.0
14		Dhenkanal	19.2	24.2	13.2	56.6
15		Hindol	11.2	25.2	17.2	53.6
16	Jagatsinghpur	Raghunathpur	21.0	52.0	17.0	90.0
17	Jharsuguda	Kirmira	0.0	8.0	91.6	99.6
18		Kolabira	0.0	7.3	70.5	77.8
19		Jharsuguda	0.0	2.0	51.0	53.0
20	Keonjhar	Harichandanpur	0.0	42.2	55.5	97.7
21		Telkoi	0.0	17.2	75.1	92.3
22	Khordha	Bhubaneswar	36.0	42.0	11.0	89.0
23		Balianta	36.0	42.0	0.0	78.0
24		Bolagarh	56.0	8.0	0.0	64.0
25		Khordha	36.0	19.0	4.0	59.0
26		Jatani	28.0	18.0	5.0	51.0
27	Mayurbhanj	Badasahi	41.0	49.0	5.0	95.0
28		Morda	40.0	43.0	10.5	93.5
29		Bangripasi	12.6	38.2	38.0	88.8

30		Baripada	10.0	56.0	20.0	86.0
31		Suliapada	20.0	41.0	23.4	84.4
32		Kuliana	5.0	30.0	49.0	84.0
33		Samakhunta	12.0	22.0	47.0	81.0
34		Sarasakana	14.5	22.0	31.0	67.5
35	Puri	Gop	38.8	38.2	15.1	92.1
36		Nimapara	30.0	47.0	4.0	81.0
37		Puri	51.0	25.0	2.0	78.0
38		Satyabadi	41.0	28.0	8.0	77.0
39		Pipili	34.2	30.0	3.0	67.2
40	Sambalpur	Bamra	0.0	1.2	98.4	99.6
41		Kuchinda	0.0	16.2	75.8	92.0
42		Rengali	0.0	2.2	75.0	77.2
43		Naktideul	0.0	13.0	54.0	67.0
44		Jamankira	0.0	11.6	54.6	66.2
45	Sundargarh	Bonai	0.0	28.0	63.0	91.0
46		Bargaon	0.0	6.2	73.6	79.8
47		Sundargarh	0.0	6.3	48.4	54.7

CHAPTER – IV

PREPAREDNESS MEASURES UNDERTAKEN

Review Meetings:

The State Government in line with the principle of restoring the essential public services in least possible time to minimize hardship to the people took necessary steps well before the cyclone. A host of professionally skilled groups of manpower along with required equipment pertaining to key disaster response sectors like search & rescue/ evacuation, relief line/ tree cutting/ road clearance and energy restoration were prepositioned in strategic locations in the district jointly decided by Collector and SP of the districts to start working for restoration of the respective services immediately after the cyclone subsides. The manpower and equipment were mobilized from the districts which not likely to be affected due to cyclone and deployed in the 4 most vulnerable districts i.e., Balasore, Bhadrak, Kendrapada and Mayurbhanj. This not only gave a high lead time to the District Administration for earliest restoration of the key services but also allowed planning for optimum utilization of the available skilled manpower at different places simultaneously. The detailed deployment of skilled human resources is indicated below:

Co-ordination meetings:

- Hon'ble Chief Minister reviewed the status of preparedness for impending cyclone with Secretaries of line Departments & Collectors on 22.05.2021 through VC.
- Three rounds of preparatory meetings were taken by Chief Secretary and Special Relief Commissioner (SRC) with Collectors of 14 probable districts likely to be affected by the cyclone.
- Preparatory meetings with NDRF, ODRAF, Fire Services, IMD, Indian Coast Guard & Indian Navy undertaken.
- District Administration alerted and guided through elaborate Video Conferencing by Special Relief Commissioner and Chief Secretary.
- Preparedness review meeting with Line Departments by Special Relief Commissioner and Chief Secretary.
- Meeting with Telecom Operators conducted in coordination with E&IT Dept.
- Meeting with OPTCL and Distribution Companies (Discoms) undertaken for power management and quick Restoration.
- SRC physically reviewed the preparedness in Balasore, Bhadrak and Kendrapara districts on 22 & 23 May.

Dissemination of IMD warnings & Bulletins:

- IMD weather Bulletins & cyclone warnings were disseminated to Collectors, Departments and other stake holders at regular intervals.
- Early warning voice messages were disseminated through Alert Siren Systems installed in coastal areas under Early Warning Dissemination System (EWDS).
- District Administration disseminated the warning through official channels and PRI members. Public address systems were used for dissemination at local level.
- Fisheries and ARD Department communicated the warning messages to marine/ Chilika fishermen.
- All cyclone bulletins and warning messages of IMD were disseminated with key State Level Officers, Collectors and Media.
- Community Level Volunteers and Task Force Team members of Multipurpose Cyclone/ Flood Shelters were engaged for ensuring family preparedness, warning dissemination and expediting evacuation.
- Social Media platforms were effectively used not only for dissemination of warnings but also for sending vital information to the general public for safety and survival.

Preparedness of Districts:

1. In view of the formation of a low pressure area over north Andaman Sea and adjoining east-central Bay of Bengal all district administration were instructed to be in readiness for an impending cyclone.
2. On forecast of cyclone by IMD about impending cyclone Collectors of 14 coastal and adjoining districts (Balasore, Bhadrak, Cuttack, Dhenkanal, Gajapati, Ganjam, Jagatsinghpur, Jajpur, Kendrapada, Keonjhar, Khordha, Mayurbhanj, Nayagarh and Puri) were alerted and advised to undertake required preparedness measures to effectively handle the disaster.
3. The district administration of 14 vulnerable districts were directed to keep Multipurpose Cyclone Shelters (MCS)/ Multipurpose Flood Shelters (MFS) in readiness and to identify adequate safe RCC roofed public buildings for use as additional shelters to accommodate evacuees observing COVID-19 protocol.
4. Total 6891 (860 MCS/ MFS and 6031 additional shelters) shelters were identified and kept in readiness with cumulative capacity to accommodate more than 9 lakh people, maintaining social distancing norms, in 14 districts.
5. Three Govt. functionaries were identified for each shelter to coordinate evacuation to their designated shelters.

6. Necessary arrangement was made for food, drinking water, lighting and sanitation facility in each MCS/ MFS and additional shelter in readiness and also instructed to make arrangement for alternate power supply and drinking water arrangement in case of failure of electric supply. Arrangement was also made for hand wash, Sanitizer, Soaps, phenyl, bleaching powder, 3 ply mask etc. in each shelters.
7. It was directed to operate the District Emergency Operation Centres (DEOC) and Control Rooms of other offices round the clock in three shifts under charge of responsible officers with required supporting staff on 24x7 basis.
8. Comprehensive plan was prepared to identify all vulnerable people and to shift them to safe shelters in the event of cyclone. For that purpose, all people living in kutcha houses/ huts or living near the coast or in low lying areas were identified and were evacuated to shelter them in Multipurpose cyclone/ flood shelters and other safe shelters.
9. Detailed vulnerability assessment of the houses having COVID-19 persons in home isolation was made and they were kept in special isolated shelters during cyclone.
10. Special care was taken to shift the old, physically challenged, women and children to shelters much before the cyclone approaches.
11. In vulnerable locations, all pregnant women having their Expected Date of Delivery (EDD) in June 1st week were shifted to the nearest District HQ hospital or sub-divisional hospital having adequate child birth facilities.
12. All ASHA and Anganwadi Workers were kept in readiness to provide required support to the pregnant and lactating women in the cyclone affected areas.
13. Shelters used as TMCs were thoroughly and visibly sanitised not only to ensure prevention of infection but also to gain the psychological confidence of the evacuated people.
14. The livestock and domestic animals vulnerable areas were evacuated to safer places. No cattle left tied in kutcha house.
15. The households, whose houses are damaged in the cyclone / heavy rain and storm surge, were provided with temporary shelter materials (polythene sheet). Necessary dry food like chuda, guda etc. were also provided to the affected people.
16. Satellite phones in each district were kept in readiness with test calls to use those in case the terrestrial communication systems fail. Besides, satellite phone and digital mobile radio communication systems have been established in six coastal districts under the EWDS project were kept in readiness to be used during need.

17. To support failure of power supply during peak period of cyclone, all Govt. Offices/ Institutions were asked to make alternate power back-up arrangement for that period.
18. Mobile health and veterinary teams were organised in advance and kept in readiness for deployment in the affected areas. Feed & fodder was arranged for the animal population.
19. Necessary steps like miking should be taken up to create awareness among people to follow COVID-19 guidelines during evacuation as well as in cyclone/ temporary shelter/ free kitchens.
20. Collectors were requested to take immediate steps to remove all hoardings in ULB areas and roadside hoardings put in rural areas to avoid any casualty/ damage during cyclone.

Identification of Shelters:

- Facility verification check has been conducted in all the Multi Purpose Cyclone and flood shelters in the coastal & adjoining districts.
- Large numbers of alternate shelters were identified to accommodate evacuees observing COVID protocol. Three Govt. officials were identified for each shelter to coordinate evacuation of people to their designated shelters.
- **No. of Shelters identified- 6891 (Cyclone/ flood shelters- 860, Addl. Shelters- 6031)**

Sl.No.	Name of the district	No. of shelters identified
1	Balasore	1240
2	Bhadrak	623
3	Cuttack	1204
4	Dhenkanal	134
5	Gajapati	136
6	Ganjam	1093
7	Jagatsinghpur	223
8	Jajpur	408
9	Kendrapada	520
10	Keonjhar	87
11	Mayurbhanj	425
12	Nayagarh	214
13	Puri	584
Total		6891

Evacuation Plan:

- Evacuation Plan was made for evacuation of people from the vulnerable locations. PRIs and WSHGs were involved in evacuation and Shelter management.
- One 3 ply face mask and sanitizer provided to each evacuee to use it during the entire period of stay in the shelter.
- Collectors of coastal districts were instructed to evacuate the vulnerable people / people living in kutcha houses and shift them to Multipurpose cyclone/ flood shelters and other safe shelters.

Free Kitchen Arrangements

- Cooked food through free kitchen, safe drinking water, lighting with alternate power supply, health & sanitation facilities were arranged for evacuated people at the shelters.

Deployment of Response Forces:

52 teams of NDRF, 60 teams of ODRAF, 206 Fire Service teams and 86 wood cutting teams of Forest & Environment Department (Total- 404 Teams) were pre-positioned in 10 coastal & adjoining districts for search and rescue operation and road clearance.

SI No	Name of the District where deployment was made	NDRF	ODRAF	Fire Services	OFDC	Total Teams
1.	Balasore	9	12	40	23	84
2.	Bhadrak	10	9	20	6	45
3.	Mayurbhanj	7	6	29	5	47
4.	Kendrapada	5	6	15	4	30
5.	Jagatsinghpur	3	3	14	2	22
6.	Jajpur	4	6	15	1	26
7.	Cuttack	-	-	19	2	21
8.	Puri	1	3	12	3	19
9.	Khordha	-	3	13	4	20
10.	Keonjhar	5	3	12	4	24
11.	Dhenkanal	-	-	10	1	11
12.	Angul	-	-	7	1	8
13.	Reserve	8	9	-	30	47
	Grand Total	52	60	206	86	404

Communication:

The Collectors, State Disaster Response Forces and other officers having Satellite Phones were directed to recharge and keep the phones ready for use. The Digital Mobile Radio installed in six coastal districts were also tested and kept ready for use for communication with Collectors, BDOs and others in case the telephone / cell phone networks are down due to cyclone. The V-sat communications at State HQ and in 3 districts (Khordha, Jajpur and Cuttack) were also in readiness.

Arrangements for temporary shelter materials:

Arrangement for providing temporary shelter materials (polythene sheet) was made for the households anticipating damage of houses due to effect of cyclonic wind/ heavy rain.

Other Measures:

- Collectors were instructed to make back-up power arrangement/ generators arrangements with adequate fuel at different utility services like Drinking water supply, petrol pumps, health institutions, telecom facilities, electrical grid/ sub stations, police stations and others.
- Adequate power back up/ stock of essential medicines/ food stuff arranged in all hospitals/Covid Care Centres/ Cluster TMCs/ TMCs.
- Inventory of search and rescue equipment were done by the concerned district administration.
- Collectors were instructed for alternate arrangement of drinking water during and aftermath of the cyclone.
- All the telephone service providers were asked to keep their manpower and equipment in readiness for quick restoration of the telephone lines.
- Go-NGO coordination meeting was taken at district level.

Preparatory Measures taken by Departments:

Engineering Departments like Works, Rural Development, Housing and Urban Development, Energy, Water Resources and Panchayati Raj and Drinking Water (PR&DW) have made arrangement for immediate restoration of damaged infrastructure.

Agriculture:

- Agro based crop advisory, prepared by OUAT and Directorate of Agriculture for protection of matured and harvested paddy as well as non-paddy crops along with other crop protection practices was issued by the A&FE Department for wide circulation among the field functionaries and farmers.
- Crop advisories were disseminated through All India Radio, Community Radio Stations across the state and Door Darshan.

Works Department:

- **154 Quick Reaction Teams** (NHAI-20 teams, CE, NH- 20 teams, CE Roads- 114 teams) were constituted for clearing of roads / immediate restoration of roads for relief line clearance.(Balasore- 24 teams, Bhadrak- 11 teams, Mayurbhanj- 15 teams, Keonjhar- 14 teams, Kendrapara-14 teams, Jagatsinghpur- 11 teams, Jajpur- 14 teams, Khordha-28 teams, Puri-10 teams)
- **Machineries & Equipment in readiness : JCB- 336, Excavator-16, Loader-17, Tipper-95, Dozer-6, Tractor-460, Sand Bag-78880, Proclaim- 4, Truck- 52, Cutter/ Power shaw- 305, Gas cutter- 521, Bullah-11695, Bamboo mat-3652, Roller-50, Generator-82,Water tanker-36, Pump-32, Sand- 6156 cum, Moorum- 1314 cum, Stone aggregates- 2704 cum, Diesel-5626 ltr)**

Rural Development Department:

Executive Engineers of vulnerable districts were instructed to take all precautionary measures with men, machine, roller, etc. in vulnerable locations of different roads, so as to avoid any dislocation in road communication system.

- **313 Quick Response Teams** were in readiness for clearing of roads / immediate restoration of roads for relief line clearance.(Balasore- 49 teams, Bhadrak- 16 teams, Mayurbhanj- 58 teams, Keonjhar- 16 teams, Kendrapara-25 teams, Jagatsinghpur- 11 teams, Jajpur-20 teams, Khordha-18 teams, Puri-24 teams, Cuttack-42, Dhenkanal- 13,Ganjam-21)
- **Machineries & Equipment in readiness : JCB- 369, Tractor- 425, Cutter - 72, Crane- 12)**

Water Resources Department:

- **Machineries & Equipment in readiness : JCB- 201, Excavator- 154,Truck/Tipper-273, Tractor-597, Cutter/ Power shaw- 50, Generator- 67, Water tanker-67, Haiwa- 4)**
- **Flood Fighting Materials in readiness: Sand- 1,18,391 cum, Empty cement bags- 23,78,829 nos., Bamboo- 4500 nos, Bullah- 1844 nos.**
- 24x7 Control rooms in each Division, Circle and CE Office were operationalised.
- Executive Engineers were instructed to keep tree cutting machines available with them.
- Instruction was given to Ex. Engineers to keep readiness of generators with fuel.
- Chief Engineer, drainage was instructed for clearance of weeds, causeways for free flow of water.
- Flood fighting materials were kept in readiness at some strategic locations.
- Close watch was on reservoir level & operation of gates.
- All officers were instructed not to leave HQrs
- Senior level Engineers were deputed to different districts to assist Collectors and field officers.

Drinking water measures:

Urban Water Supply: (Housing & UD Department)

- 285 DG sets, 292 tankers and 1105 PVC tanks were arranged for deployment in the ULB areas of Balasore, Bhadrak, Kendrapada, Jagatsinghpur and Mayurbhanj districts for ensuring uninterrupted water supply.
- H&UD Department is taking steps for de-clogging drainage channels & keep pump sets available for dewatering low lying areas

Rural Water Supply: (PR &DW Department)

- 474 DG sets were kept ready for Rural Pipe Water Supply (PWS) projects for uninterrupted water supply in absence of electricity.
- 395 vehicles loaded with PVC tanks and 486 water tankers were in readiness for use.
- 310 mobile repair units (each comprising of two SEMs) and 173 local electricians were kept ready for taking up repair work on emergency basis.
- 3821 no. of overhead tanks were kept loaded with water.
- 3420 bags of bleaching powder were supplied for disinfection.

District wise Status of TWs & PWS:

SI No	Name of the district	Tube Wells in nos.			Pipe Water Supply in nos.		Disinfection
		No. of Hand pump TW in operational condition	No. of vehicles ready for carrying PVC Water Tank	No. of mobile repairing unit	No. of PWS functional	No. of PVC Tanks	Available Quantity of bleaching powder for disinfection in bags
1.	Balasore	20032	88	42	665	80	255
2.	Bhadrak	18222	36	32	325	70	400
3.	Cuttack	23821	54	25	595	74	206
4.	Jagatsingpur	14331	63	29	302	116	280
5.	Jajpur	17341	24	20	371	69	350
6.	Kendrapara	17038	30	18	314	44	310
7.	Khordha	15878	30	20	496	62	70
8.	Mayurbhanj	30735	31	71	688	32	277
9.	Puri	13663	0	13	361	134	222
Total		171061	356	270	4117	681	2370

District wise status of DG Sets & Water Tankers:

Name of the district	DG Sets in nos.			Water Tankers in nos.				
	HUD	PR & DW	Total	HUD	PR & DW	WR Deptt	Works	Total
Balasore	66	125	191	18	45	3	3	69
Bhadrak	33	40	73	24	5	3	0	32
Kendrapara	39	47	86	23	53	2	0	78
Mayurbhanj	42	56	98	19	107	2	1	129
Jagatsinghpur	35	25	60	19	7	3	0	29
Jajpur	44	40	84	10	37	4	3	54
Puri		21	21	48	136	7	4	195
Cuttack		43	43	57	58	11	0	126
Keonjhar	26		26	23	0	0	2	25
Khordha		28	28	51	14	2	9	76
Total	285	425	710	292	462	37	22	813

District wise Status of PVC Tanks:

Sl. No.	Name of the district	PVC Tanks in Nos.		
		HUD	PR & DW	Total
1	Balasore	110	80	190
2	Bhadrak	92	70	162
3	Kendrapara	63	44	107
4	Mayurbhanj	52	32	84
5	Jagatsinghpur	50	116	166
6	Jajpur	19	69	88
7	Puri	67	134	201
8	Cuttack	166	74	240
9	Keonjhar	160		160
10	Khordha	326	62	388
	Total	1105	681	1786

Energy Department:

- Advance action was taken Odisha Power Transmission Corporation Limited (OPTCL) and Distribution Companies (DISCOMs) for mobilizing technical gangs and materials to take up restoration immediately after the cyclone. Gangs with Gen Sets, gas cutters and vehicles were kept in readiness for immediate deployment.
- As power supply was likely to be shut down before the cyclone, the life line institutions including Government offices were asked to make power back up arrangement (Genset with sufficient fuel).

