MARINE SPATIAL PLANNING FOCUSING ON FISHING AND ENVIRONMENTAL PROTECTION IN THE GULF OF MANNAR AND PALK BAY, TAMIL NADU

PART A

FINAL REPORT

JUNE 2025

Marine Spatial Planning focusing on fishing and environmental protection in the Gulf of Mannar and Palk Bay, Tamil Nadu

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THE ENERGY CONSORTIUM
IIT MADRAS

Danish Energy Agency

Marine Spatial Planning focusing on fishing and environmental protection in the Gulf of Mannar and Palk Bay, Tamil Nadu

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EXECUTIVE SUMMARY

The Palk Bay and Gulf of Mannar region in Tamil Nadu, identified as a potential site for offshore wind development, is a critical biodiversity hotspot and a cornerstone of the local economy, sustaining the livelihoods of coastal and fishing communities. However, this ecologically sensitive area faces mounting pressures from anthropogenic activities, including modern fishing practices, coastal infrastructure development, pollution, resource extraction, and the accelerating impacts of climate change. Balancing these competing interests while ensuring sustainable growth necessitates the adoption of Marine Spatial Planning (MSP) as a strategic framework.

This report, prepared by The Energy Consortium at IIT Madras, builds on the foundational Marine Spatial Planning study conducted by the Danish Energy Agency (DEA) in Tamil Nadu. It places a focused lens on the fishing industry and environmental protection in the Palk Bay and Gulf of Mannar. The analysis examines key legislations and policies, such as the Tamil Nadu Marine Fishing Regulation Act, the Coastal Regulation Zone notification, and policies related to offshore wind energy and deep-sea fishing, to evaluate how existing legal frameworks align with offshore wind development in India.

The report draws from an extensive review of secondary literature, detailed case studies on subsea cables and port infrastructure, and insights gathered from stakeholders. This multi-faceted approach, combined with legislative analysis, identifies critical research gaps and implementation challenges. By synthesizing best practices and science-based recommendations, the report outlines conflict mitigation strategies and highlights the need for robust stakeholder engagement in the MSP process.

The report underscores the urgent need for implementing MSP with active stakeholder participation to foster a resilient coastal ecosystem that safeguards biodiversity while supporting livelihoods in the Palk Bay and Gulf of Mannar region for sustainable development of the proposed offshore wind industry.

1. INTRODUCTION

Marine Spatial Planning (MSP) serves as a critical framework for managing the intricate relationships between the fishing industry and environmental conservation in the context of offshore wind development in the Gulf of Mannar and Palk Bay, Tamil Nadu. This region contains significant biodiversity, and encompasses essential habitats, including coral reefs, seagrass beds, and diverse fish populations, which underpin both the local ecology and the regional economy. Despite their ecological richness, these areas are increasingly subjected to various anthropogenic pressures from the fishing industry, coastal development, and infrastructure expansion (R, J., Balachandran et al., 2020).

Suitable climatic condition in the Gulf of Mannar and Palk Bay in Tamil Nadu presents a prime opportunity for offshore wind energy development (The European Union, 2018). To fully leverage this location while balancing ecological, social, and economic interests, a more in-depth MSP is essential. Through such a framework, previously dismissed zones may be reconsidered for sustainable use, fostering informed discussions and negotiations when allocating sea use areas. Two areas of particular interest—fishing and environmental protection—stand out due to their interdependent nature and the local challenges they face. The expertise of the Energy Consortium at the Indian Institute of Technology (IIT) Madras is particularly valuable, as it brings a wealth of knowledge in the research and analysis of coastal conflicts related to fishing and conservation, as well as marine mammal protection and interactions with coastal development. IIT Madras's local knowledge and network provide critical support for data gathering and stakeholder engagement, which are crucial for robust and context-sensitive planning.

The fishing industry stands as the cornerstone of Tamil Nadu's coastal economy, sustaining the livelihoods of thousands and supporting traditional fishing communities. In Tamil Nadu, as per the Fisheries Department, the marine fishing population is 10.48 lakh people, living in 608 marine fishing villages across 14 coastal districts. According to the Tamil Nadu Fisheries Department, a predominant number of active boats in the states are traditional, small-scale, artisanal fishing crafts.[1] These communities maintain a profound connection to the marine environment, relying on relatively sustainable fishing practices. However, rapid modernization and the intensification of fishing activities, alongside increasing coastal development projects, have precipitated ecological challenges, including habitat degradation, overfishing, and disruptions to marine species (Makarand Purohit, 2017). Broader threats including climate change and pollution, further compound these challenges (ETB Sivapriyan, 2024).

[1] Tamil Nadu Fisheries Department
https://www.fisheries.tn.gov.in/MarineFisheries

Amidst escalating industrial activities, such as the installation of undersea cables and the expansion of port infrastructure, MSP emerges as a strategic approach to mitigate adverse impacts. Through a collaborative and systematic methodology, MSP seeks to harmonize competing interests, integrating conservation principles with sustainable resource use. Active engagement of stakeholders—including fishermen, industries, conservationists, and local authorities—plays a pivotal role in planning initiatives aimed at reducing conflicts and enhancing the resilience of marine ecosystems. Moreover, MSP facilitates the integration of emerging sectors, such as offshore wind energy, into existing marine spaces, ensuring that traditional fishing grounds are respected while exploring new opportunities for sustainable growth. (Farella et al., 2021).

According to Tuda et al. (2013), Marine Spatial Planning (MSP) emerges as a dynamic solution for resolving conflicts in multi-use coastal and marine zones by fostering balanced ecosystem-based management. They explain that MSP incorporates tools like Geographical Information Systems (GIS), multi-criteria decision analysis, and optimization techniques to map overlapping uses, identify conflict hotspots, and propose alternative allocation plans. For instance, it enables the systematic allocation of marine zones by engaging stakeholders, ensuring that competing interests —like traditional fishing, conservation of seagrass beds, and infrastructure projects—are harmonized. This process ensures that user-user conflicts (e.g., between artisanal fishers and tourism operators) and user-environment conflicts (e.g., habitat damage from industrial expansion) are mitigated effectively.

They discuss the adaptability of MSP that allows it to assess and plan for future conditions, providing critical insights into potential conflict escalation under different management scenarios, such as increased fishing, recreation, or conservation. By incorporating stakeholder preferences into decision-making and visually representing conflicts, MSP builds trust and collaboration among users, creating solutions that respect ecological, economic, and social priorities. This ensures that traditional fishing grounds are preserved while promoting sustainable opportunities like offshore wind energy. Consequently, MSP fosters informed negotiations and cultivates a resilient marine ecosystem, critical for sustaining both biodiversity and livelihoods in the region.

This report builds on the existing study on MSP conducted by the Danish Energy Agency (DEA) in Tamil Nadu by focusing specifically on the fishing industry and environmental protection in the Palk Bay and Gulf of Mannar region. By examining legislative frameworks, industry regulations, case studies, and recent trends, this report provides actionable recommendations for effective marine spatial planning that harmonises the needs of the fishing industry with environmental protection.

1.1 Review methods

As the objective of the report is to specifically focus on the fishing industry and environmental protection, we relied on secondary literature and other available sources to compile information. These sources include peer-reviewed journal articles and reports, official government documents, reports published by international and bilateral agencies, news reports and documents produced by local non-governmental organizations. In doing so, we examine legislative frameworks applicable to fishing and environmental protection mainly with respect to coastal regulation zone (CRZ) and other important legislation for environmental and social protection.

We mapped the legislations that intersect with offshore wind infrastructure including cable landing points, on-shore substation, power evacuation, offshore substation, port infrastructure and the turbine itself. We review industry regulations with respect to reporting sustainability impact and provide relevant information. In addition to this, we undertook detailed case studies, which include subsea cable landing points in Chennai, Tamil Nadu and port infrastructure in Vizhinjam, Kerala. We also review trends in marine fisheries in Tamil Nadu with the specific emphasis on deep sea fishing and its policy. We provide suggestions and recommendations to mitigate the negative environmental and social implications of offshore wind development in India.

While it is important to cover all aspects of knowledge on the environmental and fishing related factors with respect to development of offshore wind in the Palk Bay and Gulf of Mannar, there are limitations in availability of data. This could be in terms of published literature from this region, which is limited despite the rich biodiversity and presence of critical habitats, and publicly available data in terms of fish catch and ecological diversity. To fill this gap, the authors of this report rely on their long-term experience of having worked in this region along with gathering available information from extensive networks. In doing so, we have attempted to provide references to studies wherever possible in preparation of this report and used our discretion to record information that is pertinent to this study.

1.2 A background to the geography of the Palk Bay and Gulf of Mannar

1.2.1 Environmental characteristics of the region

The Palk Bay and Gulf of Mannar region along the Tamil Nadu coast is rich in biodiversity and is home to critical habitats such as mangroves, estuaries, seagrass beds, salt marshes, mudflats, wetlands, coral reefs and island ecosystems. This region also remains to be the most dynamic marine environment along Tamil Nadu coast due to shifting seasons under the influence of monsoon winds, bathymetric features and marine resource availability.

The area between Nagapattinam and Pamban Island in Ramanathapuram falls under the Palk Bay region. The sea is characterised by shallow waters and lush sea grass beds. South of this region extending until Kanyakumari district is the Gulf of Mannar.

The Palk Bay is a shallow water body with an average depth of 15 m extending between the state of Tamil Nadu in India and Sri Lanka. This shallow sea is entirely covered in lush seagrass, characterised by rich fish diversity and is also home to highly endangered species of marine mammals such as the dugong, which primarily feed on seagrass.

Figure 1: Underwater photos of corals and sandy habitat around Nallathanni Theevu in Gulf of Mannar. Photo credits: Rahul Muralidharan

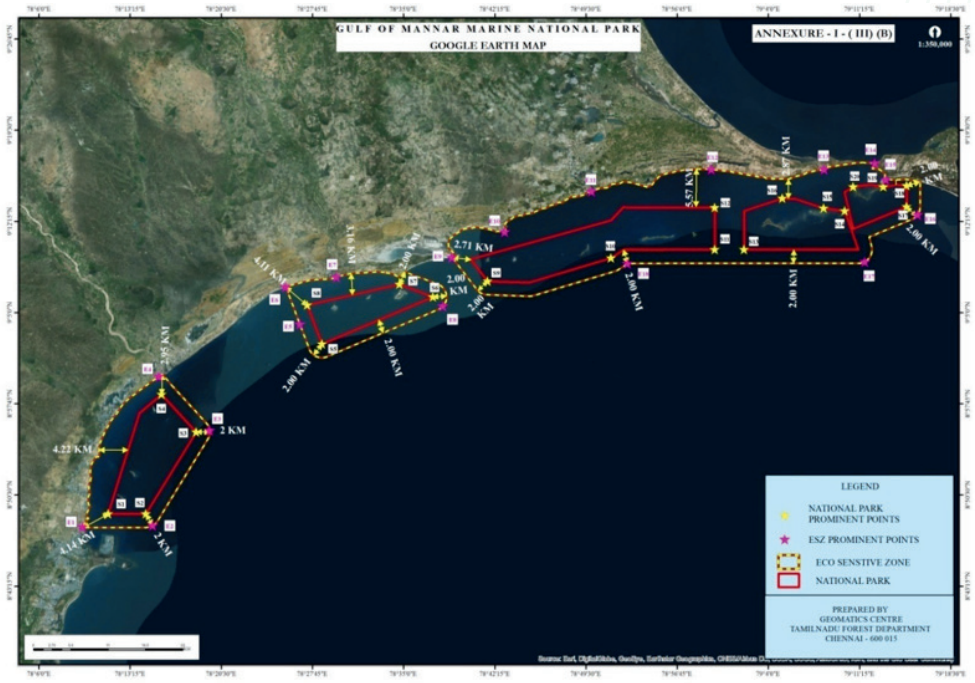

Figure 2: Map of Gulf of Mannar National Park. Source: MoEFCC (2020), The Gazette of India: Extraordinary

The Gulf of Mannar region is home to the Gulf of Mannar Marine National Park, a marine protected area (MPA) established in 1986 to protect 21 fringing coral reef islands, under the Wildlife Protection Act (WLPA), 1972.

The WLPA accords priority to conservation of wildlife and prohibits human use in core zones of the protected area and by allowing certain activities in the buffer zone (See Figure 2). The Gulf of Mannar islands are rich in biodiversity. The artisanal fishers who primarily fish in near-shore areas have depended on the islands for their livelihoods for many generations. However, with declaration of the MPA, the entry of fishers to the island was banned (Panipilla, 2014).

