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Fisheries dimension of marine oil spills

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Abstract

Despite being endowed with a vast exclusive economic zone and significant proportion of subsistence fishers at risk, scholarly work on marine fisheries in India has largely overlooked the fisheries dimension of marine oil spills. As a consequence, contingency planning for oil spills at all levels has paid inadequate attention to the entire gamut of fisheries aspects ranging from physical contamination and toxic effects of oil spills on fishing and mariculture resources, socio-economic impact on the fishing community, repercussions of contaminated seafood on public perception, seafood safety and fisheries closures following an oil spill, and compensation for pollution damages to the affected fishers. This review outlines the recent oil spill incidents around the world, and lists out the damage it has caused to the marine fisheries and associated economy. Besides, it also deals with the legal and public health safety aspects of an oil spill and argues for a balanced view to minimize loss to the industry without compromising on the quality of seafood and, discusses imperatives for successful compensation claims for oil pollution damages to the fishermen.

Keywords: *Oil spills, fisheries, pollution damages*

Introduction

India is the second largest consumer of oil equivalent primary energy in the Asia-Pacific region after China. About 70% of the world oil demand is ferried along the Indian coastline. The major ports in India handle over 7,000 tanker calls each year. Over eighty companies are in operation in 228 offshore blocks and fields, and the whole of the sedimentary basin area is likely to be covered by exploration activities in the coming years. Oil spills could occur from ships either accidentally or due to illegal operational discharges; accidental discharges from petroleum terminals and facilities and the offshore petroleum exploration and production industry. As per the National Oil Spill Disaster Contingency Plan, the Ministry of Agriculture and Farmers Welfare will provide scientific advice regarding species at risk, restriction of fishing activities, etc. and State fisheries authorities will assist and advise local action groups in identifying the rich fishing grounds so as to accord priority for protection. Also, as per the national plan, the Central Marine Fisheries Research Institute would estimate the effect of spill to fish and livelihood of fishermen, identify affected fish types, advice on post-cleanup restoration of fishing, and estimate economic loss due to fishing restrictions. The national plan recommends maintenance of accurate records to support claims and supporting documentation to demonstrate how the

claim has been calculated. The plan states that State fisheries authorities may temporarily prohibit or restrict fishing, on precautionary basis, if resources are, or are likely to become contaminated to prevent health risk to consumers and cautions that a delay in revocation of such prohibition or restrictions must take into consideration the implications for reimbursement of claims for damages from the P&I Club and IOPC Fund (Indian Coast Guard, 2015).

Undoubtedly, oil spills can cause damage to fishing and mariculture resources by physical contamination, toxic effects and by disrupting business activity. India has a significant proportion of subsistence fishermen that adds to the scale and complexity of the socio-economic impact of marine oil pollution on the fishing community. The repercussions of contaminated seafood on public perception can be serious unless the issues of market confidence and public health are well managed. Maintenance of public confidence and ensuring safety of public health following an oil spill calls for adoption of management strategies relying on scientific methods and data to ensure seafood safety and quality.

Fisheries impact in select major oil spill incidents

Several major oil spills across the world are illustrative of the impact on wide range of species and ecosystems. The spill in Alaska, United States, in March 1989, particularly affected commercially important salmon and herring whereas, the 80,000 tonnes of oil spilt from the *Braer* in Shetland, United Kingdom, in January 1993, resulted in contamination of both wild fisheries and farmed salmon and required implementation of a fishing ban in a 'Fisheries Exclusion Zone' for varying periods for different species as described in table 1 (IPIECA, 2000). Experience from the *Braer* incident indicated that reliable sensory testing was an adequate fisheries screening and monitoring technique (Moller *et al*., 1999). Great harm was similarly caused to the local fishing industry and offshore fishing was suspended for six months following the 76,000 ton spill from the M.V. Prestige in November 2002, during a storm off Galicia, in the northwestern Spain (http://en.wikipedia.org/wiki/Prestige_oil_spill). Yender *et al.* (2002) meticulously documented the seafood monitoring and taint and contamination in major oil spills (Table 2 and 3).

