

In the Eye of Tempestuous Bay of Bengal: Measuring the Disaster Resilience of Major Ports on India's East Coast

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ABSTRACT The Bay of Bengal—home to a number of major ports that are lifelines for the economies and populations in India's east coast that depend on them—is highly prone to extreme weather events. This brief examines the disaster-resilience of three of the ports on the Bay of Bengal: the ports of Kolkata in the state of West Bengal, Visakhapatnam in Andhra Pradesh, and Chennai in Tamil Nadu. The brief describes the destruction wrought on these ports by the most recent cyclones and tsunamis that have hit the Bay. It gives an overview of the 2016 National Disaster Management Plan, as well as the draft 2018 plan. The brief analyses the applicability of the specific disaster management plans of the three ports, and offers recommendations on how those plans may be improved to ensure effective disaster management.

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INTRODUCTION

The Indian sub-continent, with its 7,500-km-long coastline,¹ is highly vulnerable to extreme weather events like tropical cyclones[@] and tsunamis[#].² The country's eastern coast facing the Bay of Bengal, in particular, gets the wrath of an average three cyclones^{\$} between the months of May-June and October-November³ every year.⁴ These events claimed the lives of over 300 people, damaged some 500,000 houses and 7.68 lakh hectares of cropped land along the east coast between 2017 and 2018 alone.⁵

Ports bear the brunt of the impact of these natural calamities. As these ports provide employment and are crucial in the supply chains of industries, the impact of a calamity on a port carries socio-economic consequences apart from causing logistical distress. A port's reliability thus depends on how well it can cope with disasters and how soon it can restore normalcy in its functioning in the aftermath of a disaster.⁶

Ports across the country altogether handle 90 percent of the country's foreign trade, by volume, and 70 percent by value.⁷ Maintaining the physical integrity of these ports, therefore, makes for a strong economic argument. The ports on the Bay of Bengal in the country's east coast are especially vulnerable to extreme

weather events. The tempestuous Bay owes its turbulence to its shallow waters, funnel shaped coastline, the low flat coastal terrain⁸ and what are known as the 'easterly waves'[%].⁹ So great is this turbulence that two cities on this coast—Kolkata and Chennai, both home to major ports—rank fifth and ninth in the world, respectively, in susceptibility to tsunamis.¹⁰

This brief assesses the measures that are being taken to build the resilience of three major ports on India's east coast. One is the Kolkata port in West Bengal, the oldest in the country and therefore whose durability against disasters should be analysed; the second is the Visakhapatnam port in Andhra Pradesh, which offers the largest transshipment facility amongst major ports on the east coast; and the third is the Chennai port in Tamil Nadu, which was gravely affected in the tsunami of 2004 and whose rehabilitation thereafter is necessary to examine. The brief will first assess the vulnerability to disasters of the coastal areas where these ports are located; it will then investigate the impact of recent natural calamities on these ports and their surrounding coastal areas, and evaluate the disaster management policies that have been adopted by the authorities in these ports. The brief will close with recommendations for improving the protection and mitigation capacities of these ports.

@ Tropical Cyclones are rotating, organised system of clouds and thunderstorm that develop over the seas or oceans in tropical and subtropical regions.

Tsunamis are enormous waves created by an underwater disturbance such as an earthquake or a volcanic eruption.

\$ Cyclones are divided into five categories of severity based on the strength of their wind speed: Cyclonic storm (62-87 kmph), Severe Cyclonic Storm (88-117 kmph), Very Severe Cyclonic Storm (118-166 kmph), Extremely Severe Cyclonic Storm (167-221 kmph) and Super Cyclone (222 kmph and more).

% Easterly waves are small travelling circulations which have the potential to develop into larger tropical cyclones.

MAJOR PORTS ON INDIA'S EAST COAST: AN OVERVIEW

Given the crucial role played by ports in the lives and economies of the people not only in their locales but the surrounding regions, it is imperative that their physical resilience be built and secured. The *Sagarmala* document which is aimed to enhance port and port-led development¹¹ in India also discusses the geographical vulnerabilities of the ports due to their location. This section examines the physical susceptibilities of the three ports selected for this brief.