The Gulf of Mannar islands acts as a barrier by buffering the extreme weather conditions and is considered to be a haven for the labour-intensive artisanal fishing practices that are predominantly practiced in the region.

Unlike the Palk Bay, the Gulf of Mannar sea is deep, with a wide range of habitat and this influences the diversity of fisheries practiced in this region.

1.2.2 Fishing related features

Fishing in the Palk Bay and Gulf of Mannar has deep historical roots, tied to the harvest of pearl oysters in this region. For instance, there has been a mention of pearl fishing in this region as early as 1 CE in Greek literature (Panipilla, 2014). In the 15th century the Arabs controlled the trade, then taken over by the Portuguese and later by the Dutch in the 16th century; followed by the British East India company in the 18th century (ibid, pp-6). In 1906, pearl fisheries came under the fisheries department of the Madras Presidency and it was banned in the 1960s due to unsustainable harvesting.

As mentioned earlier, the waters of Palk Bay and the Gulf of Mannar exhibit dynamic qualities in seasonality and weather patterns as they are influenced by the north-east and south-west monsoons, respectively. The wedge-shaped land features of Ramanathapuram coast acts as a barrier shielding winds on alternating sides. For instance, during the south-west monsoon, between May and September, the Palk Bay waters turn calm for six months.

This is the period when high wind speeds and swells are reported in the Gulf of Mannar part. Whereas between October and April Gulf of Mannar waters turn calm and this is considered as a peak fishing season. Historically, with the lack of advanced fishing technologies, the fishers would migrate between Palk Bay and Gulf of Mannar during these seasonal shifts to find calm waters to pursue their livelihoods.

Recent technological changes and increasing competition for the declining fishing resources has meant that such seasonal migrations have reduced. When the weather conditions turn unfavourable, fishers now turn to work as labour in the mechanized trawl harbour for fishing or taking up net mending jobs to earn a wage.

Initially, mechanized fishing practices using bottom trawling techniques were introduced in the late 1950s in the Palk Bay through fisheries development efforts and came into conflict with traditional techniques of capturing fish practiced among artisanal fishing communities (Bavinck, 2003). Artisanal fishing gears are designed taking into consideration the shallow waters feature of Palk Bay.

However, bottom trawling practices are highly incompatible with the ecological features of the bay, while the introduction of bottom trawling in the Palk Bay imposed spatial restrictions on fishing practices carried out by the artisanal fishers (Scholtens et.al., 2012).

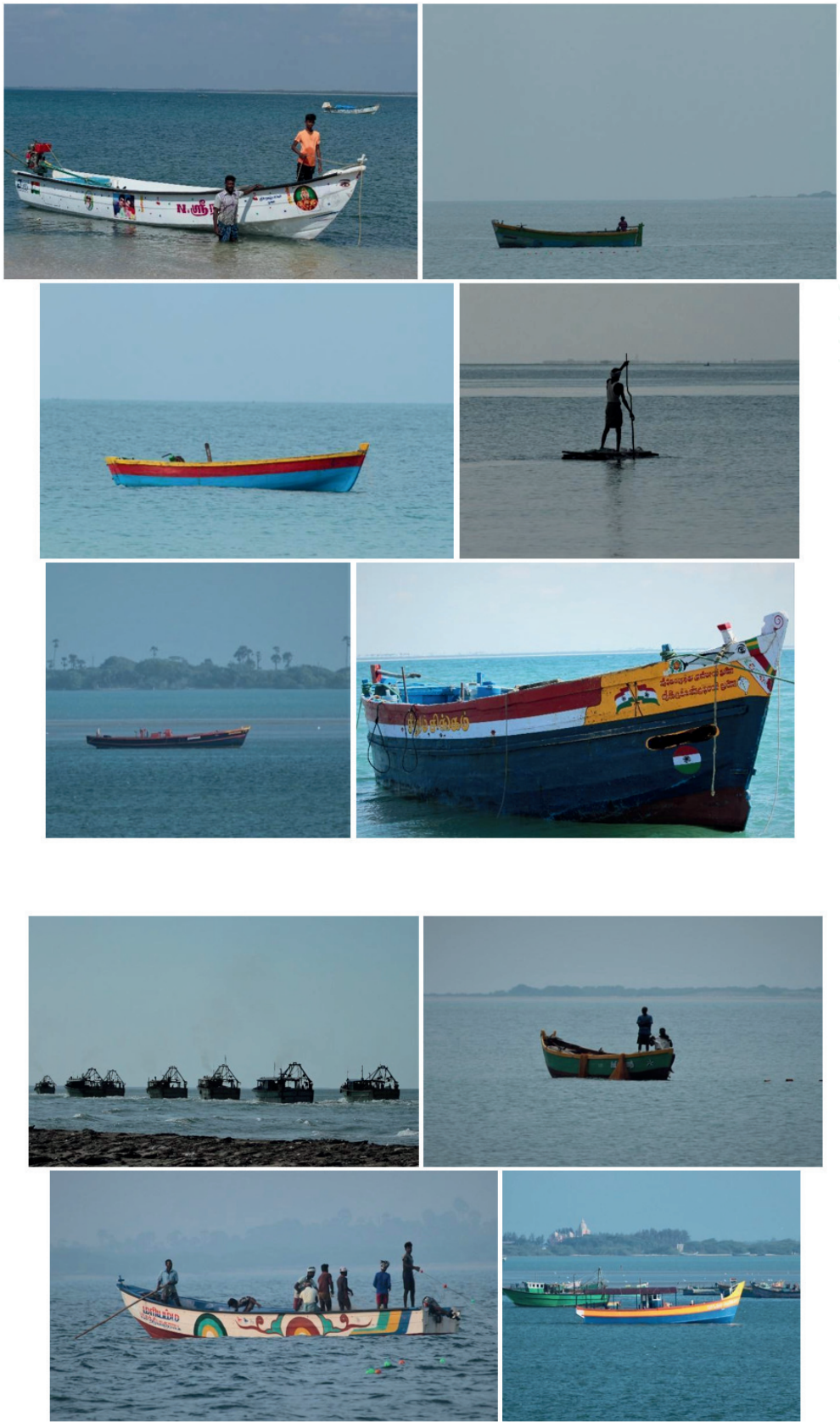

Figure 3: (Clockwise from top) a) Fibre boats (medium); b) Vallam (medium); c) Vathai; d) Catamaran; e) Purse seine boat (small); f) Vallam (Large); g) Mechanised bottom trawlers; h) Marukku thoni (Shore seine); i) Fibre boats (Large); j) Purse seine (Kerala). Photo credits: Rahul Muralidharan

Table 1: Species specific fishing equipment mainly used in artisanal, small-scale fishing

S.No	Local name	Common name	Target species	Type
1	Soodai valai	Sardine nets	Gold-stripe sardinella	Surface drift
2	Motta valai	Snapper nets	Snapper	Bottom set
3	Kelaikaan valai	Sand whiting nets	Sand whiting (Sillaho sihama), Goat fish (Upeneus sp.)	Bottom set
4	Mural valai	Half-beak nets	Half-beaks, small seer fish and ribbon fish	
5	Seela valai	Seer fish nets	Seer fish, barracuda	Surface drift
6	Kumula valai	Mackerel net	Mackerel	Surface drift
7	Saatu valai	Trammel net	Mixed species including squid	Surface drift
8	Sutthu valai	Encircling nets	Sardines	Water column
9	Raal valai	Shrimp net	Shrimp	Bottom set

The shallow and sheltered waters of the Palk Bay attracted trawlers from other parts of Tamil Nadu, and their conflict with the artisanal sector compounded as fishers were targeting the same resources in near-shore areas (Bavinck and Karunaharan, 2006).

The operation of bottom trawlers for shrimp during the night interfered with traditional fishing practices carried out by artisanal fishers.

Palk Bay's artisanal fishers carried out unrelenting protests demanding the state to act against trawling. This made the Revenue Divisional Officer of Aranthangi Taluk in Pudukkottai district in the Palk Bay to pass an order on 17 March 1976 which banned night fishing by trawlers and allowed them to fish between 6 am and 6 pm (Bavinck, 2003).

The mechanized fishers challenged this decision in the Madras High Court arguing that it is through fishing during the night they earn revenue and that they are incurring a loss due to night fishing ban.

In 1977 the Madras High court tweaked this original order to allow three days in a week for mechanized boats and four days for artisanal boats, popularly known as the 'three-four' day rule in the Palk Bay (Bavinck, 2003).

While other districts in the Palk Bay such as Pudukkottai and Thanjavur adopted this rule in 1977, this order was instituted in the Ramanathapuram district only in 1993.

This was possible because Nambuthalai, an artisanal fishing village in Ramanathapuram organised several protests demanding amends (Bavinck and Karunaharan, 2006).

In 1993, the collector approved the three-four-day rule regulation in Ramanathapuram when the conflicts peaked into riots between artisanal and mechanized fishers.

However, this 3 nautical mile zone rule has hardly ever been enforced since its implementation but the three-four day rule is still in place and practiced even to this day.

2. MARINE ENVIRONMENT LEGISLATION AND REGULATIONS

This legislative mapping is being conducted to provide a comprehensive guide for stakeholders involved in the OSW sector. By understanding the legal requirements and regulatory frameworks governing various components of OSW projects—such as turbine installation, submarine cable network, offshore substations, cable landing points and environmental compliance thereof—developers and regulatory bodies can navigate the complexities of project implementation more effectively. This mapping aims to streamline the approval processes, ensure compliance with national and international standards, and ultimately facilitate the successful deployment of OSW projects in India.

2.1 Fishing-related legislation and offshore wind infrastructure

To ensure a comprehensive understanding of the intersection between offshore wind energy (OSW) projects, fishing regulations and environmental protection in India, it is essential to consider the relevant Coastal Regulation Zone (CRZ) laws and their implications on marine life and fishing zones. Here is a categorised mapping of the pertinent fishing-related legislation:

2.2 Coastal Regulation Zone Notification:

Category	Description
CRZ-I: Environmentally Most Critical Areas	CRZ-I A: Ecologically Sensitive Areas (ESAs) and geomorphological features that maintain the integrity of the coast. CRZ-I B: The intertidal zone, i.e., the area between the Low Tide Line (LTL) and High Tide Line (HTL).

CRZ-II: Developed Land Areas	Land areas close to the shoreline, within municipal limits, or legally designated urban areas. These areas are substantially built-up, with more than 50% of plots developed. Infrastructure such as roads, drainage, water supply, and sewerage is provided.
CRZ-III: Relatively Undisturbed Areas	Land areas not classified under CRZ-II, mainly rural areas. CRZ-III A: Areas with population density >2,161 people per square kilometre (2011 Census). NDZ: 50 m from HTL (if CZMP is approved), 200 m if not approved. CRZ-III B: Population density <2,161; NDZ: 200 m.
CRZ-IV: Water Areas	CRZ-IV A: Water area and seabed between the LTL and 12 nautical miles seaward. CRZ-IV B: Water area and seabed between the LTL on either side of a tidally influenced water body, up to the salinity level of 5 ppt during the driest season.
Application Requirements	Projects must submit a CRZ map (1:5000 scale) demarcated by an authorised agency, showing project activities concerning CRZ boundaries. Recommendations from the State Coastal Zone Management Authority must be included for obtaining clearance under CRZ Notification.

