

Spatial Technology Based Governance for Enforcement of International Environmental Law in Marine Ecosystem Protection

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Abstract: *Marine ecosystems are the biggest ecosystems, which cover around 71% of Earth's surface and contain 97% of our planet's water. Water law usually has the objective of restoring and maintaining the chemical, physical and biological integrity of inland and marine waters. It may regulate the discharge of pollutants, activities affecting wetlands, accidental spills, and the use and disposal of wastes. UN Convention on the Law of the Sea (UNCLOS) contains and codifies the principles respecting the protection and preservation of the marine environment in all maritime zones. Spatial governance (based on GIS, RS & GPS) is instrumental in shaping and management of marine ecosystems. By identifying the risks and vulnerabilities, geo spatial data can aid in increasing the adaptability and resilience of the affected. Use of GPS surveying and satellite imageries for data capture and GIS for interpretation, analysis and modeling of spatial and referenced non-spatial data have contributed to the process of planning.*

Keywords: spatial, technology, governance, law, marine ecosystem.

1. Introduction

Water is critical to life and waters cover over 70% of the earth's surface. Environmental Governance comprises mechanisms, processes and institutions through which citizens and groups articulate their interests, exercise their legal rights, meet their obligations and mediate their differences. Good governance involving equity, transparency, participation, responsiveness, accountability and the rule of law is instrumental in furthering the cause of development. In 1982 the UN Convention on the Law of the Sea (UNCLOS) was adopted to create an overall legal framework for the law of the sea. It identifies the different maritime zones and the legal regime appropriate for each of them. Its Part XII codifies the principles respecting the protection and preservation of the marine environment in all maritime zones. Several provisions of the Convention are also related to marine pollution or living resources in the context of specific marine areas [1-5].

Laws and regulations typically require that any discharges into water require a permit and impose strict liability on those who make discharges without or in violation of the conditions of a permit. Knowledge or intent is frequently irrelevant, as decided in France, Tribunal administratif de Grenoble, June 8, 1984, Michallon v. Secrétariat d'Etat à l'Environnement, R.J.E., 1984/3, 240. The Marine and Coastal Access Act, 2009 of UK has received Royal Assent creating a new regime for forward planning and licensing of activities in marine areas and for marine nature conservation. Fresh water and marine environments are undeniably interlinked, but the legal regimes applicable to them differ widely in response to varied geographic, economic, social and political factors [6-8]. One-quarter of all freshwater is found under the soil and generally is closely connected with surface waters, but their legal regimes are often distinct. Judges in many countries encounter cases concerning water pollution, allocation of water, and the

regulation of fishing and other uses of water resources [9-14]. The legal treatment of pollution is also complicated by differences between identifiable "point" sources and "diffuse" sources of pollution.

2. Spatial Technology

Spatial technology i.e. Remote Sensing (RS), Geographical Information system (GIS) and global positioning system (GPS) play important role in marine ecosystem management. Remote sensing or satellite data due to synoptic coverage, repetitive data gathering capabilities, spatial information, economically cheaper & sustainable technology, real time data collection & computer compatibility, coupled with GIS are extremely useful in monitoring, assessment, evaluation & management of total environment. Remote sensing data or satellite data are extremely useful for monitoring, assessment & evaluation, planning and feedback mechanism and management of all components of environment (various ecosystems, natural resources etc.) and marine ecosystem. Satellites provide both spatial and temporal information needed to understand changes in resources for their distribution, qualitative & quantitative assessment.

Multi-spectral satellite data having specific utilities for mapping, classification, quantification, spatial analysis, temporal change detection, detection of stressed conditions etc. Parameters like fish production, pollution in ocean, etc can be estimated. Because reflected electromagnetic radiations are different for different substance or object therefore digital number (DN) value is different for different objects, this DN value is useful for object identification & image interpretation which is done through involvement of shape, size, tone, shadow, pattern, texture, size (location), association and resolution of satellite imagery/ data. Spatial information/ data & distribution pattern of each Parameter/ component of Natural Resources (NRs) & ecosystem is obtained through interpretation of satellite/ Remote sensing

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data with limited ground truth/ checks (field based). GIS can handle huge data sets (spatial & non-spatial data). All the data (spatial & non-spatial) are integrated in GIS and analysis & modeling in GIS using satellite and other data is done for monitoring, planning & management plans and finally for decision making & sustainable development and therefore biodiversity in marine ecosystem for management and future planning.

