Chapter VIII

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The recent trends of globalization and privatization are opening coastal zones for free trade dominated by ever growing trans-national cooperation. These are likely to put pressure on the coastal and marine environment of the world especially in tropical countries. There are many evidences of environmental degradation across the coastal regions of the world particularly in urban estuaries of large mega cities. Kandla and Halifax are the major port-cities in their respective countries and both have already been showing signs of environmental degradation. The anthropogenic pressure is manifesting in them in terms of coastal water pollution, heavy traffic at the harbour and threats of oil spill creating danger for the marine resources.

The present study therefore, attempts to understand the process of urban and port related activities in these two case study ports, one in a developing country i.e. in India and the other in the developed world i.e. in Canada. We have assessed the environmental and anthropogenic pressures and their effects on port and city environment and communities in both the study areas. An attempt has also been made to identify sustainable policies and strategies for port-city development and management in the developed and developing countries. Based on the present study the following conclusions have been drawn:

1. The concern for marine environment at international, national and regional levels indicates the need for understanding the issues related to the impact of land and sea based activities on the marine environment and the approaches propagated for their planning. Due to unplanned development coastal regions particularly urban estuaries have been bearing the brunt of land based developmental activities. They have been suffering both from ecological as well as socio-economic impacts on their physical, chemical and biological status which impair the legitimate uses of sea and coastal environments.
2. Estuaries traditionally have provided site for human settlements. Human activities in the modern world have become more complex and have also developed many new uses of the harbour /estuarine system. Urban developmental activities, including port activities, use estuaries as a sink for refuse and waste disposal. These new uses have given rise to various concerns of marine pollution in the coastal areas especially in urban estuarine systems. These concerns have been well recognized by the international, regional and national conventions on the protection of coastal areas.

3. A Port city like Kandla provides an excellent example of a gateway city. Its immediate hinterland accommodates those activities that are well connected with its foreland and its larger hinterland. Morphology of Kandla is determined by the location and spatial arrangement of port facilities and industrial and other urban economic activities that are derived from the port.

4. Demographic trends influence the morphology of any city. It is true in the case of Kandla. The rapid increase in population of Kandla-Gandhidham since 1950 has brought many changes in the port as well as in the city. The high growth rate of urban and port related activities have attracted migrants from various parts of India. The economic activities of Kandla have diversified which indicates the high potentials of Kandla port city as an industrial urban centre in Gujarat.

5. Kandla’s industrial structure is dominated by heavy and chemical based industries. The port has attracted chemical and petroleum-based industries since they depend on the import of bulky raw material by sea.

6. Converting land under salt-based industrial activities into port facilities, will release more developed land which is now under open space category. These open spaces are likely to be put under various economic activities in the future. The topography of Kandla port region provides limited land area for the construction of facilities as large areas of this region are covered by the Little Rann i.e., marshy and boggy land. Kandla-Gandhidham urban complex
is likely to remain under the influence of Kandla port for a considerable time to come.

7. The overall water quality of Kandla port region has been analysed for a number of parameters. The concentration of toxic element is by and large found to be low and suggests fewer inputs in the marine water of Kandla port area. Primary water quality parameters such as DO, BOD and Nutrients are within the permissible limit of marine water quality standards. However, localized enrichment of some nutrients such as phosphorous ($\text{PO}_4^{3-}$) and NH$_3$ – N is observed. This is due to the fallout at the IFFCO fertilizer plant located at the Kandla Port.

8. The concentration of petroleum products such as PAH and Phenol at the port is of great concern. These petroleum products are found in high concentration as a result of the leakages at the oil jetties due to loading and unloading of oil and other petroleum products. However, other geo-chemical parameters such as salinity, turbidity and suspended solids are found in high concentration for obvious geographical reasons.

9. The present state of water quality of Kandla port region suggests that anthropogenic activities have started showing their impact in terms of inputs into the Kandla port area. It is likely that these inputs soon have a deleterious impact on the harbour environment resulting in pollution that originates from land-based sources.