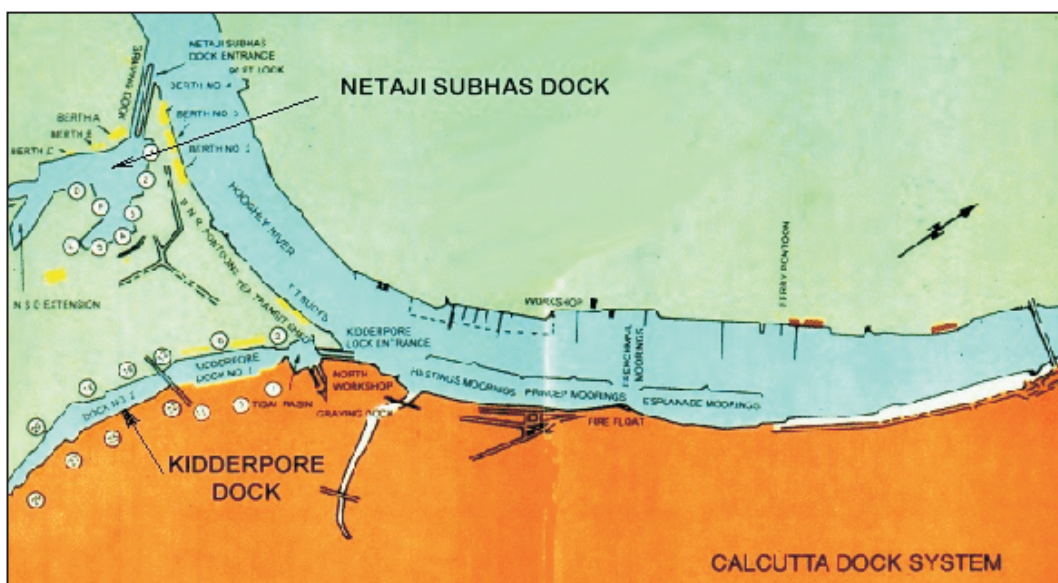
Kolkata Port and the Haldia Dock Complex

The Kolkata Port (KoPT) situated on the bank of the Hooghly River in West Bengal is the only major riverine port of India.¹² It is divided into two branches: the Kolkata Dock System (KDS) located in the city proper, and the Haldia Dock Complex (HDC) that is 117.8 km away in the industrial town of Haldia. Both Kolkata and Haldia, and their respective docks, are located

in areas that are geologically categorised as 'Moderate risk seismic intensity zones'.¹³ This means that irregular tidal currents often influence the efficiency of the docks. Haldia is also classified under the Cyclone High Damage Risk Zone,¹⁴ while Kolkata is located in close proximity to such a zone.¹⁵ Therefore, in severe cyclonic situations, port operations are likely to be hampered and the port officials and employees are exposed to the resultant dangers.¹⁶ In the 2018 Composite Hazard Index of States/UTs listed in the draft Disaster Score Card for States and Union Territories of India, West Bengal's score is 8.88 out of 10 in terms of hazards caused by cyclones.¹⁷

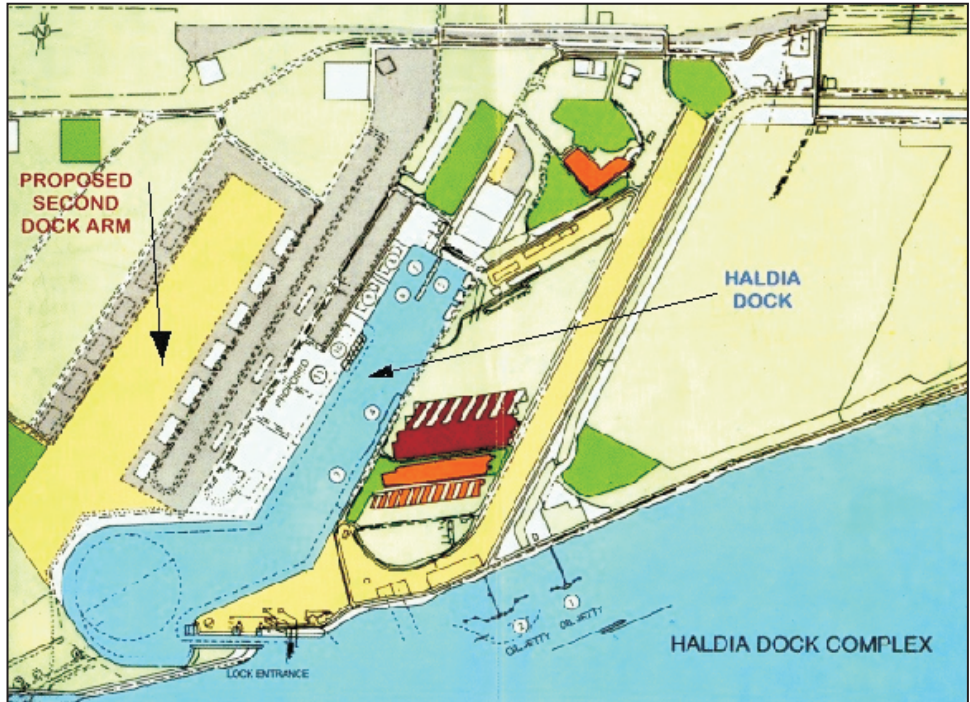
Cyclones are often accompanied by storm surges that cause severe coastal flooding.¹⁸ Indeed, Kolkata is one of the most flood-prone cities in the world,¹⁹ which in turn adds to the problem of dredging that is already facing the Kolkata Dock. As regards the risk of tsunami, Haldia unlike Kolkata is not overtly exposed but may be affected by water surges

