

## A Comprehensive Pattern for Environmental Impact Assessment of Ports in Iran

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### Abstract

Ports in Iran are strategic places which have got important roles in oil export, public trade and country's income. Construction and operation of ports in coastal areas will cause a group of proper and inverse impacts on physiochemical, biological and social-economical environments. Mitigation and management of these impacts are only possible by considering environmental consideration in design, construction and operational phases through environmental impact assessment studies. Preparing of ports' EIA reports which is a must on the basis of Iran legislation, needs a standard pattern consists of all related resources and parameters. In this paper by describing the different kinds of ports, usual components and facility of them, related activity of each phase and their impacts in impacted environments are presented. Furthermore, base on available international EIA reports and intimated resources, suggested terms of reference for port environmental impact assessment are prepared. These terms which are afforded by studying the involved processes, their impacts and last experiences on ports' EAI studies, supply comprehensive pattern for evaluation and preparation of these reports by the projects' administrators and consultants.

**Keywords:** Environmental impact assessment, Inverse impacts, Port, Terms of references.

### 1. Introduction

The development and industrialization of human community, increasing level of welfare and production of new stuffs has caused excessive environment operation which associate by lots of negative impacts. Due to increasing public concern, international convention about the importance of environment, protection of it involved in national legislation and standards of countries where the governments are responsible of implementation and supervision of them. In all these legislation and rules, environmental impact assessment (EIA) has been recognized as one of the most effective tools to reduce and control of projects negative impacts.

Port is one of the most important transportation terminals which caused deeper communication between countries, as more than 90% of international commercial and commodity transportation take place in ports.[1]

According to Iran's department of environment act (1994), environmental impact assessment is essential for all great projects such as ports construction and development. Sustainability of port area activities can be achieved only through effective assessment procedures that integrate legal, techno-economic and environmental requirements which the modern port has to function. In general all ports depending on their size/activity impact the environment locally/regionally or globally. Environmental Impact Assessments (EIA) identifies potential impacts and proposes actions to avoid reduce or mitigate them through Environmental Management Plans (EMPs).

Suggesting the complete and perfect guidance to take ports EIA by identifying activities and procedures in operational and constructional phases of ports is the main objective of this paper. Moreover, submitting a new and complete terms of references for ports is another purpose of this research.

### 2. Port and its environmental impacts

Coastal ecosystems are one of the most populated ecosystems. About 44% of the world population is inhabited near 150km of coastal ecosystem and 66% of cities that populated more than 2.5 million are located near the coastal zones.[2] Besides, increasingly growth of immigration to these cities and industrialization has more negative environmental impacts. For example, the location of a port may cause changes in current patterns and littoral drifts due to alteration of wave refraction, diffraction and reflection. The change of littoral drift may lead to erosion or accretion in shore zones. Altered currents or reflected waves may endanger small ships maneuvering near structures. The creation of a port may cause changes in river flow and waterfront drainage. Moreover, the location of a port may accelerate sediment deposition in stagnant water behind structures and cause contamination of the sea bottom. Aquatic fauna and flora can be affected by the location of the port through changes of water quality, coastal hydrology and bottom contamination.[3] Land reclamation from the sea destroys bottom habitat and displaces fishery resources. The visual quality of a project area is affected by the creation of a port, port facilities, lighting, and other optical disturbances. Building or expanding a port often requires relocation of the local community, sometimes causing ethnic, cultural, tribal, or religious conflicts with local people. Industrialization and modernization may change the cultural traditions of the local community. Pile driving, deposition of rubble, dredging, sand compaction and other construction work in water cause re-suspension of sediments and turbid water. Work vessels are a possible cause of oil spills, garbage discharge, and leakage of other substances into water.

## 2.1. Background of act and guidance of environmental impact assessment

Shipping is an international activity and hence national specifications and regulations relating to loading and safety at sea are largely based on international agreements and conventions. International regulations such as those of the “International Maritime Dangerous Goods Code (IMDG-code)” and “International Convention for the Prevention of Pollution from ships (MARPOL)” must be observed as the international standards relating to protective measures. Iran also is a signatory to these international agreements/conventions.

