Integrated management strategy for the coastal development program of Jiangsu Province

Meifeng Luo

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INTEGRATED MANAGEMENT STRATEGY
for the Coastal Development Program of Jiangsu Province

By

MEIFENG LUO
The People's Republic of China

A dissertation submitted to the World maritime University in partial fulfilment of the requirements for the award of the degree of

MASTER OF SCIENCE
in
GENERAL MARITIME ADMINISTRATION & ENVIRONMENTAL PROTECTION
1996

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DECLARATION

I certify that all material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

(Signature)          
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National Oceanic and Atmospheric Administration
ACKNOWLEDGMENT

Few life’s successes are accomplished in isolation. No matter how personal a claim I may lay on this dissertation, the truth is that the previous work of my colleagues, the knowledge of professors, and the love of my family all contributed to the character and accomplishment of this dissertation.

Many experiences and many people lie behind the accomplishment of this dissertation. Most notably, and most obviously, my colleagues working in the East Sea Branch of State Oceanic Administration, the People’s Republic of China. It is their arduous works in field investigation that provided essential information for my research. Without them, there would be no “point of departure” from which the research could take off.

I want to express my special gratitude for all the instructions and guidelines given by all the professors in WMU. Especially to my two course professors: T. J. Sampson and T. G. Callahan for their great contribution to my dissertation and their knowledgeable instruction during this one year’s study. Special thanks should also be given to my assessor, Professor Shuo Ma for his guidance on the arrangement of the whole dissertation.

I am also obliged to express my gratitude to my dear wife and son for overcoming all the difficulties and inconveniences during my one-year’s absence, and also for collecting and sending me the valuable information for my dissertation.

Finally, I should also express my deep gratitude to my nominator, the Deputy Director of the East Sea Branch, and my financial supporter, the International Maritime Organization. Without them, my study at WMU would have been impossible.
Title of Dissertation: Integrated Management Strategy for the Coastal Development Program of Jiangsu Province

Degree: MSc

The development in the coastal area of Jiangsu Province is still managed on a sectoral basis. This low level management method causes huge wastes of natural resources, fosters intense competition between different sectors for limited natural resources and space, and results in conflicts between different interests groups, over exploitation and even depletion of natural resources, environmental pollution and ecosystem degradation.

With the development of the national economy, the coastal development activities will be greater in number and broader in scope. There will be more conflicts between different sectors, between exploitation and resources conservation, between development and environment protection. Thus, to establish a high level integrated management system based on the overall development objectives is an urgent task needed to solve these problems and achieve sustainable development.

This paper introduced existing geographical advantages, natural resources and coastal environmental conditions, marine industry status, related laws and institutions in the coastal area, and the sustainable development concept and the integrated coastal zone management theory; discussed the proposed coastal development project of Jiangsu Province; identified and analyzed main problems including unfavorable socio-economic factors, existing conflicts and their adverse impacts on sustainable development; suggested an integrated coastal zone management system, including a series of strategies that should be incorporated into an integral system, an evaluation mechanism to monitor and evaluate the performance of the management strategies and a set of principles to build a capacity within the region for sustainable development practices that will promote beneficial economic activities in the coastal area of Jiangsu Province.
TABLE OF CONTENTS

DECLARATION ................................................................................................................................. ii
ACKNOWLEDGMENT ......................................................................................................................... iii
ABSTRACT ................................................................................................................................................ iv
TABLE OF CONTENTS .......................................................................................................................... v
LIST OF TABLES ....................................................................................................................................... vii
LIST OF FIGURES ................................................................................................................................... viii
LIST OF ABBREVIATIONS ..................................................................................................................... ix

1. INTRODUCTION ..................................................................................................................................... 1

2. BACKGROUND .......................................................................................................................................... 4
   2.1 GEOGRAPHICAL INFORMATION .................................................................................................... 4
   2.2 STATUS QUO OF THE MARINE ECONOMY OF JIANGSU PROVINCE ............................................... 6
   2.3 MARINE RESOURCES ...................................................................................................................... 7
   2.4 ENVIRONMENTAL CONDITION ..................................................................................................... 11
   2.5 LEGISLATION AND INSTITUTIONS .................................................................................................... 12
   2.6 INTRODUCTION TO SUSTAINABLE DEVELOPMENT AND INTEGRATED COASTAL ZONE MANAGEMENT ......................................................................................................................... 14
      2.6.1 Sustainable Development Concept ............................................................................................ 14
      2.6.2 Integrated Coastal Zone Management .......................................................................................... 15
   2.7 SUSTAINABLE DEVELOPMENT STRATEGY OF PRC ........................................................................... 16
      2.7.1 Economic Development Objectives and Strategy ........................................................................ 16
      2.7.2 Environmental Protection and Management Objectives ............................................................. 18
      2.7.3 Marine Resource Protection and Management .............................................................................. 18

