



August
2025

A POST DISASTER SOCIAL
IMPACT ASSESSMENT OF
ENNORE OIL SPILL

FINAL REPORT

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Typeset and designed by Ayesha Ajmal

Date of Publication: August 2025

Acknowledgements

This report would not have been possible without the help of several people. First, we would like to thank the people of Ennore, specifically village leaders and elders from Nettu Kuppam, Kattukuppam, Ennore Kuppam, Sivan Padai Veedhi, VOC Nagar and Periyakuppam for spending their time to talk to us.

We would also like to extend our sincere thanks to Mr. Vishanth from Ennore Solidarity Group, Mrs Subashini, Ishwarya, Sumathi, Kathiravan, Surya Prakash, Sundar and Sarathy from *Singara Velar Padipagal* for conducting the door-to-door surveys.

Our thanks are due to Pooja Kumar for orienting us to Ennore and its challenges and for helping us writing the report. We also thank Vani Mathuram for helping with the research, Srimathi Balasubramani for helping us with the FGDs and Joel Shelton for his work on the surveys.

Further, we would also like to thank Dr. S Angel Deborah, Assistant Professor, SSN College of Engineering from for helping us with conceptualising and refining the index methodology.

Last but not least, we extend our gratitude to our interns Ankitha Reddy and Bharath Rao for helping us with data analysis, research and reporting.

Suggested Citation:

Roy, P., Ayyangar, A., Vivek, R. & Ramachandran, A. (2025). A Post Disaster Social Impact Assessment of Ennore Oil Spill: Final Report, Okapi Research and Advisory.

Executive Summary

Introduction

Oil spills are catastrophic events that not only have severe consequences for natural ecosystems but also have significant impacts on surrounding communities. These are often categorised as technological disasters because they result from human activities such as malfunctions, errors, regulatory failures, or management shortcomings. These disasters have identifiable causes and responsible parties, distinguishing them from natural disasters that occur due to phenomena like cyclones or earthquakes (Sandifer & Walker, 2018; Sandifer et.al, 2021). The Ennore oil spill, which occurred in Chennai in December 2023, is one such mishap triggered by the Michuang cyclonic storm.

The oil spill caused widespread damage to property, health and disrupted livelihoods. To support meaningful and long-term recovery of affected communities, this study aims to conduct a thorough socio-economic impact assessment to fully understand and address the extent of harm caused. Therefore, this study addresses the following research objectives:

1. To assess the level of socio-economic impact of the Ennore oil spill on affected communities in terms of impact on income/livelihood, health, and property damage.
2. To examine how such socio-economic impact is correlated to place-based social vulnerability.
3. To assess current policy and governance challenges that further aggravate the impact on communities.

Based on this assessment, the study aims to offer strategic recommendations for protecting vulnerable communities and building greater resilience to such human/technological disasters in the future.

Methodology

This study used a mixed methods and participatory approach to assess the socio-economic impact of the Ennore oil spill. A primary survey was conducted, encompassing 428 samples from fishing villages and non-fishing residential areas affected by the oil spill. Focus Group Discussions (FGDs) and interviews were carried out to gather qualitative insights and contextualise the survey findings. Table 1 shows the villages selected for the study which were based on the Indian Institute of Technology (IIT) Madras (March 2024) and TNPCB Technical Assessment Report (January 2024). In addition, two more villages were included following initial interviews with local community leaders in the area.

Table 1: Table showing villages selected for this study.

Si. No.	Name	Category	Surveys	FGDs	Individual Interviews
1	Thazhan Kuppam	Marine fishing	✓	✓	
2	Nettu Kuppam	Marine fishing	✓	✓	
3	Ennore Kuppam	Inland fishing	✓		✓
4	Sivan Padai Veedhi	Inland fishing	✓	✓	✓
5	Kattukuppam	Inland fishing	✓	✓	✓
6	VOC Nagar	Residential/ Inland fishing		✓	
7	Periyakuppam	Marine fishing			✓
8	Ernavur	Residential area	✓		
9	Sathyamurthy Nagar	Residential area	✓		
10	Kargil Nagar	Residential area	✓		

The study also carried out a policy analysis of national and state-level oil spill contingency plans and legal documents related to the spill to contextualise disaster response. List of key documents reviewed includes: the National Oil Spill Disaster Contingency Plan (NOS-DCP) 2015, the Tamil Nadu State Oil Spill Disaster Contingency Plan (TN-SOS-DCP) 2024, the Chennai city Disaster Management Perspective Plan 2024: legal documents submitted to the National Green Tribunal (NGT) for its *Suo motu* case on the oil spill.

Data Analysis: The study developed a Social Impact Score (SIS) by quantifying livelihood, property damage, and health impacts at the village level. Individual scores from sampled households were aggregated and weighted (livelihood impact score (LIS): 50%, health impact score (HIS): 30%, property damage impact score (PDIS): 20%) to reflect the severity of impact across villages. Vulnerability parameters, such as household composition and economic status, were analysed to explain variations in impact across villages through descriptive statistics. FGDs and interview transcripts were processed using open coding to identify key themes. These insights complemented quantitative findings, providing a nuanced understanding of community experiences and chronic vulnerabilities.

Key Findings

- 1. Overall Impact measured by a Social Impact Score (SIS):** Traditional fishing villages have a higher SIS than non-fishing villages. Five of the eight villages surveyed experienced the highest levels of impact. These villages are: Ennore Kuppam (2.07), Sivan Padai Veedhi (2.06), Ernavur (2.05), Thazhan Kuppam (2.04), and Nettu Kuppam (2.04). Ernavur, the only non-fishing village amongst the five, recorded a high SIS due to its proximity to the spill site and severe contamination.
- 2. Fishing and non-fishing villages experienced the impact of the oil spill differently:** For fishing villages (Nettu Kuppam, Kattukuppam, Ennore Kuppam, Sivan Padai Veedhi and Thazhan Kuppam), the impact was primarily linked to loss of livelihood and income due to decline in fish populations, and damage to livelihood-related equipment such as boats and nets. Whereas for non-fishing, residential areas (Ernavur, Sathyamurthy Nagar and Kargil Nagar), the impact experienced was through oil-contaminated water from Buckingham Canal/ Kosasthalaiyar River entering houses and damaging homes/household items/vehicles. This difference is reflected in the villages' Livelihood Impact Scores (LIS).
 - **LIS values exceed 2.5 for fishing villages** which faced the most significant livelihood disruptions, reflecting their dependence on fishing-related activities. The oil spill caused a ripple effect of economic loss across the entire fishing supply chain, i.e. fishing, fish processing, fish selling etc. which was corroborated by all the FGD participants across the villages studied. Among the survey respondents, more than 75% of the respondents (n=326) (includes nearly all the fishers) stated that their income reduced significantly, specifically after the oil spill. By contrast, the non-fishing villages had a score of 2.25 and below, with Sathyamurthy Nagar recording the lowest LIS of 0.93, indicating lower livelihood disruptions.
 - **Property Damage Scores (PDIS) are higher for non-fishing villages which reflected scores of 1.23 and above** compared to fishing villages whose scores were less than 0.95. The non-fishing villages, including Ernavur, Sathyamurthy Nagar, and Kargil Nagar, suffered higher property damage as oil-contaminated floodwaters infiltrated homes, damaged household appliances, and rendered repairs infeasible: 98% of all the respondents surveyed in residential areas reported damage to their homes/household items/ vehicles because of the oil spill. By contrast, fishing villages experienced lower property damage but incurred significant losses to boats and fishing equipment: nearly 50% of fishers (n=137) who responded to the survey reported damage to their fishing equipment and among these fishers 76% reported that this damage was to the boat surface, and around 82% stated that they could not use their boats for more than 60 days after the oil spill.

3. Unlike LIS and PDIS, health impact scores (HIS) were high for fishing and non-fishing villages with Ennore Kuppam (2.22), Sivan Padai Veedhi (2.11), Ernavur (2.07) and Thazhan Kuppam (2.02) signifying severe health concerns related to oil exposure.

- Skin irritation (71%) and shortness of breath (63%) were the most reported health conditions post the oil spill (n=306) among survey respondents.
- Further, fishers who participated in clean-up activities also reported developing related rashes and allergies, questioning the adequacy of the safety equipment provided to those engaged in the clean-up activity.
- A statistically significant difference was found between the HIS across villages with respect to oil clean-up activities ($F=9.09$, $p<.01$), which suggests that villages where more residents were involved in oil clean-up efforts tended to have higher HIS.

4. The Dec 2023 oil spill heightens pre-existing vulnerabilities: Ennore has undergone a rapid transition since the 1960s, shifting from a coastal economy to an industrial economy. As a result, the area has experienced severe environmental degradation over the decades, negatively impacting traditional livelihoods and health. The December 2023 oil spill has only exacerbated this pre-existing condition, significantly limiting the extent to which communities can fish due to the loss of fish breeding grounds, change in species diversity and quality of the catch. All the survey respondents who were fishers (n=137) confirmed that the fish population had died and/or changed and/or decreased since the oil spill.

5. Compensation was not provided to all the impacted communities: For instance, residents of some streets of Ernavur, a village identified in IIT Madras' Preliminary Assessment Report 2024, and fishers in VOC Nagar (identified by this team through field observations and interactions) were not provided with official compensation.

Recommendations

1. Design more flexible rehabilitation and compensation packages to accommodate community needs, especially since fishing and non-fishing villages were impacted differently by the oil spill. Conducting an immediate and quick socio-economic survey of impacted areas would help in understanding the ground realities. This will also ensure that non-traditional fishing communities or villages with lower caste fishers who are officially not recognised as fishing villages will also get government attention and compensation if they are impacted.

2. Enforcing strict regulation on polluting industries and plugging sewage outfalls through regular audits, deploying advanced monitoring technologies such IoT-based sensors and exploring the option of citizen-based monitoring. In the long run, these

interventions will help restrict continuous pollution, protect the sensitive ecology, and revive fishing as a viable livelihood option for traditional fisherfolk.

- 3. Develop and operationalise alternative livelihood and skill development programs** for local community youth, men, and women. Although local industries in Ennore had promised villagers jobs, these promises were largely unfulfilled - too few jobs were made available, and those offered were non-transferable across generations. Local companies can develop a rigorous skills training program and offer decent job opportunities to the local community.
- 4. Increase preparedness within industries for oil spills.** Industries should be mandated to install spill control equipment such as containment booms. This ensures that oil spilling into the Buckingham canal from the industrial premise does not spread further into the waterway, buying time to clean the leakage. The TNPCB could mandate the following:
 - Highly polluting industries (CPCL is classified as such) should possess the necessary spill control equipment, such as the containment booms mentioned previously, Skimmer boats to remove the spilt oil, and sorbents – materials that absorb/adsorb oil.
 - Industries could have preparedness plans, including regular drills and emergency response training.
- 5. Strengthen TN-SOS-DCP to work with communities** by including representatives of the local communities in the state oil spill crisis management group (SOSCMG), the group responsible for assisting and providing advice to all departments designated to manage oil spills.
- 6. Invest in community-based disaster response** by building capacity of the community and local NGOs to respond to disasters, investing in early warning systems, building community relief infrastructure and creating a local disaster relief fund.
- 7. Improve the adequacy and quality of local health infrastructure** by making health camps more accessible and increasing the number of serviceable public health centres in the area. Communication on the details of the camps need to be advertised in villages through different modes (social media, local newspapers etc.) well in advance to ensure people are aware of such services and can avail them.

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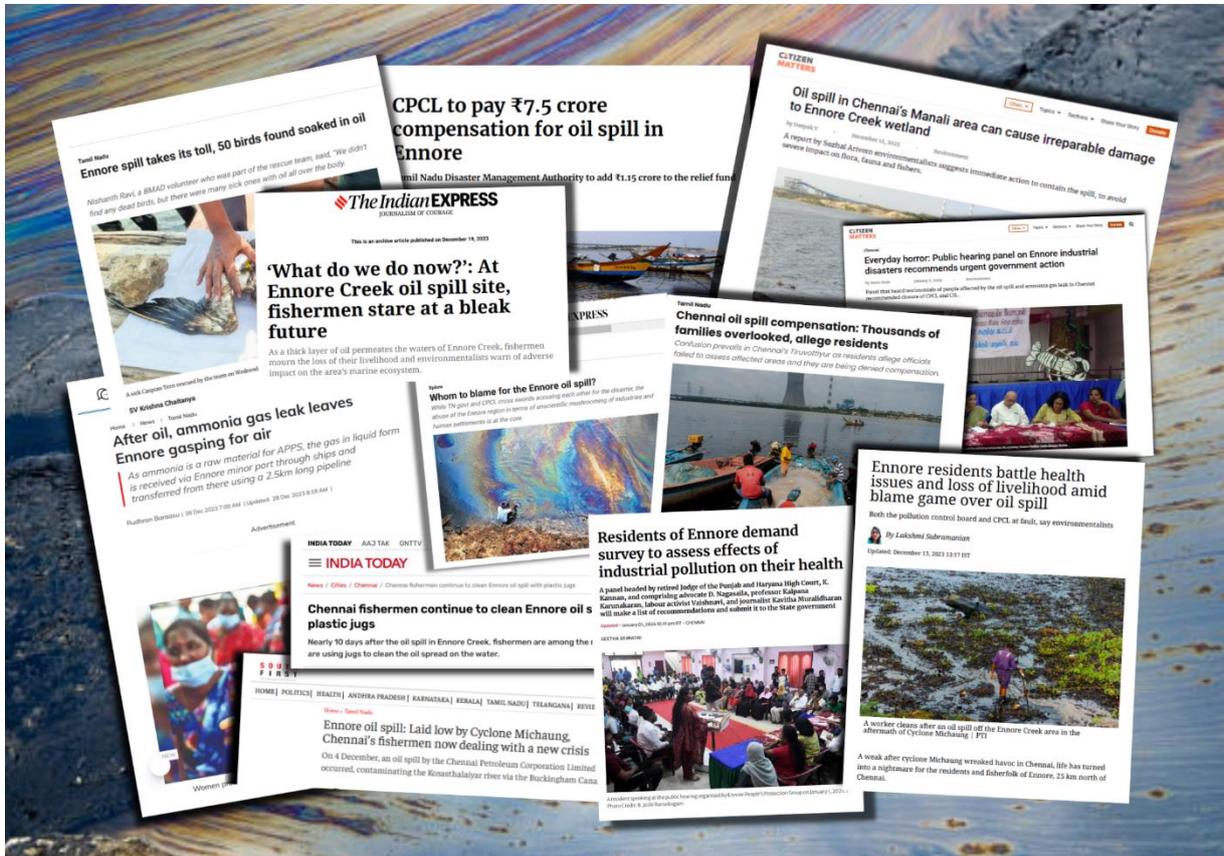
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LIST OF ABBREVIATIONS

Abbreviation	Full Form
ANOVA	Analysis of Variance
CPCL	Chennai Petroleum Corporation Limited
CSR	Corporate Social Responsibility
ERDMP	Emergency Response and Disaster Management Plan
FGDs	Focus Group Discussions
GCC	Greater Chennai Corporation
HAZOP	Hazard and Operability Analysis
HIS	Health Impact Score
ICG	Indian Coast Guard
IIT	Indian Institute of Technology
KIIs	Key Informant Interviews
LIS	Livelihood Impact Score
MTPA	Million Metric Tonne Per Annum
NGO	Non-Governmental Organization
NOS-DCP	National Oil Spill Disaster Contingency Plan
NCTPS	North Chennai Thermal Power Station
NDRF	National Disaster Response Force
NGT	National Green Tribunal
PDIS	Property Damage Impact Score
QDA	Qualitative Data Analysis
RADMMD	Revenue Administration, Disaster Management and Mitigation Department
SDRF	State Disaster Response Fund
SII	Social Impact Index
SIS	Social Impact Score
SOSCMG	State Oil Spill Crisis Management Group
TNEB	Tamil Nadu Electricity Board
TNPCB	Tamil Nadu Pollution Control Board
TNSDMA	Tamil Nadu State Disaster Management Authority
TN-SOS-DCP	Tamil Nadu State Oil Spill Disaster Contingency Plan
UPHC	Urban Primary Health Centre
WRD	Water Resource Department

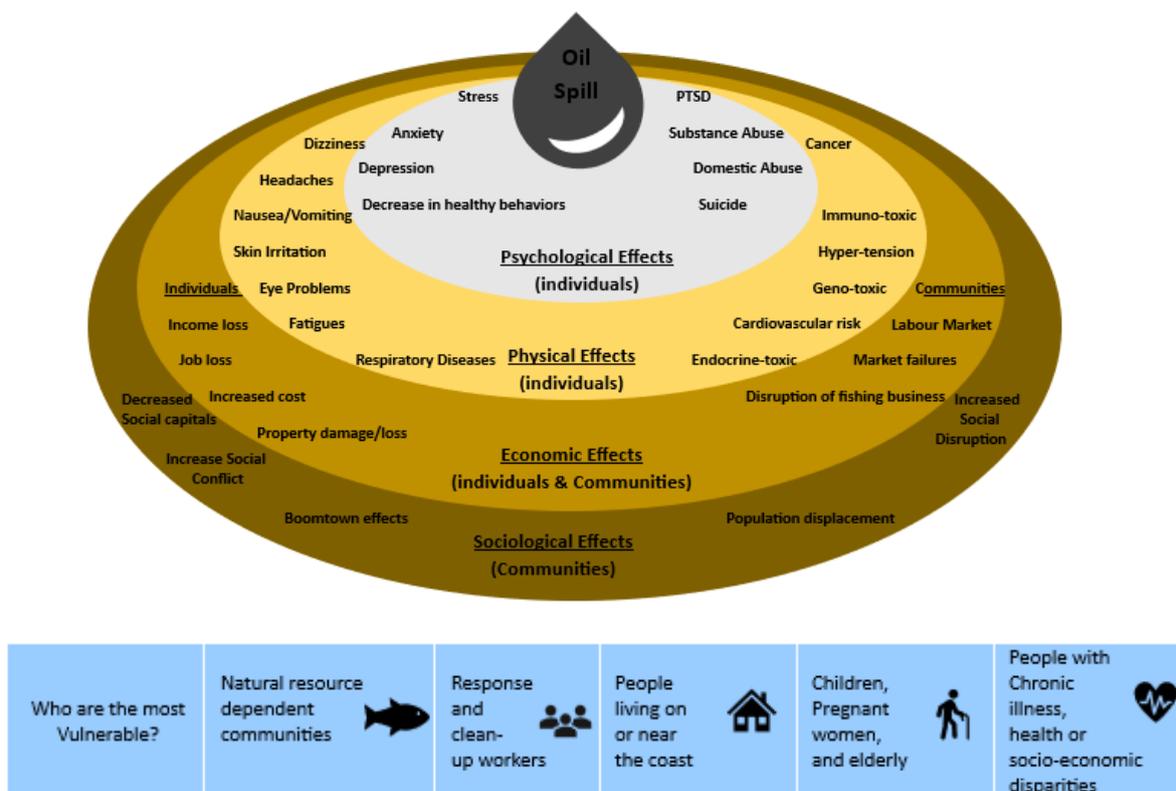
CHAPTER 1: INTRODUCTION – WHAT, HOW, WHY OF THIS STUDY



What Is This Study About?