Layout of Kolkata Dock System



Source: Map of KDS, Kolkata Port Trust, <http://kolkataporttrust.gov.in/index1.php?layout=1&lang=1&level=2&sublinkid=652&lid=566>

Layout of Haldia Dock Complex



Source: Map of HDC, Kolkata Port Trust, <http://www.kolkataporttrust.gov.in/index1.php?layout=1&lang=1&level=2&sublinkid=653&lid=567>

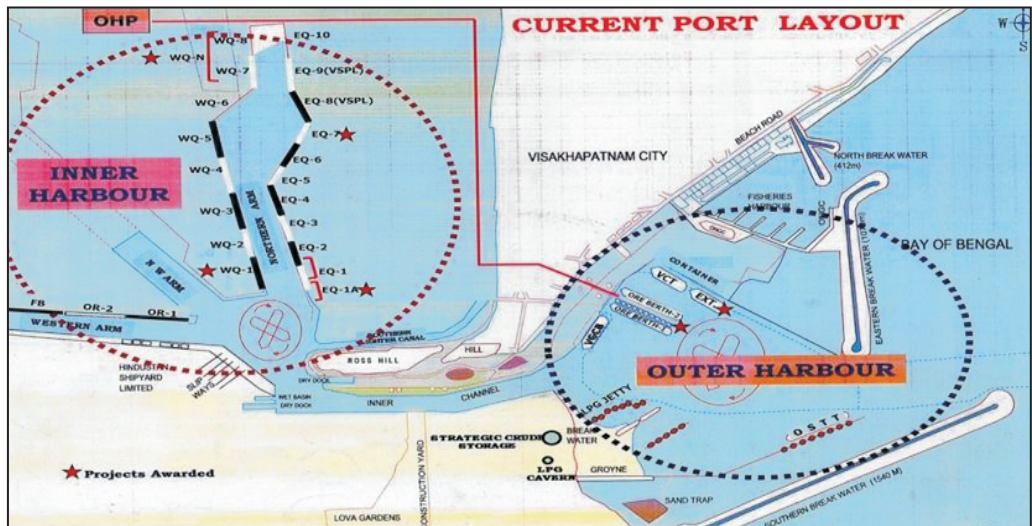
that can reach up to a height of 12 metres at the coast.²⁰

Port of Visakhapatnam

Further south, the Port of Vishakhapatnam (VPT) is a major port in the state of Andhra Pradesh, with one of the largest drafts (18

metres) and offering trans-shipment facilities. Nepal recently decided to expand its maritime commerce through this port because of its reliability.²¹ Although the city is classified as ‘Highly Prone’ to cyclonic activity,²² the port is relatively sheltered from cyclones because it opens into a calm natural harbour protected by the ‘Dolphin’s nose’ (a small hill expanding for

Layout of Visakhapatnam Port



Source: Image collected by researchers during Visakhapatnam-Chennai Field Trip, August 2017

almost three km into the sea). Still, if the weather events are of extreme intensity, the port suffers adverse impacts. The 'Outer Harbour' is more affected as it is more exposed to the open sea.²³ This hampers port operations as the 'Outer Harbour' is used to accommodate 200,000 DWT vessels that frequent the port.²⁴ On average, Visakhapatnam experiences three to four cyclones per year, especially in the months of August, October and November.²⁵ AP's score is 6.34 out of 10 in terms of hazards suffered due to cyclones in the Composite Hazard Index.²⁶ Intense cyclones can jeopardise the reliability of Visakhapatnam port's operations.²⁷ The port is also exposed to intermittent storm surges²⁸ but is not too susceptible to earthquakes as it is located in a moderate to little tectonic activity zone.²⁹

Port of Chennai

Unlike the Visakhapatnam Port, the Port of Chennai (ChPT) which functions as a hub port for containers, cars and project cargo is not sheltered by any natural barrier. Instead, with its artificial harbour, it was considerably vulnerable to cyclones until its entrance was shifted from the eastern to the north-eastern