3. PROPOSED DEVELOPMENT PROJECT IN THE COASTAL AREA OF JIANGSU PROVINCE ................. 20
   3.1 OVERALL DEVELOPMENT OBJECTIVE ............................................................................................ 20
   3.2 PORT AND MARITIME TRANSPORTATION DEVELOPMENT ............................................................. 22
      3.2.1 Before the Year 2000 ................................................................................................................... 22
      3.2.2 Between the Years 2000 and 2020 ............................................................................................... 23
      3.2.3 Maritime Transportation .............................................................................................................. 23
   3.3 FISHING AND MARICULTURE ......................................................................................................... 23
      3.3.1 Fishing ........................................................................................................................................ 23
      3.3.2 Mariculture .................................................................................................................................. 24
   3.4 SALT INDUSTRY ................................................................................................................................... 24
   3.5 COASTAL TOURISM DEVELOPMENT ................................................................................................. 26
   3.6 COASTAL LAND RECLAMATION ...................................................................................................... 27
   3.7 OFFSHORE OIL AND GAS EXPLOITATION ...................................................................................... 27
   3.8 MARINE HIGH-TECH INDUSTRY DEVELOPMENT ........................................................................... 27

4. EXISTING PROBLEMS IN THE PROPOSED COASTAL ECONOMIC DEVELOPMENT PROGRAM OF JIANGSU PROVINCE ........................................................................................................ 28
   4.1 SOCIO-ECONOMIC FACTORS ........................................................................................................... 28
      4.1.1 Low Starting Point for Economic Development ........................................................................... 28
LIST OF TABLES

TABLE 1: GENERAL INFORMATION OF PRC AND JIANGSU PROVINCE ................................................................. 5
TABLE 2: MIPV OF PRC AND JIANGSU PROVINCE ........................................................................................................ 6
TABLE 3: TOP 11 FINFISH SPECIES AND THEIR DISTRIBUTION ..................................................................................... 9
TABLE 4: DISTRIBUTION OF COASTAL BEACH AND WETLAND RESOURCES ............................................................... 9
TABLE 5: BIOLOGICALLY IMPORTANT SPECIES ............................................................................................................. 11
TABLE 6: SOURCES AND AMOUNTS OF MARINE ENVIRONMENTAL POLLUTANTS ..................................................... 11
TABLE 7: LAWS AND REGULATIONS RELATED WITH MARINE AFFAIRS ...................................................................... 13
TABLE 8: CENTRAL MANAGEMENT INSTITUTIONS AND THEIR RESPONSIBILITIES .................................................. 14
TABLE 9: MARINE ENVIRONMENTAL PROTECTION OBJECTIVES .................................................................................. 18
TABLE 10: MARICULTURE DEVELOPMENT PLAN FROM 1990 TO 2000 ....................................................................... 24
TABLE 11: DEVELOPMENT OBJECTIVES OF SALT INDUSTRY ...................................................................................... 24
TABLE 12: PREDICTION OF MUNICIPAL SEWAGE DISCHARGES ................................................................................... 37
TABLE 13: ESTIMATED RELATIVE SEA LEVEL RISE IN 3 SENSITIVE REGIONS ............................................................... 40
TABLE 14: CBA STRUCTURE OF A PROPOSED PROJECT .............................................................................................. 54
LIST OF FIGURES

