



CYCLONE YAAS 2021: A PREPAREDNESS & EMERGENCY RESPONSE PERSPECTIVE



Resilient India - Disaster free India

National Institute of Disaster Management
(Ministry of Home Affairs, Government of India)



CYCLONE YAAS 2021: A PREPAREDNESS & EMERGENCY RESPONSE PERSPECTIVE



National Institute of Disaster Management (NIDM)
(Ministry of Home Affairs, Government of India)

Plot No. 15, Pocket 3, Block B, Sector 29, Rohini, Delhi 110042
Website : <https://nidm.gov.in>

Cyclone Yaas 2021: A Preparedness & Emergency Response Perspective

ISBN No.: 978-81-956700-9-3

© National Institute of Disaster Management, Delhi

Edition : 2022

Authors

Maj. Gen. Dr. V. K. Naik, KC, AVSM
Maj. Gen. Manoj Kumar Bindal, VSM
Sh. Tapash Kumar Saha Roy

Published by

National Institute of Disaster Management (NIDM), Ministry of Home Affairs,
Government of India, Delhi-110042.

Citation

Naik, V. K., Bindal, M. K. and Saha Roy, T. K. (2022). Cyclone Yaas 2021: A Preparedness & Emergency Response Perspective. National Institute of Disaster Management, Delhi. Pages 108.

Disclaimer

This document may be freely reviewed, reproduced or translated, in part or whole, purely for non-profit and non-commercial basis for humanitarian, social and environmental well being with permission from the Institute and with due credits to the authors. We welcome receiving information and suggestions for improvement in its future editions. The contents of this document have been written/compiled by the authors from the various sources mentioned in the book.



कमल किशोर
सदस्य

Kamal Kishore
Member
&
Secretary I/C



राष्ट्रीय आपदा प्रबंधन प्राधिकरण
National Disaster Management Authority

भारत सरकार
Government of India

एन.डी.एम.ए. भवन
ए-1, सफदरजंग एन्क्लेव, नई दिल्ली-110 029

NDMA Bhawan
A-1, Safdarjung Enclave, New Delhi - 110 029

27th January, 2022

MESSAGE



Documentation of disasters is one of the very important roles assigned to the National Institute of Disaster Management (NIDM). I am delighted to note that the NIDM has taken a very timely initiative of publishing the document "Cyclone Yaas: A Preparedness and Emergency Response Perspective". This initiative of the NIDM is very significant as it is in conformity with the "Ten Point Agenda for DRR" enunciated by the Hon'ble Prime Minister of India, Shri Narendra Modi.

The nation has come a long way in cyclone risk mitigation since the Odisha Super Cyclone of 1999. Yet global warming and climate change continue to pose challenges that need to be addressed promptly for attaining the desirable levels of disaster resilience and the goals of DRR set in our National Disaster Management Plan 2019. Documentation of disasters and associated research is a critical function for improving upon the way we manage disasters in future. It is very heartening to note that the document covers varied aspects of preparedness and response and also describes the devastation caused by the cyclone. The study is also important as Cyclone Yaas struck during the deadly Second Wave of COVID-19 across the nation.

I take this opportunity to complement NIDM for the effort and extend my greetings and best wishes to the institute for all future endeavours.

(Kamal Kishore)



ले ज सय्यद अता हसनैन
पी.वी.एस.एम., यू.वाई.एस.एम., ए.वी.एस.एम.,
एस.एम., वी.एस.एम. ** (सेवानिवृत्त)
सदस्य
Lt Gen Syed Ata Hasnain
PVSM, UYSM, AVSM, SM, VSM** (Retd.)
Member



राष्ट्रीय आपदा प्रबंधन प्राधिकरण

गृह मंत्रालय, भारत सरकार

एन.डी.एम.ए. भवन

ए-1, सफदरजंग एन्क्लेव, नई दिल्ली-110 029

National Disaster Management Authority

Ministry of Home Affairs, Government of India

NDMA Bhawan

A-1, Safdarjung Enclave, New Delhi-110 029

टेल. / Tel.: +91 11 26701775

फै. / Fax.: +91 11 26701729

ई-मेल / E-mail: syedata.hasnain@ndma.gov.in

27th January 2022

MESSAGE



I am very pleased to note that the National Institute of Disaster Management (NIDM) has documented the recent cyclone Yaas which struck the east coast of India in May 2021 immediately on the heels of Cyclone Tautke which hit the West Coast. Given the long coastline of India, cyclones pose a grave challenge particularly in the backdrop of Global Warming and Climate Change. It is becoming increasingly important to study each cyclone in all its nuances and endeavor to bring out lessons enhance the disaster resilience of our coastal regions and further refining the strategies for disaster risk reduction.

It is heartening to observe that all the important activities towards preparedness and efficient response undertaken at various levels have been documented very systematically in chronological order and very important lessons for cyclone risk mitigation have been brought out. I am confident that the document will be very useful for all disaster management professionals.

I wish to congratulate the NIDM for the initiative and compliment all those associated with preparing this document.


(Lt. Gen Syed Ata Hasnain)



ताज हसन, भा. पु. से.
कार्यकारी निदेशक

Taj Hassan, IPS
Executive Director



राष्ट्रीय आपदा प्रबंधन संस्थान
National Institute of Disaster Management

(गृह मंत्रालय, भारत सरकार)

Ministry of Home Affairs, Govt. of India

प्लॉट नं. 15, ब्लॉक बी, पॉकेट 3,
सेक्टर 29, रोहिणी, दिल्ली - 110042

Plot No. 15, Block B, Pocket 3,
Sector 29, Rohini, Delhi - 110042



FOREWORD

India, with its long coast line is extremely vulnerable to cyclones. Cyclones of varying intensity have been causing havoc in the coastal regions at regular interval. On 26 May 2021, the severe cyclonic storm “Yaas” made landfall on the east coast of India causing heavy losses and damage to infrastructure, predominantly in the coastal districts of Odisha and West Bengal. The cyclone hit at a time when the disaster management systems in India, particularly the medical and health care systems, were over stretched in managing the deadly second wave of the COVID-19 Pandemic. The disaster was responded to in a very professional manner by the Central Government and also by the respective State Governments. The challenging conditions during the cyclone have thrown up issues which merit consideration particularly in multi hazard scenarios. It is important to document such disasters in order to further improve upon the efficiency of handling such disasters and mitigating its impact on people in future.

I compliment the NIDM for documenting the Cyclone Yaas in a chronological manner highlighting response from all the important stake holders and bringing out valuable lessons. I am sure that the “Cyclone Yaas 2021: A Preparedness & Emergency Response Perspective” being published by the NIDM will be useful to all the practitioners and students of disaster management.

Taj Hassan

आपदा प्रबंधन महाविचार: पूरा भारत भागीदार

Acknowledgement

As enunciated by the Honourable Prime Minister of India, Shri Narendra Modi, in his “Ten-Point Agenda for Disaster Risk Reduction”, we must “make use of every opportunity to learn from disasters and, to achieve that, there must be studies on the lessons after every disaster”. The attempt to document Cyclone Yaas, and bring out certain lessons, potentially useful for managing such disasters in the future, has been a very satisfying professional experience. I, on behalf of my team - Maj Gen M K Bindal, VSM & Shri Tapash Kumar Saha Roy, - am grateful to the NIDM, for providing us with an opportunity and a platform for this important study. First and foremost, we are thankful to the DG IMD, Ministry of Earth Sciences, for making available all the technical data on the official website of the IMD. We have made extensive use of the details made available by the IMD. We are also thankful to the MHA and the Press Information Bureau, Government of India, for making available all the relevant information in the public domain which came in handy in preparing this report.

We are thankful to Shri Dushyant Nariala, IAS, Principal Secretary, Disaster Management and Civil Defence, Government of West Bengal for his valuable inputs regarding preparedness and response in the state. We are also grateful to the Government of Odisha for sharing details on their official website without which it was not possible to complete this document. The details provided were very useful and have been extensively used. We are also grateful to the HQ IDS and HQ ICG for providing formal inputs regarding Humanitarian Assistance & Disaster Response Operations conducted by the Indian Armed Forces and the Indian Coast Guard.

Our most sincere thanks to Lt. Gen. N. C. Marwah, PVSM, AVSM (Retd.), former Member, NDMA and Prof. V. K. Sharma, Vice Chairman Sikkim SDMA, for sparing their precious time to review the document and provide guidance in finalizing it.

Our Special thanks to Shri S. K. Tiwari, Librarian and Ms. Karanpreet Kaur Sodhi, Jr. Consultant, NIDM for assistance and coordination for printing this document. Lastly, we would like to thank the staff of the NIDM in administration, accounts, and IT sections for providing institutional support.

We sincerely hope that the publication is useful towards further research and studies on disaster preparedness and response in the country.


(Maj Gen Dr V K Naik)

Contents

	Page
Message	iii-v
Foreword	vii
Acknowledgement	ix
Contents	xi
List of Figures	xv
List of Tables	xvii
List of Acronyms	xix
1. CHAPTER 1: INTRODUCTION	1
1.1 Background	1
1.2 Cyclones - The Phenomenon	2
1.3 Risk and Vulnerability of Cyclones - The Indian Context	3
1.4 Climate Change and Cyclones	11
2. CHAPTER 2: EARLY WARNING & PREPAREDNESS	15
2.1 Background	15
2.2 Cyclone Warning and Preparedness Measures - 19 th May 2021	15
2.3 Cyclone Warning and Preparedness Measures - 20 th May 2021	16
2.3.1 Pre-emptive Measures by the Indian Coast Guard (ICG)	16
2.4 Cyclone Warning and Preparedness Measures - 22 nd May 2021	17
2.5 Cyclone Warning and Preparedness Measures - 23 rd May 2021	17
2.5.1 Preparation by Armed Forces to Mitigate Cyclone Yaas	18
2.5.2 Review of Preparedness & Planning by the Prime Minister	19
2.6 Cyclone Warning and Preparedness Measures - 24 th May 2021	21
2.6.1 Review of Preparedness & Planning by Central Govt. Ministers with Industry Leaders	22
2.6.2 Review Meeting by the Union HM with Chief Ministers	23
2.7 Cyclone Warning and Preparedness Measures - 25 th May 2021	25
2.7.1 Preparatory Measures in Odisha	27
2.7.2 Preparatory Measures in West Bengal	34
3. CHAPTER 3: LANDFALL, IMPACT AND EMERGENCY RESPONSE	43
3.1 Situation on 26 th May 2021	43

	3.1.1 Situation in Odisha	44
	3.1.2 Situation in West Bengal	52
	3.1.3 Situation in Jharkhand	57
	3.2 Situation on 27 th May 2021	58
	3.2.1 Situation in Odisha	58
	3.2.2 Situation in West Bengal	59
	3.2.3 Situation in Jharkhand	59
	3.3 Situation on 28 th May 2021	60
	3.3.1 Disaster Resilient Power System	62
	3.4 Situation on 29 th May 2021	63
4.	CHAPTER 4: ROLE OF ARMED FORCES, NDRF & ICG IN EMERGENCY OPERATIONS	65
	4.1 Introduction	65
	4.2 Indian Army Operations	65
	4.3 Indian Air Force Operations	66
	4.4 Indian Navy Operations	67
	4.4.1 Odisha	67
	4.4.2 West Bengal	68
	4.5 Rescue and Relief Operations by the (NDRF)	69
	4.6 Indian Coast Guard (ICG)	72
	4.6.1 Role of ICG in Disaster Situations	72
	4.6.2 Preventive Measures and Preparedness	73
	4.6.2.1 ICG operations During Cyclone Yaas	74
5.	Chapter 5: LOSS AND DAMAGES - WEST BENGAL & ODISHA	77
	5.1 Introduction	77
	5.2 Loss and Damages in Odisha	77
	5.3 Loss and Damages in West Bengal	80
	5.4 Summary of Damage	87
6.	CHAPTER 6: LESSONS & RECOMMENDATIONS	89
	6.1 Introduction	89
	6.2 Early Warning & Forecasting	90
	6.3 Cyclone Risk & Climate Change	90
	6.4 Climate Change Adaptation (CCA) Strategy	90
	6.5 Cyclone Risk Evaluation	91

6.6	Enhancing Resilience & Cyclone Risk Reduction	91
6.7	Cyclone Resilience in Housing Sector and Critical Infrastructure	91
6.8	Study of Coastal Inundation Pattern	91
6.9	Environmental Concerns	92
6.10	Approach to Damage and Loss Assessments	92
6.11	Long Term Mitigation	92
6.12	Disaster Management Plans	93
6.13	Disaster Response Operations	94
6.14	Inter-Agency Coordination for Disaster Response	96
6.15	Strengthening Emergency Communication Plans & Systems	96
6.16	Social Media	97
6.17	Rescue Operations at Sea	98
6.18	Community Based Disaster Management	99
6.19	Capacity Building for Emergency Response	100
6.20	Employment of NDRF, Armed Forces and CAPFs	100
6.21	Issues Specific to the Deployment of the Armed Forces & ICG in Disaster Response	101
6.22	Conclusion	102
7.	Annexure-I	103

List of Figures

Figure Number	Title	Page No.
Figure 1.1	Cyclone Frequency and Wind Hazard Map of India	5
Figure 1.2	Map showing Cyclone Hazard Prone Districts of India	6
Figure 2.1	The observed and forecast track of the cyclone on 24 th May 2021	21
Figure 2.2	Hon'ble Union Home Minister reviewed the situation on 24 th May 2021	23
Figure 2.3	Indian Coast Guard (ICG) mobilizes its assets in view of cyclone Yaas expected to hit the Eastern Coast on 26 th May 2021	25
Figure 2.4	Observed and forecast track along with cone of uncertainty of severe cyclonic storm "Yaas" over West-central and adjoining East-central and North Bay of Bengal based on 0300 UTC of 25 th May 2021	27
Figure 2.5	West Bengal CM Mamata Banerjee at the Nabanna control room	35
Figure 2.6	IEC material used for awareness generation	36
Figure 3.1	Observed and forecast track along with cone of uncertainty of very severe cyclonic storm "Yaas" over North Coastal Odisha based on 0600 UTC of 26 th May 2021	43
Figure 3.2	Sea water enters through boundaries of a house during cyclone Yaas's landfall in Chandipur area of Balasore	45
Figure 3.3	Under the impact of Cyclone Yaas, tidal surges inundated 3 seaside villages in Balasore district marooning about 5,000 people	45
Figure 3.4	A woman stands next to her stall damaged by heavy winds in the Balasore district	46
Figure 3.5	Cyclone Yaas-District wise cumulative rainfall in Odisha, 25 th - 27 th May 2021	46
Figure 3.6	Relief Measures announced by The CM of Odisha	48
Figure 3.7	To ensure early restoration in Cyclone Yaas affected districts, Odisha FS HGs CD personnel carrying out restoration work on a war footing in different parts of the state	49
Figure 3.8	Digha, West Bengal: As per IMD estimates storm came with wind speed of 130-155 kmph	53

Figure 3.9	Pedestrians waded through a flooded road during landfall of cyclone 'Yaas', in Kolkata, Wednesday, May 26 th , 2021	54
Figure 3.10	Devastation caused to the hotels in the aftermath of the cyclone in Digha	55
Figure 3.11	Storm water inside Bhagabatpur crocodile centre in Sundarbans	56
Figure 3.12	Storm fear pushes down footfall in most hospitals	57
Figure 3.13	Many trees and electric poles were also uprooted in Ranchi due to high-speed winds, disrupting power supply	58
Figure 3.14	A Collapsed Bridge in Ranchi	59
Figure 3.15	Observed track of very severe cyclone storm "Yaas" over east central Bay of Bengal during 23 th -28 th May, 2021.	60
Figure 3.16	Hon'ble Prime Minister Shri Narendra Modi during a meeting with Odisha CM Naveen Patnaik to review the impact of Cyclone 'Yaas', in Bhubaneswar, on Friday, May 28 th , 2021	61
Figure 4.1	A member of the NDRF uses a megaphone to appeal to residents to move to safer place ahead of Cyclone Yaas at Digha in Purba Medinipur district in West Bengal	71
Figure 4.2	NDRF teams clearing uprooted trees on the roads	71
Figure 4.3	Rescued stranded people by ICG from Nayacharya Island, West Bengal	75
Figure 5.1	Cyclone Yaas - A glimpse of Damages & Destruction in coastal Odisha	79
Figure 5.2	Damage of Naliatapatia Talachua Saline Embankment due to "Yaas".	80
Figure 5.3	Damage of Keradagada Altnaga saline Embankment on Hansua right due to Cyclone "Yaas"	80
Figure 5.4	Distribution of Losses across Various Sectors	83
Figure 5.5	Cyclone Yaas - A glimpse of Damages & Destruction in coastal West Bengal	84
Figure 5.6	Cyclone Yaas - A glimpse of Damages & Destruction in coastal West Bengal	85
Figure 5.7	Cyclone Yaas - A glimpse of Damages & Destruction in coastal West Bengal	86

List of Tables

Table Number	Title	Page No.
Table 1.1	Indian Classification of Cyclonic Disturbances in the North Indian Ocean (Bay of Bengal and Arabian Sea)	3
Table 1.2	Classification of Cyclones based on wind speed and its capacity to cause damage	3
Table 1.3	List of Number of Cyclones crossing various Coastal Districts of the East and West Coasts of India during the Period 1891-2002	6-7
Table 1.4	List of major Cyclone Disasters in India	8-11
Table 2.1	Number of shelters identified under the COVID condition	28-29
Table 2.2	District wise availability of shelters in Odisha as on 25 th May 2021	29-30
Table 2.3	Prepositioning of Response Forces in Odisha as on 25 th May 2021	30
Table 2.4	District wise status of Tube Wells and & Pipe Water Supply in Odisha as on 25 th May 2021	32
Table 2.5	District wise status of medical facilities in Odisha as on 25 th June 2021	33
Table 2.6	District wise status of medical facilities in Odisha as on 25 th June 2021	34
Table 2.7	District wise status of Flood Shelters & Cyclone Shelters and No. of Relief Shelters utilized in Cyclone Yaas	38-39
Table 2.8	District wise breakdown of evacuated of people from vulnerable areas to shelters in West Bengal	39
Table 3.1	District wise average rainfall from 25 th May to 27 th May 2021	47-48
Table 3.2	District wise Evacuation Status in Odisha	50
Table 3.3	District wise Details of Emergent Relief Distributed in Odisha	51
Table 4.1	Summary of Army Columns Deployed in West Bengal	66
Table 4.2	Operations by the Naval Teams in West Bengal	68-69
Table 4.3	Deployment of NDRF Teams for Cyclone Yaas as on 23 rd May 2021	70

Table 4.4	Deployment of NDRF Teams for Cyclone Yaas as on 24 th May 2021	70
Table 4.5	Deployment of ICG ships and aircraft from 19 to 27 th May 2021	73
Table 4.6	ICG Disaster Response Teams – Cyclone Yaas	75
Table 5.1	Extent of damage due to Very Severe Cyclone “YAAS” in Odisha	77-78
Table 5.2	Extent of damage due to Very Severe Cyclone “YAAS” in West Bengal from 26 th to 28 th May 2021	81-82
Table 5.3	The details of Damaged Blocks, Municipalities, Gram Panchayats & Villages	82
Table 5.4	Synopsis of Quantum of Damages Assessed	82-83
Table 5.5	Summary of damage in the states of Odisha and West Bengal & Jharkhand	87-88

List of Acronyms

ARD	Animal Resource Development
ASHA	Accredited Social Health Activist
AVS	Anti Venom Serum
ACWC	Area Cyclone Warning Centre
ADSS	All-dielectric Self-supporting
AWC	Anganwadi Centre
AWW	Anganwadi Worker
BCW	Backward Classes Welfare
BoB	Bay of Bengal
BGSY	Banglar Gramin Sarak Yoyana
BMTPC	Building Materials and Technology Promotion Council
CAPFs	Central Armed Police Forces
CWC	Cyclone Warning Centre
CCA	Climate Change Adaptation
CHC	Community Health Centre
CMO	Chief Minister Office
COVID-19	Corona Virus Disease
CRZ	Coastal Regulation Zone
DDMA	District Disaster Management Authority
DDMPs	District Disaster Management Plans
DEOC	District Emergency Operation Center
DG	Director General
DGM	Director General of Meteorology
DHH	District Hospital
DM	District Magistrate
DM	Disaster Management
DM Act	Disaster Management Act
DMT	Disaster Management Team

DRR	Disaster Risk Reduction
DRTs	Disaster Relief Teams
DRTs	Disaster Response Teams
DWR	Doppler Weather Radar
DTR	Distribution Transformer
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
EDD	Estimated Date of Delivery
EOC	Emergency Operation Centre
EWS	Early Warning System
FRT	Flood Relief Teams
FRU	First Referral Unit
GFDL	Geophysical Fluid Dynamics Laboratory
GIS	Geographical Information System
GPs	Gram Panchayats
Ha	Hectare
HADR	Humanitarian Assistance and Disaster Relief
Hqrs/HQ	Headquarters
HT	High Tension
INCOIS	Indian National Centre for Ocean Information Services
INSAT	Indian National Satellite
IAF	Indian Air Force
ICG	Indian Coast Guard
IDRN	India Disaster Resource Network
IEC	Information Education Communication
IMD	India Meteorological Department
IITM	Indian Institute of Tropical Meteorology
INR	Indian Rupee
INS	Indian Navy Ships

IPCC	Intergovernmental Panel on Climate Change
IIT	Indian Institute of Technology
IRS	Incident Response System
ISN	International safety Net
ISRR	Indian Search and Rescue Region
IST	India Standard Time
Kgs	Kilograms
KMC	Kolkata Municipal Corporation
KV	Kilovolts
LT	Low tension
MA&ME	Minority Affairs and Madrasah Education
MC	Meteorological Centre
MCs	Municipal Corporations
MoES	Ministry of Earth Sciences
MHA	Ministry of Home Affairs
MOD	Ministry of Defence
MoFAH&D	Ministry of Fisheries, Animal Husbandry and Dairying
MRCCs	Maritime Rescue Coordination Centres
MRSCs	Maritime Rescue Sub Centres
MRSSCs	Maritime Rescue Sub Sub Centres
MSME	Micro, Small and Medium Enterprises
MT	Metric Ton
MTUs	Mobile Treatment Units
NIOT	National Institute of Ocean Technology
NCMC	National Crisis Management Committee
NCMRWF	National Centre for Medium Range Weather Forecasting
NCRMP	National Cyclone Risk Mitigation Project
NDMA	National Disaster Management Authority
NDMP	National Disaster Management Plan

NDRF	National Disaster Response Force
NES	Natural Emergency Sources
NGOs	Non-Governmental Organization
NH	National Highway
NIDM	National Institute of Disaster Management
NIO	North Indian Ocean
NMSARCA	National Maritime SAR Coordinating Authority
NOAA	National Oceanic and Atmospheric Administration
NOIC	Naval Officer-in-Charge
NYKS	Nehru Yuva Kendra Sangathan
ODAs	Offshore Development Areas
ODRAF	Odisha Disaster Rapid Action Force
OFDC	Odisha Forest Development Corporation
OHAs	Oil Handling Agencies
OMFED	The Orissa State Cooperative Milk Producers' Federation Limited
ONGC	Oil and Natural Gas Commission
OPD	Out Patient Department
OPTCL	Odisha Power Transmission Corporation Limited
ORS	Oral Rehydration Solution
OSVs	Offshore Support Vessels
P&RD	Panchayat & Rural Development
pcs	Pieces
PHC	Primary Health Centre
PHE	Public Health Engineering
PHEO	Public Health Engineering Organization
PIB	Press Information Bureau
PM	Prime Minister
PMGSY	Pradhan Mantri Gram Sadak Yojana
PMO	Prime Minister's Office

POL	Petrol, Oil & Lubricant
PPE	Personal Protective Equipment
PPP	Public Private Partnership
PR&DW	Panchayati Raj and Drinking Water
PRIs	Panchayati Raj Institutions
PTI	Press Trust of India
PVC	Poly Vinyl Chloride
PWD	Public Works Department
PWS	Pipe Water Supply
PWSS	Piped Water Supply Scheme
QRTs	Quick Response Teams
Qtl	Quintal
Radar	Radio Detection and Ranging
RMC	Regional Meteorological Centre
RSMC	Regional Specialized Meteorological Centre
R&D	Research & Development
RH	Rural Health
RIDF	Rural Infrastructure Development Fund
ROC	Regional Operating Centres
ROS	Remote Operating Stations
RORS	Remote Operating Radar Stations
SAR	Search and Rescue
SAC-ISRO	Space Application Centre- Indian Space Research Organization
SDH	Sub-District Hospital
SDMA	State Disaster Management Authority
SDMPs	State Disaster Management Plans
SDRF	State Disaster Response Force
SEOC	State Emergency Operation Centre
SHG & SE	Self Help Group and Self Employment

SHGs	Self Help Groups
SMS	Short Message Service
SOPs	Standard Operating Procedures
SP	Superintendent of Police
SRT	Search and Rescue Teams
TCs	Tropical Cyclones
UD	Urban Development
UD&MA	Urban Development & Municipal Affairs
ULB	Urban Local Bodies
UNESCO	The United Nations Educational, Scientific and Cultural Organization
US	United States America
US\$	United States Dollar
USD	United States Dollar
UTC	Coordinated Universal Time
UTs	Union Territories
VHF	Very High Frequency
VCB	Vacuum Circuit Breaker
VSCS	Very Severe Cyclonic Storm
WMO	World Meteorological Organization

1. INTRODUCTION

1.1 Background

Cyclone Yaas, a Very Severe Cyclonic Storm (VSCS) hit India's eastern coast in Odisha and West Bengal on 26th May 2021. This cyclone on the eastern coast of India struck in very quick succession to the Cyclonic Storm "Tauktae" which hit the western coast in Maharashtra, Gujarat, Diu and Goa on 18th May 2012. These cyclones hit at a very critical time when the disaster management systems in India, particularly the medical and health care systems, were overstretched in management of the deadly second wave of the COVID-19 Pandemic. Cyclone Yaas which was the first cyclonic storm to develop over the Bay of Bengal in the year 2021 was named so by Oman. The cyclone caused significant loss to urban and rural infrastructure, property, and agriculture in coastal districts of Odisha and West Bengal besides impacting Andaman and Nicobar Islands, Andhra Pradesh, Tamilnadu, Jharkhand and Bihar to some extent.