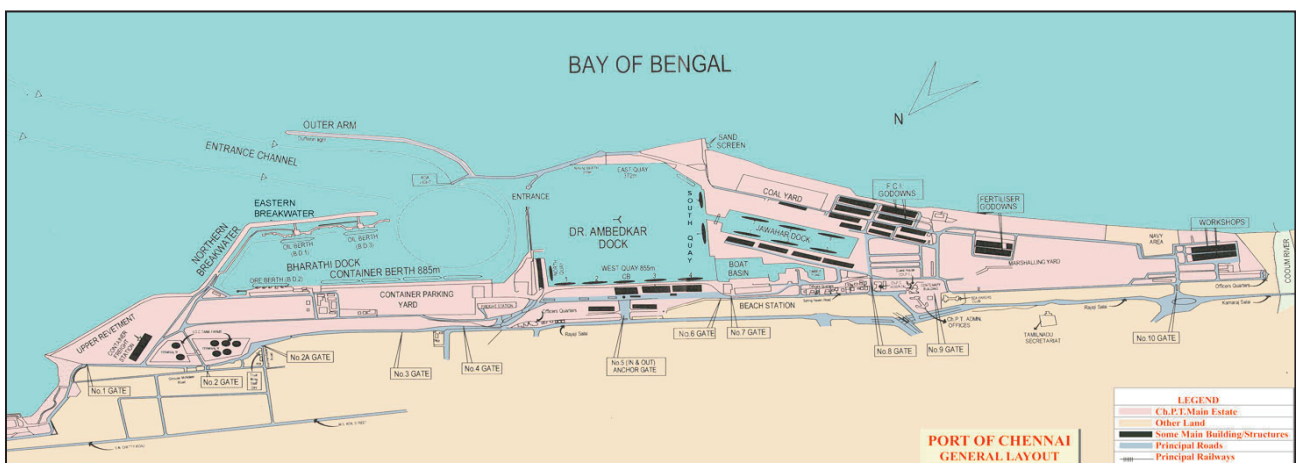
side in 1904.³⁰ This significantly reduced the port's exposure to calamities. Still, as a city port, it continues to be 'Highly Prone' to cyclones³¹ like the rest of the city particularly in the autumn months. The state of Tamil Nadu, overall, scores 5.77 out of 10 in terms of hazards suffered due to cyclones.³² Chennai is also highly susceptible to tsunamis, as stated in the *Swiss Re* report, and also falls within the Moderate Earthquake Active Zone.³³

RECALLING THE IMPACT OF RECENT NATURAL DISASTERS

The last tsunami to have hit India's east coast was in December 2004. That tsunami was triggered by a massive earthquake whose epicentre was off the coast of Sumatra. In India alone almost 18,000 people were killed due to its impact.³⁴ Several cyclones have hit these eastern coastal states since 2004. Some of these cyclones hampered port operations substantially. The following is an overview of the impact of some of the major cyclones that have hit these ports in the last ten years.

- In 2009 a severe cyclonic storm struck West Bengal, killing 23 and affecting

Layout of Chennai Port



Source: Samsara Shipping Pvt. Ltd., <http://samsarashipping.com/port/chennai.php>

200,000 people. Thousands of homes and villages were destroyed.³⁵ Both the Kolkata Port and the Haldia Dock Complex were relatively unscathed. The Sagar Islands—where the Kolkata Port Trust and the West Bengal government are considering building a deep sea port—were first to be hit by the cyclone.

- In 2011, Chennai was affected by storm Thane, categorised as a 'very severe cyclonic storm'. While Puducherry was the worst hit, there were 26 deaths in Tamil Nadu, including one in Chennai.³⁶ A ship moored at the Port of Chennai was completely destroyed. Due to early warning, however, further damage to the port infrastructure or personnel was prevented.
- When cyclone Phailin struck Andhra Pradesh in 2013, almost 1.2 crore people were affected and there was large-scale structural damage across the states of Andhra Pradesh and Odisha. As the cyclone warning was issued four days before landfall, both states had time to prepare and significant damage was avoided.³⁷ Phailin triggered one of India's biggest evacuation operations.³⁸ While the city of Visakhapatnam was relatively spared, the heavy waves caused the walls between the Visakhapatnam Port and the Fishing Harbour to collapse.³⁹
- In 2014, Andhra Pradesh was affected by Hud Hud, the most devastating cyclone to have struck an urban area along the east coast in recent times.⁴⁰ News reports reported 46 deaths.⁴¹ The Visakhapatnam

port, which is capable of dealing with a wind speed of 200 km/per hour, faced Hud Hud's wind speed of 235 km/ per hour. The port's installations suffered damage, especially in the outer Bay area. An offshore tanker terminal was destroyed.⁴²