- 24X7 Control room was set up in OPTCL/ GRIDCO for sharing of information.
- District wise nodal officers were allotted for monitoring the situation.
- Energy Department has been instructed to keep their man and machinery in readiness with stocking of additional poles, wires, transformers.
- No. of manpower deployed- **9,990**
- No. of poles available-26,565
- No. of conductor available-2516.2 km
- No. of Distribution Transformers available – 1126
- No. of cranes /Master poles in readiness- 145
- No. of Aska light available- 2
- No. of Generators in readiness-**158**
- No. of vehicles in readiness- **475**

Name of the district	Manpower deployed (Nos)	Poles (Nos)	Condu-ctors (Kms)	Distributi on Transformers (Nos)	Cranes/ Pole Master (Nos)	Genera-tors (Nos)	Vehicles (Nos)
Balasore	750	2492	45.2	166	11	17	81
Bhadrak	486	1000	20	70	10	10	41
Jajpur	580	500	10	30	16	10	35
Mayurbhanj	137	500	10	30	3	10	41
Keonjhar	89	500	10	30	2	10	39
Kendrapada	2254	6257	660	355	31	26	66
Jagatsinghpur	1571	2856	221	132	21	15	40
Cuttack	2475	7261	977	167	23	35	80
Puri	1648	5199	563	146	28	25	52
Total	9990	26565	2516.2	1126	145	158	475

Telecom:

Meetings were held with all Telecom Service Providers (TSPs) for taking necessary preparedness measures to keep the Telecom/ Internet Service functional during cyclone situation and to restore the communication in case of any damage due to cyclone. The TSPs made necessary arrangements for functioning of all the DG sets with fuel reserve of 24 hours. Movable DG sets were kept ready at central locations for movement.

All the TSPs kept **Cell-on-Wheels** in readiness for deployment in case there is damage to mobile towers in district due to impact of AMPHAN. All the telecom operators

were advised to be ready with adequate numbers of technical manpower for restoration of any affected telecom towers and Optical Fiber Cables (OFC).

Fisheries & ARD Department:

- Fishermen Warnings were issued to Collectors and fishermen were advised not to venture into sea. District Administration along with officials of Fisheries Department was in close coordination with the marine fishermen in the matter.
- Awareness campaign on protection of animal resources from possible cyclone situation was launched in electronic as well as print media.
- Supply of required medicines and vaccines to the CDVOs for distribution to vulnerable areas was expedited.
- People were advised to shelter the cattle and domestic animals at safe places. They were advised to evacuate their cattle to the ground floor of the MCS/ MFS and other suitable buildings in case of necessity.
- All the fishing boats which were in the sea have been brought back to the shore and the boats and boatmen are accounted for. No boat would be allowed to venture in to the sea.
- All fishermen brought back to the shore.
- Fishermen warnings were issued
- 120 Mobile Veterinary Units comprising of one Veterinary Doctor, One Livestock Inspector & one attendant with vehicle and driver were in readiness (one team at each Block level)
- .Required vaccines, essential medicines were prepositioned at veterinary hospitals/ dispensary.
- Buffer stock of medicines was kept at the level of CDVOs.
- 1500 MT of cattle feed was kept in readiness by OMFED.

Sl. No.	District	No. of Health Teams	No. of Medical Relief Centers	No. of Generator Available
1	Balasore	17	56	14
2	Bhadrak	35	43	7
3	Mayurbhanj	63	63	42
4	Keonjhar	55	88	56
5	Kendrapara	19	56	9
6	Jajpur	16	129	13
7	Cuttack	30	55	24
8	Puri	31	83	21
9	Khordha	22	30	12
Total		308	635	215

Women & Child Development Department:

- AWW/ASHA were instructed to take care of Pregnant Women, Children and other vulnerable sections. All pregnant women having EDD in 1st week of June were shifted to the nearby DHH and SDH
- **4510 pregnant women identified** as having their expected date of delivery in 1st week of June.
- **365** nos. of pregnant women were shifted to hospitals.

Health preparedness: (Health & FW Department)

- Mobile health and veterinary teams were kept in readiness at the district level.
- No. of Health Teams mobilized- **308**
- No. of Medical Relief Centers – **635**
- No. of Generators available – **215**
- Essential medicines, ORS packets, Halazone Tablets, Anti Snake Venum injections, PPEs, Triple Layer face masks, bleaching powder made available in District Headquarter Hospitals.
- Mobile health teams were deployed in affected areas.
- Power back up arrangement was made in all hospitals with sufficient quantity of fuel.
- Sufficient stock of essential medicines, anti snake venom was kept.
- Nodal Officers were identified for districts and blocks for continuous monitoring of disaster response activities.
- Contingency plans were made for opening of Medical Relief Centers and providing treatment to the trauma patients at health facilities.
- Contingency plan for sanitation was in place and stocking of bleaching power/ ORS/ Halogen tablets at PHC, CHC, DHHs and up to ASHA level was ensured.

Cancellation of Govt. holidays & leaves of Govt. Employees:

To facilitate unaffected districts and State level offices to provide human resource, material and logistics support to the cyclone affected districts,

- Government holidays were cancelled
- Government officials were instructed to stay in headquarters.
- Leave of all Govt. employees was cancelled till further orders.
- Govt. employees on leave were called back to duty.

Deputation of Senior Officers:

Senior IAS Officers were deputed to Balasore, Bhadrak, Kendrapara, Mayurbhanj and Jagatsinghpur districts to provide guidance and support to the District Administrations in management of the Cyclone.

CHAPTER – V

RESPONSE

1. Relief & Rescue Measures:

Evacuation/ Free Kitchen:

7.02 lakh people were evacuated from vulnerable areas to 8410 shelters. They were provided with dry food, drinking water and free kitchen. Besides this, Chuda, Gud, Biscuits, matchbox and candle were also provided. Hand wash, Sanitizer, Soaps and 3 ply mask were arranged for the people in each shelters for the evacuees. The detail district-wise evacuationstatus is as follows.

Sl. No.	Name of the district	No. of shelters opened	No. of people evacuated
1	Balasore	1745	189983
2	Bhadrak	1270	137720
3	Cuttack	701	39168
4	Jagatsinghpur	305	22437
5	Jajpur	803	42465
6	Kendrapara	974	105802
7	Keonjhar	546	25390
8	Dhenkanal	219	8183
9	Mayurbhanj	1017	100226
10	Puri	536	18425
11	Khordha	199	9747
12	Sundargarh	95	2895
Total		8410	702441

Relief Measures:

- Relief for inundated people announced for 7 days.
- Free kitchen centers opened – 8410 nos.

Emergent Relief Distributed:

Sl. No.	District	Rice in Qtl	Chuda in Qtl	Gur in Qtl	Beneficiary Covered	Polythene Sheets distributed in pcs
1	Balasore		711.37	74.63	189983	2222
2	Bhadrak	29403.33	1387.17	254.10	164638	410
3	Mayurbhanj	459.24	565.10	74.505	100491	2056
4	Keonjhar		205.00	20.5	2030	120
5	Jajpur		206.00	20.6	2115	93
6	Puri		136.29	15.986	18425	0
Total		29862.57	3210.93	460.321	477682	4945

Veterinary Measures:

- 75 Mobile Veterinary Teams deployed
- 37 animal health camps organized
- 1617 animals treated & 5100 animals vaccinated
- 582.25 MT cattle feed (Balasore – 195.25 MT, Bhadrak- 277 MT & Kendrapara- 110 MT) has been distributed.

Drinking Water

Restoration of Rural Water Supply (PR& DW Deptt.):

- No. of Tube Wells Affected: 542
- No. of Pipe Water Supply affected: 2397
- No. of PWS operationalised through Gen Sets: 571
- No. of PWS operationalised through electricity: 495
- No. of Over Head Tank Loaded: 1617
- No. of Water Tanker engaged for supply of drinking water: 346
- No. of Tube Wells disinfected: 1060
- Generator back up provided to all water supply systems.

Restoration of Urban Water Supply (H &UD Dept.):

- PHEO installations are not damaged. Power supply disrupted
- Restoration activities completed and water supply resumed.

Restoration Measures

According to available reports extensive damage has been caused to public properties, mainly roads, river/canal, saline embankments, power supply/water supply installations and telecommunication infrastructure. The concerned departments have been advised to take up restoration work on war-footing with the available funds. The status of restoration works are mentioned below:

Restoration of Electricity (Energy Deptt.):

- District Hqrs & COVID Hospitals - power restored within 8 hours
- Oxygen plants - power restored within 12 hours
- Block Hqrs are restored within 24 hours
- 80% Public Water Works & PHC/CHC are restored within 48 hours.
- All Gram-Panchayats are restored by 1st June

Sl.	Name of the district	Total Consumers	Affected	Restored
1	Balasore	5,28,470	5,28,470	5,27,416
2	Bhadrak	2,97,345	2,97,345	2,93,448
3	Jajpur	3,65,814	3,17,530	3,17,530
4	Mayurbhanj	5,41,362	5,41,362	5,41,072
5	Keonjhar	3,23,426	2,67,033	2,67,033
6	Khurda	6,20,321	81,355	81,355
7	Puri	3,06,192	1,72,592	1,72,592
8	Nayagarh	2,36,486	14,500	14,500
9	Cuttack	5,29,062	62,515	62,515
10	Kendrapada	2,90,136	2,90,136	2,90,136
11	Jagatsinghpur	2,36,716	2,36,716	2,36,716
12	Dhenkanal	2,20,990	1,47,000	1,47,000
13	Angul	2,59,758	70,000	70,000
Grand Total		47,56,078	30,26,554	30,21,313

Restoration of Rural Roads:

- No. of Roads Blocked: 510
- No. of roads cleared: 510

Restoration of PWD /NH Roads:

- 305 roads (PWD- 295, NH- 10) disrupted
- All roads (PWD-295, NH-10) have been cleared.

Aerial Survey by Hon'ble Chief Minister/ Prime Minister:

- Hon'ble Chief Minister made an aerial survey of the affected areas on 27.5.2020.
- Hon'ble Prime Minister took a review meeting with the Hon'ble Governor, Hon'ble Chief Minister and senior officers of the State Govt. on 28.05.2020 at 11.00 AM at Bijupattnaik International Airport about the damages and relief measures taken for cyclone "Yaas" and then visited the cyclone affected Bhadrak and Balasore district by helicopter.

CHAPTER – VI

IMPACT & DAMAGE

The damages caused by the cyclone were mainly due to gusting action of wind and heavy rainfall on 26th&27th May, the water level had risen in the rivers Subarnarekha, Baitarani, Budhabalanga, for which floods occurred in these rivers affecting the downstream areas of the districts & storm surge in 84 coastal villages of Balasore district and 44 villages of Chandbali Block in Bhadrak district.

As per report received from Collectors, 87.42 lakh people in 13541 villages of 125 Blocks and 533 wards of 35 Urban Local Bodies (ULBs) in 11 districts have been affected. Extensive damage have occurred to agriculture/ horticulture crop & livestock/ poultry of farmers, net & boat of fishing communities, equipment, accessories & raw materials/ finished goods of traditional artisans/ weavers. Besides, substantial damage has been caused to public properties.

Extent of Damages

Abstract of extent of damages due to severe cyclonic storm "YAAS" is indicated below;

Sl. No.	Name of the district	Blocks affected	GPs affected	Villages affected	ULBs affected	Wards affected	Population affected (in Lakh)	House damaged	Human lives lost
1	Balasore	12	360	2762	4	68	18.799	3474	1
2	Bhadrak	7	218	1372	4	79	15.060	8404	
3	Cuttack	14	373	1959	4	113	0.360		
4	Dhenkanal	7	72	202	3	19	0.354	46	
5	Jagatsinghpur	8	198	1321	2	40	11.969	1	
6	Jajpur	10	311	1647	2	22	20.000	998	
7	Kendrapara	9	129	1592	2	42	15.230	601	
8	Keonjhar	13	165	1108	5	49	0.475	2283	1
9	Mayurbhanj	26	308	1219	4	61	4.557	2050	1
10	Puri	11	172	263	4	36	0.576	0	
11	Sundargarh	8	76	96	1	4	0.035	237	
Total		125	2382	13541	35	533	87.42	18094	3

House Damage

Total 18094 nos. of house (including 1100 nos. of hut) and 3024 nos. of cow shed attached to house have been damaged due to due to cyclone. The district-wise details are as given in the following table.

Sl. No	Name of the district	Fully damaged		Severely damaged		Partially damaged		No. of hut damaged	Total no. of house damaged including hut	No. of Cow shed damaged
		No. of Pucca house	No. of Kutcha house	No. of Pucca house	No. of Kutcha house	No. of Pucca house	No. of Kutcha house			
1	Balasore		5		33	115	2974	347	3474	242
2	Bhadrak		12		8	7	8152	225	8404	1554
4	Dhenkanal				3	1	42		46	
5	Jagatsinghpur						1		1	
6	Jajpur				4	9	682	303	998	501
7	Kendrapara				0	1	541	59	601	239
8	Keonjhar		8		26	49	2199	1	2283	310
10	Mayurbhanj	2	9	2	49	49	1774	165	2050	172
12	Sundargarh		4		16	4	213		237	6
Total		2	38	2	139	235	16578	1100	18094	3024

Agriculture/ horticulture crop Loss (SMF):

2197.34 hectares of agriculture, horticulture and perennial crops have sustained crop-loss to the extent of 33% and above due to cyclone associated with flood/ heavy rain and storm surge out of total affected agriculture/ horticulture crop of 5672.99 hectares. The district-wise details is as given bellow.

Sl. No.	Name of the district	Total agriculture/ horticulture crop area affected (area in Ha.)	Total area under crop loss of 33% & above (area in Ha.)			
			Rainfed	Irrigated	Perennial	Total
1	Balasore	510.00	5.60	98.27	19.66	123.53
2	Bhadrak	1319.00	269.60	615.60	1.50	886.70
3	Jagatsinghpur	39.50	0.00	8.96	0.00	8.96
4	Jajpur	1768.00	154.50	339.50	0.00	494.00
5	Kendrapara	277.00	36.00	185.00	9.92	230.92
6	Keonjhar	646.91	41.60	165.47	0.60	207.67
7	Mayurbhanj	1020.89	11.11	146.17	0.60	157.88
8	Puri	7.00	0.00	3.00	0.00	3.00
9	Sundargarh	84.69	0.00	84.69	0.00	84.69
Total		5672.99	518.41	1646.66	32.28	2197.34

Livestock affected

1358578 livestock and 1115810 poultry birds were affected due to cyclone & heavy rain/ flood and storm surge. The district-wise figures of affected livestock are given in following table.

Sl. No.	Name of the district	Livestock affected			Poultry affected
		Large	Small	Total	
1	Balasore	220656	103986	324642	234213
2	Bhadrak	419116	95221	514337	653450
3	Cuttack	1	0	1	0
4	Jajpur	80186	15433	95619	8717
5	Kendrapara	294600	110906	405506	216890
6	Keonjhar	3463	4214	7677	392
7	Mayurbhanj	4339	6457	10796	2148
Total		1022361	336217	1358578	1115810

Livestock Lost:

72milch and draught animals and 28502 poultry birds have lost their lives due to cyclone. The district-wise details in as given in following table.

Sl. No.	Name of the district	No of Livestock/ Birds lost					Total nos. of livestock lost including poultry birds
		Milch Animal		Draught Animal		Poultry Birds	
		Buffalo/ Cow	Sheep/ Goat	Camel/ Horse/ Bullock	Calf/ Donkey/ Pony		
1	Balasore	3	5		5	24426	24439
2	Bhadrak	12	3		9	3816	3840
3	Jajpur	2	2		2		6
4	Kendrapara	16	3		2	260	281
5	Keonjhar	3			2		5
6	Mayurbhanj	2	1				3
Total		38	14	0	20	28502	28574

Fisheries Sector affected:

40 nos. of boat and 14 nos. of net have been fully/ partially damaged due to cyclone and consequent heavy rain/ flood and storm surge. Similarly, 1257.72 hectares of fish pond and 333.734 hectares of fish seed farm have been affected in the calamity. The district-wise detail is as in following table.

Sl. No.	Name of the district	Boat damaged		Net damaged		Fish pond damaged		Fish Seed farm damaged	
		No. fully damaged	No. partially damaged	No. fully damaged	No. partially damaged	No.	Area in hectares	No.	Area in hectares
1	Balasore	18	11			510	137.39	1074	308.77
2	Bhadrak		5			1876	781.93	5	2.40
3	Jajpur					27	8.8	0	0

4	Kendrapara					1001	328.00	50	21.00
5	Mayurbhanj	3	2	11	3	9	1.6	8	1.564
6	Sundargarh	1							
Total		22	18	11	3	3423	1257.72	1137	333.734

Loss of livelihood of handloom weavers and handicraft artisans:

In the cyclone, 5022 traditional handicraft artisans and 48 handloom weavers have been affected due to damage to their equipments and raw materials/ finished goods. The district-wise details as given in following table.