While the Centre and the State Governments initiated very prompt pre-disaster and post-disaster actions to mitigate the impact of the disaster, the disaster and the various activities undertaken for its management must be documented objectively to help introspect and analyze the gaps in our system and arrive at lessons to improve upon the contemporary disaster management structures, mechanisms, and practices. This document aims at discussing the phenomenon of cyclones in general, the past history, patterns and observations and impact of climate change on the pattern of cyclones in general followed by documenting the full spectrum of events ranging from early warning & preparedness to emergency response, relief and rescue and long term mitigation measures undertaken by state governments.

The impact of the disaster was unfathomable for the local coastal population in Odisha and West Bengal states. The Odisha and West Bengal Governments launched a huge rescue and relief operation immediately with the assistance of the Centre, accomplishing one of the biggest rescue and relief operations in which more than 2.15 million people were evacuated to safe places. The armed and paramilitary forces, the NDRF, the State administration, and the SDRFs worked tirelessly to bring comfort to the suffering population.

The total damages in West Bengal were estimated to be around ₹20 thousand crores (US\$2.76 billion). The cyclone also caused an estimated ₹610 crore (US\$83.63 million) in damage in Odisha¹.

¹Cyclone Yaas. https://en.wikipedia.org/wiki/Cyclone_Yaas(accessed on 1st November 2021)

1.2 Cyclones - The Phenomenon

Cyclone is a term used for describing the multi-hazard weather system i.e. a system of clouds and thunder storms, in which high-speed winds swirl inwards towards the center of a low-pressure area. Cyclones are usually accompanied by heavy rains and storm surges when they make landfall. The India Meteorological Department (IMD) describes “Cyclonic Storm” or a “Cyclone” as “an intense vortex or a whirl in the atmosphere with very strong winds circulating around it in anti-clockwise direction in the Northern Hemisphere and in clockwise direction in the Southern Hemisphere”².

Cyclones that form over warm tropical or subtropical seas are termed “tropical cyclones”. These are also termed Typhoons, Hurricanes, and Tornados. “Tropical cyclones are known by various names in different parts of the world. In the North Atlantic Ocean and the eastern North Pacific, they are called hurricanes, and in the western North Pacific around the Philippines, Japan and China the storms are referred to as typhoons. In the western South Pacific and the Indian Ocean, they are variously referred to as severe tropical cyclones, tropical cyclones or simply cyclones. All these different names refer to the same type of storm.”³

These are usually associated with several other hazards such as high-speed winds, heavy rainfall, storm surge, and floods in the coastal regions, which combine with a severe impact on the life and livelihoods of coastal communities, particularly in the tropical and subtropical areas all over the world.

Cyclonic disturbances are classified based upon the associated maximum sustained wind. The criteria followed by the IMD to classify the low-pressure systems in the Bay of Bengal and the Arabian Sea as adopted by the World Meteorological Organisation (WMO) are given in Table 1.1⁴.

²“Cyclone Warning in India, Standard Operating Procedure”, India Meteorological Department, Ministry of Earth Sciences, Government of India, March 2021, p-1, (accessed on 1st December 2021).https://mausam.imd.gov.in/imd_latest/contents/pdf/cyclone_sop.pdf (Accessed on 09 November 2021)

³Tropical Cyclone, Meteorology; <https://www.britannica.com/science/tropical-cyclone>, (Accessed on 10 Nov 2021)

⁴Supra, note 2 at p-9

Table 1.1: Indian Classification of Cyclonic Disturbances in the North Indian Ocean (the Bay of Bengal and the Arabian Sea)

Type of Disturbance	Wind Speed (Km/hr)	Wind Speed in Knots
Low Pressure Area	Less than 31	Less than 17
Depression	31-49	17-27
Deep Depression	50-61	28-33
Cyclonic Storm	62-88	34-47
Severe Cyclonic Storm	89-118	48-63
Very Severe Cyclonic Storm	119-221	64-119
Super Cyclone	222 or more	120 or more

In the US, the system cyclones are classified into five different levels based on wind speed and the potential damage capacity. As stated in the NDMA Guidelines on Management of Cyclones “In the US, cyclones are classified into five different categories on the basis of their wind speed as measured on the Saffir-Simpson scale. This classification is given in Table 1.2”⁵.

Table 1.2: Classification of Cyclones based on wind speed and its capacity to cause damage (Source: NDMA, 2008).

Cyclone Number (Category)	Sustained wind Speed in m/hr (Knots)	Damage Capacity	Storm Surge (in feet)
01	74-95 (64-82 Kt)	Minimal	4-5
02	96-110 (83-95 Kt)	Moderate	6-8
03	111-130 (96-113 Kt)	Extensive	9-12
04	131-155 (114-135 Kt)	Extreme	13-18
05	156 or more (135 Kt or more)	Catastrophic	Greater than 18

1.3 Risk and Vulnerability of Cyclones - The Indian Context

As per the WMO, “over the past 50 years, 1,942 number of disasters have been attributed to tropical cyclones, which killed about 7,79,324 people and caused USD 1,407.6 billion in economic losses”⁶. In India about 10 thousand people were killed in the infamous Odisha Super Cyclone in the year 1999.

⁵National Disaster Management Guidelines, Management of Cyclones, 2008, National Disaster Management Authority, Government of India, p-5 <https://ndma.gov.in/sites/default/files/PDF/Guidelines/cyclones.pdf>, (accessed on 1st November 2021).

⁶World Meteorological Organization (WMO). Tropical Cyclones. <https://public.wmo.int/en/our-mandate/focus-areas/natural-hazards-and-disaster-risk-reduction/tropical-cyclones> (Accessed on 01 November 21).

India with its long coastline is highly vulnerable to hydro meteorological disasters. “Of the nearly 7,500 km long coastline, close to 5,700 km is prone to cyclones and tsunamis”⁷. Besides the long coastline, the high risk and vulnerability of India to cyclones can be attributed to factors such as its location, the shallow continental shelf and high population density etc. “a long coastline of about 7,516 km of flat coastal terrain, shallow continental shelf, high population density, geographical location and physiological features of its coastal areas makes India, in the North Indian Ocean (NIO) Basin, extremely vulnerable to cyclones and its associated hazards like storm tide (the combined effects of storm surge and astronomical tide), high-velocity wind and heavy rains”⁸.

Behera and Panda reported that “analysis of the cyclonic disturbances of the Indian Ocean region of the last century reveals that the Indian east coast facing Bay of Bengal is more than six times vulnerable than the west coast of India along the Arabian Sea”⁹.

The risk of cyclones and the attendant vulnerability of the country is also reflected in the fact that India has a total of 13 coastal States/UTs on its eastern and western coast (Figure 1.1 and Figure 1.2). “Recurring cyclones account for a large number of deaths, loss of livelihood opportunities, loss of public and private property and severe damage to infrastructure, thus seriously reversing developmental activities. About one-third of country’s total population living in 13 coastal states and UTs, is vulnerable to cyclone related disasters”¹⁰. “In the coastal region of India, cyclone is the major natural disaster that affects the most, as it is exposed to nearly 10 percent of the world’s tropical cyclones”¹¹.

A total of 356 cyclones afflicted the Indian coastal areas during the period 1891-2002. “The details of cyclones which crossed the coastal districts of India during the period 1891-2002, are presented in Table 1.3”^{12,13}. The data suggest that

⁷“National Disaster Management Plan, 2019. A publication of the National Disaster Management Authority, Government of India, November 2019, New Delhi pp -24, <https://ndma.gov.in/sites/default/files/PDF/ndmp-2019.pdf>, (accessed on 1st December 2021).

⁸Supra, note 5 at p- XXIV

⁹Behera, Jitendra Kumar, Panda, Gopal Krishna, 2020. International Journal of Recent Scientific Research, vol. 11, Issue 08 (B), pp. 39445-39453, August 2020. Vulnerability analysis of cyclone hazards and the changing dimensions of disaster management in Odisha along the east coast of India. 39448 pp. <https://www.recentscientific.com/sites/default/files/16712-A-2020.pdf> (accessed on 1st November 2021)

¹⁰Supra, note 5 at p- XXIV

¹¹National Disaster Management Plan, 2019. A publication of the National Disaster Management Authority, Government of India, November 2019, New Delhi pp -24, <https://ndma.gov.in/sites/default/files/PDF/ndmp-2019.pdf> (accessed on 1st November 2021).

¹²Study report on Gaja Cyclone 2018, National Disaster Management Authority, September 2019. pp 17, National Disaster Management Authority, <https://www.ndma.gov.in/sites/default/files/PDF/Reports/Study-Report-Gaja-Cyclone-2018.pdf> (accessed on 1st November 2021).

¹³Supra, note 5 at p- 3

all the coastal states and UTs are not equally vulnerable to cyclones. “There are 13 coastal states and union territories (UTs) in the country, encompassing 84 coastal districts which are affected by tropical cyclones. Four states (Tamil Nadu, Andhra Pradesh, Orissa and West Bengal) and one UT (Puducherry) on the east coast and one state (Gujarat) on the west coast are highly vulnerable to cyclone disasters.”¹⁴ As per the vulnerability analysis of cyclone hazards by Behera and Panda “analysis of the cyclonic disturbances of the Indian Ocean region of the last century reveals that the Indian east coast facing Bay of Bengal is more than six times vulnerable than the west coast of India along the Arabian Sea”¹⁵.

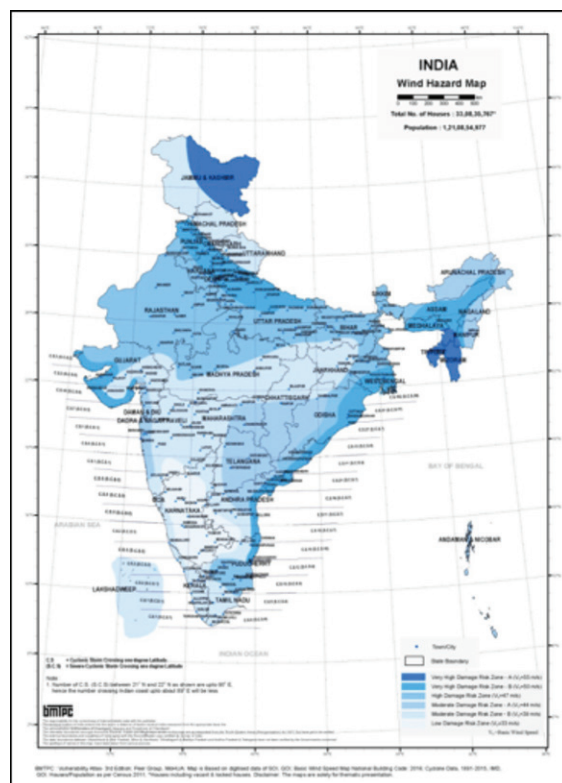


Figure 1.1: Cyclone Frequency and Wind Hazard Map of India^{16, 17, 18}
(Source: BMTPC, 2019, NDMA, 2008 and NDMA, 2019)

¹⁴Supra, note 5 at p- 2.

¹⁵Supra, note 9.

¹⁶Supra, note 5 at p-31.

¹⁷Building Materials And Technology Promotion Council (BMTPC), 2019. Vulnerability Atlas of India, Third Edition 2019. Earthquake, Wind, Flood, Landslide, Thunderstorm Maps and Damage Risk to Housing. <https://www.bmtpc.org/DataFiles/CMS/file/VAI2019/wind.html> (Accessed on 1st December 2021).

¹⁸Supra, note 7 at p-24.

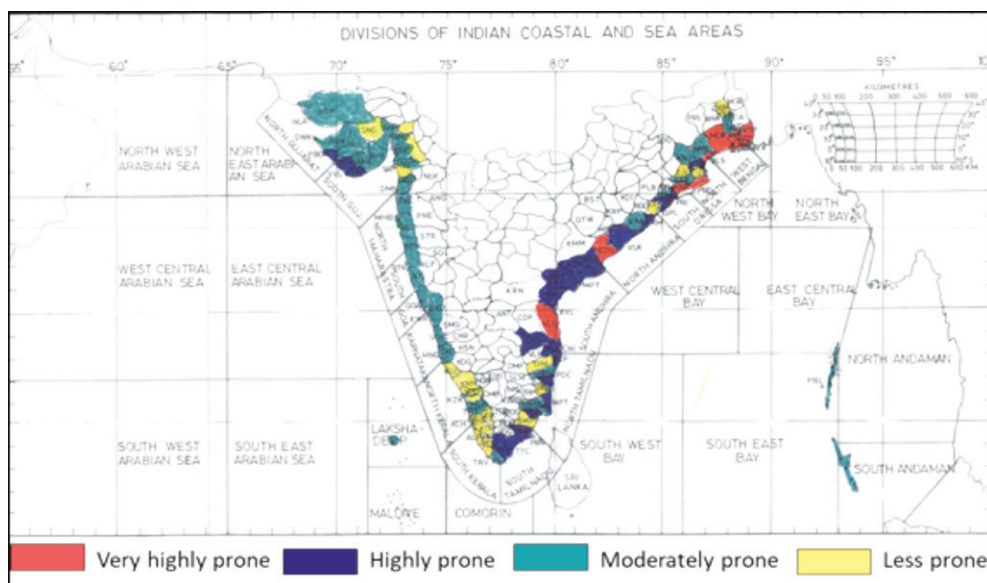


Figure 1.2: Map Showing Cyclone Hazard Prone Districts of India^{19,20}
(Source: NDMA, 2010)

Table 1.3: List of Number of Cyclones crossing various Coastal Districts of the East and West Coasts of India during the Period 1891-2002²¹

West Coast			East Coast		
State	Coastal Districts	No. of Cyclones	State	Coastal Districts	No. of Cyclones
Kerala (3)	Malappuram	1	West Bengal (69)	24 Parganas (North and South)	35
	Kozikode	1		Midnapur	34
	Kannur	1			
Karnataka (2)	Dakshina Kannada	1	Odisha (98)	Balasore	32
	Uttar Kannada	1		Cuttack	32
				Puri	19
				Ganjam	15

¹⁹Mandal, G. S. and Mohapatra, M., 2010. Cyclone Hazard Prone Districts of India: A Report. National Disaster Management Authority, 2010. Pp. 44, <https://ndma.gov.in/sites/default/files/PDF/cyclone/cyclonepronedistrict.pdf>(accessed on 1st November 2021).

²⁰Supra, note 2 at p-12

²¹Supra, note 5 at p-3

Maharashtra (13)	Sindhudurg	3	Andhra Pradesh (79)	Srikakulam	14
	Ratnagiri	3		Visakhapatnam	9
	Mumbai	3		East Godavari	8
	Thane	4		West Godavari	5
				Krishna	15
				Guntur	5
				Prakasam	7
				Nellore	16
Goa (2)	Goa	2	Tamil Nadu (54)	Chennai	18
				Cuddalore	7
				Southarcot	5
				Tanjavur	12
				Pudukkottai	5
				Ramnathpuram	3
				Tirunelveli	2
				Kanyakumari	2
Gujarat (28)	Surat	1	Puducherry (8)	Puducherry	8
	Kaira	1			
	Bhavnagar	4			
	Amreli	4			
	Junangarh	7			
	Jamnagar	6			
	Kachchh	5			
Total Cyclones		48			308

India's east coast is more vulnerable to cyclones as compared to the west coast in the context of the frequency of cyclones. "More Tropical cyclones form in the Bay of Bengal than in the Arabian Sea and the ratio is 4:1. It has been observed that between 1891 and 2002, 308 cyclones crossed the east coast, out of which 103 were severe. The less cyclonic activity was observed on the west coast during the same period, with 48 cyclones (Table 1.3) crossing the west coast, out of which 24 were of severe intensity"²². The relative vulnerability of India's east coast as against the west coast is also well established. As per the researchers, "Most of the low-pressure systems, develop in North Indian Ocean (NIO) basin over the Bay of Bengal that make landfall along the east coast and travel inland. Tropical cyclones are often accompanied by sturdy wind, heavy rain, flooding and storm surges that cause serious damages to houses, infrastructure and standing crops and human loss of life along the track of cyclonic disturbance and neighbouring areas"²³.

As per the NDMA guidelines on "Management of Cyclones", "the Tropical cyclones generally originate in the eastern side of the North Indian Ocean

²²Supra, note 5 at p-1

²³Supra, note 9 p-39445.

(NIO) Basin and initially move in a west-north westerly direction. The NIO Basin (including the Indian coast) generates only about 7% of the world's cyclones, their impact is comparatively high and devastating, especially when they strike the coasts bordering the North Bay of Bengal. The frequency of cyclones in the NIO Basin is bi-modal, which is specific to this region. Cyclones occur in the months of May-June and October-November, with their primary peak in November and secondary peak in May"²⁴.

As per the report of Behera and Panda, "roughly 7% of the total global genesis of the tropical cyclones occurs in the North Indian Ocean. During the period of 128 years (1891-2017), the Indian region has experienced 1,562 number of cyclonic disturbances of which 77% had their origin in the Bay of Bengal region, 14% had their origin in the Arabian Sea region and 9% were of land origin. Out of all these disturbances, 58% were depressions, 22% were cyclonic storms and the remaining 20% were severe cyclonic storms"²⁵.

A list of major Cyclone Disasters in India for the period 1618 to 2021 compiled from inputs from multiple sources is given in Table 1.4. The data suggest a declining trend in the loss of life due to cyclones which conform to improvement in disaster management particularly the improvement in the weather forecasting technology and precise and timely issue of early warning, proactive approach, improved preparedness and good governance. Besides the high vulnerability of the eastern coast as compared to the west coast is also reflected.

Table 1.4: List of major cyclone disasters in India ^{26,27,28,29,30,31,32,33}

Sl. No.	Year	Cyclone	Location	Deaths	Storm Surge (Height in Feet)
1.	1618	Severe Cyclonic Storm	Bombay, Maharashtra	2,000	

²⁴Supra, note 5 at p. 1.

²⁵Supra, note 9 p. 39447.

²⁶Supra, note 5 at p-2.

²⁷Cyclones of Odisha. <https://www.utkaltoday.com/cyclones-of-odisha/> (accessed on 1st December 2021).

²⁸Supra, note 12 at p-4.

²⁹List of super cyclonic storms. https://en.wikipedia.org/wiki/List_of_super_cyclonic_storms (Accessed on 1st November 2021).

³⁰Pre-1890 North Indian Ocean cyclone seasons. https://en.wikipedia.org/wiki/Pre-1890_North_Indian_Ocean_cyclone_seasons (Accessed on 1st November 2021).

³¹Chittibabu, Chittibabu, Dube, S. K., Macnabb, J. B., Murty, T. S., Rao, A. D., Mohanty, U. C., and Sinha, P. C., 2004. Mitigation of Flooding and Cyclone Hazard in Orissa, India. Natural Hazards. 31: 455-485, 2004. Kluwer Academic Publishers. Pp 460-470. https://www.researchgate.net/publication/226504527_Mitigation_of_Flooding_and_Cyclone_Hazard_in_Orissa_India (Accessed on 1st November 2021).

³²Ray, Saon, Jain, Samridhi, and Thakur, Vashundhara, 2020. India's disaster risk resilience strategy: lessons from cyclones in Odisha.p 3-8. https://www.researchgate.net/publication/342009119_India%27s_disaster_risk_resilience_strategy_lessons_from_cyclones_in_Odisha (Accessed on 1st November 2021).

³³Supra, note 2 at p 26-32.

2.	1737	Hooghly River Cyclone, Super Cyclone	Hooghly, West Bengal	3,00,000	40
3.	1779	Machilipatnam Cyclone	Machilipatnam, Andhra Pradesh	20,000	12
4.	1782	Coringa Cyclone	Coringa, Andhra Pradesh	20,000	
5.	1787	Coringa Cyclone	Coringa, Andhra Pradesh	20,000	
6.	1789	Great Coringa Cyclone	Andhra Pradesh	20,000	
7.	1807	Super cyclone	West Bengal	90,000	
8.	1831	Very Severe Cyclonic Storm	Balasore, Odisha	22,000	6.6
9.	1833	Very Severe Cyclonic Storm	Sagar Island, West Bengal	30,000	
10.	1839	Coringa Cyclone, Very Severe Cyclonic Storm	Coringa, Andhra Pradesh	20,000	
11.	1847	Severe Cyclonic Storm	West Bengal	75,000	
12.	1854	Severe Cyclonic Storm	Bombay, Maharashtra	1,000	
13.	1864	Severe Cyclonic Storm	Machilipatnam, Andhra Pradesh	30,000	12
14.	1864	Very Severe Cyclonic Storm	Contai, West Bengal	50,000	36
15.	1867	Great Calcutta Cyclone, Very Severe Cyclonic Storm	Contai, West Bengal	50,000	
16.	1842	Bengal Cyclone, Very Severe Cyclonic Storm	Contai, West Bengal	15,000	
17.	1882	Great Bombay Cyclone	Bombay, India	100,000	
18.	1885	Odisha Cyclone, Super Cyclone	False Point, Odisha	5,000	22
19.	1888	Gujarat Cyclone	Gujarat Cyclone	1,300	

20.	1895	Super Cyclone	False Point, Odisha	5,000	21
21.	1942	Severe Cyclonic Storm	Contai, West Bengal	19,000	10
22.	1948	Severe Cyclonic Storm	Mumbai, Maharashtra		
23.	1961	Severe Cyclonic Storm	Mumbai, Maharashtra		
24.	1964	Severe Cyclonic Storm	Naliya, Gujarat	27	6
25.	1967	Severe Cyclonic Storm	Puri, Odisha	1000	27
26.	1971	Extremely Severe Cyclonic Storm	Paradip, Odisha	10,000	13-17
27.	1975	Very Severe Cyclonic Storm	Porbandar, Gujarat	85	12
28.	1976	Very Severe Cyclonic Storm	Bhavnagar, Gujarat	70	
29.	1977	Very Severe Cyclonic Storm	Mangalore and Honavar, Karnataka	72	
30.	1977	Super Cyclonic Storm	Chirala, Andhra Pradesh	10,000	16-18
31.	1982	Very Severe Cyclonic Storm	Veraval, Gujarat	507	
32.	1990	Super Cyclonic Storm	Machilipatnam, Andhra Pradesh	967	13-17
33.	1996	Very Severe Cyclonic Storm	Kakinada, Andhra Pradesh	2,000	10
34.	1996	Very Severe Cyclonic Storm	Veraval and Diu, Gujarat	46	
35.	1998	Very Severe Cyclonic Storm	Kandla, India	1173	6
36.	1999	Super Cyclonic Storm	Paradip, Odisha	9,885	30
37.	2008	Cyclonic Storm	Nisha cyclone, Tamil Nadu	189	
38.	2010	Severe Cyclonic Storm	Jal cyclone, Tamil Nadu	55	

39.	2011	Very Severe Cyclonic Storm	Thane Cyclone, Tamil Nadu	48	
40.	2012	Cyclonic Storm	Nilam Cyclone, Andhra Pradesh and Tamil Nadu	65	
41.	2013	Phailin Cyclone	Gopalpur, Odisha	23	6.5-8.2
42.	2014	Hudhud cyclone	Andhra Pradesh	64	4.5
43.	2016	Very Severe Cyclonic Storm	Vardha Cyclone, Tamil Nadu	47	
44.	2017	Very Severe Cyclonic Storm	Ockhi cyclone, Tamil Nadu & Kerala	292	
45.	2018	Very Severe Cyclonic Storm	Titli cyclone, Ganjam and Gajapati, Odisha	85	
46.	2018	Very Severe Cyclonic Storm	Gaja Cyclone, Tamil Nadu	45	
47.	2019	Very Severe Cyclonic Storm	Fani Cyclone, Puri, Odisha	89	
48.	2019	Very Severe Cyclonic Storm	Bulbul cyclone,	43	
49.	2020	Super Cyclonic Storm	Amphan Cyclone, Odisha and West Bengal	102	16
50.	2021	Extremely Severe Cyclonic Storm	Tauktae Cyclone, Gujarat, Maharashtra and Karnataka	169	9.8

1.4 Climate Change and Cyclones

It is well established that the ongoing climate change will further aggravate the impact of cyclones. As per the IPCC assessment report “warming of the surface ocean from anthropogenic (human-induced) climate change is likely fuelling more powerful Tropical cyclones (TCs). The destructive power of individual Tropical cyclones through flooding is amplified by rising sea level, which very likely has a substantial contribution at the global scale from anthropogenic climate change”³⁴

³⁴KNUTSON, THOMAS R., CHUNG, MAYA V., VECCHI, GABE, SUN, JINGRU, HSIEH, TSUNG-LIN and SMITH, ADAM J. P. 2021. Climate change is probably increasing the intensity of tropical cyclones, 26th March 2021. NOAA Climate.gov <https://www.climate.gov/news-features/understanding-climate/climate-change-probably-increasing-intensity-tropical-cyclones> (Accessed on 1st December 2021)

Climate change is likely to cause an increase in frequency as also the intensity and destructive potential of cyclones in Indian coastal regions. IPCC is of the opinion that “with the current trend of climatic variability accompanied with global warming and increased greenhouse effects, the Indian coastal states are likely to be affected with more number of cyclones and specifically with more intense storms of very high magnitude with greater frequency”³⁵.