- In 2015, Cyclonic storm Komen struck the east coast. It partially affected West Bengal, where 48 people were killed and more than 36 million suffered from the floods.⁴³ The Kolkata Port and the Haldia Dock Complex were not affected. Andhra Pradesh was also ravaged by Cyclonic storm Komen and Disaster Warning Signal 2[^]⁴⁴ was hoisted at the ports of Visakhapatnam, Nizampatnam, Machilapatnam and Krishnapatnam.⁴⁵
- In 2016, Andhra Pradesh was affected by Cyclone Vardah and over 9,000 people had to be evacuated to relief camps.⁴⁶ The cyclone also hit the coast of Tamil Nadu,⁴⁷ killing 18 people in six districts and destroying property worth INR 6,700 crore. Trees were uprooted and buildings were damaged.⁴⁸ The Chennai Port also sustained some damage as this cyclone with a wind speed of 150-160 km/ per hour had gone directly over the port.
- No sooner had Tamil Nadu started recovering from the damage, that a year later in 2017 the state was hit by Cyclone Ockhi. Fourteen people died and many fishermen went missing. Kanyakumari was the worst affected district,⁴⁹ where almost a thousand people had to be evacuated.

[^] Disaster Warning Signal 2 indicates that a depression has formed far at sea with surface winds of almost 60-90 kmph. Ships leaving the port are therefore warned.

- Cyclone Gaja hit Tamil Nadu in November 2018, killing 45 people.⁵⁰ The economic impact on the state is said to be comparable to post-2004 tsunami levels. Massive displacement took place in the districts of Tiruvarur and Pudukottai. Houses collapsed, electric supply was disrupted, and over 3.7 lakh people were rendered homeless.⁵¹ The district of Kanyakumri was the worst affected.⁵²

Although these ports are frequently exposed to cyclones, in most of the cases they have suffered relatively little damage. This is because the port infrastructure are built to be disaster resilient, capable of withstanding cyclones till a certain level of severity. In the past ten years, the cyclones have been within the ports' bearing capacity. However, if a cyclone is of exceptional intensity, or if it directly hits the port city as had happened during Cyclone Hud Hud, the ports sustain severe damage.

It is therefore necessary for these ports to be covered by disaster management plans that will ensure its resilience to almost regular cyclones and even those of unprecedented intensity. The subsequent sections describe the National Disaster Management Plans (of 2016 and the 2018 draft), as well as the State Disaster Management Plans.

NATIONAL DISASTER MANAGEMENT PLANS: REVISITED

After the tsunami of 2004, disaster management in India experienced a paradigm

shift from a relief-centric approach to a comprehensive, proactive one focused on disaster risk reduction and encompassing all aspects of the disaster management spectrum. To integrate the disaster management apparatus of the country, the National Disaster Management Plan (NDMP) was formulated in 2016,⁵³ putting emphasis on adequate mitigation.⁵⁴ Accordingly, the National Disaster Management Plans (2016 and the 2018 draft) provide two pillars in minimising the impact of disasters: 'Response' and 'Recovery'. *Response* denotes being prepared to respond immediately to the crisis situation through rescue, relief and evacuation measures. *Recovery* may be further classified into 'Reconstruction' and 'Rehabilitation'.⁵⁵ The first refers to rebuilding damaged infrastructure, keeping in mind the principle of 'Build Back Better' (BBB)[&],⁵⁶ and the latter means relocating the affected people and providing them with alternative means of livelihood. The 2018 draft NDMP provides a number of noteworthy additions to the 2016 plan, such as the principle of social inclusion⁵⁷ and the section on adaptation to climate change.⁵⁸

Both the national plans, however, do not cover any specific guidelines for disaster management in major ports of the country which fall under central jurisdiction. In that context it is noteworthy that section 37 of the Disaster Management (DM) Act of 2005 states that every ministry and department of the Government of India, including the hazard-specific nodal ministries, shall prepare comprehensive disaster management plans detailing how each will contribute to the

& This envisions going beyond restoration of the affected area to the pre-disaster 'normal' and seizing the opportunity for better reconstruction.

national efforts in the domains of disaster prevention, preparedness, response, and recovery.⁵⁹ Accordingly, the authorities in-charge of the ports collaborate with the necessary departments and ministries of their respective State Governments in the purview of disaster management.