Figure 1: Dissertation Organization ................................................................. 2
Figure 2: Geographical Information of PRC and Jiangsu Province .................. 4
Figure 3: Marine Resource Distribution in Jiangsu Province ............................ 7
Figure 4: Three Types of Coastal Mineral Resources ....................................... 9
Figure 5: Micro-organisms in three major fishing fields ................................. 11
Figure 6: Water Quality Changes in the Coastal Area .................................... 12
Figure 7: Marine Development Plan of Jiangsu Province ............................... 21
Figure 8: Fishery Development Objectives ................................................... 23
Figure 9: The Percentage of TAIPV of the Coastal Area ............................... 29
Figure 10: TAIPV per Capita of the Coastal Area Compared with the Whole Province ................. 29
Figure 11: TAIPV per Capita of the Coastal Area Compared with Inland Area ...... 30
Figure 12: The Percentage of Electricity Consumption of the Coastal Area in the Whole Province .............................................................................................. 31
Figure 13: The Marine Industry Structure in Jiangsu Province .......................... 32
Figure 14: Available wetland resources and proposed land reclamation plan ........ 36
Figure 15: Prediction of Industrial Wastes and COD Wastes Discharges .......... 37
Figure 16: Flow Chart of the Evaluation Process ........................................... 66
# LIST OF ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD</td>
<td>Biological Oxygen Demand</td>
</tr>
<tr>
<td>CBA</td>
<td>Cost and Benefit Analysis</td>
</tr>
<tr>
<td>CEARC</td>
<td>Canada Environmental Assessment Research Council</td>
</tr>
<tr>
<td>COD</td>
<td>Chemical Oxygen Demand</td>
</tr>
<tr>
<td>EEZ</td>
<td>Exclusive Economic Zone</td>
</tr>
<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Production</td>
</tr>
<tr>
<td>ICZM</td>
<td>Integrated Coastal Zone Management</td>
</tr>
<tr>
<td>IOM</td>
<td>Integrated Ocean Management</td>
</tr>
<tr>
<td>ITQ</td>
<td>Integrated Tradable Quote</td>
</tr>
<tr>
<td>LBMP</td>
<td>Land Based Marine Pollution</td>
</tr>
<tr>
<td>LCA</td>
<td>Life Cycle Analysis</td>
</tr>
<tr>
<td>MIPV</td>
<td>Marine Industrial Production Value</td>
</tr>
<tr>
<td>NEPA</td>
<td>The National Environmental Protection Agency of PRC</td>
</tr>
<tr>
<td>NEPA</td>
<td>National Environmental Protection Agency of PRC</td>
</tr>
<tr>
<td>NOAA</td>
<td>National Oceanic and Atmospheric Administration</td>
</tr>
<tr>
<td>NPV</td>
<td>Net Present Value</td>
</tr>
<tr>
<td>PCB</td>
<td>Polychlorinated Biphenyl</td>
</tr>
<tr>
<td>PRC</td>
<td>The People's Republic of China</td>
</tr>
<tr>
<td>RMB</td>
<td>Ren Min Bi (The Chinese Currency)</td>
</tr>
<tr>
<td>SIA</td>
<td>Social Impact Assessment</td>
</tr>
<tr>
<td>SOA</td>
<td>The State Oceanic Administration of the PRC</td>
</tr>
<tr>
<td>TAIPV</td>
<td>The Total Agricultural and Industrial Production Value</td>
</tr>
<tr>
<td>UNCED</td>
<td>United Nations Conference on Environment and Development</td>
</tr>
</tbody>
</table>
1. INTRODUCTION

In 1993, a high market demand for prawns escalated the mariculture activities in the coastal area of Jiangsu Province, one of the coastal provinces of the People’s Republic of China (PRC). Intensified mariculture activities generated too much waste water, exceeded the coastal dilution capacity, caused sea water eutrophication and induced prawn diseases. Consequently, prawn production declined sharply.

Eel fry catching was very lucrative in 1991. Numerous fishing boats were mobilized to catch eel fry in the coastal area in the next year and the amount of the catch was tremendous. However, one year later, this amount reduced to only one sixth of the previous year with even larger fishing fleets. It was even less in the next two years. Now, the eel fry industry has totally disappeared in this region.

A chemical fiber factory was built near the coast where there were many prawn and other shellfish mariculture ponds. Waste water from the factory flowed constantly to the intertidal mud flat, polluted the surrounding waters, and finally killed what existed in the nearby ponds.

These three examples that occurred in the coastal area of Jiangsu Province clearly demonstrate the undesired consequences of uncoordinated development activities and hence display the necessity and importance of an integrated management method for the development of coastal areas.
The national economic development objectives of the PRC required Jiangsu Province to accelerate the development of its economy. Therefore, the later proposed a coastal development project, intended to make full use of its coastal natural resources to promote its marine economy. With the continued increase of economic development activities in the coastal area, there will be more conflicts between different development activities and much more intense competition for natural resources. This will further highlight the importance of establishing an integrated management system, coordinating the development activities, preventing conflicts between different sectors, protecting the coastal environment, maintaining a sustainable resource base, and achieving sustained overall economic development objectives.