SI No	Name of the district	No. of handicraft artisans affected	No. of handloom Weavers affected
1	Balasore	3542	16
2	Bhadrak	858	26
3	Keonjhar	302	0
4	Mayurbhanj	320	6
Total		5022	48

Damage to roads with breaches:

730.62 kms. of PWD roads including breaches, 625.65 kms. of rural roads, 49.79 kms. of urban roads, 625.65 kms. of GP/ PS roads and 56.72 kms. of NH maintained by state have been damaged due to the cyclone. The district-wise abstract is as in following table.

SI. No.	Name of the district	PWD road	Rural road	Urban road	GP/ PS road	NH maintained by state	Total length of road with breaches
		Kms.	Kms.	Kms.	Kms.	Kms.	Kms.
1	Balasore	203.79	429.54	8.33	4749.56		5391.22
2	Bhadrak	112.92	130.05	27.21	4336.02	8.51	4614.71
3	Cuttack			3.90			3.90
4	Dhenkanal	36.85		2.25			39.10
5	Jagatsinghpur					15.20	15.20
6	Jajpur	131.28		1.00	1342.67	10.10	1485.05
7	Kendrapada	112.07	34.79		790.18	8.17	945.21
8	Keonjhar	14.00	19.77	1.55	279.97	6.48	321.77
10	Mayurbhyanj	119.72	11.50	5.50	280.00	5.00	421.72
11	Puri					3.26	3.26
Total		730.62	625.65	49.74	11778.41	56.72	13241.14

Damage to public buildings:

4 nos. of PHC/ CHCs, 1002 nos. of Anganwadi Centers (AWCs), 684 nos. of GP/ PS building, and 2377 nos. of primary/ secondary buildings have been damaged due to the cyclone. The district/ department-wise details is as follows.

Sl. No.	Name of the district	PHC/ CHC	AWC	GP/ PS buildings	Primary/ Secondary School			
			PR & DW dept.	PR & DW dept.	H & UD dept.	Works dept.	Total	
1	Balasore	1	128	178	629	7	16	652
2	Bhadrak		313	322	448	7	2	457
3	Dhenkanal			1	31			31
4	Jagatsinghpur						4	4
5	Jajpur	1	172	146	363		3	366
6	Kendrapada		173	0	552		5	557
7	Keonjhar	1	51	21	90	1	1	92
8	Mayurbhanj	1	165	16	208		10	218
Total		4	1002	684	2321	15	41	2377

Irrigation Sector damaged:

443.38 Kms. of River/ saline embankment(including breaches) have been fully/ partially damaged due to cyclone. 133.47kms. of canal, 25.26 kms. of drainage channel, 797 nos. of Lift Irrigation Projects and 10.95 kms. of roads in minor irrigation projects have been damaged due to the calamity. The district-wise details are as follows.

Sl. No.	Name of the district	River/ Saline embankment	Restoration of Canals		Drainage Channel	LIP	Minor Irrigation Project damaged	
		Length of embankment fully/ partially damaged with breaches in Kms.	No. of canals partially damaged	Length of canals partially damaged	Length of road/ drainage channel damaged in Km	No. of Lift Irrigation Project damaged	Length of road damaged in MIP in Km	No. of CD Bridges damaged in MIPs
1	Balasore	245.63	45	49.57	5.70	83	0.22	6
2	Bhadrak	62.65	58	44.39	19.56	34	0.03	1
3	Jajpur	0.02					0.45	11
4	Kendrapara	135.08	13	39.51		72		
5	Keonjhar					386	0.35	25
6	Mayurbhanj					175	9.89	7
7	Sundargarh					47		
Total		443.38	116	133.47	25.26	797	10.95	50

Electric infrastructure damaged:

3 nos. of feeder transformer, 29259 nos. of poles, 23305 kms.ofconductors and 1975 nos. of distribution transformer have been damaged due to cyclone.

Sl. No.	Name of the item	TPNODL	TPCODL	TPWODL	TPSODL	DISCOM Total
1	Feeder Transformer damaged (Nos.)	3				3
2	33 KV Poles damaged (Nos.)	1054	23			1077
3	33 KV conductor damaged (Nos.)	1338	42			1380
5	11 KV Poles damaged (Nos.)	8204	2169	309	7	10689

6	11 KV conductor damaged (Nos.)	10037	813	141	2	10993
7	Distribution Transformer damaged (Nos.)	1528	310	131	6	1975
8	LT line poles damaged (Nos.)	14192	3040	247	14	17493
9	LT line conductor damaged (kms.)	8814	1804	312	2	10932

Drinking Water System (DWS) damaged:

845 nos. of rural drinking water system and 18 nos. of urban drinking water system have been damaged due to the cyclone. The district-wise details are given in following table.

Sl. No.	Name of the district	Nos. of rural DWS damaged	No. of urban DWS damaged
1	Balasore	137	18
2	Bhadrak	523	
3	Kendrapara	47	
4	Mayurbhanj	103	
5	Puri	35	
Total		845	18

Damage to Public Properties & Pure Relief Items

Loss to public properties and requirement of fund for relief measures on account of Super Cyclonic Storm "YAAS"-2021			
Sl. No.	Departments/ Items	Quantity	Actual Loss
			<i>(Rs. in Lakh)</i>
1	Commerce & Transport Department		
	Damage to Infrastructure of State Transport Authority		2.01
	Damage to Infrastructure of State Transport Authority		299.86
	Damage to infrastructure of Directorate of Printing , Stationary & Publication		15.00
	Total		
2	Cooperation Department		
	Damage to infrastructure of Cooperative Societies	92 Nos.	228.58
	Damage to Govt. office building	1 No.	3.00
	Other infrastructure damaged	35 Nos	19.62
	Total		
3	Energy Department		
	Damage to Transmission Line of OPTCL		67.70
	Feeder Transformer damaged	3 Nos.	205.00
	33kv pole damaged	1077 Nos.	43.00
	33kv conductor damaged	1380 Kms.	690.00
	33kv VCB damaged	5 Nos.	30.00
	11kv poles damaged	10689 Nos.	427.00
	11kv conductor damaged	10993 Kms.	5497.00
	11kv VCB damaged	9 Nos.	30.00
	Distribution Transformer damaged	1975 Nos.	1975.00
	LT line pole damaged	17493 Nos.	700.00
	LT line conductor damaged	10932 Nos.	5466.00
	Minor material damaged		64.00
	Civil Works		96.00
	Erection Charges		365.00
	Total		
4	Electronics & Information Technology Department		
	ADSS Fiber 48F damaged	2.5 kms	5.61
	ADSS Fiber 24F damaged	32.73 Kms	65.04
	8 mter PSC pole damaged	51 Nos.	5.24
	Total		

5	Fisheries & Animal Resources Department		
	Damage to Infrastructure of ARD Sector		193.10
	Damage to Infrastructure of Fisheries Sector		263.54
	Total		456.64
6	Forest & Environment Department		
	Damage to road/ CDs/ Bridges/ Embankment/ Inspection Path		101.28
	Loss to trees/ wildlife/ Eco-Tourism facilities/ Plantation/ Nurseries/ Water bodies		239.26
	Total		340.54
7	Housing & Urban Development Department		
	Road damaged	212 Nos./49.74	951.88
	Culvert/ Bridge damaged/ washed away	28 Nos.	202.20
	Drain damaged	63 Nos./ 8.92 Kms.	570.70
	Clearance of debris from road/ public area		14.40
	Hiring of DG Sets for emergent supply of drinking water	928 Nos.	315.82
	Hiring of Water Tanker	469 Nos.	40.18
	Drainage of flood water		8.95
	Chlorination, cost of chemical etc.		11.91
	Engagement of Labour		22.38
	Other Expenditure		325.69
	Tube well damaged	18 Nos.	2.50
	Street Lights damaged	232 Nos.	42.62
	Primary/ Secondary School Building damaged	15 Nos.	81.80
	Govt. Office/ establishment damaged	23 Nos.	150.00
	Battery Operated Vehicle damaged	1 Nos.	1.50
	Total		2742.53
8	MSME Department		
	Damage to infrastructure	52 Nos.	66.81
	Damage to plant & Machinery	20 Nos.	28.41
	Total		95.22
9	Panchayati Raj & DW Department		
	Anganwadi Center damaged	1002 Nos.	1532.78
	Primary School Building damaged	2321 Nos.	3912.15
	GP/ PS Building & Community Hall damaged	684 Nos.	1202.3
	GP/ PS road damaged	11778.41 Kms.	16686.55
	Damage to drinking water systems/ PWS systems	845 Nos.	683.32
	Emergent supply of drinking water in rural area		473.63
	Total		24490.73

10	Rural Development Department		
	Damage to rural roads including breaches	509 Nos./ 623.07 kms.	4744.34
	Breaches in rural roads	98 Nos./ 2.56 Kms.	
	CD/ Bridges damaged/ washed away	230 Nos.	3110.10
	Drain damaged	9 Noss./ 3.47 Kms.	88.00
	Residential building damaged	20 Nos.	296.50
	Other Hospital building damaged (Res. & non-res.)	2 Nos.	9.00
	RD Dept. building damaged	15 Nos.	75.00
	Revenue Dept. building damaged	24 Nos.	91.50
	Home Dept. building damaged	9 Nos.	35.50
	Debris cleared on roads/ public area		55.76
	Hiring of DG Set.		0.35
	Engagement of Labour		1.46
	Other Expenditure		82.71
	Total		8590.22
11	School & Mass Education Department		
	Damage to infrastructure of Elementary & Secondary School	2267 Nos.	3154.055
	Books damaged	1583 Nos.	0.284
	Total		3154.34
12	Water Resources Department		
	Breaches in river/ saline embankment	126 Nos./ 6.80 Kms.	2808.60
	Partial damage in river/ saline embankment	140 Nos./ 436.58 Kms.	6764.06
	Partial damage to canals	116 Nos./ 133.47 Kms.	756.84
	Damage in drainage Channel	25.26 Kms.	293.50
	Cost towards drainage clearance	454.08 Kms.	472.18
	Damage to Lift Irrigation Projects	797 Nos.	362.23
	Damage to roads/ embankment with breaches of MI sector	127 braches/10.945Kms	691.50
	Damage to CD/ bridges of MI sector	50 Nos.	120.00
		Total	
13	Works Department		
	Damage to PWD Roads	254 Nos./ 730.62 Kms.	4918.05
	Damage to CD/ Bridges	68 Nos.	716.00
	Breaches on PWD road	23 Nos./182 mtr.	26.30
	Damage to secondary School Buildings	41 Nos.	107.70

	Damage to CHC	4 Nos.	14.00
	Damage of hospital buildings other than PHC & CHC	24 Nos.	158.50
	Damage to Govt. offices	105 Nos.	174.60
	Damage to Govt. Qtrs./ Ibs/ Guest Houses etc.	99 Nos.	151.70
	Damage to NHs maintained by State	10 Nos./ 63.22 Kms.	69.12
	Damaged to drain	13 Nos./ 2.85 Kms.	255.00
	Debris cleared on roads/ public area	525.29 Kms.	182.56
	Hiring of DG Sets	28 Nos.	35.30
	Engagement of Labour		0.32
	Other Expenditure		2.43
	Cost of preparedness such as Mobilization of QRT		130.00
	Total		6941.58
14	Women & Child Development Department		
		103 Nos.	103.27
	Total (Public Properties)		75483.64
15	Pure Relief Items		
	Ex-gratia for loss of lives	3 Nos.	12.000
	House building assistance	18094 house+3024 cowshed	823.451
	Assistance for Clothing & Utensils	1281 no. households	48.678
	Gratuitous Relief		3000.000
	Cost of evacuation, search & rescue measure		148.420
	Expenditure on relief camps		1597.220
	Temporary Shelter	13046 Nos.	208.736
	Agriculture input subsidy-SMF	5672.99 has.	263.360
	Replacement of milch/ draught animals & poultry birds	72 Nos. + 28502 Nos	16.680
	Assistance to fisherman for repair/ replacement net & boat	Net-14 nos., Boat-40 nos.	3.199
	Assistance for damaged fish pond	1257.72 ha.	153.442
	Input subsidy for fish seed farm	333.734 ha.	27.366
	Cost of Cattle feed		148.760
	Assistance for handicraft artisans	5022 artisans	411.804
	Assistance for handloom weavers	48 weavers	1.968
			6865.084
	Grand Total		82348.724

CHAPTER – VII

Amount released/to be released from SDRF for Relief & Immediate Repair/ Restoration of Infrastructure damaged due to cyclone "YAAS"

Sl. No.	Item	Amount required
		(Rs. in lakh)
1	Ex-gratia for loss of lives	12.000
2	House building assistance	823.451
3	Assistance for Clothing & Utensils	11.058
4	Gratuitous Relief	1437.651
5	Cost of evacuation, search & rescue measure	99.079
6	Expenditure on relief camps	1597.220
7	Temporary Shelter	208.736
8	Agriculture input subsidy-SMF	263.360
9	Replacement of milch/ draught animals	16.684
10	Assistance to fisherman for repair/ replacement of net & boat	3.199
11	Assistance for repair/ restoration of fish pond	153.442
12	Input subsidy for fish seed farm	27.366
13	Assistance for damaged tools & equipment of handicraft artisans	205.902
14	Assistance for loss of raw materials/ finished goods of handicraft artisans	205.902
15	Assistance for loss of raw materials/ finished goods of handloom weavers	1.968
16	Cost of Cattle feed	148.760
17	Repair of river & saline embankment	916.370
18	Repair of Canals	274.670
19	Repair of drainage channel	51.730
20	Repair of Minor Irrigation Projects	98.170
21	Repair of Lift Irrigation Projects	1195.500
22	Emergent supply of drinking water in urban area	356.000
23	Emergent supply of drinking water in rural area	473.630
24	Repair/ restoration of rural drinking water supply systems	683.320
25	Repair/ restoration of urban drinking water supply systems (Tube wells)	2.500
26	Repair of GP/PS roads	16686.550

27	Repair of Anganwadi Centers	1532.780
28	Repair of GP/PS buildings & community assets	1202.300
29	Repair of Primary School Buildings	3912.150
30	Repair of Rural roads & breaches	1295.540
31	Repair of CD/ Bridges on rural roads	2303.050
32	Repair of PWD roads & breaches	1857.990
33	Repair of CD/ Bridges on PWD roads	425.500
34	Repair of NH maintained by State	61.920
35	Repair of roads in urban area	99.970
36	Repair of CD/ bridges on rurban roads	154.000
37	Repair of Secondary School buildings	82.000
38	Repair of Community Health Centers	8.000
39	Repair of School Building in urban area	30.000
40	Repair of Street Light in Urban area	42.620
41	Drainage of flood water	8.950
42	Chlorination, cost of Chemical etc.	11.910
43	Clearance of debris from drainage/ roads/ public places	691.900
44	Hiring of DG Sets	35.650
45	Engagement of Labour	24.160
46	Other Expenditure	410.830
47	Restoration of Power supply	14064.780
	Grand Total	54210.218

CHAPTER – VIII

CONCLUSION

Severe damage to private and public properties has occurred in some districts due to Very Severe Cyclone "YAAS" & consequent flood/ heavy rain and storm surge.

The requirement of financial assistance is to be appreciated for strengthening mitigation measures in the context of regular natural calamities occurring almost every year. The coastal Odisha is frequently affected by cyclonic disturbances originating from the Bay of Bengal which is adversely affecting the livelihood of the people and burdening the State with huge cost for restoration of the damaged infrastructure.

With a view to strengthening the disaster preparedness of the State, Hon'ble Chief Minister had requested Hon'ble Prime Minister to assist the State in building a robust disaster resilient power infrastructure and storm surge protection in the long term. Central assistance for long term rehabilitation and re-construction like resilient power infrastructure in view of frequent natural disasters & strengthening of saline embankments in coastal areas to withstand storm surge would be the focus area of intervention.

Considering the financial burden on Government of India for COVID-19 management across the Country, the State Government does not seek any support under NDRF for response (relief, restoration, rehabilitation) activities of very severe cyclonic storm "YAAS". Government of Odisha would manage the expenditure on such heads from its own sources. Government of India may consider providing funds under mitigation head for creation of disaster resilient infrastructure to reduce loss due to frequent occurrence of disasters .