Oil spills are catastrophic events that not only have severe consequences for natural ecosystems but also have significant impacts on surrounding communities. These are often categorised as technological disasters because they result from human activities such as malfunctions, errors, regulatory failures, or management shortcomings. These disasters have identifiable causes and responsible parties, distinguishing them from natural disasters that occur due to phenomena like cyclones or earthquakes (Sandifer and Walker, 2018; Sandifer et.al, 2021). Large oil spills can lead to a wide range of interrelated effects on communities, including both immediate and long-lasting negative impacts on health and well-being, as shown in the figure below.

Figure 1: Impact of Oil Spill on Human Society (adopted from Sandifer & Walker, 2018)



The Ennore oil spill, which occurred in Chennai last December, is one such event triggered by the Michuang cyclonic storm. The December 2023 oil spill was a result of a devastating incident at the Chennai Petroleum Corporation Limited (CPCL) during this time. CPCL, a Category-1 Miniratna under the Indian Oil Corporation, is a vital contributor to Tamil Nadu’s energy landscape, meeting a substantial share of the state’s aviation turbine fuel and diesel requirements through its 10.5 million metric tonne per annum (MMPA) refinery at Manali. This refinery, while instrumental to the region’s economy, faced unprecedented operational challenges during Cyclone Michuang in December 2023.

As the cyclone battered the eastern coast of Tamil Nadu, the heavy rainfall and high winds caused infrastructure failures at the CPCL facility, leading to a large-scale spillage of oil into the surrounding waters of Ennore Creek and along the Bay of Bengal coastline. Media reports claimed that the oil spill polluted the Ennore creek, Buckingham Canal, Kosasthalaiyar River, and the coastline, affecting over 20 sq. km of coastal waters and approximately 20,000 residents of North Chennai. The spill also impacted 2,301 fisherfolk communities and made the waters unfit for fishing. A preliminary study conducted by IIT Madras estimated the volume of oil contamination in the environment

to be about 517 to 2,569 tonnes, excluding oily sludge collected by CPCL post-spillage and oil in inaccessible islands and river sediments (Environmental Engineering Division, 2024). The report suggested that urgent remedial actions are imperative to mitigate the environmental and socio-economic consequences of this oil spillage.

To support meaningful and long-term recovery of the affected community, this study aims to conduct a thorough socio-economic impact assessment to fully understand and address the extent of harm caused.

Therefore, this study addresses the following research objectives:

1. To assess the level of socio-economic impact of the Ennore oil spill on affected communities in terms of impact on income/livelihood, health, and property damage.
2. To examine how such socio-economic impact is correlated to place-based social vulnerability.
3. To assess current policy and governance challenges that further aggravate the impact on communities.

Based on this assessment, the study aims to offer strategic recommendations for protecting vulnerable communities and building greater resilience to such human/technological disasters in the future.

How Has the Study been Conducted?

This study uses a mixed methodology, collecting and analysing quantitative and qualitative data. While a more detailed methodological discussion is provided in the next chapter, the figure below presents an overview of the steps followed.

Step 1: Initial Planning and Scoping – Using a review of existing literature/reports and direct interactions with community leaders/gatekeepers and/or experts with knowledge of the Ennore area, affected communities/villages and relevant stakeholders were identified.

Step 2: Data Collection – Secondary data from census, government reports and other studies were assessed to understand the socio-economic background of the affected communities. Primary data on community socio-demographics and the impact of the oil spill were collected via structured survey questionnaires targeting households with a random sampling method ensuring diverse representation. In-depth interviews and focus group discussions were also conducted for gathering a detailed understanding of perceived impacts and coping strategies with local leaders, health officials, environmental experts, and NGO representatives.

Figure 2: Proposed methodology to study the social impact of Ennore oil spill.



Step 3: Data Analysis to Identify Impact - Part of the survey data was used to generate a social impact score (SIS) for the affected villages for comparison. These scores were then examined vis-à-vis the basic descriptive statistics on socio-economic conditions of the villages to understand how place-based vulnerability affects social impact of disasters. While Excel, SPSS, and GIS mapping are used to calculate and visualise the SIS, qualitative data from interviews/FGDs were transcribed, coded, and thematically analysed using QDA Miner Lite, an open-source qualitative data analysis software. The findings from both quantitative and qualitative assessments were integrated to offer a comprehensive understanding of the spill's social impacts.

Step 4: Identify recommendations/strategies for recovery - Based on the data analysis and inputs from the community members, local authorities, NGOs, and experts a set of recommendations and strategies has been proposed.

Why Is This Study Important?

Studying the social impacts of oil spills on communities is of great significance for several reasons. Coastal regions are especially susceptible to the effects of oil spills due to their proximity to the ocean and the presence of vital ecosystems (Andrews et.al, 2021). These ecosystems provide habitats for various marine species and support the fishing and tourism industry, which are often the backbone of coastal communities. Therefore, understanding how oil spills affect these ecosystems and the communities reliant on them is crucial for developing effective strategies to mitigate their impacts and promote sustainability. Secondly, oil spills can have wide-ranging social and health impacts on coastal communities. These can include economic losses, loss of livelihoods, and displacement of residents (Sandifer et.al, 2021). Additionally, the social fabric and cultural heritage of these communities can be deeply affected (Andrews et.al,

2021). Thirdly, studying the social impacts of oil spills on coastal communities can help in the development and implementation of effective response and recovery strategies.

In the case of Ennore - an area that has experienced rapid transition, especially since the 1960s, from being a predominantly fishing-based coastal economy to a region heavily dominated by industries - the local community has been exposed to extreme pollution and environmental degradation, with negative effects on their livelihoods and health. With coal-based power plants, two ports handling oil, gas and coal, a mega petrochemical complex anchored by the state's largest oil refinery, Ennore is highly industrialised. The 2023 December oil spill was not an isolated incident – the local community has repeatedly been exposed to multiple and often unnoticed events of oil spill, gas leak, and fly ash contamination among other pollutants. As such, this study is particularly significant in drawing attention to the long-time neglect and degradation of the environment and community in Ennore and identifying pathways for ensuring protection and building resilience of the community in the future.

CHAPTER 2: METHODOLOGY

As mentioned earlier, this study is guided by the following research objectives: to assess the level of socio-economic impact of the Ennore oil spill on affected communities; to examine how such socio-economic impact is correlated to place-based social vulnerability; and to assess current policy and governance challenges that further aggravate the impact on communities. In this research study, the social Impact of the oil spill on the surrounding community is assessed primarily in terms of the impact on people’s livelihood and income, property/resource damage, and health. Based on this assessment, the study presents recommendations to rehabilitate the community, build community resilience and protect it from similar future events.

Study Area Selection

To identify villages impacted by the oil spill two previous studies conducted by IIT Madras and the Tamil Nadu State Pollution Control Board (TNPCB) immediately after the incident were examined. Both studies identified a list of fishing villages and residential areas that were impacted by the oil spill (Table 1). The IIT Madras research team also conducted spatial mapping of oil contamination in residential areas, which was exacerbated by the inundation of floodwaters. In this study, an initial selection of study sites was guided by this list.

Table 1: List of affected villages identified by previous studies.

Si. No.	TNPCB Report	IIT Madras Report	Fishing Villages/ Residential Area
1	Thazhan Kuppam	Thazhan Kuppam	Fishing Village
2	Nettu Kuppam	Nettu Kuppam	Fishing Village
3	Kattukuppam	Kattukuppam	Fishing Village
4	Ennore Kuppam	Ennore Kuppam	Fishing Village
5	Mugathwarakuppam		Fishing Village
6	Sivan Padai Veedhi		Fishing Village
7	Thalakuppam*		
8	Sathyamurthy Nagar	Sathyamurthy Nagar	Residential Area
9	Kargil Nagar	Ernavur	Residential Area

* Thalakuppam-doesn't exist as a village, it was likely a mistaken reference to the Thazhan Kuppam village.

However, during preliminary field visits, and interactions with local community leaders from affected villages, it was evident that there were few additional fishing/non-fishing villages which had been impacted by the oil spill but were not included in either of the reports mentioned above (such as Chinnakuppam, Periyakuppam, VOC Nagar, SVM Nagar and Rajaji Nagar). Some of these villages were also excluded from the government's compensation program, leaving their residents without support.

Therefore, in this study, these additional villages have also been included through surveys and/or focus group discussions/interviews. The final list of villages covered in this study are listed in the table below. In terms of categorising villages as fishing, non-fishing/residential, it should be noted that traditionally, villages with residents from predominantly fishing castes (i.e. *Pattinavar and Sembadavar*) were referred to as fishing villages. This categorisation has been followed in this report too. Further, there are also villages which have fishers but not from the conventional fishing castes, such as VOC Nagar, which are referred to as non-traditional fishing villages. Additionally, those that are non-fishing/ residential areas where residents are occupied in other livelihoods, referred to interchangeably as non-fishing villages or residential areas.

Table 2: List of villages covered in the study.

Si. No.	Name	Category	Survey	FGD	Individual Interview
1	Thazhan Kuppam	Marine fishing village	✓	✓	
2	Nettu Kuppam	Marine fishing village	✓	✓	
3	Ennore Kuppam	Inland fishing village	✓		✓
4	Sivan Padai Veedhi	Inland fishing village	✓	✓	✓
5	Kattukuppam	Inland fishing	✓	✓	✓
6	VOC Nagar*	Non-traditional Inland fishing village		✓	
7	Periyakuppam	Marine fishing village			✓
8	Ernavur	Residential area / non-fishing village	✓		
9	Sathyamurthy Nagar	Residential area / non-fishing village	✓		
10	Kargil Nagar	Residential area / non-fishing village	✓		
11	Rajaji Nagar ¹	Residential area / non-fishing village	✓		

*VOC Nagar is predominantly a residential area, with fewer than 100 families still relying on fishing as their primary livelihood.

The initial intent was to include Mugathwarakuppam (a traditional inland fishing village) in the study – however, the community refused to be part of the study. This is likely because of the community’s sense of continued neglect by authorities and lack of attention despite multiple attempts to voice their needs through interactions with government, academic and other civic institutions since the 1990s when the community was resettled in order to set up the North Chennai Thermal Power Station (NCTPS) by the

¹ For the purposes of data analysis, Rajaji Nagar has been combined with Kargil Nagar. The total number of surveyed villages are thus, eight.

Tamil Nadu Electricity Board (TNEB). Also, news of some villagers being bribed by CPCL to remain silent about the December 2023 oil spill incident made other villagers feel that by speaking up against the company, they might be at risk of adverse reaction.

Data Collection and Analysis

The essence of a Social Impact Assessment at the community level lies in the collection of relevant socio-economic data at that scale. Given the paucity of such data, this study largely depended on primary data collection through household survey questionnaires, in-depth semi-structured interviews and focus group discussions (FGDs). Secondary data from policy documents, existing academic and non-academic literature, and Marine Fisheries Census Tamil Nadu, 2016 data were also used in this study.

Household Survey

To gain a deeper understanding of how communities were affected by the oil spill and the general socio-economic conditions in the community, a random sample survey of 436 households was conducted. The survey employed a multistage clustering approach to randomly select households. It is also important to note that though households were randomly selected, non-response may introduce bias. After, data cleaning, the final sample size was 428. Approximately ~10% of total number of households were surveyed from the identified villages, including five fishing villages and three residential ones, as listed below.

Table 3: Sample units

S. no.	Village	Number of samples
1	Ennore Kuppam	30
2	Ernavur	51
3	Kargil Nagar	54
4	Kattukuppam	38
5	Nettu Kuppam	41
6	Sathyamurthy Nagar	104
7	Sivan Padai Veedhi	40
8	Thazhan Kuppam	70
	Total	428

The survey questionnaire was prepared to cover the three key social impact components as identified in the study goal earlier - (i) livelihood and income, (ii) property/resource

damage, and (iii) health. In addition, to identify place-specific vulnerability parameters, information on household level gender and age characteristics, education level, health conditions, earning members, income, duration of stay in Ennore etc was also collected through the survey². This study engaged community youth along with study team members for conducting the survey to ensure that the respondents were more at ease and open while sharing their experiences and conditions.

Figure 3: Interviewers at work.



FGDs/ Interviews

To complement the survey data with deeper explanations, focus group discussions and individual interviews were conducted. Five FGDs were conducted with residents of Kattukuppam, Thazhan Kuppam, Nettu Kuppam, VOC Nagar, and Sivan Padai Veedhi. The FGD participants were almost always male village leaders and fishers, except in VOC Nagar where the three participants included two women. The average count of participants for the other FGDs is around 10.

Eight in-depth semi-structured Key Informant Interviews (KIIs) were conducted. Four of these were with village leaders, one with a woman fish seller, one group interview with staff from the Urban Primary Health Centre (UPHC) in Thazhan Kuppam, and two individual interviews – one with a former village leader of Kattukuppam and another with a resident from Kattukuppam village who runs a local NGO and is very active in the community.

² The survey form can be accessed here: <https://ee.kobotoolbox.org/x/sYSfhSme>

Figure 4: FGDs in different villages.



Policy Review

To understand the management of and response to the CPCL oil spill incident and situate it within the context of national, state and local governance systems handling such situations the following disaster management policies were examined: the National Oil Spill Disaster Contingency Plan (NOS-DCP) 2015, the Tamil Nadu State Oil Spill Contingency Plan (TN-SOS-DCP) 2024, the Chennai city Disaster Management Perspective Plan 2024, and legal documents submitted to the NGT for its *suo motu* case on the oil spill.

Data Analysis - Social Impact and the Influence of Emplaced Social Vulnerability

In this study, the survey data was used specifically for developing a Social Impact Score (SIS). In explaining the variations within the score for the different villages, basic descriptive statistics on social vulnerability parameters (such as the number of earning members, children and elderly in the family etc) were used.

Social Impact Score

Data on livelihood, property damage, and health collected through the survey were used first to measure the livelihood impact score (LIS), property damage impact score (PDIS), and the health impact score (HIS) separately, at individual scale. Then, the scores of these three indicators were weighted and aggregated to find the total Social Impact Score (SIS) for each respondent. Following this, the LIS, HIS, PDIS and SIS were aggregated at the village-level for comparison. The scores were calculated considering the following sub-indicators.

Table 4: Variables included in the scoring.

Livelihood Impact Score (LIS)	Property Damage Impact Score (PDIS)	Health Impact Score (HIS)
Job Loss/affected	House/household damage	Change in health conditions
Income Decrease/ Loss	Cost of damage	Increase in health spending
Days of income lost	Boat/fishing equipment damage	New physical health symptoms
		Mental health symptoms

To translate the responses/raw data (which is in both categorical and unstructured textual format), it needed to be changed to a numerical score. Thus, the ordinal responses were recoded into integers reflecting increasing levels of impact contribution. For example, for the sub-indicator “no. of days income was reduced post spill”, the responses were recoded as follows: less than 10 days (1), no income for one month after the oil spill (2), no income for several months after the oil spill (3) and no income till now (4). This gives a higher score to the response indicating greater impact. The recoded sample responses were then normalised by Min-Max normalisation (used responses were categorical) to ensure all values are within a specific range [0, 1].

$$X_{norm} = \frac{X - X_{min}}{X_{max} - X_{min}}$$

Where X_{norm} is the normalised value

X is the original value

X_{min} is the minimum value in the data point

X_{\max} is the maximum value in the data point.

The normalised values were aggregated to arrive at the individual sample score. The individual sample scores are clustered to like values. The SIS for each respondent was calculated as an aggregation of their individual LIS, HIS and PDIS, which was weighted. The village-level scores were computed as the mean of data points within each respective village (Maxwell et al., 2011). The Social Impact Score (SIS) is computed as an aggregation of the LIS, PDIS, and HIS for individuals in each village.

Weightage

To better reflect the ground reality, weights were added to the three variables – LIS, HIS and PDIS – 50% for LIS, 30% for HIS and 20% for PDIS. This weighting of the Social Impact Index is a heuristic and data-driven approach informed by the quantitative survey results and qualitative data findings through interviews and FGDs. This study utilises the mean value of each component after applying the weights as a practical approximation to estimate the overall extent or prevalence of impact. The employment of qualitative findings to determine weighting distribution takes into account the historic socio-cultural-political characteristics of the study site thereby making the weighting process more accurate. Therefore, this weighting scheme is designed to reflect the relative magnitude of impact observed across these key dimensions within the surveyed communities (OECD, 2021).

Analysis

Different types of correlation tests were run between the three index scores and socio-demographic variables which were not used to determine the scores. These variables included the job of the primary earning member, distance to the spill site, demographic variables such as the number of dependent family members in the household (elderly and children) and so on. Depending on the type of variable analysed i.e. continuous, categorical, ordinal variables etc, the appropriate correlation tests were used to test the relationship between variables. The correlation tests used were:

- Chi-square Test: Used to test relationships between categorical variables by checking whether the distribution of values differs across groups. The chi-square statistic is represented by X^2 .
- ANOVA (Analysis of Variance): Used to compare the mean of continuous variables across multiple groups to see if at least one group is significantly different. ANOVA is represented by F .
- Pearson's correlation: used to test liner relationships between continuous variables that are normally distributed. Pearson's correlation coefficient is represented by r .