10. We have presented a limited but detailed water quality study of the Kandla port region in this thesis. The presence and distribution of toxic matter such as heavy metals in the water column has not been discussed due to lack of previous studies and database. This suggests that a detailed study of water quality analysis is necessary in the Kandla Port region for heavy metals in order to monitor the environmental parameters. Fecal coliform (for bacteria and pathogen) needs to be observed, as domestic and industrial wastewaters are also being drained untreated into the sea along the Kandla port area.
11. Nutrient enriched sediments are found in Kandla Creek. However, gross metal contamination has not been observed. The higher concentration of phosphorous and nitrogen at few stations are the localized influence of anthropogenic activities. The fallouts at the IFFICO fertilizer plant due to loading and unloading results in the high nutrient concentration of sediments in the Kandla Port region. Localized concentration of petroleum hydrocarbons does not indicate anthropogenic discharge. Compared to water contamination the sediments of Kandla Port areas are less contaminated.

12. Halifax Harbour is one of the most strategically located harbours of North America on the Atlantic coast. That is why Halifax Harbour acquired traditional glory and was called ‘Warden of North.’ Halifax has the comparative geographical advantages of a natural harbour which can operate throughout year and due to its strategic advantages supports very complex urban and port activities.

13. Halifax Harbour has been supporting port and urban activities ever since its establishment in 1749. Because of the comparative geographical advantage of the natural harbour with deep ocean water into the main land, it has become North America’s best port on the Atlantic Coast. It has better access to the mainland of Canada and reduces the travel time of ships coming from Europe by a day. However, the Halifax has diversified its role from primarily being a port city to a commercial and service center of the Atlantic region of Canada. It houses one third of the total population of Nova Scotia.

14. Recent trends in population shows rather a slow growth rate, however, there has been a constant increase in the absolute number of population of Halifax Regional Municipality. This has been possible due to increase in the immigration of population from other parts of the world as well as from within Canada. A large population of Halifax depends on port related activities.

15. The urban economic activities of Halifax Metro Region are diversified as it supports a variety of urban economic activities. If one goes by the composition of labour force, ‘other services’ provide most of the employment. Hence it
can be said that Halifax is primarily a service center of Nova Scotia. However, one cannot deny the importance of Halifax Harbour that supports either directly or indirectly a variety of urban and port related activities.

16. There has been a constant stability in the total cargo handled at the Halifax Harbour. However, it specializes in container cargo which has registered an increasing trend in recent times. Halifax has been a major tourist destination in Atlantic Province of Canada in recent times. There has been a substantial increase in both the domestic and international tourists visiting Halifax. There are many recreational activities that attract tourists in Halifax Harbour. Halifax Harbour also supports shipbuilding, military and industrial activities at the harbour.

17. Present land use pattern of Halifax Regional Municipality shows large open spaces available for development. The natural resource use reserves are also very large while residential areas occupy a small area compared to the riparian buffer. The proposed land use puts emphasis on the reorientation of the city center by substantially increasing land area under this category. The total land has increased substantially in the proposed land use plan for the year 2010.

18. The Harbour provides marine research facilities and houses Bedford Institute of Oceanography, Defense Research Establishment of Atlantic Canada, Halifax Fisheries Research Laboratory, The Atlantic Research Laboratory (NRC), Dalhousie University and other private firms.

19. Halifax urban harbour has also witnessed various kinds of ocean dumping activities such as accidental or deliberate spills of oils and other chemical products. It has also been used as a receptacle for urban sewage and runoff in the belief that its assimilative capacity will take care of the toxic impact of various inputs. However, this has been proved wrong over the years.

20. The process of contamination through the accumulation of metals in the sediments has revealed dangerous signals as far as the environment of Halifax Harbour is concerned. However, the heavy metals present in the water column
of the harbour have been found to be well below the environmental quality guidelines of various international studies and agencies. But the average metal contamination in the (surface) sediments (within 2cm of the bottom) of Halifax Harbour has been found to be one to two orders of magnitude above these guidelines.

21. Contamination in the Halifax Harbour has been reported to be very high especially of heavy metals in the sediment. For instance, copper in surface sediment of the Halifax Harbour has been reported to be the highest found in any harbour of the industrialised world not to mention other non-industrialised places. Nevertheless, there has been a declining trend in the average accumulation of heavy metals in the Halifax Harbour in the recent past, particularly after the 1970s for all the metals studies so far.