Climate change is causing a change in several hydro metrological phenomena. Many researchers believe that “Anthropogenic climate change has increased observed precipitation, winds, and extreme sea-level events associated with some tropical cyclones, which has increased intensity of multiple extreme events and associated cascading impacts. There is emerging evidence for an increase in the annual global proportion of Category 4 or 5 tropical cyclones in recent decades. Increases in tropical cyclone winds and rainfall, and increases in extreme waves, combined with relative sea-level rise, exacerbate extreme sea-level events and coastal hazards”^{36,37}.

There are increasing concerns among the scientific community and researchers about the way climate change is likely to affect the impact of cyclones, “Climate scientists say with a rapidly warming Indian Ocean, these severe cyclones are projected to increase in number on both the east and the west coast of India. Climate change is increasing the damage that cyclones like Nisarga and Amphan cause in several ways like increasing sea surface temperatures that can make cyclones more powerful, increasing the rainfall intensity during the storm and rising sea levels, which increases the distance inland that storm surges reach. The strongest cyclones have become more common across the world and scientists project that climate change will continue to make the strongest cyclones more powerful. The strength of cyclones affecting the countries bordering the North Indian Ocean has been increasing as the planet has warmed, say multiple studies.”³⁸

³⁵Cambridge University Press, 2007. Climate Change 2007: Impacts, Adaptation and Vulnerability. Eds. Parry, Martin, Canziani, Osvaldo, Palutikof, Jean, Linden Paul Van der, Hanson, Clair, pp 479. Fourth Assessment Report, Intergovernmental Panel on Climate Change.

https://www.ipcc.ch/site/assets/uploads/2018/03/ar4_wg2_full_report.pdf (Accessed on 1st November 2021).

³⁶KNUTSON, THOMAS R., CHUNG, MAYA V., VECCHI, GABE, SUN, JINGRU, HSIEH, TSUNG-LIN and SMITH, ADAM J. P. 2021. Climate change is probably increasing the intensity of tropical cyclones, 26 March 2021. ScienceBrief Review. <https://news.sciencebrief.org/cyclones-mar2021/> (Accessed on 1st November 2021).

³⁷Tom, Knutson, NOAA/GFDL, 2021. Global Warming and Hurricanes: An Overview of Current Research Results. <https://www.gfdl.noaa.gov/global-warming-and-hurricanes/> (Accessed on 1st November 2021)

³⁸The New Indian Express, 2020. Climate change making cyclones fiercer, more frequent: Researchers, 3rd June 2020. <https://www.newindianexpress.com/nation/2020/jun/03/climate-change-making-cyclones-fiercer-more-frequent-researchers-2151411.html> (Accessed 08 Deceber 2021)

The National Disaster Response Plan (NDMP) 2019 has since taken note of the need to factor climate change in DRR. The plan acknowledges that “Anthropogenic drivers for climate change are now widely recognised among the scientific community as playing the major role in magnifying the disaster risks globally. The knowledge and understanding of climate change hold the key to the unprecedented changes in the disaster risk scenarios facing the world today. A changing climate leads to changes in the frequency, intensity, spatial extent, duration, and timing of extreme weather and climate events, and can result in unprecedented extreme weather and climate events. Extreme and non-extreme weather or climate events affect vulnerability to future extreme events by modifying resilience, coping capacity, and adaptive capacity”³⁹. Climate Change Risk Management has accordingly been included as one of the six thematic areas for DRR in the NDMP 2019.

³⁹Supra, note 7 at p 46.

EARLY WARNING & PREPAREDNESS

2.1 Background

The cyclone Yaas, like its immediate predecessor cyclone Taukte struck when India was in the midst of handling the deadly second wave of the COVID-19 pandemic. It is to the credit of the Government of India and respective state governments that the cyclone was managed very efficiently under most trying conditions. The well-embedded institutional mechanism for disaster management at the centre down to state and district level, as mandated by the DM Act, 2005, has proved to be a game-changer. The nation has come a long way since the Odisha super cyclone of 1999 causing around 10000 deaths to very low figures of fatalities resulting from cyclones frequenting Indian coastal areas. There has been remarkable progress on the capability and capacity of the early warning agencies of India. The IMD has been consistently giving very accurate and impact-based early warnings of cyclonic systems over a period of time. The experience of handling cyclones like Fani (April 2019) and Amphan (May 2020) came in very handy. The central government deployed the NDRF and the armed forces in anticipation, on receiving the first early warning communication from the IMD. The NCRMP programme has paid great dividends. The communities residing in the coastal areas are well aware of the need for timely evacuation and they respond promptly to the early warning of cyclones provided by print and electronic media. Very intense preparatory activities were initiated at various levels, and by several stakeholders, soon after getting the first warning on 19th May 2021 regarding the likelihood of a cyclone forming in the Bay of Bengal. The focus of all the preparedness measures undertaken was on saving maximum lives and mitigating the impact of the cyclone through prompt relief and restoration activities. The seriousness with which the preparatory activities were undertaken can be measured by the fact that the Prime Minister and the Home Minister were directly involved in overseeing the preparedness, as also the Chief Ministers of Odisha and West Bengal.

Relevant details to include early warning and preparedness measures undertaken at various levels and by numerous stakeholders of the Central Government and the State Government/UT Administration are described in the following text in chronological order.

2.2 Cyclone Warning and Preparedness Measures - 19th May 2021

On 19th May the IMD Met. Centre, Bhubaneswar informed that a low-pressure area was very likely to form over the north Andaman Sea and adjoining east-central Bay of Bengal around 22nd May. It was very likely to intensify gradually into a Cyclonic Storm during the subsequent 72 hours and reach West Bengal - Odisha coasts around 26th May evening.

Accordingly, the fishermen were advised not to venture into the deep sea area of central Bay of Bengal from 23rd May to 25th May and into North Bay of Bengal along & off Odisha coast from 25th May to 27th May. Fishermen, those who were out in the deep sea were advised to return to the coast by 23rd May 2021.⁴⁰

2.3 Cyclone Warning and Preparedness Measures - 20th May 2021

2.3.1 Pre-emptive Measures by the Indian Coast Guard (ICG)⁴¹

The ICG which is the nodal organisation responsible for coordinating and executing Search and Rescue (SAR) in Indian Search and Rescue Region (ISRR) promptly initiated extensive pre-emptive measures on the Eastern coast to include the following:-

- All the ashore, afloat and aviation units were put on high alert.
- Close monitoring of weather in the Bay of Bengal relaying weather alert messages on MMB radio by ICG Remote Operating Stations (ROS) in the States/UTs of Tamilnadu, Puducherry, Andhra Pradesh, Odisha, West Bengal as well as A & N Islands, both in English and in vernacular languages to alert Merchant vessels, fishing boats, fisheries survey, Scientific research vessels, Oil rigs, accommodation barges, support vessels for Off shore Development Areas (ODAs), etc.
- Ships at anchorage advised to take shelter and necessary safety measures.
- Regular Navtex warnings and activation of International Safety Net (ISN) to alert the vessels in/transiting through the area.
- Port authorities, oil rig operators, shipping, fisheries authorities and fishermen associations were informed about the likelihood of cyclone formation and a close liaison and coordination for the safety of boats, vessels and fixed platforms were being maintained.
- Though the fishing ban was enforced on the east coast of India, the ICG Dornier aircraft and Ships at sea were broadcasting weather warnings to fishermen operating at sea about the likely formation of the cyclone and directing them to return to the nearest harbour for safety.
- ICG also requested respective State/UT governments to sensitise fishers and ensure accounting of fishing boats present in harbours. A close liaison was being maintained with State/UT authorities.
- Coast Guard Disaster Relief Teams (DRTs) were put on standby for undertaking Disaster response operations.
- Medical teams & ambulances were also kept standby for swift mobilisation.

⁴⁰Met .Centre Bhubaneswar, Special Bulletin -1, Date: 19.05.2021 Time: 1400hrs

⁴¹Press Information Bureau, Government of India, Ministry of Defence Press Release posted on 20th May 2021 (Release ID: 1720423), Accessed at :pib.gov.in.

2.4 Cyclone Warning and Preparedness Measures - 22nd May 2021

The IMD informed that the low-pressure area in the North Andaman Sea was likely to intensify as Cyclonic Storm, 'Yaas' during the next 24 hrs over the Bay of Bengal and moving in North Westerly direction it was likely to cross the coast between North Odisha and West Bengal around 26th May. All-round preparations commenced at various levels at the Centre as also in Odisha and West Bengal such as:-

- **Meeting of the National Crisis Management Committee (NCMC)** - The Cabinet Secretary took a meeting of the NCMC, one of the key national-level decision-making bodies for disaster management in the country, with Chief Secretaries of all the Coastal States and UTs and Central Ministries/Agencies concerned on 22nd May 2021.
- **Involvement of the Armed Forces** - The armed forces started preparations for rendering humanitarian assistance and disaster relief. The Indian Navy in particular was closely monitoring the movement of the cyclonic storm and the Indian Naval Ships and aircraft were placed on standby for rescue and relief operations. Headquarters, Eastern Naval Command, and Naval Officers-in-Charge at West Bengal and Odisha Area carried out preparatory activities to combat the effects of the Cyclone 'Yaas' and were in constant liaison with the respective State Administrations for rendering assistance as required.⁴² The following actions were initiated as part of the preparedness:-
 - ♦ Eight flood relief teams and four diving teams were prepositioned at Odisha and West Bengal to augment the existing resources.
 - ♦ Four naval ships were on standby with Humanitarian Assistance and Disaster Relief (HADR) bricks, diving, and medical teams to render assistance in the most affected areas along the Odisha and West Bengal coast.
 - ♦ Naval aircraft were kept ready at Naval Air Stations, INS Dega at Visakhapatnam and INS Rajali near Chennai to undertake an aerial survey of the most affected areas, casualty evacuation, and airdrop of relief material as required.

2.5 Cyclone Warning and Preparedness Measures - 23rd May 2021

The IMD informed that Cyclone Yaas was likely to intensify into a Very Severe Cyclonic Storm and was likely to hit West Bengal and Odisha Coast on Wednesday, 26th May 2021. "India Meteorological Department (IMD) said, a low-pressure area had formed over the east-central Bay of Bengal and the adjoining north Andaman Sea the previous day. It was likely to cross West Bengal and adjoining north Odisha and Bangladesh coasts around the evening of 26th May".⁴³

⁴²Press Information Bureau, Government of India, Ministry of Defence Press Release posted on 22nd May 2021 (Release ID: 1720915) , Accessed at : pib.gov.in.

⁴³<http://newsonair.com/News?title=Cyclone-Yaas-likely-to-intensify-into-very-severe-cyclonic-storm%3b-To-hit-West-Bengal-and-Odisha-Coast-on-Wednesday&id=417671> (accessed on 23rd May 2021)

It is creditable that by 23rd May the national disaster management apparatus was fully geared up to face the impending disaster. A host of activities were underway for mitigating the impact and ensuring prompt and efficient response by the Central Government and respective State Governments and UTs. The Prime Minister chaired a high-level review meeting to check the progress on preparedness measures underway. The Union Home Minister also held a review meeting with the Chief Ministers on the next day i.e. 24th May 2021.

2.5.1 Preparation by Armed Forces to Mitigate Cyclone Yaas⁴⁴

The Armed Forces had commenced preparations to mitigate the impact of Cyclone Yaas well in advance. As of 23rd May 2021, the following preparatory actions were taken:-

- Indian Air Force (IAF) had airlifted 950 National Disaster Response Force (NDRF) personnel and 70 tonnes of load from Jamnagar, Varanasi, Patna and Arakonnam to Kolkata, Bhubaneswar and Port Blair in 15 Transport Aircraft.
- Sixteen transport aircraft and 26 helicopters were placed on standby for immediate deployment.
- The Indian Navy, fresh from Humanitarian Assistance and Disaster Relief (HADR) and rescue operations on the Western Coast, had moved 10 HADR pallets to Bhubaneswar and Kolkata, while five HADR pallets were kept ready at Port Blair.
- Eight ships of Eastern Naval Command and Andaman and Nicobar Command were embarked with HADR Bricks to provide succour to the people likely to be impacted.
- Four diving and 10 flood relief columns were pre-positioned at Kolkata, Bhubaneswar and Chilika for rendering assistance to civil administration at short notice.
- Seven flood relief teams and two diving teams were ready at different locations in Andaman and Nicobar Islands.
- In addition, Naval Aircraft and helicopters in Vishakhapatnam and Port Blair were kept on operational readiness mode to undertake search and rescue missions.
- Eight flood relief columns and three Engineer Task Forces of the Indian Army were ready for immediate deployment on requisition by the civil administration.
- The Armed Forces were in constant touch with the civil administration of the affected states. Armed Forces teams were prepared to keep the road & rail links open to ensure an uninterrupted supply of life-saving oxygen & drugs required for treatment at COVID-19 hospitals.

⁴⁴Press Information Bureau, Government of India, Ministry of Defence Press Release posted on 23rd May 2021 (Release ID: 1721092), Accessed at : pib.gov.in

2.5.2 Review of Preparedness & Planning by the Prime Minister⁴⁵.

The Hon'ble Prime Minister Shri Narendra Modi chaired a high-level meeting on 23rd May 2021 to review the preparedness of States and Central Ministries/Agencies concerned to deal with the situation arising out of Cyclone 'Yaas'.

The meeting was attended by Home Minister, Principal Secretary to Prime Minister, Minister of State for Home Affairs, Cabinet Secretary, Secretaries of Ministries/Departments of Home, Telecommunications, Fisheries, Civil Aviation, Power, Ports, Shipping & Waterways, Earth Sciences, Chairman Railway Board, Members & Member Secretary of NDMA, Director Generals of IMD and NDRF, and senior officers of the PMO and the MHA. During the meeting, the preparatory actions taken thus far by various Central Ministries were confirmed as under:-

Ministry of Home Affairs (MHA)

- The MHA was reviewing the situation 24*7 and was in touch with the State Governments/UTs and the Central Agencies concerned.
- The MHA had already released the first instalment of the State Disaster Response Fund (SDRF) in advance to all the States.
- 46 NDRF teams equipped with boats, tree-cutters, telecom equipment etc. were pre-positioned in 5 States/UTs. In addition, 13 NDRF teams were being airlifted on 23rd May 2021 for deployment and 10 teams were on standby.

Ministry of Defence (MOD)

- Indian Coast Guard and the Navy had deployed ships and helicopters for relief, search and rescue operations.
- Seven ships with Humanitarian Assistance and Disaster Relief Units were on standby along the eastern coast. Air Force and Engineer Task Force units of the Army, with boats and rescue equipment, were on standby for deployment.

Other concerned Ministries/Agencies

- **Ministry of Petroleum & Natural Gas** - The Ministry of Petroleum & Natural Gas had initiated measures to secure all oil installations in the sea and to bring back their shipping vessels to safe harbour.
- **Ministry of Power** - The Ministry of Power had activated emergency response systems and was keeping transformers, DG sets and equipment in readiness for immediate restoration of electricity.

⁴⁵Press Information Bureau, Government of India, Prime Minister's Office Press Release posted on 23rd May 2021 (Release ID: 1721030) , Accessed at : pib.gov.in

- **Ministry of Telecom** - The Ministry of Telecom was keeping all the telecom towers and exchanges under constant watch and was fully prepared to restore the telecom network.
- **Ministry of Health & Family Welfare** - The Ministry of Health & Family Welfare had issued advisory to the States/UTs, likely to be affected, for health sector preparedness and response on COVID in affected areas.
- **Ministry of Port, Shipping and Waterways** - The ministry had initiated measures to secure all shipping vessels and had deployed emergency vessels (Tugs) for any emergency situations.

National Disaster Response Force (NDRF)

- The NDRF was assisting the State agencies in their preparedness for evacuating people from the vulnerable locations and was continuously holding community awareness campaigns for dealing with the cyclonic situation.

Directions by the Prime Minister (PM)

The PM directed the following:-

- All senior officers to work in close coordination with states to ensure the safe evacuation of people from high-risk areas.
- He instructed all concerned departments to ensure timely evacuation of those involved in off-shore activities.
- He spoke about the need to ensure that the time duration of outages of power supply and communication network was kept at a minimum and that these services were restored swiftly.
- The PM also asked officials to ensure proper coordination and planning with state governments to ensure no disruptions in Covid treatment and vaccination in hospitals.
- He also spoke about the need to involve district administrations in the process of planning and preparedness for better learning from best practices and seamless coordination.
- PM directed officials that advisories and instructions on do's and don'ts during the cyclone be made available in easy to understand and local language to citizens of the affected districts.
- PM spoke about the need to involve various stakeholders i.e. coastal communities, industries, etc by directly reaching out to them and sensitising them.

2.6 Cyclone Warning and Preparedness Measures - 24th May 2021

The IMD maintained that the depression over the east-central Bay of Bengal was very likely to move slowly north-northwest wards and intensify into a very Severe Cyclonic Storm and reach Northwest Bay of Bengal near north Odisha and West Bengal coasts by 26th May morning. It was very likely to cross north Odisha - West Bengal coasts between Paradip and Sagar islands by the evening of 26th May as a very Severe Cyclonic Storm. The observed and forecast track of the cyclone on 24th May 2021 is depicted in Figure 2.1⁴⁶.

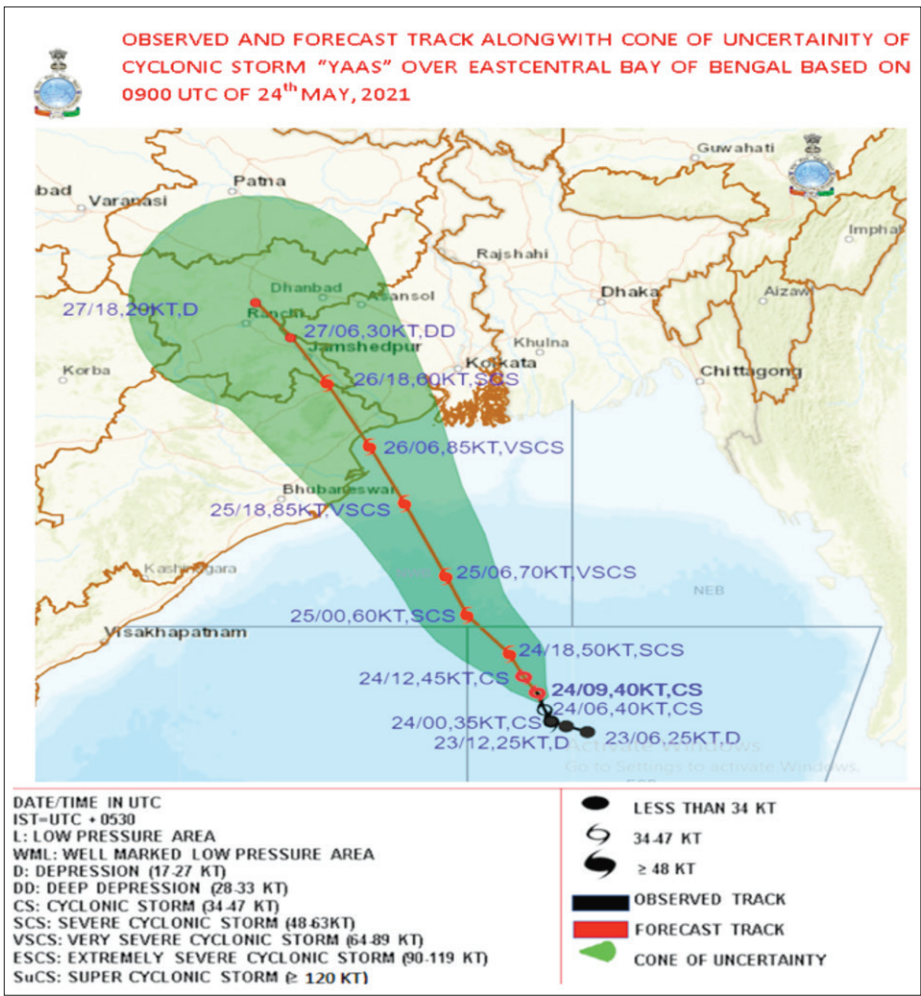


Figure 2.1: The observed and forecast track of the cyclone on 24th May 2021 (Source: IMD, 24th May 2021)

⁴⁶https://mausam.imd.gov.in/imd_latest/contents/cyclone.php#. (Accessed on 24th May 2021)

2.6.1 Review of Preparedness & Planning by Central Government Ministers with Industry Leaders⁴⁷.

The Hon'ble Union Minister of Railways, Commerce & Industry, Consumer Affairs and Food & Public Distribution Shri Piyush Goyal, along with the Hon'ble Minister of Petroleum and Natural Gas & Steel Shri Dharmendra Pradhan and the Hon'ble Minister of Ports, Shipping and Waterways Shri Mansukh Mandaviya, interacted with the industry leaders on preparedness for Cyclone Yaas. The meeting was also attended by the senior officers of IMD, NDMA, the Ministry of Shipping, the Ministry of Railways, and various State Governments. Salient aspects of the preparedness discussed during the meeting are summarised below:-

- The DG Shipping informed that Control rooms were set up, and advisories were being sent four times a day. Steps were being taken as per the guidelines and SOPs.
- The Railway authorities informed that passenger trains would be cancelled from 25th June onwards in the areas likely to be worst affected, the plans to regulate freight trains were in place and that the Railways had since moved the emergency equipment and relief materials to strategic places, and the restoration work would be done at the earliest. The movement of Oxygen Express from Rourkela was to continue through alternative routes.
- Shri Piyush Goyal said that Central and State Governments were working hand in hand and undertaking orderly planning to ensure that there was a minimal loss to people and the property. He urged that relief supplies should be properly channelized, minimum outages of Communication and electricity ensured, mobile phones and torches kept fully charged, and diesel generator sets fully stocked up with fuel. Shri Goyal called for constant monitoring of the situation, supporting the healthcare workers, and also all those in distress.
- The Industry representatives appreciated sharing of timely information and the spirit of collaboration and cooperation among all the stakeholders for mitigating the impact of the cyclone.
- State Governments officials apprised about the steps taken by them to reduce the impact of the cyclone, and their preparedness for undertaking rescue, relief and rehabilitation in their respective areas. They confirmed that measures were in place to ensure a smooth supply of essential goods, particularly for medical supplies.
- Shri Dharmendra Pradhan assured that the supply of liquid medical oxygen from eastern India to the rest of the country would not be affected. He

⁴⁷Press Information Bureau, Government of India, Ministry of Commerce & Industry, Press Release posted on 24th May 2021 (Release ID: 1721264) , Accessed at : pib.gov.in

said that the Ministry of PNG had made a full assessment of various oil and gas installations, ships, docks etc in the area, and learning from recent experience, had taken all precautionary steps to ensure minimal damage.

