Analyzing Shipping Induced Damage and Oil Spill Occurrences in the Coastal Region of Chennai, Tamil Nadu

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Abstract

The coastal expanse of Tamil Nadu, India, not only boasts remarkable biodiversity but also serves as a crucial epicenter for maritime trade and shipping operations. Nonetheless, these maritime activities carry inherent risks, most notably the potential for shipping-related damage and oil spill incidents, which can wield significant ecological and economic repercussions. This research embarks on a thorough examination to delve deeply into the prevalence, characteristics, and consequences of these occurrences, with the overarching goalof providing an all-encompassing perspective on the predicaments confronting this ecologically paramount region.

It is noteworthy that a substantial portion of oil pollution, approximately 45%, arises from marine transportation, with an additional 32% attributed to routine activities of tanker ships. Moreover, 8% emanates from natural seepage, and the remaining 15% originates from a multitude of other sources.

By meticulously scrutinizing historical archives, pertinent case studies, and pertinent literature, our endeavour is to unearth recurrent patterns and evolving trends pertaining to shipping-induced damage and oil spill incidents along the Tamil Nadu coastline. Our inquiry encompasses a comprehensive analysis of both natural forces and human-driven factors that contribute to these events, including but not limited to navigational errors, vessel collisions, and equipment malfunctions. Furthermore, we undertake a critical evaluation of the efficacy of extant mitigation protocols and strategies for emergency response.

The primary objective of this research is to ascertain the most significant oil ship accidents and their resultant impact on the Tamil Nadu coastline. It is crucial to underscore that this study relies extensively on secondary data sources, consolidating a wealth of information to shed light on the intricate dynamics at play in this maritime context.

Keywords: *Coastal Region, Oil Spills, Ship Accidents, Tamil Nadu*

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Introduction

An oil spill is the release of a liquid petroleum hydrocarbon into the environment, especially the marine ecosystem, due to human activity, and is a form of pollution. The oil reaching the coast in this manner affects different ecosystems – open and protected sandy beaches, estuaries, and rocky shores – or remains in the water to be finally deposited on the sea bottom in deep or shallow waters.

The discharge in to the sea in various forms as crude oil and as separate fractions. Most of the oil fraction area biodegradable. Oil and its fractions are used in various ways from household needs to automobiles and industries. The spilled oil more devastation in the marine environment. 45% is due to marine transportation, 32% is due to routine loading, discharging and flushing of tanker ships, 8% is due to natural seeps, 15% by other means.

Related Reviews

Alesia Ferguson et.al (2020) this paper focuses on describing a method for evaluating the impacts of oil spill chemicals (OSC) to human physical health following exposures. The paper begins by providing a description of research programs that address oil spills and literature supporting the need to address human health risk. A methodological approach for determining health risks is then described in detail including the need to evaluate chemical concentration distributions, human activity patterns, and chemical toxicological profiles. Importantly, data gaps are described for this methodological approach in the context of developing a health risk modelling platform for future oil spills. Since healthrisks from oil spills are both physical and mental and are sometimes intertwined, the complexity of these interactions are briefly mentioned, along with challenges in communicating risks to communities given uncertainties and variabilities in the exposures and outcomes.

C.F. Santos and F. Andrade (2022) the main objective of the present work is to identify the best coastal sensitivity assessment approach for Portugal, in the scope of an oil spill event. Two different methods are compared: sensitivity maps and algorithm based

sensitivity models. The development process and potential for use of these approaches in the Portuguese situation are considered and discussed. Although both approaches are viable to assess coastal sensitivity and the corresponding protection priorities, the proven feasibility and effectiveness of sensitivity maps grant them an operational advantage. Considering all the discussed aspects, and although not assuming the character of a deterministic conclusion, the development and use of sensitivity maps (with their proven feasibility and effectiveness) appears to be potentially more effective for the assessment of the Portuguese coastal sensitivity.

Theoretical Background

Ecological theory has traditionally emphasized equilibrium community states and the development of criteria for exclusion and indefinite persistence. However, exclusion takes place over some timescale. If this is long communities may exhibit transient dynamics and befar from equilibrium. This is particularly likely when considering interactions among species which are very similar in their niche requirements and environmental effects; their abundances can vary through time in an essentially random fashion. An important task for future ecological theory and empirical work is to derive a deeper understanding of transient dynamics and the drift hypothesis.