CHAPTER- IX

State Disaster Risk Management Fund

Status of Receipt and Expenditure from State Disaster Risk Management Fund

(As on 25.06.2021)

Year – 2021-22

State – Odisha

(Rs. in crore)

Sl. No.	Item	Amount
	(I) Receipts	
1	Opening balance in SDRMF account as on 1.4.2021 (Provisional figures)	1198.300
	SDRMF Releases made during instant financial year (Central and State share)	
	(a) First installment (SDRMF)	
2	(i) Central share	641.600
	(ii) State share	213.860
	(b) Total (i + ii)	855.460
3	NDRMF releases during the instant financial year, if any	0.000
4	Interest received on investments made	0.000
5	Total funds available in the SDRF account(1+2+3+4)	2048.760
	(II) Expenditure	
	Expenditure incurred as per norms on approved natural calamities as per the scheme of SDRMF/NDRMF(indicate calamity-wise expenditure)	
	(a) Cyclone	14.295
	(b) Flood	4.004
6	(c) Fire	3.578
	(d) Hailstorm	0.076
	(e) State Specific disasters	20.596
	(f) Expenditure incurred on Capacity building activities	16.957
	(g) Expenditure towards combating COVID-19 outbreak	553.73
7	Expenditure incurred on Cyclone "YAAS" during 2021-22	497.276
8	Total expenditure incurred (a+ b+ c+ d+ e+ f + g + (7))	1110.512
9	Balance available in the SDRMF account of the instant calamity (5-7)	938.248

CHAPTER-X

Appendix-II

Extent of damage due to Very Severe Cyclone "YAAS"

State-Odisha

Sl. No.	Item	Total
1	Total number of districts in the State	30
2	Number and names of districts affected	11 (Balasore, Bhadrak, Cuttack, Dhenkanal, Jagatsinghpur, Jajpur, Kendrapara, Keonjhar, Mayurbhanj, Puri & Sundargarh)
3	Total number of Blocks in the districts	
4	Number and names of Blocks affected	135
5	Number of villages affected	13551
6	Population affected (in lakh)	86.91
7	Total land area affected (in lakh ha.)	
8	Cropped area affected (in lakh ha)	
	i) Total cropped area affected	5626.91Ha.
	ii) Estimated loss to crops (Rs. in lakh)	
	iii) Area where cropped damage was more than 33%	2197.35 Ha.
9	Percentage of area held by SMF	
	i) In the State as a whole	
	ii) In the affected districts	
10	House damaged	
	a) No. of houses damaged (including hut)	18094
	i) Fully damaged pucca houses	2
	ii) Fully damaged kutch houses	38
	iii) Severely damaged pucca houses	2
	iv) Severely damaged kutch houses	139
	v) Partly damaged pucca houses	235
	vi) Partly damaged kutch houses	16578
	vii) No. of huts damaged	1100
	b) Estimated value of damage to houses (Rs. in lakh)	759.95
11	No. of human lives lost	3
	No. of persons with grievous injuries	0
	No. of persons with minor injuries	0

12	Animals lost	28574
	a) No. of big animals lost	38
	b) No. of small animals lost	34
	c) No. of poultry (birds) lost	28502
13	Damage to public properties:-	
	(a) In physical terms (sector wise details should be given – e.g. length of State roads damaged, length of district roads damaged, length of village roads damaged, No. of bridges damaged, No. of culverts damaged, No. of school buildings damaged etc.)	Details given under Chapter-V
	(b) Estimated value of the damage to public properties (Rs. in lakh)	
14	Estimated total damage to houses, crops and public properties (Rs. in lakh)	

Appendix-III

Assistance for provision of temporary accommodation, food, clothing medical care etc. of the people affected/ evacuated due to very severe cyclonic storm "YAAS" and consequent flood/ heavy rain & storm surge (Operation of Relief Camps)

Sl. No.	Name of the Block/ ULB	Total no. of relief camps opened	Total no. of people accommodated in relief camps (cumulative)	Average no. (in a day) of relief camps	Average duration of operation of relief camps	Average no. of People accommodated per day in the relief camps	Expenditure incurred on (Rs. In Lakhs)					
							Temporary accommodation	Food	Clothing	Medical care	Other essential items (to be specified)	Total
1	2	3	4	5	6	7	8	9	10	11	12	13
1	Balasure	1833	508113	1833	3	188963		449.530			116.710	566.240
2	Bhadrak	1206	122215	1206	2	122215		271.120		1.020	59.830	331.970
3	Cuttack	724	36454	724	2	36454	21.143	36.589		7.510	4.290	69.531
4	Dhenkanal	210	8674	210	1	8674	0.716	7.876			3.920	12.512
5	Jagatsinghpur	333	23668	333	2	23668	5.648	28.145			7.185	40.978
6	Jajpur	839	42525	839	2	43978	1.520	64.523		0.450	4.083	70.576
7	Kendrapara	1126	125236	1126	2	125236		252.727			0.000	252.727
8	Keonjhar	582	26899	288	2	18303	1.720	42.079		0.058	7.106	50.963
9	Khordha	217	9422	174	1	3942		9.783			5.950	15.733
10	Mayurbhanj	1392	200227	1392	2	98232	8.737	121.887		1.899	30.592	163.114
11	Puri	536	18425					14.012		1.080	2.318	17.409
12	Sundargarh	67	2931	15	2	2897		3.431			2.035	5.467
Total		9065	1124789	8140	2	672562	39.483	1301.702	0.000	12.016	244.019	1597.220

Appendix-IV

Agriculture/ Horticulture crop loss and fund required for input subsidy due to very severe cyclonic storm "YAAS" and consequent flood/ heavy rain & storm surge											
Sl. No.	Name of the Block/ ULB	Total agriculture/ horticulture crop area affected (in Ha.)	Total agriculture/ horticulture crop area where crop loss is >33% (in Ha.)	Total area under crop loss of 33% & above (area in Ha.)				Agriculture input subsidy required in Rs.			
				Rainfed	Irrigated	Perennial	Total	Rainfed @ 6800/- per Hect.	Irrigated @13500/- per Hect.	Perennial @ 18000/- Per hect.	Total fund required in Rs.
1	2	3	4	5	6	7	8	9	10	11	12
1	Balasore	510.00	123.528	5.60	98.27	19.66	123.53	38080	1326645	353844	1718569.00
2	Bhadrak	1319.00	886.70	269.60	615.60	1.50	886.70	1833280	8310600	27000	10170880.00
3	Jagatsinghpur	39.50	8.96		8.96		8.96		120960		120960.00
4	Jajpur	1768.00	494.00	154.50	339.50		494.00	1050600	4583250		5633850.00
5	Kendrapara	277.00	230.92	36.00	185.00	9.92	230.92	244800	2497500	178560	2920860.00
6	Keonjhar	646.91	207.67	41.60	165.47	0.60	207.67	282880	2233805	10800	2527484.50
7	Mayurbhanj	1020.89	157.88	11.11	146.17	0.60	157.88	75548	1973268	10800	2059616.00
8	Puri	7.00	3.00		3.00		3.00		40500		40500.00
9	Sundargarh	84.69	84.69		84.69		84.69		1143315		1143315.00
Total		5672.99	2197.35	518.41	1646.66	32.28	2197.34	3525188.00	22229842.50	581004.00	26336034.50

Appendix-V

Agriculture/ horticulture crop loss and fund required for input subsidy due to very severe cyclonic storm "YAAS" and consequent flood/ heavy rain & storm surge (Other than SMF)															
Sl. No.	Name the district	Total agriculture/ horticulture crop area affected (in Ha.)	Total agriculture/ horticulture crop area where crop loss is >33% (in Ha.)	Out of (4) area belong to farmers other than SMF (in Ha.)				No. of farmers other than SMF affected by the instant calamity				Assistance required in Rs.			
				Rainfed	Irrigated	Perennial	Total	Rainfed	Irrigated	Perennial	Total	Rainfed @ 6800/- per Hect.	Irrigated @13500/- per Hect.	Perennial @ 18000/- Per hect.	Total fund required in Rs.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Balasore														
2	Bhadrak														
3	Cuttack														
4	Dhenkanal														
5	Jagatsinghpur														
6	Jajpur														
7	Kendrapara														
8	Keonjhar														
9	Mayurbhanj														
10	Puri														
11	Sundargarh														

Nil

Appendix-VI

Assistance required towards replacement of animals for death of livestock due to very severe cyclonic storm "YAAS" and consequent flood/ heavy rain & storm surge																		
Sl. No.	Name of the district	No of Livestock / Birds lost					No of animals qualifying for relief grant (i.e., subject to ceiling of 3 large milch animal or 30 small milch animals or 3 large draught animal or 6 small draught animal per household					Expenditure incurred (Milch animals @ Rs.30000 for large animal , Rs.3000 for small animals & Draught animals @ Rs 25,000 for large animal, Rs. 16000 for small animals)				Poultry @ 50/- per bird subject to a ceiling of assistance of Rs.5000/- per beneficiary household.	Total fund required in Rs.	
		Milch Animal		Draught Animal			Poultry Birds	Milch Animal		Draught Animal			Milch Animal		Draught Animal		Amount required	(12+13+14+15+16)
		Buffalo/ Cow	Sheep/ Goat	Camel/ Horse/ Bullock	Calf/ Donkey / Pony	Buffalo/ Cow		Sheep / Goat	Camel/ Horse/ Bullock	Calf/ Donkey / Pony	Buffalo/ Cow	Sheep/ Goat	Camel/ Horse/ Bullock	Calf/ Donkey/ Pony				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		
1	Balasore	3	5		5	24426	3	5		5	90000	15000		80000	145550	330550		
2	Bhadrak	12	3		9	3816	12	3		9	360000	9000		144000	10800	523800		
3	Jajpur	2	2		2		2	2		2	60000	6000		32000		98000		
4	Kendrapara	16	3		2	260	16	3		2	480000	9000		32000	10000	531000		
5	Keonjhar	3			2		3			2	90000			32000		122000		
6	Mayurbhanj	2	1				2	1			60000	3000				63000		
Total		38	14	0	20	28502	38	14	0	20	1140000	42000	0	320000	166350	1668350		

Appendix-VII

Assistance required towards repair / restoration of damaged houses (in Rs.) due to very severe cyclonic storm "YAAS" and consequent flood/ heavy rain & storm surge																		
Sl. No	Name of the district	Fully damaged		Severely damaged		Total fully/ Severely damaged pucca/ kutcha house		Partially damaged				Hut damaged		Total		Cow shed damaged		Grand total
		Pucca house	Kutcha house	Pucca house	Kutcha house	No. of house damaged	Fund required @ Rs 95100/- or Rs.101900 /- per house	Pucca house	Funds required @ Rs.5200/- per house	Kutcha house	Funds required @ Rs.3200/- per house	No. of hut	Funds required @ Rs.4100/- per hut	No. of house damaged (7+9+11+13)	Funds required (8+10+12+14)	No. of cow shed	Cow Shed @ Rs.2100/- per cowshed	Funds required (16+18)
		No.	No.	No.	No.	No.	Amount	No.	Amount	No.	Amount	No.	Amount	No	Amount	No.	Amount	Amount
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	Balasore		5		33	38	3613800	115	598000	2974	9516800	347	1422700	3474	15151300	242	508200	15659500
2	Bhadrak		12		8	20	1902000	7	36400	8152	26086400	225	922500	8404	28947300	1554	3263400	32210700
4	Dhenkanal				3	3	285300	1	5200	42	134400			46	424900			424900
5	Jagatsinghpur									1	3200			1	3200			3200
6	Jajpur				4	4	380400	9	46800	682	2182400	303	1242300	998	3851900	501	1052100	4904000
7	Kendrapara							1	5200	541	1731200	59	241900	601	1978300	239	501900	2480200
8	Keonjhar		8		26	34	3233400	49	254800	2199	7036800	1	4100	2283	10529100	310	651000	11180100
9	Mayurbhanj	2	9	2	49	62	5896200	49	254800	1774	5676800	165	676500	2050	12504300	172	361200	12865500
10	Sundargarh		4		16	20	1902000	4	20800	213	681600			237	2604400	6	12600	2617000
Total		2	38	2	139	181	17213100	235	1222000	16578	53049600	1100	4510000	18094	75994700	3024	6350400	82345100

CHAPTER-XI

MITIGATION PROPOSAL

Executive Summary:

Coastal areas and Energy infrastructure of the State were the worst affected in the very severe cyclonic storm "YAAS". Long term planning and investment is felt necessary for building cyclone resilience in these two sectors. Technological intervention and capital expenditure required for such resilience cannot be supported by the State budget alone. Two Mitigation Proposals (A) **Cyclone Resilient Power System Infrastructure** and (B) **Cyclone Resilient Odisha Coastal Embankment Strengthening Project** are proposed for financial support to strengthening disaster resilience in the State. The abstract of both the proposals are placed below:

A. Cyclone Resilient Power System Infrastructure

Abstract of Estimate

(Rs. in Crore)

Scope of Work	TPCODL	TPNODL	OPTCL	Total
132kV & 220kV line and GSS Renovation	-	-	3,525	3,525
33kV, 11kV, LT Lines conversion with DT refurbishment	2,827	5,174	-	8,001
UG Cabling in Urban area	269	282	-	551
33/11 kV Sub-station Renovation	126	256	-	382
Material Bank	85	75	80	240
Total	3,307	5,787	3,605	12,699
Disaster Response Equipment				154
Grand Total	3,307	5,787	3,605	12,853

B. Cyclone Resilient Odisha Coastal Embankment Strengthening Project

SI No.	District	Length of the Embankments proposed for Improvement (in Km.)	Amount (Rs. in Lakhs)	No of Villages to be benefitted	Population to be benefitted (In Nos.)	Agricultural Land to be protected (In Ha.)
1	Balasore	116.95	51458.00	72	270000	2680
2	Bhadrakh	100.90	34820.00	51	166950	14630
3	Kendrapara	224.52	98006.82	229	238164	25524
4	Jagatsinghpur	19.82	14394.00	45	47000	4580
5	Puri	70.45	23507.34	85	104680	17410
6	Khurdha	16.30	5216.00	13	26600	1710
7	Ganjam	6.50	800.00	10	15000	2000
B	Beach restoration of Tourism importance	26	72000.00	-	-	-
	TOTAL	581.43	300202.16	505	868394	68534

Rs.15855.02 crore is required for implementation of the proposed mitigation activities. Government of India may kindly consider providing funds to Government of Odisha for the above purpose.

C. Cyclone Resilient Power System Infrastructure in YAAS affected Districts of Odisha:

1.0 Introduction

Odisha is a multi-hazard prone State in the eastern part of India. Among the various disasters, the frequency and severity of cyclones have increased at an alarming rate in the last two decades, which is attributed to climate change. Intense and more frequent cyclones such as the 1999 Super Cyclone, Phailin in 2013, Hudhud in 2014, Titli in 2018, Fani & Bulbul in 2019, Amphan in 2020 and YAAS in 2021 as well as severe flood have resulted huge devastation in Odisha. Power sector infrastructure is mostly affected with cyclones and floods.

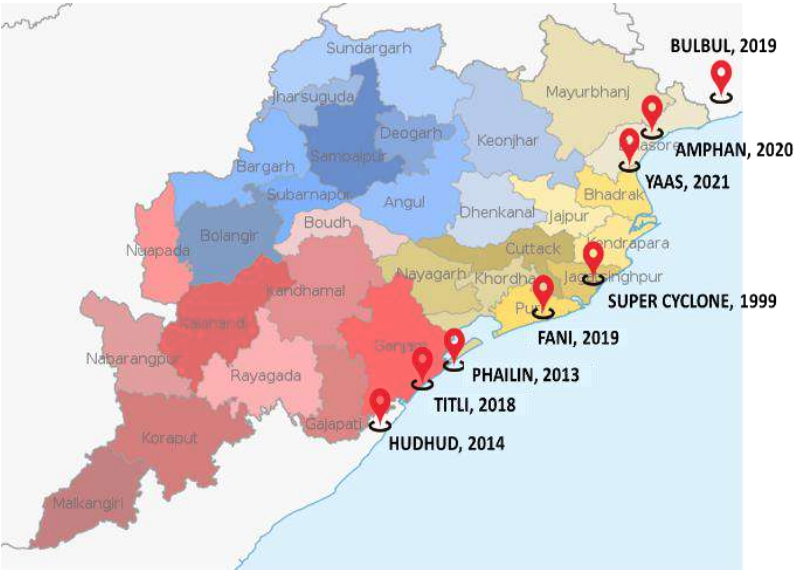


Year	1999	2013	2014	2018	2019	2019	2020	2021
Cyclone	SUPER CYCLONE	PHAILIN	HUDHUD	TITLI	FANI	BULBUL	AMPHAN	YAAS
Severity	Super Cyclone	Extremely Severe	Extremely Severe	Very Severe	Extremely Severe	Very Severe	Super Cyclone	Very Severe
Category	CAT-V	CAT-V	CAT-IV	CAT-III	CAT-IV	CAT-III	CAT-V	CAT-III
Wind Speed (Kmph)	260-270	205-220	180-190	140-150	200-215	110-120	155-165	130-150
Affected Districts	14	19	15	17	14	9	4	13
Affected Consumer (Lakh)	2	38	7	9	30	15	45	30
Damage (in Crore)	400	1048	104	133	1069	6	75	155



While efficient disaster preparedness by the utilities in Odisha has helped to achieve Zero casualty, there remain significant challenges in rebuilding damaged infrastructure and returning to normalcy after the disruptions. Power infrastructure is considered

as a critical infrastructure and has been affected significantly by different past disasters. Further, it was observed that the power sector became the most crucial infrastructure in comparison to the other sectors and is required to be restored immediately after disasters, since all other services, such as water supply, telecommunication and health care etc. are dependent on the restoration of the power supply.



Odisha has a coast line of about 480 km length along the Bay of Bengal and is more prone to cyclones and tsunamis. The frequency of occurrences and intensity of cyclonic wind have increased over the years causing large scale damage to T&D infrastructures leading to long outage of power supply in affected areas. It has been observed that the impact of cyclones and the damage of infrastructure is mostly within 60 km from the coastline. However, the damages have also taken place beyond 60 km. The major impact is in form of damage to towers, poles, DTRs, sub-station equipment & structure, snapping of conductor & jumpers and failure of insulators due to high wind pressure and saline effects. Sub-station equipment gets submerged due to surge of sea water as well as flooding.

Based on the experience of dealing with eight cyclones in the last two decades, the Energy Department prepared contingency plans since April 2021 anticipating a summer cyclone, pre-positioned materials, manpower, equipment and vehicles, along with the technical and support staff and made communication plans to deal with the cyclone impact. It also held advance meetings with electricity generators, and the local load distribution centres to plan for the systematic reduction and subsequent restoration of electrical loads during and after the passing of the cyclone, in order to prevent total grid collapse.

2.0 Impact of Cyclone YAAS on Odisha's Power Infrastructure

The very severe cyclone YAAS hit Odisha coast on 26.05.2021 and resulted in serious damage and disruption of critical services and infrastructures in 5 coastal districts of Odisha and 2 northern districts. The wind speed was reported to be within 130-150 km per hour along with heavy rainfall. The distribution infrastructure, particularly 33 kV, 11 kV and LT lines and Distribution Transformers suffered heavy damage. Around 170 nos. of 33kV feeders, 366 nos. 33/11 kV sub-stations, 1201 nos. of 11kV feeders, 1,05,004 nos. of DTRs and around 30.27 Lakhs consumers were affected.