2.6.2 Review Meeting by the Union Home Minister with Chief Ministers

Following the high-level review meeting by the Hon'ble Prime Minister Shri Narendra Modi on 23rd May, the Hon'ble Union Home Minister, Shri Amit Shah, held a review meeting, through video conferencing on 24th May, with the Chief Ministers of Odisha, West Bengal and Andhra Pradesh and the Lt. Governor of the Andaman & Nicobar Islands, to assess their preparedness and that of Central Ministries and agencies concerned, to deal with the situation arising out of the Cyclone⁴⁸ (Figure 2.2). Given the ongoing covid pandemic, the Hon'ble Union Home Minister emphasised medical preparedness to include an uninterrupted supply of oxygen to hospitals.



Figure 2.2: Hon'ble Union Home Minister reviewed the situation on 24th May 2021.

The Home Minister specifically reviewed and re-iterated the following critical issues:-

- To make adequate power backup arrangements in all COVID-19 hospitals, labs, vaccine cold chains and other medical facilities.
- Need to ensure adequate stocks of all essential medicines and supplies in hospitals, keeping in view likely disruption of the movement of vehicles.

⁴⁸Press Information Bureau, Government of India, Ministry of Home Affairs, Press Release posted on 24th May 2021 (Release ID: 1721231), Accessed at : pib.gov.in

- Arrangements for securing medical facilities from losses, and evacuation of patients in advance, if necessary.
- The Union Home Minister also reviewed the impact of the cyclone on oxygen generation plants located in the States of West Bengal, Odisha and Andhra Pradesh.
- Need for advance planning for keeping a buffer stock of oxygen for two days and movement of oxygen tankers to allocated states.
- State Governments to ensure the safety of oxygen generation plants.
- Need to make necessary arrangements for the safety of power plants to ensure uninterrupted power supply to hospitals and health facilities.
- Safety of all shipping and fishing vessels, and all ports and oil installations in the area.
- Preparedness of the concerned States and UTs to ensure that all fishermen were brought back to shore and the timely evacuation of people from low lying and vulnerable areas.
- Dissemination of messages in local languages over mobile phones, television, social media and through village panchayats, with a view to educate and motivate people.
- As practised by Odisha, volunteers, such as Home Guards, NCC and civil defence to also be mobilized in helping the people evacuate.
- Need to ensure the safety of power and telecommunication services and their timely restoration and to plan and position required manpower, equipment and material at vulnerable locations.
- Safety of power lines during the cyclone, and to promptly restore any damage that might occur.
- Timely pruning of heavy trees for damage mitigation.
- Liaison and coordination with all central government agencies, particularly with the IMD for their advance warnings and updated forecasts.
- Advised the State Governments and the Union Territory of Andaman & Nicobar Islands to be in touch.
- 24x7 control room was functioning in the MHA, which could be contacted at any time for any assistance by the States and the UTs.
- The Hon'ble Union Home Minister informed that the Indian Coast Guard (Figure 2.3), the Navy, the Army and Air Force units had also been put on standby and surveillance aircraft and helicopters were carrying out aerial sorties.



Figure 2.3: Indian Coast Guard (ICG) mobilizes its assets in view of cyclone Yaas expected to hit the Eastern Coast on 26th May 2021 (Source: PTI Photo)

2.7 Cyclone Warning and Preparedness Measures - 25th May 2021

As per the IMD, the Severe Cyclonic Storm “Yaas” lay centred at 0830 hrs IST of the 25th May 2021 over West-central and adjoining East-central & North Bay of Bengal near latitude 18.3°N and longitude 88.3°E, about 280 km south-southeast of Paradip (Odisha), 380 km south-southeast of Balasore (Odisha), 370 km south-southeast of Digha (West Bengal) and 370 km south-south-west of Sagar Islands (West Bengal). The IMD maintained that it was very likely to move north-northwestwards and intensify further into a very severe Cyclonic Storm during the next 12 hours. It would continue to move north-north-westwards, intensify further and reach Northwest Bay of Bengal near north Odisha coast very close to Chandbali-Dhamra port by the early morning of Wednesday, the 26th May. It was very likely to cross north Odisha-West Bengal coasts between Paradip and Sagar Island close to the north of Dhamra and south of Balasore, during noon of Wednesday, the 26th May as a very severe Cyclonic Storm.⁴⁹ The IMD also issued an impact-based warning of storm surge and high-speed winds as under⁵⁰:-

⁴⁹IMD Press Release - No.7, Dated: 25-05-2021, Accessed at : https://internal.imd.gov.in/press_release/20210525_pr_1114.pdf,

⁵⁰Ibid

- Tidal waves of height 2-4 meters above astronomical tide were likely to inundate low lying areas of Medinipur, Balasore, Bhadrak and about 2 meters above astronomical tide were likely to inundate low lying areas of South 24 Parganas, Kendrapara & Jagatsinghpur districts around the time of landfall. Damage expected for coastal districts of North Odisha, West Bengal and adjoining interior districts of these states was:-
 - ♦ Total destruction of thatched houses/extensive damage to kutcha houses.
 - ♦ Some damage to pucca houses.
 - ♦ Potential threat from flying objects.
 - ♦ Bending/uprooting of power and communication poles.
 - ♦ Major damage to Kutcha and Pucca roads.
 - ♦ Flooding of escape routes.
 - ♦ Disruption of railways, overhead power lines and signalling systems.
 - ♦ Widespread damage to standing crops, plantations, orchards, falling of green coconuts and tearing fronds of palm trees.
 - ♦ Blowing down of bushy trees like mango.

The intensification & movement of the system was under continuous surveillance of the IMD and the concerned state governments were being informed regularly. The IMD suggested the following action for the coastal districts of North Odisha, West Bengal and adjoining interior districts of these states⁵¹

- Suspension of fishing operation and movement of ships in disturbed areas.
- Ports along the east coast of India may take necessary precautions.
- Naval base operations may maintain necessary precautions
- Tourism activities may be restricted over these areas.
- Mobilise evacuation from coastal areas of West Bengal & North Odisha.
- Judicious regulation of rail and road traffic.
- People in affected areas to remain indoors.
- Preparatory action before the cyclones.
- The observed and forecast track of the cyclone as of 25th May 2001 is shown in Figure 2.4.

⁵¹Ibid

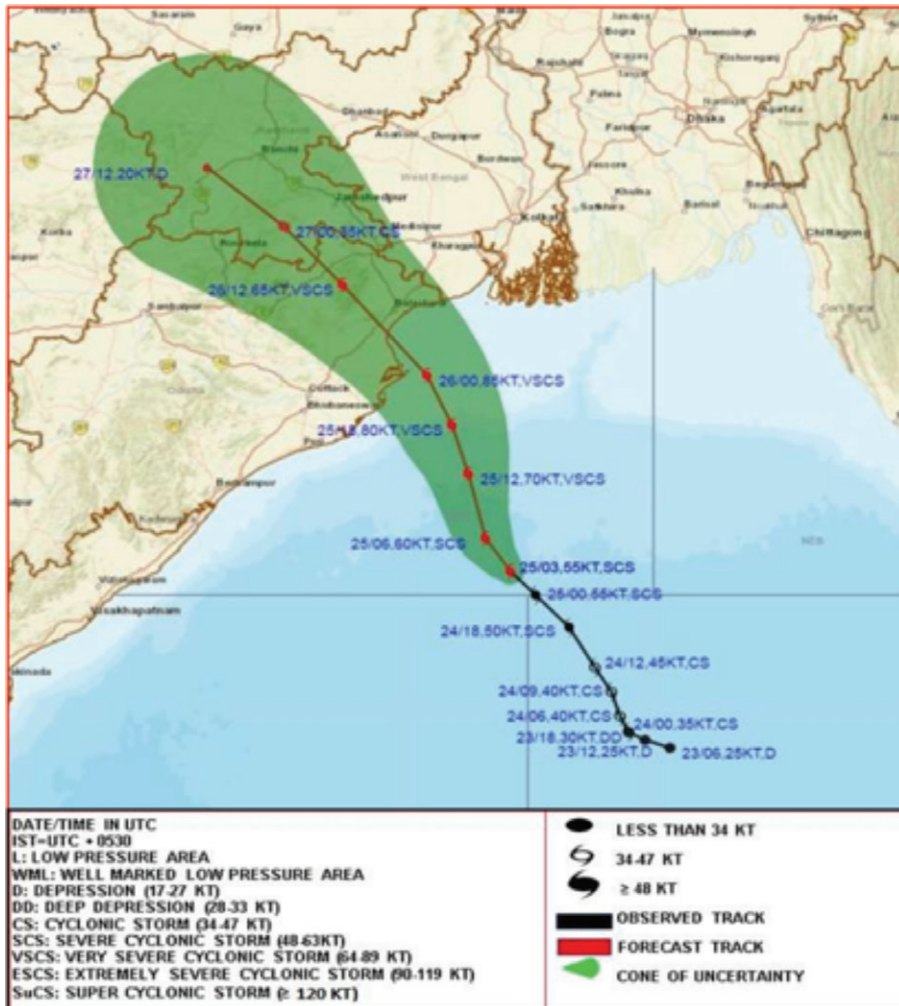


Figure: 2.4: Observed and forecast track alongwith cone of uncertainty of severe cyclonic storm “Yaas” over West-central and adjoining East-central and North Bay of Bengal based on 0300 UTC of 25th May 2021.

2.7.1 Preparatory Measures in Odisha

The Odisha government was closely monitoring the situation and had undertaken very comprehensive and praise worthy preparedness measures by 25th May 2021. Salient aspects of the preparedness measures undertaken are discussed in the succeeding paragraphs⁵².

⁵²Report on Impending Cyclone over Bay of Bengal dated 25.05.2021, <https://www.osdma.org/wp-content/uploads/2021/05/Reports-on-Impending-Cyclone-over-Bay-Of-Bengal.pdf> (Accessed on 17th June 2021)

Instructions for Government Officials: To facilitate unaffected districts and State level offices to provide human resource, material and logistics support to the cyclone-affected districts, the orders were issued as under:-

- ♦ Cancellation of Government holidays.
- ♦ Government officials to stay in headquarters.
- ♦ Cancellation of leave of all Govt. employees till further orders.
- ♦ Recalling Govt. employees on leave for duty, if required

Dissemination of IMD warnings & Bulletins: IMD weather Bulletins & cyclone warnings were being disseminated to Collectors, Departments and stakeholders at regular intervals.

Functioning of Control Room:

- State and District Emergency Operation Centre and Control Rooms of other offices were functioning round the clock in three shifts with a senior officer in charge of each shift.
- Satellite phones of all Collectors were kept in a state of readiness in case of disruption/failure of telecommunication.

Evacuation and Shelter under Covid Conditions: Keeping in mind the challenges posed by the ongoing COVID-19 pandemic, a large number of alternate shelters were identified to accommodate evacuees observing Covid protocol. A total of 6,891 shelters were identified in anticipation to accommodate the affected population in various coastal districts to include 860 Cyclone/flood shelters and 6,031 additional shelters. A facility verification check was conducted in all the multi-purpose cyclone and flood shelters in the coastal & adjoining districts. District wise availability of shelters is indicated in **Table 2.1**.

Table 2.1: Number of shelters identified under the COVID condition

Sl. No.	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		6,891

The Collectors of coastal districts were instructed to evacuate the vulnerable people/people living in kutcha houses and shift them to Multi-purpose cyclone/flood shelters and other safe shelters as per evacuation plans well in time. Directions were in place to involve Panchayati Raj Institutions (PRIs) and Self Help Groups (SHGs) in evacuation and Shelter management and for provision of one 3 ply face mask to each evacuee.

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

Status of evacuation as on 25th May 2021: As the landfall was expected on 26th May, the state administration had evacuated 2,48,049 people, opened 5,523 shelters and operationalised 651 free kitchen centres (Kendrapara-568 and Jagatsinghpur-83). Status of evacuation as of 25th May in various districts to include the number of shelters opened and the number of people evacuated is indicated in **Table 2.2**.

Table 2.2: District wise availability of shelters in Odisha as on 25th May 2021

Sl. No.	District	No. of Shelters Opened	No. of People Evacuated
1	Balasore	1,412	79,558
2	Bhadrak	774	73,103
3	Cuttack	762	1,915
4	Jagatsinghpur	179	11,184
5	Jajpur	120	3,623
6	Kendrapara	800	62,009
7	Keonjhar	12	453

8	Mayurbhanj	427	10,281
9	Dhenkanal	30	979
10	Puri	166	3,500
11	Khordha	841	1,444
Total		5,523	2,48,049

Prepositioning of Response Forces: A total of 404 disaster response teams to include 52 teams of NDRF, 60 teams of ODRAF, 206 Fire Service teams and 86 wood cutting teams of Forest & Environment Department were deployed in 10 coastal & adjoining districts for search and rescue and road clearance. District-wise distribution of various Response Forces is given in Table 2.3.

Table 2.3: Prepositioning of Response Forces in Odisha as on 25th May 2021

Sl. No.	District	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

Other Preparedness Measures: The State government had taken several other measures to mitigate the impact of the impending cyclone which included the following:-

- Arrangement for provision of temporary shelter materials (polythene sheets) for the households in the contingency of damage to houses due to the effect of cyclonic wind/heavy rain.

- 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/substations, police stations etc.
- 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 was updated by the concerned district administration.
- Alternate arrangements of drinking water during and aftermath of the cyclone.
- Directions to all the telephone service providers to keep their manpower and equipment in readiness for quick restoration of the telephone lines.
- Coordination meetings with NGOs at the district level.

Preparatory Measures the State Government Departments: Besides the above, various departments of the state government responsible for emergency support functions had also initiated preparatory measures. Salient features of preparatory action taken by various departments are described as under:-

- **Engineering Departments:** Engineering Departments like Works, Rural Development, Housing and Urban Development, Energy, Water Resources and Panchayati Raj and Drinking Water (PR & DW) made arrangements for immediate restoration of infrastructure.
- **Public Works Department:** 154 Quick Reaction Teams were constituted for clearing of roads and immediate restoration of roads (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). Besides 336 JCB Machines, 460 Tractors, 82 Generators and other assorted equipment were arranged and kept in a state of readiness.
- **Agriculture Department:** Crop advisories were issued.
- **Rural Development Department:** 313 Quick Response Teams were kept in readiness for clearing of roads with 369 JCB machines, 425 Tractors, 12 Cranes and other assorted equipment
- **Water Resources Department:** Flood Control Room was functioning round the clock, equipment and material for flood fighting were kept in readiness. The department was continuously keeping a close watch on the water level of reservoirs & the operation of gates in anticipation of heavy rainfall.
- **Housing & UD Department and the PR & DW Departments:** They had taken steps for an uninterrupted supply of drinking water in the Urban and rural areas. Measures were also taken for de-clogging drainage channels &

keeping pump sets available for dewatering low lying areas in case of heavy rains. District wise Status of Tube Wells and & Pipe Water Supply is indicated in Table 2.4.

Table 2.4: District Wise Status of Tube Wells and & Pipe Water Supply in Odisha as on 25th May 2021

Sl. No.	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 units	No. of PWS functional	No. of PVC Tanks	
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		1,71,061	356	270	4,117	681	2,370

- **Energy Department:** The department was directed to be prepared for early restoration of power. Accordingly men and equipment such as additional poles, wires, transformers, generators, cranes and vehicles etc were kept in readiness.
- **Fisheries & ARD Department**
 - ♦ All the fishing boats which were in the sea were brought back to the shore and the boats and boatmen were accounted for.
 - ♦ 120 Mobile Veterinary Units were in readiness (one team at each Block level)

- ♦ Required vaccines and essential medicines were stocked in the veterinary hospitals/dispensaries.
- ♦ 1500 MT of cattle feed was kept in readiness by OMFED.
- **Women & Child Development Department:** AWW/ASHA were instructed to take care of pregnant women, children and other vulnerable sections in particular. Instructions were issued for all pregnant women having EDD in 1st week of June to be shifted to the nearby DHH and SDH. A total of 4,510 of such pregnant women had been identified and by 25th May, 365 nos. of pregnant women had been shifted to various hospitals.
- **The Health & FW Department:** The department had established 635 Medical Relief Centers and mobilized 308 Health Teams besides stocking essential medicines, ORS packets, Halogen Tablets, Anti Snake Venum injections, PPEs, Triple Layer face masks and bleaching powder etc in District Headquarters (Table 2.5). The district-wise breakdown of medical facilities is given in Table 2.6.

Table 2.5: District wise status of medical facilities in Odisha as on 25th June 2021

Sl No	District	ORS Sachet (Pkt)	Inj. Anti Snake Venom	Anti Rabies Vaccine	Bleaching Powder (25 kg Bag)	Halogen Tablet	Triple-layer face mask	PPE	Inj. Rem-desivir	Tab. Favi-piravir
1.	Balasore	291660	1810	600	11397	775000	43000	2614	260	2690
2.	Bhadrak	513840	4100	500	1000	114000	35050	3440	56	9990
3.	Cuttack	219040	990	300	1000	500000	184500	1325	120	900
4.	Jagatsinghpur	243640	4115	2280	1000	337000	45880	1706	232	1530
5.	Jajpur	174470	2930	700	1000	601000	39230	3538	310	5306
6.	Kendrapara	203460	2494	600	1000	600000	50700	680	440	5778
7.	Mayurbhanj	527115	2335	1220	10323	830000	7950	2055	700	17680
8.	Puri	213250	2515	1020	1000	500000	650	2820	56	1020
9.	Khordha	312320	2031	1320	1000	900000	45000	512	100	4240
10.	Keonjhar	491820	3695	1300	1000	99998	47400	3900	1261	1634
Total		3190615	27015	9840	29720	5256998	499360	22590	3535	50768

Table 2.6: District wise status of medical facilities in Odisha as on 25th June 2021

Sl. No.	District	No. of Health Teams	No. of Medical Relief Centers	No. of Generators 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

Covid Scenario & Preparedness - Odisha

Odisha had placed nine districts on high alert with the meteorological department warning that Cyclone Yaas was likely to make landfall near the Dhamra coast in Bhadrak. All of these districts were in the COVID red zone with more than 1,000 active cases each.

On 25th May, the state government added Jajpur, Dhenkanal, Keonjhar and Bhadrak to the list of districts under cyclone threat, apart from Jagatsinghpur, Kendrapara, Balasore, Mayurbhanj and Cuttack where heavy rainfall was expected. Of these, Cuttack topped the Covid chart with 57,061 cases and 154 deaths in all, with an active caseload of 9,721.

The Health Department had asked all these districts to keep testing kits ready for immediate screening and testing after the cyclone. The state had suspended all work related to Covid, including testing, vaccination and door to door surveys, from 25th-27th May.

2.7.2 Preparatory Measures in West Bengal

The government of West Bengal started preparing for mitigating the likely impact of the cyclone in the right earnest starting with the initial warnings issued by the IMD. The experience of responding to the devastating super cyclone Amphan which had struck the state on 16th May 2020 was fully optimised by all the stakeholders in the state. The Hon'ble Chief Minister Ms Mamta Banerjee was personally involved in initiating and supervising the preparedness measures at the apex level.

The first high-level meeting was chaired by the Chief Minister soon after receipt of the first early warning bulletin regarding the cyclone from the IMD

on 19th May 2021. This was followed by another meeting on 22nd May with all the representatives of relevant Central and State government agencies and all the DMs, SPs and Police Commissioners.

On 25th May also, meetings were conducted at Kolkata Municipal Corporation (KMC), Power Department, Irrigation & Waterways Department and different agencies to coordinate the joint effort of response to the cyclone.

The state government had taken well-conceived preparatory measures by 25th May. Leave of all officials of the departments of Disaster Management & Civil Defence, Power, Irrigation, Agriculture, Fisheries, Transport, Urban Development & Municipal Affairs (UD & MA), Health & Family Welfare, P&RD etc were cancelled. Some of the important preparatory measures are outlined below⁵³.

Activation of Control Rooms:

- A special control room manned by senior officers was established alongside the SEOC of the State Government. Emergency Operation Centres were also activated simultaneously at the District, Subdivision, Municipality and Block level. It is noteworthy that Special Control room(s) were activated by various line departments to include Kolkata Police, WB Police, KMC, Power & NES, Public Health Engineering (PHE), Irrigation & Waterways, Fisheries, Agriculture, Transport and other departments.
- A parallel State level Control Room was also activated at Upanna working round the clock with phone numbers the same as the main control room at the State Headquarters at Nabanna (Figure 2.5).
- Satellite phones were tested and kept ready for emergency communication in all districts and with the key officials.



Figure 2.5: West Bengal CM Mamata Banerjee at the Nabanna control room.
(Source: CMO Office)

⁵³Government of West Bengal, Department of Disaster Management & Civil Defence - “Memorandum on Very Severe Cyclone Yaas” July 2021

Dissemination of Early warning and Advisories

- Advisory for the Cyclone was issued to all concerned departments with action points for quick response. The Cyclone warning bulletins of IMD were shared with all heads of departments/agencies.
- Fishermen warnings and weather alerts were being continuously issued from various control rooms.
- The Agriculture Department was issuing regular weather warnings and guidelines to farmers and cooperatives.
- A tourist advisory was issued advising tourists against venturing near the sea in three coastal districts from 24th May onwards.

Awareness Generation through Public Announcements

- Weather alert issued by the IMD and an audiovisual message on “Dos and Don’ts” for cyclones prepared by the Disaster Management department of the State Government was disseminated to people regularly through the All India Radio & Doordarshan.
- Bulk SMS messages and audio clip messages containing the cyclone warning were sent to the mobile phone subscribers of Kolkata, Howrah, Hooghly, Western West Bengal and the coastal districts.
- The warnings and precautions to be taken against the impending cyclone were also communicated through newspapers. A sample of IEC material used for Awareness generation is given at Figure 2.6.



Figure 2.6: IEC material used for awareness generation
(Source: DM&CD, Govt. of West Bengal)

Deployment for Emergency Response

- Deployment of NDRF, SDRF and QRTs was completed by 24th May 2021, which included 46 teams of NDRF, 42 teams of SDRF and 7 Naval teams.
- The army was also requisitioned on 24th May 2021. A total of 17 Army Columns were deployed and their teams moved to Western and coastal West Bengal where damage to life and property was anticipated due to strong winds and tidal waves.
- More than 3 lakh personnel from Police, Civil Defence, Fire & Emergency Services, Power etc. were deployed.
- 971 medical teams were deployed for quick response to emergencies.
- 1000 teams for power restoration and 550 teams for telephone restoration were deployed.

Mitigation Measures

- Sufficient funds & relief materials were made available to districts.
- Weak embankments were repaired on an urgent basis by the Irrigation department. Teams for the repair of breached embankments were also kept in a state of readiness.
- Ban on fishing was imposed from 23rd May and the Indian Coast Guard pushed back errantboats from coast to harbours.
- A team of officials led by Principal Secretary, Labour and the District Magistrate South 24 Parganas district carried out an aerial survey of the coast to check if there were any vessels at sea and if all boats and barges etc were properly harboured in Sundarbans and rivers close to the coast.
- Ferry services were completely suspended from 23rd May 2021.
- Public Health Engineering (PHE) department moved their Mobile Treatment Units (MTUs) to strategic locations for water supply in coastal areas, islands and other vulnerable and remote locations.
- Municipal corporations and municipalities cleaned drains and water outlets before the Cyclone. The local bodies also cut dangerous tree branches before the cyclone. Tree cutting teams were ready to clear roads in all cities, towns and districts.
- The Health Department prepared and executed a plan for taking care of treatment of covid patients during the cyclone by keeping sufficient reserve stock of oxygen for three days and ensuring an uninterrupted power supply to hospitals.

Preparedness for Water Logging and Road Clearance

- Unified control and integrated command system was adopted to address likely water logging and disruption in road communication due to fallen trees, particularly in urban centers. Nodal officers of key departments and agencies were stationed at Control Rooms of Kolkata Police and Kolkata Municipal Corporation for a prompt and unified response.
- Similar unified and integrated arrangements with officials of departments of power, PWD, telecom, irrigation etc were made in all the other districts, subdivision and block control rooms.

Evacuation of Vulnerable population

- Cyclone/Flood shelters were sanitized and made ready for housing the evacuated population as per covid norms. Several schools/colleges/educational institutions were also sanitized and made ready to be used as cyclone/relief shelters. Masks and sanitisers were kept ready for people arriving at relief shelters. District-wise details of various shelters used in cyclone Yaas are given in Table 2.7.