Objectives

To ascertain the most significant oil ship accidents and their resultant impact on theTamil Nadu coastline.

Material and Methods

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This paper is included the study area map and tables and Chat. It shows that clearly about the oil spill risk and prevention methods.

Research Approach

The study is based on secondary data. The secondary data have been received from Chennai Port Authority and the projects of development studies, Tamil Nadu pollution Control board, and central marine fisheries research institute, national institute of ocean technology, and department of fisheries.

Data source

This paper is based on the Secondary data.

Area of the Study

The present study identifies the locations of our endeavor is to unearth recurrent patterns and evolving trends pertaining to shipping-induced damage and oil spill incidents along the very important coastline areas in Tamil Nadu.

Chennai is considered as the center of Tamil Nadu. Moreover, Chennai has to be seen mainly as it has more marine traffic and more marine pollution spots.

Oil Spill in Coastline Sensitive Areas of Tamil Nadu

Coastal information of Tamil Nadu

The Tamil Nadu coast is 1076 km long along the boy of Bengal the continental shelf extends to about 41000 square km. The exclusive economic zone covers an area of 0.19 million square km to the sea. Costal part of the state covers an area of approximately 4456 square km. The coast is along the eastern side of the state across 12 districts the state capital Chennai and the union territory of Puducherry Lie along the coast line having high populationdensity which ranges from as low as 320 people per square km to more than 3000 people per square meter.

This research embarks on a thorough examination to delve deeply into the prevalence,characteristics, and consequences of these occurrences, with the overarching goal of providing an all-encompassing perspective on the predicaments confronting this ecologically paramount region.

Chennai is the fourth largest metropolitan city in India, and its coast is the typical example of enormous wastewater and serious pollution levels in the country. The anthropogenic impacts are due to burgeoning population needs and the development of small and large scale industries along this coastal city (Giridhar, 2001). A proper study of assessing the coastal pollution is a dire need to both spatially and temporally, to make recommendations for controlling the discharge of polluting agents into the coastal waters. The non-point sources of pollutants originate from oil trafficking with accidental releases, tank washing, and marine drilling.

Chennai port is about 125 years old which is serving as a major transportation port before becoming a major container port. It is a substantial reason for the economic growth of Tamil Nadu, especially for the manufacturing booms in South India. Its container traffic crossed 1

Million TEUs for the first time in 2008. Chennai port has a capacity of 36 million tons of commodities such as furnace oil, diesel oil, vegetable oil, etc being trafficked annually. Thereare 2500 vessels move around the harbor. It is currently ranked the 91st largest container port and is expanding in the coming years.

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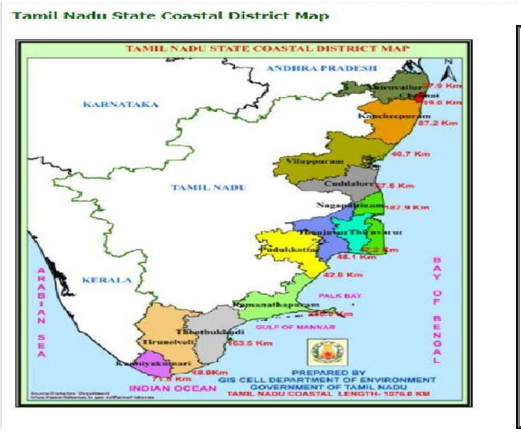
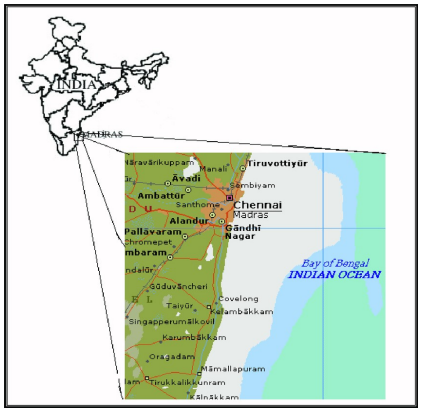


Tamil Nadu state Coastline District Map Chennai Coastal



Chennai Coastline Map

Activities responsible for oil pollution of the marine environment in Tamil Nadu include oil exploration, oil refining, oil transport, oil spills and leakages from ships and fishing trawlers as well as from petrochemical industries. The places where such activities take place and their magnitude are presented in the table 1 alongside. The southern Bay of Bengal, the Gulf of Mannar region, forms a part of one of the two major tanker routes.