The Deepwater Horizon oil drilling rig exploded on April 20, 2010, releasing over 200 million gallons oil into the Gulf of Mexico, United States with unparalleled consequences. Twelve days following the incident, the United States' National Oceanographic and Atmospheric Administration (NOAA) closed 6,817 square miles of the Gulf of Mexico to commercial and recreational fishing and by June 2, 2010, the closed area was 88,522 square miles or nearly 37% of federal waters in the Gulf of Mexico. The fishery closures, consumer concerns related to the safety of Gulf seafood, and decrease in demand for Gulf seafood caused significant economic harm to the Gulf fishing industry. The total Gulf landings for all shrimp species during the closures decreased by 1,600 tonnes (27%) as compared to the same period in 2009. The spill resulted in mortality of organisms, eggs, and early life stages and harm to habitat and other elements of the Gulf ecosystem. Fishery closures constrained harvesters and disrupted seafood supplies for the region's processors, distributors, and buyers which resulted in the loss of some of the region's seafood markets and induced buyers to use substitutes such as products from other regions or imports (Upton, 2011).

Oil spills in Indian waters have had relatively negligible impacts on fisheries. On August 7, 2010, the *MSC Chitra* carrying about 1,200 containers grounded off Mumbai harbour, India rupturing two of her fuel tanks and causing a spill of about 800 tonnes of furnace fuel oil. The spill affected 33 fishing villages in three districts. The effects on the fishery resources were relatively short and no mass mortality of fish was reported. However, stranding of about 100-150 sting rays and a dolphin was reported along the beaches at Uran and Mandva respectively. Fishing effort by mechanized vessels for August 2010 decreased by 29% and landings declined by 6% while the non-mechanized fishing recorded 49% decline in landings. The bag net fishing in Mumbai harbour suffered heavily as the landings in August

Table 1. Affect of the *Braer* oil spill on different species of fishes and fishing restrictions (IPIECA, 2000, pp.23-24)

Species	Affect	Period of ban
Fish farms	elevated mortalities	-
Wild fish	light contamination	four and a half months
Farmed salmon	contamination quite high initially but depurated exponentially to background levels after about 5–6 months	until tests on commercial species showed negligible contamination (12 months)
Mollusks	hydrocarbons and taint depurated rapidly to start with	-
Scallops and mussels	elevated hydrocarbon levels for more than a year	two years and one month
Crustaceans except Nephrops (scampi)	affected for seven months	one year and 10 months
Nephrops (scampi) and mussels	affected for several years, probably from being re-contaminated from oil trapped in muddy seabed sediments	two years and 10 months

Table 2. Seafood monitoring in select oil spills (Yender *et al.,* 2002, p.5)

Spill Name	Date	Closures
M/V *New Carissa*	4 Feb 1999	Bivalves: 21 days, longer adjacent to the vessel
M/V *Kure*	5 Nov 1997	Mariculture oyster, crabs: 49 days
M/T *Julie N*	27 Sep 1996	Shellfish: 15 days
M/T *Provence*	2 Jul 1996	None
M/T *Sea Empress*	15 Feb 1996	Marine finfish: 82 days whelk & crustaceans: 183 days cockles: 125 days mussel: 8-19 months
M/T *North Cape*	19 Jan 1996	Finfish and bivalves: 73 days lobsters: 75-155 days
M/T *Braer*	5 Jan 1993	Wild finfish: 2 months farmed salmon: 12 months burrowing lobster: >6 yrs
M/T *Exxon Valdez*	24 Mar 1989	Herring and salmon: entire season; Advisories on bivalves in four subsis¬tence harvest areas

Table 3. Presence and duration of taint and tissue contamination with petroleum compounds (Yender, Michel & Lord, 2002, p.25)

Spill Name	Species name	Persistence (in months)	
		Tissue	Taint
Finfish			
M/T *Sea Empress*	Wild salmon	Declined rapidly	No
M/T *Braer*	Cod	1	No
	Haddock	1	1
	Plaice	1	2 (suspected)
	Whiting	1	No data
	Lemon sole	1	No
	Dab	2	1
	Caged Salmon	5	7
M/T *North Cape*	Finfish	0	No
Crustaceans			
M/V *Kure*	Rock crab	0.5	No
M/V *New Carissa*	Dungeness crab	-	Not tested
M/T *Braer*	Lobster	1	1
	Velvet crab	2	-
	Edible crab	12	No
M/T *North Cape*	Lobster	2.5-5	2.5-5
Bivalves			
M/V *Kure*	Oyster	0.5	No
M/V *New Carissa*	Oyster	0.75	No
M/T *Sea Empress*	Whelk	4	No
	Mussel	2.5-5	No data
	Cockle	2.5-5	-
M/T *Braer*	Whelk	12	No data
	Scallop	12	2 (suspected)
M/T *North Cape*	Steamer clam	3	No
	Oyster	3	No
	Mussel	3	No
El Salvador Refinery	Oysters	<1	No data
M/T *Exxon Valdez*	Bivalves	12	No data