### 2.1.1. International Maritime Dangerous Goods Code (IMDG-code)

The IMDG code relates to methods of safe transport of dangerous cargoes and related activities. It sets out procedures for documentation, storage, segregation, packing, marking and labeling of dangerous goods.

### 2.1.2. International Convention for the Prevention of Pollution from ships (MARPOL)

The main objectives of this convention are to prevent the pollution of the marine environment by the operational discharges of oil and other harmful substances and the minimization of the accidental discharges of such substances. MARPOL (73/78) covers all the technical aspects of pollution from ships, except the disposal of waste into the sea by dumping, and applies to ships of all types, although it does not apply to pollution arising out of the exploration and exploitation of seabed mineral resources. The convention has two protocols dealing respectively with reports on incidents involving harmful substances and arbitration; and five annexes, which contain regulations for the prevention of various forms of pollution i.e.

- Pollution by oil;
- Pollution by noxious liquid substances carried in bulk;
- Pollution by harmful substances carried in packages, portable tanks, freight containers, or road or rail tank wagons, etc.;
- Pollution by sewage from ships; and
- Pollution by garbage from ships.

### 2.1.3. United Nations Convention on the Law of the Sea (UNCLOS), 1982

The main objective is the obligation to prevent pollution damage by addressing particular sources of pollution, including those from land based activities, seabed activities, dumping, vessels and from or through the atmosphere. This convention establishes a comprehensive framework for the regulation of all ocean space and its resources. It is divided into 17 parts and nine annexes, and contains provisions governing, among other things, the limits of national jurisdiction over ocean space, access to the seas, navigation, protection and preservation of the marine environment, conservation and management of living resources, scientific research, seabed mining and other exploitation of non-living resources, and a unique obligatory system for the settlement of disputes.

### 2.1.4. Ramsar Convention on Wetlands

The convention requires states to designate at least one wetland site on the basis of ecology, botany, zoology, limnology or hydrology and requires the conservation of all wetlands by establishing nature reserves. There is also a requirement that any loss of a wetland should be compensated for by creation of new habitat.

To achieve environmentally sound and sustainable development, all these international and national agreement and considerations emphasized that efforts should be placed on familiarizing EIA and recalling the importance of allocating financial and human resources to environmental protection activities in developing and operating of projects and plans. In these cases environmental Impact Assessment (EIA) becomes essential to minimize the adverse effects of any major plans such as port construction, operation and development projects.

At the national level legislation and administrative regulations on EIA are being adopted in many countries partly due to pressure from funding agencies which request EIA as part of the appraisal of development project and partly due to the increasing environmental awareness in the developing countries. In United state of America (1969), Germany (1971), Sweden (1972), Canada (1973), Britain (1973), Jamaica (1991), Australia (1974), Denmark (1974), France (1976), Japan (1981), European Union (1981), Nederland (1986) authorities officially declared the necessity of EIA studies in the more important projects. Similarly in 1996, Iran department of environment in order to make fiftieth principle of Iran constitution real and under environmental supreme council's notification (1994, No. 138) promulgated preparation of EIA reports in their Natural resources conservation and protection plans. Under Iran national environmental regulations and standards, port and harbor projects need EIA studies. Since then port authorities are obligated to implement EIA studies in design, construction and operation phases of port which accumulate all port's environmental related considerations.

## 2.2. Types of ports

Harbors are protected water bodies that shelter ships from waves and winds. Ports are the land facilities provided alongside a harbor. Harbors can be natural or artificial. Natural harbors result in minimal changes to the environment, while artificial harbors require significant construction to provide the required tranquil conditions for ships. The objectives in the design and construction of ports and harbors are to provide a reasonably large sheltered area of water of adequate depths for safe anchorage of ships and to provide for transfer of cargo and passengers between ships and shore.

Harbors may also be classified according to the purpose such as harbors of refuge, commercial harbors, naval harbors, fishing harbors, etc.

## 2.3. Ports' construction and operational activities

In this section in order to identify port environmental adverse impacts, activities and action that should be taken in each phase of port construction and operation are presented.[4] Differences in content of ports' environmental impact assessment reports arise from difference in ports' targets and goals of construction and therefore their component, facilities and actions is construction and operation phases. In the current study, construction stage of ports and harbor activities are categorized in to four subordinate groups entitled preparation activities, general activities, facility installations and building activities respectively.