Table 2 : Coastal Regulation Zone categories

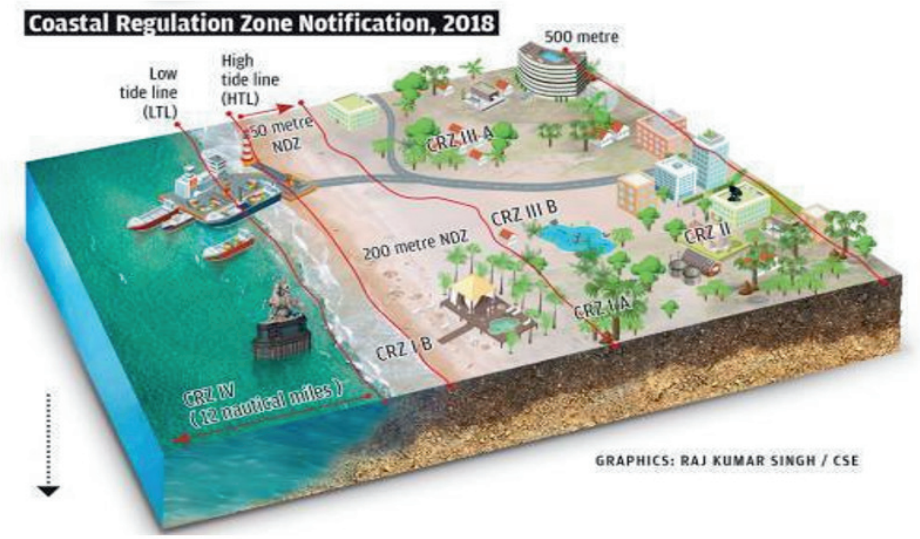

Figure 4: Coastal Regulation Zone. Source: Centre for Science and Environment (CSE)

Table 3: CRZ classification of OSW infrastructure

Infrastructure	CRZ classification
Wind turbine	CRZ IV (Low tide line to 12nm)
Offshore array cable	CRZ IV (Between wind turbine and Offshore Substation, distance varies according to distance between wind turbine and location)
Offshore substation	CRZ IV (Closer to Low tide line)
Offshore export cable and Onshore export cable	Starts at CRZ IV, can potentially utilise all CRZ zones until termination point. (based on subsea cables laid in the coast of Chennai)
Onshore substation	CRZ - II (based on the location of Thoothukudi port)

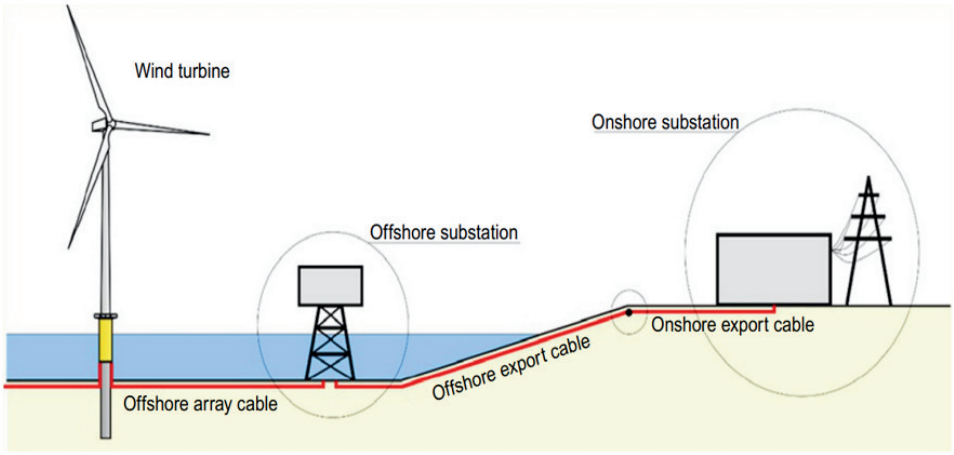

Figure 5: Offshore Wind Infrastructure

The table lists four key elements of OWF projects: wind turbines, offshore array cables, offshore substations, and export cables (offshore and onshore). All these components are primarily situated within CRZ IV, which covers the area from the low tide line to beyond 12 nautical miles.

The applicable legal framework includes several environmental, pollution control, and management rules, such as the Environment (Protection) Act, 1986, and specific offshore wind energy lease rules introduced in 2023.

While most OWF components fall under CRZ IV, any onshore infrastructure might affect community land. In such cases, the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation, and Resettlement Act, 2013, would apply.

This ensures that all necessary legal clearances are in place for OWF projects, with special consideration for onshore infrastructure.

Additionally The Offshore Wind Energy Lease Rules, 2023 regulate leasing offshore areas in India's Exclusive Economic Zone for wind energy projects. Lessees are selected through the National Offshore Wind Energy Policy, and must obtain clearances from various ministries.

They are granted exclusive rights to conduct surveys, install wind turbines, and restrict activities like fishing and navigation in designated areas during construction and operation.

The lease period is initially for three years, extendable to five for surveys, and up to 35 years for project operations. Lessees must pay security deposits and annual lease fees, follow strict guidelines, and decommission sites after the lease ends. Breaches, environmental damage, or misuse can result in lease cancellation.

The government retains control during emergencies and can suspend operations if national security or environmental risks arise.

2.3 The National Offshore Wind Energy Policy (2015)

1. Maritime Zones and Clearances: Offshore wind projects can be established in two key zones: Indian territorial waters (up to 12 nautical miles) and the Exclusive Economic Zone (up to 200 nautical miles). Projects in these areas require various clearances, including environmental impact assessments (EIA), defence, coastal security, and maritime safety approvals from ministries like Defence, Shipping, and Petroleum, depending on the project's location.

2. Regulatory and Approval Process: The National Institute of Wind Energy (NIWE) acts as the nodal agency, facilitating the issuance of necessary clearances and No Objection Certificates (NOCs) from relevant ministries. Before any installation begins, developers must secure clearances related to subsea cabling, turbine installation, and grid integration. This ensures the project complies with security, environmental, and operational standards.

3. Challenges and Coordination: The policy outlines the coordination between multiple government bodies, including the Ministry of Environment, Ministry of Defence, and others, to streamline the approval process. NIWE plays a key role in simplifying this, acting as an intermediary between project developers and regulatory authorities to secure timely permits and facilitate smooth project execution. The necessary permits have been listed under Table 4.

2.4 Clearance/No Objection Certificate (NOC) for surveys & studies

NIWE will take in-principle clearance from the Ministries of Defence, Home, External Affairs, Environment & Forests and Department of Space before notifying the offshore wind energy blocks for International Competitive Bidding (ICB) (Stage-I Clearances).

On allocation of blocks, the successful bidder/developer will have to take Clearances/NOCs from various Central and State Government Ministries/Departments (Stage-II Clearances).

The Central Government Ministries/Departments which will be involved in the process of granting clearance or NOC, as the case may be, for Offshore Wind Power /Projects with the nature of clearance are listed below.

Table 4: Required Clearances for OSW Projects

Ministry/Department	Stage-I Clearances	Stage-II Clearances (or NOCs)
Ministry of Environment & Forests	In-principle Clearance	EIA and CRZ clearance
Ministry of Defense	In-principle Clearance	Clearance related to defence & security aspects, related to Army, Navy, Air force, DRDO and other such institutions under MoD
Ministry of External Affairs	In-principle Clearance	Clearance for development of offshore wind energy projects within the maritime zones of India
Ministry of Home Affairs	In-principle Clearance	Clearance regarding deployment of foreign nationals in offshore wind energy blocks
Ministry of Civil Aviation	No clearance needed at this stage	Clearance for construction near aviation radars/aerodromes. No clearance/NOC required for all other locations

Ministry of Petroleum & Natural Gas	No clearance needed at this stage	Clearance for offshore wind power installations proposed in Oil & Gas Blocks. No Objection Certificate for construction outside the offshore Oil & Gas Blocks
Ministry of Shipping	No clearance needed at this stage	Clearance for projects near Major Ports. No Objection Certificate to operate away from shipping lanes
Department of Space	In-principle Clearance	Clearance from security angle with regard to Dept. of Space installations and for minimum safety distance to be maintained from the Dept. of Space installations
Department of Telecommunication	No clearance needed at this stage	No Objection Certificate to operate outside subsea communication cable zones
Ministry of Mines	No clearance needed at this stage	No Objection Certificate to operate outside mining zones

2.5 Possible EIA exemption for OWF:

CRZ Clearance for installation of 19 windmills in the Mahuva Taluka of Gujarat, makes a mention that "Wind energy being clean energy projects, is exempted from the Environmental Impact Assessment (EIA) notification-2006." for the onshore project. The same has been repeated by the former minister of New & Renewable Energy and Power. On 30/11/2021 he stated in the Rajya Sabha "Renewable Energy projects lead to reduction of CO2 emissions at 1800 metric tons per MW every year.

Solar and Wind Power projects are beneficial for the environment and so they are not covered under the ambit of Environmental Impact Assessment (EIA) Notification, 2006 & as such they do not require prior environmental clearance.

Hydro-electric projects less than 25 MW, Thermal Power Plants up to 15 MW based on Biomass, or non-hazardous municipal solid waste using auxiliary fuel such as coal, lignite/petroleum products up to 15% and Thermal power plants using waste heat boilers without any auxiliary fuel are exempted from the requirement of prior environmental clearance."

3. SUMMARY OF ALL APPLICABLE LEGISLATION

Table 5: Applicable Legislations for OSW Projects

Legislation	Features	Level
Environment (Protection) Act, 1986	• Provides a comprehensive framework for the protection and improvement of the environment. • Empowers the central government to take measures to protect and improve environmental quality, control pollution, and manage hazardous substances. • Authorises the government to set standards for emissions and discharges of pollutants into the environment.	National

Environmental Impact Assessment Notification, 2006	• Requires prior environmental clearance for certain projects based on their potential environmental impact. • Categorizes projects into Category A (requiring clearance from the Ministry of Environment, Forest and Climate Change) and Category B (requiring clearance from the State Environmental Impact Assessment Authority). • Involves a detailed assessment process including screening, scoping, public consultation, and preparation of an EIA report.	National
Coastal Regulation Zone Notification	• Regulates activities in coastal areas to protect the environment and ensure sustainable development. • Defines four zones (CRZ-I to CRZ-IV) with specific permissible and prohibited activities. • Mandates the preparation of Coastal Zone Management Plans (CZMPs) by coastal states and union territories.	National
Air (Prevention and Control of Pollution) Rules, 1982	• Establishes standards for air quality and permissible levels of pollutants. • Empowers the Central and State Pollution Control Boards to monitor air quality and enforce regulations. • Provides guidelines for the prevention, control, and abatement of air pollution from industrial and vehicular sources.	National
Noise Pollution (Regulation and Control) Rules, 2000	• Sets permissible noise levels for different areas (industrial, commercial, residential, and silence zones). • Provides measures for the control of noise pollution, including restrictions on the use of loudspeakers and public address systems. • Empowers authorities to take action against violators and enforce noise pollution standards.	National

Water (Prevention and Control of Pollution) Rules, 1975	• Establishes standards for water quality and effluent discharge from industries. • Empowers the Central and State Pollution Control Boards to monitor water quality and enforce regulations. • Provides guidelines for the prevention, control, and abatement of water pollution from industrial and domestic sources.	National
Solid Waste Management Rules, 2016	• Regulates the management, handling, and disposal of hazardous and other wastes. • Controls the import and export of hazardous wastes to ensure safe and environmentally sound management. • Mandates the preparation of a hazardous waste management plan by industries generating such wastes. • Provides guidelines for the management of solid waste, including segregation, collection, transportation, processing, and disposal. • Emphasises the principles of reduce, reuse, and recycle to minimise waste generation. • Mandates the involvement of local authorities, waste generators, and other stakeholders in the implementation of solid waste management practices.	National
E-Waste (Management) Rules, 2022	• Regulates the disposal and recycling of electronic waste to prevent environmental pollution. • Mandates extended producer responsibility (EPR) for manufacturers, importers, and brand owners to ensure proper e-waste management. • Provides guidelines for the collection, storage, transportation, and recycling of e-waste.	National

The Public Liability Insurance Act, 1991	• Requires industries handling hazardous substances to obtain insurance coverage for potential environmental damage. • Provides immediate relief to affected persons in case of accidents involving hazardous substances. • Establishes a mechanism for the payment of compensation to victims of environmental accidents.	National
Biological Diversity Act, 2002	• Aims to conserve biological diversity and ensure the sustainable use of its components. • Regulates access to biological resources and associated traditional knowledge to ensure fair and equitable sharing of benefits. • Establishes the National Biodiversity Authority (NBA) and State Biodiversity Boards (SBBs) to oversee the implementation of the Act.	National
Wild Life (Protection) Act, 1972	• Provides for the protection of wild animals, birds, and plants through the establishment of protected areas such as national parks, wildlife sanctuaries, and conservation reserves. • Regulates hunting, trade, and possession of wildlife and their products. • Empowers authorities to take measures for the conservation and management of wildlife habitats.	National

The Public Liability Insurance Act, 1991	• Requires industries handling hazardous substances to obtain insurance coverage for potential environmental damage. • Provides immediate relief to affected persons in case of accidents involving hazardous substances. • Establishes a mechanism for the payment of compensation to victims of environmental accidents.	National
Ancient Monuments and Archaeological Sites & Remains Act, 1958	• Protects ancient monuments, archaeological sites, and remains of national importance. • Regulates construction activities and development projects around protected sites to prevent damage.	National
Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013	• Ensures fair compensation and transparency in the process of land acquisition for public purposes. • Mandates social impact assessment (SIA) for large projects to assess the impact on affected communities. • Provides for the rehabilitation and resettlement of displaced persons to ensure their livelihoods and well-being.	National
Offshore Wind Energy Lease Rules, 2023	• Provides guidelines for leasing offshore areas for wind energy projects. • Establishes procedures for the application, evaluation, and approval of leases for offshore wind energy development. • Ensures that offshore wind projects comply with environmental and safety standards.	National

National Offshore Wind Energy Policy	• Promotes the development of offshore wind energy in India to diversify the energy mix and enhance energy security. • Provides a framework for the planning, development, and implementation of offshore wind projects. • Offers incentives and support mechanisms to attract investment in the offshore wind sector.	National
Tamil Nadu Marine Fishing Regulation Act, 1983	• Regulates fishing activities in Tamil Nadu's territorial waters to ensure sustainable fishing practices. • Establishes measures for the conservation and management of marine resources, including the prohibition of destructive fishing methods. • Provides for the registration and licensing of fishing vessels and the enforcement of fishing regulations.	National

4. CASE STUDIES: CONFLICTS BETWEEN THE FISHING INDUSTRY AND COASTAL DEVELOPMENT

4.1 Subsea cables of Chennai:

At present there are two major subsea cables with landing points in the coast of Chennai. To be more specific they land at different landing points present between the coast of Santhome and Nochikuppam (localities in Chennai). Here we discuss the implementation aspects of these subsea cables pertaining to legality, its potential environmental and social impacts. It is important to note that there are no legally established standards in India to protect subsea cables from damage.