Based on the geographical and economic conditions in the coastal area of Jiangsu Province and through the discussion of the proposed coastal development project, this paper will identify and analyze existing problems and suggest an Integrated Coastal Zone Management (ICZM) system for the sustainable development of the area. In Figure 1 the arrangement of the paper is shown.

Following the introduction background information is provided that establishes the geographical characteristics, the current economic, resource and environmental conditions, the legislative and management institutions, the concept of sustainable development and ICZM, and the sustainable development objectives of the PRC. It is followed by the discussion of the proposed coastal development project. After that, the author identifies and analyzes both the problems that currently exist in the coastal area and that are embedded within the development project, that will either impede the success of the development itself or impair the sustainability of Jiangsu Province. Then, the discussion shifts to the
integrated management strategies that are indispensable for: solving these identified problems, promoting the efficiency of resource exploitation and environment management, and ensuring the sustainable development of the coastal area. As a conclusion of this research, this paper summarizes suggested ICZM strategies and recommends a series of actions for the integrated management of the development program in the coastal area of Jiangsu Province.

For better understanding of the scenario of the proposed development project and the problems, the next chapter describes the current situations in the coastal area of Jiangsu Province.
2. BACKGROUND

2.1 Geographical Information

The Chinese coast is located at the eastern edge of the Euro-Asia continent, facing the Pacific Ocean to the East, with Korea to the North and Vietnam to the South. The total length of the mainland coastline is 18000 km (refer to Figure 2). Along the coast there are three marginal seas - the Yellow Sea, the East China Sea and the South China Sea. There is one internal sea - the Bohai Sea. The total area of the seas is 4.7 million km$^2$.

Jiangsu coast is in the middle of the Chinese coast, from 31°33’N to 35°07’N. The typical geographical nature of this Province is a vast coverage of inter-tidal wetland along the coast of the Yellow Sea and the East China Sea. Typically 93% of the
coastline consists of mud flats, the remaining areas consists of sand beaches and rocky coastline. There is also a large underwater radiating shoal in the middle this coastline. General information comparing Jiangsu Province with the Nation is listed in Table 1.

<table>
<thead>
<tr>
<th></th>
<th>Land area (km²)</th>
<th>Population (millions)</th>
<th>Population density (Persons/km²)</th>
<th>Length of Coastline (km)</th>
<th>Coastal intertidal area (10⁶ ha)</th>
<th>Shallow Sea (within -15m) (km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRC</td>
<td>9 596 960</td>
<td>1 200</td>
<td>125</td>
<td>18 000</td>
<td>217.09</td>
<td>123 802</td>
</tr>
<tr>
<td>Jiangsu Province</td>
<td>102 600</td>
<td>70</td>
<td>682</td>
<td>1 000</td>
<td>51.32</td>
<td>24 378</td>
</tr>
<tr>
<td>Percentage of PRC</td>
<td>1%</td>
<td>6%</td>
<td>546%</td>
<td>6%</td>
<td>24%</td>
<td>20%</td>
</tr>
</tbody>
</table>

The coastal zone of Jiangsu Province has a very important strategic position for economic development and an advantageous geographical location. First, Jiangsu Province is located at the center of the Chinese coast, opposite to the Taiwan Strait and the Korea Strait, while the Chinese coast is located at the center of the Pacific Coast of Asia. It is not only the pivotal area for marine transportation from the South to the North within the PRC, but also from the North-East Asia region to the South-East Asia region. It is also the gate of sea transportation to the PRC and for the Euro-Asia continent to the America and Australia continents. The Asia-pacific region has become the fastest growing area in the world in recent years. This new world economic center further highlights the strategic importance of the coast area of Jiangsu Province. Second, the southern part of the coastal area is the meeting point of the coastal economic belt and river-side economic belt of the PRC. The northern part of the province provides the eastern end of the new "Euro-Asia Continental Bridge". The configuration of these three factors formed a "π" structure of economic zone of PRC. The coastal zone of Jiangsu Province is just where these two joint points located and its coastline is very important part of this "π" formation. Third, the coastal area of Jiangsu Province has China’s largest plain - Huanghuai Plain with its
rich natural resources in the hinterland. The Changjiang Delta Economic Region, the Shanghai Economic Region and the Pudong Economic and Technological Development Area, forms the largest economic and technological center in our country, are just to the south. The province is also closely linked to developed countries like Japan and Korea by sea. Therefore, Jiangsu Province has a very advantageous geographical position and the economic potential to become a frontier for economic development of PRC.

