

Discussion on the Indicator System and Methods of Environment Impact Assessment for Port Master Planning

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ABSTRACT

Planning Environment Impact Assessment is regarded as one of the most important measures to achieve sustainable development in China. Conduct environment impact assessment for port planning was prescribed by *Environment Impact Assessment Law of the People's Republic of China*. This Paper introduces the basic concept of Planning Environment Impact Assessment and Port Planning firstly, and then discusses the assessment indicators and assessment methods adopted in the Environment Impact Assessment for port planning. At last, the application of the indicators and methods are illustrated in case studies based on the practice on Port Planning's Environment Assessment in China.

1 Introduction

Environment Impact Assessment Law of the People's Republic of China (hereinafter referred to as "the EIA Law") was approved by the Standing Committee of the National People's Congress (NPC) of the People's Republic of China in the 30th Session in October, 2002, and had come into force as of September 1, 2003. One of the most important contents of the law is to bring the economic development planning constituted by the governments of all levels into the range of objects that should be assessed on their environment impacts, which was prescribed detailedly in a special chapter. The *EIA Law* provides: The Planning environment assessment in China is applicable to two kinds of plannings. One is called "one land and three areas", namely, plannings of land use, integrated exploitation and utilization plannings of local area, drainage area and sea area. Another kind is "ten kinds of special plannings" such as plannings of industry, agriculture, stockbreeding, forestry, energy, water conservancy, transportation, urban construction, tourism and exploitation of natural resources. To cooperate with the implementations of *EIA Law*, the National Environmental Protection Agency (NEPA) formulated *Technical*

Guidelines for planning environment impact assessment (on trial) to instruct the operation of the Planning Environment Impact Assessment (PEIA) in China.

In this Paper, the assessment indicators and methods adopted in the Environment Impact Assessment for port planning are discussed after the introduction of the main concept of Port Master Planning and the Environment Impact Assessment for Port Master Planning in China. And finally, three case studies are presented to illustrate the application of the indicators and methods.

2 Port Master Planning

Ports refer to the areas of water and land within certain range with corresponding dock facilities of functions for entry and exit of ships, anchorage, moorage, off and on of passengers, handling of freight, lighterage, as well as storage. Ports may consist of one or more port districts. When overall, systemic technical and economical investigation and research on the ports' development and construction are conducted based on the national economic develop policy and the need of domestic and international trade increase, and a building scheme is put forward, a port planning would come into being.

According to the *Port Law of The People's Republic of China*, Ports planning should be prepared and compiled according to the requirements for national economy and social development and the demands for defense construction, which shall in the principle of rational utilization of the shoreline resources, conform to the planning of urban and township system and dovetail and be in harmony with the land use master planning, urban master planning, river drainage area planning, flood prevention planning, functional division of seas, development planning of waterway transportation, development planning of transportation of other means, as well as other relevant planning specified by laws and administrative regulations.

The port planning consists of port distribution planning and port master planning. The port distribution planning refers to the layout and distribution planning of ports, including national port distribution planning and port distribution planning of the province, autonomous region and municipality directly under the Central Government. The port master planning refers to the specific planning of a port in a certain period, including the water and land scopes of the port, division of the port district, throughput and categories of potential ships, character and functions of the port, utilization of the water and land areas, use of the coastal lines to build port facilities, configuration of construction land, and sequences for construction by stages, etc. The port master planning shall conform to the port distribution planning. Now in the actual operation in China, the port master planning emphasize particularly on the develop orientation and spatial layout of the port, yet pay less attention to the temporal construction arrange.

3 The Indicator System and Methods of EIA for Port Master Planning

3.1 Indicator System

With the reference on the assessment indicator system of traditional project-level environment impact assessment, also considering the character of port master planning and the situation and function of Planning Environment Impact Assessment in China, We put forward that the indicators of Environment Impact Assessment for port master planning should include four categories: natural environment indicators (water

dynamic situation, water quality, atmospheric environment, acoustic environment, etc), ecological environment indicators (aquatic ecosystem, terrestrial ecosystem), social environment indicators(transport, economic development, infrastructure, etc) and resources indicators (water resources, land resources and coastal line resources etc). Based on the analysis above, the common-used assessment indicators are screen out as shown in table 1.