Disaster Management Plans of Selected Ports

Exposure to natural calamities does not necessarily translate into an impact of an equal intensity. This is because some coastal cities are more developed than others and consequently have higher protection levels.⁶⁰ The ports located in these cities also differ in their defence capabilities against natural hazards. Amongst the three ports covered in this brief, the Port of Visakhapatnam was the first to formulate its Crisis and Disaster Management plan in 2014. Two years later, HDC designed its Disaster Management Plan (DMP) explicitly deriving its legal mandate from the NDMP of 2016.⁶¹ The DMP for the Kolkata Dock System, for its part, is still awaiting approval from authorities.⁶² Following the 2004 tsunami, the Port of Chennai also created contingency plans to manage natural calamities.⁶³ The plans focus particularly on three aspects of disaster management: disaster preparedness; early warning; and crisis management. Developing capabilities in these three arenas will enable the port officials to manage the emergency situation until help arrives. The following are the key provisions of the plans for these ports.

Disaster Preparedness

Training and mock drills are necessary as they expose flaws in existing DMPs and point the

way for immediate action in crisis situations. The draft Disaster Management Plan of Kolkata Dock, for instance, requires port personnel and port users to undertake monthly drills. The participation of mutual-aid agencies is also mandatory during mock drills so that teamwork can be set up. An evacuation route for vessels and in buildings are also required to be properly shown so that they are visible in the dark.⁶⁴ For the Haldia Dock, capacity building is an important aspect of disaster management. Four types of exercises are prescribed: notification exercises meant to check communication systems; table top exercises; equipment deployment exercises; and incident management exercises. The fourth exercise varies depending on the kind of disaster and also includes evacuation operations.⁶⁵ Evacuation routes and assembly points are also pre-designed at HDC. The DMP for Visakhapatnam Port, for its part, calls for regular hazard analyses and mock drills. It prescribes that employees at all levels must share a sense of collective responsibility and that all handling equipment are in proper condition.⁶⁶ In the Chennai Port, safe transit areas are identified outside the port with the consent of the Chennai District Administration and Chennai City Corporation to facilitate evacuation.⁶⁷

It is to be noted that all these plans provide a general framework for training and mock drills and that these are not disaster-specific. After all, fire or medical emergencies can happen as a result of both natural and man-made disasters and therefore require the same preparations.

Early Warning Systems

According to the draft Kolkata Port Disaster Management Plan, once a storm signal is

issued by the Kolkata Radio, the Director Marine Department and the Harbour Masters keep in close touch with the Alipore Observatory.⁶⁸ The Port Fire Watch rooms and wireless stations inform the concerned people of the emergency and the Director of Marine Department issues directives to Harbour Masters to ensure the safety of crafts. Special instructions are also issued to the Master of Ships for implementing necessary precautions. In Haldia, the Deputy Chairman is authorised to officially declare the disaster in the Dock whereupon the Disaster Control Room orders the fire and security forces to sound the emergency siren, signalling evacuation. Marine maintenance is put on alert and contact is established with all officials of the dock. For Visakhapatnam Port, a cyclone station comes into operation at the Emergency Control Centre as soon as the storm warning signal 5* is raised⁶⁹ or a cyclone threat is located "close and imminent".⁷⁰ Like in the Kolkata Dock, here too the Harbour Master gives the call for the ships and other port crafts to be moored to more protected shelters. Under the command of the port Chairman acting in the capacity of the Chief Emergency Controller, all other departments of the port open their cyclone coordination rooms for round-the-clock operation and, depending on the severity of the situation, District Authorities are summoned and an offsite emergency is declared.

What is evident from these provisions is that these ports are all dependent on external agencies for their early warning systems. As yet the ports do not have any such early

detection systems installed within their premises. In the event of a disaster, therefore, the communication systems are of supreme importance if the ports are to receive timely warnings. While the Visakhapatnam Disaster Management Plan specifically calls for the setting up of an Emergency Communication System,⁷¹ the draft Disaster management plan of Kolkata assigns a special Communications Officer to look after the communication channels during a disaster⁷² and the Haldia Dock Disaster Management Plan also underlines the importance of communication in its provisions.