4.2 CANI

Between the coasts of Chennai and of the Andaman & Nicobar Islands archipelago, there lies a 2,300 kilometre network of submarine optic fibre cable. The Chennai-Andaman & Nicobar Islands system, or CANI for short, is the only submarine cable that serves within Indian territory alone (Deep, 2021). It serves the purpose of providing better internet speeds to the Andaman and Nicobar Islands, which was not widely available on the islands prior to 2020.

The cable disrupts Coastal Regulation Zone (CRZ) rules, but had acquired the necessary sanctions for the same post submission of an impact assessment report. While granting CRZ clearance, one condition by the Ministry was that all beach manhole locations must be on landward side and not on the beach (SV Krishna Chaitanya, 2020).

However, DoT has the beach manhole terminal near Nochikuppam towards the seaward side of Marina loop road (CRZ-1A) ("Environmental Assessment of Beach ManHole at Chennai Under CANI Submarine Cable System," n.d.).

In terms of community resistance, there have been claims of the cable possibly disrupting fishing. Representatives from the fishing communities mentioned that DoT contractors are doing the construction literally inside the sea. During high tide, the sea water runs over Marina loop road.

"There is only a narrow strip of beach at Nochikuppam which is used by fishermen for parking their boats and fish landing. This has been encroached by DoT for building a beach manhole for Chennai-Andaman cable project." SS Ramakrishnan, Director, Institute of Remote Sensing (IRS), had also added that no construction should be carried out on the beach.

"Nochikuppam is a hazard-prone area. The manhole terminal should be on the landward side. The beachfront falls in an intertidal zone where no construction can be carried out." Chaitanya, K. (2020, January 23)

4.2.1 Legal aspects and CRZ clearance of CANI

The Santhome beach designated as BMH location is under the CRZ 1-A category according to map number 109 of Approved CZMP maps of Tamil Nadu. According to its clearance letter, a study conducted by Anna University finds that the cable route falls under the CRZ II, CRZ I-A, CRZ IB and CRZ IVA areas as per Coastal Regulation Zone Notification.

It passes through these areas and enters its landing station at Leela Information Technology Park in MRC Nagar, which is situated just outside the CRZ 2 area close to it (Rohit, 2018).

4.2.2 Key insights from EIA report of CANI

While an impact assessment has been conducted and the construction has happened with legal approval, there are a few things to be noted from the report. During implementation, there seems to be no consultations held with the community, yet the report claims that the cable doesn't pose any risk to fishing activity or community. As a minimum measure, the cables have been buried in certain areas to prevent such conflicts.

There are no secondary sources that validate or invalidate these claims. The report also contradicts these claims of security by a mention of possible conflicts during and after implementation. No clearance has been received from the fisheries department due to no designated fishing zones having been mapped in Chennai.

While there is no information available in the context of the cable burial depth in India, there are practices undertaken globally to provide some context. In German waters cable burial depths are proposed to be not less than 1 m in the EEZ and at least 3 m in areas with heavy ship traffic (e.g. shipping channels).

Within offshore wind farms, cable burial depth is at least 0.6 m. In tidal channels of the Wadden Sea cables are buried at least 2 m below the seabed. In NorthAmerica and Southeast Asia typical burial depths for all sorts of cable are between 0.9 and 3.5 m. (Commission OSPAR, 2008).

4.2.3 MIST/IAX

The Myanmar/Malaysia India Singapore Transit (MIST)/India Asia Xpress (IAX) cable system has a total length of 8,100km, connecting Singapore, Malaysia, Myanmar, Thailand, India (Mumbai and Chennai). It is a project has its entry into the coast of Chennai at Santhome and terminates at a BMH (Beach ManHole) at Leela Information Technology Park in MRC Nagar.

This cable landing had received the necessary legal sanctions required for its implementation through an assessment by the Expert Appraisal Committee (EAC) of the Ministry of Environment, Forest and Climate Change (Landing of India Asia Xpress Cable, n.d.).

4.2.4 Legal aspects and CRZ clearance of MIST/IAX

Santhome beach, the designated BMH location is under the CRZ 1-A category according to map number 109 of Approved CZMP maps of Tamil Nadu. According to its clearance letter, a study conducted by Anna University finds that the cable route falls under the CRZ II, CRZ I-A, CRZ IB and CRZ IVA areas as per Coastal Regulation Zone Notification.

It passes through these areas and enters its landing station at Leela Information Technology Park in MRC Nagar, which is situated just outside the CRZ 2 area close to it. The clearance letter mandates a public disclosure of the EIA report and other periodic reports done to assess impact of the implementation, yet there is no publicly available document as such.

4.2.5 Applicable legislation in India:

The development of coastal infrastructure in India, including the laying of subsea cables, is governed by a comprehensive framework of environmental and regulatory laws. Key among them are the Coastal Regulation Zone (CRZ) Notification, 2011, amended in 2018 under the Environment (Protection) Act, 1986, as well as the Air, Noise, and Water Pollution Acts, and rules related to hazardous waste, biomedical waste, and construction debris.

Additionally, the Forest Conservation Act, Wildlife Protection Act, and the Rehabilitation and Resettlement Act play critical roles in ensuring environmental sustainability and community welfare in coastal and marine projects.

Cable landings, solar and wind projects are kept out of the purview of stringent scrutiny since such projects are assumed to have negligible negative impact on the surrounding environment. They are not listed in Schedule I of the 2006 EIA Notification that lists projects or activities requiring prior environmental clearance and hence these are exempt from obtaining Environmental Clearance.

Still, since activities on and off shore are governed by CRZ and CZMP, rapid EIA is used as a tool for CRZ clearance. Project proponent has to ensure that CRZ clearance has been obtained and the project is not located in environmentally sensitive zones as notified under the CRZ classification.

CRZ notification of 2011 explains that construction involving more than 20,000sq meters built-up area in CRZ-II shall be considered in accordance with EIA notification, 2006 and in case of projects less than 20,000sq meters built-up area shall be approved by the concerned State or Union territory Planning authorities in accordance with the notification after obtaining recommendations from the concerned CZMA and prior recommendations of the concern CZMA shall be essential for considering the grant of environmental clearance under EIA notification, 2006 or grant of approval by the relevant planning authority.

The Wildlife Protection Act of 1972, while providing a list of species and locations to be protected, does not explicitly mandate the protection of all areas with the species specifically from development. The CRZ identified Critical Vulnerable Coastal Areas (CVCA) which includes the Gulf of Mannar and other identified ecological sensitive areas, this list yet again does not acknowledge the existence of protected species outside the designated areas, leaving the regular CRZ clearance the predominant determinant, leaving Forest (conservation) Act, 1980, Wildlife (protection) Act, 1972 and other laws mentioned are applicable based on geography of implementation.

While other projects might require clearances from the respective implementation bodies of these laws, subsea cables due to them being located in the coast of urban areas, and not contributing to direct pollution bypass them.

4.2.6 Conclusion

In summary, both the CANI and MIST/IAX subsea cable systems have secured legal clearances, despite concerns over compliance with CRZ rules and the absence of public consultations.

4.3 Major ports in India:

Figure 6: Major Ports in India. Source: Maps of India

At present India has 12 major ports as identified in the map above (Figure 6). With the country's east and west coast having 6 ports each. The following Table 6 sourced from Ministry Of Ports, Shipping & Waterways presents data on maximum port capacity, the amount of traffic handled during the 2022-2023 and the percentage of utilised capacity.

There are 12 major ports and 200 non-major ports (minor ports) in the country. While the Major Ports are under the administrative control of the Ministry of Shipping, the non-major ports are under the jurisdiction of respective State Maritime Boards/ State Government. All the 12 Major ports are functional. Out of the 200 non-major ports, around 65 ports handle cargo and the others are "Port Limits" where no cargo is handled and these are used by fishing vessels and by small ferries to carry passengers across the creeks etc.

All the 12 major ports are governed under the Major Port Trusts act, 1963. All the non-major ports (minor ports) are governed under the IPA Act, 1908 which consists of 69 sections and two schedules and regulates the berths, stations, anchoring, fastening, mooring and unmooring of vessels. Besides, it fixes the rates to be paid in a port other than major port for use of such mooring belonging to the Government. It also regulates catamarans plying for hire and deals with regulating the use of fires and light within any such port.

The port's under the central Government of India are known as major ports and other ports in India are classified as minor ports.

4.3.1 Major Port-wise Capacity Utilisation during 2022-23 (P) (MillionTonnes)

Table 6: Major port cargo utilisation. Source: Cargo Handling Capacity of Major Ports of the Country Has Gone up to 1617.39 Million Tonnes per Annum (MTPA) as on March 2023

S.No.	Name of Ports	Capacity (MTPA)	Traffic** (MTPA)	Capacity Utilisation (%)	Type of Port
1	Kolkata Ports of Authority*	92.77	65.66	70.8	Coastal, Breakwater, River Natural, Medium Seaport

2	Paradip Port Authority	289.75	135.33	46.7	Type of Port
3	Visakhapatnam Port Authority	134.18	73.75	55.0	Breakwater, Large seaport
4	Kamarajar Ports Limited	91.00	43.51	47.8	Seaport (Artificial)
5	Chennai Port Authority	135.00	48.95	36.3	Coastal Breakwater, Artificial, Large seaport
6	V.O.Chidambaranar Port Authority	111.46	38.04	34.1	Artificial, Medium deep seaport
7	Cochin Port Authority	78.60	35.26	44.9	Backwaters, seaport
8	New Mangalore Port Authority	108.96	41.42	38.0	Natural River, Medium Seaport
9	Mormugao Port Authority	63.40	17.33	27.3	Naturally protected open-type harbour
10	Mumbai Port Authority	84.00	63.61	75.7	Natural deep-water, Large Seaport

11	Jawaharlal Nehru Port Authority	141.37	83.86	59.3	Coastal Tide Gate, Larger Seaport
12	Deendayal Port Authority	267.10	137.56	51.5	Open Roadstead, Large Seaport
	Total	1597.59	784.27	49.1	

4.4 The Major Port Authorities Act, 2021

4.4.1 Objective

The Major Port Authorities Act, 2021 aims to modernize the governance of major ports in India by enhancing their autonomy and enabling faster decision-making. It focuses on improving the efficiency, transparency, and competitiveness of these ports, making them more attractive for investments and partnerships.

4.4.2 Applicability

The Act is applicable to major ports in India, including Chennai, Mumbai, Cochin, Deendayal (Kandla), Jawaharlal Nehru (Nhava Sheva), Kolkata, Mormugao, New Mangalore, Paradip, V.O. Chidambaranar (Tuticorin), and Visakhapatnam. It lays out the framework for managing and regulating these key ports.

4.4.3 Boards of Major Port Authorities

Each major port is administered by a Board of Major Port Authority, which is a statutory body appointed by the Central Government. The Board comprises a Chairperson, a Deputy Chairperson, and members from various sectors such as the concerned state government, the Ministry of Railways, the Ministry of Defence, and the Department of Customs. Additionally, it includes independent members and representatives of port employees.

This Board is vested with the power to manage the property, assets, and operations of the port, along with the authority to make contracts and manage the workforce.

4.4.4 Financial Powers

The Boards are empowered to raise loans, issue securities, and manage their financial resources, including capital reserves. They can also borrow funds from domestic and international sources, subject to government regulations. However, any loans exceeding 50% of the capital reserves require prior approval from the Central Government. The Boards are responsible for ensuring financial discipline while maintaining operational efficiency.