Oil spills at along Chennai Coast

There are many sources for oil spills such as natural and accidental. Natural spill happens through underground seepage which is a rare phenomenon, but the accidental spills happen throughout the world due to oil transportation. This study area considered being oil spill- prone zone as it had faced much accidental oil spill in the past (Table 1) and recent which is amajor source of a spill (Blue waters 2012). The minor sources of oil spill illegal oil releases like bilge water releases, tank washing, etc. Even the minor oil spills have threatened the coastal environment causing unfavorable economic, ecological and biological loss.

Data interpretation and analysis

Table 1.1

Location and Details for Chennai

Chennai coastline Details	Annual transport details
Location	Chennai (Madras)
Coordinates	13.0844^{O}N 80.2899^{o}E
Opened	1881; 134 years ago
Operated by	Chennai Port Trust
Owned by	Chennai Port Trust, Ministry of Shipping, Government of India
Type of harbor	Coastal breakwater, artificial, large, large seaports
Size of harbor	69.97 ha (420.0acres)
Land area	237.54 ha (587.0 acres)
Available berths	26
Main trades	Automobiles, motorcycles and generalindustrial cargo including iron ore, granite, coal, fertilizers petroleum products, andcontainers
Vessel arrivals	2,181 (2010-2011)
Annual Cargo tonnage	52.54 million tones (2014-15)
Annual Container	1.523 million TEUs (2010-2011)
Annual revenue	8,904.0 million (2007-08)

Source: www.chennaiport.gov.in

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Shows the environmental sensitive of selected areas and location and other related information due to oil spills. Major spills may occur in the event of blowouts, failure of structure / equipment or rupture of riser and pipe liner. All crude oil contains a large percentage of persistent oil fractions, which are the causes of oil spills situations.

Table 2

Major oil spills on the Chennai Coast of India from1990-2018 (Blue waters, 2012)

S.No	Date	Oil Type	Quantity spilt (t)	Position	Vessel/othe rincidents
1	07/9/1991	FO	692	Gulf of Mannar	MT Jayabola
2	16/8/1992	SKO	1060	Madras Harbour	MT Albert Ekka
3	27/11/1994	HO	288	Off Madras	MV Sagar
4	13/11/1995	Tanker wash	-	Eliot beach, Madras	Unknown
5	23/09/2002	Not Assessed	-	Off PtCalimare 220 NM	MV HIDERBAHY
6	30/08/2005	Not Assessed	08	Sunken Ship off Tuticorin	MV IIDA
7	06/05/2006	Not Assessed	100 ltrs	Sunken Tug off Pt.CalimerTamilnadu	DCI Tug-IV
8	02/01/2010	Not Assessed	05 tons	Off South Chennai	Not known
9	28/01/2017	Bunker fuel Oil	196	Ennore Port	MT Dawn Kanchipuram
10	2/3/2023	crude oil	-	Nagapattina mseashore	Chennai Petroleum Corporation Limited.

Source: Chennai port Authority, FO = Fuel oil; HO = Heavy oil

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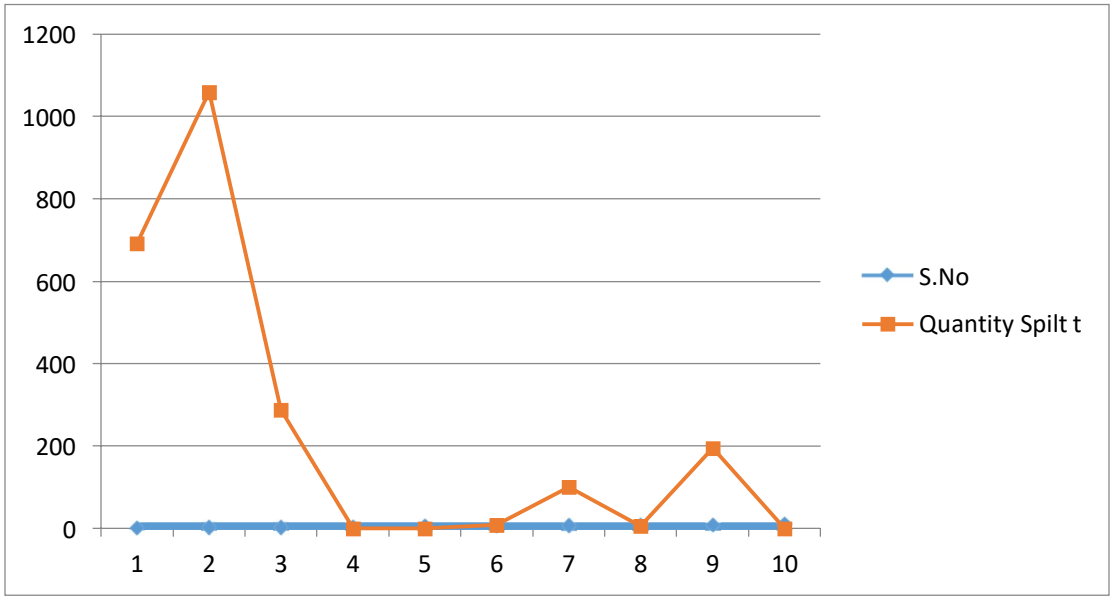