- Spearman's rank correlation: Used to assess the strength and direction of association between two ordinal or non-normally distributed variables. It uses the rankings of data from each variable (e.g., from lowest to highest) rather than the raw data itself. Spearman's rank correlation for a sample is represented by r_s (Montgomery et al. 2022).

Based on the strength of the score, Pearson's and Spearman's correlation coefficients were categorised as weak, moderate or strong based on the following scale: 0 = none, -/+0.1 to -/+0.3 = weak, -/+0.4 to -/+0.6 = moderate, -/+0.7 to -/+ 0.9 = strong, 1 = perfect correlation (Akoglu, 2018).

Descriptive Statistics

To make sense of the variation in social impact scores amongst the villages, descriptive statistics, specifically the measures of central tendency (mean, median, mode) of vulnerability parameters were assessed. This helped understand how place-specific social vulnerability, such as age structure within families (presence of elderly, children), female headed households, etc., may explain variations between impacted villages.

The measure of central tendency provide an estimate of how a group did as a whole. In this regard, the distribution of the data was analysed for the mean (average value of the distribution), median (middle value of the distribution), and mode (the most repeated value in the distribution). The mean was used as the primary measure of central tendency to estimate the impact scores (HIS, LIS, PDIS, SIS) as the data approximated a normal distribution. The median and mode were also examined to verify robustness. This assessment of the likely link between the emplaced vulnerability and the social impact score was also critically driven by the qualitative analysis of focus group discussion and interview data.

Textual Data Analysis

Qualitative data collected through focus group discussions and in-depth interviews were transcribed and manually processed using QDA Miner Lite, an open-source qualitative data analysis software. The transcripts underwent an iterative process of open coding whereby codes were identified directly from the data rather than being pre-determined - this is also described as analytic induction that involves making sense of textual material using in-vivo/emic codes. These emic codes represent how the community members experienced, perceived and interpreted the impact of the Ennore oil spill on their lives. Eventually, etic or thematic codes were developed as initial codes were revisited and grouped into broader, emerging themes (Crang, 2023; Cope, 2010).

For instance, health impacts were initially coded as "nasopharyngeal irritation," "skin disease," and "cancer". This coding revealed that while some health conditions were immediate reactions to the spill, others were long-term. From this understanding, the

codes were organised into thematic categories, such as “immediate health effects,” “acute health conditions,” and “chronic health conditions.”

This reiterative process of identifying codes and themes using both an inductive and deductive approach helped develop a more nuanced perspective of the various impacts the oil spill had on communities. The qualitative data complemented the quantitative data, presenting a more in-depth understanding of the chronic vulnerabilities and the nature of impact of the oil spill incident on the Ennore community in 2024.

Limitations

- Without benchmarked data from unaffected comparison villages or baseline information from before the oil spill, it is difficult to directly attribute the observed impacts solely to the spill. Apart from the absence of a control group, pre-existing vulnerabilities may also be contributing factors.
- Additionally, the ammonia gas leak that occurred around the same time may have influenced community perceptions and responses, further complicating the determination of the causal relationship to the oil spill.
- Although multistage clustering was used to achieve randomisation, the total sample size of 428 may not generalise across the broader affected population. Additionally, as the sample collection was proportionally distributed across all villages, the smaller number of data points in certain regions could cause more skewed results in these villages.
- Information on health conditions, work disruption, effects of cleanup efforts etc. was self-reported through a perception-based survey. As such self-reported data introduces the potential for perceptual/memory-based inaccuracies or personal biases, which may lead to underreporting or exaggeration.
- The study may reflect the experiences of individuals or groups who were more accessible, vocal, or visibly impacted. This may induce selection biases which could impact findings. For example, focus group discussions (FGDs) were often led by predominantly male village heads whose views may not fully capture the diversity of community impacts.
- Some survey variables used broad categorical ranges (e.g., “15 to 30 days”), which reduce the ability to distinguish between significantly different experiences (e.g., 1 vs. 14 days of impact are treated the same), thereby limiting the granularity and precision of analysis.
- While multivariate and regression analyses were conducted during the study, only bivariate analyses are presented in this report to maintain clarity and focus. Although it may limit the ability to account for confounding factors or identify underlying patterns and relationships.

CHAPTER 3: SOCIAL IMPACT SCORE OF ENNORE OIL SPILL

Introduction

The Ennore oil spill, triggered by Cyclone Michuung, significantly impacted both fishing and non-fishing villages in and around the areas. The severity of the impact varied across villages due to differences in socio-economic conditions, geographic location, and pre-existing vulnerabilities. Based on survey data, a Social Impact Score (SIS) was calculated for the eight affected villages, representing an average score derived from the weighted impact on livelihoods, health, and property damage at the household level. This chapter highlights the overall SIS and the livelihood impact score (LIS), health impact score (HIS) and property damage impact score (PDIS) for the villages under study. It also highlights some key vulnerability parameters that were found to have significant correlation with the LIS, HIS, and PDIS. This assessment helps:

- To understand which villages were more or less impacted.
- To gauge how such impact was shaped by the community’s socio-demographic or geographic conditions which rendered them more or less vulnerable to the oil spill event.

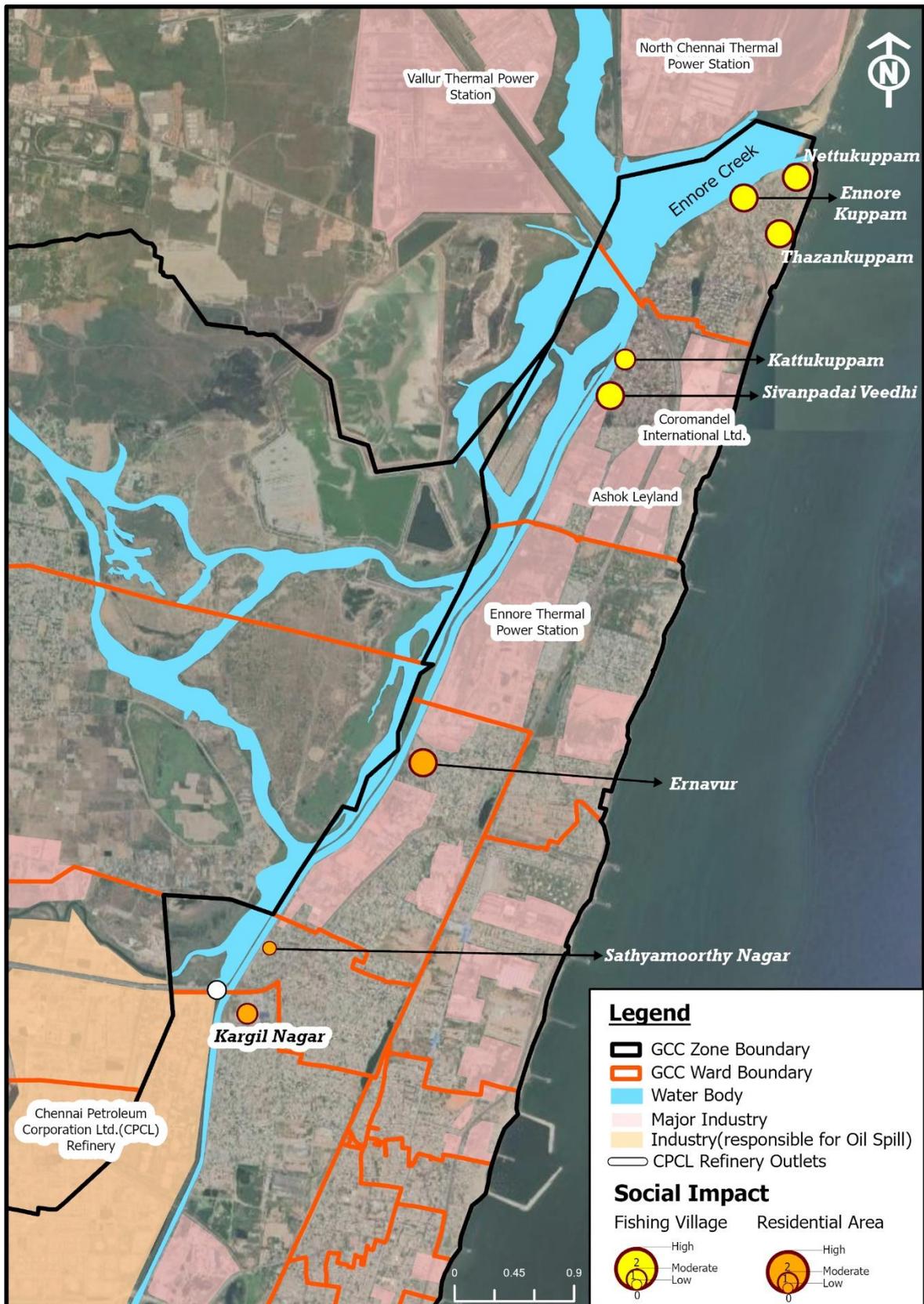
Social Impact Score (SIS)

The Socioeconomic Impact Score (SIS) provides an overview of the distribution of impacts among the affected villages. As seen in the figure below, five of eight villages recorded a score exceeding 2.0, indicating a high level of impact. These highly affected villages include Ennore Kuppam (2.07), Sivan Padai Veedhi (2.06), Ernavur (2.05), Thazhan Kuppam (2.04), and Nettu Kuppam (2.04). Notably, these are all traditional fishing villages engaged in either inland or marine fishing. However, Ernavur, despite being a non-fishing village, exhibited a similarly high impact score. This can be attributed to its proximity to the oil spill site, where floodwaters mixed with oil inundated the entire village, resulting in widespread contamination and property damage.

Figure 5: Villages ranked by SIS.



Map 1: SIS of Villages represented on a map: Source: Okapi Research and Advisory



In contrast, Kargil Nagar (1.90) and Kattukuppam (1.85) recorded moderate SIS values, indicating a comparatively lower level of impact. Kargil Nagar, a non-fishing village located south of one of the oil spill sites, experienced inundation primarily near the Buckingham Canal, leaving the rest of the village relatively unaffected. Similarly, Kattukuppam, an inland fishing village, recorded a lower-than-expected SIS score, possibly due to lower property and health-related impact scores, despite the village's dependence on fishing for livelihood.

Sathyamurthy Nagar (0.93), a non-fishing village, recorded the lowest SIS score, reflecting significantly reduced adverse effects compared to the other villages. This lower score is attributable to consistently lower values across all SIS components, indicating that the overall impact in this village was less severe.

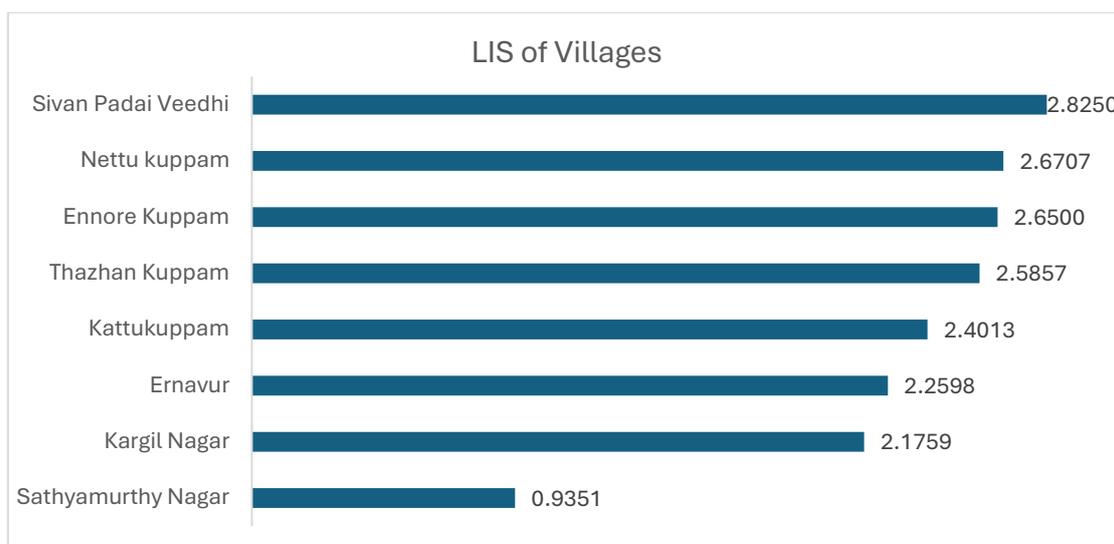
It was also found that there is **a moderate positive correlation between the SIS and the location of the village ($r_s = 0.514$; $p < .01$)** which means that as the villages get further away from the oil spill site, the SIS tends to increase. This could be attributed to the dependence on fishing-related activities and localised differences in the villages affecting SIS more significantly than just the proximity to the oil spill site.

Place-based Vulnerability Parameters Shaping Socio-Economic Impact

Livelihood Impact Score (LIS)

A village-level aggregation of the livelihood impact score reveals that the villages with the highest livelihood impact were Sivan Padai Veedhi, Nettu Kuppam and Ennore Kuppam (see figure below). While all villages record an LIS of more than 2, Sathyamurthy Nagar stands out as an exception, with an LIS below 1.0, suggesting a significantly lower level of livelihood impact compared to the other villages. Specific factors driving the LIS are reduction in the income of the primary earning member due to the oil spill and the number of days of income loss. This suggests most respondents in these villages suffered from loss of income due to the oil spill.

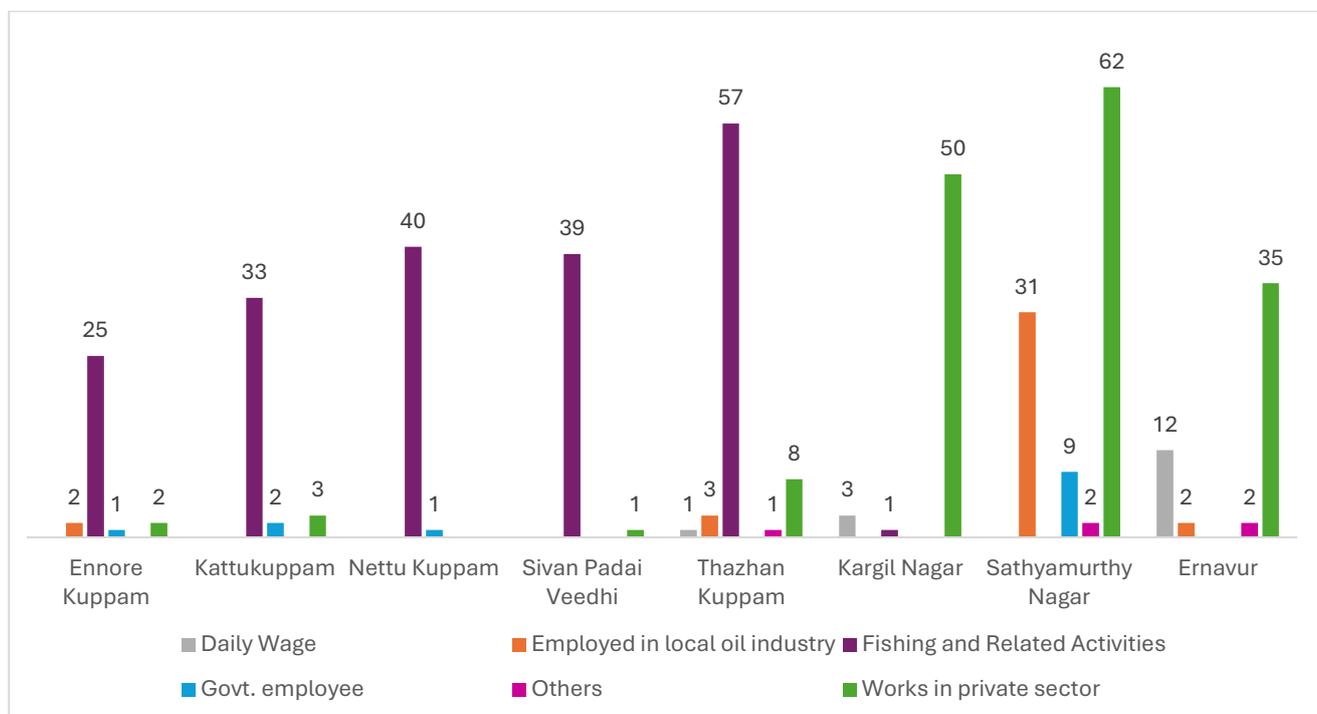
Figure 6: Villages ranked by LIS.



The following section tries to explain the possible variance in the LIS across villages.

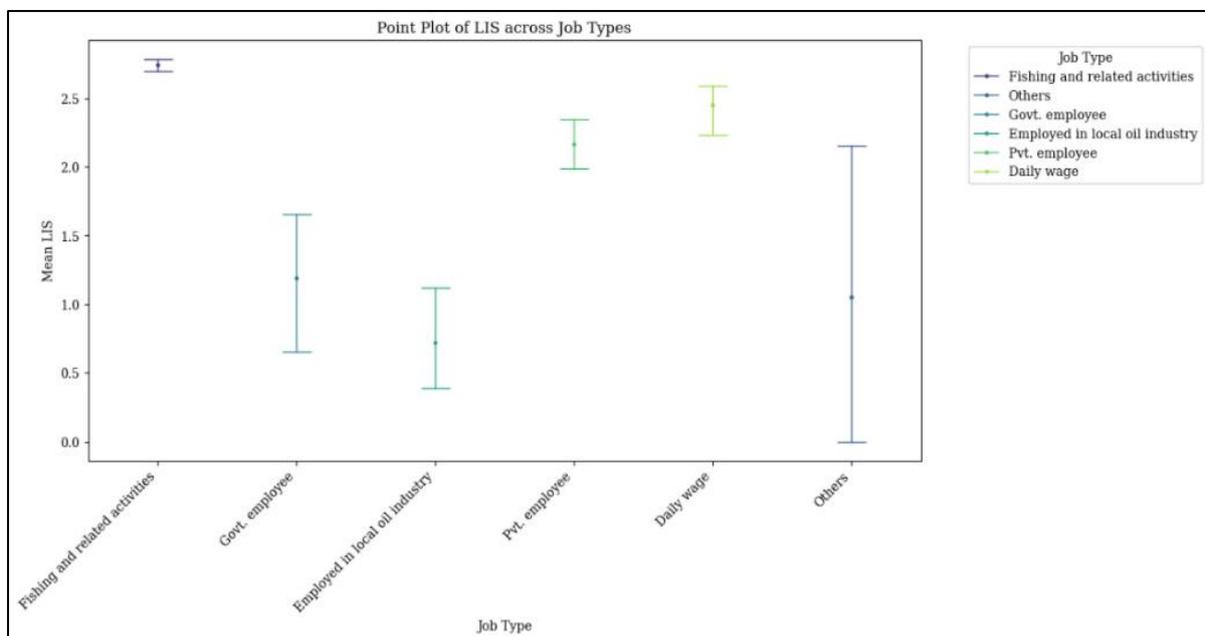
First, it was found that among all the households surveyed, all the primary earning members engaged in fishing activities lived in the traditionally known fishing villages of Ennore Kuppam, Kattukuppam, Nettu Kuppam, Sivan Padai Veedhi and Thazhan Kuppam. While the primary earning members engaged in non-fishing activities predominantly came from non-fishing villages like Sathyamurthy Nagar, Ernavur and Kargil Nagar (see figure below).