As a preparedness measure, the Energy Department mobilized manpower and materials to the districts likely to be affected to ensure the prompt restoration of power supply and 100% of electricity supply restoration was completed by 02.06.2021.

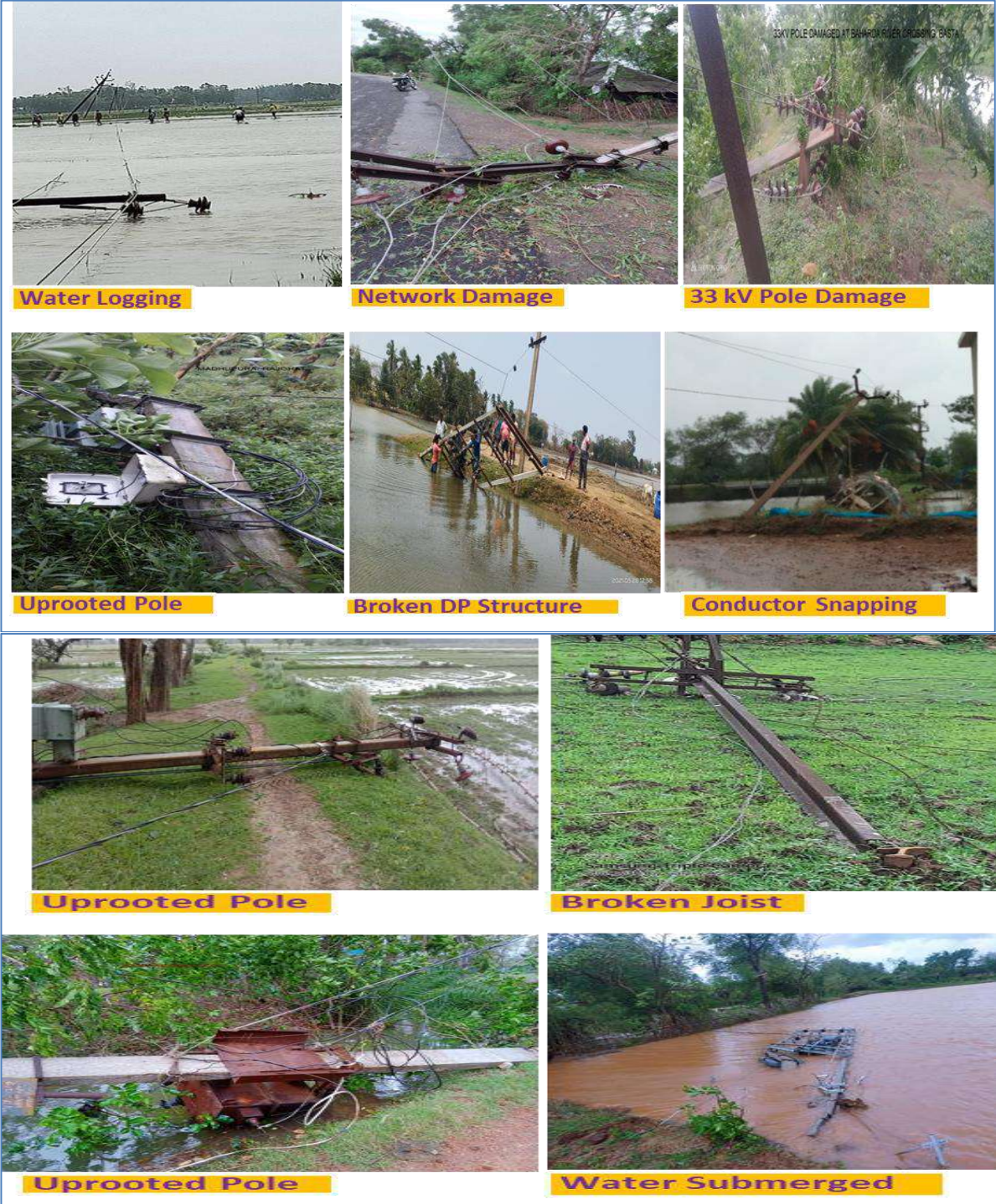
The impacts of the cyclone brought focus to the need for disaster and climate resilient power infrastructure systems in Odisha and also in India as a whole. This represents another pointer highlighting the necessity to build back better i.e. more resilient infrastructure. In a World that increasingly relies on electricity, building resilient power systems is critical to provide reliable and sustainable energy supply, energy security, economic wellbeing and quality of life. In this context, enhancing resilience refers to "strengthening the ability of a system and its component parts to anticipate, prepare for, absorb, accommodate or recover from the effects of a hazardous event in a timely and efficient manner, including through the preservation, restoration, or improvement of its basic structures and functions" (IPCC 2012).

2.1 Districts severely affected in Cyclone YAAS:

Districts highlighted are severely affected by YAAS



2.2 Snapshots of damaged distribution network during YAAS:



2.3 Snapshots of challenges during YAAS restoration:



3.0 Existing Design Practice

For better safety of structures, the IS Code 875 (Part 3) 2015 presents the cyclonic importance factor (k factor) according to the importance level of structure with a maximum value of 1.30 for post cyclonic importance structures category. This factor is recommended in static and dynamic analysis of wind load computations. This is the additional wind speed multiplication factor besides the offshore wind velocity multiplication factor of 1.15 that has been retained in the revised wind code 2015 version for coastal areas up to 20 Km.

Existing Design Practice								
Sl. No.	Lines	Conductor sizes	Type of Support	Span Length (m)	Pole Height (m)	Weight of the Support	Pole Size (mm)	Resiliency wind speed (km/hr)
1	33kV	232 mm ²	NBLS	200	13	4ton	NA	200
		100 mm ²	Rail Pole	80-100	11	120 Lbs/Yrd	NA	216
		80 mm ²						
		55 mm ²						
		100 mm ²	Joist Pole	80-100	11	308 kg/m	200x100	140
		80 mm ²				275 kg/m	150X150	198
		55 mm ²				300 kg/m	NA	180
55 mm ²	PSC DP	80-100	9	300 kg/m	NA	180		
2	11kV	100 mm ²	Joist Pole	60	9	225 kg/m	150X150	198
		80 mm ²						
		55 mm ²						
		34 mm ²						
		100 mm ²	Rail Pole	60	9 & 8	90Lbs/Yrd.	NA	198
		80 mm ²						
		55 mm ²						
		34 mm ²						
		80 mm ²	PSC Pole	60	9 & 8	300 kg/m	NA	180
		55 mm ²				200 kg/m		
34 mm ²								
34 mm ²								
3	LT	95/50mm ² A BC	Joist Pole	40-50	8 & 7.5	162 kg/m	100X116	180
		55 mm ²						
		34 mm ²						
		21 mm ²						
		95/50mm ² A BC	Rail Pole	40-50	8 & 7.5	55 Lbs/Yrd	NA	180
		55 mm ²						
		34 mm ²						
		21 mm ²						
		95/50mm ² A BC	PSC Pole	40-50	8 & 7.5	200 kg/m	NA	180
		55 mm ²						
34 mm ²								
21 mm ²								

Even it is designed for a particular level of resiliency, the constant wear and tear due to saline effects in the coastal districts, frequent whirlwinds and floods make the infrastructure very weak to withstand any kind of disasters for a long time.

4.0 Cyclone Resilient Power Infrastructure: DISTRIBUTION

In Odisha the density of the electricity network is higher in the coastal belt and mostly urban and industrial areas. As a result, the chance of higher disruption is in the coastal zone. It is evident that the low tension (voltage) lines, DTRs (Distribution Transformers), 11kV&33kV lines and 33/11 kV sub-stations within a distance of upto 60kms from the coastal zone are at higher risk. Five districts i.e. Balasore, Bhadrak, Kendrapada, Jajpur and Jagatsinghpur affected in YAAS are within that range from the sea coast. Further, parts of Keonjhar & Mayurbhanj districts are also affected in the cyclonic path. Hence, it is important to build a Resilient Power Infrastructure to avoid or minimize the chances of failure and disruptions of the lives of people as well as for continuity of emergency services.

➤ **Upgrading poles and structures**

The most common practice for cyclone resiliency is replacing the Utility poles with poles made of galvanized steel, concrete or a composite material and upgrading transmission & distribution towers to galvanized-steel lattice. Besides, increase in the number of poles per kilometre, i.e. reducing the line span can also be adopted. Such measures are intended to allow the pole, tower or other structure to better withstand windstorms, including cyclones. Structural designs of such poles and towers have been made.

➤ **Changes in distribution system design**

The power distribution system can be made more resilient with changes in the existing network. It may be advantageous to split up the large network into smaller circuits, and to re-examine the circuit arrangements to enhance the speed of repair. This also enhances the reliability of supply system.

➤ **Conversion of OH lines to UG Cabling System**

Placing Utility lines underground eliminates their susceptibility to lightning and wind damage. The cost of UG cabling is very high. Plan is to restrict the overhead network to non-coastal areas and underground cables in the critical part of the coastal towns.

➤ **Elevated sub-stations & Control Rooms**

Renovation of existing substation switchyards and making them cyclone resilient is also one of the prime objectives. Outdoor structures need to be strengthened with resilient structures and equipment. Also the most prevalent cause of damage to sub-stations being flooding from storm surge and rain, common

practice is elevating sub-stations. This reduces the supply disruption and facilitates restoration of power supply immediately after flood. A defined flood level (DFL) has been taken into account while providing structural designs for elevating sub-stations and allied equipment.

➤ **Acquiring mobile T&D equipment, special tools and tackles**

Mobile transformers and sub-stations can be used to temporarily replace sub-station transformers in the low and medium power range that are damaged in a cyclone. Day-to-day operations in a sub-station are much more difficult when the entire apparatus is raised off the ground. For situations like these, risk can be mitigated by acquiring/arranging in advance spare equipment and materials, so that they are prepared to make rapid repairs when a cyclone does hit.

➤ **SCADA/DMS**

Electricity Utilities rely on SCADA systems to monitor and control their transmission & distribution grid. These systems operate continuously and play a key role in cyclone response and recovery by enabling Utility controllers to identify damaged assets and dispatch repair crews quickly and efficiently. Sub-station automation uses computer-based control and monitoring technology to create highly reliable, self-healing power systems that can rapidly respond to real-time events. They can work in combination with SCADA systems or independently. *(This proposal is not included in this report and are taken up in other Govt. schemes)*

➤ **Renewable generation**

Renewable generation in the form of decentralised & distributed solar PV power generation, if located close to the load would be an attractive option particularly when these sources are not available in the area. *(This proposal is not included in this report, however separate initiatives are being taken as per various schemes of GoI and GoO).*

5.0 Design of special structures & foundations for 33 kV overhead lines & Sub-stations

In accordance with IS: 875 (Part-3), the subject area falls under the wind zone V with wind speed of 50 mtr/sec. Based on this criteria, 33kV and 11kV lines need to be upgraded by mixture of Galvanized H-Poles and NBLS towers.

However, on occurrence of super cyclone with a wind velocity of approximately 250 kmph, the H-Pole structures carrying the 11 kV and 33 kV lines as well as the lattice

structure carrying the 33 kV lines fell short in terms of the design wind load & the actually applied wind load.

Thus, as a primary step towards building a cyclone resilient distribution system the H-Poles structures & foundations have been designed with consideration of the maximum actual applied wind load of approximately 300 to 350 kmph for 11KV & 33KV line support structures.

For the above reason, use of Narrow Base Lattice Structures (NBLs) for 33KV network is also being designed with the same applied wind load. Accordingly narrow base lattice structure (NBLs) towers and special H-Poles have been specified for certain feeders and sections/stretches of the overhead lines in those areas to take care of the cyclone & flood resiliency.

33kV Lines:

Since 33kV lines are the backbone of distribution system, the supporting structures are to be selected based on the wind speed. Three categories of 33kV lines are proposed to be adopted for cyclone resilient infrastructure. 33kV lines emanating from 132/33kV Grid Stations and connecting to 33/11kV sub-stations are proposed to be replaced either by UG cabling or by NBLs towers based on the availability of RoW. 33kV lines in the cities are to be converted to UG cabling system. Other 33kV lines shall be replaced by GI H-Type Poles.

a. NBLs Towers:

Narrow Based Lattice Structures are robust in design and can withstand wind speed upto 300kmph. Such type of towers require less space 2mx2m (Approx.) with either panther or dog conductors to erect in any critical areas.



The line can be constructed with double circuits at the emerging points near Grid Stations. Basically there are two different types of NBLs towers are used for 33kV lines i.e. Hx and Hz type. Typical weight of Hx and Hz type NBLs Tower: NBLs D/C tower (Hx type): Hx type tower (Unit Weight 1.05 MT), Hardware Fittings: (Unit Weight 0.054 MT), STUB (Unit Weight 0.131 MT). NBLs D/C tower (Hz type): Hz type tower (Unit Weight 2.58 MT), Hardware Fittings for Hz type (Unit Weight 0.149 MT), Hardware Fittings for extension (Unit Weight 0.024 MT), STUB (Unit Weight 0.526 MT).

b. H-Type Galvanized Structure:

One of the most cost effective structure which can withstand wind speed upto 300kmph and reliable to use in coastal regions. It can be constructed at any congested area sand requires very less space to erect. Two Galvanized GI channels are rigidly embedded with each other to form a single structure. The structure is robust and can withstand wind speed upto 300kmph.33kV D/C lines with H poles can be designed with Panther or Dog conductors.



c. 33 kV UG cabling system:

All 33kV feeders in urban areas shall be converted to UG Cabling system. Most of the trunk lines will be connected between two sources for alternate power supply during exigencies. Normally 33kV, 400sqmm, single core, XLPE, corrugated aluminium sheath UG cable is preferred to be used. Cable trench can be either in trenches or through prefabricated half cut hume pipes depending on the availability of RoW.



6.0 11 kV System Improvements/ Augmentations

11kV trunk lines are either to be converted to UG cabling system or replaced by H-Type joist poles depending on the availability of RoW. All 11kV lines inside cities of important installations with corresponding feeding lines are to be converted to UG cabling system. All spur lines are to be replaced by H-Type Joist poles. Following proposals are made for strengthening the distribution system in order to be cyclone resilient and for better reliability. Similar to 33kV lines, special designs have been proposed for the 11 kV poles associated with the 11 kV overhead lines to take care of the extreme wind conditions in the area.

6.1 Proposal of OH 11kV line:

Following proposals are made for strengthening the distribution system in order to be cyclone resilient and for better reliability. Similar to 33kV lines, special designs have been proposed for the 11 kV poles associated with the 11 kV overhead lines to take care of the extreme wind conditions in the project area. Special H-Poles are recommended for 11 kV feeders and sections of the overhead lines in the areas to take care of the cyclone resiliency. Specific sections/stretchches where the H-poles are to be erected are mentioned subsequently.

- a. The OH lines are to be erected on H-type pole using polymer insulators and with 100sqmm AAAC conductor to withstand the cyclone.
- b. The span length of the feeders is proposed to be 40-50 meter in the urban areas.
- c. The design of H-Pole structures and foundations are made considering the wind speed experienced during past cyclones in the subject area.



6.2 Proposal for 11kV UG cabling System.

11kV UG Cabling is proposed in the urban areas of the affected districts.

- a. Some of the important areas, main roads and crowded areas are proposed to be fed through Underground cable in Urban areas
- b. Main UG cable of 400/300 sq.mm, XLPE, 3C is to be used for direct connection between main RMUs and new parallel feeder for feeder bifurcation purpose. DTCs and spur lines are connected through loop 240 sqmm cables
- c. Loop UG cable of 240sqm, XLPE, 3C is to be used for looping between Main RMUs containing load point i.e. DTCs and spur line loads.
- d. 3 Way RMU's are proposed for cable looping between main cable line and by lanes.
- e. The Main RMU's are proposed for linking of other 11kV feeders for better reliability and alternate supply during exigencies.

6.3 11kV Ring Main Units (RMU)

This is one of the most important cyclone resilient equipment which ensures uninterrupted power supply to the region even during exigencies. 11kV RMUs are combination of SF6 Circuit Breakers and Load break switches (LBS). Provision of operating with at least two incoming sources in the circuit. The number of LBS and Circuit breakers are designed as per the distribution schemes with provision of SCADA automation in future.



7.0 Conversion/Renovation of LT Lines

LT lines depending on the site conditions are to be replaced with AB cables. Selected areas are to be converted to LT AB cable and if required defective poles to be replaced. Intermittent poles may be required to reduce span length. Some of the existing poles required to be properly erected with coupling. Damaged poles/eroded poles need to be replaced. LT lines to important installations inside cities are to be converted to UG cabling system with Feeder Pillar Box arrangements. LT lines in the Rural areas are to be replaced either by H-Type GI joist poles or only GI joist poles depending on the site conditions. LT lines if required may be bifurcated for balanced load.

8.0 Cyclone Resilient Distribution Sub-stations

8.1 Plinth Mounted Prefabricated Foundation:

DP mounted or Plinth mounted distribution substations are more vulnerable to cyclone. DP mounted substations such as 16kV, 25kV, 63kV, 100kV, 250kVA and 500kVA substations are to be renovated with prefabricated foundations with other accessories. Existing DTs are either pole mounted or Plinth mounted. Some of the substations need to be renovated or converted to prefabricated foundation with other accessories. DPs, replacement of AB switches, installation of LA, HG fuse, LT panel, LT Cable, Earthings etc. are to be renovated.

8.2 Compact Secondary Substation:

Compact type secondary sub-stations are proposed at urban areas in the UG cabling system. CSS are housed with Transformer, 11kV RMU and LT distribution panel with FRTU for SCADA automation. These DTs are fully protected from outer forces and safe to operate remotely and locally. Different sizes of CSS can be designed at specific locations mostly at higher capacity substations are advisable. Alternatively for small DTs, existing DT can be placed on pre-fabricated foundation with single LBS and LT panel and can be controlled in group.