2010 declined by 73.4% in weight and 77% by value despite increase in average catch rate from 151.9 kg/unit in the year 2005 to 172.9 kg/unit in 2009. A prohibition on landing of contaminated fish by the Mumbai Municipal Corporation immediately after the spill caused fish prices to plummet by 25-50%. The preventive orders and notifications from various government agencies and wide publicity by media to refrain from eating fish kept the fish-eating public at bay, drop in demand and fall in fish prices (Deshmukh *et al.*, 2010; NEERI, 2011).

Around 60 fish markets across Mumbai were empty for the week consequent to the *Chitra* spill and the industry suffered an estimated loss of rupees 60-80 crore. Because of the ban, fish from other states were not allowed to enter the city. A large number of retail shops who had a stock of frozen fish also met a loss in selling their merchandise at a low price following the ban, as they were forced to clear the stock (Jog, 2010).

A power failure at the Oil and Natural Gas Corporation, Uran facility on October 6, 2013 resulted in a minor spill of about 5 m^3. The fisherfolk suspected at least six kilometers of the coastline covering the villages of Peerwadi and Kegaon to be affected by the spill and inability to go to sea for at least a fortnight. The Uran fishermen who earned about rupees 2,000 a day by selling fish claimed damage to fishing nets and sighting dead fish, two kilometers into the sea and being washed ashore for two days after the spill (Tatke, 2013).

Also in October 2013, crude oil leakage from pipeline at Mahul creek transporting crude oil to Bharat Petroleum refinery in Chembur through Mumbai Port Trust impacted an area of approximately 20,000 m^2. Fishermen's income plummeted by more than 50% in the following two months. Crabs from Mahul creek were reported to be impacted by the spill. Fishermen reported sighting dead fish in the water, and severe tainting of fish catch. They also reported having to spend twice the regular amount to go deeper into the sea to catch fish unaffected by the spill. The fishermen further reported contamination of nets and boats and rashes due to splashing of oil contaminated water. Fisherwomen had to spend longer hours in the market, impacting household chores (Choksi, 2013).

Consequent to the spill of crude oil from the ONGC Bombay High pipeline in 1993, however, there was neither any evidence of damage to the fish caught nor there were any tar lumps in the catch. The catch composition continued to be comparable to the baseline. Though tarry patches caused considerable deterioration in water quality and localized damages to plankton, the fishery however was observed to have not been affected (NIO, 1993).

Similarly, a 3000 liter spill of diesel on September 10, 2002 from the subterranean pipeline of Hindustan Petroleum Corporation

Ltd. near the ecologically sensitive Mangalavanam in Kochi port was found to have resulted in the death and drying up of mangrove vegetation mainly *Acanthus ilicifolius* population though no mortality of fish, crab, shrimps, or birds was noticed (Kaladharan and Nandakumar, 2003). The studies of impact of oil spills in Indian waters are apparently fragmented and would require consolidation so as to serve as a reference for potential impacts in the event of an oil spill contingency.

Estimation of economic impact on Indian fisheries in the event of oil spills

According to the Marine Fisheries Census 2010, India (MoA and CMFRI, 2010), fishing and fisheries contributes roughly 10% to the country's GDP. Over four million people comprising about 8.65 lakh families, of which nearly 61% are below poverty line, make a living out of marine fisheries. The nine maritime states and two union territories together bear 3,288 fishing villages and 1,537 landing centres (Table 4) whereas daily domestic consumption of marine products is about 6,300 tonnes which valued at roughly 143 crore rupees.

Overall daily export of marine products is about 2,500 tonnes and earns foreign exchange of nearly 45 crore rupees. From Table 5 and 6 depicting the state-wise export and consumption of marine products, it is evident that the major marine fish production states of Gujarat, Maharashtra, Karnataka, Kerala, Tamil Nadu, and Andhra Pradesh, with over 85% of the market share, export an average daily quantity of 2,100 tonnes which valued at approximately 43 crore rupees, and support a daily domestic consumption market of average 5,700 tonnes valued at 124 crore rupees (MoA, 2014). Thus, fishing restrictions and changes in consumer demand following a major spill from any of the tankers plying the coast of India, or a spill or blow-out from any of the offshore installations in the Exclusive Economic Zone will significantly jeopardize the subsistence of poor fishers and deal a blow to the export revenues.