Figure 7: Distribution of jobs of primary earning members by village.



Further, a **statistically significant difference ($F = 66.78, p < .01$)** exists between the job of the primary earning member and the Livelihood Impact Score (LIS) i.e. the type of job of the primary earning member of each respondent’s family significantly impacts LIS. **Families whose primary earning members have jobs in fishing and related activities like curling, fish selling etc were found to be more severely impacted by the Dec 2023 oil spill than those with non-fishing related jobs.** It was also found that the variance in the impact experienced by these families was limited, as indicated in the first column of the chart (see figure below). Whereas other families which are not dependent on fishing or related activities seem to have a high variance or difference in impact depending on the nature of their job. This suggests that other factors are influencing the impact of households who are not engaged in fishing and allied livelihoods.

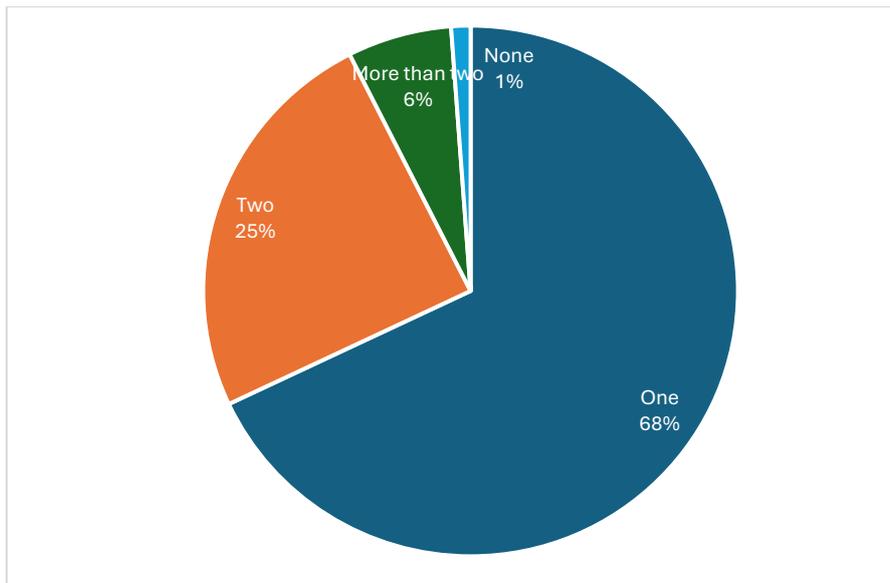
Figure 8: Plot showing variance in LIS across type of job.



Therefore, it can be ascertained that the livelihood impact is significantly higher for families who are dependent on fishing or related activities. It is also clear that the majority of these families live in fishing villages, which results in the higher LIS for these villages.

Next, the majority of the survey respondents (68%) reported **that they had only one earning member in their family**, which suggests that if the livelihood of this member is disrupted (see figure below), it is likely to have a significant effect on the vulnerability of the entire family.

Figure 9: Number of Earning Members in a Family



There was a **weak negative correlation** ($r = -0.27, p < .01$) between the number of earning members in the household and the LIS, indicating that as the number of earning members in a family reduces, their LIS increases (green and yellow portions of the column) due to the oil spill (see figure below).

Figure 10: Comparison LIS and number of earning members.



It was also found that there is a **moderate positive correlation between LIS and site location** ($r_s = 0.652; p < .01$) which suggests that as the villages get farther away from the spill site, the LIS slightly increases. This result is not surprising since livelihood was impacted more for fishers and those engaged in fishing-related activities who lived in

fishing villages further downstream. The community experiences of impact on livelihoods are explained in detail in the next chapter through community voices.

Health Impact Score (HIS)

HIS quantifies the extent to which the oil spill affected the health of households in the project area, aggregated to the village level. The analysis highlights that Ennore Kuppam, Sivan Padai Veedhi, Ernavur and Thazhan Kuppam recorded high HIS scores exceeding 2.0, indicating severe health impacts on the 0 – 3 HIS scale (see figure below). FGDs revealed that residents from these villages commonly reported symptoms such as skin rashes and breathing difficulties, which they associated with oil exposure (see the next chapter for more details). The remaining three villages recorded moderate impact scores, with Kattukuppam, Nettu Kuppam, and Kargil Nagar exceeding 1.7, suggesting significant but slightly lower health risks. Sathyamurthy Nagar stands out as an exception, with an HIS below 1.0, indicating a comparatively lower level of health impact.

Specific factors driving the health impact score for each village are the increase in household per month spending on health after the oil spill and the presence of new physical health issues in family members right after the oil spill.

Figure 11: Ranking of villages based on HIS



A correlation test was run to check the strength of the relationship between the location of each village and the HIS. It was found that there is a **moderate positive correlation between the HIS and the location of the village ($r_s = 0.512$; $p < .01$)** which means that as the villages get further away from the spill site, their HIS keeps increasing. This could be because fishing villages were involved in clean-up activities due to which there was more consistent exposure to oil contamination. Further, the ammonia gas leak, which occurred near the coast and a few days after the oil spill, may also have influenced the

respondent's answers. Therefore, the reporting of health issues may have been aggravated due to these reasons.

Additionally, **a statistically significant difference was found between the HIS across villages with respect to oil clean-up activities ($F=9.09$, $p<.01$) which suggests that villages where more residents were involved in oil clean-up efforts tended to have higher HIS³**. These findings are corroborated by FGDs with fishers across villages who underscored the inadequacy of safety equipment provided and the resultant impact on the health of those involved in clean-up activities (see the next chapter for further details).

Property Damage Impact Score (PDIS)

PDIS quantifies the extent to which the oil spill affected household items and material possessions like boats and fishing nets at the household level and then aggregates to the village level. The analysis indicates that non-fishing villages – Ernavur, Sathyamurthy Nagar and Kargil Nagar – recorded higher PDIS values (above 1.0), whereas fishing villages exhibited relatively lower scores (below 1.0) (see figure below). The non-fishing villages were also the ones which were relatively closer to the oil spill site: **a weak negative correlation between PDIS and site location ($r_s = -0.383$; $p<.01$)⁴ was found**. This indicates that the PDIS keeps increasing for villages as they get closer to the spill site, whereas villages farther from the spill tend to have lower PDIS values. Non-fishing villages i.e. Sathyamurthy Nagar, Kargil Nagar and Ernavur were located closer to the spill site. This variation between fishing and non-fishing villages arises because non-fishing villages experienced severe flooding mixed with oil, which inundated homes and caused extensive damage to household items. Many residents reported that oil-contaminated floodwaters reached up to one metre inside their homes, resulting in irreparable damage to essential appliances such as washing machines, refrigerators, water pumps, and other electrical items. The high oil density made cleaning or repairing these items impossible, as the residue stuck to furniture, appliances and other belongings.

By contrast, fishing villages did not experience significant damage to houses or household items, but the primary impact was on boats and fishing nets. Inland fishers, who dock their boats in the river, suffered damage to their vessels which were directly exposed to the contaminated water (see the next chapter for further details). However, it must be noted that fishing villages in general played an important role in cleaning up the oil spill, and exposure during cleanup also may have caused damage to boats. Thazhan Kuppam's score of 0.70 and Nettu Kuppam's score of 0.94 may account for this. On the

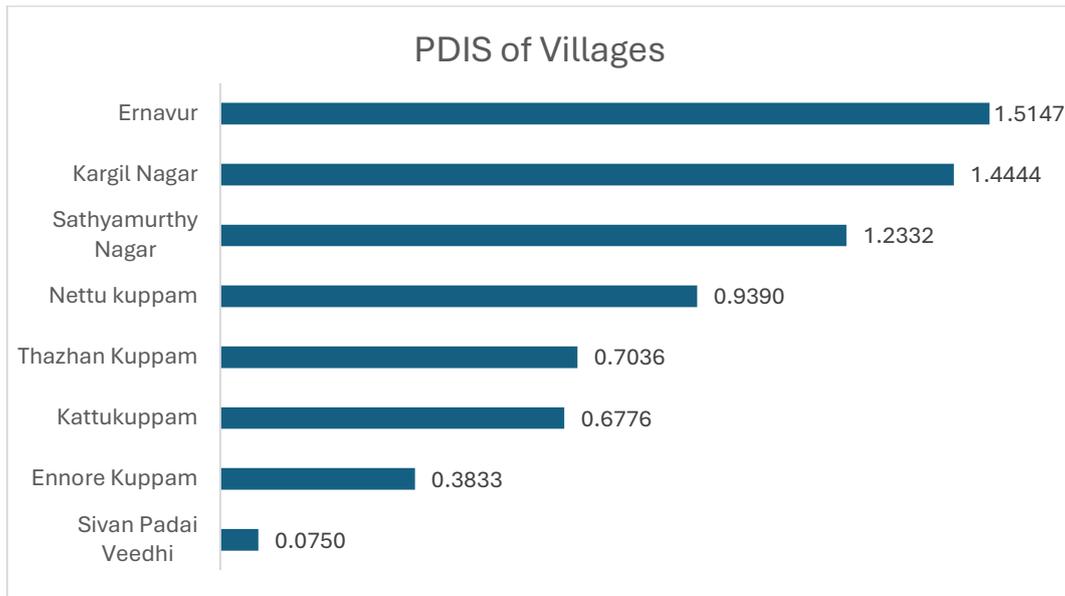
³ Since the sample size for the number of survey respondents who reported being a part of the clean-up activity was small ($n=52$), non-parametric tests were run to double check the results. Specifically, the Mann-Whitney U test and bootstrapping to estimate confidence intervals were used to address the small sample size.

⁴ The Pearson's correlation is statistically significant but weak, suggesting that proximity to the spill does have some influence on PDIS, though other factors are likely also contributing.

other hand, Sivan Padai Veedhi had a lower score, suggesting either less participation in cleanup efforts or that their boats were docked in elevated areas, reducing exposure to contamination.

Specific factors which contributed to this score were damage to fishing equipment/boats due to the oil spill, damage to households and property due to the oil spill and estimated cost of household damage.

Figure 12: Ranking of villages based on PDIS.



Conclusion

These findings illustrate how different communities i.e. fishing and non-fishing communities are impacted differently by the oil spill due to specific socio-demographic or geographic conditions. This also highlights the need for targeted rehabilitation plans for different villages. For instance, while one-time compensation for those experiencing property damage may suffice, those affected by job loss and income loss require medium to long term attention – that needs to go beyond one-time compensation. The assessment of pre-existing vulnerability parameters also emphasises the need for long-term planning to address issues like chronic disease, which is possibly an indicator of the area’s continued exposure to polluting industries. Beyond reactionary and rehabilitation efforts, there is a need to reduce such pre-existing vulnerability parameters to strengthen community resilience. Similarly, the higher livelihood impact on those with single earning members suggests perhaps the need for alternative (even non-fishing-based) livelihood opportunities and skilling to improve household-level economic participation.

The next chapter presents voices from the community which further provides a deeper understanding of place-based conditions that, in many cases, have persisted over long periods making communities in Ennore specifically vulnerable to the impact of disasters like the Ennore oil spill.

CHAPTER 4: VOICES FROM THE COMMUNITY

Livelihoods

Context

Fishing has been the traditional occupation for communities in Ennore, indicative of the high number of traditional fishing villages (eight) to be found here. Apart from these traditional villages, there are also other villages with relatively newer fishing communities who are dependent on the creek, river and sea for their livelihoods such as VOC Nagar (Jayaraman et al., 2024).

However, **severe environmental degradation has occurred over the past few decades** with the presence of several heavy industries, indiscriminate dumping of industrial effluents, sewerage and solid waste in the Buckingham Canal, Kosasthaliyar River and Ennore Creek, ultimately reaching the sea (Jayaraman et al. 2024; Kumar 2017). FGD participants from several villages have also reported seeing effluents and solid waste being dumped in these water bodies over the years. This has **significantly limited the extent to which communities' fish, in terms of reduced fish breeding grounds, change in species diversity and decreased quality of the catch**. Through several FGDs, fishers brought out how these issues have changed the waterscape in the region. Fishers now have to go further out to fish: FGD participants from Kattukuppam said that the previous two generations used to travel only 3km into the Kosasthaliyar River to catch fish, whereas over time this has become 15km, and even then, a similar quantity and quality of fish were not found in the river. Participants from Kattukuppam and indeed all the villages who participated in FGDs and interviews described how the deteriorating quality of water had led to a change in species diversity and quality: *“The companies have come and encroached upon all the breeding spots, the mangrove forest areas where the fish lay eggs and breed. Within 5 kilometres there is Kamaraj port and L&T port.” – FGD Participants from Kattukuppam*

“...fly ash gets deposited in the mangroves and causes it to wither; it becomes like acid. Fish are not able to go there and reproduce.” – FGD Participants from Thazhan Kuppam

“We used to get a lot of shrimp. Amongst the fishes, we used to get Prawn, Kota sala, Kalavan, Sankara, Kelanga, Koduva, ooda, Nethili (so many used to be in the river), Saala or kenda, Veral, Shark, and Paarai. We used to get a lot of Nethili. To some extent these are sea fishes. If 50 boats go, at least 10 boats will catch sharks. This is a place where we used to get so much; the water used to be clear and deep. The fish used to come here for breeding. Whatever was in the sea, we used to get it here. Now, there is nothing left: no koduva, sankara, shrimp, or kelanga. We aren't catching anything anymore.” – Senior resident from Kattukuppam

Further, some of the participants interviewed also spoke about how the pollution and hot water continuously released from a thermal power station into the Ennore Creek have

destroyed fish breeding grounds, especially those in the mangroves. For example, a participant from Kattukuppam stated that there used to be a lot of **mangroves in Ennore, but these had been systematically destroyed** and replaced with companies. As a result, the fish that reproduce in the mangroves were also gone, impacting livelihoods.

Figure 13: Hot water (indicated by white steam) being released into the Ennore Creek from the thermal power station (picture taken by IIT Madras field team in Sep 2024)



All these issues were already impacting the earnings of the fishers before the Dec 2023 oil spill. Fish catch and fish quality had significantly reduced over time, resulting in **fishing no longer being a viable primary livelihood** option since fishers were unable to get even 20% of their old income from it (fisher from Kattukuppam). Fishers from other villages also shared similar experiences:

“Before, we used to earn Rs. 5000 a day and a maximum of Rs. 10,000. Now we don't have the opportunity to work. We used to earn well before” – Fisher from VOC Nagar

Even though our earnings used to be 50,000 INR, we had the capacity of earning a lakh from the river... – Fisher from Kattukuppam

These findings are corroborated by several academic and news reports, including a report by Kumar (2017) where the author recounts, through in-depth interviews and discussions with Ennore Creek’s fishers, that over the past 20 years their daily income had declined on average from Rs. 5000-6000 to Rs. 500-600 per boat. Here, it is

interesting to note that the thermal power stations (NCTPS) and TNEB promised jobs to the villagers who were displaced, but these **promises were largely unkept**. Some of the other prominent industries which came up in the area later also followed suit by providing some jobs. But, in general, the number of jobs provided was limited and not transferable across generations. Kumar (2017) found that while TNEB promised employment to one member of each resettled household, these were often short-term (6-7 months) gruelling contract jobs with low salaries that were not enough to sustain a family. For a lot of families who managed to get the TNEB jobs, they work there between 7.30am and 4pm and go out for fishing and other odd jobs like weaving wire baskets before and after work to make ends meet (interview with residents in Kattukuppam). Others who have not gotten their promised jobs go out for contract work.

As such, since fishing has become unviable, fishing communities in Ennore have had to find other livelihood opportunities, which some have been able to do but others have not due to various constraints, including the lack of skills to engage in other viable alternatives.

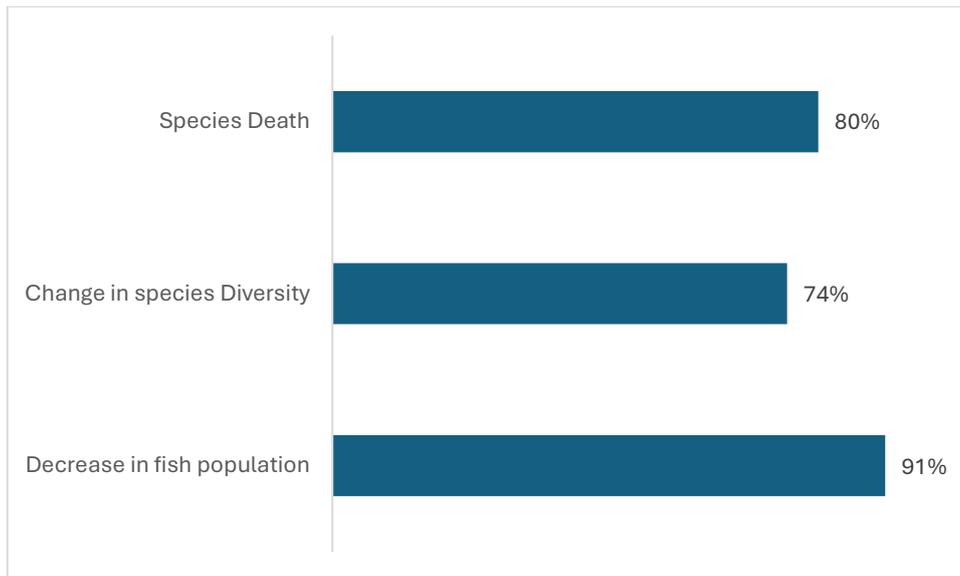
“Some fishermen have moved on to other work because they have no other option. But for those of us who don't know anything else, what can we do? There is no alternative for us; we don't know any other work.” – fish seller, selling fish in Sivan Padai Veedhi

Further, according to media reports (Pandian, 2023), members of the fishermen's union in Kattukuppam have been quoted to say that over the last decade, a lot of fishers in the locality started to take up daily wage work. Now they are working as construction workers, conservancy workers, and even security guards. As of 2023, there were only about 450 fishers in the Kattukuppam village.