33/11kV Sub-station Renovation

Outdoor substations are vulnerable to cyclone and flood and hence need to be renovated with respect to wind zone and its severity. It is proposed to convert the outdoor joist pole structures to H-Type pole structures with replacement of isolators and other accessories. Plinth of the transformers needs to be increased beyond the DFL in the particular area. It has also been observed that few substation switch yards were inundated totally under flood water up to approximately 2.0 mtr. average height. Thus, for the sub-station equipment structures & foundations, measures have to be adopted to take care of both increased wind velocity of approximately 300 to 350 kmph and the HFL condition as well. Thus the lattice structures have been designed for two conditions as follows;

- To withstand the actual increased wind velocity for areas never inundated by flood water,
- To withstand the actual increased wind velocity for areas inundated by flood water up to approximately 2.0 mtr. average height.



9.0 Building a Resilient Power Infrastructure : TRANSMISSION

Most of the grid substations within the cyclone affected areas are AIS type, which are vulnerable to failure as compared to GIS sub-stations. Due to heavy winds, damages were observed to sub-station equipment like Surge Arrestors, Current

Transformers (CTs), Capacitor Voltage Transformers (CVTs), Wave Traps, Isolators, snapping of Jumpers, damage to control room and DG sets etc. in AIS. Water logging in the switchyard areas of the substations due to heavy rain was also observed.

Within 60 kms of the coastal districts of Bhadrak, Balasore, Kendrapada and part of Jajpur & Jagatsinghpur, the transmission system consists of 3nos 220/132/33kV AIS grid sub-stations, 7 nos.- 132/33kV AIS grid sub-stations, one no 132/33kV GIS grid sub-station, 329 kms - 220KV lines and 560 kms – 132KV transmission line. Most of the grid sub-stations and transmission lines have covered a service life of minimum 24 years to maximum 42 years.

The transmission lines, owing to their height, long stretches with maximum span length and rusting of tower legs due to water logging & long life, are highly vulnerable to cyclones. The current design of equipment does not optimize the factor of safety. Furthermore, the towers of existing overhead line with lattice structures are being designed according to IS 802 (1977/1995). There is no special consideration for design of overhead lines in coastal areas, prone to high intensity winds.

In addition, low lying sub-stations within the above districts are prone to flooding, following a cyclone. Moreover, the quick supply of towers and accessibility to remote locations remain a challenge for the T&D organisations. The damage due to natural disaster cannot be ruled out completely because such events are likely / expected to occur during service life of installation. A good emergency preparedness plan, accompanied by strategic investments, can shorten restoration time and limit the impact of disaster.

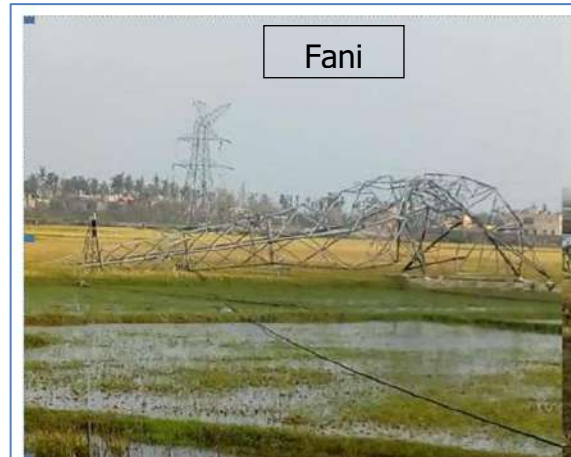
Transmission lines failed/affected due to cyclone (132 kV & above):

Cyclone	Voltage Level	Type of Towers		Total Towers Failed
		Suspension	Tension	
PHAILIN	220kV	62	9	71
	132kV	19	2	21
TITLI	220KV/ 132KV	Conductor Snapping		-
FANI	220kV	52	21	73
	132kV	41	1	42
AMPHAN	220KV/ 132KV	Conductor Snapping		-
YAAS	220KV/ 132KV	Conductor Snapping		-

Though there was no major damage to transmission system in YAAS and no transmission tower was collapsed, some of typical tower failure pictures occurred in past cyclones are given under;



Phailin



Fani

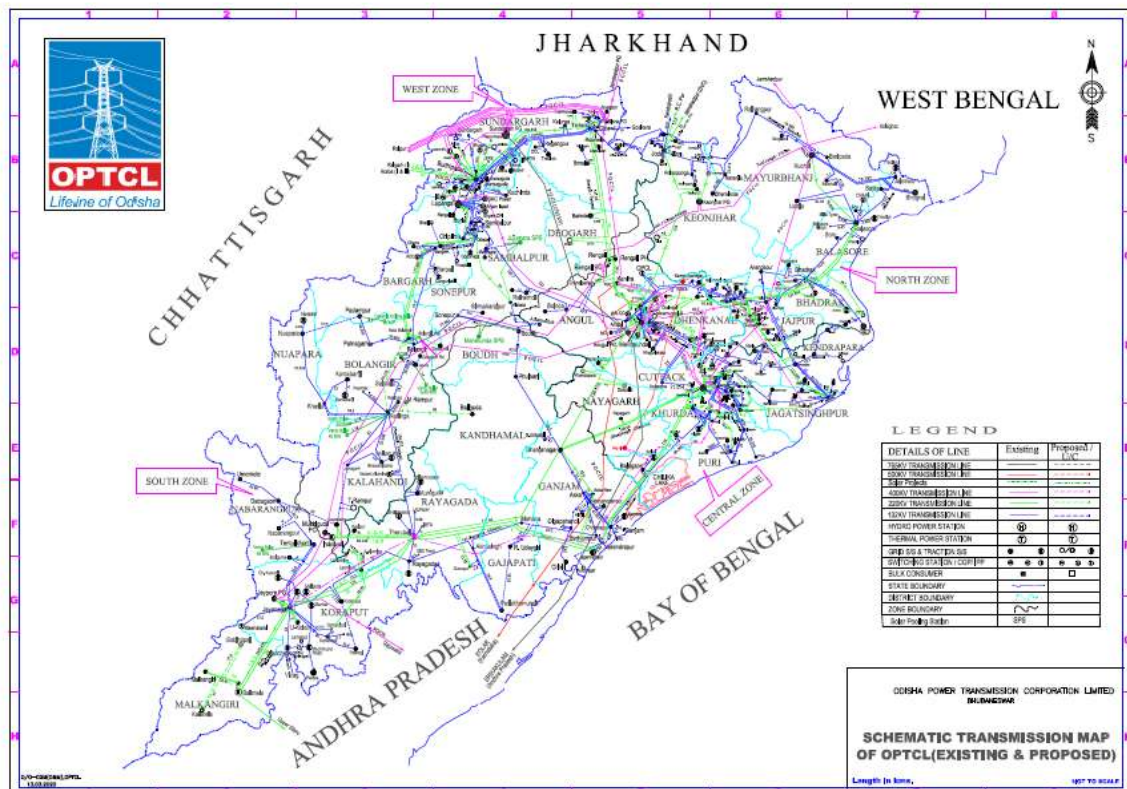


Hudhud



Amphan

The Power transmission map of Odisha is given below.



10.1 Existing Transmission Network and its Reliability& Risk:

The towers of existing overhead line with lattice structures are being designed according to IS 802. The towers of number of overhead line in operation have been designed according to old IS 802 (1977 / 1995). There are no special consideration for design of overhead lines in coastal areas, prone to high intensity winds. Special care is not being taken for design of foundation of overhead distribution lines resulting uprooting of structures during cyclones. Most of the transmission and distribution sub-stations are Air Insulated Substations (AIS), which are exposed to high speed wind during cyclones.

Reconstruction / rectification of damaged power infra after cyclone is a challenging task. Huge funds are required to bringing back to normal condition within very limited period. It becomes a herculean task for transportation of man and materials in the inaccessible situation arises during cyclone.

10.2 Resilient Transmission Infrastructure:

Resilient Power Infra covers redundancy level to be considered to reduce risk of outages, critical Infrastructure Protection Framework in cyclone affected zones, provision for ERS & material bank, digitalization of system etc. This includes transmission lines / underground cable system and associated terminal sub-stations. The replacement of failed / damaged tower (s) [designed as per old standard] with new tower (s) designed according to latest standard. Strengthening of the towers using hip bracing below the bottom cross arm level. Exploring the possibilities of conversion of existing AIS to GIS sub-station.

The **“Report of Task Force on Cyclone Resilient Robust Electricity Transmission and Distribution (T&D) Infrastructure in Coastal Area”** has recommended the measures for creating resilient Transmission infrastructure for existing infrastructure as well as for creation of future/new Transmission & Distribution system. The recommended measures include various Planning aspects, Design & Technological aspects and steps to be taken by Utilities for capacity building to create cyclone resilient infrastructure. The future road map to be adopted by Utilities has also been clearly brought out.

The measures recommended for existing Transmission lines and substations are as follows:

- a) The replacement of failed / damaged tower (s) [designed as per old standard] with new tower (s) designed according to latest standard (replacement can be with similar tower/ tension type tower / Steel pole) and strengthening of the towers using hip bracing below the bottom cross arm level
- b) In case of substantial damage / flooding, possibility of shifting the loads of exiting Air Insulated Substation (AIS) to nearby station and conversion of the existing installation to a GIS installation [located above historical water stagnation/ logging level (based on locally available data) or HFL] should be explored. The flood protection wall may be provided to protect the substations in coastline where damage due to storm surge is encountered and facility may also be provided for pumping of water.

10.3 EHV Grid sub-stations to be converted to GIS:

Sl. No	Name of the Project	Date of Commissioning	Life Period
1	Paradeep 220kV	220kV-2009 132kV-1981	220kV-12 years 132kV- 40 years
2	Bhadrak 220kV	220kV-2009 132kV-1979	220kV-12 years 132kV- 42 years
3	Balasore 220kV	1981	40 years
4	Kendrapara 132kV	1979	42 years
5	Pattamundai 132kV	1997	24 years
6	Soro 132kV	1997	24 years
7	Basta 132kV	2010	11 years
8	Jaleswar 132kV	1991	30 years
9	Jajpur Town	1998	23 years
10	Jagatsinghpur	1996	25 years

10.4 Material Banks:

Availability of materials and advanced positioning of men & materials at strategic locations had resulted quick restoration of electricity supply to the consumers during the cyclone YAAS. From the above experiences, restoration of supply of electricity in the affected areas in the shortest possible time with the existing infrastructure need to keep an emergency stock of materials to meet the future contingencies. Based on the experience

and requirement of the material for quick start of restoration, the estimated requirement of materials and funds are proposed.

The power systems to become resilient and withstand high wind speeds and heavy rains, the following approaches for recovery could be adopted:

- (i) An immediate approach to use the existing design systems with proper foundations and reduced spans. This may be cost efficient but may not be long-lasting.
- (ii) Gradual changeover of Transmission line with same RoW, for Disaster vulnerable areas, stable towers/monopoles @ smaller span to withstand wind speeds of up to 250/ 300 km per hour (kmph).

11.0 Cost Estimation: TRANSMISSION

11.1 Considering the above guidelines and existing transmission assets, the tentative Estimate for Disaster Resilient Transmission System is proposed below (OPTCL):

Sl.No.	DESCRIPTION	QTY	UNIT COST (CR)	TOTAL AMOUNT (CR)
ESTIMATED COST FOR CONVERSION FROM AIS TO GIS				
1	220KV AIS TO GIS	3	200	600
2	132KV AIS TO GIS	7	120	840
CONVERSION OF EXISTING LINES TO RESILIENT TRANSMISSION SYSTEM				
3	220KV	329 KMS	2.75	905
4	132KV	560 KMS	1.75	980
ESTIMATED COST FOR CONVERSION OF OVERHEAD TL TO UG CABLING NEAR URBAN AREAS				
5	URBAN TOWNSHIP PERIPHERY		Lump sum	200
TOTAL				3525

11.2 Material Bank for the Transmission requirements (OPTCL):

Sl. No.	ITEM DESCRIPTION	UNIT	QTY	Unit Cost (Rs.)	Amount (Rs.Lakh)
A	Line Equipment				
1	Conductor				
i	ACSR Panther	km	200	2,00,218	400.44
ii	ACSR Zebra	km	100	3,58,208	358.21
iii	ACSR Moose	km	70	3,98,633	279.04
iv	AAAC Zebra	km	15	3,59,777	53.97
v	AAAC Moose	km	15	3,98,633	59.79

vi	7/3.15 G.I Earth Wire	km	15	32,221	4.83
2	OPGW 24 fibre	KM	50	3,00,000	150.00
3	Insulator				
v	90 kN L/R Porcelain Insulator (132 kV)	Nos.	600	7,000	42.00
vi	120 kN L/R Porcelain Insulator (132 kV)	Nos.	400	8,500	34.00
vii	90 kN L/R Porcelain Insulator (220 kV)	Nos.	400	8,900	35.60
viii	160 kN L/R Porcelain Insulator(220KV)	Nos.	300	9,500	28.50
4	Conductor accessories				42.34
5	ERS towers				
i	ERS towers	Sets	30	75,00,000	2,250.00
ii	Spare and consumables of existing ERS tower	Lot			200.00
6	Tower-Structure				
6.1	220KV (OA,OB,OC)	MT	659		
6.2	132KV(PA,PB,PC)	MT	490		
6.3	Total	MT	1149	82,400	946.78
6.4	Spare Cross Arms and tower members	Tons	405	82,400	333.72
6.5	Nuts & Bolts	Tons	27	1,31,268.55	35.44
7	Hardware fittings for different type conductors	LS			214.47
B	Substation Equipment				
	Substation and equipment Structure	MT	90	82,400	74.16
	Nuts & Bolts	Tons	9	1,31,268.55	11.81
8	Circuit Breaker				0.00
i	220kV	Nos.	3	17,31,591.79	51.95
i	132kV	Nos.	6	7,90,656.43	47.44
i	33kV	Nos.	15	2,62,046.13	39.31
i	SF-6 Gas Cylinders (50 kg.)	Nos.	15	68,824.76	10.32
9	C.T.				0.00
i	220kV (0.2class) CT	Nos.	15	4,75,749.27	71.36
i	132kV (0.2class) CT	Nos.	30	1,82,820.85	54.85
d)	33kV(0.2s class)	Nos.	36	54,320	19.56
10	P.T. / CVT (0.2Class)				
ii	220kV PT	Nos.	3	5,64,754.59	16.94
iii	220kV CVT	Nos.	6	2,78,612.27	16.72
iv	132kV PT	Nos.	6	2,53,010.06	15.18
v	132kV CVT	Nos.	12	2,01,805.64	24.22
vi	33kV PT (0.2s class)	Nos.	15	29,819.04	4.47
11	Clamp and connectors for each type of equipment and flexible & rigid conductors	Lot	6	15,00,000	90.00
12	CT/PT CONSOLE BOX	Nos.	6	52,507.12	3.15

13	BAY MARSHALLING KIOSK	Nos.	3	1,75,024.22	5.25
14	A.C DISTRIBUTION BOARD	Nos.	3	4,37,561.32	13.13
15	D.C DISTRIBUTION BOARD	Nos.	3	4,37,561.32	13.13
16	Wave Trap				
i	Wave trap (220kv,1200A /1mh)	Nos.	3	5,98,956	17.97
ii	Wave Trap (132kv,1200A/1mh)	Nos.	3	3,50,049.96	10.50
17	Surge Arrestor				
ii	220kV	Nos.	12	56,475.46	6.78
iii	132kV	Nos.	15	37,650.31	5.65
iv	33kV	Nos.	30	12,048.1	3.61
18	Post Insulator				0.00
i	Single Stack PI for 132 KV	Nos.	15	11,851	1.78
ii	Single Stack PI for 33KV	Nos.	30	2,020	0.61
iii	Single Stack PI for 220KV	Nos.	12	28,279	3.39
19	Isolator				
i	220 KV Isolators	Nos.	8	3,83,115	30.65
iv	132KV Isolators	Nos.	18	3,58,313	64.50
xi	33KV Isolators	Nos.	36	1,74,615	62.86
20	Different type Relays				29.18306
21	Control Cable & Power cable				510.2622
22	Station Transformer				
i	250 kVA	Nos.	6	6,95,572.84	41.73
ii	500 kVA	Nos.	3	8,79,931	26.40
iii	1 MVA	Nos.	3	14,95,000	44.85
23	Station DG Set				
	DG Set-80KVA (Medium to Large 132kV Grid S/S)	Set	3	12,00,000	36.00
	DG Set-150KVA(Medium to Large 220/132/33kV Grid S/S)		5	2,00,000	100.00
24	Light Fittings	LS			15.00
25	T&P for Disaster Response				574.80
26	Construction of Store and platform for proper storing of Material with fencing				300.00
TOTAL					7,938.59

11.3 Total Cost Estimate: TRANSMISSION SYSTEM

Sl. No.	Description	Amount (Cr)
1	132kV & 220kV line and GSS Renovation	3,525
2	Material Bank	80
Total		3,605

12.0 Cost Estimation: DISTRIBUTION

The estimate of YAAS affected districts of Odisha is prepared as per the field reports on preliminary surveys. The cost estimate is prepared based on the unit rates available with DISCOMs and OPTCL in the approved cost data or rates discovered in their ongoing projects. The quantity of materials is considered as per preliminary survey and site requirements.

12.1 33kV, 11kV,LT Lines and Distribution sub-stations

The most affected districts were Balasore, Bhadrak & Kendrapada and districts of Jajpur, Mayurbhanj (eastern part), Keonjar (eastern part), and Jagatsinghpur (Paradeep adjacent industrial/ coastal areas) were partly affected. The conversion of the existing assets of major affected districts and partly affected areas of remaining districts to disaster resilient system are considered in the estimation of disaster resilient infrastructure.