22. Other organic contaminants in the sediment, water column and marine biota are localized in their distribution. Though heavy metals in the water column and marine biota have been reported to be below the acceptable level for human consumption yet there has been indication of contamination in selected locations. The water quality of Halifax Harbour has been under stress due to various contaminants such as faecal coliform bacteria from sewage and a high incidence of spills, especially petroleum products and other chemicals. The coliform bacteria may not put stress on water quality but it does put stress on the ability to harvest marine biota for human consumption. This may be of great concern for the stakeholders of Halifax Harbour and should be taken seriously. One cannot preserve pristine marine water quality if one wakes up too late. However, Fournier’s Halifax Harbour Task Force designated ‘direct contact’ areas as a desirable feature for the Northwest Arm and at least one other area – therefore water quality, according to that report, may be preserved or maintained in some particular areas.

23. Public opinion and stakeholder’s initiatives have been focusing more on the aesthetic environment, which is only a visible impact of various levels of inputs and contamination of Halifax Harbour. However, the impacts of pollution are much more beyond that, which need to be explored.
24. The harbour solution project and other such initiatives by various stakeholders of the Halifax Harbour including all three levels of government, private sectors and community initiatives focus entirely on sewage treatment, which has been recognised as the major cause of contamination of Halifax Harbour. This is an effective solution for improving the overall environment of the Harbour. However, the legitimate use of Halifax Harbour both for the present and future generations may depend upon the more rational and effective coordination towards harbour management.

25. An integrated harbour use management with various tools like land use and sea use planning may be initiated with the help of major stakeholders such as the Halifax Regional Municipality, the Halifax Port Authority and the Waterfront Development Corporation (Limited). A Master plan of Halifax city including a Zonal plan may be an effective tool both for the harbour and the city development. Initiatives of stakeholders including community initiatives of various harbour users may be mobilized for the constant monitoring of harbour use. Together they can provide sustainable harbour city management and can help in maintaining environmental quality of the harbour and its shoreline for multiple uses.

26. There has been more concern than solutions for the protection of marine environment at the global level. Nevertheless, regional and national programmes of action have been showing sign of success in implementing components of ICZM in their respective coastal regimes.

27. Several conventions like LOS (London, Oslo and Paris conventions) have not yet been able to successfully implement the framework of coastal zone management at local level. National level initiatives by the USA have incorporated various components of ICZM in coastal states. ICZM components like regional land use planning, master planning, sea use planning and local zoning have been incorporated in many of the coastal states in USA. But ICZM approaches have been showing more failure than success at the
implementation level particularly in tropical (mostly developing) countries due to the lack of technology, finance and human resources.

28. Canada's approach to coastal area management has been area-based. However, the approaches so far in progress at the regional and local levels seem to be bottom up. It is expected that they can be developed to address issues of ICZM in the long run. Currently, they are implementing various frameworks of marine area protection from the land-based activities.

29. The approaches in India for coastal area protection have been top down so far. Local level initiatives have not been tried in coastal area management. The controlling and regulative measures are highly centralised. This hinders the implementation of ICZM components at local level in the case of Kandla port region. However, national legislative instruments have been encouraging. Recently the ICMAM programme of national importance has been launched to address the issues of integrated coastal management.

30. There are various constraints in addressing the components of ICZM at the port-city especially in Kandla due to lack of technical, financial and managerial resources. However, there has been a good progress in Halifax in this regard. Halifax Harbour still does not fully address the components of ICZM.

Future Prospects of the Study

The present study looked into the aspects of port city development and their influence on marine environment along the harbours of the two case study ports. The overall impact of anthropogenic activities on the harbour environment depends on the complex use of harbour. Thus following studies may be taken up in future to understand the issues related to the impact of land and sea based activities on the marine environment.
• A harbour management information system may be developed to prepare baseline information for impact assessment.

• Detailed land use analysis is required which will lead to identification of polluting activities.

• User’s conflicts can be studied with a detailed stakeholder analysis.

• A regional analysis may be carried out in the Kuchchh region especially in the coastal districts. The study should also look into the trade links through Kandla and other minor ports along this region.