



Socio-Economic Impact Assessment for Exploration of Coastal Zone in Yantai Region

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Abstract

Based on analyzing different definitions for Coastal Zone, a new definition paying more attention to the determination of the regional border of Coastal Zone is obtained and adapted to the concept of scientific development. According to the above, with a new regional border of coastal zone in Yantai region gotten, the potential environmental impacts on the development strategy of this zone are discussed and a socio-economic impact assessment for the development is also advanced, finally, some suggestions are proposed.

Keywords: Coastal areas, Development strategy, Socio-economic impact assessment, Yantai region

1. Introduction

Coastal zone is a kind of transitional zone between the terrestrial and marine ecosystems, influenced by both natural forces, such as the ocean, land and atmosphere, and other non-natural forces coming from human society, making matter and energy exchange actively (Zhang Yongzhan and Wang Ying, 2000). In addition, the coastal zone is a typical fragile ecosystems and in poor stability, for being disturbed frequently by marine and terrestrial ecosystem (Lin Tao *et al.*, 2007). Definition of the coastal zone can be divided into two kinds of narrow and broad sense. Based on an international biosphere plan on coastal zone, the narrow concept of coastal zone divided the coast into three parts: coastal zone from coast, intertidal zone and underwater bank slope, (IGBP/LOICZ, 1995). Broad sense of coastal zone, refers to watershed areas where rivers flow directly into ocean and the whole outer continental shelf, but actually refers to a belt region extend certain distance on both sea and land side (Shen Chengping and Han Xue, 2007). There are differences between narrow and broad sense, mainly due to the narrow definition of coastal zone only consider the direct effect of sea or land, such as a role of ocean tides; broad definition of coastal zone seems to take the indirect effects of sea or land into account, and a role of sea and land along the coast on both sides to the coastal zone boundary line are reducing, the farther from the shore, the more fuzzy (Chen Shupeng, 1996). As in the East Asian region, for example, according to the impact of oceans on land in different ways, the landward side of coastal zone from near and far from the coast can be divided into inter-tidal zone, sea-land breeze area, typhoon zone, monsoon areas, inland areas, and several other areas. Boundary of each district furthest away from the sea roughly follows as: inter-tidal zone 2km; sea-land breeze area 60km (Xue Deqiang *et al.*, 1995); Typhoon District 1000km (a well-developed typhoon, circular vortex radius is generally 500km ~ 1000km); monsoon region 3000km. Inland area of more than 3000km from the shore. Interactions of land and sea are obvious in inter-tidal zone; force in sea-land breeze area is mainly the land-sea breeze; while typhoon in the typhoon area; the main force in the monsoon region coming from differences in the formation of hot air masses from sea and cold air masses from land.

Traditionally, Human development and utilization of marine resources mainly based on taking marine resources as objects to obtain a product, and following the use of marine space resources. Strategy of coastal development that is also a typical strategy of developing the coastal zone (Fang Qinhua, 2006, p. 51) will, directly or indirectly, impact on

the environment of coastal zone through the guide or restrict economic activity (Munsinghe M, 1998). Among them, the socio-economic impact assessment is an important organic part of a strategic environmental assessment of coastal development (Field JG *et al.*, 2002), and also an important part to evaluate the sustainability of coastal zone strategy. Current coastal development strategy highlights two aspects in China: the socio-economic impact macroeconomic and microeconomic assessment. The former is an analysis of coordination between proposed strategy and related strategies that have been implemented, and the latter analysis in equity among different groups to the impact of proposed strategy results (Fang Qinhua, 2006, p. 94). According to the new definition of coastal zone boundaries, this paper assesses the coastal socio-economic effects of Yantai, development, then presents the corresponding countermeasures and suggestions.