12.1.1 Investment Proposal for cyclone resilient system in YAAS affected districts (Kendrapada and parts of Jagatsinghpur & Jajpur) under TPCODL

(Rs. in Crore)

Conversion of existing system to	Unit Rate (in Cr.)	Jagatsinghpur		Kendrapada		Jajpur (Badchana)		TPCODL Total	
		Qty	Cost	Qty	Cost	Qty	Cost	Qty	Cost
33kV line with NBL Tower up to 20 km (Excl. Urban)	0.80	163	130	109	87	0	0	272	217
33kV line with H-Type GI pole 20-60 km (Excl. Urban)	0.25	80	20	65	16	55	14	200	50
33kV UG cabling up to 20 km (Urban Area)	0.60	18	11	3	2	0	0	21	12
33kV line with H-Type GI pole 20-60 km (Urban Area)	0.25	14	4	95	24	0	0	109	27
11kV Line Length with H-Type GI pole up to 20 km (Excl. Urban)	0.20	2344	469	435	87	0	0	2779	556
11kV Line Length with H-Type GI pole 20-60 km (Excl. Urban)	0.20	902	180	886	177	450	90	2238	448
11kV UG cabling up to 20 km (Urban Area)	1.50	24	36	110	165	0	0	134	201
11kV Line Length with H-Type GI pole 20-60 km (Urban Area)	0.20	116	23	1061	212	0	0	1177	235
LT Line with AB Cable on Joist pole up to 20 km (Excl. Urban)	0.14	3290	461	422	59	0	0	3712	520

LT Line with AB Cable on Joist pole 20-60 km (Excl. Urban)	0.14	1052	147	1503	210	700	98	3255	456
LT Line with UG Cabling up to 20 km (Urban Area)	0.30	54	16	130	39	0	0	184	55
LT Line with AB cable on joist pole 20-60 km (Urban Area)	0.14	30	4	1354	190	0	0	1384	194
DTR Renovation Required (Nos) up to 20 km	0.01	3170	32	3506	35	0	0	6676	67
DTR Renovation Required (Nos) 20-60 km	0.01	2370	24	2629	26	750	8	5749	57
33/11 kV PSS up to 20 km	2.00	17	34	17	34	0	0	34	68
33/11 kV PSS 20-60 km	2.00	11	22	14	28	4	8	29	58
Total Estimated Cost			1613		1392		217		3222
Estimated Cost for within 20 km Infra			1188		508		0		1696
Estimated Cost for 20-60 km Infra			424		884		217		1525

12.1.2 Investment Proposal for cyclone resilient system in YAAS affected districts (Balasore, Bhadrak and parts of Keonjhar, Mayurbhanj & Jajpur) under TPNODL

(Rs. in Crore)

Conversion of existing system to	Unit Rate (in Cr.)	Balasore		Bhadrak		Jajpur		Mayurbhanj		Keonjhar		TPNODL Total	
		Qty	Cost	Qty	Cost	Qty	Cost	Qty	Cost	Qty	Cost	Qty	Cost
33kV line with NBL Tower up to 20 km (Excl. Urban)	0.80	395	316	101	81	3	2	0	0	0	0	499	400
33kV line with H-Type GI pole 20-60 km (Excl. Urban)	0.25	5	1	161	40	23	6	38	10	19	5	246	62
33kV UG cabling up to 20 km (Urban Area)	0.60	77	46	31	18	2	1	0	0	0	0	109	65
33kV line with H-Type GI pole 20-60 km (Urban Area)	0.25	1	0.2	9	2	5	1	10	3	8	2	32	8
11kV Line Length with H-Type GI pole up to 20 km (Excl. Urban)	0.20	5640	1128	1544	309	181	36	0	0	0	0	7365	1473
11kV Line Length with H-Type GI pole 20-60 km (Excl. Urban)	0.20	78	16	1825	365	138	28	237	47	160	32	2437	487
11kV UG cabling up to 20 km (Urban Area)	1.50	45	68	40	60	14	21	0	0	0	0	99	148

11kV Line Length with H-Type GI pole 20-60 km (Urban Area)	0.20	11	2	114	23	55	11	40	8	32	6	252	50
LT Line with AB Cable on Joist pole up to 20 km (Excl. Urban)	0.14	8830	1236	2288	320	227	32	0	0	0	0	11345	1588
LT Line with AB Cable on Joist pole 20-60 km (Excl. Urban)	0.14	1849	259	2219	311	335	47	637	89	192	27	5231	732
LT Line with UG Cabling up to 20 km (Urban Area)	0.30	92	28	85	26	49	15	0	0	0	0	226	68
LT Line with AB cable on joist pole 20-60 km (Urban Area)	0.14	156	22	564	79	112	16	56	8	45	6	933	131
DTR Renovation Required (Nos) up to 20 km	0.01	14275	143	2906	29	264	3	0	0	0	0	17445	174
DTR Renovation Required (Nos) 20-60 km	0.01	958	10	5312	53	275	3	308	3	52	1	6905	69
33/11 kV PSS up to 20 km	2.00	52	104	7	14	4	8	0	0	0	0	63	126
33/11 kV PSS 20-60 km	2.00	5	10	24	48	14	28	15	30	7	14	65	130
Total Estimated Cost			3387		1778		257		198		93		5712
Estimated Cost for within 20 km Infra			3068		857		118		0		0		4043
Estimated Cost for 20-60 km Infra			319		921		139		198		93		1669

12.1.3 Investment Proposal for cyclone resilient system in YAAS affected districts under TPCODL and TPNODL

(Rs. in Crore)

Conversion of existing system to	Total Qty	Resilient System Proposal	TPCODL		TPNODL		TOTAL	
			Qty	Cost	Qty	Cost	Qty	Cost
33kV line with NBLS Tower up to 20 km (Excl. Urban)	3498	1489	272	217	499	400	771	617
33kV line with H-Type GI pole 20-60 km (Excl. Urban)			200	50	246	62	447	112
33kV UG cabling up to 20 km (Urban Area)			21	12	109	65	130	78

33kV line with H-Type GI pole 20-60 km (Urban Area)			109	27	32	8	142	35
11kV Line Length with H-Type GI pole up to 20 km (Excl. Urban)	45299	16481	2779	556	7365	1473	10144	2029
11kV Line Length with H-Type GI pole 20-60 km (Excl. Urban)			2238	448	2437	487	4675	935
11kV UG cabling up to 20 km (Urban Area)			134	201	99	148	233	349
11kV Line Length with H-Type GI pole 20-60 km (Urban Area)			1177	235	252	50	1429	286
LT Line with AB Cable on Joist pole up to 20 km (Excl. Urban)	79104	26271	3712	520	11345	1588	15058	2108
LT Line with AB Cable on Joist pole 20-60 km (Excl. Urban)			3255	456	5231	732	8486	1188
LT Line with UG Cabling up to 20 km (Urban Area)			184	55	226	68	410	123
LT Line with AB cable on joist pole 20-60 km (Urban Area)			1384	194	933	131	2317	324
DTR Renovation Required (Nos) up to 20 km	84913	36775	6676	67	17445	174	24121	241
DTR Renovation Required (Nos) 20-60 km			5749	57	6905	69	12654	127
33/11 kV PSS up to 20 km	278	128	34	68	63	126	97	194
33/11 kV PSS 20-60 km			29	58	65	130	94	188
Total Estimated Cost				3222		5712		8934
Estimated Cost for within 20 km Infra				1696		4043		5739
Estimated Cost for 20-60 km Infra				1525		1669		3194

12.2 Conversion Overhead lines to UG Cabling System in Urban areas

District	Towns	33kV Line (km)	11kV Line (km)	LT Line (km)
		Qty (0-20km)	Qty (0-20km)	Qty (0-20km)
Jagatsinghpur	Jagatsinghpur	-	-	-
	Paradeep	17.5	24	54
Kendrapada	Kendrapada	-	-	-
	Pattamundai	3	110	130
TPCODL Total		20.5	134	184
Estimated Cost		12.3	201	55.2
Rs. 269Cr.				
Balasore	Balasore	40	19	39

	Nilgiri	15	0	0
	Soro	16	14	31
	Jaleswar	5	12	22
Bhadrak	Bhadrak	0	0	0
	Basudevpur	20	23	48
	Chandabali	11	17	0
	Dhamnagar	0	0	37
Jajpur	Jajpur Town	2	14	49
TPNODL Total		109	99	226
Estimated cost		65.4	148.5	67.8
		Rs. 282Cr.		
Total TPCODL+TONODL		130	233	410
Estimated cost		78	350	123
		551Cr.		

12.3 Renovation of 33/11kV sub-station

Scope	Total PSS	PSS up to 20km	PSS 20-60km	Amount @ Rs. 2 Cr./ PSS
Jagatsinghpur	28	17	11	56
Kendrapada	31	17	14	62
Jajpur (Badchana)	4	0	4	8
TPCODL Total	63	34	29	126
Balasore	58	52	5	114
Bhadrak	33	7	24	62
Jajpur	34	4	14	36
Keonjhar	40	-	7	14
Mayurbhanj	50	-	15	30
TPNODL Total	215	63	65	256
Total Proposed	278	97	94	382

12.4 Material Bank for TPCODL (Kendrapada & parts of Jagatsinghpur):

Sl No	Material Description Specification	Unit	Quantity	Rate(Rs)	Total cost (Lakh)
1	9Mtr 300kg PSC Pole	no	6000	3000	180
2	150*150 RS Joist (13 mtr)34.6kg/Mtr	no	4000	29237	1169
3	116*100 mm RS Joist 11 mtr(23kg/meter)	no	5000	16445	822

4	80 mm2 Conductor AAAC	Km	5000	43000	2150
5	100 mm2 Conductor AAAC	Km	600	55000	330
6	LT XLPE ABC 3X50+1X35 MM2	KM	2000	130000	2600
9	LT PVC Cable 3.5CX240 mm2 PVC	KM	20	808000	162
10	63KVA 11/0.4KV AL Transformer	no	300	86500	260
11	100KVA 11/0.4KV AL Transformer	no	200	117000	234
12	Power Transformer, 33/11kv, 5MVA	no	5	4315500	216
13	Power Transformer, 33/11kv, 8MVA	no	3	5700000	171
14	AB Switch, 11kv 400amp, 3 pole	no	500	11850	59
15	Lightning Arrester, 12KV, 10KA	no	1000	3550	36
16	33kv Pin Insulator polymer	no	3000	480	14.4
17	11kv pin Insulator Polymer	no	5000	200	10
18	Disc Insulator, B&S, 90 KN	no	5000	360	18
	Hard Ware Fitting (B&S)	Nos	5000	390	20
19	50X50X6mm GI Angle, 100x50x6mm GI channel	kg	20000	65	13
20	33kv V cross arm 16.8kg GI	Kg	5000	1240	62
21	11kv V cross arm 10.2kg each	kg	5000	1410	71
22	LT Distribution Box with MCCB for 63kva	no	300	18322	55
23	LT Distribution Box with MCCB for 100kva	no	200	24419	49
TOTAL					8520
				Or Say	Rs. 85.20 Cr

**12.5 Material Bank Proposal for TPNODL
(Balasore, Bhadrak, Jajpur, Keonjhar & Mayurbhanj):**

Sl No	Material Description Specification	Unit	Quantity	Rate(Rs)	Total cost(Lakhs)
1	9Mtr 300kg PSC Pole	no	5000	3000	150
2	150*150 RS Joist (10 mtr) 34.6kg/Mtr	no	3500	22490	787
3	116*100 mm RS Joist 11 mtr(23kg/meter)	no	3000	16445	493
4	80 mm2 Conductor AAAC	Km	250	43000	108
5	100 mm2 Conductor AAAC	Km	500	55000	275
6	LT XLPE ABC 3X50+1X35 MM2	KM	600	130000	780
7	LT XLPE ABC (3X95+1X70+1x16) MM2	KM	1200	243000	2916
8	11KV 3X95 mm2 XLPE AB Cable	KM	0	673000	0
9	11KV 3X185 mm2 XLPE AB Cable	Km	20	855000	171
10	3CX185mm2 33kv XLPE Cable armoured	km	10	1366000	137
11	3CX300 mm2 33kv XLPE Cable armoured	Km	10	1756000	176
12	LT PVC Cable 3.5CX240 mm2 PVC	KM	20	808000	162

13	63KVA 11/0.4KV AL Transformer	no	110	86500	95
14	100KVA 11/0.4KV AL Transformer	no	220	117000	257
15	Power Transformer, 33/11kv, 5MVA	no	9	4315500	388
16	Power Transformer, 33/11kv, 8MVA	no	6	5700000	342
17	AB Switch, 11kv 400amp, 3 pole	no	300	11850	36
18	Lightning Arrester, 12KV, 10KA	no	700	3550	25
19	33kv Pin Insulator polymer	no	3800	480	18
20	11kv pin Insulator Polymer	no	6500	200	13
21	Disc Insulator, B&S, 90 KN	no	2500	360	9
22	50X50X6mm GI Angle, 100x50x6mm GI channel	kg	7000	65	5
23	33kv V cross arm 16.8kg GI	Kg	4000	1240	50
24	11kv V cross arm 10.2kg each	kg	2700	1410	38
25	LT Distribution Box with MCCB for 63kva	no	110	18322	20
26	LT Distribution Box with MCCB for 100kva	no	220	24419	54
TOTAL					7503
				Or Say	Rs.75.03 Cr

12.6 Total Cost Estimate: DISTRIBUTION SYSTEM

Sl. No	Descriptions	TPCODL	TPNODL	Total Amount (Crore)
1	Lines &DT	2,827	5,174	8,001
2	UG Cabling	269	282	551
3	Sub-station Renovation	126	256	382
4	Material Bank	85	75	160
Total		3,307	5,787	9,094

13.0 Institutional setup for Disaster Response to Distribution Network

The tools & implements not limited to following and capacity building exercise may be kept in the scope of work

- **Mechanized Tools and Equipment:** Each of the Supply Circle in the State shall have one Disaster Management Cell (DMC). The DMC shall have the emergency supply restoration equipment such as pole mounting tractors, Mobile substations, Emergency restoration system for HT line, Hydraulic jacks, Hydraulic pooling machine, Cable jointing tools, gas cutters, power cutters, Trifor, Tripod and single derricks, chain pulley block, Pulley, manila/ PP rope,

welding machine, drilling, insulation megger, earth tester, Tong Tester, spanner sets, portable 5kVA generator sets, etc. The number of equipment shall be commensurating the size of the Circle.

- **Skilled Manpower:** Adequate number of staffs (linemen, helper and officers) shall be identified and trained to meet the exigency during disaster time.
- **Mock Drill:** Mock drill shall be done mostly in the month of June as preparedness exercise.

14.0 Estimate for Institutional set- up for Disaster Response Centres

The estimated requirement of the DRC for the State will be **Rs.154.35 crore** as detailed in the following table.

Sl. No.	Items	Qty	Unit Rate (Lakhs)	Total (Lakh)
1	Portable DG Set - 5 kVA	284	1.65	468.60
2	Mobile sub-stations 250 kVA	284	14.00	3,976.00
3	Emergency Restoration System (ERS) tower- HT line	71	85.00	6,035.00
4	Hydraulic pulling machine	1065	1.50	1,597.50
5	Hydraulic jacks	2130	0.12	255.60
6	Cable Crimping tools	3195	0.04	127.80
7	Gas cutters	355	0.10	35.50
8	Power cutters	710	0.08	56.80
9	Trifor (Hock chuck)	1065	0.21	223.65
10	Tripoid	1065	0.30	319.50
11	Single Derricks	1065	0.10	106.50
12	Chain pulley block(5T capacity)	2130	0.11	234.30
13	Lift Pulley (2T, 5T)	2130	0.15	319.50
14	Manila / PP Rope (kg)	71000	0.01	710.00
15	Welding Machine	284	0.30	85.20
16	Drill Machine	284	0.35	99.40
17	Insulation Megger	2130	0.04	85.20
18	Earth tester	2130	0.05	106.50
19	Tounge Tester	3195	0.03	95.85
20	Spanner Sets	7100	0.07	497.00
21	Pole mounting Tractors	24	12.00	288.00
TOTAL				15,435.40

15.0 Abstract of Estimate

The aggregate cost estimate of **Rs.12,853 Crore** based on the above for disaster resilient infrastructure in the YAAS affected districts is summarized below;

Scope of Work	TPCODL	TPNODL	OPTCL	Total (Rs. in Cr)
132kV & 220kV line and GSS Renovation	-	-	3,525	3,525
33kV, 11kV, LT Lines conversion with DT refurbishment	2,827	5,174	-	8,001
UG Cabling in Urban area	269	282	-	551
33/11 kV Sub-station Renovation	126	256	-	382
Material Bank	85	75	80	240
Total	3,307	5,787	3,605	12,699
Disaster Response Equipment				154
Grand Total	3,307	5,787	3,605	12,853

The above estimates are tentative and shall be finalised at the time of DPR preparation based on the funds availability.

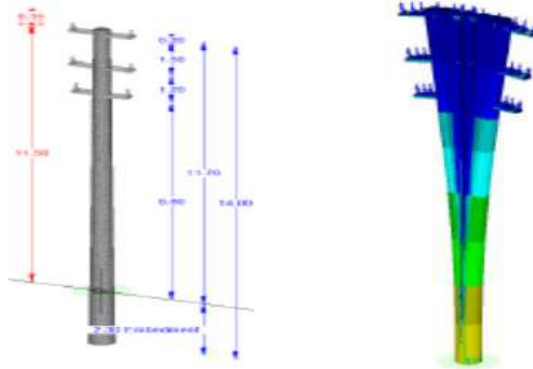
16.0 International Technologies under Study in Indian conditions

A number of innovative design solutions / Technology products which can help in achieving **reliability & safety** which are 2 to 6 times costlier comparing to traditional distribution network. Better design solutions will also help in achieving smaller carbon footprints and will provide better returns on investments in long run. Few of these latest innovations are under study under Indian conditions

STEEL TUBULAR MONOPOLES



COMPOSITE MATERIAL - FRP POLES



Steel Pole vs Distribution Poles

Pole

- ❑ Structure
 - ❑ Self supporting single pole structures. No Stays or Struts
 - ❑ More flexible structure, so less prone to failure
 - ❑ Span up to 150 m even with MC lines. Less poles per Km
 - ❑ Less poles creates less RoW issues & saving in H/Ws
- ❑ Design
 - ❑ Flexibility in design. Different orientation possible
- ❑ Life span
 - ❑ Longer service life of > 50 Yrs.
 - ❑ Comes with protective coating
 - ❑ Less life cycle cost

Conventional Poles (PCC & RSJ)

- ❑ Structure
 - ❑ Guyed structures. Needs wider land in the field, create RoW issues
 - ❑ Rigid structure, prone to failure under severe conditions or in case of failure of stays
 - ❑ Span 50 m to 70 m Smaller for MC lines. More poles per Km
 - ❑ More poles creates more RoW issues in the field
- ❑ Design
 - ❑ Conventional poles. Difficult to make MC orientation
- ❑ Life span
 - ❑ Service life of 25 Yrs.
 - ❑ No protective coating
 - ❑ Higher life cycle cost

Poles are made from an advanced composite material with integrated UV protection that combines an ultra-strong polyurethane resin and E glass fiber rovings. Poles can also be pre-drilled and pre-assembled.