Impact of the December 2023 Oil Spill on livelihood, income and property

The oil spill in Dec 2023 has exacerbated the long-standing issues, casting serious doubts on the long-term viability of fishing in Ennore. The fishing industry was severely affected by the December 2023 oil spill as it further decimated fishing grounds, contaminated the waters and made it nearly impossible for fishermen to operate. All the survey respondents who were fishers (n=137) confirmed that the fish population had died (80%) and/or changed (74%) and/or decreased (91%) since the oil spill, as seen in the figure below.

Figure 14: Reported change in fish population after oil spill.



As a result, in the immediate aftermath of the spill, fishing activities came to a complete halt for around three months, according to all interviews and FGDs. Several media outlets reported that a thick layer of oil had spread across Ennore Creek and the nearby coastal waters, resulting in **significant damage to fishing boats and nets as they became soaked with oil** (Sundaram & Yazhiniyan, 2023; Shekhar, 2023). This was reported by many survey respondents and FGD participants as well. Of 219 respondents surveyed across five fishing villages (Thazhan Kuppam, Nettu Kuppam, Kattukuppam, Ennore Kuppam, Sivan Padai Veedhi), 45% (n=98) reported that the oil spill had affected their boats/fishing equipment. Amongst the 98 respondents, 76% reported severe damage to their boats/ fishing equipment primarily through damage to the boat's surface, and around 82% stated that they could not use their boats for more than 60 days after the oil spill. The following are some reflections on how the oil spill affected fishermen's boats:

“The oil also gets soaked up by the boat and adds to the weight. Then the boat cracks under the sun because of the oil expanding. As soon as we step into the boat it breaks...When the oily water goes inside the boat, the oil settles forming a sludge...We cannot scrape and remove the oil, we have to grind the fibre down.” – FDG participant from Sivan Padai Veedhi.

“Since we park it [the boat] in the water with an anchor, it is not possible for any boat to not be touching the water. All boats touch the water compulsorily. Even now there are oil marks on all the boats. First, the paint comes off. When the paint flakes off, it exposes the fibre mat which weakens allowing water to go in easily...” – FGD participant from Thazhan Kuppam

Additionally, several of the participants spoke about how the **nets were soaked with the corrosive oil** and had to be thrown as they melted / broke when exposed to the sun.

While the boats and nets were affected, fishers across villages confirmed that the boat engines were not damaged because they were positioned at a height above the water.

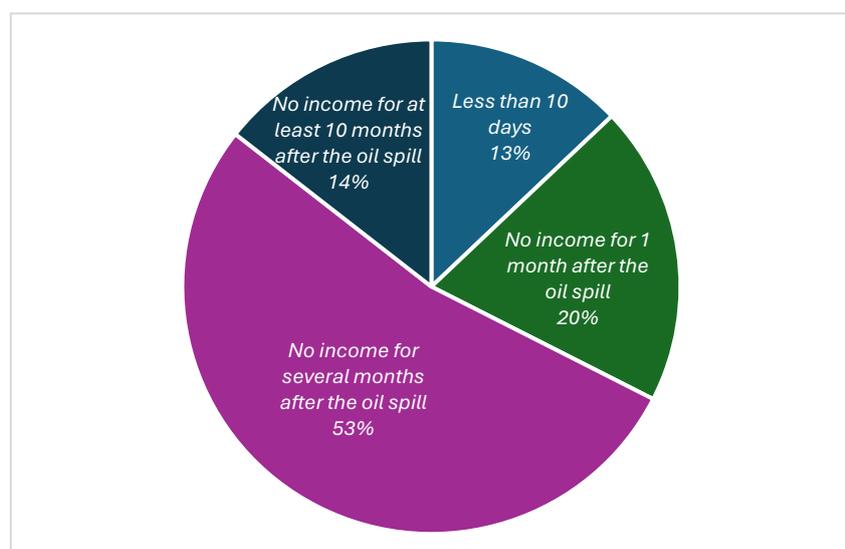
The **spill also contaminated fish species, leading to large-scale fish deaths**, and those that survived were covered in oil, making them unsellable due to health concerns (Pandian, 2024). All the survey respondents whose primary occupation is fishing reported a decrease in fish populations and/or a change in species diversity and/or extensive species deaths. Additionally, fishers across all the villages who participated in the FGDs recounted that the oil spill resulted in immediate fish deaths, including crabs, shrimps etc. Some of the participants also illustrated how, **even nearly a year after the oil spill, fish/shrimp breeding grounds have not recovered** (FGD with Thazhan Kuppam). Some fishers also spoke of specific populations decreasing:

“Normally we used to catch shrimp, crab and madavu fish. After the spill, its population has reduced. Mathi, kalathi are all dying because of the Katcha oil (crude oil).” – FGD participants, VOC Nagar.

“We are not getting those [what was available earlier] fish anymore. There used to be so many fish; whatever we asked for, we would get. The size was also bigger. Kala, Sudumbu, and Parai were common. Now, it's not the same. The taste used to be so good, but now it's different. There's no taste, and no one is craving or buying the fish anymore. The fish population has died off, and there's no business because of the oil. The fish from the river is black in colour.” – Fish seller at Sivan Padai Veedhi.

Since fishing activities came to a complete halt for nearly three months after the oil spill, fishers have had to find other occupations in the short term to sustain their families, including participating in clean-up activities. Among the 428 respondents of the survey, more than 75% of the respondents (n=326) (including nearly all the fishers) stated that their income reduced significantly after the oil spill. Among the 326 who reported reduced income, more than half (53%) stated that they did not have any income for several months after the oil spill (figure below).

Figure 15: Number of days that survey respondents had no income.



Nearly all the FGD participants mentioned that the **only work available to them was being part of the clean-up operations** for the first two months. However, even this option was not available to fishers from non-traditional fishing villages like VOC Nagar, who were actively discouraged from participating in the clean up by the larger traditional fishing villages. This could be because the latter perceived their participation in clean-up activities as a rare opportunity to earn some income during that particular period of time. Therefore, fishers from VOC Nagar largely relied on working as contract labour on large fishing boats operating out of the Kasimedu harbour.

Traditionally, fishing in the river/creek is governed by the *paadu* system, which regulates which village fishes where and what kind of boats and nets to ensure that everyone equally benefits and the river is not overexploited. Fishers from VOC Nagar are later entrants to fishing in this area and therefore do not have a prominent voice among the traditional fishing villages governing and operationalising the system. Since the villages take turns to fish, the oil spill had further reduced the working days available to them. For instance, FGD participants from Kattukuppam mentioned that they usually fish for 150 days a year, but now in the 150 days that they had, they could not take out even two boats because the catch was so poor.

Additionally, **fish sellers stated that they had no business for the first three to four months** after the oil spill. The prices of fish fell in local markets as consumers avoided buying seafood from Ennore out of fear of contamination, reducing the income potential even when the fish catch was restored. Women involved in fish processing and vending also suffered due to declining fish catches, resulting in a severe decline in their occupation and the market economy. This caused a **ripple effect of economic loss across the entire fishing supply chain** which was corroborated by all the FGD participants across the villages. For example, fish sellers from Sivan Padai Veedhi reported that the selling price of fish which was usually Rs. 100 came down to Rs. 10 and even then, there were no takers. Others had this to say:

“Even if we catch it, there are no buyers for 'ennore meen' (ennore fish) wherever we take it. We don't have any business as no one is able to eat this fish.” – FGD participants from VOC Nagar

“After hearing about the oil leakage, no one is buying river fish from here. They [presumably through media] are instructed not to buy. Because of this, in the future, fish growth and fishing will stop completely” – FGD participants from Nettu Kuppam

While the 2023 December oil spill was a significant event impacting the ecosystem and hence the local community's lives and livelihood, all the FGD participants reiterated that this was not the first time that oil had been released in the waterscape. They reported that **small quantities of crude oil have constantly been released into the Buckingham Canal and Kosasthaliyar River for several years**. A fish seller selling fish at Sivan Padai Veedhi stated that since her marriage 21 years ago, she had never eaten fish from the river because it smelled like oil. Others from Kattukuppam, Thazhan

Kuppam and Nettu Kuppam revealed that some amount of oil has been continuously let out into the river for at least a decade or more.

“The company lets out waste oil frequently. Whenever it rains, they let it out. It is so visible this time only because the amount they let out is more.” – FGD Participants from Thazhan Kuppam

As a result of the constant pollution and oil contamination, boats and fishing nets are not lasting as many years as they used to in the past. Fishers from Sivan Padai Veedhi reported that their **fishing nets used to last for at least two years but are now lasting only three months due to the water’s condition.**

Even as immediate cleanup efforts were conducted, the ecological damage to marine life is expected to last for years. Recovery of fish populations may take significant time, and the persistence of oil residues in the water and soil sediments will likely impact the health and reproductive cycles of fish and other marine species, causing long-term livelihood challenges for the local fishing community.

Property Damage to Fishing Communities

As illustrated above, **economic losses to the fishing communities were immense** as fishing is a daily wage activity, and even short disruptions can lead to devastating financial consequences for these families. The sudden halt in fishing activities resulted in significantly less disposable income and left families unable to pay off existing debts, pushing them further into poverty (Koushik, 2023). While the government did announce some compensation (discussed later) and 80% of the survey respondents reported receiving it, the compensation amount was not enough to cover even 50% of the cost of repairing damages to the fishing equipment, as reported by study participants.

With respect to boats, **among the survey respondents who reported boat damage (n=98), 62% spent Rs. 25,000 or less for repair, while 17% reported spending between Rs. 25,000 and Rs. 50,000.** This was endorsed by fishers from Kattukuppam and Sivan Padai Veedhi, who mentioned that depending on the extent of the damage, **they spent anywhere between Rs. 5,000 and Rs. 50,000 to repair boats,** but since the boats were in the sun and the oil settled in the boat, costs were likely to be on the higher side.

Depending on the size, nets were priced between Rs. 10,000 and Rs. 1 lakh and the **cost of replacing/repairing fishing nets is as or even more expensive** than buying new nets. Those with the ability to pay out of pocket do repair and replace damaged nets, but others who are already financially vulnerable are forced to take loans, pushing them further into debt.

While fishers were compelled to buy new nets because the oil caused their existing ones to rot, the new ones now had a reduced lifespan due to being exposed to the same waters. Thus, fishers had to first reinvest large sums of money to buy nets and knit them

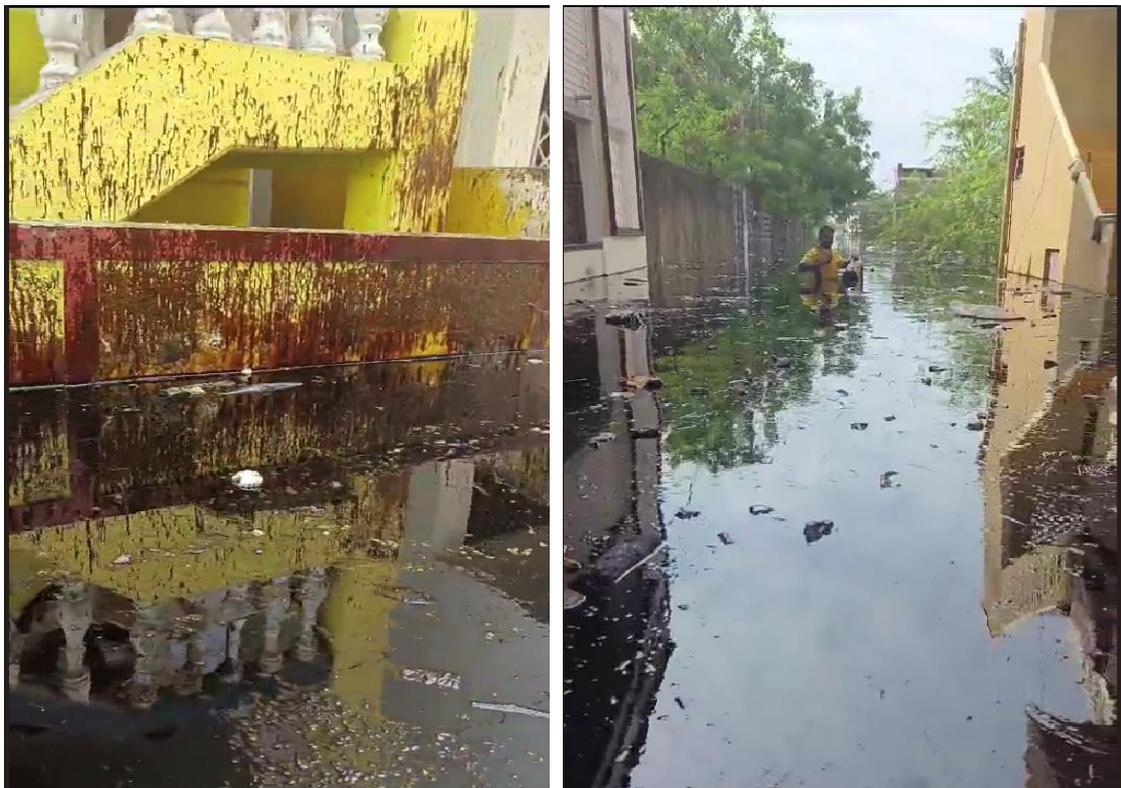
– which takes 10 days to a month – for the nets to then last only 3 months, whereas previously they lasted 2 years (FGD participant from Sivan Padai Veedhi).

However, from the various discussions with the fishers, it was learnt that while they are all members of the respective co-operative society in their villages, they do not seem to have access to boat / net insurance. The society seemed to only assist with buying nets and boats or give loans for starting businesses like fish processing etc. but not for replacing damaged equipment (interview with a senior resident from Kattukuppam). It is interesting to note that official compensation from the government came to the fishers through the cooperative societies and has been discussed in detail later.

Property Damage in Residential Areas

A significant proportion of non-fishing communities were also impacted by the Dec 2023 oil spill, primarily through oil-contaminated flood waters entering houses. Through the survey, it was found that nearly 50% of respondents across fishing and non-fishing villages recounted damage to their home/household items/ vehicles due to the oil spill. It is important to note that **98% of all the respondents surveyed in residential areas of Sathyamurthy Nagar, Kargil Nagar, Ernavur and Rajaji Nagar reported damage to their home/household items/ vehicles.**

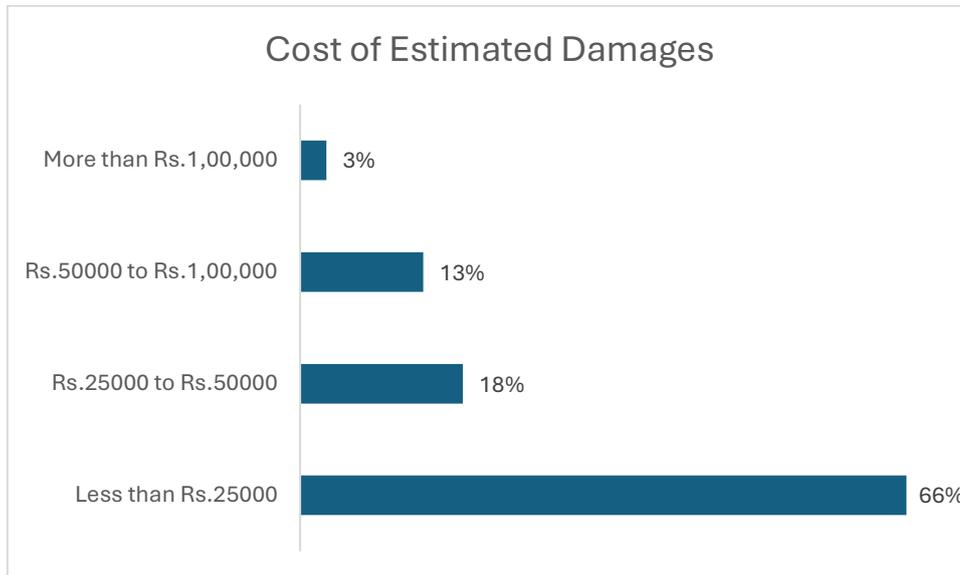
Figure 16: Oil inundated houses in Ernavur and surrounding areas just after the spill.



Respondents who confirmed that they had damage (n=209) also discussed the estimated cost and how much they spent to repair/replace items: 66% estimated the cost of the damage was around Rs. 25,000 or less (figure below). Nearly half the

respondents (49%) whose possessions were damaged seem to have taken loans to repair or replace their items.

Figure 17: Cost of estimated damage to household items.



Compensation

As reported in the press, the Department of Fisheries and Fishermen Welfare provided three types of compensation as per the directions of the National Green Tribunal. An amount of Rs. 10,000 was given to 780 fishermen for boat damages, Rs. 12,500 was given to 2,300 families whose houses were damaged and who lost their livelihoods due to the spill, and Rs. 7,500 was given to families that had oil-mixed floodwater enter their houses (Padmanabhan, 2024a). However, **some impacted communities (fishers or those whose houses were inundated) were not identified for compensation.** For instance, residents of some streets of Ernavur, a village identified in IIT Madras' Preliminary Assessment Report 2024, and fishers in VOC Nagar (identified by this team through field observations and interactions) were not provided with compensation.