Preparation activities actually involve all the required action that make the site ready for the next structural activities is include Brushwood and shrub cleansing of the area, deforestation, accession, land used changes and reclamation, grading and paving, dredging and sea bed changes, embankment and sea water repercussion and excavation.

General activities in construction phase of ports also consist wide range of activities include employee and worker hire, transportation of worker, motor Vehicles transport (heavy vehicles and automobile), ship traffic in the area.

Facilities installations subgroup consist all the activities that taken for set up and install the needed facilities and convenience in port that include facilities and tools transportation, facilities and tools installations, Lighting and energy resources supply, Restraint fixture in the sea bed and buoys adjustment.

And finally building activities as the most important and influential activities of port construction phase consist of welling, insulation, trench digging, concert and metal working, buffering, fencing, draining (gathering and disposal), paving and asphaltting, general works of building and workhouse establishing and destruction.

Similarly in operation stage of ports and harbor concern to ports types and goals of creation, wide ranges of activities may be taken. Liquid and solid waste disposal, vessels manufacture, maintenance and repair, bunkering, ports and ships painting, ballast and bilge water discharge, dredging, cargoes and passengers and bulk loading and uploading, storage sheds charging and recharging, vessels anchorage, staffs activities and transportations, worker and passengers housing and lodging, telecommunication, fuel and energy storage and consumption, food and drinking water supply, vessels and motor vehicles accident, explosion and fire, sudden discharge or leakage of liquid or solid bulk, public facilities, pesticide, herbicide and fertilizer utilization, Fridge Facility maintenance and work, siren and navigator systems, lighting system of port's environment, aggregation and production of sludge and sediment in gravingdock and haven, deforestation and forestation, maintenance and service of facilities and equipments and etc are some example of ordinary activities in operating of ports and harbors. [5]

Considering normal process in construction, operation and development a broad list of activities (though not exhaustive) involved in a port and harbor construction and operation are given in Table. 1. All these are overall activities, which involve a number of tasks or sub-activities. The activities are divided on the basis of their potential impacts in affected media which show a comprehensive image of the whole involved processes and actions.

Table 1: Activities having potential impacts

Phase	Landside Activity	Waterside activity
Construction	<ul style="list-style-type: none"> <li>· Site clearing/deforestation</li> <li>· Resettlement</li> <li>· Rehabilitation</li> <li>· Soil excavation / Quarrying</li> <li>· Transportation of raw materials</li> <li>· Construction/ Precasting / Fabrication/Welding Laying of roads/railways/crane tracks</li> <li>· Land reclamation/ disposal of dredged material on-shore</li> <li>· Labour camps for all activities</li> </ul>	<ul style="list-style-type: none"> <li>· Capital dredging</li> <li>· Disposal of dredged material into sea</li> <li>· Berth/wharf/jetty/trestle Construction (Piling/operations/ Construction of gravity foundation/ diaphragm walls)</li> <li>· Breakwater Construction</li> <li>· Single Point Mooring (SPM)</li> <li>· Trenching the seabed for underwater pipeline/intake/outfalls/underwater blasting</li> </ul>
Operation	<ul style="list-style-type: none"> <li>· Afforestation</li> <li>· Vehicular traffic (roads &amp; railways)</li> <li>· Storage of dry cargo</li> <li>· Loading and unloading of dry cargo</li> </ul>	<ul style="list-style-type: none"> <li>· Maintenance dredging</li> <li>· Disposal of dredged material into sea</li> <li>· Maintenance of Breakwater/water-front structures</li> </ul>

<ul style="list-style-type: none"> <li>· Loading and unloading of liquid cargo</li> <li>· Storage of wet cargo/ Tank farm operation</li> <li>· Pipeline operation</li> <li>· Disposal of dredged material on land / Land reclamation</li> <li>· Waste management and effluent discharge</li> <li>· Maintenance Infrastructure</li> <li>· Desalination plants</li> <li>· Captive power plants</li> <li>· Induced development</li> </ul>	<ul style="list-style-type: none"> <li>· Brine discharge from desalination plants</li> <li>· Cooling water discharge from power plants</li> <li>· Ship operations (bunkering, ballasting/deballasting, discharges)</li> <li>· Fishing Activities</li> </ul>
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#### 2.4. Impacts of port construction, development and operation projects