3. Marine Ecosystems

Approximately 70% percent of earth surface area is covered with maritime waters. Human activities everywhere are depleting marine and coastal living resources and degrading ecosystems in sometimes irreversible ways, threatening the economic well-being and health of communities and states throughout the world. The problems emerge in cases before judges concerning liability, licensing, traditional rights and other concerns. Water in Marine ecosystems features in high amounts minerals and salts dissolved in them. Many kinds of organisms live in marine ecosystems: the brown algae, corals, cephalopods, echinoderms, dinoflagellates and sharks.

The different divisions of the marine ecosystem are: (1) Oceanic: lies on the continental shelf; very large amount of earth is covered by ocean (~75%), 40% of all photosynthesis occurs in oceans; (2) Profundal: deep or Bottom water; (3) Benthic: Bottom substrates; (4) Inter-tidal: The place between low and high tides; (5) Estuaries; (6) Coral reefs; (7) Salt marshes ; (8) Hydrothermal vents where chemosynthetic bacteria make up the food base. The major threats to the health, productivity, and biodiversity of the marine environment result from human activities that take place on land, in coastal areas, and even further inland, but the marine environment is also under threat because the traditional uses of the sea have intensified and diversified. Consequently, National and international environmental law is developing in response to this evolution of distinct but converging categories of problems.

The first group of tasks focuses on combating intentional or accident marine pollution that originates from many different human activities. The second set of problems involves protecting living marine resources, something clearly linked to the first set of issues. Nearly all coastal states in the world have become party to UNCLOS and enacted its provisions into law to establish maritime boundaries and regulate activities in the various maritime zones. Judges in such case are thus likely to encounter issues about the lawfulness of activities within the zones, especially in regard to illegal fishing or pollution of coastal waters.

4. Marine Pollution

The problem of maritime pollution frequently requires measures be taken on the national, regional and the global level, with local variation being resolved through appropriate specific regulations at the same time that universal norms are formulated. While the oceans share homogeneous characteristics such as ocean currents, salt, and contiguity, their geophysical situation differs widely

among the regions of the world. There are nearly enclosed seas, such as the Baltic, the Mediterranean and the Black Sea, which do not have the same enormous intermixing of waters from which other seas benefit. They are less able to absorb and diffuse pollution, although these seas have among the highest known densities of maritime traffic and also suffer from exceptionally concentrated population levels along their shores, with all the attendant pollution.

Many times many large ships carrying hazardous products, heightens the risk of serious marine pollution. Fishing has been transformed into an industry which today impacts upon biological resources in the farthest and most inhospitable ocean reaches. With annual total catches of many stocks decreasing, it appears that the limits of sustainable exploitation of marine biological resources are close to being reached or in some instances being exceeded. Those fish that are caught are increasingly showing signs of contamination and damage from pollution, including concentrations of carcinogens, tumors, wounds, and malformations, which render them unsuitable for consumption and which threaten their ability to reproduce.

Massive utilization of the sea as a dumping ground for waste can involve thousands of tons of matter dumped by a single ship in one voyage. The polluting acts that affect the marine environment vary greatly. Some are intentional, for example the dumping of wastes and the cleaning of oil tanker hulls on the high seas followed by discharge of the residue of oils into the ocean waters. Pollution also can be accidental, resulting from tanker grounding or loss of containers of toxic or dangerous products. Regulatory techniques must take into account these differences. International environmental law places its emphasis on prevention. Numerous standards prohibit certain deliberate or intentional acts or strictly regulate them. To minimize accidental environmental harm, other legal principles must be applied, such as strict rules governing the construction of tankers, navigation, and the training of crews. It is clear that marine environmental pollution due to accidents can only be combated through international cooperation.

States have the duty to prevent, reduce and control vessel source pollution of the marine environment under the international framework. Principles stated in UNCLOS are supplemented by a global convention and by several conventions governing regional seas. The general instrument, the International Convention for the Prevention of Pollution by Ships (MARPOL), adopted Nov. 2, 1973 and modified several times applies to vessels of any type whatsoever, operating in the marine environment, including hydrofoil boats, air-cushion vehicles, submersibles, floating craft, and fixed or floating platforms. States parties must give effect to the provisions of the Convention as well as to those of its annexures. International instruments concerning marine environmental pollution tend to distinguish four categories of intentional pollution: vessel-based pollution coming from normal utilization of the oceans; deliberate and large, mostly industrial, dumping of wastes; pollution arising from exploration or exploitation of the sea-bed; land-based pollution whether coming from direct discharges into the ocean or carried into it by rivers. National laws

implementing the relevant international instruments tend to reflect the organizational thrust and objectives of international instruments themselves. Accordingly, some familiarity with the international framework can be instructive with respect to understanding and applying relevant local laws.