2. Yantai coastal zone development strategy and environmental impact

2.1 General setting

Yantai Locating in the southern part of Jiaodong peninsular close to the Yellow Sea and Bohai Sea, facing Japan, South Korea and North Korea across the sea, governs 5 districts, 1 county and 7 county-level cities only one of which is not bordered on the sea within all areas under jurisdiction. The coastline of yantai stretches for 702.5km, two parts of the north or south, the width of north and south sides is both about 120km, due to land-sea breeze extends inland about 60km, North-South cross-strait sea-land breeze converged in the central region (Xue Deqiang *et al.*, 1995), so two parts in Yantai: the inter-tidal zone at a distance of 2km from the coast and the rest of the region in the land-sea breeze area. Most county-level cities (counties, districts) have inter-tidal zone, namely: Zhu Zhifu, Laishan, Fushan, Muping District, Economic and Technological Development Zone and Hi-tech zone, an area of 2643.6 km², with a total population of 1.7million people, accounting for 26.5% of the city; Longkou City, Zhaoyuan City, Laizhou City, Penglai City and Changdao County also on the verge of the northern coast, five cities (counties), with a total area of the city accounted for 38.8%and the total population of 2.5million people, accounting for 38.7% of the city; Laiyang and Haiyang, 2 county-level cities on the verge of southern coast. These two citis and Qixia city, the only city not having the inter-tidal zone, located in south-central region of Yantai, with a total area of 5634.3 km², a total population of 2.2million people, accounting for 34.1% of the city.

2.2 Yantai Coastal Zone Development Strategy

In these geographical conditions, Economic Development Strategy of Yantai and the Coastal Zone development strategy are inseparable. The major coastal development strategies in the next five years are mainly the following point: firstly, focusing on building the port group, in this port group, Yantai Port as a center port, Longkou port as a main port, supplemented by other small and medium sized ports. Secondly, strengthening the coastal land area development. Finally, strengthening economic interaction of land and sea, promoting marine economic development. By 2010, total port cargo throughputs of Yantai strive to reach 200 million tons, the container up to 200 million standard containers. And marine industry output value reach up to 800 billion yuan, accounting for 20% of the city's GDP (Municipal Planning Bureau of Yantai, 2005).

2.3 The Environmental Impact of Coastal Development of Yantai

With the rapid economic development, utilization and protection in the coastal zone resources of Yantai are also facing increasing pressure. These pressures that are mainly coming from the economic activities in coastal zones are mainly manifested in the following aspects:

2.3.1 Population growth and changes in the structure of life

The urban population annual growth rate is around 6%, by 2010, the urban population in the center city close to 2 million people, the total population in county-level cities up to 2 million people (Municipal Planning Bureau of Yantai, 2005). With the population growth and consumption patterns changing in the Coastal Zone, More pressure to the limited energy and resources in Yantai will emerge. Through an annual survey estimates of land-based emissions from domestic sewage waste water, it reached to nearly 150 million tons or more once year, and the emissions increase every year and will damage to coastal eco-environment seriously (State Oceanic Administration Institute for Marine Development Strategy Planning Group,2007). Parts of the coastal region which absorbed nutrients or were taken as a place for hatching are completely abandoned now for being full of garbage wastes (Li Shitai, 2000).

2.3.2 The rapid development of industrial

Surveys in 2000 showed that, there are 18 rivers flowing into the sea and 27 sewage draining exits discharged more than 40 million tons of industrial and domestic sewage every day (Li Shitai,2000). Impact to the coastal zone environment is mainly embodied in industrial wastewater emissions increasing constantly, and will increase in Eleventh Five-Year period, for many high-polluting enterprises, such as petrochemical, metallurgy, bio-pharmaceutical and other potential industries being raised. Loads to the ecological environment in the inter-tidal zone of Yantai also are increasing for some reasons, such as a regional central city being under construction and a coastal industrial belt till Laizhou Bay to

Yangma island planning to construct (Mao Berkow, 2005).

2.3.3 Coastal Engineering continuous construction

Coastal construction projects, including port construction that occupy coastal resources, also produce large amounts of oil, wastewater and waste causing severe environmental stress and Reclamation land from the sea. It is noteworthy that, with the West Yantai Port building and petrochemical industries developing, the number of oil throughput and the harbor greater risk of oil spills will both increase. The statistics results in 2000 show that, the pollution from ships in Zhifu Harbor, is mainly manifested in the oil port and operational areas. More than 15,000 pieces of ships of Yantai discharged oil into the sea about 680 million tons each year (Li Shitai, 2000). With blind development of saltern, shrimp pond, over the past 20 years in Yantai, Large amounts of seawater invade into the interior (Li Shitai, 2000).