Additionally, according to FGD participants across villages, CPCL, by way of compensation, had promised to clean damaged boats and inundated houses of those affected; however, they failed to do so. Participants stated that the company also made promises of providing a monthly financial compensation for six months and employment to the residents of the affected villages; however, this too did not happen.

Communities that received compensation were unhappy with it as they perceived it to be a short-term consolation for a persistent problem and inadequate to the damages incurred. For instance, FGD participants from Sivan Padai Veedhi believed that when there was a problem, the company which caused the problem would provide rice sacks and sarees to appease the villagers. They also stated that the compensation amount provided was not enough, considering the nature of the problem: *"They gave Rs. 12,000 once but this is a recurring problem. How long will that Rs. 12,000 last?"*.

Respondents from Thazhan Kuppam had this to say, *“The government announced 12,500 INR as compensation, and for boat damage they gave 10,000 INR separately. We then filed a petition saying this is not enough. After we put a case in court, they responded saying that this is only an initial amount. The court has not ruled on this matter yet.*

Aside from the official cash compensation, CPCL supposedly provided material relief to residents who expressed derision as they saw this as an attempt to appease the community.

Confusion with compensation received for the Ammonia gas leak: Quite a bit of confusion was recorded by the research team during discussions regarding compensation. This confusion largely stemmed from the leakage of ammonia gas from Coromandel International Limited on 26th December 2024, which occurred around two weeks after the oil spill. Both events (i.e. the oil spill and ammonia gas leak) resulted in compensation for the affected communities, with similar amounts being disbursed and some overlap in the communities impacted.

However, while the compensation for the oil spill came from the government through an official process, it was reported by the study participants that the compensation for the gas leak was more of an informal payment made to four villages. News reports stated that Thazhan Kuppam and Nettu Kuppam received one crore rupees each, while Periyakuppam and Chinnakuppam received Rs. 50 lakhs and Rs. 35 lakhs, respectively (The News Minute, 2024). Residents of villages who did not receive this form of compensation expressed disappointment towards the villages that chose to accept it rather than support them in their protest against Coromandel International Limited, pointing towards a perceived lack of solidarity.

When asked specifically about the source of the compensation, FGD participants mentioned receiving Rs. 10,000 through the co-operative society, while 59% of survey respondents who received this compensation (n=338) believed that it was a company compensating them.

Feeling of Neglect: A common sentiment expressed by FGD participants and interviewees across all villages was that the government has been largely inactive in providing support. Affected communities acutely felt the absence of swift government during/ just after the oil spill. Participants from Thazhan Kuppam felt that government officials should have been present at the disaster site immediately. One participant stated, *“The revenue officials should be on-site, rather than sitting at home and giving directions over the phone.”*

Participants also felt excluded from decision-making processes regarding remediation. A case in point was the mangrove reforestation initiated by the Department of Environment, Forests and Climate Change (DoEFCC). Mangrove forests are crucial breeding grounds for marine species, and studies have observed that they had already been affected by the ongoing fly ash pollution from the power plants in the region (The Hindu, 2023). As of March 2024, in an attempt at restoration, the DoEFCC had planted

30,000 mangrove saplings in Ennore (Padmanabhan, 2024b), but fishers believed this move may not be effective and that they should have been consulted:

“What they are doing right now is of no use. It is not effective because they are doing it on the other side of the canal. They are putting it in the Buckingham Canal (wastewater), where not one species will come to breed. What is the point of this? Are they consulting the fishing community before doing this?” – FGD participant from Kattukuppam

Participants also felt neglected by the companies operating in the area as they have reportedly not directed any of their CSR funds towards them. *“The companies surrounding us have CSR funds but only Kamaraj Port Limited has distributed ice boxes, boats, engines, sewing machines, daal, and rice. No other company has done so. CPCL has not done so”* says a participant from the FGD at Thazhan Kuppam.

Access to Existing Social Security Schemes

Through FGDs across villages, it was learnt that the fishing cooperative societies provide savings schemes, subsidies, and insurance to their members. The most popular scheme is the “National Savings-Cum-Relief Scheme for Marine Fishermen” (CRRT, 2020). This centrally sponsored scheme aims to provide relief to fishers during lean months when their catch is low. Under this scheme, fishers contribute Rs. 175 per month for 8 months and Rs. 100 for the ninth month, totalling a contribution of Rs. 1,500. Both the central and state governments match this contribution by providing Rs. 1,500 each, resulting in a total payout of Rs. 4,500 credited in equal parts over three months to the bank accounts of fishers during lean fishing periods. Women from self-help groups (SHGs) are also eligible for this scheme (CRRT, 2020).

The Group Accident and Insurance Scheme, initiated by the central government in 1982, aims to provide financial relief to families of fishers who die at sea. Under this scheme fishers do not pay any premium; the Rs. 30 annual premium is fully covered by the State and Central Governments. The scheme offers Rs. 5,00,000 for death or permanent disability and Rs. 2,50,000 for partial disability. The scheme is implemented by the National Fisheries Department and is applicable for inland fishers as well (Vohra, 2021).

Participants also mentioned that the Government provides a diesel subsidy that is available for 300 litres per month. Apart from the schemes mentioned above, the society also supports fishers in establishing small businesses by providing loans.

Gaps in delivery: A major issue is that fishers are not always aware of these schemes and the procedures for availing them. **Local government has the scope here to play a significant role in educating fishers and connecting them to welfare schemes.**

The Clean-Up

Through interactions with fishers across the project site, it was learnt that CPCL hired fishers (as labour) and 10-15 boats each from Kattukuppam, Thazhan Kuppam, Nettukuppam, and Sivan Padai Veedhi to clean the oil from the river and creek. Two boats were

hired from VOC Nagar as well, but the village was more a source of daily wage labour. Each boat had roughly four to ten people, and each individual was paid approximately Rs. 1000 per day. The clean-up activities went on for a duration of 2 to 3 months.

From all the FGDs, it was apparent that the fishers took up this work given the lack of any other source of income at that point in time. However, they felt exploited by the process. FGD responses revealed a shared sentiment among participants that the company "used" them to clean their pollution: FGD participants from Kattukuppam said that *"after mixing oil in our river, damaging our boats, they [CPCL] are paying us to clean their mess"*. Participants from Nettu Kuppam similarly said that *"They used us for cleaning; if they used anyone else it would have been very expensive."* Since fishing was no longer an option due to the oil spill, the company provided them with employment, which was seen as a small consolation. Many participants felt compelled to take up the work, as they had no other choice, reflecting the unfortunate state of affairs.

Evaluating the Success of the cleanup

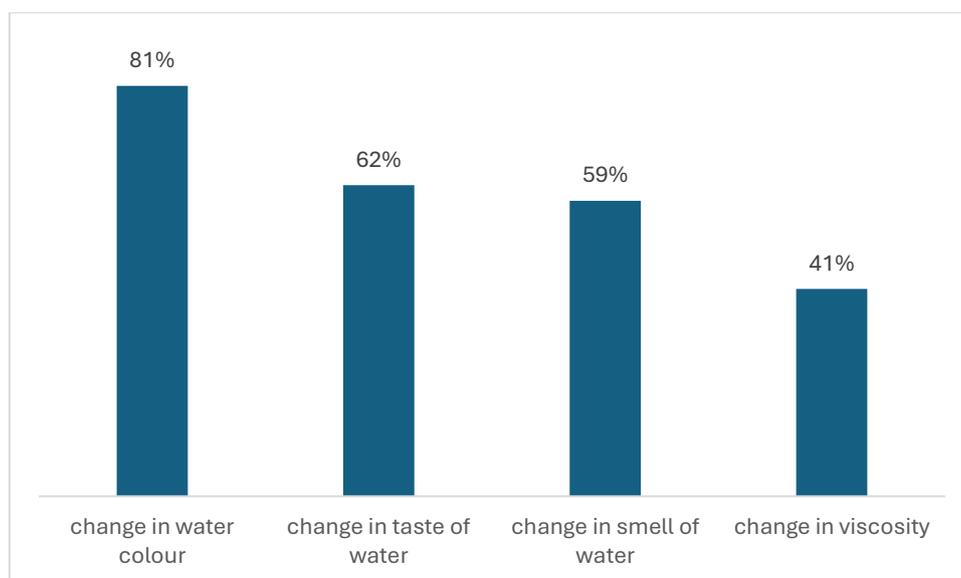
Field observations and discussions with fishers across villages disclosed that the cleanup was limited in that it only skimmed the surface and did not remove oil contamination in the soil bed. However, the high density of industrial oil means that it sinks fast into the soil. An FGD participant from Sivan Padai Veedhi echoes what many others have said *"they said they would clean it, but they did it only superficially. Only the layer on top was cleaned"*. Even after a year since the cleanup occurred, participants from Nettu Kuppam claim that *"there was no proper cleaning; now too the oil floats, if you come you will be able to see it"*. In fact, field observations in September 2024 also revealed large traces of oil in the river (adjacent figure).

Not only did the oil seep into the soil, but it also contaminated groundwater in the area, as reported by FGD respondents and survey participants. In Thazhan Kuppam, participants recounted how oil seeped into the soil and resurfaced as they dug. *"Oil got soaked into the soil, and as we dug, it kept coming. After the oil got deposited in the soil, the water quality changed,"* they explained. Of the total survey sample, 54% of respondents noticed changes in groundwater quality, such as colour, smell, taste, or texture across residential and fishing villages. Among those who noticed changes (n=229), 81% reported a change in water colour and 62% reported a change in taste (see figure below). Additionally, among this group, 75% observed changes in more than one category.

Figure 18: Oil observed in the Kosasthaliyar in Nettu Kuppam; (pic taken by IITM field team in Sept 2024)



Figure 19: Reported changes in ground water.



The effectiveness of the clean-up was limited by the rudimentary equipment provided to fishers for it. FGD participants recalled that *“we would remove the oil and put it in a drum”*. Aside from the rudimentary tools provided for cleaning the oil, CPCL initially did not supply safety equipment in time, as reported during FGDs. *“They only gave us safety equipment after we started experiencing health issues,”* noted a participant from Thazhan Kuppam. When the company eventually began supplying masks and gloves, they only provided single-use items and did not replace them afterwards. *“They gave masks and gloves. But they didn't give it again, they gave it only once. Look at my hands, even now they remain spotted”* said an FGD participant from Nettu Kuppam. Adding to the inadequacy of safety provisioning, the single-use masks and gloves were only given to the individuals on the boats directly handling the oil, while others involved in operating the boats reported receiving no safety gear at all.

An FGD participant from Kattukuppam aptly summarised the three major shortcomings in equipment provisioning for the clean-up: inadequate equipment provided, delayed distribution of single-use safety gear and selective allocation of gear only to those directly handling the oil, excluding other boat members. He reflected,

“They should have arranged for an ambulance and provided N90 masks, if not chemical-grade ones. Initially, they only gave us a jug to work with. We had to demand glasses to protect our eyes during cleaning, and masks before they finally provided them. Even then, the safety gear was given only to those directly lifting the oil. The other two people on the boat received nothing. And the gloves they gave us had to be discarded after a single use.” – FGD participant from Kattukuppam

Villagers also felt that the wages provided to fishers involved in the clean-up were not sufficient given the high medical expenditure incurred due to the oil spill. While workers were paid approximately Rs. 1000 a day, it was not necessary for the same individual to be called for work daily. A village elder from Kattukuppam, who participated in the

cleanup for two days, shared, *“I went to clean the river for two days. They paid us Rs. 2,000, but the hospital charges were Rs. 18,000.”*

Survey analysis of those who participated in the clean-up activities (n=52) highlights that a significant proportion of people who were part of the clean-up activities were not paid: most people who were involved, worked for less than 10 days and received less than ₹10,000 or no payment.

Health Implications of the Dec 2023 Oil Spill

The villages of Ennore have historically been exposed to pollutants from surrounding industries, which have adversely affected their health (Nisha & Nisha, 2024). A 2016 study by the Coastal Resource Centre titled ‘Unfit to Breathe’ tested air samples in Kattukuppam and observed that the levels of manganese, lead, arsenic, and nickel far exceeded the standards set by the United States Environmental Protection Agency (EPA) and the California Office of Environmental Health Hazard Assessment (OEHHA). Manganese and lead, both neurotoxins, exceeded the standard by 1.2 - 2.5 times and 3.7 times, respectively. These elements are known to damage central nervous system functions such as visual reaction time, hand steadiness, and hand-eye coordination. Children in Ennore are particularly vulnerable as even limited exposure is linked to impairing IQ, learning, memory, and behaviour (The Coastal Resource Centre, 2016).

Nickel similarly exceeded the limit by 1.2 times and is linked to respiratory and immune system diseases. Arsenic, a carcinogen, was 1.25 times higher than permissible levels set by the Indian Ministry of Environment, Forest and Climate Change (MoEFCC). The study also found that airborne particulate matter concentration ranged from 105.7 to 141.5 $\mu\text{g}/\text{m}^3$ (micrograms per cubic meter), far exceeding the 60 $\mu\text{g}/\text{m}^3$ prescribed by the Ministry of Environment, Forests and Climate Change (MoEFCC) and the 15 $\mu\text{g}/\text{m}^3$ recommended by WHO (The Coastal Resource Centre, 2016). Other than this, studies examining the health impact of pollution in Ennore are limited.

Through FGDs and household surveys, this study finds that, in addition to air pollution, groundwater contamination is also likely and may be contributing to health issues experienced by residents. An FGD participant from Sivan Padai Veedhi stated that *“water is getting polluted through the mud, and we are suffering from various diseases”*.

While the above evidence shows that the Ennore area in general is polluted and continues to be polluted every day, there have been no systematic studies conducted to determine the impact of this pollution on human health and the prevalence of illnesses/diseases over a period of time.

The Oil Spill’s Immediate Effect on Health

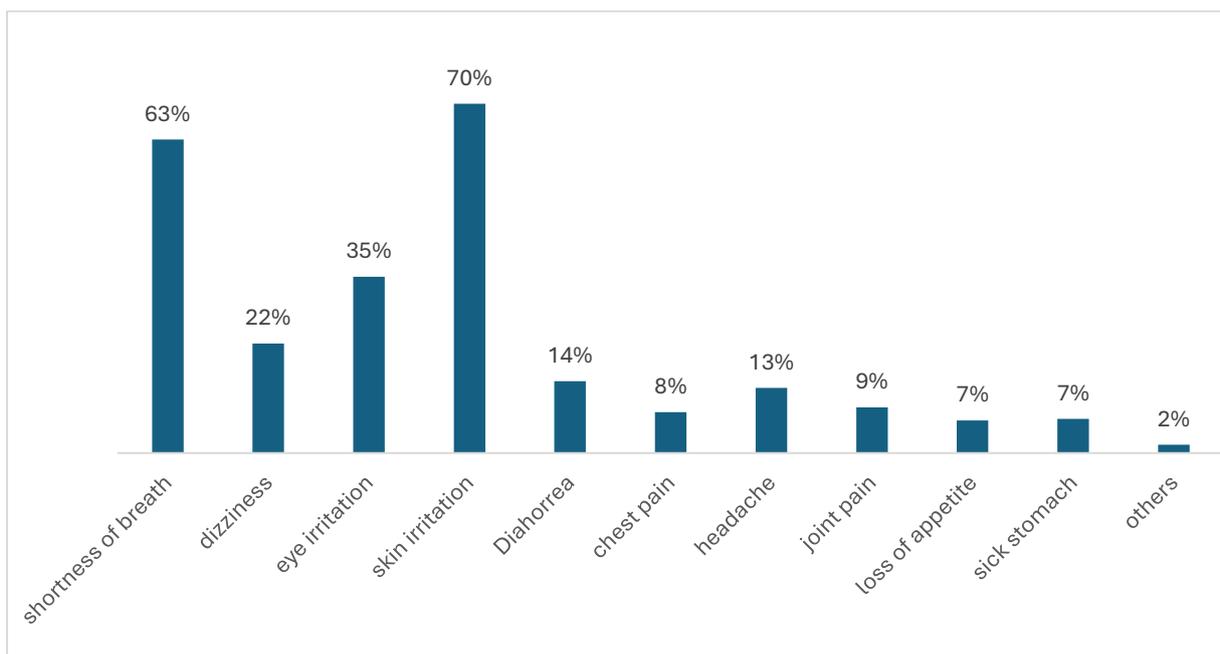
As such, the Dec 2023 likely compounded pre-existing health challenges and further strained the already inadequate health care system in the region. The oil spill caused a range of health issues that were determined by the level of exposure. The fishing community and other residents were affected directly and indirectly by inhaling toxic oil

fumes, through physical contact with the oil and/or through exposure to oil-contaminated groundwater, as detailed in the following section.

Several FGD participants recall the immediate effects of the oil spill on December 4th, 2023. The foul smell and toxic fumes emanating from the oil caused residents to experience difficulty in breathing. While breathlessness was the most commonly experienced effect shortly after the spill, eye irritation and headaches were also mentioned. Describing the experience, a resident of Kattukuppam shared, *“Suddenly, the air became heavy with a smell, making it difficult to breathe. I had a headache, felt like vomiting, and was extremely uneasy”*.

Around 70% (306 respondents) of the total survey sample across fishing and non-fishing villages (428 respondents) reported having developed a new health condition post the oil spill. Of this, skin irritation was experienced the most – by 70%, followed by shortness of breath by 63%, and eye irritation by 35%, as is depicted in the figure below. Out of the 70% who developed new physical health conditions, 62% had developed comorbidities i.e., the simultaneous presence of two or more diseases (see figure below).

Figure 20: Respondents reporting new health issues after the oil spill.



Development of Acute Health Conditions Post Oil Spill

Over time, residents began to develop more severe health conditions, particularly those affecting the skin. Following the oil spill, fishers employed to clean the river came in direct contact with the oil for extended periods. An FGD participant from Sivan Padai Veedhi shared, *“They did not use machinery to clean the oil, nor did they have any labour; they used us and our boats, and we ended up with skin diseases.”*

It is noteworthy that 73% of fishers who participated in the clean-up developed skin-related issues as corroborated by the household survey. This suggests that the fishing community's health was mainly affected because they were tasked with the cleanup of the spill, and not due to place-based reasons. As discussed earlier, the inadequate safety gear provided to fishers heightened their exposure.