Table 2.7:
District-wise status of Flood Shelters & Cyclone Shelters and No. of Relief Shelters utilized in Cyclone Yaas

District-wise Nos. of Flood Shelters and Cyclone Shelters				No. of Relief Shelters used in Cyclone Yaas	
Sl. No.	District	No. of Flood Shelters	No. of Cyclone Shelters	No. of School Buildings & Govt Buildings utilized as relief shelters	Total No. of Relief shelters used
1	Bankura	-	-	1314	1314
2	Birbhum	6	-	635	641
3	Darjeeling	3	-	-	-
4	Hooghly	16	-	949	965
5	Howrah	39	-	948	987
6	Jhargram	12	-	1000	1012
7	Kalimpong	-	-	-	-
8	Malda	17	-	-	-
9	Murshidabad	83	-	-	52
10	Nadia	9	-	147	156
11	North 24 Parganas	91	63	1200	1354
12	Paschim Burdwan	-	-	671	671

13	Paschim Medinipur	13	-	2897	2910
14	PurbaBardhaman	45	-	175	220
15	Purba Medinipur	19	43	1834	1896
16	Purulia	-	-	1253	1253
17	South 24 Parganas	22	115	1609	1746
18	Kolkata	-	-	38	38
Total		375	221	14,670	15,215

- Evacuation of vulnerable populations to safe shelters was carried out from 15 districts. More than 15 lakh people were evacuated by the morning of 25th May 2021. The number exceeded 20 lakh people on 26th May 2021. A District-wise break down of evacuation is given in Table 2.8.

Table 2.8: District-wise breakdown of evacuated of people from vulnerable areas to shelters in West Bengal

Sl. No.	District	Number of People Evacuated
1	Purba Medinipur	4,12,000
2	South 24 Parganas	3,46,000
3	Paschim Medinipur	3,27,103
4	North 24 Parganas	2,70,805
5	Howrah	1,74,952
6	Bankura	96,488
7	Jhargram	79,572
8	Purulia	77,675
9	Hooghly	65,967
10	Birbhum	56,179
11	Paschim Burdwan	52,031
12	Nadia	51,502
13	Kolkata	10,809
14	Purba Burdwan	9,747
15	Murshidabad	4,325
Total		20,35,155

COVID-19 Scenario & Preparedness Measures - West Bengal

Response to the cyclone under Covid conditions presented peculiar challenges. The health sector in the state was also impacted which further compounded the complexities of disaster response. It also adversely affected the ongoing fight against the COVID-19 pandemic. It was observed that the worst affected districts were those which already had a high level of infection. It is creditable that the state government had comprehended the seriousness of the situation and took several preparatory measures which included the following⁵⁴ :-

- Adherence to COVID-19 protocols during the evacuation of people.
- Distribution of masks and sanitisers.
- Shifting COVID-19 patients from vulnerable areas.
- Ensuring the availability of oxygen cylinders in COVID hospitals.
- Installation and maintenance of power backups in hospitals.
- Availability of essential medicines on the day of landfall.
- Coordination with local urban authorities and police departments in ensuring uninterrupted traffic movement especially ambulances.
- 24x7 COVID-19 control rooms were functional at State, District, Sub-Division and Block level for any urgent requirement of covid related help during the cyclone.
- Functioning of relief camps following the covid protocols.
- Dedicated repair and maintenance teams for electrical or civil works on an urgent basis in health institutions.
- Schools/colleges/flood shelters/cyclone shelters were sanitized before shifting.
- The number of relief camps/shelters were doubled to prevent the spread of covid infection.
- Medical teams were arranged for visiting relief camps and the people residing in low lying areas and sufficient stock of Halogen tablets, bleaching powder, ORS, AVS, analgesics etc was ensured.
- The power supply was maintained uninterrupted in all the Hospitals/Vaccine Centres maintaining a proper Cold Chain.

⁵⁴Ibid at p-21

Significance of Early Warning

The early warning provided by the IMD enabled the central government as well as the state governments to undertake timely preparedness and response measures with due prioritization in face of limited resources at hand. The IMD had informed that the cyclone may strike earlier than expected as against the earlier forecast and also that the cyclone might not be as severe as Cyclone Amphan. “There is an advancement of about 12 hours in its time of the cyclonic storm crossing the Bengal Odisha coast,” said G. K. Das, Director (Weather) at Regional Meteorological Centre Kolkata. Weather scientists said the weather models, through which they are tracking the system, shows that it is moving very fast over the sea. According to them, this is a good sign because if the system moves at a slow pace, it gets time to gather more strength. “Less amount of time spent on the sea means its intensity while approaching the land, will get restricted,” said a Weather Scientist. In such a case, the Met officials said that the cyclone might not create the kind of destruction that Amphan had done last year in May.⁵⁵

⁵⁵“Cyclone-likely-to-hit-land-earlier-than-expected” The Times of India, Kolkata, Friday, 21st May, 2021.

LANDFALL, IMPACT AND EMERGENCY RESPONSE

3.1 Situation on 26th May 2021

As predicted by the IMD the very severe Cyclonic Storm “Yaas”, crossed the north Odisha coast in the forenoon of 26th May 2021. “It crossed the North Odisha coast near 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 on 26th May 2021. It lay centred at 1130 hrs over north coastal Odisha, near latitude 21.4° N and longitude 86.9° E, about 15 km south-southwest of Balasore (Odisha). It further weakened into a severe Cyclonic Storm over north Odisha in the afternoon (1230 hours IST)”⁵⁶. It was also indicated by the IMD that the system was very likely to weaken gradually into a Cyclonic Storm during the next 3 hours. The observed and forecast track of the cyclone as on 26th May 2021 is shown in Figure 3.1.



Figure 3.1: Observed and forecast track alongwith cone of uncertainty of very severe cyclonic storm “Yaas” over North Coastal Odisha based on 0600 UTC of 26th May 2021.

⁵⁶IMD Press Release - No.8, Dated: 26-05-2021, Accessed at : https://internal.imd.gov.in/press_release/20210526_pr_1115.pdf

The cyclone caused considerable devastation of property and crops, though the loss of human life was minimal due to very good standards of early warning and preparedness in the states. “As Cyclone Yaas made landfall in north Odisha around 10.30 am on 26 June Wednesday, strong winds and heavy tides lashed several coastal towns and villages on either side of the Odisha-West Bengal border, inundating low-lying areas and uprooting trees, and claiming at least three lives - two in Odisha and one in West Bengal”.⁵⁷ Certain important aspects in the context of the impact of the cyclone and the relief and rescue operations in the affected states (mainly Odisha and West Bengal) are described in chronological order in the following text.

3.1.1 Situation in Odisha

The Cyclone Yaas struck the Odisha coastline between Bhadrak and Balasore districts with very high-speed winds. The landfall continued until 1 pm on 26th May. Later in the day the cyclone turned weak and moved towards Mayurbhanj district. “The cyclone made land fall between north of Dhamra coast in Odisha’s Bhadrak district and Bahanga coast in the state’s Balasore district. The land fall continued until 1 pm, with estimated wind speeds of 130-155 kmph. By afternoon, as predicted, the cyclone had weakened into a ‘Severe Cyclonic Storm’, before moving towards Mayurbhanj district in Odisha.”⁵⁸

The maximum impact of the cyclone was in the coastal districts of Balasore and Bhadrak, “IMD officials said very severe cyclonic storm Yaas made landfall on Barajadhauli village in Balasore district on the Odisha coast at 9 am and then moved north-north-westwards wreaking havoc on coastal Balasore and Bhadrak district. By 1 pm the landfall process had been completed as it lay about 15 km west-southwest of Balasore”⁵⁹.

Very high velocity winds impacted the coastal areas of the state on 25th and 26th May. “Due 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 the 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”⁶⁰.

⁵⁷The Indian Express May 27, 2021 “Cyclone Yaas pounds Odisha- Bengal coast: three killed, villages flooded”, <https://indianexpress.com/article/india/cyclone-yaas-west-bengal-odisha-jharkhand-weather-7331444/> (Accessed on 05th November 2021)

⁵⁸ibid

⁵⁹The Hindustan Times, May 26, 2021, “No major damage as Cyclone Yaas hits northern Odisha coast, 2 dead,” <https://www.hindustantimes.com/india-news/no-major-damage-as-cyclone-yaas-hits-northern-odisha-coast-2-dead-101622028433594.html>, Accessed on 05th November 2021

⁶⁰Government of Odisha Memorandum on Very Severe Cyclonic Storm, May 2021, pp 8

As the cyclone made landfall, three sea side villages in Balasore district namely Banajoka, Charigochhia and Naupalagadi were inundated, cutting off about 5,000 people (Figure 3.2, Figure 3.3 and Figure 3.4). A flash flood was also reported in Basudevpur block of Bhadrak district, affecting 10 villages.⁶¹



Figure 3.2: Sea water enters through boundaries of a house during cyclone Yaas's landfall in Chandipur area of Balasore (Source: PTI)



Figure 3.3: Under the impact of Cyclone Yaas, tidal surges inundated 3 seaside villages in the Balasore district marooning about 5,000 people. (Source: PTI)

⁶¹Supra note 57



Figure 3.4: A woman stands next to her stall damaged by heavy winds in the Balasore district. (Source: Reuters)

There were very heavy rains in several coastal areas. “Cyclone Yaas triggered very heavy rainfall in most parts of north coastal Odisha on Wednesday morning with Chandbali station in Bhadrak district receiving the maximum rainfall of 288.3 mm followed by 251 mm in Rajkanika of Kendrapada district.”⁶² As per the OSDMA, heavy rains were experienced in Balasore, Bhadrak, Kendrapara, Jagatsinghpur, Mayurbhanj & Keonjhar districts due to the cyclone. District-wise cumulative rainfall is depicted in **Figure 3.5**.

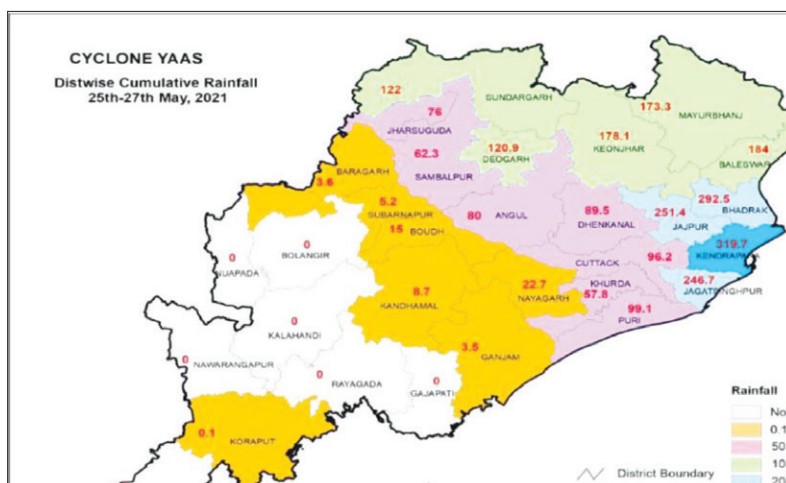


Figure 3.5: Cyclone Yaas- District wise cumulative rainfall in Odisha, 25th-27th May 2021.

⁶²Supra note 59

Under the impact of cyclone, heavy rains occurred in the Balasore, Bhadrak, Kendrapara, Jagatsinghpur, Mayurbhanj & Keonjhar districts (Figure 3.5). Average rainfall in various districts of the state between 25th-27th May is indicated in Table 3.1.⁶³

Table 3.1: District-wise average rainfall from 25 th May to 27 th May 2021 (in mm)					
Sl. No.	District	25 th May	26 th May	27 th May	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

⁶³Supra note 60, at 9-10

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

The Hon'ble Chief Minister Shri Naveen Patnaik, reviewed the post-cyclone situation in the evening on 26th June and announced seven days of ration and other supplies to families of 128 villages in cyclone-affected districts (Figure 3.6). He also stated that the work on the restoration of roads had begun and 80% of the electricity supply was expected to be restored in the next 24 hours in the affected districts.⁶⁴

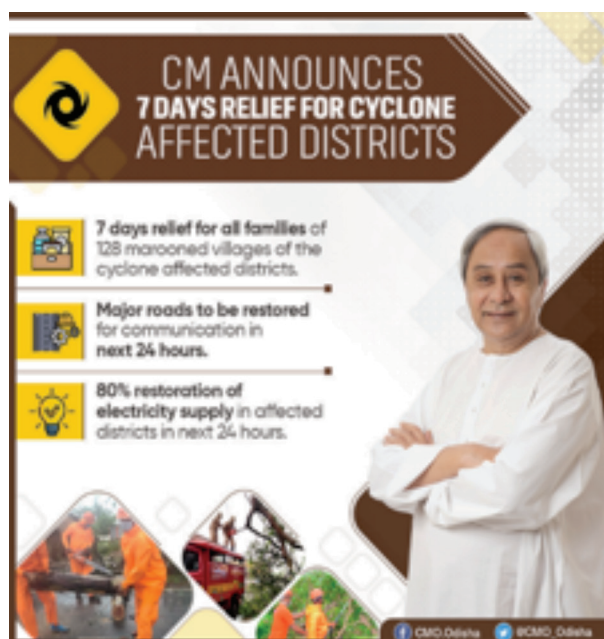


Figure 3.6: Relief Measures announced by The CM of Odisha

The cyclone caused extensive damage to power transmission lines in coastal areas. Hundreds of thatched houses were ravaged.⁶⁵ By the evening of 26th May, the cyclone had moved further northwest towards the Mayurbhanj district.

⁶⁴Supra note 57

⁶⁵The Hindu, Bhubaneswar / Kolkata, 26th May, 2021 “Cyclone Yaas makes landfall in Balasore, triggers heavy damage”, <https://www.thehindu.com/news/national/cyclone-yaas-makes-landfall-in-balasore-triggers-heavy-damage/article34652295.ece>, (accessed on 01st November 2021)

The state authorities were keeping a close watch over the progress of the cyclone. As stated by the State Special Relief Commissioner Shri P. K. Jena, over 1 lakh people from low lying areas of the district had been evacuated to safer locations.⁶⁶

The state government commenced restoration work without loss of time. As per a tweet from the CMO office, restoration work was underway on 26th May by the afternoon. “Restoration work underway in full swing to ensure early resumption of normalcy in cyclone-hit areas of the state. PWD Baleswar QRT Team along with the Odisha Disaster Rapid Action Force (ODRAF) team is removing fallen trees in different parts of Baleswar, tweets CMO Odisha (Figure 3.7).”⁶⁷



Figure 3.7: To ensure early restoration in Cyclone Yaas affected districts, Odisha FS HGs CD personnel carrying out restoration work on a war footing in different parts of the state.⁶⁸

⁶⁶Supra note 57

⁶⁷<https://timesofindia.indiatimes.com/city/kolkata/cyclone-yaas-live-tracking-odisha-west-bengal-brace-for-severe-cyclonic-storm/liveblog/82962051.cms> (accessed on 17 November 2021)

⁶⁸https://twitter.com/CMO_Odisha?ref_src=twsrc%5Etfw%7Ctwcamp%5Etweetembed%7Ctwterm%5E397476185433538565%7Ctwgr%5E%7Ctwcon%5Es1_&ref_url=https%3A%2F%2Ftimesofindia.indiatimes.com%2Fcity%2Fkolkata%2Flive-updates-cyclone-yaas-leaves-heavy-damage-in-west-bengal-odisha%2Fliveblog%2F82962051.cms (accessed on 17th November 2021)

The state administration was very quick and efficient in disaster response to include essential relief, rescue and restoration measures. As per the state government figures, a total of 7.02 lakh people were evacuated from vulnerable areas to 8,410 shelters and provided with dry food, drinking water and free kitchen. In view of the ongoing COVID-19 pandemic hand wash, sanitizers, soaps and 3 ply masks were also arranged for the evacuees in each shelter. Table 3.2 indicates the district-wise evacuation status⁶⁹.

Table 3.2: District-wise Evacuation Status in Odisha

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

The relief operations were well planned and executed by the state government notwithstanding the COVID-19 constraints. About 4.77 Lakh needy people were given emergency rations and polythene sheets. Details are given in Table 3.3⁷⁰.

⁶⁹Supra note 60, at p 27.

⁷⁰Supra note 60, at p 28.

Table 3.3: District Wise Details of Emergent Relief Distributed in Odisha

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

The emergency response by the state government also included veterinary care which included the deployment of 75 Mobile Veterinary teams for care and treatment of animals in the affected area. Besides 582.25 MT cattle feed was also distributed in three districts (Balasore-195.25 MT, Bhadrak-277 MT & Kendrapara-110 MT).

The cyclone caused extensive damage to infrastructure to include roads, power supply, water supply installations and telecommunication infrastructure etc. Restoration work was conducted on war-footing by line departments of the state government. Certain salient details of the prompt restoration work executed are mentioned below.

- **Restoration of Rural Water Supply (Panchayati Raj and Drinking Water Department):**
 - ♦ 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 the supply of drinking water: 346
 - ♦ No. of Tube Wells disinfected: 1060
 - ♦ Generator backup provided to all water supply systems.

- **Restoration of Urban Water Supply (Housing & Urban Development):**
 - ♦ PHEO installations are not damaged. Power supply disrupted
 - ♦ Restoration activities were completed and the water supply resumed.
- **Restoration of Electricity (Energy Department):**
 - ♦ District Hqrs & COVID Hospitals - power restored within 8 hours
 - ♦ Oxygen plants - power restored within 12 hours
 - ♦ Block Hqrs were restored within 24 hours
 - ♦ 80% of Public Water Works & PHC/CHC are restored within 48 hours.
- **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) had been cleared.

3.1.2 Situation in West Bengal

There was a severe impact of the cyclone in the coastal areas of West Bengal. Though the capital Kolkata was largely spared, the city suffered through heavy rains, water logging and disruption in road communication due to fallen trees as also disruption in power and water supply.

The Purba Medinipur and South 24 Parganas districts were most affected due to the cyclone. “Large parts of Digha, Tajpur and Haldia town in Purba Medinipur district (district bordering Odisha) along with several areas in the Sunderbans were inundated. Experts and the Chief Minister said the combined effects of the full moon tide and the cyclone led to breaching of embankments in South 24 Parganas and Purba Medinipur districts. Ms Banerjee said there were reports of breach of embankments at 134 places in the State”⁷¹.

In Digha, a coastal town in the Purba Medinipur district, tall tidal waves breached embankments and flooded villages around a kilometre from the sea before the landfall (Figure 3.8). “Shops, huts, resorts and hotels along the beach were damaged as the waves pounded them. Coastal towns in the vicinity of Digha namely Tajpur, Shankarpur and Mandarmani, were also affected with roads adjacent to the sea damaged and fields flooded. In Ramnagar area of the district, one person reportedly drowned after water flooded the village. The rural areas of Purba Medinipur district in Nandigram and Contai were also waterlogged”⁷²

⁷¹“Cyclone Yaas makes landfall in Balasore, triggers heavy damage”, The Hindu, Bhubaneswar / Kolkata, 26th May, 2021, <https://www.thehindu.com/news/national/cyclone-yaas-makes-landfall-in-balasore-triggers-heavy-damage/article34652295.ece> , (accessed 01st November 2021).

⁷²ibid

In the South, 24 Parganas district, embankments were breached in Frazerganj, Bakkhali, Sundarban, Kakdwip, Namkhana, Sagar Island, Gosaba and some other places.

The West Bengal Chief Minister Mamata Banerjee made a statement saying that the cyclone had damaged more than 3 lakh houses and affected about 1 crore people in the state. She informed that 15 lakh people from coastal areas had been evacuated. The state capital Kolkata suffered heavy rain fall inundating several localities and disrupting traffic in the city.

As per initial estimates, there was wide spread damage to agriculture as stated by the Chief Minister. “There has been extensive damage to agriculture due to ingress of saline water. Allied sectors such as fisheries, horticulture have suffered damage, but we will be able to estimate the complete situation in 72 hours.”⁷³

In Howrah, several villages were submerged in the Amta and Shyampur areas. After the cyclone, people were seen wading through deep water carrying children and cattle to safer places.



Figure 3.8: Digha, West Bengal: As per IMD estimates storm came with a wind speed of 130-155 kmph. (Indian Express photo by Partha Paul).

⁷³ ibid

The capital Kolkata was also impacted where there were heavy rains and trees were uprooted due to high-speed winds disrupting road communications and breakdown in power supply. There was water logging in several areas (Figure 3.9).



Figure 3.9: Pedestrians wade through a flooded road during landfall of cyclone ‘Yaas’, in Kolkata, Wednesday, May 26th, 2021. (Source: PTI)

Impact on Tourism

The cyclone caused a big blow to the tourism industry in West Bengal. There are more than 1100 hotels across the 71 kilometres long coastline from Digha to Khejuri with several popular beach destinations. Most of these hotels are located in Digha and New Digha. Sea water flooded several hotels in the Digha-Mandarmani belt. “As Yaas made landfall in neighbouring Odisha, water from the sea gushed into the hotels and inundated the ground floors and the first floors of properties built across the beaches”⁷⁴.

Mandarmani was the second worst-hit place after Old Digha where most resorts were inundated. As stated by Debu Das Mahapatra, secretary of Mandarmani Hoteliers’ Association the hotels were badly damaged. “The water has not just damaged the walls and the landscapes. From furniture to appliances, from interiors to upholstery, nothing is left. For over 6 hours there was 8 to 10 feet of water inside the hotels. It started receding only after 7 pm”⁷⁵. In contrast to

⁷⁴“Cyclone Yaas: Sea water floods hotels in Digha-Mandarmani belt”. The times of India, Kolkata, Thursday, May 27, 2021.

⁷⁵ibid

this area, the hotels in coastal areas of South 24 Parganas were not affected so severely and some hotels were even used to provide shelter to affected villagers. Figure 3.10 indicates the devastation caused to the hotels in the aftermath of the cyclone in Digha.



Figure 3.10: Devastation caused to the hotels in the aftermath of the cyclone in Digha (Source: Times of India)

Impact on Sundarbans and Wild Life:

The Cyclone also impacted the wildlife and several forest camps in the Sundarbans (Figure 3.11). “Since the landfall coincided with the high tide on Wednesday morning it led to major damage to Bhagabatpur crocodile breeding and Jharkhali rescue centres and inundation of at least 18 forest department camps and three range offices. At least five spotted deers and a wild boar were also rescued by villagers and forest staff throughout the day.”⁷⁶

⁷⁶“West Bengal: Crocodile safety worry after tide water floods breeding center”, The Times of India, Kolkata, Thursday, May 27th, 2021



Figure 3.11: Storm water inside Bhagabatpur crocodile centre in Sundarbans. (Source: Times of India)

Impact on the ongoing management of the COVID-19 Pandemic

The cyclone affected the ongoing efforts towards prevention and treatment of the COVID-19 in all the affected areas as also the vaccination drive. For instance, in Kolkata, very few patients reported to OPDs of hospitals and many patients, though treated, did not return to their homes from hospitals due to the cyclone alerts and warnings. There was a significant drop in the number of covid patients reporting at OPDs as also to the emergency wards of various hospitals (Figure 3.12).

As stated by Subhasish Datta, general manager operations, Ruby General Hospital, Kolkata, the covid patient footfall in hospitals dropped remarkably on 26th May. “Our fever clinic had no patient on Wednesday. We had stepped up infrastructure at our emergency unit in case people were injured in the natural calamity, but much fewer patients than usual came during the day,” said Subhasish Datta, general manager operations, Ruby General Hospital. OPD footfall in other hospitals, like RN Tagore Institute of Cardiac Sciences and all three units of AMRI Hospitals, remained 10% to 20%.⁷⁷ (Figure 3.12).

⁷⁷“OPDs, emergencies wear deserted look on Yaas day, many patients defer discharge” - The Times of India, Kolkata, Thursday, 27th May, 2021

“With the memories of Amphan devastation still fresh, many recovered COVID patients, who were due for discharge on Wednesday, preferred to stay back for a day. As a result, the discharge count also went down on Wednesday. But hospitals could accommodate all as only a few number of people came for admission.”⁷⁸



Figure 3.12: Storm fear pushes down footfall in most hospitals.
(Source: Times of India)

3.1.3 Situation in Jharkhand

The state of Jharkhand was on high alert as of 26 May as the cyclone was expected to hit the state around midnight 26/27th May after striking areas in West Bengal and Odisha. The authorities in the state carried out the evacuation of the vulnerable population from low-lying areas in East and West Singhbhum districts, besides some other districts on 26th May as per the Secretary Disaster Management Shri Amitabh Kaushal. “Operations are being executed on war-footing in the vulnerable areas in East and West Singhbhum, besides some other districts, in view of the very severe cyclonic storm Yaas.”⁷⁹ Uprooted trees and electric poles in Ranchi area were erected by the concerned department (Figure 3.13).

⁷⁸Ibid

⁷⁹“As cyclone Yaas pounds Bengal, Odisha, Jharkhand evacuates people from low-lying areas” <https://www.newindianexpress.com/nation/2021/may/26/as-cyclone-yaas-pounds-bengal-odishajharkhand-evacuates-people-from-low-lying-areas-2307803.html>(accessed on 22nd November 2021)

In the East Singhbhum district, in particular, people were shifted from low-lying areas of the two rivers in the district, though these rivers were flowing below the danger mark on 26th May. As stated by Deputy Commissioner Suraj Kumar “We are witnessing high-speed wind and have evacuated about 6,000 persons from thatched houses and danger zones to shelter homes in safer locations,”⁸⁰



Figure 3.13: Many trees and electric poles were also uprooted in Ranchi due to high-speed winds, disrupting the power supply. (Source: PTI)

3.2 Situation on 27th May 2021

By the midnight of 26th June, the cyclonic storm had weakened and it developed into a deep depression. At 2330 hrs on 26th May it laid centred over south Jharkhand and adjoining north interior Odisha. As per the IMD, it was likely to move north-westwards and weaken gradually into a depression during the next 12 hrs. Hon’ble Prime Minister again chaired a meeting to review the impact of the cyclone on 27th May 2021.