Table 1 Assessment Indicators of EIA for Port Master Planning

Theme	Resource and environmental element	Assessment Indicators
Ecological environment	Aquatic and terrestrial ecosystem	<ul style="list-style-type: none"> ● distance between planned port districts and ecological sensitive areas (m) ● reclamation area by planned port districts (km²) ● loss of ecological values (million dollars) ● change of ecological landscape patterns
	Hydrodynamic situation	<ul style="list-style-type: none"> ● reduction of tide contained in the bay (%) ● amount of back silting (m³/a) ● change of current velocity and direction (%)
Natural environment	Water quality	<ul style="list-style-type: none"> ● annual discharge amount of sewage (t/a) ● annual discharge amount of major water pollutants (ammonia nitrogen, COD_{Cr}, etc) (t/a) ● range of influence aroused by sewage discharge(m²) ● distance and range of influence by risk accidents(m, m²)
	Atmospheric environment	<ul style="list-style-type: none"> ● annual discharge amount of major air pollutants(TSP, NO_x, etc)(t/a) ● safe distance of bulk cargo terminals(m) ● range of influence aroused by air pollution
	Acoustic environment	<ul style="list-style-type: none"> ● safe distance of port concentrated and scattered convey roads(m) ● safe distance of high-noise port districts(m)
Social environment	Social and economic environment	<ul style="list-style-type: none"> ● influence on local transport ● facilitation to economic development ● promotion to infrastructure ● number of villages should be transplant ● influence on city spatial layout
Resources	Water resource	<ul style="list-style-type: none"> ● Maximum water consumption (m³/d) ● Water consumption per throughput(m³/t)
	Land resource	<ul style="list-style-type: none"> ● New added land occupation (km²) ● Land consumption per throughput(m²/t)
	Coastal line resource	<ul style="list-style-type: none"> ● New added coastal line occupation (km) ● Coastal line consumption per throughput(km/t)

Due to the difference of the actual situation and types of docks contained among the ports, it is difficult to acquire all values of the indicators above, as well as to ascertain the criteria of the indicators. In the certain EIA project for port master planning, we should emphasize different indicators according to the characters of local environment and planning scheme.

3.2 Assessment Methods

Planning is on a more macroscopic level than construction project, while it is in a state of developing and the information it indicates is also macroscopic and uncertain, so the technical methods for the Planning Environment Impact Assessment (PEIA) should be adapted well to the uncertainty and complexity of the planning. Because of the methods used in project-level environmental impact assessment (EIA), regional environment impact assessment (REIA), overseas strategic environmental assessment (SEA) and so on are already mature, Based on the present character of port planning, the methods of the above assessment can be used for reference.

(1) Methods in project-level Environmental Impact Assessment (EIA)

Although there are many differences in aim, mode, methods, precision and depth between EIA and PEIA, their process and basic train of thoughts are in common. Therefore PEIA can be used for reference many methods of traditional project-level EIA, such as environmental mathematic model, analogy analysis, environmental impact list, environmental impact matrix and so forth.

(2) Methods in foreign Strategic Environmental Assessment (SEA)

Much experience of SEA has been accumulated and the related laws have made in many developed countries. Because PEIA is a type of SEA, the methods in port PEIA can follow that of the SEA, for example, simulating analyses, regional forecast, scenario analysis etc.

(3) Methods in Regional Environmental Impact Assessment (REA)

REIA is based on the regional developmental planning, while the scope of the port master planning is regional too. Consequently port PEIA has the analogical characters with REIA whose ripe methods can be used in reference, such as geographic information systems (GIS), remote sensing (RS), landscape simulating, graphics superposing and so on.

While different methods should be used to estimate different indicators, a variety of methods should be adopted in the each specific project of port PEIA.

4 Case studies

Up to now, Transport Planning and Research Institute the authors serve has completed the PEIAs for port master planning of Shanghai Port, Xiamen Port, Zhoushan Port, Wenzhou Port, Yantai Port, Zhuhai Port, Qingdao Port and so on. Every port has its own particular property on local natural environment and planning scheme, so that the assessment methods and key indicators are diverse. Herein examples of Shanghai Port, Xiamen Port and Zhoushan Port are given to illustrate the various uses of assessment methods and indicators in different project of PEIA for port master planning.

(1) Shanghai Port

Shanghai Port is the largest port in China. It is also a developed and mature harbor. The port district along the Huangpu River and port districts of Waigaoqiao, Luojing-Baoshan are already developed into shaped, the first-stage project of port district of Yangshan is also finished. So the main idea contained in Shanghai Port

master planning is the combination of new-building, rebuilding and function adjustment of port districts. The most rapidly increased cargo category in planning period is container, and the port development will jump out of the Huangpu River. After the implementation of the Shanghai port master planning, the port will be far from the midtown, and the major cargo category will be container which is relative cleaner. The regulation and integration of the cargo categories will lead to the concentrated emission of pollutants, which would be advantageous to take action to prevent and abate the pollution. So the Shanghai Port master planning is a planning considering environmental protection sufficiently. In the assessment we attached more importance upon the impact caused by container conveyance and the favorable effect aroused by the adjustment of port districts' function and layout.