The actions mentioned above are the major sources of adverse effects in ports and harbors. Impacts of these activities affect the environment depending upon how, when, where and by how much they occur. Environmental facets to be considered in relation to port development, construction and operation are categorized in to three major groups. As the results of this study it is emphasized that ports impacts are better to categorized in three separate media of port's surrounding environment consist of Physical, biological and social-economical environments.[8] Probable impacts of ports in each of the media are categorized into different subgroups as below:

##### 2.4.1. Physical environment

- Water Quality

Breakwaters and landfills may change current patterns and cause stagnation of water behind the structures. If municipal or industrial effluent flows into a port, stagnant port water may deteriorate through a dramatic increase of phytoplankton and a decrease of dissolved oxygen, resulting from eutrophication of water, caused by effluents containing nutrient salts (chemical compounds including N and P). Anaerobic water leads to the generation of hydrogen sulphide (H<sub>2</sub>S) and can be identified by its odor which has serious effects on organisms and human health. Municipal sewage also brings coli form bacteria into the port and may cause unacceptable contamination of the ports' surrounded area.[6]

- Coastal hydrology

The location of a port may cause changes in current patterns and littoral drifts due to alteration of wave refraction, diffraction and reflection. The change of littoral drift may lead to erosion or accretion in shore zones. Altered currents or reflected waves may endanger small ships maneuvering near structures. The creation of a port may cause changes in river flow and waterfront drainage.[7]

- Sea bottom

The location of a port may accelerate sediment deposition in stagnant water behind structures and cause contamination of the sea bottom. Sediment deposition covers bottom biota and physical habitat. Pile structures shade the bottom and affect habitat. Eutrophication of water induces sedimentation of dead plankton and changes chemical characteristics of bottom sediments, resulting in an increase of organic matter, hydrogen sulfide, and mobilization of harmful substances.

- Air Quality

Increase in air pollutant concentration such as NO<sub>x</sub>, CO, HC, Pb, RPM, and SPM in vicinity of ports especially petrochemical and oil ports.[6]

- Noise and odor

Noise is defined as unwanted sound. Port and harbor projects can involve short-term impacts during construction and long-term impacts during operation due to increased noise levels. The impacts however range from hearing damage to interference on human activities such as sleep, communication and concentration. Moreover, discharge of industrial and human waste to environment, transport and store some chemical stuff make odor pollution.[7]

##### 2.4.2. Biological environment

The location of a port affects aquatic fauna and flora through changes of water quality, coastal hydrology and bottom contamination. Land reclamation from the sea destroys bottom habitat and displaces fishery resources. Terrestrial fauna and flora may also be altered by the location of a port.

Diminution of bottom biota is usually linked to a reduction of fishery resources, and occasionally to an increase of undesirable species. Deterioration of water quality usually gives rise to changes in aquatic biota, a decrease in the number of species and an increase in the quantity of one or two specific species. Further deterioration may lead to the destruction of all kinds of aquatic biota.

Diminution of plants in a shore zone within enclosed water may degrade its aeration capability and worsen water pollution. Mangroves in wetlands play an important role in providing habitat for terrestrial and aquatic biota and indirectly recovering water quality.

Disturbance from construction activities may cause displacement of fishery resources and other mobile bottom biota. Dredging removes bottom biota and dumping of dredged material covers bottom habitat, both of which may reduce fishery resources. Settlement of re suspended sediments on fragile marine fauna and flora damages the ecosystem particularly coral reefs, which are formed by the extracellular product of symbiotic plants. The great number of coral polyps attached need dissolved oxygen for respiration and the plants need sunlight for photosynthesis.

Piles, concrete surfaces, rubble mounds and other similar structures in water could form new habitats, which may introduce undesirable species. If toxic substances and other contaminants are re suspended through dredging or dumping, they may lead to contamination of fishery and shellfishery resources.