3.2.1 Situation in Odisha

In Odisha, around 120 villages were swamped by heavy rain and sea water whipped up by the cyclone but people in most areas had already been moved to storm shelters. There was heavy rainfall in the coastal areas triggered by the cyclone.

Four districts were placed on high alert by the state government after water levels in the Baitarani river started rising. “Keonjhar, Jajpur, Kendrapara and Bhadrak districts have been ordered to take immediate measures as water levels of Baitarani are flowing above the danger level at Anandapur and Akhuapada,

⁸⁰*ibid*

special relief commissioner Shri P K Jena said while speaking to reporters, according to news agency PTI”⁸¹.

Chief Minister Shri Naveen Patnaik undertook an aerial survey of the affected areas to assess the damages caused by the calamity on 27th May 2021.

3.2.2 Situation in West Bengal

In West Bengal, authorities said that around 1,100 villages had been flooded by storm surges, leaving at least 50,000 homeless, news agency Reuters reported.

3.2.3 Situation in Jharkhand

In Jharkhand 201 nos. of relief, camps were set up and 596 no. of people were evacuated in the West Singhbhum district as part of relief efforts ahead of cyclone Yaas, as per Shri Ananya Mittal, District Collector, West Singhbhum.⁸²

There were heavy rains in some parts of the state. Heavy rain triggered by the cyclone Yaas damaged a major bridge in Ranchi. Besides two people were also killed as a result of a house collapse.⁸³ “A bridge over river Kanchi collapsed yesterday due to heavy rainfall as an impact of cyclone Yaas in the Tamar area of Ranchi; no casualties were reported”⁸⁴ (Figure 3.14).



Figure 3.14: A Collapsed Bridge in Ranchi. (Source: Times of India)

⁸¹<https://www.hindustantimes.com/india-news/Cyclone-Yaas-Highlights-Flight-ops-at-Patna-airport-suspended-till-9am-tomorrow> By hindustantimes.com, Hindustan Times, New Delhi, updated on 28th may, 2021 12:01 AM IST Accessed on 18th June 2021

⁸²ibid

⁸³“From 10,000 in 1999 to 6 in 2021: How India cut cyclone deaths”, The times of India, Kolkata, Friday, May 28th, 2021

⁸⁴<https://timesofindia.indiatimes.com/city/kolkata/live-updates-cyclone-yaas-leaves-heavy-damage-in-west-bengal-odisha/liveblog/82962051.cms>(accessed on 24th November 2021)

3.3 Situation on 28th May 2021

The cyclonic storm which had weakened and turned into a depression over central parts of Jharkhand on 27th May moved north westwards and was further weakened into a well-marked Low-pressure area in the early morning of 28th May 2021 over Bihar and adjoining East Uttar Pradesh. It lay as a well-marked low-pressure area over eastern parts of Uttar Pradesh and adjoining Bihar at 0830 hours IST on the 28th May 2021. The observed track of the cyclonic storm over the east-central Bay of Bengal during the period 23th-28th May 2021 is indicated at Figure 3.15.



Figure 3.15: Observed track of very severe cyclone storm “Yaas” over east central Bay of Bengal during 23th-28th May, 2021. (Source: IMD)

The Hon’ble Prime Minister Shri Narendra Modi visited West Bengal and Odisha on 28th May 2021 (Figure 3.16). He took a review meeting on the impact of the cyclone and the relief measures with the Governor, Chief Minister and senior officers of the Odisha Government at 11.00 AM at the Biju Patnaik International Airport and made an aerial survey of the cyclone-affected areas

in Bhadrak and Balasore districts. “The PM appreciated the preparedness and disaster management activities by the Government of Odisha which resulted in minimal loss of lives. He also noted that the state had embarked on long term mitigation efforts for dealing with such natural disasters.”⁸⁵ He also carried out an aerial survey of the worst affected Purba Medinipur district in West Bengal. He announced an ex-gratia amount of Rs. 2 lakh for the next of kin of the deceased and Rs. 50,000 to the seriously injured due to the disaster. The central government was quick in granting financial aid to the affected states. “On 28.05.2021, Hon’ble Prime Minister reviewed damages due to cyclone Yaas and also undertook an aerial survey of Cyclone Yaas affected areas in Odisha & West Bengal. After review, the Hon’ble Prime Minister announced financial assistance of Rs. 1000 crore to Odisha, West Bengal and Jharkhand for immediate relief activity. Accordingly, financial assistance from NDRF of Rs. 500 crore to Odisha, Rs. 300 crore to West Bengal and Rs. 200 crore to Jharkhand have been released”⁸⁶



Figure 3.16: Hon’ble Prime Minister Shri Narendra Modi during a meeting with Odisha CM Naveen Patnaik to review the impact of Cyclone ‘Yaas’, in Bhubaneswar, on Friday, 28th May, 2021. (Source: Photo Credit: Biswaranjan Rout, the Hindu Bhubaneswar, 28th May 2021).

The chief minister of Odisha stated that in the view of the COVID-19 situation in the country, the state did not want to burden the central government with funds for immediate financial assistance for cyclone restoration works, instead, he requested central assistance for long-term cyclone mitigation measures.

⁸⁵Press Information Bureau, Government of India, Prime Minister’s Office Press Release posted on 28 May 2021, “PM reviews damage due to cyclone Yaas” (Release ID: 1722467), Accessed at : pib.gov.in

⁸⁶Ministry of Home Affairs, Disaster Management Division, (National Emergency Response Centre), Situation Report about Very Severe Cyclonic Storm “Yaas” over Bay of Bengal as on 29.05.2021 at 1800 hrs.

Earlier, after meeting with Mr. Modi, Mr. Patnaik said Odisha did not want to burden the Centre at the peak of COVID-19 second wave by demanding immediate financial assistance for carrying out cyclone restoration works. He instead called for the provisioning of assistance for long-term cyclone mitigation measures.

“As the country is at the peak of the COVID-19 pandemic, we have not sought any immediate financial assistance to burden the Central government and would like to manage it through our own resources to tide over the crisis,”⁸⁷ said Mr. Patnaik.

In a series of tweets, Mr. Patnaik thanked the Prime Minister for visiting the State. He said, “I have sought assistance for long-term measures to make Odisha disaster resilient as we are frequented by such climate hazards every year and highlighted State’s demand for disaster resilient power infrastructure and resilient coastal protection with storm surge resilient embankments.”

It needs to be mentioned that on May 1, the Centre had released ₹641.6 crores in advance as the first instalment of the Central share of the State Disaster Response Fund.

3.3.1 Disaster Resilient Power System

After the review meeting, Shri Pradeep Kumar Jena, Special Relief Commissioner, elaborated that a disaster-resilient power system meant the adoption of better technology and design preferably going in for underground power supply and strengthening of the power infrastructure.

“Similarly, though we have a 480-km long coastline, we have more than 1,600 km of saline embankment. Of which, about 400 to 450 km is vulnerable as it can give protection to a tidal surge of 2 to 2.5 metre. If the storm surge goes beyond that height, we will be unable to give protection to the coastal region. The model says Balasore district could receive a storm surge upto 7-8 metre high, for which we want a robust protection system,”⁸⁸ Mr. Jena pointed out.

⁸⁷The Times of India, Bhubaneswar, May 29 2021, “Odisha: Naveen Patnaik says no to Centre’s aid, won’t burden it amid pandemic”. <https://timesofindia.indiatimes.com/city/bhubaneswar/odisha-naveen-patnaik-says-no-to-centres-aid-wont-burden-it-amid-pandemic/articleshow/83055454.cms> (Accessed on 24th November 2021).

⁸⁸The Hindu Bhubaneswar, May 28, 2021 “Cyclone Yaas, I PM announces ₹1,000 crore aid for three cyclone-hit States”, <https://www.thehindu.com/news/national/other-states/pm-announces-1000-crore-aid-for-three-yaas-hit-states/article34664999.ece#:~:text=%E2%80%9C9C%20though%20we%20have%20a,protection%20to%20the%20coastal%20region,> (Accessed 23rd November 2021)

3.4 Situation on 29th May 2021

The cyclone finally turned into a low-pressure area over southeast UP and adjoining Bihar on 28th May evening (1730 IST/1200 UTC) and became less marked on 29th May morning (0530 IST/0000 UTC).⁸⁹

The IMD stopped issuing bulletins on the cyclonic system from 29th May onwards as indicated by the MHA situation report, “On 28.05.2021, IMD also intimated that bulletin no 33 will be the last bulletin pertaining to this system. However, regular weather warning bulletins will continue from National Weather Forecasting Centre and all regional & state level forecasting centres of IMD”⁹⁰.

⁸⁹“Very Severe Cyclonic Storm YAAS over the Bay of Bengal (23rd - 28th May, 2021): A Report” https://internal.imd.gov.in/press_release/20210611_pr_1133.pdf, Accessed on 06th November 2021

⁹⁰Ministry of Home Affairs, Disaster Management Division, (National Emergency Response Centre), Situation Report about Very Severe Cyclonic Storm “YAAS” over Bay of Bengal as on 29.05.2021 at 1800 hrs.

ROLE OF ARMED FORCES, NDRF & INDIAN COAST GUARD IN EMERGENCY OPERATIONS

4.1 Introduction

The armed forces were deployed well in time in a proactive mode for anticipated relief and rescue operations in Odisha and West Bengal. The Defence Forces, on being requisitioned, promptly reacted with great synergy with the central, state and district authorities and all other stakeholders. The main focus of the operations was on preventing the loss of lives of the civil population, keeping in mind the severe second wave of COVID-19.

4.2 Indian Army Operations

The government of West Bengal had requisitioned assistance from Armed Forces for 12 districts of the state and nine sub-divisions of Kolkata city. The state government was assured of all possible assistance by the Armed forces for restoration of normalcy after the impact of the cyclone. The deployment and operations of the Armed Forces were well-coordinated through Unified Control Centres at the State Government Secretariat (Nabanna) under the Chief Secretary and the Kolkata Police Control Room functioning under the commissioner Kolkata Police. The Army also established a control room at HQ Bengal Sub Area at Kolkata under the Station Commander of the Kolkata Military Station on 24th May 2021.

A total of 21 Army columns from the Eastern Command of the Army were positioned in various parts of the state and the Kolkata city well before the expected landfall. The army provided one column each (consisting of 01 Officer, 03 JCOs and 75 Other Ranks) to 12 districts of the state. Nine Army columns consisting of 01 Officer, 02 JCOs and 30 Other Ranks were also earmarked for nine sub-divisions of Kolkata. The columns were equipped with Power Cutters, Hand Saw Cutters, JCB, Recovery Vehicles, Suction Pumps, Life Jackets, Boats and Communication Equipment. Table 4.1 gives a summary of the army columns deployed in West Bengal⁹¹.

⁹¹HQ IDS DO Letter No IDS/Ops/Op Lgs/31012/Dis Gen dated 21st Sep to the Executive Director, NIDM, MHA, New Delhi.

Table 4.1: Summary of Army Columns Deployed in West Bengal

Sl. No.	No. of Columns	District / Area
(i)	02	- West Midnapur - Nadia
(ii)	02	- West Burdhaman - Purnia
(iii)	02	- Jhargram - Bakura
(iv)	01	- Birbhum
(v)	03	- Howarah - SW Div - Port Div
(vi)	02	- North 24 Pargana - South 24 Pargana
(vii)	05	- East Medinapur - Northern Div - Eastern Suburban Div - Central Division - Southern Division
(viii)	01	- Hoogly
(ix)	01	- SE Div
(x)	02	- South Suburban Div - Eastern Div

4.3 Indian Air Force Operations

The IAF commenced HADR operations on 21st May 21. Transport aircraft of the IAF were employed for the deployment of the NDRF teams and equipment in the states of West Bengal and Odisha. It played a spectacular role in mobilisation for emergency response. Between 21th-25th May 2021, the IAF carried out 79 transport sorties moving 1334 personnel and shifting 124 tons of load.

The transport fleet of the IAF included C-17, IL-75, C-130 and AN-32 aircraft. NDRF teams along with their loads were airlifted from Jamnagar, Patna, Varanasi and Lilabari to Kolkata. Units of NDRF were also airlifted from Arakonam to Kaliakunda, Lilabari to Durgapur and from Guwahati, Pune and Jamnagar to Bhubaneswar⁹².

⁹²*ibid.*

4.4 Indian Navy Operations

The Eastern Fleet, The Naval Officer In-charge (Odisha) and the Naval Officer In-charge (West Bengal) were involved in the rescue and relief operations. Salient aspects of the HADR operations of the Indian Navy are as follows⁹³:-

4.4.1 Odisha

A Command and Control Base was immediately set up at ITR, Chandipur in the Balasore District on 26th May 21 post-landfall of cyclone by the Naval Officer In-charge (Odisha). The affected low lying areas were identified with the assistance of the Civil Administration, Ex-Servicemen community and local Sarpanchs. The diving teams and equipment were fully rigged up to meet any contingency at short notice. However, no such requirement was envisaged and hence the manpower of the diving teams was also utilized for other relief activities.

A community kitchen was operated in Balasore from 27th-30th May 2021 and a large scale of the needy populace was covered by providing approximately 3000 cooked meals every day. The initial preparation of meals included challenges viz. shortage of potable water and insect menace. Further, the movement of vehicles was also limited owing to the narrow and marshy roads in the cyclone-affected areas. The major challenges faced were the breakdown of vehicles, inclement weather, crowd control and distribution of cooked meals to isolated areas with COVID-19 restrictions. The cooked meals were packed and distributed to the needy on two-wheelers with the help of Sarpanch, local Ex-servicemen and Volunteers. Post rehabilitation of low lying areas and no requirement of cooked meals from the civil administration, the community kitchen was terminated on 31st May 2021. Approximately 1600 families were provided relief with dry rations at various villages of Sadar Block. Besides, approximately 500 clothing packets were also distributed to the needy families identified by the Sarpanch of the villages in the Block.

Eastern Fleet ships namely INS ships Mysore, INS Ranvijay, INS Shakti and INS Kamorta were deployed off the Odisha coast for HADR operations from 24th-30th May 2021. The ships had embarked the HADR items as per the Indian Navy policy. INS Mysore, Shakti and Kamorta had embarked helicopters also for the operation. The objective of the deployment was to provide humanitarian aid and relief materials in cyclone-affected areas of Odisha. The ships were also deployed for Search & Rescue operations in case any boat or personnel were reported missing at sea as well as to set up a relief camp ashore.

The ships proceeded to North Odisha maintaining a 250 nautical miles distance from the eye of the storm. The ships were directed to operate off Dhamra given the extent of damage caused by the cyclone.

⁹³*ibid.*

All the ships arrived off Dhamra at 0600 hrs on 27th May 2021 post-landfall. Along side berths envisaged for INS Ranvijay and INS Kamorta for setting up of HADR camps did not materialize as berths were not available. All ships anchored off Dhamra from 27th-29th May. Flying operations by helicopters could not commence on 27th May 21 in view of the weather being unsuitable for flying operations.

Aerial reconnaissance of Dhamra port, Balasore, Talasari and Bhograi was undertaken based upon intimation from the NOIC (Odisha). Bhograi was observed in grim condition with roads/land inundated with water and personnel sighted at rooftops. Two landing spots for helicopters were identified at Dhamra and Wheeler Island. The civil administration, however, decided that no relief material was to be air dropped by helicopters in the cyclone-affected areas to maintain COVID protocol. A total of 10 sorties were undertaken by three helicopters for a duration of 13 hrs and 15 min for aerial recce and transfer of 2400 dry provision packets and 993 Kgs of relief material from ships to ITR, Balasore. The Indian Navy ships were thus able to augment the relief material at Balasore for distribution in the cyclone-affected regions.

4.4.2 West Bengal

The deployment and operations by the naval teams in West Bengal under the Naval Officer In-charge (West Bengal) are indicated in Table 4.2.

Table 4.2: Operations by the Naval Teams in West Bengal

Sl. No.	Date	Deployment and tasks
(i)	26 th May 2021	Naval team at Diamond Harbour re-deployed by State Authorities to East Medinipur by Road and later moved to Contai for anticipated relief operations on 27 th May 21.
		Part of Naval team at Fraserganj re-deployed to Narayanpur village for rescue operations. Mission postponed to 27 th May 21 in view sunset and poor visibility.
(ii)	27 th May 2021	Deployment of one FRT (Ex Diamond Harbour) to Contai for rescue and relief operations based on request of State government.
		Naval teams (01 Diving and 02 Flood Relief Teams) at Fraserganj continued rescue and relief operations in Narayanpur village.
		Naval teams (01 Diving and 02 Flood Relief Teams) at Digha continued rescue and relief operations at Digha.

(iii)	28 th May 2021	Naval teams (01 Diving and 02 Flood Relief Teams) at Fraserganj were attached with State Authorities for rescue and relief operations in affected villages of South 24 Paraganas.
		Naval teams (01 Diving and 02 Flood Relief Teams) at Digha continued rescue and relief operations at Digha as assigned by the Local state administration.

4.5 Rescue and Relief Operations by the National Disaster Response Force (NDRF)

The National Disaster Response Force (NDRF) is a unique disaster response force created by the Government of India in conformity with the Disaster Management Act 2005. The organisation has been rendering yeoman service in all the disasters since its raising and has earned an enviable reputation in disaster rescue and relief operations. Currently, it has 16 specialised battalions, spread all over the country.

A very large number (a total of 101) of teams of NDRF were deployed for rescue and relief operations on the western coast of India in view of the extremely severe cyclonic storm Tauktae which struck the western coast in Goa, Maharashtra and Gujarat on 18th May 2021.

On receipt of the early warning of the cyclone Yaas, the NDRF promptly started planning for deployment on the eastern coast which included moving units from the western to the eastern coast. “NDRF Director General S.N. Pradhan tweeted that the force had decided to “airlift” West Bengal and Odisha-based teams of the force in view of Cyclone Yaas and its “possible impact” in the coastal districts of the two States⁹⁴.”

A NDRF team consists of 47 self-contained personnel. They are equipped with state of the art equipment to include tree and pole cutters, communication gadgets, inflatable boats and basic medical aid for disaster response operations. Due to the COVID-19, these teams were provided with orange-coloured full-bodied personal protection gear including a face shield for each team member.

As a part of proactive measures, by 23rd May a total of 85 self-contained teams of NDRF were earmarked for the coastal region of West Bengal, Odisha, Andhra Pradesh, Tamil Nadu and Andaman and Nicobar Island in collaboration with state authorities. Apart from this, fully equipped 16 Search and Rescue Teams were kept on alert as a backup.⁹⁵ All the deployed teams were in close

⁹⁴“NDRF prepares for Cyclone Yaas, positions teams in Bengal, Odisha” The Hindu, New Delhi , May 21, 2021, <https://www.thehindu.com/news/national/other-states/ndrf-prepares-for-cyclone-yaas-positions-teams-in-bengal-odisha/article34614996.ece> (accessed on 22nd November 21)

⁹⁵“NDRF Teams Deployed on Eastern Coast” PR Cell, NDRF HQ, Press Note dated 23th May 2021, <http://www.ndrf.gov.in/pressrelease/ndrf-teams-deployed-eastern-coast>, (accessed on 23rd November 2021)

touch with concerned authorities and working in coordination with the local administration for evacuation and warning to the local population. Table 4.3 gives the deployment of NDRF teams for the Cyclone Yaas as of 23rd May 2021.

Table 4.3: Deployment of NDRF Teams for Cyclone Yaas as on 23rd May 2021

Sl. No.	State	No of Teams
1	West Bengal	32
2	Odisha	28
3	Andhra Pradesh	03
4	Tamil Nadu	02
5	Andaman and Nicobar Island	04
6	Reserve teams as back up	16
Total		85

Due to the severity of the situation, additional NDRF teams were made available for disaster response. By 24th May, a total of 109 teams were committed, out of which 48 teams were moved by air due to the urgency of the situation and deployed in West Bengal and Odisha. Some teams were moved to Jharkhand too. The Table 4.4 gives the deployment of NDRF teams for the Cyclone Yaas as of 24th May 2021.

Table 4.4: Deployment of NDRF Teams for Cyclone Yaas as on 24th May 2021

Sl. No.	State	No of Teams	Remarks
1	West Bengal	32	10 more teams being airlifted in addition to the 03 teams kept on alert in the state.
2	Odisha	44	08 teams kept as immediate reserve at Mundali, Cuttack NDRF Base
3	Andhra Pradesh	03	
4	Tamil Nadu	02	01 teams on alert at Arakkonam NDRF BN,
5	Andaman and Nicobar Island	01	
6	Jharkhand	03	02 teams on standby in the state.
Total		85 Teams	24 Teams

The NDRF teams were constantly engaged with the State & District administration in evacuating people to safer places or cyclone shelters, clearing roads and sensitizing localities about the preventive measures (Figure 4.1 and Figure

4.2). HQ NDRF was closely monitoring developments and all efforts were being made to ensure zero casualty and minimum damage to life and property.⁹⁶

As the cyclone made landfall on 26th May, a total of 113 teams of NDRF, the highest ever number of teams for cyclones, were earmarked/deployed in five states and the UT⁹⁷.



Figure 4.1: A member of the NDRF uses a megaphone to appeal to residents to move to safer place ahead of Cyclone Yaas at Digha in Purba Medinipur district in West Bengal.
(Source: Reuters & Tribune News Service, New Delhi, May 25th, 2021)



Figure 4.2: NDRF teams clearing uprooted trees on the roads

⁹⁶“Cyclone Yaas : NDRF Teams Deployed on Eastern Coast“ PR Cell, NDRF HQ, Press Note Dated 24th May 2021, <http://www.ndrf.gov.in/pressrelease/cyclone-yaas-ndrf-teams-deployed-eastern-coast>, (accessed on 23rd November 2021)

⁹⁷“Cyclone‘Yaas’:NDRF Engaged In Restoration Work “ PR Cell, NDRF HQ, Press Note Dated 26th May 2021, <http://www.ndrf.gov.in/pressrelease/cyclone-yaas-ndrf-engaged-restoration-work>, (accessed on 23rd November 2021)

The NDRF teams went about relief and rescue operations in the most professional manner. Operating in close coordination with respective state governments they evacuated thousands of people in low lying areas to safer locations in the most affected districts of Odisha and West Bengal. They were also employed for the restoration of road communications by cutting and removing fallen trees and electric poles from the roads.

The NDRF swift and effective response proved to be very valuable in saving lives and restoring essential services. The NDRF teams were gradually pulled back after restoration in the affected areas, all the teams had returned to their parent locations by end of June 2021.

4.6 Indian Coast Guard (ICG)

4.6.1 Role of ICG in Disaster Situations

The ICG is responsible for Search and Rescue (SAR) assistance to mariners and protection to fishermen including assistance while in distress at sea. It is the nodal agency responsible for executing/coordinating Search and Rescue (SAR) in Indian Search and Rescue Region (ISRR) which is about 4.6 million sq km. The Director General Indian Coast Guard is the National Maritime SAR Coordinating Authority (NMSARCA). “Under NMSARCA, the ISRR of India is divided into three areas with Maritime Rescue Coordination Centres (MRCCs) located at Mumbai, Chennai and Port Blair. There are 10 Maritime Rescue Sub Centres (MRSCs) and 03 Maritime Rescue Sub Centres (MRSSCs) operating under these MRCCs. The multi-mission Indian Coast Guard Stations located along the coast deploys state of the art ships and aircraft to provide SAR coverage in ISRR”⁹⁸. The SAR operations of the ICG are conducted from respective MRCCs. “Post formation of a cyclone, ICG ships operating at sea are dispersed to clear the swath of the cyclonic path and be ready for SAR. As the cyclone moves, ICG ships follow the trail for undertaking rescue operations and aircraft are tasked for aerial reconnaissance. Concurrently, Maritime Rescue Coordination Centres (MRCCs) and Maritime Rescue Sub-Centres (MRSCs) of respective states coordinate with various stakeholders for responding to distress calls, if any, received from ships/boats at sea. Further, MRCCs also interact with MRCCs of neighbouring countries for coordination of SAR, if any, of Indian vessels transgressed into their waters”.⁹⁹

⁹⁸https://www.indiancoastguard.gov.in/content/447_3_NMSARCA.aspx, National Maritime Search & Rescue Coordinating Authority (accessed on 14 November 2021)

⁹⁹Coast Guard Headquarters, New Delhi, Letter No.OP/0209/DM dated 21st Sep. 21

4.6.2 Preventive Measures and Preparedness

The following measures were initiated by the ICG on receipt of early warning of the cyclone from the IMD¹⁰⁰:-

- ICG operational Headquarters on East Coast including Andaman & Nicobar Islands alerted Fisheries authorities/associations and commenced maintaining one to one liaison with State/Central Agencies through MRCC Chennai and respective state/UT MRSC to account fishing boats and alert fishing boats at sea to take shelter in nearest port/return to base port.
- Regional Operating Centres (ROC) and Remote Operating Radar Stations (ROs) on the East Coast/Andaman & Nicobar Islands commenced transmitting weather alerts in vernacular languages to warn fishing boats/mariners in their area of jurisdiction.
- Port authorities on the East Coast/Andaman & Nicobar Islands and merchant vessels at anchorages were alerted on weather requesting for initiating preventive measures and proceed to safety.
- The ICG ships and aircraft were deployed off A&N Islands, Puducherry, Tamil Nadu, Andhra Pradesh, Odisha, and West Bengal coasts for alerting fishing boats to take shelter, merchant vessels transiting through the area to clear path of cyclone and merchant vessels anchored at various ports to pick up anchor and move to a safe area. The weather alerts by ICG ships and aircraft were issued in vernacular language on VHF radio. Deployment of ICG ships and aircraft from 19th to 27th May 2021 is given in Table 4.5.