Table 4. State-wise landing centers and fisherfolk population (MoA, 2014, p. 107

State	Landing centers	Fisherfolk Population
Gujarat	121	336181
Maharashtra	152	386259
Goa	33	10545
Karnataka	96	167429
Kerala	187	610165
Tamil Nadu	407	802912
Andhra Pradesh	353	605428
Odisha	73	605514
West Bengal	59	380138
UTs	56	151642
Total	1537	4056213

Table 5. State-wise quantity and value of annual export of marine products in 2012-13 (MoA, 2014, p. 80)

State	Quantity		Value	
	tonnes	%	` crore	%
Gujarat	233738	26.05	2808.25	15.77
Maharashtra	148887	16.59	2723.57	15.30
Goa	41377	4.61	366.95	2.06
Karnataka	95907	10.69	849.01	4.77
Kerala	135240	15.07	3409.20	19.15
Tamil Nadu	86585	9.65	2298.63	12.92
Andhra Pradesh	78542	8.75	3344.97	18.79
Odisha	0	0	0	0
West Bengal	63832	7.11	1811.21	10.17
UTs	13078	1.46	190.91	1.07
Total	897186	99.98	17802.7	100.0

Table 6. State-wise quantity and value of annual domestic consumption of marine products in 2012-13 (MoA, 2014, p. 11)

State	Quantity		Value	
	tonnes	%	` crore	%
Gujarat	459822	18.97	9926.41	18.97
Maharastra	300023	12.38	6476.75	12.38
Goa	32333	1.33	697.99	1.33
Karnataka	261413	10.79	5643.25	10.79
Kerala	395400	16.31	8535.70	16.31
Tamil Nadu	341855	14.11	7379.79	14.11
Andhra Pradesh	335808	13.86	7249.26	13.86
Odisha	118310	4.88	2554.02	4.88
West Bengal	88518	3.65	1910.88	3.65
UTs	90112	3.72	1945.29	3.72
Total	2423594	100.00	52319.34	100.00

Fishing restrictions consequent to an oil spill

Fishing may be required to be suspended in an oil spill area if there is a significant risk of fishing gear or catches becoming contaminated but it is equally important for such restrictions to be lifted as soon as it is established that the spill has been removed and stocks are acceptable in the light of chemical and sensory testing.

According to the IPIECA (2000), fisheries and aquaculture may be affected by oil spills either directly or indirectly through impacts on their supporting ecosystems such as mangroves, seagrass beds, and areas used for wild-fry collection. It further states that potential damage is greater in inshore shallow water areas, particularly for species with restricted spawning grounds and that inshore shellfish beds, and fish and shellfish in aquaculture units are at greatest risk of direct effects where there is a greater potential for direct contamination by oil. The

IPIECA adds that in some situations a short-term suspension of fishing or harvesting activities may be appropriate.

According to the U.S. Coast Guard and U.S. EPA., 2014 if it is concluded that consumption of chemically contaminated fish or shellfish poses an unacceptable human health risk, local fish consumption advisories or bans may be issued for specific waters bodies or parts of water bodies and specific fish and shellfish species for specific populations (www.oceanfloridamarine.org).

The International Oil Pollution Compensation (IOPC) Fund (2014) suggests that while appropriate authorities may temporarily prohibit or restrict fishing, on precautionary basis, if resources are, or are likely to become contaminated to prevent health risk to consumers, it must be noted that a delay in revocation of such prohibition or restrictions must take into consideration the implications for reimbursement of claims for damages from the Protection and Indemnity Club and IOPC Fund.