2.2 Status Quo of the Marine Economy of Jiangsu Province

Marine industry in this area includes fishery, sea salt production, maritime transportation and coastal tourism. In 1990, the total MIPV (marine industrial production value) amounted to 2048 million RMB Yuan. Table 2 compared the MIPV of Jiangsu Province with that of the whole country. It revealed some defects in the marine industry of Jiangsu Province, including:

1. Offshore oil and gas, coastal sand mineral and sea water direct use are not developed.
2. Traditional sectors (fishery and sea salt production) accounted for 78% of the MIPV, while new sectors (marine transportation and coastal tourism) only 22%.
3. Fishery production just equal to the national average in terms of the length of coastline. The advantage of vast coastal intertidal mud flat for mariculture has not been exploited to increase the production value of fishery.

Therefore, in general, the development of marine industry is still at a low degree, small scale, with high resource consumption. The regional advantage of marine and coastal area has not yet been transferred into economic advantages.

<table>
<thead>
<tr>
<th></th>
<th>National</th>
<th>Jiangsu Province</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fishery</td>
<td>20670</td>
<td>1204</td>
<td>6%</td>
</tr>
<tr>
<td>Sea Salt industry</td>
<td>1679</td>
<td>391</td>
<td>23%</td>
</tr>
<tr>
<td>Offshore Oil &amp; Gas</td>
<td>1165</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Coastal Sand Mineral</td>
<td>78</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Sea Water Direct Use</td>
<td>300</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Maritime Transportation</td>
<td>9921</td>
<td>435</td>
<td>4%</td>
</tr>
<tr>
<td>Coastal Tourism</td>
<td>2390</td>
<td>18</td>
<td>1%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>36203</strong></td>
<td><strong>2048</strong></td>
<td><strong>6%</strong></td>
</tr>
</tbody>
</table>

Source: National Marine Information Center, 1993
2.3 Marine Resources

Figure 3: Marine resource Distribution in Jiangsu Province

Jiangsu Provinical Scientific Committee and East Sea Branch of SOA conducted jointly a comprehensive coastal zone and wetland resource investigation in 1985 (Ocean Press, 1986). This investigation revealed the natural resource base in the coastal area, which mainly include resources for port construction, fishery, coastal beach and wetland, coastal mineral, offshore oil and gas, sea salt, marine energy, and coastal tourism (Figure 3).
1. **Resources for port construction:** There are different types of coastlines in Jiangsu Province. Even in some of the marsh estuaries and mud flat areas some wide deep water tidal channels exist, that are attractive location of new port construction. The mild climate ensures year-round access; the normally low wave heights provide for stable berth conditions; the low possibility for cyclones and sea fog facilitates safe and continuous shipping; and the open land area along most of the natural approaches would accommodate sufficient dock and storage areas. All of these characteristics are attractive conditions for port development and construction.

2. **Fishery:** The ecological system in the coastal area of Jiangsu Province is very complicated and diversified. It is caused by the entrance of a variety of different river systems, the existence of many shoals and shallow beaches, and the convection of cold and warm currents. All of these contribute to rich and diversified fishery resources. Table 3 shows the top 11 finfish resources and their distribution. Apart from finfish resources in this region, there are also many other living marine species such as shrimp, crab, other shellfish, and diverse valuable fishery products such as sea cucumbers and sea urchins, as well as laver. The shellfish resources are the richest, and account for 91.6% of the biomass of the living marine resources harvested in this province.

3. **Beach and wetland resources:** Table 4 shows the distribution of wetland resources in the coastal area. The annual growth rate of the coastal wetland in this province is 20 thousand acres. Most of the growth occur in the southern part, due to the huge amount of sediments carried by the Changjiang River that are deposited there. The erosion rate of coastal land is 3.5 thousand acres per year, which is normally centered around the Old Yellow River Estuary, caused by the cessation of the sediment input. This makes the net growth rate 16.5 thousand acres per year (Comprehensive report on Coastal Zone and Wetland Resource Investigation of Jiangsu Province, 1993). Since the radiating shoal is away from coastline, it does not belong to any coastal municipality. Therefore, the total provincial wetland area is larger than the sum of the three coastal municipalities.
Table 3: Top 11 Finfish Species and Their Distribution