4.4.5 Asset Management

The Act grants the Boards control over port assets, allowing them to develop and manage these assets for the benefit of the port. The Boards can lease land and properties within the port premises for both port-related and non-port-related purposes, while also entering into Public-Private Partnership (PPP) agreements for the development of infrastructure. This flexibility in asset management is designed to enhance the commercial viability of the ports.

4.4.6 Adjudicatory Board

The Act establishes an Adjudicatory Board, which replaces the Tariff Authority for major ports. This Board is responsible for resolving disputes related to port operations, including those involving Public-Private Partnership projects. It also reviews the performance of stressed PPP projects and ensures that any grievances related to port services are addressed fairly and efficiently.

4.4.7 Tariff Setting

The Boards are given the authority to set tariffs for services provided at the port, including access and usage of port facilities. The Act ensures that these tariffs reflect market conditions, particularly in the context of Public-Private Partnerships. This flexibility in tariff-setting is intended to foster competitiveness and improve service quality at the ports.

4.4.8 Central government oversight

Although the Act grants significant autonomy to the Boards, the Central Government retains oversight authority. It can issue policy directives, conduct inspections, and even take over the management of a port in cases of mismanagement or failure by the Board. This ensures that while the ports operate independently, they remain aligned with national interests.

5. THE INDIAN PORTS ACT, 1908

5.1 Introduction:

The Indian Ports Act, 1908, is a legal framework governing the management, regulation, and operation of ports in India. Below is a summary of its key provisions:

5.1.1 Objective

The primary objective of the Act is to consolidate and regulate the laws related to ports and port charges, ensuring efficient management and smooth operation of Indian ports.

5.1.2 Powers of the government

The Central and State Governments have the authority to extend or withdraw the Act's applicability to specific ports and navigable channels, alter port limits, and establish rules for port management. These rules can govern port access, anchoring, navigation, and port safety regulations.

5.1.3 Port officials and their powers

The Act allows the appointment of port conservators, who are responsible for maintaining order in ports. Conservators are granted powers to manage obstructions, cut ropes in emergencies, and ensure compliance with port regulations. Additionally, they can remove wrecks that impede navigation and recover the cost of these operations from the ship's owner.

5.1.4 Port-dues, fees, and charges

Ports can levy port-dues, pilotage fees, and other charges for services like docking, pilot assistance, and vessel movement. The government has the authority to set these fees and can vary them based on the type and size of vessels. The Act also allows for the grouping of ports to ensure uniform fee structures across multiple ports.

5.1.5 Safety and conservation of ports

The Act includes provisions to safeguard shipping and maintain port infrastructure. It penalizes activities that could damage buoys, beacons, and moorings, and prohibits the discharge of ballast, oil, or other hazardous materials within port limits. Additionally, ships are required to maintain fire extinguishing apparatus for safety.

5.1.6 Penalties and offences

The Act outlines penalties for violations, such as disobeying port rules, causing obstructions, or failing to report a vessel's arrival. Fines vary depending on the severity of the violation, with provisions for more serious penalties like imprisonment for certain offenses, including unauthorized vessel movements.

5.1.7 Supplemental provisions

Supplementary clauses address the reporting of foreign deserters, the handling of port dues, and procedures for the recovery of unpaid dues. The Act also includes clauses for handling emergencies and maritime security. This comprehensive legal structure ensures that Indian ports operate under uniform rules, maintaining safety, efficiency, and government oversight.

5.2 Harit Sagar - Green Port Guidelines

The Harit Sagar - Green Port Guidelines outline a framework for developing eco-friendly, sustainable practices at India's major ports. Key provisions focus on reducing carbon emissions, promoting renewable energy, enhancing green infrastructure, and managing environmental impacts across port operations.

5.2.1 Vision and objective

The Guidelines aim to transform major Indian ports into green, sustainable hubs by reducing carbon intensity and promoting environmental stewardship through optimized port procedures and green technologies. These efforts align with India's "Panchamrit Commitments," aiming for net-zero emissions by 2070.

5.2.2 Principles of Green Port Operations

Sustainability in development and operations: Promotes environmentally compatible designs and low-carbon technologies to foster economic, environmental, and social sustainability.

Ecosystem dynamics: Ensures port operations respect local ecosystems, supporting biodiversity and minimizing environmental impact.

Green energy: Maximizes clean energy use, prepares for green fuels (e.g., green hydrogen), and follows "Eliminate, Reduce, and Control" (ERC) strategies to lower harmful emissions.

Waste management and impact monitoring: Encourages a zero-waste model through the 5R concept (Refuse, Reduce, Reuse, Repurpose, Recycle) and environmental impact assessments.

5.2.3 Applicability

Applicable to all major Indian ports, establishing comprehensive guidelines for environmental performance and monitoring.

5.3 Focus areas for implementation

5.3.1 Cover

Expands green belt coverage to over 20% by 2030 and 33% by 2047 to capture emissions, support biodiversity, retain soil moisture, and recharge groundwater.

5.3.2 Port Equipment

Targets over 50% electrification of port vehicles and equipment by 2030 and 90% by 2047, with new procurements focusing on electric or low-carbon alternatives.

5.3.3 Crafts

Retrofits port crafts with cleaner fuel technologies (e.g., green hydrogen, green ammonia). Green ammonia bunkering facilities are to be established by 2035.

5.3.4 Energy

Aims for renewable energy to comprise over 60% of port energy consumption by 2030 and 90% by 2047. EV charging and LNG bunkering infrastructure should be developed by 2025 and 2030, respectively.

5.3.5 Power Supply

Ports are to provide phased shore-to-ship power supply starting with port crafts by 2023, expanding to Coast Guard vessels by 2024, and EXIM vessels by 2025.

5.3.6 Utilization

Ports will focus on water conservation by reducing freshwater consumption by 20% per ton of cargo and implementing recycling initiatives. Installation of desalination and rainwater harvesting systems is encouraged.

5.3.7 Equipment

Prioritizes energy-efficient equipment (e.g., LED lighting, high-rated appliances) to reduce energy demand and mandates pollution checks for all port vehicles.

5.3.8 Promotion of Coastal Shipping

Coastal shipping is encouraged as a lower-emission alternative for cargo transport. Ports will create infrastructure and support mechanisms to facilitate this mode of transportation.

5.3.9 Discharge

Ports are to comply with international standards for effluent discharge (IMO MARPOL standards) and monitor discharges closely to minimize environmental contamination.

5.10 Ecosystem Conservation

Conservation initiatives, including mangrove protection, pollution response protocols, and ballast water management, aim to protect the local marine ecosystem.

5.3.10 Waste Management

Ports must provide reception facilities for ship waste disposal and adhere to Indian waste management regulations.

5.3.11 Environment Management

Each port should establish an Environment Cell for environmental compliance and annual environmental audits, which should be published on the port's website.

5.3.12 Credits

Ports are encouraged to reduce greenhouse gas emissions to earn carbon credits.

5.3.13 Measures

Incentives for green practices include discounts and priority for green ships and facilities using clean fuel or electric power, rewarding operators and truckers adhering to green standards.

5.4 Monitoring and Reporting (Environment Performance Indicators - EPIs)

The guidelines provide specific Environment Performance Indicators (EPIs) for air, water, waste, and noise pollution to measure and monitor environmental impact. Ports are required to submit reports and maintain real-time monitoring systems integrated with the MoPSW server.

5.4.1 Implementation and Compliance

Ports must establish an action plan with clear targets for environmental impact and real-time monitoring within defined timeframes (e.g., air quality monitoring by 6-18 months, depending on port type).

5.4.2 Interpretation, Relaxation, and Review

MoPSW reserves the right to interpret and, if needed, relax provisions of the guidelines in the public interest. The guidelines may be reviewed periodically to address emerging environmental concerns.

5.4.3 Global Reporting Initiative (GRI)

Ports are encouraged to adopt the Global Reporting Initiative, a global standard for environmental impact reporting, to maintain transparency and demonstrate accountability in sustainable practices.

6. COMMUNITY SCENARIO AND LEGAL CLEARANCES

At present India has about 4 ports being built across its geography (Colachel Commercial Port, International Container Transhipment Terminal (ICTT) project, Kattupalli Port, Vadhavan Port Project). All ports are at the time facing resistance from local communities.

In addition to this we have the Sagarmala programme worth eight lakh crore, a Union Ministry of Shipping project. Under the port modernisation plan, new port development and port-linked industrialisation would be undertaken from 2015 to 2035. Six ports were planned as part of the programme in Sagar Island, West Bengal; in Paradip Outer Harbour, Odisha; in Sirkazhi and Enayam, Tamil Nadu; in Belikeri, Karnataka and in Vadhavan, Maharashtra.

The Union government identified 12 locations in total, Karwar, Belekeri, Tadadi, Pavinakurve, Honnavar, Manki, Bhatkal (Uttara Kannada district), Kundapur, Hangarkatta, Malpe (Udupi district), Padubidri and Old Mangalore port (in Dakshina Kannada district) either to set up new minor ports or renovate existing ports under government ownership, private-public partnership, or private ownership.

6.1 Common impacts of port infrastructure on community:

On analysing the nature of the resistance movements against the aforementioned ports, some common themes were arrived at:

6.1.1 Environmental and ecological impact

Concerns about damage to marine ecosystems, increased turbidity, introduction of alien/invasive species and reduced fish abundance highlight how development projects (e.g., ports) disrupt the natural environment. This ecological damage directly affects the livelihoods of coastal communities who rely on the health of these ecosystems for their income (fishing, coastal activities).

6.1.2 Loss of livelihoods

When the environment is compromised, local communities, particularly fishermen, lose access to their primary source of income. Additionally, port infrastructure requires large swathes of coastal land, which result in enclosure and loss of access to beach spaces to operate fishing crafts.

Such concerns are exacerbated for non-mechanized and small-scale fishers, making them more vulnerable. Especially, artisanal/small-scale fishing communities lack the resources to adapt or mitigate the impact of environmental changes, unlike larger or mechanised fishing operations.

6.1.3 Inequality and Vulnerability

The development projects disproportionately impact marginalised groups such as non-mechanized boat users and women hand-pickers. These groups are more vulnerable not only because of their direct reliance on natural resources but also due to socio-economic disadvantages that limit their ability to recover from losses. This inequality are acute among the marginalised groups as these communities often receive inadequate or unfair compensation, worsening their vulnerability.

6.1.4 Concerns about Compensation

Marginalised communities (e.g., small-scale fishers) often report that the compensation they receive does not adequately reflect their losses, particularly as their livelihoods are tied to ecosystems that take much longer to recover or may never recover from damage.

7. CASE STUDY OF VIZHINJAM PORT

The Vizhinjam International Deepwater Multipurpose Seaport is a project taken up by the Government of Kerala, (GoK). It is designed primarily to cater to container trans-shipment besides multi-purpose and break-bulk cargo.

The port is developed in a Public-Private Partnership (PPP) component on a design, build, and finance, operate and transfer ("DBFOT") basis. The construction at this port commenced on 5th December 2015 and is expected to complete construction around the September of 2024.

Vizhinjam International Seaport Ltd (VISL) - a company fully owned by GoK is the implementing agency for the project, will be representing GoK in respect of the project. The proposed project is being developed in accordance with the terms and conditions set forth in the concession agreement signed between AVPPL and GoK/VISL.

The investment for land, external infrastructure (rail, water and power) and breakwater will be borne by the land owners (VISL/GoK). The investments for other port infrastructure (dredging & reclamation, berths, terminals, superstructure & equipment) will be shared on PPP basis availing Viability Gap Funding (VGF). The PPP concessionaire, AVPPL has been given the right to operate the port for a specified concession period of 40 years.

The project obtained Environmental & CRZ Clearance ("EC") from the Ministry of Environment & Forests (MoEF), Government of India (GoI) on 3rd January 2014, wherein it has been specified to carry out intense monitoring and regulatory reporting of the shoreline changes in the project area.

Accordingly, VISL has entered into a memorandum of understanding (MoU) with the National Institute of Ocean Technology (NIOT), Chennai, under the Ministry of Earth Sciences (MoES), for a long-term shoreline monitoring programme including the seasonal bathymetry mapping.

7.1 Resistance

Actions by fishing communities against the Vizhinjam port project on the coast of Kerala have continued for years. Since construction began in 2015 on Vizhinjam International Seaport expansion, coastal residents have faced major problems. On the northern side of the project, more and more houses are being destroyed by the sea each year. Several scientists say that the port's breakwater construction and sea dredging are causing this erosion of the coast. Several families are living as climate refugees in the fishing villages of Panathura, Poonthura, Bimapalli and Veli (Tandon, 2018). The old fishing harbour at Vizhinjam, which was thought to be very safe, now suffers deadly boat capsizes that many say are the result of waves ricocheting off the port's huge new breakwater.