In addition to skin rashes and allergies experienced during the cleanup, fishers were forced to return to the same contaminated waters to sustain their livelihoods. This prolonged exposure possibly turned otherwise treatable conditions, such as skin rashes, into chronic ailments. Fisherfolk also report developing more chronic ailments such as haemorrhoids in the same manner. The lack of access to appropriate medical attention further exacerbated these conditions.

While the oil spill cannot be identified as the sole cause of more chronic ailments such as asthma, it has contributed to their development. In December 2023, residents of Ennore not only suffered the consequences of an oil spill but also the ammonia gas leak on 26th Dec 2024 from the Coromandel International Ltd, a fertiliser manufacturing plant. The two events occurred within a span of three weeks, both causing significant difficulty in breathing.

A resident of Kattukuppam mentioned that her daughter had developed wheezing at the time of the oil spill, and she herself was on the verge of developing it. Over time, however, she also began experiencing the condition. Reflecting on her current state, she said, *“Back then [before the events of Dec 2023], I didn't have it, but now I've gotten it. At night, when I go to bed, my lungs feel like a motor running inside. By evening, my voice often changes. This happens three days a week.”*

It must be acknowledged that health issues were a significant challenge in themselves, but even more so as they resulted in an inability to work. Around 68% of the survey respondents reported losing work time due to health-related issues caused by the oil spill across fishing and non-fishing villages. Of these, 47% lost between 15 and 60 days of work, and 38% lost more than two months of work. This study also attempted to assess the mental stress of the oil spill on survey respondents; however, as there is not much awareness on recognising symptoms of mental health issues and general reluctance to talk about it, the survey results were insignificant. Further, discussions with health workers at a local Urban Primary Health Centre (UPHC) in Thazhan Kuppam linked mental health issues primarily to substance abuse and sleep deprivation. While reported prevalence was low, factors like awareness, willingness to disclose sensitive information, and healthcare capacity to reach out to individuals experiencing distress remain key considerations.

Health Care Response

Health camps were organised in response to the health fallout following the oil spill. According to a health care worker from Thazhan Kuppam, these camps were held daily for a month in their village as well as in Nettu Kuppam, Mugathuvarakuppam and Ennore

Kuppam. However, through FGDs and interviews with residents, it was found that the knowledge of these camps varied significantly between the villages. The FGD at Kattukuppam suggested that residents were likely not properly informed about the camps, as they appeared unaware of them.

FGD respondents from the villages of Katukuppam and Thazhan Kuppam reported that no specific government-organised camps were conducted for skin-related issues, which were a major concern due to the spill, nor were they aware of any general health camps held; however, eye camps were organised in these two villages by the PHCs during which vision glasses were distributed. The FGD at Sivan Padai Veedhi indicated that it was the only village to have had a skin camp as well as a general health camp.

The camps were held in villages identified as impacted areas as per the report published by the TNPCB (TNPCB 2024). VOC Nagar, a smaller fishing village, was also impacted by the spill but did not feature in this document. As a result, this village did not receive the necessary healthcare response. FGD participants over here mentioned that they had to seek medical attention on their own accord. This highlights the unequal distribution of healthcare responses to the oil spill.

Regarding quality of care at these camps, it was learned that residents were often treated without being properly informed by medical practitioners about the cause of their illness. One FGD participant from Thazhan Kuppam described this, saying, *“Nobody told us that our health problems were caused by pollution. They just treat the symptoms without explaining why it's happening”*. A senior resident of Kattukuppam opined that the camps were “in name only” as they did not come prepared with all the necessary medication.

According to FGD participants from Nettu Kuppam and Sivan Padai Veedhi, the medicines provided in the camps were largely ineffective as they did not result in much improvement. Further, as highlighted during the discussions, the medication provided only temporary relief to fisherfolk who were compelled to return to the contaminated waters, making them susceptible to recurring illnesses. One FGD participant from Sivan Padai Veedhi remarked *that, “They set up a medical camp and gave us medicines, and for that one day, everything feels fine. But we have to go back into the same water. If we could avoid work, maybe it would get better, but we have to go, don't we?”*

During the discussions, participants also expressed a preference for private hospitals over government hospitals. This preference possibly stemmed from the type of treatment provided; government hospitals prescribed medications requiring continuous application, whereas private hospitals offered a ‘one-time solution’. As one participant explained, *“We went to a private hospital. If we go to the government hospital, they give us an ointment that we have to keep applying. In the private hospital, they give us an injection.”* The preference for private hospitals may also be attributed to the insufficient number of Urban Primary Health Centres (UPHCs) in the area. Currently, the Ennore area, which falls within Zone – 1 (Thiruvottiyur), comprises 14 wards with a population of

over 2,50,000 residents, according to the 2011 census. However, this zone has only six UPHCs, of which only two are serviceable to the population in Ennore (GCC, n.d.).

As such, the community at large felt that the healthcare response to the December oil spill had been inconsistent across villages and the quality inadequate. In the camps that were held following the spill, residents were often not informed about the cause of their illnesses; they were simply diagnosed and treated.

Considering Ennore's history of pollution, the lack of health studies is concerning. While health data was collected through the camps, it does not remain in possession of the local UPHC, hindering the effective targeting and implementation of interventions. As noted by a senior resident of Kattukuppam, government officials become aware of health impacts only when they receive complaints, there is no official door-to-door survey conducted to record the health consequences of industrial mishaps.

CHAPTER 5: Governance and Legal Framework

Effective oil spill management requires a structured policy framework, with well-defined responsibilities and mechanisms at the national, state, and local levels. This section evaluates the preparedness and response mechanisms in place, identifying key gaps and challenges in implementation, particularly in the wake of the Ennore oil spill incident of December 2023. It then examines various environmental frameworks that pertain to protecting the creek and the legal proceedings of the suo motu case filed by the NGT due to their violation.

National Level Oil Spill Management

At the **National level, the policy guiding management of oil spills in Indian waters is the National Oil Spill Disaster Contingency Plan or NOS-DCP**. This policy was published by the Directorate of Fisheries and Environment, Ministry of Defence, Government of India, in 1996 but has since been updated in 1998, 1999, 2000, 2006 and most recently in 2015. The objectives of the Plan include, to put in place measures to prevent oil and chemical pollution, to effectively detect and report spills, to facilitate rapid response, to establish adequate safety measures for respondents and the marine environment, to maintain evidence of the polluter and take suitable administrative/ legal action against the polluter. The plan also delineates the roles and responsibilities of various departments and agencies and a framework for coordinated response among these organisations (Directorate of Fisheries and Environment, 2015).

The critical point to note is that the **scope of the plan in terms of geographic area is restricted to incidents in the sea, which is likely to affect the maritime zones of India**. There is no national-level guideline or policy for the management of oil spills in inland waterways. Further, in the plan, State governments are required to prepare oil spill contingency plans based on NOS-DCP. Some states including Tamil Nadu and Maharashtra and local authorities such as the Cochin Port Trust have done so. However, since the focus of the national plan is on coastal and marine waters, these plans have largely followed suit **except Tamil Nadu which specifically includes management of oil spills in in-land water ways**.

Tamil Nadu State and Local Level Oil Spill Management

Tamil Nadu released its plan, **The Tamil Nadu State Oil Spill Disaster Contingency Plan (TN-SOS-DCP)**, in January 2024. While it is a proactive and structured plan and goes one step beyond the NOS-DCP to include management of oil spills in inland waterways, **the release date suggests that the plan or parts of it were developed as a reaction to the Dec 2023 event:**

“There is a set standard operating procedure (SOP) when the oil spill happens in the ocean. You have big machines, ships; the Coast Guard comes in. But nobody has been

able to share an SOP for an oil spill in an estuary.” (Former ACS, DoEFCC - as quoted in The Hindu by Ramakrishnan & Srimathi, 2023)

Specifically, the TN-SOS-DCP states that it is designed to respond to ‘marine oil spills of any manner that occur within 12 nautical miles (24 km) off the State’s coastline and the riverine systems extending 40 km inland or till tidal effect is evident, whichever is more’ (DoEFCC, 2024, p.6). While marine oil spills are suggestive of the event originating from the sea, the plan also clearly lays out responsibilities for departments when the events occur near the shore. The next section details some of the salient features of the plan.

TN-SOS-DCP: A Framework of Preparedness

The TN-SOS-DCP’s primary objective is “to protect the ecology and environment by preventing or reducing potential effects or damage to the inland waterways near the coast, marine and shoreline environments, natural resources, and other installations from impact due to an oil discharge” (DoEFCC, 2024, p.5). The plan aligns itself closely with the NOS-DCP 2015, ensuring a well-structured response to oil spills, particularly in Tier-1 and Tier-2 scenarios⁵.

The plan also **presents a rudimentary risk profiling of coastal ecosystems of Tamil Nadu**, such as creeks and mangroves along the coast, primarily based on their ecological richness and distance to coastal infrastructure like ports, refineries and shipping lines. This assessment classifies coastal zones into categories such as very high risk of oil spills, high risk of oil spills, moderate risk and low risk. Ennore has been categorised into a ‘very high risk’ zone.

In terms of oil management and response, the plan nominates the District Collector as the lead for shoreline clean-up operations and the Tamil Nadu State Disaster Management Authority (TNSDMA) under Revenue Administration, Disaster Management and Mitigation Department (RADMMD) as the Nodal Agency in the management of oil spill disasters. Both these organisations are to work closely with the Indian Coast Guard (ICG) and other departments as required. It also proposes the **formation of a ‘state oil spill crisis management group’ (SOSCMG)** which is to meet once every six months to review preparedness, conduct mock drills under normal circumstances, and meet as frequently as required during a disaster.

Preparedness is also emphasised through training workshops for local teams, including port operators, who can be trained to deploy containment booms, skimmers, and dispersants in a timely manner. The state can leverage its existing relationships with Chennai Port Trust and other coastal facilities to enable quick resource mobilisation when needed.

However, this preparedness plan is not without its limitations. One of the **key challenges lies in ensuring consistent monitoring** along Tamil Nadu’s vast coastline. While

⁵ Tier 1 refers to oil spills where quantity of oil spilt is less than 700 tons while Tier 2 refers to spills where the quantity of oil spilt is more than 700 tons but less than 10,000 Tons.

industrial hubs are well-monitored, other regions remain under-resourced, increasing their vulnerability to unanticipated spills. Additionally, the **reliance on the ICG and national resources, particularly in Tier-2 and Tier-3 incidents, raises concerns about response delays** during concurrent crises elsewhere in the country. The December 2023 oil spill in Ennore, as per IIT Madras' estimates of 912 tonnes and TNPCB estimates of 883 tonnes of oil contamination (Environmental Engineering Division, 2024), would fall in the category of Tier – 2.

Furthermore, **the plan does not adequately involve local fishing communities in its operations and response:**

- The objectives of the plan which is “to protect the ecology and the environment...” suggests that the plan is more focused on preventing damage to and protecting the natural environment rather than the communities which live in these socio-ecological spaces.
- The plan does not provide steps for what is to be done to safeguard local communities, address resultant health issues, and mitigate the cascading implications it has on their livelihood and poverty intensification.
- It omits communicating to residents the measures to be taken to ensure their safety, distribution of relief materials, and rehabilitation efforts in terms of health and livelihood.
- It misses an opportunity to tap into local communities for citizen-led monitoring and reporting.

Further, while the plan seems thorough, proper implementation is also crucial. **Critical gaps exist within the preventive infrastructure.** The scarcity of modern containment and dispersal equipment—such as advanced booms, skimmers, and real-time detection technologies—limits the effectiveness of response actions. Current monitoring systems rely primarily on periodic inspections, which may fail to detect pollution in real-time, delaying containment efforts and exacerbating environmental impacts. Technology that can monitor spills as they occur is still at a nascent stage of development. It was only in early August of 2024, following the spill in Ennore, that the Indian Coast Guard inaugurated the Regional Marine Pollution Response Centre in Chennai which is equipped with advanced systems for monitoring coastal emergencies using satellite and terrestrial technology (Ministry of Defence, 2024). Furthermore, the involvement of multiple agencies with a lack of specificity in identifying the particular officers from these stakeholders who constitute the SOSCMG can lead to coordination-related challenges and ultimately delays in addressing pollution incidents effectively.

As such, since the plan was not in place during the oil spill in Dec 2023, the reaction to the spill was not very effective. As discussed in the previous chapter, communities are not satisfied with CPCL's and the government's response. The National Green Tribunal (NGT) seems to have also had similar sentiments since it decided to take *suo motu* action on the event. The ongoing case at the NGT and brief analysis of how other similar cases have been dealt with are discussed in the next section.

Chennai City Disaster Management Perspective Plan 2024

GCC's Disaster Management Plan of 2017 addresses all kinds of disasters, stating in its preface that it covers "natural disaster or man-made disaster". Under the types of disasters, it includes chemical, industrial, and radiological events such as industrial fires, gas and chemical leaks, and nuclear disasters. The 2024 City Disaster Management Perspective Plan takes this further by incorporating 'accidental disasters,' explicitly mentioning oil spills.

However, while the 2024 plan acknowledges the occurrence of such events, its coverage stops there. The rest of the document focuses extensively on hydro-meteorological disasters, detailing events including the 2004 tsunami, Cyclone Nilam (2012), the infamous floods of Dec 2015 and Cyclone Vardah of 2016, as well as preparations for similar disasters. The focus is firmly on the experience of South Chennai, where floods pose the greatest risk.

The experience of disaster in regions like Ennore pertains more to a history of industrial mishaps, so much so that it is routinised. As a respondent from Kattukuppam stated – *"We are used to ammonia gas being leaked. Coromandel always releases ammonia not just every year, but whenever it rains. They release it at 1 a.m., and when we wake up, we realise, "Oh, it seems like they've released the gas; our lungs are burning."*

GCC's disaster management plan should not focus only on the South Chennai experience but on disaster experiences from other areas as well. Further, the plan can provide more details on how rehabilitation can be done in the context of disasters such as oil spills. In this regard, the GCC plan could follow the Tamil Nadu State Disaster Management policy, 2023, TN Disaster Management plan which acknowledges the disruptive effect disaster can have on life and livelihood. Its conception of rehabilitation, hence, is to conduct a loss and needs assessment, reconstruct housing and public amenities that were destroyed such that they are resilient to future risks, coordinate relief measures with NGOs, and reinstate livelihood through schemes like MNREGA (Tamil Nadu State Disaster Management Authority, 2023).

Ennore Dec 2023 Oil Spill: A Suo Motu Legal Action Following Media Coverage

Two cases in the NGT are pertinent to the Dec 2023 oil spill; one was filed by a local resident and fisher, while the other was a *suo motu* case taken up by the Tribunal itself. The first case with Application No. 183 of 2023 was submitted to the National Green Tribunal's South Zone on December 18, 2023, by R.L. Srinivasan. The application raised concerns about the impact of the Ennore oil spill on avian species, particularly Pelicans, Cormorants, and Darters. Pelicans, listed as "Near Threatened" and are the largest waterbird species in Tamil Nadu, were found drenched in oil, disrupting their migratory patterns. The application is based on an independent survey by Palluyir Trust on December 17, 2023, which documented 18 oil-drenched pelicans exhibiting severe health issues, including matted feathers and restricted wing movement. The oil damage

made their feathers non-waterproof, impairing their ability to hunt (R.L. Srinivasan vs TNSCZMA & Ors, 2023). This case is still pending in the NGT.

The second case, a suo motu action initiated by the Southern Bench of the National Green Tribunal (NGT), was prompted by a news clip by Vikatan TV titled ‘Chennai Rains: மக்களை வதைக்கும்⁶ Oil Companies | Shocking Story | Ennore Ground Report’. The eleven-minute video brought attention to the event of the oil spill in Ennore and highlighted the very particular experiences of the people here as compared to South Chennai, battling floods at the time. It suggested that the issue of oil spills was a recurrent one and so cannot be considered an accident in a simplistic sense (Vikatan TV, 2023). This report raised alarms about CPCL’s failure to handle oil spillage and pollution during heavy rains, which compounded the impact on Ennore Creek’s already fragile ecosystem and impacted local communities (The Hindu 2023).

This NGT case focused on several critical issues, including **industrial accountability, regulatory oversight failures, and environmental violations**. NGT investigations revealed that CPCL and other industries had discharged pollutants into the creek, leading to extensive damage to its mangroves and aquatic habitats. Regulatory bodies like the Tamil Nadu Pollution Control Board (TNPCB) were also critiqued for lapses in monitoring and enforcement, which have contributed to sustained environmental degradation in the region (*Ibid.*). The case is still ongoing, reflecting the complexities of navigating institutional accountability and effective environmental governance.

Court Arguments

To evaluate the situation, an environmental team from The Energy and Resources Institute (TERI), appointed by the court, conducted a boat survey on December 20, 2023. The team found that while most of the oil had been cleaned from the creek’s mouth to the Ennore road bridge, residual contamination remained in the mangrove areas. Another report by the TNPCB submitted to the court stated that cleanup efforts involved oil skimmers and waste collection, with contaminated water safely stored within CPCL’s premises (TNPCB 2024).

The court was presented with evidence highlighting CPCL's vulnerability to flooding. This included data from water sensors installed within CPCL premises in 2023, which recorded significant water depths during rain events, **demonstrating the compound's susceptibility to inundation**. Additionally, records from the 2015 flooding, exacerbated by the release of water from nearby reservoirs, showed that CPCL’s premises were heavily inundated, causing extensive contamination. **The Water Resources Department (WRD) argued that these instances underscored the insufficiency of CPCL’s stormwater management systems and pointed to infrastructural deficiencies** as the primary cause of ecological damage, rather than attributing the issues solely to natural flood events (Times of India, 2023). **The WRD also stated in its**

⁶ Translates to ‘to torture people’

response to the NGT that, it believed CPCL deliberately engaged in leaking oil through its pipelines during the monsoon periods which was evident from the oil floating at the top surface of the Buckingham Canal (DTNEXT 2024).