5. Convention based Provisions

The United Nations Convention on the Law of the Sea (UNCLOS) contains important provisions relating to conservation of marine living resources. Its general rule affirms coastal state authority to ensure the conservation of biological resources in zones within its jurisdiction, i.e., the territorial sea, the exclusive economic zone (EEZ), and the continental shelf. The exclusive economic zone, because of its size and above all because of its objectives, is of primary importance in conservation of the marine living resources. The extent of the zones under coastal state jurisdiction creates problems with respect to marine animals that traverse more than one nation's zones. In recent years marine biodiversity has become increasingly threatened due to pollution from land-based and other sources, over-exploitation, the introduction of alien species, coastal development, and global climate change and ozone depletion.

More than 44% percent of the world's commercial fish stocks are estimated to have reached their yield limit. The Convention designates five categories: (i) stocks of species that occur within the exclusive economic zones of several coastal states or within the economic zone of one and an area adjacent to that zone, are regulated by conservation measures agreed upon by the concerned states either directly or through appropriate international organizations; (ii) for highly migratory species, such as tuna, whales, and sharks, the coastal state and other states whose nationals fish in the adjacent regions, shall seek agreement on the measures necessary to conserve and develop these species. Art. 64; (iii) marine mammals can be regulated more strictly by the coastal state or a competent international organization. Measures may include prohibition, limitation or regulation of the exploitation of such animals; (iv) some species reproduce in rivers but live in sea (anadromous species) like salmon fish. For such legal problems, UNCLOS Art. 66 provides that states in whose rivers these stocks originate have the primary interest in and responsibility for them.

They must ensure their conservation by establishing appropriate regulatory measures for fishing in all waters to the outer limits of the exclusive economic zone. For fishing outside the exclusive economic zone, the states concerned consult in order to establish the terms and conditions of such fishing, giving due regard to the conservation requirements and the needs of the state of origin; (v) some species (Catadromous species) like eels, reproduce in the sea and live in other environments. As per Art. 67, the coastal state in whose waters these species spend the greater part of their life cycle has responsibility for their management and shall ensure their ingress and egress. These species may not be harvested on the high seas and

fishing for them within the exclusive economic zone is regulated by the general regulations governing the zone. Where such species migrate through the waters of more than one state, rational management must be assured by agreement between the states.

6. International Laws in Resources Protection

The law is more stringent than the Convention, prohibiting driftnets more than one kilometer in length and giving broad powers of search, arrest and seizure to enforcement officers. Persons convicted of an offense under the act are subject to fines. International Convention for the Prohibition of Fishing with Long Driftnets in the South Pacific (Wellington, November 24, 1989) is one of the effective Law available. The Convention requires each party to take measures to prohibit the use of driftnets more than 2.5 kilometers long and the trans-shipment of driftnet catches. Several legal measures on both global and regional levels attempt to combat large scale pelagic driftnet fishing. At the beginning of the regulatory efforts, more than one thousand fishing vessels used large-scale pelagic driftnets of up to 48 kilometers (30 miles), nets that were often referred to as "walls of death" because they captured everything in their path. In 1991, New Zealand adopted legislation to prohibit driftnet fishing activities in its EEZ and to implement the Wellington Convention.

UN Agreement (1995) concerned primarily with stocks that are beyond the limits of national jurisdiction, looks principally to flag states for action, which is understandable given the focus on high seas activities. It requires states parties to ensure that flag ships do not engage in any activity that might undermine the effectiveness of conservation and management measures. States are not to authorize or license high seas fishing unless they can ensure compliance with applicable national, regional and international regulations. The Agreement foresees a system of boarding and inspections within the regional or sub-regional framework followed by sanctions imposed by the flag state. Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, New York, adopted August 4, 1995, opened for signature December 14, 1995.

The United States adopted similar legislation, called the High Seas Driftnet Fisheries Enforcement Act, on 2 November 1992. The Act denies port privileges and establishes sanctions for high seas driftnet fishing. The South Pacific Forum Fisheries Agency took similar action when it adopted a Treaty on Cooperation in Fisheries Surveillance and Law Enforcement in the South Pacific Region at its 23rd session (Niue, July 9, 1992). The Council of Fisheries Ministers of the EC in 1998 agreed to ban driftnet fishing on the high seas by all vessels flying the flags of EU states as of January 1, 2002. One of the more important cases, the Case on the Conservation and Sustainable Exploitation of Swordfish Stocks in the South-Eastern Pacific Ocean (Chile v. EC) was discontinued after the parties reached agreement.

The Washington Convention on International Trade in Endangered Species (CITES) prohibits trade in certain kinds of whales, such as the blue whale and the narwhale. A series of international treaties intend to ensure the conservation of specified species or groups of species, such as sea turtles, cetaceans, and marine mammals. Some of these are endangered species also protected by CITES. The first group to be protected was whales. The International Convention for the Regulation of Whaling (Washington, Dec. 2, 1946) was drafted as a fishing treaty regulating whaling in order to prevent over-exploitation and conserve and develop whale stocks. Strong national measures to implement the Convention have been taken by various states including the United States, which prohibits U.S. nationals or vessels from whaling on the high seas.