Crisis Management

This is the most highlighted aspect of the ports' disaster management plans and it is in this segment that specific response plans are provided for tsunamis or cyclones. Also within these response plans, the evacuation and mooring of ships to safer shelters are in focus. In all the three cases, the Port Fire Service plays a major role in evacuation operations and people are to be rescued not only from the port premises but also from on board the vessels that are moored there. In Kolkata Dock, this is to be done in consultation with the Control Room and disaster Management Group which is headed by the Chairman. The Port Mechanical and Electrical Engineering Department is also instructed to keep divers ready for rescue and relief operations.⁷³ At Haldia Dock, the Chief Incident Controller oversees the safety of the employees and decides whether search parties need to be organised. This official is also responsible for

* Signal 5 in the case of a cyclone means that the deep depression has transformed into a cyclonic storm and is likely to hit the coast.

permitting volunteers to use yacht tenders and ferry stranded people to safer locations.⁷⁴ In the Visakhapatnam Port the Deputy Conservator, in his role as Chief Incident Controller, initiates the required emergency operations.⁷⁵ The Crisis Management Plan of Chennai Port also covers the process of evacuation required during an emergency, although the nature varies depending on the kind and degree of crisis.⁷⁶ In cases of extreme disaster, all the ports are required to summon assistance from district and state authorities.

Apart from stating the necessary provisions for evacuation, the DMPs of Haldia Dock and Visakhapatnam Port also provide detailed action plans to be followed in the event of a cyclone or a tsunami. The Chennai Port also has a Crisis Management and Disaster Preparedness Plan to deal with all kinds of natural calamities. The Kolkata Port provides a detailed action plan to be followed in the case of any natural calamity. It is noteworthy that the Disaster Management Plans of all these three ports provide response plans to deal with earthquakes, cyclones and tsunamis, except Kolkata, which despite its vulnerability to tsunamis does not have a specific mitigation plan.

It must also be kept in mind that a port's test of efficiency in disaster management is how soon it can return to normalcy. Accordingly, the disaster management plans of these selected ports provide for damage assessment and subsequent communication about resumption of operations. Post-disaster revisions are also made to existing DMPs in consultation with the respective core disaster management groups.

The Question of Recovery

Reconstruction and rehabilitation activities of the ports are carried out in accordance with the provisions of the state government. This is because both these processes require allocation of land, which falls within the jurisdiction of the State government.

While the Kolkata Port's Civil Engineering Service assists in rehabilitating the affected port personnel to their homes, for instance, the main responsibility rests with the West Bengal government. In the West Bengal Disaster Management Plan (WBDMP) of 2015-2016 (draft) that is currently operational,⁷⁷ post-relief assessment paves the way for further mitigation which includes restoration of basic infrastructure (short-term) and providing assistance to affected families and restoring local economic system in the long term.⁷⁸ The plan is, however, silent on the various kinds of rehabilitation necessary such as psychological trauma care and environment rehabilitation. It also refrains from discussing the principle of "Build Back Better" in its reconstruction initiatives but deems it essential to mainstreaming disaster management in all development projects.⁷⁹ According to the draft Disaster Score Card for States and Union Territories of India, 2018, out of 50, WB scores 19.5 for disaster preparedness, 24 for disaster response, 18.5 for disaster relief and rehabilitation, and 17.5 for disaster reconstruction.⁸⁰

Unlike the other plans, the DMP of Visakhapatnam Port vests the responsibility of seeking rehabilitation centres to the Emergency Action Groups and provides a list of rehabilitation centres in and around the

port premises.⁸¹ Recovery efforts are, however, not undertaken without the guidance of the Andhra Pradesh State Disaster Management Plan (APSDMP) of 2017-2018. In AP the Revenue Department is the nodal agency for monitoring and directing rescue, relief and rehabilitation operations.⁸² Following disaster assessment, relief packages are planned for the affected population. Reconstruction and Rehabilitation activities are primarily executed by local authorities and reconstruction work is guided by the principle of Owner Driven Reconstruction and BBB.⁸³ Out of 50, AP scores 19.5 for disaster preparedness, 22 for disaster response, 20.5 for disaster relief and rehabilitation, and 20.5 for disaster reconstruction.⁸⁴

For Chennai Port, once evacuees are settled in the relief shelters, the recovery activities are executed with the Tamil Nadu Government at the helm. The Tamil Nadu State Disaster Management Plan focuses on multi-purpose evacuation shelters which provide facilities like kitchen, water storage and toilets.⁸⁵ The Department of Social Welfare provides psycho-social rehabilitation, which begins with community participation.⁸⁶ Climate Change Adaptation (CCA) is integrated with BBB and incorporated into development projects.⁸⁷ Out of 50, TN scores 24.5 for disaster preparedness, 24.5 for disaster response, 26 for disaster relief and rehabilitation, and 22 for disaster reconstruction.⁸⁸

Applicability of Ports' Disaster Management Plans

India's east coast is yet to face a disaster of the same magnitude as the tsunami of 2004 and

therefore the efficacy of the ports' plans is yet to be fully tested. Cyclones of varying magnitude have, however, intermittently hit the coast in the past few years.