**Table 4.5: Deployment of ICG ships and aircraft
from 19th-27th May 2021**

Sl. No.	Date	Ships	Aircraft
(a)	19 th May 21	19	04
(b)	20 th May 21	23	03
(c)	21 th May 21	17	03
(d)	22 nd May 21	21	05
(e)	23 rd May 21	17	03
(f)	24 th May 21	22	02
(g)	25 th May 21	20	02
(h)	26 th May 21	05	01

¹⁰⁰ibid

4.6.2.1 ICG Operations During Cyclone Yaas

The ICG played a pivotal role in minimizing loss of lives by tireless actions to warn fishing boats at sea in coordination with respective State/UT governments. The ICG activities are summarised as under:-

- MRCC Port Blair and MRCC Chennai maintained constant liaison with various stakeholders and issued advisory to the local fisheries department for alerting boats and ports to alert the vessels at anchorages.
- ICG District Headquarters, Visakhapatnam issued advisory to ONGC/Oil Handling Agencies (OHAs) for alerting Oil Rigs and other vessels in Off shore Development Areas (ODAs) to take preventive measures for safety as per their SOPs, monitoring of all Off shore Support Vessels (OSVs)/support vessels and initiate contingency measures.
- A ban on mechanized fishing boats was operative from 15th April to 14th June 2021 on the east coast including Andaman & Nicobar Islands as per MoFAH&D Notice No.30035/15/97-Fy(T-1) Vol. V dated 30th Mar 2021. Traditional non-motorised fishing boats were exempt from the ban. Accordingly, only traditional boats were sighted by ICG patrols.
- The ICG establishments along the East coast and Andaman & Nicobar Islands coordinated with State/UT Fisheries Departments. The significance of the ICG operations is reflected in the following achievements:-
 - ♦ It was ensured that 265 Indian Fishing boats were accounted for having returned to various ports/harbours in Indian Maritime boundaries.
 - ♦ ICG ships shepherded 55 Indian Fishing boats to safety.
 - ♦ 242 Merchant vessels at sea/anchor ages were alerted for taking safety measures. It was ensured that there were no vessels at anchor age off ports in West Bengal and Odisha. This was done through continuous liaison with various port authorities. Oil Rig Operators and Oil Handling Agencies along the eastern sea board were alerted to prevent damage and loss of life. Total 07 SPMs and 10 platforms on East Coast were sensitised and operations were suspended temporarily.
 - ♦ Coast Guard District HQ-8 at Haldia (West Bengal) evacuated 77 stranded people from Nayachara Island. Two hovercrafts were launched for the evacuation immediately on receipt of information from the district administration (Figure 4.3)
 - ♦ All the ICG establishments along the east coast and A & N Islands were on standby for relief operations. A total of 37 Disaster Response Teams (DRTs) were activated at different locations as indicated in Table 4.6.

Table 4.6: ICG Disaster Response Teams - Cyclone Yaas		
Sl. No.	Location	No. of Disaster Response Teams Activated
1	Diglipur	1
2	Mayabunder	1
3	PortBlair	1
4	HutBay	1
5	Kamorta	1
6	CampbellBay	1
7	Puducherry	2
8	Chennai	2
9	Krishnapatnam	2
10	Nizamapatnam	1
11	Kakinada	4
12	Vizag	9
13	Haldia	4
14	Paradeep	4
15	Bhubneshwar	2
16	Gopalpur	1
Total		37

The considerable effort put in by the Armed Forces, NDRF and ICG during Cyclone 'Yaas' towards rescue and relief operations in the affected areas was instrumental in the prevention of loss of life and property and mitigating the impact of cyclone Yaas on the affected population to a great extent. The coordinated effort towards the response and relief operations between the central and state government agencies was remarkable.



Figure 4.3: Rescued stranded people by ICG from Nayacharya Island, West Bengal

LOSS AND DAMAGES - WEST BENGAL & ODISHA

5.1 Introduction

Though the loss of human life was negligible - only 3 deaths were reported in Odisha, which was essentially due to the very accurate early warning by the IMD - the cyclone caused widespread devastation and damage to infrastructure, agriculture and livelihoods in the coastal districts of Odisha and West Bengal. The environmental degradation due to the cyclone, particularly in the Sundarbans delta merits attention.

5.2 Loss and Damages in Odisha

In Odisha, the very heavy rainfall, mainly on 26th and 27th May coupled with high wind velocities caused significant damage. The heavy rainfall caused floods in the rivers Baitarani, Budhabalanga and Subarnarekha affecting areas downstream. Besides 84 coastal villages of Balasore district and 44 villages of Chandbali Block in Bhadrak district were affected due to storm surge. A total of 11 districts out of 30 districts of the state suffered losses to a varying degree mainly in the agriculture, fisheries and horticulture sectors and public properties.

A population of 86.91 lakh people and 13,551 villages were affected. Damage in the agriculture sector included a total cropped area of 5626.91 Ha, including an area of 2197.35 Ha where cropped damage was more than 33%. The extent of damages due to the cyclone is indicated at Table 5.1¹⁰¹. The glimpses of damages to infrastructure is presented in Figure 5.1 to Figure 5.3.

Table 5.1: Extent of Damage Due to Very Severe Cyclone “YAAS” in Odisha

Sl. No.	Item	Total
1	Total number of districts in the State	30
2	Number and names of districts affected (Balasore, Bhadrak, Cuttack, Dhenkanal, Jagatsinghpur, Jajpur, Kendrapara, Keonjhar, Mayurbhanj, Puri & Sundargarh).	11
3	Total number of Blocks in the districts	
4	Number of Blocks affected	135

¹⁰¹Government of Odisha Memorandum on Very Severe Cyclonic Storm Yaas, May 2021 pp 44-45

5	Number of villages affected	13551
6	Population affected (in lakh)	86.91
7	Total land area affected (in lakh ha.)	
8	The cropped area affected (in lakh ha)	
	i) Total cropped area affected	5626.91 Ha.
	ii) Estimated loss to crops (Rs. in lakh)	
	iii) Area where cropped damage was more than 33%	2197.35 Ha.
9	Percentage of the 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	a) Damage to public proprieties:-	Details are at Ser1 to 14 of Annexure 1
	b) Estimated value of the damage to public properties (Rs. in lakh)	75483.64 (Ser15 of Annexure 1)



Figure 5.1: Cyclone Yaas - A glimpse of Damages & Destruction in coastal Odisha.
(Source: Government of Odisha Memorandum on Very Severe Cyclonic Storm, Yaas, May 2021)



Figure 5.2: Damage of Naliatapatia Talachua Saline Embankment due to “YAAS.”
(Source: Government of Odisha Memorandum on Very Severe Cyclonic Storm, Yaas, May 2021)



Figure 5.3: Damage of Keradagada Altnaga saline Embankment on Hansua right due to Cyclone “YAAS”. (Source: Government of Odisha Memorandum on Very Severe Cyclonic Storm, Yaas, May 2021)

Damage to public property to include State/district/village bridges, culverts and school buildings etc. was estimated as Rs. 75483.64 lacs. Expenditure on relief to include ex-gratia for loss of lives, house building assistance, assistance to fisherman for repair/replacement of nets & boats, expenditure on relief camps and temporary shelters etc. was estimated at Rs. 6865.084 Lakhs. The total cost of damage to public property and requirement of funds for relief measures on account of the Cyclonic Storm was estimated at Rs. 82348.724 Lacs¹⁰². Details are given at Annexure-I.

5.3 Loss and Damages in West Bengal

Though there are only three coastal districts in West Bengal, there was substantial loss and damage that occurred in several districts of the state due to storm surge, gusting winds and heavy rainfall associated with the cyclone Yaas. A total of 18 out of the 23 districts of the state were affected. The cyclone affected the infrastructure, agriculture, fisheries, power and tourism in different districts. The fishing community was severely affected, and there was environmental degradation of the Sundarbans delta in particular which is very complex to be quantified in monetary terms. The extent of damage as accessed and communicated to the central government by the state is indicated in Table 5.2 below¹⁰³.

¹⁰²Government of Odisha Memorandum on Very Severe Cyclonic Storm, May 2021, P 36-39

¹⁰³Government of West Bengal, Department of Disaster Management & Civil Defence, Memorandum on very severe Cyclonic Storm Yaas, July 2021, p 55-56

Table 5.2: Extent of Damage Due to Very Severe Cyclone “YAAS” in West Bengal from 26th to 28th May 2021

Sl. No.	Item	Details
1	Total number of districts in the State	23
2	Number and names of districts affected	18 (South 24 Parganas, North 24 Parganas, Kolkata, Purba Medinipore, Howrah, Paschim Medinipore, Hoogly, Nadia, Purba Burdwan, Paschim Burdwan, Bankura, Jhargram, Murshidabad, Purulia, Birbhum, Malda, Darjeeling and Kalimpong)
3	Population affected	2 crore
4	Cropped area affected	
	(i) Total cropped area affected	4.06212 Lakh Ha
	(ii) Estimated loss to crops	Rs. 342452 Lakh
	(iii) Area where cropped damage was more than 33%	2.21262 Lakh Ha.
5	Houses damaged:	
	(a) No. of houses damaged:	2,84,101(approx.)
	(b) Estimated value of damage to houses	Rs. 1,07,446.22 Lakh
6	Damage to public properties: - 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.)	The total length of damaged PWD road =383.68 km No. of Damaged culvert / bridge under BGSY & RIDF = 101 nos. Length of Damaged BGSY Road = 3943.39 km. Length of damaged RIDF Road = 1007.90 km. Length damaged other Road = 8301.30 km. Total no. of PWSS affected = 280 Total no. of Schools Building affected = 4525 No. Health Infrastructure affected = 451 No. of College Building affected = 41 (including Polytechnic Colleges) No. of AWC Damaged = 2759

		Damaged: HT & LT Pole: 4188 Nos. DTR Damaged: 536 Nos. Conductor in Km.: 1076.01
7	Estimated total damage to houses, crops and public properties.	Rs. 21535 Crores

The details of Damaged Blocks, Municipalities, Gram Panchayats & Villages are as under in Table 5.3¹⁰⁴

Table 5.3: The details of Damaged Blocks, Municipalities, Gram Panchayats & Villages

Sl. No.	Items	Numbers
1	No. of district affected	18
2	No. of Blocks affected	210
3	No. of MCs / Municipalities affected	62
4	No. of GPs affected	1764
5	No. of villages affected	16315

The total cost of damage to houses, crops and public properties was Rs. 21,535 Crore. A Synopsis of Quantum of Damages Assessed is given in Table 5.4 below¹⁰⁵. Figure 5.4 indicates the percentage-wise distribution of losses across various sectors¹⁰⁶.

Table 5.4: Synopsis of Quantum of Damages Assessed

Sl.No.	Sector	Quantum of Damages assessed by State Govt. (INR Crore)
1	Dwelling Houses, Evacuation, Search & Rescue, Relief Camps & Relief Articles etc.	3452
2	Agriculture Sector	3425
3	Horticulture	1540
4	Fisheries	1317
5	ARD	405

¹⁰⁴*Ibid* p 57

¹⁰⁵*Ibid* p 71

¹⁰⁶*Ibid* p 72

6	Drinking Water	410
7	Roads including rural roads & culverts / bridges : (P & RD & PWD)	2628
8	Irrigation including Micro Irrigation Scheme	4059
9	Power	12
10	Forest	89
11	Education infrastructure	84
12	Health infrastructure	13
13	Anganwadi infrastructure	70
14	Urban Infrastructure	1476
15	MSME (Damage to raw materials to products)	323
16	Industry Sector	677
17	Tourism	1003
18	Miscellaneous (Transport, Food & Supplies, Sundarbans Higher Education, MA & ME, Technical Education, SHG & SE, Correctional Homes, BCW etc.)	554
TOTAL LOSSES		21536

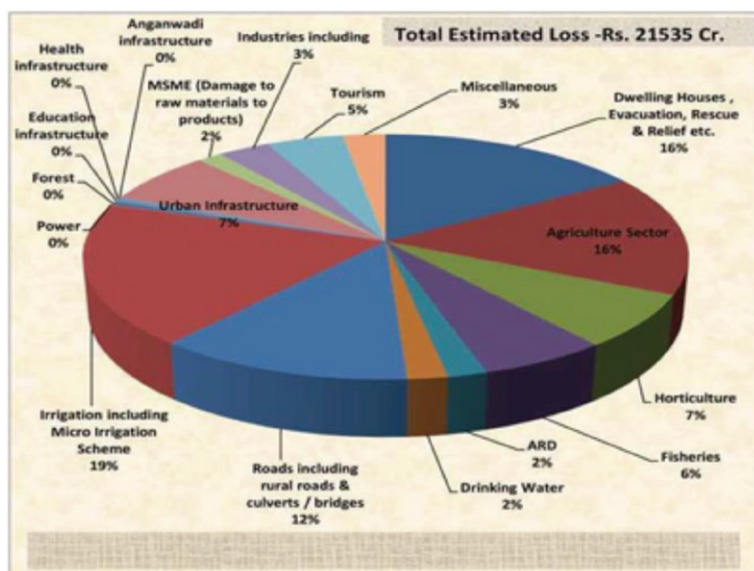


Figure 5.4: Distribution of Losses across Various Sectors
(Source: Memorandum on Very Severe Cyclonic Storm Yaas, Department of Disaster Management & Civil Defence, Government of West Bengal)

Some photographs depicting of the damage and destruction to property, infrastructure and environment in West Bengal are at Figures 5.5 to 5.7.



Figure 5.5: Cyclone Yaas - A glimpse of Damages & Destruction in coastal West Bengal.
(Source: Government of West Bengal Memorandum on Very Severe Cyclonic Storm, Yaas, May 2021)



Figure 5.6: Cyclone Yaas - A glimpse of Damages & Destruction in coastal West Bengal.
 (Source: Government of West Bengal Memorandum on Very Severe Cyclonic Storm, Yaas, May 2021)

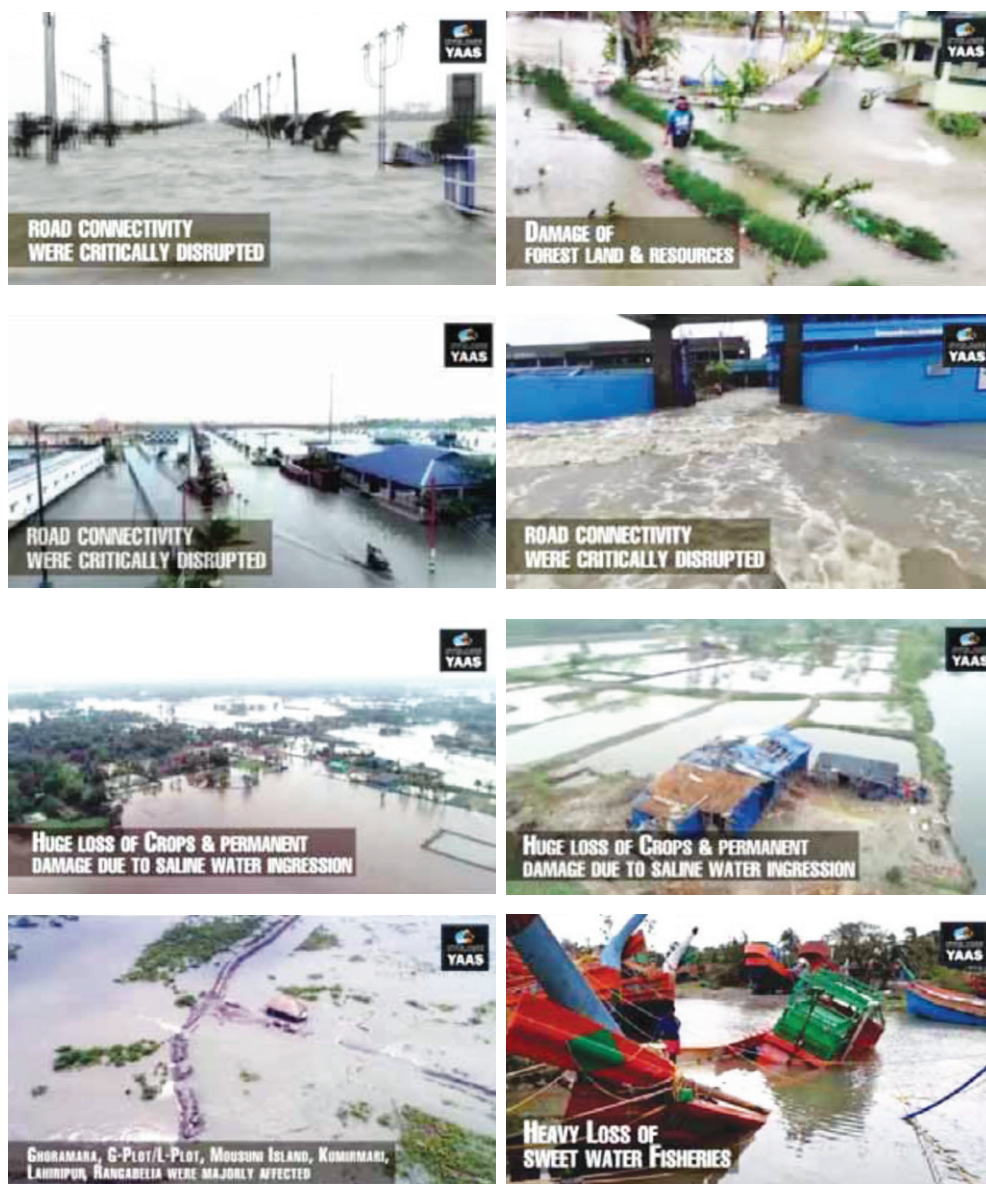


Figure 5.7: Cyclone Yaas - A glimpse of Damages & Destruction in coastal West Bengal.
(Source: Government of West Bengal Memorandum on Very Severe Cyclonic Storm, Yaas, May 2021).

5.4 Summary of Damage

A summary of damage in the states of Odisha, West Bengal & Jharkhand, as reflected in the MHA situation Report dated 08th June 2021 is given in Table 5.5 below.¹⁰⁷

Sl. No.	Items	Odisha	West Bengal	Jharkhand
i.	Rainfall in mm. (State Average)	86	-	-
ii.	No. of districts affected with name	12 (Balasore, Bhadrak, Cuttack, Dhenkanal, Jagatsinghpur, Keonjhar, Khorda, Kendrapara, Mayurbhanj, Jajpur, Puri and Sundergarh)	18 (Purba Medinipur, South 24 Parganas, North 24 Parganas, Paschim Medinipur, Jhargram, Bankura, Purulia, Paschim Bardhaman, Purba Bardhaman, Hooghly, Howrah, Kolkata, Nadia, Birbhum, Murshidabad, Malda, Darjeeling and Kalimpong).	12
iii.	No. of village affected	9942	-	1057
iv.	Population affected (in lakh)	17.5	2 Crore (Approx.)	8 (Approx.)
v.	Human lives lost	2 (Keonjhar, Mayurbhanj)	-	04
vi.	No. of missing	-	-	-
vii.	No. of injured	-	-	18
viii.	Houses damaged	22479 (fully-933, partially-21546)	3 lakh (Approx.)	Fully-76 Partially -1432
ix.	Animal deaths	204	-	03
x.	No. of persons evacuated	7,03,058	15,04,506	17,165

¹⁰⁷Ministry of Home Affairs, Disaster Management Division, (National Emergency Response Centre), Situation Report about Very Severe Cyclonic Storm “YAAS” (pronounced as ‘Yass’) over Bay of Bengal as on 08.06.2021 at 1800 hrs.

xi.	No. of relief camp opened	6,870	15215 (Presently 3306 camps are running)	486
xii.	Inmates in the relief camps	7,03,058	6,56,323	17,165
xiii.	Relief material distributed	Cooked food through free kitchen, safe drinking, Polythene emergent relief (Rice, Chuda, Gur, etc).	-	Food packets distributed
xiv.	Total crop area affected (in ha.)	167	Yet to be reported	74.94
xv.	Infrastructure Damage	103 no. of Anganwadi centres damaged, 128 villages affected due to storm surge, 510 rural roads disrupted, 305 roads (PWD-295, NH-10) disrupted, 169 nos. Of 33 KV feeder, 339 nos. Of 33/11 substation, 1141 nos. Of 11 KV feeder, 98551 distribution substation have been affected, 08 canals partially damaged, 96 river/Saline embankment partially damaged.	40 telecom towers still affected and more than 300 embankments breached.	06 bridges (01 in Ranchi & 05 partially damaged in Paschim-Singhbhum district)

LESSONS & RECOMMENDATIONS

“We have to continue the focus towards more scientific management of disasters. As the frequency and impact of cyclonic systems are increasing in the Arabian Sea and the Bay of Bengal, communication systems, mitigation efforts and preparedness have to undergo a major change.”¹⁰⁸

Prime Minister Shri Narendra Modi during the review of damage due to Cyclone Yaas

6.1 Introduction

The vulnerability of the Indian coastal states to hydro metrological hazards stands well established. Factors such as global warming and climate variability are said to further accentuate the risk of cyclones. There has been a very creditable improvement in India’s approach to disaster risk reduction which is evident from the manner in which cyclones in the recent past such as Phailin (2013), Hudhud (2014), Titli (2015), Bulbul (2019), Fani (2019) and Amphan (2020) etc. were managed. At the same time, the economic losses and social impact of such disasters have been prohibitive and unaffordable in the long run. Needless to say that there have been certain avoidable losses in the past such as the loss of 66 lives due to the sinking of the ONGC Barge P305, during Cyclone Tautkae on 17 May 2021 on the west coast, only a few days before Cyclone Yaas struck the eastern coast. While this could possibly be seen as a piece of evidence for the need to improve coordination during disaster response because of the visible and tangible loss of lives, the need for further improving upon and ensuring long term risk mitigation measures, such as correct land use planning and creation of bio shields in coastal areas etc., impact of which will only be visible in long term, is inescapable. To that extent, it is important to analyse the gaps and draw lessons from the cumulative experience of the cyclones frequenting Indian Coasts.

It will not be an exaggeration to reflect that though there has been a remarkable improvement in disaster response yet there is a long way to go in the context of overall risk reduction with particular reference to cyclones, which will be a function of the application of the latest scientific knowledge coupled with cyclone resilient development of our coastal regions.

The lessons and recommendations enumerated below are concerning the increasing vulnerability of coastal areas to cyclones and improving upon the

¹⁰⁸Press Information Bureau, Government of India, Prime Minister’s Office Press Release posted on 28th May 2021 (Release ID: 1722467) , Accessed at : pib.gov.in

current state of preparedness, response capabilities and evolution of the long term and short term disaster risk reduction strategies. These are not specific to the sequence of events, observations and impact of the Cyclone Yaas in particular.

6.2 Early Warning & Forecasting

- **Further Strengthening of the IMD:** Though the IMD has a creditable reputation in the field of early warning and forecasting, yet there is a need to further strengthen the capabilities of IMD and associated early warning agencies in the country by enabling them with the state of art instruments and technology. There is a need to enhance the deployment of the Doppler Weather Radar Network in the coastal areas and deploy airborne and satellite-enabled warning systems. The benefits of investment in advanced systems and technologies will justify the cost involved in tangible and non-tangible terms.
- **Last Mile Connectivity for Early Warnings:** All possible communication links to be used to communicate an early warning to the vulnerable population including fishermen at sea. There is a need for the acquisition of systems enabling tracking of all fishing vessels for monitoring compliance to the early warning communication.
- **Coordination in Dissemination of Warnings:** There is also a need to improve coordination in the dissemination of warnings down to the Panchayat level. SOPs need to be evolved at the DEOC level to monitor compliance of instructions following early warning, particularly in remote areas.