2.3.4 Sea-beach wetland aquaculture

In addition to the transformation of coastal outline and the intensity and mode changes of action caused by coastal dynamics directly (Du Guoyun *et al.*,2007), rapid development of marine aquaculture also increase the pollution of the coastal zone. Aquaculture pollution is still important sources of marine pollution (State Oceanic Administration Institute for Marine Development Strategy Planning Group 2007).Among these, shrimp farming are the most profitable and also pollutant one. For example, organic materials to discharge into the sea from the process of shrimp farming were about more than 85,000 t in Yantai, heavily polluted coastal environment (Li Shitai, 2000).

2.3.5 Coastal Tourism

The total tourism revenue of Yantai would reach 24 billion in 2010, with an average annual increase of 17% (Municipal Planning Bureau of Yantai, 2005). The impact of coastal tourism business on the coastal zone environment is mainly reflected in sewage emissions being swelled with tourists increasing constantly. An example that some tidal flat area in a beach named Golden Sands beach in the Economic and Technological Development Zone governed by Yantai government is occupied to build tourism facilities, resulting in destruction of beaches balanced cross-section, and exacerbating beach erosion, shows that tourism development would also damage the beach tourism resources.

2.3.6 Other Terrestrial Coastal Zone Resource Development

Other coastal zone resources development specifically manifest in misusing non-renewable resources, such as the acceleration of coastal coal mines (Longkou coal) and gold (Sanshandao gold, the gold warehouse) and other non-metallic and metallic mineral resources development in east coast of Laizhou Bay coastal zone since 1960s, causing surface subsidence (Du Guoyun *et al.*,2007); and in the exploitation intensity of renewable resources too excessive to seriously damage their regeneration process, so in a serious imbalance in resource structure. For example, although the coastal dune-fixing wind Japanese black pine forest has not yet folded, there are many manners of deforestation could be found. Some scholars have pointed out that along the coast sand-fixing storm Japanese black pine forest in Tiou long zui region Yantai domain has been severely damaged, almost as a barren land there (Li Shitai,2000).

3. Socio-economic impact assessment

3.1 Macro Impact Assessment

In connection with a region, land value affected by the environmental pollution, that is to say if the land was contaminated, its market price would be bound to decline, can be converted into a total investment of local economic development, and the total economic benefits received are the regional gross national product affected by degree of regional development, pattern of city layout, structure and layout of regional industries and resource utilization efficiency. The higher coastal development of Yantai, the more land prices needed, and the maximum investment amount of land will be the most close to. Suppose the land price of inter-tidal zone and sea-land breeze zone farther than inter-tidal zone from coastline where land price is lower than inter-tidal zone are separately set to 1,000 and 300 yuan/m² as values of urban construction land in 2005. Then the total purchase price of coastal zone of Yantai is 13.75 trillion yuan with dimensions of roughly 702.5km by 2km in inter-tidal zone and 702.5km by 58km in sea-land breeze zone in 2005. As a total investment of local economic development of Yantai, assuming the rate of return on investment is 10%, the estimated total revenue of Yantai(abbreviated as TLRY) would be 1.375 trillion yuan. While the real GDP of Yantai is 201.25 billion yuan in 2005, about 15% of TLRY and the estimated GDP in 2010 would reach to 370 billion yuan, or about 27% of TLRY and close to TLRY in 2020, that means, the urbanization of yantai would be more complete and coastal zone resources fully used at that time. While one of prerequisites for GDP reaching to 1 trillion yuan in 2020 is the environmental quality and ecological conditions of Yantai still remained the state in 2005. Due to environmental pollution continuously, in all probability, before the GDP of Yantai had exceeded 1 trillion yuan, earlier than the year estimated, the GDP would equal to TLRY when changing the rational planning of urban layout, improving resource utilize efficiency and scientific adjustment of the regional industrial structure and layout would be needed if the GDP still increased.