These composite pole can absorb significant elastic strain energy in high-load situations like hurricanes, tornados, ice storms and seismic events providing high degree of reliability and safety. With an 80 year service life, integrated UV protection requiring no scheduled maintenance resulting in the lowest lifecycle cost and immunity to rot, corrosion, woodpeckers and termites.

Poles unique tapered design enables the modules to be nested in compact bundles allowing for maximized efficiencies in storage and transportation. The eight module system can be configured to build virtually any pole class up to 155 ft. [47.2 m], which lowers the lead time for deliveries, reduces inventory requirements and simplifies transportation, handling and installation.

The above technological development may be used at the time of implementation based on their suitability in Indian ambience and their prices.

17.0 Conclusion

The proposed network design is being implemented almost across the Country and are proven technologies. This has many advantages over the conventional design apart from cyclone resiliency. Few advantages are as under;

- The designed infrastructures are robust and highly resilient to any extreme climate and wind pressure during any disaster.
- Power supply restoration within very less time post disasters.
- Since the equipment are to be installed near coastal region, deterioration due to saline effect is a prime concern. This is being taken care up while designing specifications of the equipment.
- The proposed network not only ensures reliability during exigencies but also will meet demand growth for future years.
- **Huge loss of public property due to such repeated cyclones in the region especially in the power sector will be very negligible after this one time investment.**
- T&D loss will be reduced and hence will improve the quality and cost of power.
- This new system will ensure safety to life and property.
- Urban areas will become wireless and will improve public conveniences & less disruption, besides aesthetic values.
- The overall improvement in electricity supply reliability will enable the continuity of other emergency services during or immediate post disaster situation.

D. Cyclone Resilient Odisha Coastal Embankment Strengthening Project

Introduction

The east coast of India is one of the six most cyclone prone areas in the world. Odisha is situated in the east coast of India and has 480 Km coast line along Bay of Bengal. Its geographic location makes the coastal zone vulnerable to frequent cyclonic disturbances accompanied by tidal surge. Even though coastline of Odisha is only about 17% of the Indian east coast, it has been affected by nearly 35% of all cyclonic and severe cyclonic storms that have crossed the east coast. Cyclone associated storm surges more often inundates large tracts of coastal districts. On an average, about five to six tropical cyclones form in the Bay of Bengal every year, of which two to three are within the mild to severe range. Taking together the storms and severe storms, coastal Odisha is about twice as vulnerable as compared to the other eastern states. Indian sub-continent witnessed 359 cyclones of varying magnitude during the period 1891 to 2000. Out of which, 98 cyclones have crossed Odisha coast which is more than that of cyclones crossed coast of Andhra Pradesh, West Bengal, Karnataka, Taminadu, Maharastra, Goa , Gujurat & Kerala.

Necessity of the Project :

The coastal districts of Odisha are thickly populated and have fertile agricultural land due to formation of delta by major rivers such as the Mahanadi, Subarnarekha, Brahmani, Baitarani, Rushikulya, Vansadhara and their branches. Therefore, these districts are vulnerable to multiple disasters such as cyclones and floods. Further, Mahanadi, Brahmani, and the Baitarani have a common delta. During flood, water intermingles causing large scale devastation. This problem becomes more acute when floods coincide with high tide. The water level rises on the river-bed and rivers often overflow their banks causing heavy damages. The entire coastal belt is prone to storm surges, which is usually accompanied by heavy rainfall thus making the estuary region vulnerable to both storm surges and river flooding.

The state has constructed around 7500 km of different type of embankments for flood protection and to arrest saline ingress. Out of which, 1636 Km of embankment has been constructed for arresting saline ingress and storm surge. The district wise details are given below.

District-wise Length of Odisha Coastline and Saline Embankment:

Coastal District	Length of Coast (Km)	Length of Saline Embankment (Km)
Ganjam	60.85	70
Puri	136.48	485
Jagatsinghpur	58.95	264
Knedrapara	83.55	508
Bhadrak	52.61	148
Balasore	87.96	128
Khordha	0.00	70
Total :	480.40	1636

The state witnessed Super Cyclone in 1999 and 7nos. of severe to very severe cyclonic events; namely, PHAILIN, HUDHUD, TITLI, FANI, BULBUL, AMPHAN and YASS in last decade. It is observed that the saline embankments constructed are not capable to provide reasonable degree of protection to life and property of people from the above extreme events. A large part of coastal area was inundated due to these extreme events. Large scale damages occurred due to these extreme events.

Storm Surge of 3.70 m to 4.00 m was observed along the shoreline of four districts during recently occurred very Severe Cyclonic Storm **YAAS**. The saline embankments could not provide reasonable degree of protection due to its low height.

Climate scientists have forecasted that such type of extreme events will occur frequently in future in the east coast of India due to climate change effect. In order to protect the villages including lives & livestock of coastal people and their agricultural fields, it is planned for constructing a storm surge resilient embankment along the Odisha Coast as a long term measure to make the coastal belt state disaster proof.

PRESENT PROPOSAL:

The objective of the project is to protect the life and property of the people residing in the coastal belt particularly in low laying areas by constructing storm surge resilient embankments which will tackle the extreme cyclone events on long term basis. Besides, our focus is also on sustainable coastal protections at five places of tourism importance namely

at Talasari Beach in Balasore, Pentha beach in Kendrapada, Siali beach in Jagatsingpur, Puri beach from Mangala river to Bhrgabi river & Ramayapatana beach in Ganjam district. Our past experience shows that saline embankments constructed during 2013-16 on pilot basis in 52 km stretch in four coastal districts of Jagatsingpur, Kendrapada, Gnjam, Puri under National Cyclone Risk Management Project (NCRMP) have witnessed six major cyclonic events and have provided reasonable degree of protection to the life and property of people in nearby areas without much damage. That apart, coastal erosion work taken up at Pentha in Rajnagar Block in Kendrapada district under ICZMP also performed satisfactorily during cyclonic events.

While preparing the present proposal, the guidelines followed during execution of NCRMP Works has been adopted. A tentative estimate has been prepared by keeping embankment TBL 6.00m for Balasore, Bhadrak, Kendrapara and Jagatsinghpur Districts, 5.20m for Puri and 4.50m for Ganjam as has been adopted during execution of NCRMP project. Similarly, the crest width of the embankment has been made at 4.50m for smooth vehicular movement. The sea side slope has been kept as 1:2 whereas country side slope of the embankments has been made as 1:2 or 1:1.5 depending upon availability of land. The seaside slope would be protected by providing stone packing with gabions. The launching aprons and protection to scoured banks would be provided at suitable vulnerable locations of the embankments. There is provision for new construction and renovation of existing sluices, wherever required. Provision has also been made to develop the embankment top road to water bound macadam standard for facilitating movement of vehicular traffic. However, detail design IS specification would be followed during implementation of the project.

The proposal envisages following items of work:

- (i) Raising & Strengthening of Saline Embankments as per NCRMP Standard.
- (ii) Seaside Protection of Embankment through Stone Packing with Gabions
- (iii) Launching Aprons with Scoured Bank Protection at Vulnerable Locations
- (iv) Construction of New Sluices/Renovation of Existing Sluices for Drainage Clearance
- (v) WBM Road Work over Top of Embankment for Communication
- (vi) Sustainable coastal protection of beaches at five places of tourism importance

Accordingly, the following proposals are prepared in 6 Districts.

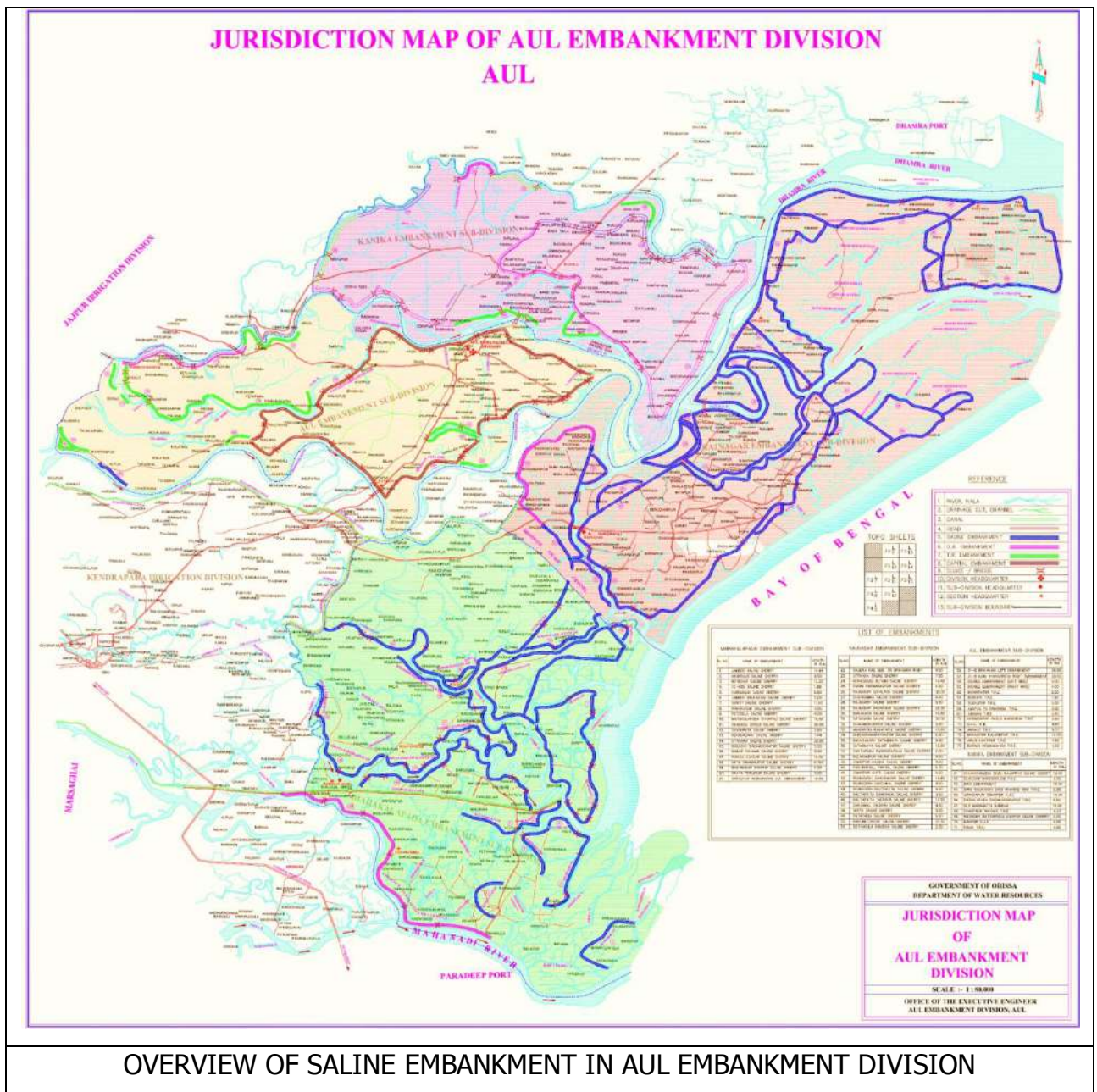
SI No.	District	Length of the Embankments proposed for Improvement (in Km.)	Amount (Rs. in Lakhs)	No of Villages to be benefitted	Population to be benefitted (in Nos.)	Agricultural Land to be protected (in Ha.)
1	Balasore	116.95	51458.00	72	270000	2680
2	Bhadrakh	100.90	34820.00	51	166950	14630
3	Kendrapara	224.52	98006.82	229	238164	25524
4	Jagatsinghpur	19.82	14394.00	45	47000	4580
5	Puri	70.45	23507.34	85	104680	17410
6	Khurdha	16.30	5216.00	13	26600	1710
7	Ganjam	6.50	800.00	10	15000	2000
B	Beach restoration of Tourism importance	26	72000.00	-	-	-
	TOTAL	581.43	300202.16	505	868394	68534

OUTCOME OF THE PROJECT:

Upon completion of the project, 8,68,394 population in 505 villages covering 23 blocks would be provided protection against storm surge and saline inundation. The details are given in the above table.

Photographs

1. Map of Saline embankments constructed in shape of rings to protect the villages and agricultural lands.
2. Damages inflicted to river & saline embankments in recent cyclone "YAAS"
3. Collapse of bank on shoreline at Rameyapatna in Ganjam District.
4. Saline embankments raised & strengthened under NCRMP(2013-16).
5. Geo-tube embankment constructed at Pentho in Kendrapara District under ICZMP with Design by IIT, Madras





Damage of Naliatapatia Talachua Saline Embankment due to "YAAS"



Damage of Keradagada Altnaga saline Embankment on Hansua right due to Cyclone "YAAS"



Parikhi Saline embankment submerged due to storm surge of cyclone "YAAS"



RAMAYAPATANA - Shoreline erosion during cyclone "Titili " on 11.10.2018



Saline Embankment done through in Jagatsingpur district under NCRMP (2013-16)



Saline Embankment done through in Puri district under NCRMP (2013-16)



Laying of Geo Tube during construction at Pentha in Kendrapada district



Accretion of sand has started in front of Geo Tube embankment at Pentha

CHAPTER-XII

VISUAL ACCOUNTS



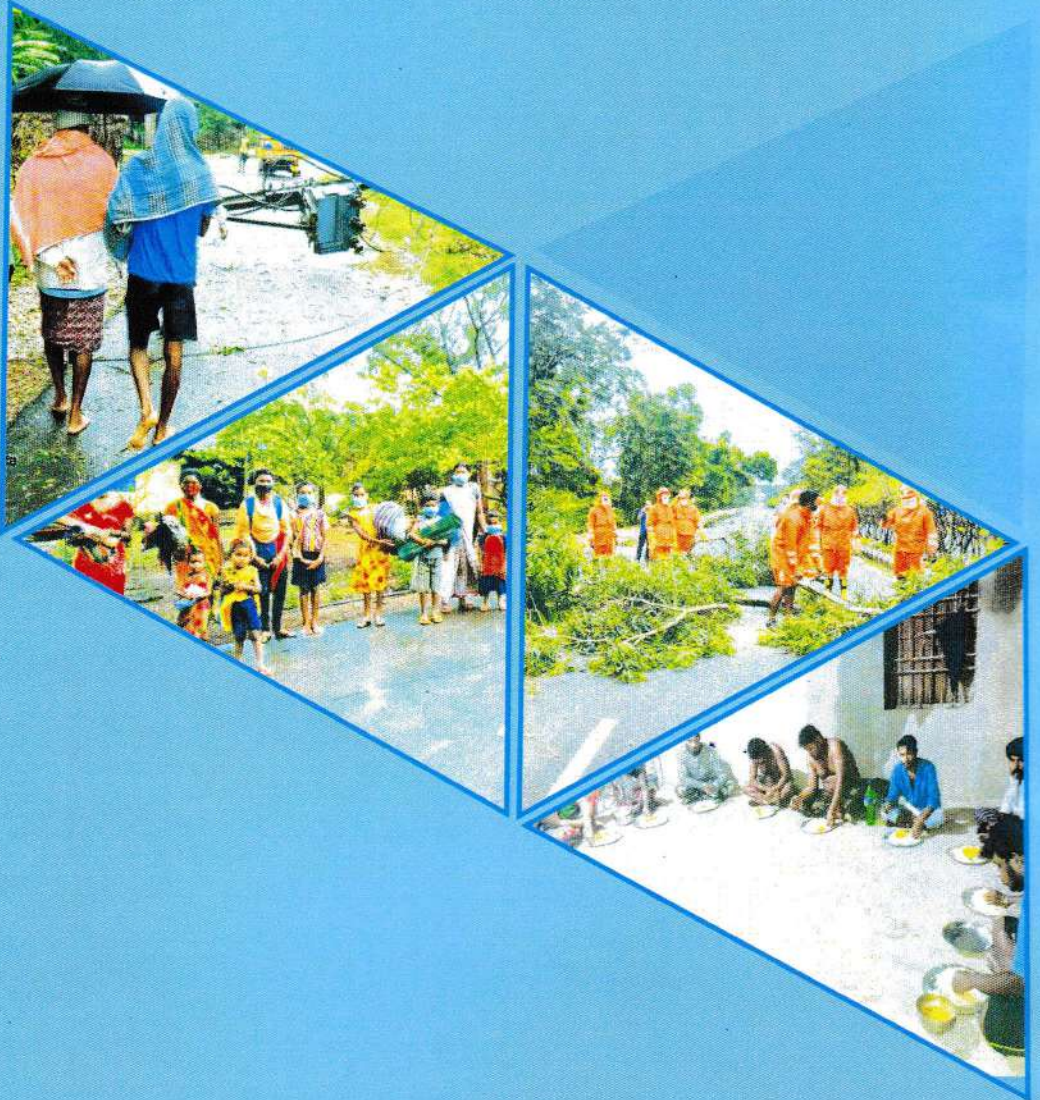








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