Figure 1:
Major oil spills on the Chennai Coast of India from1990-2018 (Blue waters, 2012)

The Chennai port is India's second busiest container hub, handles all types of cargo including bulk materials, petroleum, and oil liquids (POL) at the traffic rate of 13.32 million tonnes 57.15 million tons of cargo. The maximum draft is 17.0m, permitting carriers up to 1, 50,000 DWT. The Chennai Petroleum Corporation Limited has proposed to install Single Point Mooring (SPM) facility off Ennore Port which imports about 10 million tonnes of crudeoil for its refinery through Very Large Crude Carriers thereby optimizing the transportation cost ("Maritime agenda: 2010 - 2020," 2011). In the past two decades, ten major oil spills accidental incidents were reported in Chennai coastal water i.e.

The spilt oil on the coastal substratum damages the demersal ecological environment and thereby bring fatal end to the benthic community (Reddy et al., 2012). The oil that enters the coastal wetlands, mangroves and marine protected areas reduces the biodiversity (Goldman et al., 2015). Environmental modeling plays a vital role in impact assessment in ecological sciences and helps with making the best professional judgment. Quantification of the impacts or the weighing factors are used as part of the modeling (simulation process) for deriving the impact index methods (Cartwright, 1993). Coastal impact assessment integrated
with species sensitivity distribution usually supports the professional judgment approach to characterize potential impacts and evaluate the spill response actions in the aftermath of the accident (Bejarano and Mearns, 2015). Most damage is done by spilt oil when it gets to shallow water or comes ashore. Oil spill response action aims to prevent oil from reaching theshore especially sensitive resources and to prevent the long term effect by cleaning the shore using various technological measures (Kirby and Law, 2010).

Environmental damage of oil spill incidents of coastal hazards

Impacts of coastal hazards are determined by geographic features of affected location,environmental or weather condition, ecological features and socio- economic factors. Highly populated and high biodiversity areas are vulnerable to coastal hazards. Benefits of coastal zones attract people to settle along

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coast and these human interferences make ecosystems more vulnerable (Dwarakish et al., 2009).

A major spill could affect several areas around the coast. The density of marine traffic, especially oil tankers, nearby of the Indian coast and offshore petroleum exploration and production platforms, make our region a high-risk area.

Lead to negative impact on the environment and spoil natural habitat of many marine flora and fauna. Mangrove and wetlands are highly affected.

Major impacts of the coastal hazards are loss of life including human and animals. Structures such as seawalls, groins, jetties and breakwaters built to mitigate thenatural hazards have multiple impacts on the coast .

Oil spill directly affect marine fauna and flora.

Local people lose their livelihood as fishing and tourism activities decline. As oilslicks spread plumage and fur of animals, they are put in vulnerable condition.

The major impact of this is loss of human and animal lives as well as coastalresources and other properties.

Bio-diversity losses, marine ecosystem including animal and aquatic plant life

In February 2017, the Indian Coast Guard said that approximately an area of 34,000square meters (370,000 sq ft) was affected.

Recent Oil Spillage Incidents in Tamil Nadu

The crude oil leakage which occurred in the nine km long, 20" crude oil pipeline fromCPCL CBR Crude Storage Tanks at Nagapattinam to Karaikal Port on March 2, 2023. The

M/s CPCL with the help of coast guard the pipeline leak was arrested on 4 March 2023. The dispersants have been applied to clean the sea surfaces.