In addition leading to the decline in the value of land, environmental pollution can also wear the national income through environmental improvement. For instance, every million tons of sewage treatment almost need one-time investment in 0.5 million yuan (based on 20 years of depreciation), and operating costs for 2 million yuan annually, then totally the economic losses about 2.5 million yuan in one year. A variety of unexpected events, for example, fishery pollution accidents resulting from illegal dumping of wastes due to harbor dredge and also caused by land-based sewage (Oceanic and Fishery Bureau of Yantai, 2003) are also the depletion of the total investment. With increasing rapidly of marine refuse in recent years, the amount of garbage dumping is also increasing, for instance, 2.86 million m³ in 2005 (Oceanic and Fishery Administrator of Shandong Province, 2005), 42.437m³ in 2006 (Oceanic and Fishery Administrator of Shandong Province, 2006). To dispose the above-mentioned marine litter, it will take a one-time investment in 3.7 million yuan according to 10-year depreciation, for the purchase of a large-capacity marine refuse collection fleet and a pier to construct for vessels collecting marine garbage to park. In addition, in order to maintain the marine refuse collection daily, the maintenance costs would be about 0.7million every year, and another 0.24 million yuanaslo need for of 20 refuse collection staffs' salaries ($20 \times 1000 \text{ yuan} / (\text{months} \cdot \text{persons}) \times 12 \text{ months}$). It is means that the economic losses of marine litter every year is about 4.64 million yuan, the cost of total as follows: $3.7 + 0.7 + 0.24 = 4.64$ million yuan / a. The direct impacts of the economic losses on coastal development are in Table 1 where some of these not reflected, such as, the direct and indirect losses of waterway dredging and remediation for clogging waterways by siltation sediment.

There are some conflicts also to reduce TLRY amongst coastal zone development related strategies of Yantai, such as conflicts between coastal tourism and port-related maritime industry; conflicts for beach resources between marine aquaculture and port construction manifesting in ports occupied by some marine fishery not conducive to construct and fairway waters occupied endangering the security of maritime transport, mainly manifested in contradictions between the marine sewage discharge of the non-marine industries polluting marine environment and the development of marine industries needing high-quality marine environment; conflicts in the exploitation and utilization of coastal zone resource between marine industries and non-marine industries; also inconsistencies between economic and social development planning of Yantai and coastal tourism planning. One instance manifests conflicts that the Coastal Tourism Development Project of Yantai includes 18 major goals distributed along the coastal zone, most of these in the inter-tidal zone (State Oceanic Administration Institute for Marine Development Strategy Planning Group 2007), meanwhile, where a coastal industrial belt with 200km from Yangma island to the Laizhou Bay have been implemented in.

3.2 Micro-impact assessment

The socio-economic impact assessment in micro level which is an important content of the strategic sustainability evaluation is mainly analysis of effects of the proposed strategy in fairness among different groups. The impact of coastal zone development strategy of Yantai to intra-generational equity relevant to intra-generational equity and intergenerational equity in a view of sustainable development (Hong Huasheng *et al.*, 1998) is the market allocation mechanism far from completion, causing that resources and ecological environment of Yantai originally jointly owned by all members of citizens, while were occupied by companies with a certain rate of return or departments of power with a low-return rate, and meanwhile economic losses due to pollution undertaken by personal themselves, such as, in most instances, hospital treatment costs caused by a problem of environmental pollution undertaken by the sick individual without the complete health care system. Coastal zone pollution could impact on the health of residents living in the coastal zone and infect them primarily after residents swam in contaminated water or ate the deteriorated seafood that were polluted. Coastal zone polluted water also as a means of disease transmission, spread of diseases, such as hepatitis, malaria, etc (Hong Huasheng *et al.*, 1998). The following formula could calculate economic losses of human impaired health caused by marine pollution: $T_{\text{value}} = P \cdot L \cdot H$; $T_{\text{treat}} = (T_c \cdot P_c \cdot L_c) + (T_n \cdot P_n \cdot L_n)$ (Hong Huasheng *et al.*, 1998). Where T_{value} refers to the lost gross national product during workers are sick; $T_{\text{treatment}}$ refers to the increase in expenditure in treatment of workers' diseases; P refers to the average net output of one person in one day; H refers to the days of illness time of one person; T_c , T_n respectively refers to the average outpatient and inpatient treatment expenditure daily; L_c , L_n respectively refer to the number of outpatient and hospital patients; P_c , P_n respectively refer to the average sick days of a patient, one treatment cycle of hepatitis A patients caused by marine pollution about 15-30d (taking 22.5d when calculate their economic losses). Then in Yantai, according to the formula: $T_{\text{value}} = \text{gross national product per capita}(20,221\text{yuan in } 2003 \text{ and } 58.48 \text{ thousand U.S. dollars in } 2010) \div 365 \times 22.5\text{d}$ (Statistics Bureau of Yantai, 2004; Municipal Planning Bureau of Yantai, 2005), then T_{value} in 2003 = $20221 \div 365 \times 22.5 = 1246.5$ yuan; Similarly, T_{value} will be 3604.9 yuan in 2010. T_{treat} should be equal to the average daily expenditure multiplied by 22.5, then $T_{\text{treat}} = 800 \times 22.5 = 18000$ yuan in 2003. Taking the level of health care reform and the improvement of health care into account, proportion to the growth of the average daily expenditure in outpatient and hospital treatment higher than per capita gross national product, T_{treat} may be calculated by per capita growth in gross national product temporarily, then, T_{treat} will be 52,056.8 yuan in 2010, so $T_{\text{total}} = T_{\text{output}} + T_{\text{treat}} = 19,246.5$ yuan in 2003, while $T_{\text{total}} = 55,661.7$ yuan in 2010. Namely, the economic loss of hepatitis A amounted to 19,246.5 yuan in