The continuous dredging activities in Vizhinjam region has led to environmental problems and the rocky reefs which are a habitat for marine organisms have been covered with sand and are completely desgraded. This has also led to the loss of livelihood of the fishermen community, especially traditional mussel collectors. Several studies carried out by volunteers of the city-based Friends of Marine Life (FML) led by their chief coordinator have found that several of the rocky reefs have already been destroyed due to the dredging activities and other remaining ones are on the verge of destruction (Steni Simon, 2021).

A a marine biologist who works closely with the fishermen community, said the traditional fishermen have tabulated that a few types of fishes such as Chennavara (Red mullets), Numb fish and Torpedo Ray found in the rocky reefs of the coastal regions of the district have completely disappeared.

Dredging is the process of removing accumulated sediment from the banks or bottom of bodies of water. A dredge is a specialised piece of equipment that creates a vacuum to suck up and pump out the unwanted sediment and debris. Like trawling, it is a noisy activity and increases the turbidity of water. Pollution from the noise and turbidity rise decreases water quality, and the dredging itself destroys the reefs, thus destroying an entire ecosystem where fish thrive and breed.

The ongoing construction of breakwaters has altered the direction of sea currents, causing coastal erosion across the entire coast of the project area. The city of Thiruvananthapuram has lost its famed Shanghumukham beach entirely to sea erosion over the last few years.

In fishing villages including Valiyathura and Muttathara, around 600 people have already been shifted to relief camps after their houses were lost to sea erosion, reported Mongabay-India. They are demanding a fair compensation package, as they continue to live in relief camps. Fisherfolk are also losing access to beaches, and their livelihoods are at risk from all the aforementioned developments.

The Kerala government has till 10 July 2024 distributed a total compensation of ₹106.93 crore to 2,697 fish workers who lost their livelihood due to the construction of the Vizhinjam international seaport terminal, Fisheries Minister told the Kerala Assembly on July 10.

The compensations were awarded based on reports prepared by the Livelihood Impact Appraisal Committee (The Hindu Bureau, 2024). The mitigation measures taken up during the construction of the Vizhinjam International Seaport are listed under Table 8.

7.2 The EIA by L&T-Ramboll Consulting Engineers Limited in 2013 validates concerns

- The area will be developed in a more industrial manner, disturbing and dispersing the soil, increasing vulnerability to contamination from spills, leakages, and improper construction, which may hinder proper water runoff, causing flooding or unsafe conditions. The region is flood-prone during monsoon seasons.
- The proposed construction could exacerbate the region's existing water shortages if not properly managed. Additionally, port construction might block natural water outlets, causing flooding, altering drainage patterns, and increasing water contamination from sewage discharge.
- The sea sediments risk contamination from spills, oil, chemicals, wastewater overflows, and waste from ships. These pollutants will also degrade the water quality, harming the marine environment near the breakwater.
- There is concern about the breakwater's effectiveness, as it claims to reduce wave power in the fishing harbour, but sources suggest it may worsen sea conditions, leading to multiple fatalities due to harsher seas.
- Dust from traffic on unpaved roads, emissions from construction vehicles, and pollution from machinery engines will significantly degrade air quality. Noise and vibrations from construction equipment and ships will disrupt nearby communities, local wildlife, and marine mammals.
- The closest settlements, including Vizhinjam fishing village, Mulloor, Pulinkudi, and nearby resorts, are expected to be most affected by these disturbances. Additionally, poor project management could worsen environmental impacts, leading to cost and time overruns, and increased emissions.
- Waste generation is a major concern, including construction materials, oils, chemicals, and human waste. The lack of a sanitary landfill adhering to international standards raises additional red flags for waste management.
- Noise, light pollution, and increased traffic from the project will disturb local fauna more than expected, with substantial evidence challenging claims of minimal impact. Similarly, the marine ecology will be affected by dredging activities that increase turbidity, reducing oxygen levels and endangering marine species.

- Fishing activities will be restricted up to 1500 metres from the shore, reducing fish availability and affecting local livelihoods. Additionally, Mulloor beach, where the Hindu ritual Vavu Bali is annually performed, will be converted into portland, impacting cultural heritage.
- The health and safety of nearby communities are at risk due to potential land instability, water contamination, and increased exposure to hazardous conditions like traffic accidents and unplanned spills of chemicals or oil.

7.3 Legalities involved in Port construction:

In terms of the 14th September 2006 notification of the MoEF, ports and harbour projects are divided into two categories:

Category A: Projects that have greater than or equal to 5 million TPA (Tons Per Annum) cargo handling capacity (excluding fishing harbours). The authorities responsible for approval or rejection of environmental clearance are the Ministry of Environment, Forest and Climate Change of India, and the Government of India based on the recommendations of an Expert Appraisal Committee (EAC).

Category B: Projects that have less than 5 million TPA of cargo handling capacity, and greater than or equal to 10,000 TPA for fish handling. The responsible for approval is the State Impact Assessment Authority based on the recommendations of the State Expert Appraisal Committee (SEAC).
The notification also presented General Conditions for classification of ports:

Any project or activity specified in Category 'B' will be treated as Category 'A' if located in whole or in part within 10 km from the boundary of:

1. Protected areas notified under the Wildlife (Protection) Act, 1972.
2. Critically polluted areas as identified by the Central Pollution Control Board from time to time.
3. Eco-sensitive areas as notified under section 3 of the Environment (Protection) Act, 1986, such as, Mahabaleshwar, Panchgani, Matheran, Pachmarhi, Dahanu, Doon Valley.
4. Inter-state boundaries and international boundaries.

The requirement regarding distance of 10km of the inter-state boundaries can be reduced or completely done away with by an agreement between the respective states or U.Ts sharing the common boundary in the case the activity does not fall within 10 kilometres of the areas mentioned at item (i), (ii) and (iii) above.

The notification applies to capital dredging - dredging which is carried out in a new location and in material that has never been dredged before. Maintenance dredging which is recurrent dredging to maintain or improve existing waterways is exempt.

The environmental clearance process for new projects will comprise a maximum of four stages:

7.3.1 Screening:

In case of Category 'B' projects or activities, this stage will entail the scrutiny of an application seeking prior environmental clearance made in Form 1 by the concerned SEAC for determining whether or not the project or activity requires further environmental studies for preparation of an Environmental Impact Assessment (EIA) for its appraisal prior to the grant of environmental clearance depending upon the nature and location specificity of the project.

The projects requiring an EIA report shall be termed Category B1 and remaining projects shall be termed Category B2 and will not require an EIA.

7.3.2 Scoping:

'Scoping' refers to the process by which the EAC in the case of Category A projects or activities, and SEAC in the case of Category B1 projects or activities, including applications for expansion and/or modernization and/or change in product mix of existing projects or activities, determine detailed and comprehensive TOR addressing all relevant environmental concerns and CRZ issues for the preparation of an EIA report in respect of the project or activity for which prior environmental clearance is sought.

The EAC or SEAC concerned shall determine the TOR on the basis of information furnished in the prescribed application Form 1 including TOR proposed by the applicant, a site visit by a sub-group of EAC or SEAC concerned, if considered necessary by the EAC or SEAC and other information that maybe available with the EAC or SEAC. The CRZ maps indicating the High Tide Line (HTL), Low Tide Line (LTL), demarcated by one of the authorised agencies and the project layout superimposed on the map shall be submitted on a 1:5000 scale map.

7.3.3 Public consultation:

"Public consultation" refers to the process by which the concerns of local affected persons and others who have plausible stake in the environmental impact of the project or activity are ascertained with a view to taking into account all the material concerns in the project or activity design as appropriate. All Category 'A' and Category 'B1' projects or activities shall undertake public consultation, except the projects or activities concerning national defence and security or involving other strategic considerations as determined by the central government and all B2 Projects and activities.

After completion of the public consultation, the applicant shall address all the material environmental concerns expressed during this process, and make appropriate changes in the draft EIA and EMP. The final EIA report, so prepared, shall be submitted by the applicant to the concerned regulatory authority for appraisal.

The applicant may alternatively submit a supplementary report of draft EIA and EMP addressing all the concerns expressed during the public consultation.

All category A and category B1 projects of ports and harbours shall undertake public consultation except "all projects or activities concerning national defence and security or involving other strategic considerations as determined by the Central Government".

7.3.4 Appraisal:

Detailed scrutiny by the EAC or SEAC of the application and other documents like the final EIA report, outcome of the public consultations including public hearing proceedings, submitted by the applicant to the regulatory authority concerned for grant of EC.

In addition to the above, in respect of category A projects, it shall be mandatory for the project proponent to make public the environmental clearance granted for their project along with the environmental conditions and safeguards at their cost by prominently advertising it at least in two local newspapers of the district or state where the project is located and in addition, this shall also be displayed in the project proponent's website permanently.

In respect of category B projects, irrespective of its clearance by MoEF/SEIAA, the project proponent shall prominently advertise in the newspapers indicating that the project has been accorded environmental clearance and the details of MoEF website where it is displayed.

The project management shall submit half-yearly compliance reports in respect of the stipulated prior environmental clearance terms and conditions on 1st June and 1st December of each calendar year to the regulatory authority concerned.

All such reports shall be public documents. The latest such compliance report shall also be displayed on the website of the concerned regulatory.

7.3.5 General Guidelines on CRZ and EC requirements for typical marine terminals:

Table 7: General Guidelines on CRZ and EC requirements for typical marine terminals subject to the requirements as stipulated in the EIA Notification and CRZ Notification

Type of marine terminal/facility	EC requirement	CRZ requirement
Bulk cargo, container cargo, multi commodity terminals/facilities	Required	Required
Roll on - roll off terminals	Not required	Required
Cruise terminals	Not required	Required
Virtual ports	Required	Not required
SBMs	Required	Pipelines
Break waters and dredging	Required	Required

7.3.6 Applicable legislation for port construction:

- Environment (Protection) Act, 1986: The Environment Protection Act 1986 Amendment 1991 introduced stricter regulations and increased penalties for environmental violations. It enhanced the enforcement capabilities of regulatory authorities, emphasising pollution control and the management of hazardous substances.
- Environmental Impact Assessment Notification, 2006: The EIA Notification of 2006 is a set of guidelines for assessing the environmental impact of a proposed project or development.
- Coastal Regulation Zone Notification: Since ports and harbours are generally located at the intersection of land and sea, they naturally come under the purview of Coastal Regulation Zone Notification 1991 and its amendments thereon.
- Air (prevention and control of pollution) Rules, 1982: An Act to provide for the prevention, control and abatement of air pollution, for the establishment, with a view to carrying out the aforesaid purposes, of Boards, for conferring on and assigning to such Boards powers and functions relating thereto and for matters connected therewith.
- Noise Pollution (Regulation and Control) Rules, 2000: The Noise Pollution (Regulation and Control) Rules of 2000 in India regulate noise pollution from various sources, including construction, vehicles, and firecrackers. The rules aim to create a healthy living environment by limiting noise pollution and setting ambient noise standards for different areas.

- Water (Prevention and Control of Pollution) Rules, 1975: The Water (Prevention and Control of Pollution) Rules, 1975 are a set of rules that were enacted by the Central Government to prevent and control water pollution. The rules were created in accordance with the powers given by the Water (Prevention and Control of Pollution) Act, 1974.

- Hazardous and other wastes (Management and Transboundary Movement) Rules, 2016: Hazardous Waste Management Rules are notified to ensure safe handling, generation, processing, treatment, package, storage, transportation, use reprocessing, collection, conversion, and offering for sale, destruction and disposal of Hazardous Waste. These Rules came into effect in the year 1989 and have been amended later in the years 2000, 2003 and with final notification of the Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008 in supersession of former notification. The rules lay down corresponding duties of various authorities such as MoEF, CPCB, State/UT Govts., SPCBs/PCCs, DGFT, Port Authority and Custom Authority while State Pollution Control Boards/ Pollution Control Committees have been designated with wider responsibilities touching across almost every aspect of hazardous wastes generation, handing and their disposal.

- Solid Waste Management Rules, 2016: The SWM Rules2016 provide fordetailed criteria forsetting-up solid wasteprocessing and treatmentfacility, solid wastemanagement in hillyareas, for wasteto energy process,for sanitary landfills, for siteselection, development offacilities at thesanitary landfills, specifications for landfilling operations andclosure on completionof landfilling, pollutionprevention, closure and rehabilitation of old dumps.