#### 2.4.3. Socio-economic Environment

The most important impacts in Socio-economic Environment are listed in following:

##### Social impacts

- Resettlement of coastal population
- Loss of livelihood for the local fishing population
- Increased risk of accidents to adjacent neighborhood
- Increase in traffic flow and congestion at and around the project location
- Disruption in area due to construction activities
- Increase in transient population in the area
- Health and life style impairment because of noise effects
- Increase in population in the area
- Change in character of the surrounding community
- Increased housing requirements for the employees

#### 2.4.4. Economic impacts

- Loss of fishing grounds
- New jobs created from construction and operation activities
- General growth in commercial and industrial activity in the area
- Potential loss of taxable property due to acquisition of private lands
- Increased cost for public services such as police and fire protection
- Change in adjacent property values
- Increased energy consumption of port facilities
- Increase in local sales tax revenues and other tourist oriented revenues

### 3. Results and Discussions

#### 3.1. Terms of reference for port environmental impact assessment

The terms of reference to environmental impact assessment of ports development and construction are provided by studying EIAs' of port report in Iran and other country, is listed below. The current EIA term of reference promotes the systematic identification, prediction and evaluation of the potential impacts of a proposed project on the physical, chemical, biological, cultural and socio-economic components of the environment.

- 1) Abbreviation definition which used in the text
- 2) Executive summary
  - a. Name, address and all data required of project
  - b. Brief detail of project (necessity and activities)

- c. EIA methodology and guidance to conduct EIA studies
  - d. Environment background
  - e. Important environmental impact caused by project
  - f. Mitigation measure (negative impacts)
  - g. Remained and cumulative impacts
  - h. Environmental management and monitoring plan
  - i. Public participation and concern
- 3) Introduction
- a. Name, address and all data required of employer
  - b. description about necessity and importance of the project
  - c. Case study description
  - d. The necessity of EIA
  - e. Terms of reference
  - f. EIA methodology and policy
- 4) Description of proposed project
- a. Need for the project and its objectives
  - b. Importance of the project according to national or international development plan
  - c. The location of the project and propose alternative
  - d. All activities required in the project (construction and operation phase)
  - e. All equipments required (construction and operation phase)
  - f. Types of ships which work in the port
  - g. Description of preconstruction, construction and operation phase
  - h. Types of waste will be produced
  - i. Types of produced contamination and the method to prevent or reduced them
- 5) National and international port relevant regulation and standard beside coastal integrated management framework of the area
- a. Defining the environmental policy of the region
  - b. Defining integrated coastal zone management of the area
  - c. Review of the port's related legislation, rules and standards
  - d. Regulatory requirements
  - e. responsibilities for implementation
- 6) Description of present environmental conditions (physical, biological and socio-economic and cultural environment)
- a. Baseline parameters for each media
  - b. Natural environment and sensitive areas
  - c. Resources availability and restrictions
  - d. Environmental costs in each media
  - e. Sampling criteria
- 7) Prediction of potential impacts of ports projects in construction and operation phases in each physical, biological, socio-economical and cultural environment
- a. Methodology of impact identification
  - b. Determination of type and intensity of impacts during construction phase

- c. Determination of type and intensity of impacts during operation phase
  - d. Impacts without the project in future
  - e. Characteristic and significance of each impacts
  - f. Estimate of Environmental Costs
- 8) Alternatives assessment
    - a. Project alternative
    - b. Site alternative and options for required facility and component
    - c. Project no alternative
  - 9) Mitigation measures
    - a. Control and mitigate measures
    - b. Safety valves and measures
  - 10) Environmental management system
    - a. Port's environmental management program
    - b. Port's mentoring plan
    - c. Port's associated training programs and plans
    - d. Public participation and disaster management plan
  - 11) Conclusion and documentation
  - 12) Reference
  - 13) Team workers
  - 14) Annexes and appendixes

#### **4. Conclusion**

In this study, all activities and procedure to construct and develop the ports and harbors are investigated. The environmental impacts of such projects on physical, biological and socio-economic and cultural environment were considered. The main international and national acts and conventions to protect environment were studied. All above studies and reviews provide data required to propose terms of reference for ports and harbors EIA in Iran. Although the proposed terms of reference are common in detail for all types of ports, the more study and investigation on any specific types of port required to propose specific terms of reference for those types of ports.

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