2003, while 55,661.7 yuan which close to per capita gross national product at that time in 2010. If a liver disease is prevalent in the popular crowd, it would cause more economic loss.

The impact of intergenerational equity in the coastal zone of Development Strategy of Yantai is mainly reflected in the standard of living of future generations likely lower than contemporary people beyond 2020 if coastal resources exploitation end by 2020 while the population has not been a corresponding restriction in Yantai.

4. Countermeasures and Suggestions

In addition to improving the overall urban planning, strengthening urban environmental infrastructure construction, rational development and utilization of resources to achieve the maximization of resources and optimization, changing in energy structure, curbing environmental pollution, there are still the following two aspects need to focus on:

4.1 Transformation of economic growth mode, adjust the industrial structure and optimize the industrial space layout

There are two reasons to adjust economic growth mode as soon as possible in the view of the coordinated regional development to increase TLRY in the future. Firstly, a similar structure between the neighboring cities, including Dalian, Qingdao, Yantai, with same industrial development direction, such as three pillar industries in the future or potential industry equipment manufacturing, composed of electronic information and software industry and bio-pharmaceuticals in the next decade will result in a highly competitive market price lower than the value, causing the yield decline in resource development. Value of the coastal zone with the original ecological environment at that time in Bohai Rim region will be manifest, resulting in increased earnings of eco-tourism. Secondly, with the evolution of global industrial structure and the wage level along China's coast rising, then the original layout of the manufacturing sector in China's coastal areas transferred to inland, it is inevitable that some industries, such as coastal tourism, port logistics and services become pillar industries. Therefore shifting the direction of industrial development to coastal tourism, port logistics industry to an earlier date, will avoid relocation after construction of the manufacturing sector, and increase TLRY.

4.2 Strengthen management on the coastal zone

In the coastal zone management, polluting enterprises stationed in the area should be levied a higher amount of pollution control costs depended on the degree of pollution, and government should likewise facilitate these polluting enterprises relocate to the land-sea breeze area. Environmental compensation fee charged to residents, according to water price management of different areas, for example, for urban sewage treatment, water fees charged to residents in tidal zone more than 5-fold in sea-land breeze area. Note that air pollution of land-sea breeze area, due to the impact of land-sea breeze, elevated source likely to cause pollution in their own region, which is unique to the pollution of land-sea breeze circulation phenomena (Qian Donglin and Li Zhaoyong,1991).For there being a large area forest vegetation in the sea-land breeze Distribution of Yantai, the construction of polluting enterprises should pay attention away from the protection ecological sub-region of forest vegetation (Zheng Binghui *et al.*,2007).

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Table 1. direct impact on economic losses of coastal development of Yantai

	Coastal Zone environmental issues and environmental protection projects	The amount of economic loss
1	treatment cost of sewage and waste gas	the loss of every million tons of sewage treatment 2.5 million yuan / a; due to the loss of air pollution share to various businesses, it is incalculable.
2	Marine waste disposal costs	4.64 million yuan per year
3	Port economic losses resulting from oil pollution	For the number of oil spills difficult to calculate, the loss can not be estimated
4	Other terrestrial resources development in Coastal Zone	Difficult to estimate
5	Construction of coastal nature reserves	costs of Built-up and operating need 0.2million yuan per year
6	regression caused disorder of aquaculture fisheries	Some of the most serious incidents, the economic loss can not be measured, such as billions of dollars of economic losses happened during 1997-1999 in the Long Island County.