- E-Waste (Management) Rules, 2022: These rules intend to manage e-waste in an environmentally sound manner and put in place an improved Extended Producer Responsibility (EPR) regime for e-waste recycling wherein all the manufacturer, producer, refurbisher and recycler are required to register on portal developed by CPCB. The new provisions would facilitate and channelize the informal sector to the formal sector for doing business and ensure recycling of E-waste in an environmentally sound manner. Provisions for environmental compensation and verification & audit have also been introduced. These rules also promote circular economy through EPR regime and scientific recycling/disposal of the e-waste.

- The Public Liability Insurance Act, 1991: An Act to provide for public liability insurance for the purpose of providing immediate relief to the persons affected in terms of responsibility and finances.

- Biological Diversity Act, 2002: Aimed at conservation of biological resources and associated knowledge as well as facilitating access to them in a sustainable manner and through a just process.

- Ancient Monuments and Archaeological site & Remains Act, 1958: Act to provide conservation of cultural and historical remains found in India.

- Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013: The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (RFCTLARR) Act, 2013 is a law in India that aims to ensure a fair and transparent process for acquiring land for development.

- Status of EC and compliance for the terms & conditions for the existing project.
- Validity of the air and water consent orders, and Hazardous Waste Authorization (HWA) from SPCB/ PCC for existing project.
- Compliance status to the standards and specific conditions issued by SPCB/PCC.
- Notices/directions issued by the regulatory agencies under section 33(A) of the Water Act, 1974 as amended, under section 31(A) of the Air Act 1981 as amended and directions issued under the provisions of the E (P) Act, 1986 during the last one year.
- Compliance status for the directions / enactments which are binding on activity of the project as per the notifications issued by regulatory authorities from time to time.
- Whether the proposal involves approval/clearance under the following acts should be specifically stated: The Forest (Conservation) Act, 1980 /The Wildlife (Protection) Act, 1972 / The CRZ Notification, 1991.

8. MITIGATION PRACTICES (VIZHINJAM PORT)

Table 8: Conflict mitigation practices adopted during Vizhinjam port construction

Note. All information provided above have been sourced from the Half Yearly Compliance Report (HYCR) for the Period October 2022 to March 2023, 2023 produced by Vizhinjam International Seaport Limited (VISL)

Category	Purpose	Methods/Components
Environmental Impact Assessments (EIA)	Predict and mitigate environmental impacts of projects	• Baseline Studies: Data collection on air/water quality, biodiversity, socio-economics. Impact prediction: Models and simulations. • Mitigation strategies: Habitat disruption and pollution reduction. Public Consultation: Engage stakeholders and address concerns.

Habitat restoration	Compensate for habitat loss	• Creating new habitats: Artificial reefs, wetlands. Restoring Degraded Areas: Rehabilitation. • Enhancing existing habitats: Native vegetation and invasive species control. • Monitoring and maintenance: Ongoing checks.
Pollution control	Minimize air, water, and noise pollution	• Air quality: Low-emission equipment, dust control. • Water quality: Silt curtains, wastewater treatment. • Noise pollution: Barriers, scheduling, quiet equipment.
Waste management	Reduce the environmental footprint of waste	• Recycling Programs: Reuse materials. • Hazardous waste disposal: Safe handling. • Waste minimization: Use prefabricated materials.
Energy efficiency	Reduce greenhouse emissions and costs	• Energy-efficient machinery • Optimized transportation • Renewable energy integration
Water conservation	Conserve local water resources	• Rainwater harvesting • Water-efficient equipment • Recycling Water
Construction Environmental Management Plan (CEMP)	Ensure implementation of mitigation strategies.	• Policies, mitigation actions • Monitoring/reporting • Emergency response planning

Stakeholder engagement	Address stakeholder concerns	• Public meetings • Regulatory consultation • Continuous communication
Technological upgrades	Enhance sustainability	• Advanced construction methods • Electric port equipment • Smart monitoring technologies.
Life cycle risk management	Manage risks across project lifecycle	• Risk identification and mitigation • Continuous monitoring
Land reclamation	Create land while reducing environmental impact	• Bunds and settling ponds • Controlled channels • Water quality monitoring
Soil contamination	Minimize soil risks	• Good practices • Temporary storage • Authorized disposal (e.g., 2016 Hazardous Waste Rules).
Water contamination	Protect groundwater and marine ecosystems	• Avoid groundwater withdrawal • Sustainable sources (treated wastewater, desalination) • MARPOL 73/78 compliance • Surface and seawater quality monitoring.
Environmental Impact Assessment	Optimize environmental planning	• Baseline studies and stakeholder engagement • Micro-siting: Turbine placement optimization
Habitat restoration	Support biodiversity recovery	• Artificial habitats (reefs, wetlands) • On/Off-Site conservation • Nature-inclusive design (biogenic reefs)

Pollution control	Manage air, water, and noise pollution	• Air/water: Silt curtains, eco-friendly materials. • Noise: Bubble curtains, quieter piling methods.
Waste management	Optimize construction waste use	• Recycling: Proper hazardous disposal • Material efficiency
Timing sensitivity	Plan activities to avoid ecological disruption.	• Seasonal scheduling • Curtailment for peak migration and weather
Light/turbine design	Reduce bird and bat collisions	• UV Paint, rotor adjustments • Eco-friendly lighting
Cable/seabed management	Protect seabeds and reduce habitat alteration	• Horizontal drilling, native material refill • Shield/bury cables
Operational monitoring	Track impacts continuously	• Real-time adjustments • Radar/camera shutdowns
Decommissioning	Mitigate post-project environmental risks	• Partial decommissioning • Noise abatement: Habitat restoration
Research/development	Close knowledge gaps and innovate	• Study EMF effects • Explore emerging solutions
Stakeholder involvement	Collaborate across sectors	• Multi-sector engagement • Policy advocacy

9. RECENT TRENDS IN THE FISHING INDUSTRY

The fishing industry in Tamil Nadu has seen significant shifts due to environmental, economic, and regulatory pressures. Marine fish production has fluctuated over recent decades, with a plateau in production, despite increasing fishing capacity, due to the decline in some species like oil sardines and external disruptions like the 2004 tsunami.

Mechanized boats and traditional crafts collectively exploit marine resources along Tamil Nadu's extensive coastline, and fishing villages, such as Ramanathapuram, Nagapattinam, and Thoothukudi, have emerged as major hubs.

To address these issues, sustainable fishing practices have been encouraged. This includes efforts by state fisheries departments to predict trends using models like ARIMA for planning and resource allocation, indicating moderate future increases in marine production.

Additionally, artificial reefs have been installed to foster breeding grounds for commercially valuable fish species, aiming to balance ecological sustainability with production needs.

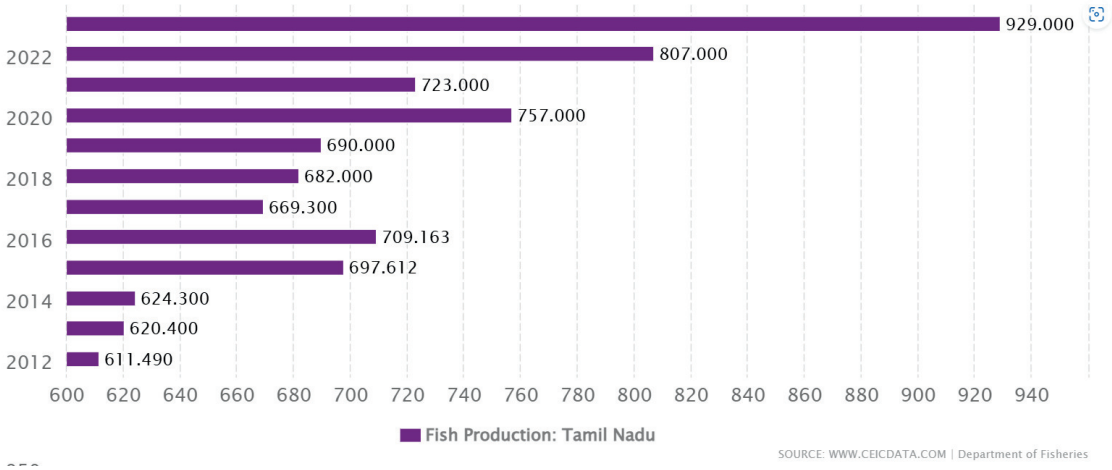

Figure 7: Fish Production: Tamil Nadu. (Source: CEIC and Department of Fisheries)

Table 9: Fishing Craft from the Marine Fisheries Census 2016 (Department of Fisheries et al., 2020)

District	Mechanized						Motorized			Non-Motorized	Total
	Trawlers	Gillnetters	Liners	Ring seiners	Others	Total Mechanized	Inboard	Outboard	Total Motorized		
Thiruvallur	0	0	0	0	0	0	0	1,590	1,590	257	1,847
Chennai	567	243	16	0	0	826	0	2,088	2,088	475	3,389
Kancheepuram	0	0	0	0	0	0	0	1,795	1,795	1,157	2,952
Viluppuram	21	0	0	4	7	32	1,400	0	1,400	1,086	2,518
Cuddalore	287	0	0	134	0	421	6	2,036	2,042	2,116	4,579
Nagapattinam	730	0	0	81	0	811	0	4,225	4,225	0	5,036
Thiruvarur	0	0	0	0	0	0	0	137	137	0	137
Thanjavur	256	0	0	0	0	256	0	1,289	1,289	0	1,545
Pudukkottai	412	0	0	0	0	412	379	874	1,253	0	1,665
Ramanathapuram	1,948	0	0	0	0	1,948	4,079	594	4,673	420	7,041
Tuticorin	239	147	0	0	0	386	2,365	2,211	4,576	1	4,963
Tirunelveli	0	0	0	0	0	0	0	1,022	1,022	6	1,028
Kanyakumari	818	51	0	0	0	869	716	4,473	5,189	597	6,655
TOTAL	**5,278**	**441**	**16**	**219**	7	**5,961**	**8,945**	**22,334**	**31,279**	**6,115**	**43,355**

9.1 Deep-sea fishing overview:

Surveys conducted by Central Marine Fisheries Research Institute (CMFRI), CIFNET, the Indo-Norwegian project, the Fishery Survey of India, and the Department of Ocean Development revealed the potential abundance of deep-sea resources within a depth range of 200–450 meters along the south-west and south-east coasts of India.

As catches from inshore waters stagnated over two decades, a shift toward the exploitation of untapped deep-sea resources became necessary.

This shift was achieved through the deployment of larger vessels or modified medium to small-sized mechanized vessels. The findings included newly discovered prawn and lobster fishing grounds near Thoothukudi and Mangalore at depths ranging from 250 to 500 meters.

By February 2003, a fleet of mechanized vessels began operating along Tamil Nadu and Pondicherry, successfully exploiting these resources.

9.1.1 Specifications of deep-sea trawlers

The vessels deployed for deep-sea fishing along Tamil Nadu were medium-sized trawlers specifically modified for this purpose. These trawlers were well-equipped with advanced features, enabling them to operate in challenging deep-sea environments.

Attribute	Details
Type of Vessel	Deep-sea trawler
Dimensions (L x B x D)	14.5-16.5m x 4-5 m x 2.5 m
Material	Agini and teak wood, known for durability and resistance to marine conditions.
Cost	₹10 lakhs per vessel.
Engine	Ashok Leyland engine with 100–120 BHP, providing adequate power for deep-sea operations.
Speed	Operating speed ranged from 6–9 knots/hour.
Capacities	Fuel 2000-3000 L), ice storage (8–10 tons), and provisions for 10-day trips.
Winch	Mechanical winch fitted with galvanized iron (GI) wire ropes.
Net	Trawl net with a head rope of 600–750 meters, designed for deep-sea fishing.
Crew	Each vessel was manned by 8 crew members with specialized training for deep-sea operations.

The design and configuration of these trawlers allowed them to endure the rigors of deep-sea fishing while ensuring efficiency in catch and storage.

9.1.2 Fishing areas and duration

Fishing operations were concentrated along specific coordinates off the Tamil Nadu and Pondicherry coasts. These areas were carefully selected based on the depth ranges known to be rich in marine resources.

Area	Coordinates	Depth	Duration
Chennai	Lat. 13°06'N, Long. 80°48'E	200–450 m	10 days
Pondicherry	Lat. 11°54'N, Long.80°05'E	200–450 m	10 days
Nagapattinam	Lat. 10°30'N, Long. 80°26'E	200–450 m	10 days

The fishing trips typically lasted 10 days, enabling the vessels to maximize their catch within the specified depth ranges and geographical areas.