According to the above characters of the planning, the noise impact is paid more attention to in allusion to the largest cargo category-containers. The indicators we chose included the safe distance of port concentrated and scattered convey roads, the safe distance of high-noise port districts. The assess method chosen were environmental mathematical model. In order to analyze the favorable effect brought by the planning, the indicators such as the annual discharge amount of sewage, annual discharge amount of major water pollutants, annual discharge amount of major air pollutants, and the facilitation to economic development were selected. The main methods used are contrast analysis and scenario analysis. By contrasting the values of indicators above before and after the implementation of the planning, we could draw the conclusion that the execution of Shanghai port master planning could realize "no increase of pollutants emission along with the increase of production".

(2) Xiamen port

Xiamen port lies in the south east of Chinese coastland and the west shore of Taiwan Strait. The environment of the around area is sensitive. There are some nature protection areas such as Chinese White Dolphin natural protection area, aigrette natural protection area, amphioxus natural protection area, and mangrove forest natural protection area around Xiamen port. Gulang Island national key scenery spot - one of the AAAA grade national tourist attractions is also located near the port.

According to nature environment characters of assessment area, the PEIA for Xiamen port master planning focuses on the impact of port planning implementation on these ecological sensitive areas. So the assessment indicators mainly comprise the nearness between the planned port districts and ecological sensitive areas, reclamation area in planned port and the change of ecological landscape patterns. Assessment methods used are analogy analysis, mathematical model and landscape simulation. Analogy analysis method, using historical monitoring data and research data, analyzes the impact range of development and constructive activities during port planning practice, analyzes the safe distance between planning port district and valuable and rare animals such as aigrette, Chinese white dolphin and amphioxus, and provides the substitute solution and compensated measures of planning proposals which affect ecological sensitive area. Because the environment of Xiamen port is so sensitive, environmental risk accident analysis is also important. Mathematical model was applied to analyze environment risk accidents. We analyzed the eventful place and the amount of oil spill accidents based on historical statistic data of local oil spill accidents, main transport goods categories, and forecasts the excursion rules and incidence of oil spill. Landscape simulation method is also adopted to simulate the landscape pattern after the port planning implementation which focused on the impact of port building on Gulang Island national key scenery spot.

(3) Zhoushan Port

Zhoushan port locates on the east of Chinese coastland and outer fringe of the Hangzhou Bay. There is a national famous fishing ground - "Zhoushan fishery farm", as well as many island tour resources. According to the general orientation of the port master planning, Zhoushan port will developed as a transshipment base of large amount bulk freights and a reserve base of national strategical materials. After the planning implementation, the main freight categories would be metallic substances, coals, and oil products. Regarding the nature environment characters of assessment area, the PEIA for Zhoushan port master planning focused on the impact of port planning implementation on region ecological environment and piscatorial resources.

According to the emphasis of PEIA, in order to consider the impact of planning implementation on ecological environment, the assessment indicators are mainly port reclamation area, the change of region ecological landscape pattern. Regarding with the impact on piscatorial resources, some assessment indicators such as annual discharge amount of sewage, annual discharge amount of main water pollutants are choosed. Considering the freight volumes of solid bulk cargo and liquid bulk cargo are huge, some other assess indicators we stress include annual discharge amount of air pollutants, the distance and range of influence by environmental accident. The methods used are Geography Information System and environmental mathematical models. There are many islands in Zhoushan area. The port planning occupies a certain amount of island shorelines. So we used spatial analysis function of GIS to calculate the reclamation area and coastal lines occupation, and to predict the change of ecological landscape pattern. The throughput of metallic substance and coal is very large, mathematical model was adopted to analysis the impact to the water quality of the fishery farm caused by port sewage discharge, in order to evaluate the port planning's influence to the fishery resources of Zhoushan. Considering the sharply increase of the freight volume of oil production, mathematical models were also applied to predict the range influenced by risk accidents, and estimate the loss of fishery resources.

5 Discussion

In china, the code of Environment Impact Assessment for Transport Planning is yet not promulgated, This paper made a pilot study on the assess indicators and methods of the PEIA for port master planning based on the practice of assessment projects conducted. Our aim is to establish a general and comprehensive technique system of PEIA for port planning in the near future, to accelerate the step to the green transportation and ecological ports in China. We would open up more case studies to reinforce, improve, practice and verify the indicators and methods, as well as make deeper study on the basic theory of SEA.

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