The Kolkata Port has not witnessed much destruction to the port infrastructure from the regular cyclones that it experiences. Being the country's oldest port, its officials have acquired enough experience and expertise to deal with intense natural disasters. Indeed, the Kolkata Port has been recognised as the best managed port in the country.⁸⁹ The present DMP is yet to be ratified by its officials. As regards executing rehabilitation and reconstruction measures for the port community (those who live around the port), it is subjective and circumstantial depending on the need for the port to step in. Haldia Dock Complex too is yet to experience any such disaster which will test the applicability of its plan. Therefore, it is also difficult to gauge how soon the Kolkata and Haldia Dock will be able to resume normal operations if affected by cyclones or Tsunamis.

During the tsunami of 2004, the Port of Visakhapatnam was compelled to stall port operations for a number of days. However, since 2014 when Visakhapatnam Port formulated its Disaster Management plan it has not been hindered much by the subsequent cyclones such as Vardah or more recently, Gaja. The DMP is largely responsible for this achievement, as well as the fact that recent disasters have not been of high intensity. While Cyclone Hud Hud—which occurred in the same year as the DMP was formulated—did cause interruptions in the port operations, it did not result in injuries or deaths within the port premises.⁹⁰ Despite the

severity of the Hud Hud's impact, officials were able to repair damages to infrastructure and roads within ten days. The damaged offshore oil tanker, however, took two years to be completely restored.

Taking care of port communities is a part of Corporate Social Responsibilities (CSR) of the ports. In that regard VPT caters to the reconstruction and rehabilitation demands of the port community (those who are employed by the port and those who live around it) in times of crisis. It is thus responsible for rebuilding the damaged living quarters of its employees. Three percent of the net profit of VPT must be assigned for CSR activities. In the case of VPT, more resources are utilised as the city is close to the port. VPT as a part of its CSR outreach has also adopted a village that had been severely damaged in a cyclone.⁹¹

The tsunami of 2004 inflicted severe damage on the port of Chennai. While the living quarters of the port employees remained relatively unaffected owing to them being situated on an elevated land, ships harboured at the dock were destroyed. What followed was a period of emergency evacuation within the port for the next ten days as ships had to be manoeuvred to a more stabilised zone and cargo re-located to a more sheltered area. The port fire stations and hospitals already trained in their evacuation drill, actively participated in remediating the several casualties distressing the port. The various disaster management contingency plans were put into action and it took nearly a month to restore the port to its full functionality.⁹²


As regards the Chennai Port, during Cyclone Vardah in 2016 armed with a DMP, the preparation level was high and the entire port

was evacuated and the roads cleared in advance. Ships had been notified in advance to steer away from the coast and damage was prevented. After the cyclone, buildings such as living quarters in and around the port were rebuilt, power supply restored and pipelines repaired. The port resumed normal operations shortly. After Vardah, Chennai Port has not suffered from any other disasters; even Cyclone Gaja did not have an impact on the port. Officials state that the current disaster management plan of the Chennai Port has considerably improved the disaster management capacity since 2011 during Cyclone Thane.⁹³

CONCLUSION

The ports of Kolkata in West Bengal, Chennai in Tamil Nadu, and Visakhapatnam in Andhra Pradesh, all sitting on India's disaster-prone east coast, are working to nurture a strong and sustainable disaster management apparatus. Although port authorities have undertaken measures to enhance their protection levels, these efforts at disaster risk management are largely ad hoc in nature. The plans are also silent on the recovery aspect of disaster management. There is a need, therefore, for more comprehensive and holistic disaster management planning for these ports. It is imperative to formulate a coordinated crisis management plan comprising requirements for the short, medium and long terms. The following components are necessary:

- A Standard Operating Procedure for ports in disaster responses and preparedness.
- Early warning systems within the port premises.

- Disaster-specific mock drills in all the three ports.
 - Regular reviews of disaster management plans.
 - Special care for the marginalised sections of port community in relief and rehabilitation.
 - Disaster Risk Reduction integrated with Climate Change Adaptation.⁹⁴ To ensure more reliable projection of disaster risks
- in the future, it is necessary to take into account the ongoing impacts of climate change. There is a need therefore to build synergy between Disaster Risk Reduction and Climate Change Adaptation.
- A standard guideline for disaster resilience with special reference to rebuilding damaged infrastructure after a calamity.
 - Special Contingency Plans to deal with disasters of extreme intensity. 

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ENDNOTES

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