9.1.3 Catch composition

The total catch from February to April 2003 was 3,800 tons, with the highest volume recorded in March. The catch composition varied across months and included prawns, lobsters, crabs, fishes, and miscellaneous items.

Category	February	March	April	Total Catch (kg)
Prawns	734,700	994,073	12,515	1,741,288
Lobsters	319,687	577,109	26,587	923,383
Crabs	47,142	261,568	22,500	331,210
Fishes	108,345	539,761	44,812	692,918
Miscellaneous	18,776	94,039	4,860	117,675

Prawns constituted the largest share of the catch (37.08%), followed by lobsters (24.36%) and fishes (23.6%). Crabs and miscellaneous items accounted for smaller proportions, at 11.53% and 3.72%, respectively. March saw the highest catches across all categories, while April recorded a decline.

9.2 The Shift toward deep-sea fishing

The shift toward deep-sea fishing is primarily driven by the depletion of inshore resources and the availability of fish in Tamil Nadu's Exclusive Economic Zone (EEZ). Deep-sea fishing targets species such as tuna and sharks, which require advanced methods and specialized equipment, diverging from traditional practices.

Mechanized and semi-mechanized vessels are increasingly employed for deep-sea trawling and longline fishing, with specific fish landing centers like Thoothukudi supporting these activities.

This shift has also led to intensified regulatory oversight. Policies mandate that mechanized fishing is restricted beyond three nautical miles to protect the interests of small-scale fishers, as inshore resources face overexploitation risks.

The current status of deep-sea fishing in India reflects a significant transition, with many fishing trawlers being converted to longline vessels, supported by funding from the Marine Products Export Development Authority (MPEDA) (John et al., n.d.).

These vessels, typically measuring 20 metres in overall length, are brought into operation through Letters of Permission (LOPs) issued by the Department of Animal Husbandry, Dairying, and Fisheries (DAHD&F) under the Ministry of Agriculture.

In Kanyakumari, the Association of Deep Sea Going Artisanal Fishermen (ADSGAF) plays a crucial role in promoting these practices. Additionally, deep-sea vessels are actively operating from Visakhapatnam in Andhra Pradesh, contributing to the expansion of sustainable fishing efforts in the region.

The focus on deep-sea fishing in India is underscored by the National Marine Fisheries Policy, 2020, and the Tamil Nadu Marine Fishing Policy, 2020, both of which actively promote deep-sea fishing as a means to enhance the sustainability and economic viability of the fisheries sector. By shifting some fishing efforts to deeper waters, the pressure on near-shore ecosystems can be alleviated, allowing for the recovery of overfished stocks and promoting healthier marine environments.

Deep-sea fishing primarily targets larger oceanic species such as tuna, including yellowfin and skipjack, through sustainable methods like longline fishing. This approach not only supports the promotion of sustainable fisheries but also aligns with broader goals of responsible marine resource management.

As technology advances, the fishing sector is witnessing improved methods for locating and harvesting deep-sea species, thus enhancing fishing efficiency while minimising ecological impacts. Furthermore, the emphasis on deep-sea fishing contributes significantly to economic development and community by strengthening value chains and creating new market opportunities (James, 2014).

9.3 Legislations around fishing in Tamil Nadu

9.3.1 Tamil Nadu Marine Fishing Regulation Act, 1983

The Tamil Nadu Marine Fishing Regulation Act, 1983, was enacted to regulate, restrict, and prohibit certain fishing activities along the state's coastline. Its key provisions include the registration and licensing of fishing vessels, with distinctions between mechanised and traditional vessels. The act establishes designated fishing zones, prohibiting mechanised and deep-sea vessels from operating within three nautical miles of the coastline to protect traditional fishermen and preserve marine resources.

It empowers the state government to issue notifications for regulating fishing gear, seasons, and specific species. The act also provides for penalties, including fines and vessel confiscation, for violations. Adjudicating and appellate authorities are designated to oversee enforcement, and the act overrides conflicting laws, ensuring comprehensive management of fishing activities.

9.3.2 The Tamil Nadu Marine Fishing Regulation Rules, 1983

The Tamil Nadu Marine Fishing Regulation Rules, 1983, were established under the Tamil Nadu Marine Fishing Regulation Act, 1983, to regulate marine fishing activities in the state. These rules focus on aspects like the registration and licensing of fishing vessels, the implementation of seasonal fishing bans to protect breeding periods, and the prohibition of harmful fishing practices such as bottom trawling within a three-nautical-mile limit.

Additionally, they ensure that mechanised fishing vessels are equipped with safety and communication gear and mandate insurance coverage for both the vessel and crew members. Enforcement mechanisms include penalties for violations, inspections, and a dispute resolution system. Provisions are made to protect traditional fishing rights and maintain harmony between different fishing communities.

9.3.3 Indian Fisheries Act, 1897

The Indian Fisheries Act, 1897, was enacted to regulate fishing activities and protect fisheries. It defines key terms like "fish," "fixed engine" (used for trapping fish), and "private waters" (exclusive fishing rights). The Act prohibits harmful practices such as the use of explosives and poisons to catch fish in both inland waters and coastal areas. Violators face penalties, including imprisonment and fines.

The Act empowers state governments to create rules for protecting fish in designated waters, which may include restricting the use of fishing gear and banning fishing for up to two years. It also allows police officers or authorised persons to arrest violators without a warrant under certain conditions.

9.3.4 Coastal Aquaculture Authority Act, 2005

The Coastal Aquaculture Authority Act, 2005, aims to establish the Coastal Aquaculture Authority to regulate aquaculture activities in coastal areas, ensuring environmentally responsible practices. Key provisions include the definition of "coastal aquaculture" as culturing aquatic life in brackish or saline water under controlled conditions, excluding freshwater aquaculture.

The Act empowers the central government to issue guidelines to safeguard the coastal environment and mandates the registration of aquaculture farms with the Authority. The Authority can inspect farms, enforce regulations, and order the removal of farms causing pollution. Additionally, the Act outlines the composition, powers, and functions of the Authority, including penalties for violations and provisions for the protection of employees acting in good faith.

9.3.5 Tamil Nadu Marine Fishing Policy, 2020

The Fisheries Policy Note 2020-2021 details the Tamil Nadu government's key provisions for enhancing the fisheries sector and safeguarding the welfare of fishermen.

It focuses on sustainable fish production through advanced technologies, infrastructure development for fishing harbors, fish landing centers, seed production, and fish farming. The policy includes provisions for deep-sea fishing, promoting brackish water aquaculture, and introducing cage culture to boost fish production.

To support fishermen’s welfare, the government provides financial assistance during fishing bans, lean seasons, and offers subsidies for high-speed diesel and fishing craft motorization. It emphasizes marine conservation through fishing regulation, seasonal bans, and artificial reef installation.

Additionally, the policy aims to empower fisherwomen through livelihood programs like seaweed culture and provides disaster relief mechanisms, ensuring the safety and security of fishers during calamities. All these efforts align with the Sustainable Development Goals.

9.3.6 Wildlife Protection Act, 1972

The Wildlife Protection Act, 1972, aims to conserve and protect wildlife, including animals, birds, and plants, while ensuring ecological security in India. It establishes authorities like the National and State Boards for Wildlife, regulates the hunting of animals, and prohibits trade in wildlife species.

The Act sets provisions for the creation and management of protected areas, such as sanctuaries and national parks, and safeguards specified plants.

It also addresses wildlife crime through a dedicated bureau and imposes penalties for violations. Key amendments have strengthened its scope, including regulating international trade of endangered species and addressing invasive alien species.

9.3.7 The Pradhan Mantri Matsya Sampada Yojana (PMMSY)

The Pradhan Mantri Matsya Sampada Yojana (PMMSY) is a flagship initiative by the Indian government aimed at promoting sustainable and responsible development within the fisheries sector.

Launched with a total investment of ₹20,050 crore over a five-year period (from FY 2020-21 to FY 2024-25), PMMSY is designed to enhance fish production, modernise value chains, and ensure the welfare of fishers and fish farmers.

The scheme's overarching goal is to achieve a Blue Revolution in India, leading to ecological health, economic viability, and social inclusiveness within the fishing industry.

Introduced in September 2020, PMMSY aims to significantly boost fish production to 22 million metric tons by 2024-25 to meet the growing domestic demand and enhance export capabilities. The initiative is expected to generate around 55 lakh (5.5 million) direct and indirect jobs in the fisheries sector.

Additionally, PMMSY focuses on enhancing productivity through the adoption of modern technologies and improving infrastructure, including fish processing, cold chains, and storage facilities. A key component of the scheme is its commitment to sustainability and conservation, aligning with India’s obligations to Sustainable Development Goal 14 (Life Below Water).

Financial assistance under PMMSY includes support for the development of essential fishing infrastructure, such as fishing harbours, landing centres, and processing units.

The scheme also offers aid for aquaculture-related activities, such as the construction of ponds and hatcheries, along with credit-linked subsidies to encourage fish farming as a viable business. Eligible beneficiaries, including fishers, fish farmers, cooperatives, and self-help groups, can apply by submitting detailed project proposals to the District Fisheries Officer or the Department of Fisheries.

10. GENERAL OFFSHORE INFRASTRUCTURE MITIGATION PRACTICES

Table 10: General mitigation practices involved in offshore infrastructure construction

Note. The information in the table above have been taken from Contestabile and Vicinanza (2020), Sundar et al. (2007), (Ocean Panel, 2022), Powell et al. (2018), FAO Fisheries & Aquaculture and Crown Estate Scotland & Xodus Group, 2024.

Category	Mitigation Practice	Details
Environmental Impact Assessment (EIA)	Baseline Studies	Collect data on existing conditions (biodiversity, air/water quality, socio-economic factors).
	Impact Prediction and Micro-Siting	Use models to forecast impacts, map sensitive habitats, migratory paths, and optimize turbine placement to prevent wildlife displacement.
	Stakeholder Engagement	Consult local communities, regulatory agencies, and conservation organizations to ensure transparency.

Habitat Restoration and Mitigation	Restoration Measures	Create artificial habitats (e.g., reefs, wetlands) and monitor their recovery.
	Innovative Habitat Design	Design nature-friendly structures, such as biogenic reefs or fish habitats integrated with turbine foundations.
	On-Site and Off-Site Conservation	Enhance biodiversity through conservation areas around wind farms and surrounding environments.
Pollution Control	Air, Water, and Chemical Emissions	Use low-emission equipment, eco-friendly materials, silt curtains, and water treatment systems. Avoid toxic anti-fouling paints.
	Noise Pollution Control	Deploy bubble curtains, cofferdams, and quieter piling techniques (e.g., vibro-piling).
Waste Management	Recycling Protocols	Maximize recycling of materials like concrete, wood, and metal.
	Safe Disposal and Waste Minimization	Ensure safe disposal of hazardous materials and reduce material waste with sustainable design.

Energy Efficiency and Vessel Management	Energy Conservation	Use energy-efficient equipment, renewable energy, and battery-powered monitoring systems.
	Vessel Management	Optimize trips, regulate speeds to minimize emissions, reduce noise, and avoid marine life collisions.
Timing and Seasonal Sensitivity	Activity Scheduling	Conduct activities outside breeding/migration seasons.
	Curtailment	Temporarily halt turbine operations during migration peaks using radar-based systems.
Light and Turbine Design Adjustments	Bird and Bat Collision Prevention	Apply UV/contrasting paint to blades and adjust rotor height based on local patterns.
	Lighting Adjustments	Use non-attracting light designs while maintaining safety for aviation and navigation.

Cable and Seabed Management	Cable Laying Techniques	Use minimally invasive methods like horizontal directional drilling to avoid sensitive habitats.
	Cable Design	Shield and bury cables to mitigate heat and EMF emissions while preserving natural seabed structures.
Operational Phase Monitoring and Curtailment	Environmental Monitoring	Continuously track ecosystem impacts, monitor sensitive species, and adjust operations if needed.
	Shutdown on Demand	Use radar or camera-based systems to halt turbine operations during critical periods.
Decommissioning and Habitat Restoration	Decommissioning Protocol	Partially decommission infrastructure to preserve adapted ecosystems or fully remove with noise abatement measures.
	Long-Term Biodiversity Preservation	Coordinate with regional strategies and restore habitats where necessary.
Ongoing Research and Development	Knowledge Gaps and Innovative Research	Study EMF effects, nutrient cycle impacts, and test predictive radar technologies and new scour protection materials.

Comprehensive Stakeholder and Regulatory Involvement	Multi-Sector Collaboration	Engage with NGOs, communities, and governments to align goals and influence policies.
	Recommendations for Policymakers	Advocate for flexible regulations on lighting, noise, and ecological mitigation. Coordinate standards across regions.

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