The Food and Drug Administration of the United States has developed an elaborate protocol for sampling, testing, and re-opening closed harvest waters. According to the Protocol, harvest area closures would include buffer zones around the contaminated areas as a precaution to account for any uncertainty about the exact location of the oil from day to day and also areas closed in anticipation that oil would enter, but if it can be confirmed through water quality sampling, aerial surveillance, or satellite imagery that a harvest area was never exposed to the oil, that area may be re-opened without first testing seafood samples. For a closed area to re-open for harvesting of a given species, the Protocol requires that samples of finfish, shrimp, crabs, and mollusks taken from the waters must successfully pass both a sensory examination and chemical analysis in an approved laboratory. The criterion for pass in sensory testing is that a panel consisting of a minimum of 10 expert sensory assessors evaluates each sample in both a raw and cooked state and a minimum of 70% of the expert assessors must find no detectable petroleum or dispersant odour or flavour from each sample. The criterion for a pass in chemical testing, which is undertaken if all tested samples of a given species from a collection site pass the sensory criteria, is that the levels of PAHs in the seafood samples do not pose a health concern. Further, all contiguous sites must pass both sensory and chemical testing for an area to re-open (www.fda.gov).

As regards the regulatory position in India, the Marine Fisheries (Regulation and Management) Act, 2009: A Bill, section 3 (1) specifies that no vessel shall engage in any fishing or fishing activity within any part of the maritime zone of India, except with the prior written permission of the Central Government and that an Indian fishing vessel shall require a specific permit under section 3 for undertaking fishing or any fishing activity in any maritime zone outside the Territorial Waters. Section 3(4) (d) states that a permit granted under the Act shall be subject to such conditions and restrictions as may be prescribed. Section 3(8) adds that the Central Government may withhold the issuance of permits, and/or alter the conditions of a permit issued under section 3, having regard to public interest. The provisions of section 3 could possibly be utilized for implementing fishing restrictions in the event of oil pollution. Effective implementation of the restrictions could be achieved by invoking section 27(1) of the proposed Act which requires the Central Government to ensure coordination with the State Governments of the various coastal states of India in relation to the effective implementation of the Act, especially in so far as such implementation has impact on the territorial waters of India in conjunction with section 27(2) which requires the State Governments of the various coastal states of India to extend full cooperation and assistance at all times when the Central Government makes a request for such assistance to ensure effective implementation of the Act.

While the Marine Fisheries (Regulation and Management) Act, 2009 does not specifically authorize fishing restrictions related to oil spills, under the State Marine Fisheries Regulation Act (MFRA), the State governments have powers to regulate, restrict or prohibit certain fishing activities within specified area. Under its MFRA, the State Government may, by notification in the Official Gazette, regulate, restrict or prohibit in any specified area, the fishing by a class or classes of fishing vessels and for any period that it may specify, the catching of such species of fish and for such period as may it specify, the use of such fishing gears as it may specify, and the mariculture. In issuing a notification the State Government shall among other matters, have regard to scientific basis. Section 7 of the Gujarat Fisheries Act, 2003 and section 5 of Tamil Nadu Marine Fishing Regulation Act, 1983 may be cited as examples of the power to regulate, restrict or prohibit fishing activities in the event of oil pollution.

Inadequate caution in marketing of contaminated products could lead to severe financial repercussions on a fishery and over-caution also can result in severe financial loss whereas the right amount of caution can emerge only from detailed guidance, sensitivity mapping for contingency planning, and regular drills to rehearse response measures and fulfillment of numerous imperatives. It is imperative that sensitivity mapping for oil spill contingency planning include the locations of spawning, nursery and fishing areas, aquaculture facilities, and information on seasonal variations. It is also imperative that the authority to issue fish advisories or closures due to human health risks from consumption, typically in the health department, be notified and duly authorized. It is preferable that authorities routinely conduct chemical contaminant analyses of fish and shellfish tissues as part of their water quality monitoring programs. It

is also important that personnel be trained for sensory testing and that they rehearse the protocol and procedures.

Considerations for sensory testing of seafood following oil spill

When an oil spill occurs, local seafood resources may be exposed to petrochemicals that affect their sensory qualities (taste, smell, and appearance). Even when seafood samples from the spill area pass the standard chemical-analytical tests, flavor or odor still may be affected. Taint in seafood renders it adulterated and unfit for human consumption. An oil spill may, therefore, necessitate sensory testing of seafood that may have been exposed. Guidelines, standard practices and sampling plans for sensory testing are published by among others the United Nations/World Health Organization Codex Alimentarius Commission (ALINORM 99/18, Procedural Manual F/3026), International Organisation for Standardization (ISO 8586-1/8586-2 1993, ISO 5492 1992, ISO 6658 1985, ISO 8589 1998), American Society of Testing & Materials (ASTM) Standards (D3696-89, E1810-96, E253-98a, E 544-75, E 1885-97, MNL 13 1992, STP 434 1999, STP 480-84, STP 758 1981, STP 913), American National Standards Institute/ American Society for Quality Control (ANSI/ASQC Z1.4 1993), and Environment Canada (EEM/1997/7). The considerations for developing national guidance for conducting appropriate sensory tests to objectively assess seafood resources for petrochemical taint following an oil spill in a scientific and legally defensible manner and instructions for the sensory professionals and assessors and other personnel responsible for managing seafood discussed in this section are drawn from NOAA Technical Memorandum NOS OR & R 9 (Reilly and York, 2001).