The Chennai Petroleum Corporation Limited (CPCL) has removed an 850-metre stretch of an underwater crude oil pipeline owned by the company, in the Pattinamcherry fishing hamlet, off the Nagapattinam coast.

Finding and Discussion

Accidental spillage of oil along the tanker route will cause severe and in some cases, irreparable damage to the marine ecosystem. Similar damage is caused if accident stake placeduring the southwest monsoon season. In addition to offshore oil exploration and production, the transfer operations of oil at single buoy mooring station, as well as in lightering operations and during bunkering operations in the major ports, also cause spillage of oil particularly during accidents. Besides such oil transfer facilities in India, lightering operationscarried out in other south Asian countries may also additional sources of oil pollution to the Indian waters especially during accidents.

The problem in worsened by the single hulls of the Indian tankers handling the bulk of imports, which are

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likely to remain in service up to 2015. These old tankers are certainly far more susceptible to accidents. Apart from this huge quantity of oil passing through the Indian maritime zone, including the exclusive economic zone (EEZ), and our own Imports, creates problems from tar balls due to leakage, manor spillage and tanker wash in high seas, which is totally uncontrolled. Our beaches and coastal facilities require frequent cleaning because of these tar balls. All the above underscore the need for comprehensive oil spill management around the Indian coastline.

The severity of the impact of an oil spill depends on several factors, including characteristics of the oil itself. Natural conditions, water temperature, weather and wind conditions also influence the behavior of oil in aquatic environment. Various types of habitatshave differing sensitivities to oil spills.

Conclusion

To combat the permanent danger of marine pollution caused by oil spills efficiently, it is extremely important, once a spill has been detected, to be able to predict both its location and the corresponding transformations as quickly and as precisely as possible.

The need for a holistic approach to oil spill management and forming of an entity is most urgent particularly when considering India's proximity to major oil traffic routes and growing

oil-handling facilities. At present oil spill combat facilities in India are inadequate, havingfragmented, legislation, and monitoring and control system.

References

Han, Y., Nambi, I. M., & Clement, T. P. (2018). Environmental impacts of the Chennai oil spill accident–A case study. *Science of the Total Environment*, *626*, 795-806.

Adzigbli, L., & Yuewen, D. (2018). Assessing the impact of oil spills on marine organisms. *J. Oceanogr. Mar. Res*, *6*(179), 472-9.

Zhang, B., Matchinski, E. J., Chen, B., Ye, X., Jing, L., & Lee, K. (2019). Marine oil spills—Oil pollution, sources and effects. In *World seas: an environmental evaluation* (pp. 391-406). Academic Press.

de Oliveira Soares, M., Teixeira, C. E. P., Bezerra, L. E. A., Paiva, S. V., Tavares, T. C. L., Garcia,

T. M., ... & Cavalcante, R. M. (2020). Oil spill in South Atlantic (Brazil): Environmental and governmental disaster. *Marine Policy*, *115*, 103879.

Elsayed, N., & Ammar, S. (2020). Sustainability governance and legitimisation processes: Gulf of Mexico oil spill. *Sustainability Accounting, Management and Policy Journal*, *11*(1), 253-278.

Little, D. I., Sheppard, S. R., & Hulme, D. (2021). A perspective on oil spills: What we should have learned about global warming. *Ocean & Coastal Management*, *202*, 105509.

Chau, M. Q., Truong, T. T., Hoang, A. T., & Le, T. H. (2021). Oil spill cleanup byraw cellulose-based absorbents: a green and sustainable approach. *Energy Sources, Part A: Recovery, Utilization, and Environmental Effects*, 1-14.

ISBN: 978-93-83302-64-2

Goveas, L. C., Nayak, S., & Selvaraj, R. (2022). Concise review on bacterial degradation of petroleum hydrocarbons: Emphasis on indian marine environment. *Bioresource Technology Reports*, 101136.

Dasari, K., Anjaneyulu, L., & Nadimikeri, J. (2022). Application of C-band sentinel-1A SAR data as proxies for detecting oil spills of Chennai, East Coast of India. *Marine Pollution Bulletin*, *174*, 113182.

Ülker, D., Burak, S., Balas, L., & Çağlar, N. (2022). Mathematical modelling of oil spill weathering processes for contingency planning in Izmit Bay. *Regional Studies in Marine Science*, *50*, 102155.

ISBN: 978-93-83302-64-2