Certain kinds of seals are protected by the general multilateral conventions concerned with endangered species, principally CITES and the Bern Convention. Similarly, as a migratory species, seals benefit from the 1979 Bonn Convention and the provisions of UNCLOS. Finally, their habitats can be protected through application of the 1972 UNESCO World Heritage Convention. Australia prosecuted (February 2002) in its courts an alleged pirate fishing vessel. The *Volga* was arrested in a naval operation that cost the Australian government some \$A15 million (\$US7 million). The fishing vessel was taken was returned to Fremantle, Western Australia, and its officers and owners held on charges of illegal fishing. The case also went to The International Tribunal on the Law of the Sea (ITLOS) when Russia contested the bond set by the Australian judge to release the fishing boat and three Spanish officers who were detained.

Under UNCLOS, alleged illegal fishing vessels and crew must be promptly released upon payment of a "reasonable" bond. In other cases, over the past decade, more than 400 Indonesian fishermen have been imprisoned in Australia for illegal fishing in Australian waters. The Darwin (Australia) Supreme Court imposed on a Thai vessel a \$50,000 fine for intentionally using a foreign boat for fishing in the Australian Fishing Zone (AFZ), while a further \$50,000 penalty was awarded for having the boat equipped for fishing in the AFZ.

In *Amoco Cadiz* case, tanker ran aground off the coast of Brittany on March 16, 1978, due to damage to its navigational equipment. During the following three weeks, nearly all the 219,617 tons of crude oil cargo as well as its fuel, together totaling nearly 230,000 tons of oil, escaped into the sea creating an oil slick eighteen miles wide and eight miles long. Three hundred seventy five kilometers of coast was polluted by 50-60,000 tons of oil. Of this, 15-20,000 tons were cleaned up by volunteers and the military. In the affected zone, in the sea and on the coast, a total of 30% of the animal life and 5% of the plant life was destroyed. Approximately 20,000 birds died, the shellfish industry suffered damage, and the fishermen lost 45-60 days of fishing. There was also indirect damage, notably to tourism.

In re Oil Spill by *Amoco Cadiz* off the Coast of France on

March 16, 1978, No. MDL376 (N.D.Ill. 1988), 1988 U.S. Dist. LEXIS 16832 Court observed and addressed the claims made by France, the harmed cities and towns, individuals, farmers, fishermen and environmental protection groups, discussing several categories of damages: (i) Cleanup operations by public employees; (ii) costs of material and equipment purchased for the cleanup; (iii) costs of using public buildings; (iv) coastline and harbor restoration; (v) lost of reputation and public image of the towns; (vi) individual claims; (vii) ecological harm. The court did not award damages for injury to the biomass, the totality of life in the sea and on the bottom in the affected zone, deeming the matter complex, attenuated, speculative and based on a chain of assumptions.

7. Protection of Indian Coastline

In *Indian Council for Enviro-Legal Action v Union of India*, the Supreme Court in regard to the 600 kms long coast line emphasized that that it would be the duty and responsibility of the coastal states and Union Territories in which the stretch exists, to see that the notifications issued, declaring the coastal stretches should be properly and duly implemented. Further the various restrictions on the setting up and expansion of industries, operation or process, etc. in the regulation Zone should be strictly enforced. In the same case the court enunciated the principle further that the polluter pays. Once the activity carried on is hazardous or inherently dangerous, the person carrying on such activity is liable to make good the loss caused to any other person irrespective of the fact whether he took reasonable care while carrying on his activity. The responsibility of repairing the damage is that of the offending industry.

8. Conclusion

Marine law is more effective than treaties. The ocean contains the largest active pool of carbon near the surface of the Earth. Surveying, mapping, remote sensing techniques, global positioning system (GPS) and geographical information system (GIS) techniques are now increasingly being used for marine ecosystem management. The sea receives a large part of its pollution from rivers, but specific rules are needed to resolve its problems. Spatial techniques identify differences in resources distribution like fish production and intensities of marine pollution due to different substances and parameters in marine ecosystems. Planning support systems in GIS are instrumental to successful objective based planning and public participation processes. In *Indian Council for Enviro-Legal Action v Union of India*, the Supreme Court of India in regard to the 600 kms long coast line held that it would be the duty and responsibility of the coastal states and Union Territories in which the stretch exists, to see that the notifications issued, declaring the coastal stretches should be properly and duly implemented.

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