Sampling kit

A sampling kit for collection of sensory samples suggested by NOAA is appended at Table 7. Samples can be presented either as 20-g blended, individual fish samples from multiple pooled organisms, or 20-g dorsal-muscle single-organism samples. The total weight of the final sample and the estimated number of samples needed will be determined by the expected recovery of fish or shellfish flesh (Table 8).

Table 7. Sampling kit suggested by NOAA for collection of sensory samples (Reilly & York, 2001)

Quantity for sample size n=21 organisms	Items
1 roll	Heavy-duty aluminum foil
25	Vacuum-packaging bags
1	Vacuum sealer
50	Zip-lock bags with straws
6	Cutting boards
6	Knives*
4	Scissors*
4	Permanent marking pens
25	Adhesive labels
2	Coolers*
6 sheets	Styrofoam or packing material
1 roll	Newsprint (unprinted)
2	Shipping cartons*
weight of samples	Dry ice or ice packs
2 rolls	Packing tape and/or masking tape

Table 8. NOAA estimate of recovery of fish (Reilly & York, 2001, p. 13)

Type of seafood	Expected % recovery of edible flesh
Finfish	38–40
Flatfish	30–33
Lobsters	14-18
Shrimp	28–30
Clams	16–20
Oysters	25–30
Scallops	20–25
Mussels	15-20

Assessors

Objective sensory measurements are obtained from assessors screened and selected for sensory tasks (usually 25), assessors selected and highly trained to participate on a panel for specific sensory tasks (usually 10 to 15), or expert assessors, e.g., product specialists, seafood inspectors (usually 1 to 5). Very large panels, of 100 or more assessors, are required for subjective (consumer) testing because their responses are personally biased and there is wide variability within and among the resulting data sets. Two types of assessor panels would be required for seafood taint assessment. A panel of 3 to 5 expert assessors or fish inspectors, employed by a regulatory agency) will have to be selected and trained to detect petroleum taint in seafood and tasked to assess fish for its suitability for sale for human consumption. A panel of 10 to 15 selected and trained assessors may be convened specifically for the task of assessing taint from a particular oil spill to ensure that conclusions can be drawn with confidence.

Sensory evaluation facility

The facility in which objective sensory evaluation is conducted is an essential component of sensory test protocols. Sensory testing requires a controlled neutral environment in which samples can be evaluated for their intrinsic attributes, and the possible presence and intensity of taint from exposure to petrochemicals. The testing environment must not interfere with or influence the sensory test. Both ASTM and ISO provide excellent guidelines for facility design. Components of the neutral environment include lighting of appropriate quality and intensity for the

assessments, ventilation that is appropriate and adequate to remove odours given off by the samples during testing, and freedom from distractions. Another important consideration is ease of sanitation and the use of products that do not add odours of their own into the test area (odour-free soaps, etc.).

Sensory evaluation protocols

Detailed sensory evaluation protocols would be required to identify presence of petroleum taint in seafood following an oil spill comprising both, general sensory testing procedures and specific instructions covering before and during testing session, and evaluation criteria, for expert and trained assessors. Procedures common to all of the sensory test methods required to be developed as part of the protocol would include those to be followed before entering the evaluation room, during testing sessions, for rinsing between samples, overcoming susceptibility to fatigue, adaptation to petroleum odours/flavours, and avoiding carry-over of odour/flavours from the previous sample. A typical 3-tiered evaluation criterion for expert assessors involves test for raw odour, cooked odour, and cooked flavor. Trained assessors would not make decisions on samples but rather, evaluate samples for the degree of difference from the control sample. The data are then statistically analyzed to determine whether there is a significant difference. Discrimination tests may be conducted with a panel of trained assessors. The "difference-from-control" test is effective in seafood tainting situations. Ballots would be required for use by expert assessors to allow for recording both quantitative and qualitative information on a category scale with an area to record descriptors and for the discrimination test chosen for use by trained assessors. The decision tree for sensory testing methodology adopted by the NOAA is illustrated in its Technical Memorandum NOS OR&R 9 (Reilly and York, 2001)