CPCL's Response to the NGT and Mitigation Efforts During Cyclone Michaung

In response to this crisis, CPCL stated that it had initiated an extensive cleanup response, deploying containment booms, oil skimmers, and collaborating with agencies such as Chennai Port Trust and Kamarajar Port Trust. It also stated that four specialised agencies were engaged to clear key zones, including Ennore Creek and Buckingham Canal, with over 740 tons of sludge and waste removed under the oversight of the National Institute of Oceanography (CPCL, Jan 11th 2024). CPCL further underscored that no equipment failures or pipeline breaches occurred during the cyclone; rather, it attributed the flooding primarily to external factors, including significant reservoir discharge and the backflow of water from the Buckingham Canal. **These arguments suggest that CPCL is using the flood risk to shun their own responsibility towards ensuring preparedness/precautions against such kinds of events.**

To support surrounding communities impacted by the cyclone, CPCL reported that it provided ₹7.5 crore in disaster relief, distributing essential supplies like rice, grocery items, and clothing, and deploying mobile medical units (*ibid.*).

On its website, CPCL mentions that it conducts safety training, mock drills, audits, performs hazard and operability analysis (HAZOP), is equipped with fire fighter vehicles, and has an alarm system for detecting leaks (CPCL, n.d). CPCL has also reportedly developed an Emergency Response and Disaster Management Plan (ERDMP) as per the Petroleum and Natural Gas Regulatory Board (PNGRB) guidelines; however, this document is not publicly available (Safety – CPCL, n.d.; The Hindu, 2024). Further, responding to questions raised by members of parliament, CPCL stated that it had installed containment booms to prevent any future spills and installed Online Continuous Emission Monitoring Systems at various locations within its premises. It had also reportedly done mangrove reforestation through bioremediation (The Hindu, 2024).

Despite these reports, it is clear that CPCL is yet to come up with its own oil contingency plan or make publicly available this plan and the ERDMP. If the oil spill contingency plan hasn't been prepared yet, CPCL can draw inspiration from the Oil and Natural Gas Corporation Limited (ONGC), to plan risk assessments, oil spill modelling studies, and installations of safety mechanisms on all equipment. It could create strategies based on the degree of a spill as ONGC has done, conduct regular mock drills, and provide training programmes to ensure operational readiness (ONGC, n.d.). As such, the ERDMP needs to be developed in line with the TN-SOS-DCP and the National Oil Spill Disaster Contingency.

Case Outcome, NGT Directives, and Recommendations Thus Far

In response to the evidence presented, the NGT issued directives for more stringent pollution controls, better waste management, and rehabilitation efforts for Ennore Creek's ecosystem. The tribunal also instructed TNPCB to conduct regular inspections, particularly before monsoon seasons, to prevent further environmental harm. The Water Resource Department's (WRD) recommendations included stricter oversight and **calls for CPCL to enhance its flood defences** and for TNPCB to have periodic inspections of the area to ensure that future operations do not endanger Ennore's fragile ecosystem (DTNEXT Bureau, 2024; Krishna Chaitanya, 2023).

Thus far, the case highlights the need for a balanced approach between industrial development and environmental preservation, with a robust regulatory framework to hold polluters accountable and protect local biodiversity and communities.

Legal Framework Governing Ennore

The long history of environmental degradation at Ennore and the current cases at the NGT necessitate a deeper discussion on the legal paradigm in the area. Therefore, this section focuses on the legal provisions protecting such kinds of ecologically sensitive zones and possible reasons for their complete failure in safeguarding this region.

The environmental regulatory framework governing Ennore Creek encompasses statutes aimed at water quality control, coastal zone conservation, hazardous waste management, and broader environmental protection. The **Water (Prevention and Control of Pollution) Act, 1974** is central to these efforts, mandating the prevention and control of water pollution through regulation of industrial and municipal effluents. This is critical for Ennore Creek, where industrial runoff and untreated sewage have posed significant threats to water quality. The **Environment (Protection) Act, 1986** serves as an umbrella law, enabling government intervention to safeguard environmentally sensitive zones such as Ennore.

Under the **Coastal Regulation Zone (CRZ) Notification, 2011**, Ennore Creek is designated as CRZ-I due to its ecological sensitivity. This designation places stringent restrictions on developmental activities, prioritising ecosystem preservation over industrial expansion. Additionally, the **Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016** govern the safe handling, storage, and disposal of hazardous materials, which is essential in preventing hazardous waste from nearby industries from contaminating the creek.

On the one hand, despite these regulations, enforcement has become a huge challenge due to overlapping jurisdictions. Agencies such as the Tamil Nadu Pollution Control Board, the Ministry of Environment, Forest and Climate Change, and local port authorities often have competing mandates, leading to fragmented oversight (Table 5). This complex regulatory structure can delay coordinated responses, diminish

accountability, and reduce the efficacy of pollution control measures in Ennore Creek. On the other hand, despite the existence of multiple regulations to protect the natural environment, development at the cost of these fragile eco-systems has been prioritised.

Table 5: Agencies and their mandates

Law/Regulation	Relevant Agencies	Primary Mandate
Water (Prevention and Control of Pollution) Act, 1974	Tamil Nadu Pollution Control Board (TNPCB)	Monitor and control water pollution.
Coastal Regulation Zone (CRZ) Notification, 2011	Ministry of Environment, Forest and Climate Change (MoEFCC)	Protect and manage coastal ecosystems.
Major Port Authorities Act, 2021	Local Port Authorities, Indian Ports Association	Regulate and develop port operations.
Environment Protection Act, 1986	TNPCB, MoEFCC	General protection of the environment.

The following examples illustrate how some of the agency’s roles and responsibilities might overlap during a specific case:

Scenario 1: An oil spill occurs, contaminating water and coastal ecosystems.

- **Agencies Involved:**
 - **TNPCB:** Monitors water pollution levels.
 - **MoEFCC:** Ensures CRZ compliance and biodiversity protection.
 - **Indian Coast Guard:** Handles marine oil spill response.
- **Conflict:**
 - Coordination delays may occur due to not knowing the source, extent or scale of impact. TNPCB may have to do water sampling to ascertain the pollutant; the coast guard may take steps to ensure no navigational issues. TNPCB may also depend on local law enforcement to identify the violating industry, which may not be a point of expertise for the police, thereby increasing the time taken to hold the polluting industry accountable.
 - In cases of industrial effluents affecting the creek, the TNPCB may focus on pollution levels while local port authorities are more concerned with navigational safety, leading to fragmented enforcement.

Scenario 2: Illegal dumping of waste damages mangroves, crucial for flood mitigation and biodiversity.

- **Agencies Involved:**
 - **TNPCB:** Enforces laws against waste dumping.
 - **MoEFCC:** Monitors mangrove ecosystem health under CRZ regulations.
 - **Local Municipal Authorities:** Responsible for waste management in their jurisdiction.
- **Conflict:**

- Disputes arise over which agency is responsible for stopping and cleaning up the dumping.

Polluter Pays Principle

A comprehensive policy approach to safeguard Ennore Creek should prioritise the **Polluter Pays Principle**, which assigns financial responsibility for environmental remediation to polluters. This principle motivates industries to adopt sustainable practices by making them accountable for the costs of environmental damage, thus aligning financial incentives with environmental protection (MoEFCC, 2018). Institutionalising this principle would help achieve environmental justice by shifting the economic burden of pollution from the public to the polluters.

For instance, the Tamil Nadu State Pollution Control Board, under Section 33A of the Water (Prevention and Control of Pollution) Act of 1974, had already directed CPCL to identify areas where oil is present and take remedial action on a “war footing” soon after the spill (Business Standard, 2023). While CPCL had undertaken cleaning efforts, as discovered through empirical data, residents attest that oil continues to float on the water and has seeped into the soil. Where the polluter fails to take adequate remedial measures, the Water Act, 1974 provides for the pollution control board to “remove any matter from such stream” and recover the resulting expenses from the offender as “arrears of land revenue or of public demand” (The Water (Prevention and Control of Pollution) Act, 1974). The TNBCB can use these clauses to assess the adequacy of the clean-up activity and take further measures to comprehensively remove all the oil from the water and soil whilst ensuring minimal damage to the littoral space.

Here is the Case of MSC Chitra, presented as an example of how the polluter pays principle has been enforced in practice:

MSC Chitra Oil Spill (India, 2010)

The MSC Chitra, a Panamanian-flagged container ship, collided with another vessel near Mumbai on August 7, 2010, resulting in a major oil spill. The spill released over 1,000 tonnes of oil into the Arabian Sea, affecting nearby ecosystems and shorelines. The Indian Coast Guard (ICG) led the response, deploying booms and using dispersants to limit the spread of the oil. Despite these efforts, significant damage occurred to marine life and coastal habitats.

This case reinforced the Polluter Pays Principle, by holding the ship’s owners and insurers financially responsible for environmental remediation and compensation (MoEFCC 2018). It prompted a review of oil spill preparedness and response frameworks by the Directorate General of Shipping and the Ministry of Shipping,

emphasising stricter regulations and the need for improved inter-agency coordination. This aligns with the recommendations of the National Guidelines for Pollution Monitoring and Mitigation (CPCB, 2022), which stress the importance of advanced monitoring systems, real-time detection technologies, and collaborative drills for better preparedness.

This case set a legal precedent in India, demonstrating the enforcement of accountability for environmental damage caused by maritime accidents.

CHAPTER 6: RECOMMENDATIONS

To improve oil spill response, community resilience and environmental protection, and ensure that such kinds of events do not reoccur, it is essential to implement comprehensive solutions ranging from policy reform to strengthening community reform. Key recommendations are discussed in this chapter. The figure below presents a word cloud of recommendations or ‘community asks’ by study participants.

Figure 21: Word cloud of recommendations as put forth by the study participants.



1. Design More Flexible Rehabilitation Plans for Communities

It is critical that rehabilitation plans for communities are flexible in design so that they accommodate the needs of all community members. Key findings reveal that the impact of the oil spill on fishing and non-fishing villages was markedly different. While fishing villages reported higher impact to their livelihood as a result of boat/net damage and large-scale fish kills, non-fishing villages predominantly reported that oil contaminated water inundated houses, damaging household items and vehicles. Conducting an immediate and quick socio-economic survey of impacted areas would help in understanding the ground realities. This will also ensure that non-traditional fishing communities or villages with fishers from other castes who are not officially recognised

as fishing villages will also get government attention and compensation if they are impacted.

2. Enforcing Strict Regulations on Polluting Industries

Residents of Ennore ask that industries in the area be strictly regulated for the effluents discharged and not for the closure of the industries themselves, as illustrated in these quotes:

“What’s done is done. I’m not saying you should shut down the companies—I’m just asking that you don’t wipe us out. Let us live. We’re not asking for money, but for you to use that money to manage your business responsibly, we’ll take care of ourselves.”
(Resident from Kattukuppam)

“I am not asking for the industries to be stopped; I am asking for the pollution to be stopped. We cannot unbuild what is already built. The pollution should be processed before it is released and whatever is in the water should be dredged. A pathway should be created for water to drain into the sea. Now, it has reached a point where water cannot flow through the river because it is filled with fly ash. Day by day, the mountain of ash continues to grow.” (Senior Resident from Kattukuppam)

The communities’ asks are not unreasonable and are in line with the existing regulations in the Water (Prevention and Control of Pollution) Act of 1974, the Environment Protection Act, 1986 and the Coastal Regulation Zone (CRZ) Notification, 2011. Stricter regulations can be enforced through the following means:

- **Conducting regular audits** of industrial and maritime operations and enforcing stringent penalties for violations, holding companies financially and legally accountable for environmental damage (MoEFCC, 2018).
- **Deploying advanced monitoring technologies** such as satellite technology and IoT-based sensors for real-time pollution detection and immediate response (ISRO, 2020).
- **Explore the option of citizen monitoring** by engaging with the village leaders / Fishing co-operative groups in the different villages to periodically monitor sensitive areas and report to the TNPCB.

3. Develop and Operationalise Alternate Livelihood Options and Skill Development Programs

It is clear that the traditional and historical fishing-based livelihoods which formed the core of Ennore are increasingly becoming unviable due to decades of environmental degradation and events such as the December 2023 oil spill. Further, local industries in Ennore had promised villagers jobs but did not fulfil these promises: too few jobs were offered, and these were not transferable across generations. Skill-based training

programs need to be actively offered to the communities, possibly through a local skill development centre. This centre could be managed by a non-governmental organisation but actively supported by the government – Skill Development Department and TNULM and local industries.

4. Increase Preparedness Within Industries

Industries should be prepared for disasters such as oil spills. They could be mandated to install spill control equipment such as containment booms. This ensures that oil spilling into the Buckingham Canal from the industrial premises does not spread further into the waterway, buying time to clean the leakage. The TNPCB could mandate the following:

- highly polluting industries (CPCL is classified as such) should possess the necessary spill control equipment, such as the containment booms mentioned previously, Skimmer boats to remove the spilt oil, and sorbents – materials that absorb/adsorb oil.
- industries could have preparedness plans, including regular drills and emergency response training.

5. Strengthen the ‘State Oil Spill Crisis Management Group’ (SOSCMG)

The TN-SOS-DCP recommends that the Tamil Nadu Disaster Management Authority (TNSDMA) forms a SOSCMG which is to meet once in six months to ‘solely guide, assist, and provide advice to all the departments designated to manage oil spills, including the Indian Coast Guard, Directorate of Shipping, TNSDMA, DoE and Forests department, District Collector, TNPCB, Police, Fishers department and scientific institutions. The following recommendations are proposed to strengthen the functions of the SOSCMG:

- **Enable SOSCMG to access real-time flood data:** Since industrial spills often co-occur with floods, providing SOSCMG access to data from existing sensors and the flood control room at GCC would help them make informed decisions to prepare and respond to oil spills.
- **Include representatives from the local community in the SOSCMG:** The SOSCMG is composed of various stakeholders but lacks representation from the community itself, preventing information of industrial disasters from reaching them on time. It is recommended that the group include community leaders who can swiftly mobilise the community, relay communication and coordinate evacuations.
- **Increase the mandate of the SOSCMG in Ennore to collect socio-economic data** on communities in the area, which can help it to make more effective decisions on oil spill management. The data could be related to livelihood and income-related parameters, village jurisdictions, demographic and health-related parameters that may inform relief efforts.

6. Invest in Community-Based Disaster Response

The NDMA has recently released Community-based Disaster Risk Reduction Guidelines in which it recognises local communities as first responders who have the potential to become key stakeholders in all stages of disaster management (NDMA 2024). The guidelines and discussions with the community suggest the following activities to strengthen community-based response:

- **Build capacity of community and local NGOs in disaster response** specifically to report unsafe practices, identify evacuation routes and conduct evacuation drills, how to avoid exposure, disseminate warnings and help authorities in response efforts.
- **Invest in early warning systems** which are critical for providing timely alerts and allowing communities to evacuate safely and efficiently in the event of an oil spill. These systems should include modern technology such as sirens, mobile alerts and public loudspeakers, to ensure that warnings reach even the most remote areas promptly.
- **Build community infrastructure** such as local PHCs and ensure that the former are stocked with essential supplies such as decontamination agents, antidotes for specific chemicals, respiratory masks, and PPE (NDMA 2024). Relief shelters also need to be built, ideally close to these PHCs with basic facilities including access to drinking water, clothing, and sanitation materials which can be utilised in the event of a disaster. Existing infrastructure should be regularly maintained, mapped and communicated to local residents through the first responders.
- **Create a local disaster relief fund** which can be used for disaster response and immediate recovery in the Ennore area. This fund could be managed by the SOS-CMG/ the Fisheries Department / the local Zonal Office or any other body deemed relevant by the government. It could mandate contributions by all the industries located in Ennore.
- **Leverage corporate initiatives like CSR to strengthen local preparedness** by nudging local industries to work with local communities. This can take the form of providing financial support to establish clear communication channels and/or building community relief shelters to be used during disasters.

7. Compensation Needs to be Provided to All Impacted Communities and Amount to be Increased to Meet Immediate Needs

Gaps seem to exist in the identification of affected communities that would receive the compensation amounts. For instance, fishers in VOC Nagar and residents close to the Kosasthaliyar River in Ernavur, whose houses were inundated, were not provided with compensation. Compensation amounts need to be provided to all affected communities in future.

Further, the official compensation amount given was Rs. 10,000 for boat damages, Rs. 12,500 for house damages and livelihood loss and Rs. 7,500 for families that had oil-mixed floodwater enter their homes. The affected population which received compensation unanimously opined that this amount was inadequate, as it fell significantly short of the actual cost of repairs or the fresh purchase of boats. While it is impossible for the government to fully bear the cost of recovery, there is a legal provision in The Tamil Nadu State Disaster Management Policy 2023 for the polluter to be directed to pay higher amounts which could better assist in recovery. The minimum standard of relief followed by the TNSDMP is based on national guidelines set by the Ministry of Home Affairs in the 'Items and Norms of Assistance from the State Disaster Response Fund (SDRF) and the National Disaster Response Fund (NDRF)' for the period 2022-23 to 2025-26. The compensation amount prescribed here for fully damaged boats is 15,000 INR. It also includes an amount of 4,000 INR for fully damaged nets, which was not provided in Ennore (Items and Norms of Assistance from the State Disaster Response Fund (SDRF) and the National Disaster Response Fund (NDRF), 2022).

8. Improve Adequacy and Quality of Local Health Infrastructure

Currently, Ennore (which falls within Zone – 1, Thiruvottiyur) comprises 14 wards with a population of over 2,50,000 residents according to the 2011 census. However, this zone has only six Urban Public Health Centres, of which only two are serviceable to the population in Ennore (GCC,n.d.). Further, given the high pollution levels in the area, the medical staff at these PHCs need to be trained and equipped to handle specific illnesses including mental health-related issues. The PHCs also need to collect and record data on the kinds of symptoms and illnesses reported so that the long-term effects of pollution can be understood. **Make health camps more accessible:** Many of the FGD participants across villages stated that they did not know when the health camps were held after the oil spill. These health camps are critical in providing immediate relief and it is important that all the people are aware of the camps and access them. Information about the camps can be disseminated through the SOSCMG and through other popular media.

Collectively, these reforms would build a resilient, adaptive policy framework that ensures the long-term sustainability and health of Ennore Creek's fragile ecosystem.

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