6.3 Cyclone Risk & Climate Change

- Cyclone Risk Reduction cannot be optimised based upon the observational data only. There is a need for redefining the risk of all the hydro-meteorological disasters in our coastal areas taking into consideration the climate change projections.

6.4 Climate Change Adaptation (CCA) Strategy

- There is a need to further study the likely impact of climate change in the coastal areas with specific reference to the trend, frequency and intensity of hydro-meteorological disasters. Such a study is considered useful for evolving a precise area-specific CCA strategy, which could be applied through its incorporation in the National and State Disaster Management Plans, as applicable.

6.5 Cyclone Risk Evaluation

- It needs to be understood that the cyclone risk is not uniform along the varied coastal regions of India. There is a need for a realistic risk assessment using the latest scientific methods and technology. The risk assessment should take into consideration the socio-economic vulnerability and the coping capacities in particular, which varies from region to region along the Indian coastline. Such risk evaluation should form the basis of “sectoral cyclone risk reduction plans” for specific areas.

6.6 Enhancing Resilience & Cyclone Risk Reduction

- There is a need to have a comprehensive look at further improving disaster resilience against cyclones in the coastal territories. The NCRMP has paid great dividends, yet the need for a critical review of the efficacy of the mitigation measures undertaken so far and homing on to efficient and cost-effective measures to enhance disaster resilience and attendant cyclone risk reduction in the coastal areas, cannot be overstated. Multiple stakeholders to include government agencies, starting from the apex central government level down to the panchayat level in the states, will need to be involved with due coordination for any meaningful risk reduction.

6.7 Cyclone Resilience in Housing Sector and Critical Infrastructure

- Though we have been able to bring down the figure of human casualties, there has been significant damage in the housing sector due to cyclones. There is a need to have plans and programmes to develop disaster resilient housing in the coastal areas.
- Critical infrastructure such as railways, roads, bridges, power generation facilities, and airports play a vital role in large scale emergency response and relief operations. All the critical infrastructure in the coastal belt should be checked and provided with cyclone resilient features where necessary. Business continuity of airports and railways is very crucial. Monitoring and forcing compliance of the latest building codes, as applicable, should be ensured by the government agencies.

6.8 Study of Coastal Inundation Pattern

- The pattern of inundation of coastal areas in the aftermath of cyclonic storms and storm surges need to be studied and long term mitigation strategies evolved for both the eastern and the western coast of India. It needs to be appreciated that all the coastal areas are not equally vulnerable to coastal inundation due to rise in sea level.

6.9 Environmental Concerns

- **Ecological Damage Assessment:** It is important to study the impact of cyclones on the coastal areas with particular reference to coastal erosions and coastline changes, increased salinity in the agricultural land and damage to mangroves and forested areas, which provide natural vegetation bio shields so vital for reducing the impact of cyclones and storm surges.
- **Threat to Sundarbans Reserve Forest:** Increased vulnerability and reduced resilience of coastal ecosystems need greater attention. For instance, the biodiversity of the Sundarbans National Park, which is a UNESCO world heritage, needs to be preserved. It is imperative to have plans for cyclone risk mitigation to its ecosystem and strategy of recovery after cyclones, taking into consideration the needs of biodiversity conservation and ecosystem services. The Sundarbans is the world's largest habitat for the Bengal tiger and other threatened species such as Ganga River dolphins.

6.10 Approach to Damage and Loss Assessments

- There is an inescapable need for adopting more systematic and technology-based methodologies for arriving at the damages and losses due to cyclones. The latest geoinformatics and satellite-based technologies should be adopted, sooner than later. The present system of damages and loss assessment based upon first-hand inputs received through revenue officials is considered highly unsatisfactory, particularly in terms of accuracy as also in terms of creating a database for any scientific study on the potential impacts of cyclones in specific areas.
- There is a need for correctly assessing the damage to farming land due to saline water and ascertaining potential losses in crop production in the years to come. This is imperative for providing appropriate rehabilitation through alternate means of livelihood, besides providing compensation as an immediate relief measure.
- While the loss of life and livestock has been relatively low as observed in some of the cyclones in the recent past, the damage to housing in the coastal areas was more pronounced for temporary and kachha mud shelters as against pucca houses. This underscores the necessity of a very deliberate process of damage assessment facilitating a systematic and sustainable reconstruction programme as against the usual practice of a quick assessment focused on quantification of economic losses in monetary terms, solely aimed at setting the compensation mechanism in motion at the earliest.

6.11 Long Term Mitigation

- **Conservation of Coastal Areas :**
 - ♦ Conservation of the full range of biodiversity along our coastal areas is crucial and it needs to be addressed on priority.

- ♦ All the existing bio shields along the Indian coastline should be protected. Besides, well-conceived result-oriented programmes need to be initiated for extending the existing bio shields and regenerating bio shields in newer areas along the coastline. Preserving the ecology of coastal areas will go a long way in DRR against cyclones.
- ♦ Erosion in the coastal belts needs to be effectively contained through vegetation plantation and the application of the latest scientific methods.
- ♦ Special grass vetiver which grows on sandy land and sand banks should be considered for planting in open areas as well as in the residential pockets of coastal urban centres, in particular.
- **Construction of Storm Surge Resilient Embankments:** There is a need to protect the low lying coastal areas in particular, by the construction of “Storm Surge Resilient Embankments”. The existing saline embankments could not provide adequate protection in some areas during the cyclone Yaas as the storm surge varied from 3.70 m to 4.00 m. The projects for sustainable coastal protection be expedited and facilitated through adequate funding on priority, with due assistance from the central government and multi-lateral donors like World Bank, JICA, ADB etc., if needed. This is critical for protecting the life and property of the people residing in low lying, coastal areas, in particular.
- **Sustainable Coastal Protection of Tourist Areas:** Cyclone Yaas devastated tourist areas like the Digha township in West Bengal. There is a need to identify all the areas of tourist interest in the coastal States and UTs and chalk out programmes for sustainable coastal protection of such areas on priority.
- **Implementation of Coastal Regulation Zone Laws:** The current “Coastal Regulation Zone Laws” have in-built elements of DRR. Advocacy, enforcement and monitoring of the CRZ laws are crucial.
- **Disaster Insurance:** The concept of risk-sharing through the insurance and re-insurance mechanisms needs to be institutionalised. There is a need to have more of the insurance schemes on the lines of the ongoing “Pradhan Mantri Fasal Bima Yojna”. The Public-private Partnership (PPP) in this domain of DRR needs to be addressed more aggressively.

6.12 Disaster Management Plans

- It is encouraging to note that several States/UTs have notified their DM plans but there is a need to further refine these plans which should clearly define and lay down the tasks to be undertaken by line directorates and other agencies in multiple disasters to include cyclones. The plans should have a strategic approach to the extent that they fulfill the requirements of mainstreaming DRR in conformity with the need to address the attendant issues of development and climate change adaptation. The National Disaster

Management Plan 2019, released by the NDMA, should serve as a guideline for the SDMPs/DDMPs.

- The DM plans should be reviewed and evaluated after every major disaster to check the efficacy and find the gaps for further improvement.
- All the DM professionals need to understand that “disaster response” to include “emergency rescue and relief measure” is a subset of the disaster management continuum and to that extent, there is a need for a specific disaster response plan for each type of disaster, which should be based on the integral response resources available from all quarters to the state/district administration and the anticipated help in terms of armed forces and NDRF assets etc. Inter-agency coordination for response should be regulated through such plans to avoid adhoc responses. All the “Emergency Support Functions” should be listed and specific responsibilities to execute such functions at the state/district level be laid down in disaster response plans. These could also be drawn in terms of SOPs for disaster response by various line departments and pre-identified stakeholders.
- Every line department to be clear of its tasks before, during and after the cyclone for which resources must be made available and pre-planned. This can happen only if foolproof hazard-specific (Cyclones) DDMPs and SDMPs are made and are reviewed and improved after every cyclone.
- The necessity for comprehensive departmental plans for the restoration of essential services such as water, electric supply etc., which need to be executed and monitored through DEOCs merits urgent attention.

6.13 Disaster Response Operations

- **Efficient Management of Resources:** There is a need to maintain accurate and updated resource inventories at the local level as also at the SEOCs/DEOCs to avoid ad hoc and inadequate deployment of requisite resources for emergency management. A sufficient quantity of machinery to include dozers, dumpers, cranes etc should be mobilized and deployed with local response agencies simultaneously with NDRF teams/Armed Forces columns. The India Disaster Resource Network (IDRN) programme of the MHA being steered by the NIDM should be revitalised and optimised by all the States and UTs.
- **Functioning of SEOCs & DEOCs:** There is an urgent need to improve the functioning of SEOCs & DEOCs. Capacity building of various revenue officials for efficient response and functioning of IRS is essential. Lack of expertise and training in emergency response at the DDMA level is considered counter

productive. The revenue officials appointed on an ad hoc basis to attend to various emergency functions do rise to occasion and perform to the best of their abilities under the given circumstances, yet it is at the cost of efficient and timely disaster response, more often than not.

- **Provision of Equipment and Training to Local Responders:** Though the Local Police, Fire Services, Civil Defence and Home Guards are pressed into service in affected districts, yet they are of little use, at times, for want of specialised and essential equipment and training for emergency response.
- **Incident Response System (IRS):** Need to improve coordination of response operations by adapting to the IRS system as recommended by the NDMA. In case of cyclones the ICG, Port and Harbour authorities and the Fisheries Departments of States/UTs, which have stakes in rescue operations at sea, are required to function through the respective SEOs/DEOs as prescribed under the IRS protocol, for better coordination and economy of effort.
- **Strengthening of Emergency Operation Centres (EOCs):** Though it is very encouraging to note that the practice of activation of EOCs at the state and district level (DEOs/SEOEs) has been institutionalised, yet such EOCs are not adequately equipped and manned for an optimal response. It needs to be appreciated that EOCs should ideally function as a “Command Decision Support System” for emergency response. The EOCs need to be accordingly equipped with the state of the art equipment and trained staff. The EOCs should be capable of the acquisition of real-time situational inputs and analysis of the acquired data through automated systems.
- **Disaster Response under COVID Conditions:** There is a need to work on a set of SOPs relevant to the execution of all the emergency support functions under COVID conditions, such as evacuation, provision of food, water, shelter, medical care etc. Issues such as sanitization of shelters, separating people into small groups, and enforcing social distancing norms should form part of such SOPs. The best practices adopted across the world during the COVID pandemic should be documented and adapted for Indian conditions.
- **Response in Multi-Hazard Scenario:** The COVID-19 has, on one hand, made the established disaster management practices difficult to follow, yet it has also highlighted the need to explore alternative ways to address challenges for response under COVID conditions, which could include digital data gathering, multi-hazard vulnerability assessment, and strategic inter-agency coordination etc. The need for greater collaboration between the Central and State Government departments, the trade and industry, the R&D Organizations, NGOs and Communities to cope up with more than one disaster of severe nature occurring simultaneously has emerged unambiguously.

6.14 Inter-Agency Coordination for Disaster Response

- **Coordination at Functional Level:** While the interagency coordination at the apex level for Central and the State governments has remarkably improved over the years, which was so evident during the early warning and preparedness stage of the cyclone Yaas, such coordination at the lower levels needs improvement which can be achieved through mock exercises on realistic scenarios involving lower functionaries and officials of all the line departments of the State/UT Governments and other stake holders. Adherence to IRS will further help in improving such coordination.
- **Collaboration and Cooperation with Industry Leaders:** It is important to involve industry leaders and all the stakeholders in the private sector in disaster response measures ab initio. This will not only instil confidence in the private sector to cope up with the situation, maintain business continuity and minimise potential economic losses but will also enable them to contribute positively towards the emergency response activities of the government by measures such as a timely and adequate supply of essential commodities and medicines, restoration of power supply and communication facilities etc. Collaboration and cooperation with the industry leaders work as a force multiplier in the emergency response efforts of the government as amply demonstrated in the management of the COVID-19 pandemic.

6.15 Strengthening Emergency Communication Plans & Systems

Integrated Disaster Communication Network:

- Though the adverse impact of cyclones on telecom system networks is well known and predictable, yet arrangements for alternate and dedicated disaster emergency communication systems do not exist. It is the State Police HF network that functions as a backup emergency network for administration right from State HQ to Panchayat or Police Thana level, which cannot be termed as satisfactory by any standards of efficient and effective emergency response. There is a need for an “Integrated Disaster Communication Network” at the national level duly integrated with States/ Districts and lower levels for efficient disaster response.
- An integrated emergency communication capability is also considered essential for all the agencies involved in the execution of requisite “Emergency Support Functions” at the field level, duly supported with compatible communication equipment and common protocols.

Emergency Communication Plans:

- Dedicated emergency communication plans for disaster response are mostly non-existent. Such plans should be embedded in SDMPs and DDMPs.

- There is undue reliance on mobile communication and applications (WhatsApp etc) for emergency communications at all levels. Even the official orders and instructions are being routinely communicated at times with inherent security risk. The necessity for a dedicated communication system for the emergency response phase cannot be overstated. However, reliance on routine communication systems including mobile phones during the pre-disaster phase is understandable.

Coordination with Telecom Service Providers:

- There is a need to co-opt the private sector agencies providing communications in the disaster management plans at all levels. A certain degree of assurance from private service provider companies should be obtained for the restoration of communications during the emergency response phase of a disaster.
- There is a need for coordination for avoiding damage to the OFC network of telecom companies during the restoration of road communications by various first responders. There have been cases of undue delay in restoration of communication by Telecom Service Providers for want of such coordination.

Encouraging HAM Radio Network:

- The HAM radio network in the country is not being optimally exploited. There is a need to encourage HAM operators to assist in emergency communications and institutionalize their integration with DEOCs and SEOCs. This is best done by including them as a resource in SDMPs and DDMPs.
- Provision of HAM radio equipment and training of volunteers to operate the system should be considered for remote areas which are highly vulnerable.

6.16 Social Media

- **Optimisation of Social Media:** Social networks, which play a very crucial role, particularly during the Emergency Rescue and Relief phase, as was evident during the Chennai floods (2015) are often rendered non-operational due to disruption in communications, affecting the poor and marginalized sections of people the most. There is a need to optimise the potential of social media, particularly during the emergency response phase of disasters.
- **False Information on Social Media:** It is important to understand that social media may sometimes turn out to be a double-edged weapon and there is a need for procedures and protocols to filter out false inputs. During the cyclone Yaas, information regarding ONGC oil rigs Aban-II, Olinda Star and DS Fortune by Lloyds List Intelligence were viral on the social network, wherein, it wrongly stated that these oil rigs were derelict and adrift. Avoidable efforts were put in by the ICG assets to address the safety concerns.

6.17 Rescue Operations at Sea

- **Compliance with Safety Instructions:** Compliance with instructions regarding the sea worthiness of fishing boats and life saving equipment on sea-bound vessels is important. It needs to be ensured that all the sea-bound fishing boats/dhows/barges have necessary life-saving equipment on board. There is a need for periodic checking and audit to ensure that all sea-bound vessels are seaworthy and safety and life-saving equipment is held as per prescribed norms and are, most importantly, operational.
- **Communication with Fishing Boats:** Presently it is not possible to communicate with the fishing boats if they are not within the range of cellular communication systems. There is a need to introduce suitable satellite communication devices which will enable tracking of fishing boats from the shore establishments and facilitate communication from a vessel to shore, if in distress.
- **Enhancing Preparedness & Efficacy of Rescue and Relief Operations at Sea:** There is a need to refine the existing procedures and SOPs for preparedness of assets in ports and harbours during the warning phase of cyclones, in consultations with relevant DDMA, the Port and Shipping Authorities, Coast Guard and the Indian Navy. Suitable mock exercises should be conducted by involving all the stakeholders. It needs to be understood that the preparedness and emergency operations in face of a disaster need to be coordinated and compliance of laid down SOPs is ensured at the district and state government level even if the critical assets like harbours and airports are governed directly by relevant ministries of the central government.
- **Accounting of Vessels and Crew:** In order to facilitate implementation of preventive measures during the warning stage, there is a need for a foolproof system at all the “Regular Fishing Harbours” as also the “Fish Landing Centres” for accounting and tracking of vessels and crew at sea. The State Fisheries Department in each coastal district should be equipped to run a “Control Centre” which should account for all the fishing boats at sea with details of the crew onboard and their probable position/area of operation etc. Such control centres should be integrated with respective DEOCs.
- **Inter-State Coordination:** The responsibility of regulating the fishing vessels is that of the Fisheries Departments of the States/UTs. It is difficult to track fishing vessels if they move from the parent state to a neighbouring coastal state. Inter-state coordination for rescue and relief operations thus assume importance, which is best facilitated if DEOCs and SEOCs are activated and they function as per the IRS protocol.

- **Agency-wise Standard Operating Procedures (SOPs):** There is a need to ensure that all other national stakeholders, such as public and private sector entities running oil rigs for oil/gas exploration off shore and small shipping companies involved in coastal shipping, should have updated SOPs for crisis management in face of cyclones. Such SOPs should be audited on regular basis by competent authorities under the DG Shipping. Besides, these should be tested and validated through periodic mock exercises and table top exercises. Such SOPs should contain aspects of preparedness, precautionary measures and mitigation actions in face of cyclones as also provisions for evacuation of non-essential crew and shelter for dispensable vessels etc.

6.18 Community Based Disaster Management

- **Community Volunteers:** The involvement of community volunteers and local resources is invaluable in emergency management. During Cyclone Yaas, the Indian Navy had resorted to the distribution of cooked food to affected people in the area of Balasore through local volunteers using two wheelers.
- **Local Capacity for Emergency Response:** There is a definite need to improve upon the local capacity for emergency response as well as for restoration of essential services in the post-disaster phase. For this purpose, certain tree cutting and earth moving equipment should be pre located at Panchayat and Police Station levels in the vulnerable areas to enable restoration of road communication by local volunteers.
- **Public Awareness**
 - ✦ **Preservation of Coastal Ecosystems:** There is a need to enhance the current level of public awareness regarding the significance of protecting and preserving the coastal ecosystems as also the importance of adopting an optimal land use management strategy in the coastal areas towards mitigating the impact of cyclones in particular.
 - ✦ **Increasing Risk and Vulnerability:** With climate change, ocean warming and predicted changes in the pattern of hydro-meteorological disasters, there is a definite need to sensitize communities towards their increased risk and vulnerability to cyclones and the necessity to enhance preparedness and adopt strategic mitigation measures at all levels in the vulnerable coastal areas.
 - ✦ **Survival in Adverse Conditions:** The community members in the vulnerable coastal areas need to be given adequate inputs about the expected difficult situations post-disaster and encouraged to be prepared at the family level to survive for at least a week without telephones,

electricity and even fresh supplies in certain worst-case scenarios. Suitable IEC material to include Do's and Don'ts and a list of essential items and medicines i.e. emergency kit and survival kit for the family to include old people and children should be developed.

- **Employment of Ex-Servicemen:** During the cyclone Yaas, the local ex-servicemen of certain affected areas were found to be very effective towards the identification of the affected populace and assisting in the response. It is recommended that utilization of the ex-servicemen community be formalized in the disaster response systems at the district level and below.

6.19 Capacity Building for Emergency Response

- ✦ **Harnessing and Local Resources and Capacity:** In certain instances, notwithstanding adequate early warning and the past experience of the accuracy of the IMD forecasts, local resources to include heavy machinery and earthmoving resources are not mobilized well in time. Timely mobilization of all available local resources in the pre-disaster phase is very essential. The tendency to rely on NDRF and Armed Forces in totality needs to be curbed.
- ✦ **Strengthening the Youth Based Organisations for Disaster Response:** The youth organizations like Civil Defence and NYKS have been rendering exemplary services in disaster response operations. The Civil Defence Act, as amended, mandates the Civil Defence Organization to take all actions to protect life and property during disasters. These organizations have well-established structures and a chain of command. There is a need to strengthen these organizations to include capacity building for disaster response, provision of essential equipment and their integration into the disaster response mechanism at all levels.
- ✦ **Strengthening of Fire Services:** The Fire Services in States/UTs be modernized and strengthened with additional manpower to create response capacity at the local levels. The fire service, along with the local medical resources and the police force is the ideal first responder, which can provide leadership to various community volunteer organisations for emergency response in absence of NDRF/SDRF/Armed Forces & CAPFs.

6.20 Employment of NDRF, Armed Forces and CAPFs

- **Review of the DM Act, 2005 for Mandating the Creation of SDRF**
 - ✦ A comparison of the number of NDRF teams vis a vis the SDRF teams deployed in certain States for disaster response in the past indicates a

tendency of over-reliance on the support from the Central Government and an apathy towards the creation of a well-equipped and well trained SDRF. Review of the Disaster Management Act 2005 to mandate the creation of local response forces by States and ULBs merits consideration.

- ✦ The large coastline, potentially vulnerable to cyclones, dictates very thin deployment of NDRF resulting in certain pockets remaining unattended during the emergency phase of cyclones. This situation can be avoided if adequate teams of SDRF and local responders are available.
- **Employment of NDRF:** Being an elite federal response force, the NDRF should be deployed only for the emergency response phase of a disaster to save lives and property and be demobilized at the earliest. Assistance in the restoration of essential services beyond the emergency phase should not be mandated to NDRF. The tasks such as opening roads by clearing trees are not very high skilled emergency response jobs and should well be managed by local authorities with the help of local emergency responders and communities.
- **Availability of the Armed Forces and CAPFs:** In the backdrop of the national security imperatives, the availability of the Armed Forces and CAPFs for disaster response, in case of potentially devastating disasters, cannot be assured. The need and urgency for local capacity building for emergency response operations can be overlooked only with prejudice to the well-being and safety of the citizens and the consequent economic losses. All the state governments should, therefore, endeavour to create a potent SDRF on the lines of the NDRF, capable of adequate emergency response, irrespective of the availability of NDRF. In this context, the ODRAF created by the Government of Odisha is a good example.

6.21 Issues Specific to the Deployment of the Armed Forces & ICG in Disaster Response

- ✦ **Movement of Military Vehicles:** Heavy vehicles held by the Army are some times found unsuitable for distribution of relief material and damage assessment in remote locations, where roads are narrow or severely damaged. It is recommended that more SUVs be employed for effective HADR operations in such conditions.
- ✦ **Capacity Building - Indian Coast Guard:** The ICG, which is responsible for assisting fishing boats while in distress at sea and coordinating Search and Rescue operations in Indian waters, needs to be further strengthened for their tasks. They should be suitably equipped to undertake rescue operations in riverine terrain too.

6.22 Conclusion

The cyclone Yaas was managed in a praiseworthy manner at all levels in face of the challenging second wave of the COVID-19 pandemic in the country. The Central and State Governments worked together towards preparedness and planning to ensure that there was minimal loss of life and the attendant damage to property and economic losses were contained to the best extent possible. It was with the collective efforts of all stakeholders, that the cyclone was managed efficiently within the resources available to the nation. The Armed forces, CAPFs, the ICG and the NDRF assisted in the disaster response operations at various levels in most professional manner. The IMD and the scientific community need a special attention for their role in providing very precise early warning enabling timely evacuation of the vulnerable population and deployment for disaster response. The Prime Minister and the Chief Ministers took charge of the situation well in time and were relentlessly monitoring the progress and the impact of the cyclone. As every disaster is unique in its nature and impact, the cyclone Yaas has also thrown up issues which need attention for reinforcing the ongoing DRR activities in the country at various levels. To that extent, it is very important to learn from the experience and further strengthen the disaster management capabilities in the nation.

Odisha - Damage to Public Properties & Pure Relief Items¹⁰⁹

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
			(Rs. in Lakh)
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		316.87
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		251.20
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

¹⁰⁹Government of Odisha Memorandum on Very Severe Cyclonic Storm, May 2021 pp 36

	LT Line Conductor Damaged	10932 Nos.	5466.00
	Minor Material Damaged		64.00
	Civil Works		96.00
	Erection Charges		365.00
	Total		15655.70
4	Electronics & Information Technology Department		
	ADSS Fiber 48F Damaged	2.5 kms	5.61
	ADSS Fiber 24F Damaged	32.73 Kms	65.04
	8 Metre PSC Pole Damaged	51 Nos.	5.24
	Total		75.89
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 Nos. / 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 Breaches/ 10.945 Kms	691.50
	Damage to CD/Bridges of MI Sector	50 Nos.	120.00
	Total		12268.91
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./lbs/ 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
15	Total (Public Properties)		75483.64
16	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 Nos. 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., Oat-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

Design & Print : kam@kamstudio.net



National Institute of Disaster Management
(Ministry of Home Affairs, Government of India)

Plot No. 15, Pocket 3, Block B, Sector 29, Rohini, Delhi 110042
Website : <https://nidm.gov.in>

978-81-956700-9-3