Oil pollution compensation claims from the IOPC Fund

The International Oil Pollution Compensation Fund (IOPC Fund) 1992 compensates oil pollution damages relating to oil spill from a tanker, provided that there is a close link of the losses with contamination, the claim is reasonable, justifiable and measurable, there is poof of losses, the losses have actually occurred and are not future losses, and the business is legal. The Fund has laid down Guidelines for presenting claims in the fisheries, mariculture and fish processing sector (IOPC Fund, 2014). This section discusses the IOPC Fund Guidelines.

A claim can be made straightaway for fishing gear or equipment affected due to oil spill whereas loss of earnings due to non-fishing may be made either in one go or at periodic intervals. In all cases, however, claims for compensation are thoroughly assessed and, therefore, it can take a little time for money to get through to the claimant.

The 1992 Fund prepares claim forms for each incident which may be downloaded from its website or requested from the 1992 Fund or shipowner's insurer. Claim can be done through the office of the local correspondent or representative of the insurer. While the IOPC Fund website will specify where the claim form should be sent details would also be usually given in the local press. The losses covered by the IOPC Fund, 1992 include damage to property such as fishing gear or other equipment, cleaning or repairing equipment, and cleaning contaminated boats and rafts; consequential loss through not being able to use the gear until it has been cleaned or replaced; pure economic loss such as compensation for the money that would have made if the pollution had not happened, losses if nobody will buy the product because they believed it is tainted by oil, and if one cannot get fish to sell because nobody is catching; preventive measures to prevent oil causing damage to fishing area such as placement of boom at the entrance to a harbour; and cost paid to the advisor for professional help in making a claim for compensation.

The 1992 fund lays down some prerequisites though. The individual is responsible for business continuity and keeping losses as low as possible. Compensation will be admissible only for the difference between normal and actual earnings and in no case is full compensation admissible if the business is stopped completely when in fact there are other ways of operating. This might mean fishing in another area, working in some other job (such as cleaning up the oil) or, for fishing businesses such as processing, marketing, supply etc. getting supplies of fish from unaffected areas. Fishermen are required to maintain records of the oil arrived, weather conditions, and costs of fishing in alternate area. They are also required to retrieve fishing gear left in the sea or take clear photographs of the extent of damage. Fishers should also know that a ban is not automatically recognized. Mariculture operators may be required to stop feeding of fishes, use measures to stop the oil, and harvest fish stock before oil reaches the farm and of course maintain good records as compensation is paid only for unavoidable losses.

Documentary information required by the Fund in support of the claim would include business records like fishing log books, sales notes, receipts for purchases such as fish feed, packaging, fuel or ice, trading accounts for the last three years before the oil spill together with monthly details of income and expenses, income and expenses during the time of the spill and normal time, to calculate the difference; description of fishing operations such as type of gear, usual fishing area, normal daily catch and normal earnings from selling of catch, as also any payments or compensation from the Government or local authorities, or any other income during the spill.

Arguably, many of the imperatives required of the claimants of the Fund may be hard to fulfill. The close link of the losses with contamination, reasonableness and justifiability of the claim, proof of losses, etc. are all open to interpretation. It would be hard to prove that the fish or product is not sold due to contamination. A marketing campaign may not necessarily reassure consumers. The reasonableness of measures adopted to avoid contamination from oil may be debatable. The reasonableness of costs paid to advisors by illiterate, vulnerable fishers may be questioned. The fishers would hardly be aware of the source of the claim form. Documentary information of business in the fisheries sector is presently, perhaps, a complete blank.

Significant economic impact to marine fisher folk and export revenues from marine products is likely in the event of major marine oil pollution. Documentation of catch revenues in great detail is, therefore, an urgent necessity. A gap exists in legislation to deal with fishing restrictions and is required to be made good. The national oil spill disaster contingency plan makes a reference to fisheries and seafood management following an oil spill and merits elucidation of guidance for sensory testing protocol and procedures to deal with fishing restrictions. Risk communication has received scant regard and calls for serious consideration. The documentation and procedure for preferring of claims to the 1992 IOPC Fund is both rigorous and tedious, and would require large-scale efforts by authorities and focused community awareness programs to ensure fruitful claims for oil pollution damages.

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