<table>
<thead>
<tr>
<th>Name of the species</th>
<th>Resource density (tons/mile²)</th>
<th>Present amount (10⁴ tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Survey size (12,240 miles²)</td>
<td>Within 4km contour (26,000 miles²)</td>
</tr>
<tr>
<td>Setipinna taty (Curiver &amp; Valencienes)</td>
<td>1.011</td>
<td>1.237</td>
</tr>
<tr>
<td>Pampus argenteus (Euphrasen)</td>
<td>0.935</td>
<td>1.144</td>
</tr>
<tr>
<td>T. muticus (Gray)</td>
<td>0.515</td>
<td>0.63</td>
</tr>
<tr>
<td>Pseudosciaena crocea (Rich)</td>
<td>0.481</td>
<td>0.589</td>
</tr>
<tr>
<td>P. Cineorus (Bloch)</td>
<td>0.271</td>
<td>0.332</td>
</tr>
<tr>
<td>Scomberomorus niphonius (C. &amp; V.)</td>
<td>0.238</td>
<td>0.291</td>
</tr>
<tr>
<td>Collochthys lucidus (Rich)</td>
<td>0.199</td>
<td>0.244</td>
</tr>
<tr>
<td>Ilisha elongata (Bennett)</td>
<td>0.176</td>
<td>0.251</td>
</tr>
<tr>
<td>C. ectens (Jordan &amp; Seale)</td>
<td>0.139</td>
<td>0.17</td>
</tr>
<tr>
<td>Muraenox cincreus (Fbrskal)</td>
<td>0.107</td>
<td>0.131</td>
</tr>
<tr>
<td>P. polyactis (Bleeker)</td>
<td>0.083</td>
<td>0.102</td>
</tr>
<tr>
<td>Total*</td>
<td>4.678</td>
<td>5.726</td>
</tr>
</tbody>
</table>

*This is the total of all the species, not just the listed.
Source: Coastal Zone & wetland resource survey of Jiangsu Province

Table 4: Distribution of Coastal Beach and Wetland Resources

<table>
<thead>
<tr>
<th>(Thousands of Acres)</th>
<th>Lianyungang</th>
<th>Yanchen</th>
<th>Nantong</th>
<th>Provincial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grand total</td>
<td>1,100.6</td>
<td>4,936.6</td>
<td>1,841.1</td>
<td>9780.9*</td>
</tr>
<tr>
<td>High tidal line</td>
<td>808.5</td>
<td>2,515.6</td>
<td>570.9</td>
<td>3,895.0</td>
</tr>
<tr>
<td>Total</td>
<td>773.1</td>
<td>1,549.9</td>
<td>430.2</td>
<td>2,753.2</td>
</tr>
<tr>
<td>reclaimed</td>
<td>749.6</td>
<td>995.1</td>
<td>321.9</td>
<td>2,066.6</td>
</tr>
<tr>
<td>developed</td>
<td>23.5</td>
<td>554.8</td>
<td>108.3</td>
<td>686.6</td>
</tr>
<tr>
<td>not developed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>inland</td>
<td>35.4</td>
<td>965.7</td>
<td>140.7</td>
<td>1,141.8</td>
</tr>
<tr>
<td>not reclaimed total</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>could be reclaimed presently</td>
<td>512.0</td>
<td>110.0</td>
<td>622.0</td>
<td></td>
</tr>
<tr>
<td>Intertidal area</td>
<td>292.1</td>
<td>2,421.0</td>
<td>1,270.2</td>
<td>3,983.3</td>
</tr>
<tr>
<td>Radiating shoal</td>
<td></td>
<td></td>
<td></td>
<td>1,902.6</td>
</tr>
</tbody>
</table>

*This figure includes the radiating shoal.

2. Marine mineral resources: Three main kinds of marine mineral resources are found and can be exploited in this area. The exploitation of these resources has not started. Figure 4 shows their estimated industrial storage (the amount that can be extracted) and prospective reserves (the amount that exists in the coastal...
area) (Comprehensive report on Coastal Zone and Wetland Resource Investigation of Jiangsu Province, 1993).

3. **Offshore oil and gas**: The North Jiangsu and South Yellow Sea Basin is one of the 6 major sediment basins in the PRC. After the Sino-American joint investigation of the oil and gas prospects in this area, it was estimated that the total deposits of oil and gas in this 100 thousand km² may be about 290 million tons.

4. **Salt production**: In Jiangsu Province the total area of saltworks is 85109 ha, 73770 ha of them are producing areas. The raw salt production in 1988 was 2.5 million tons. Half of the bittern left after the extraction of the salt is now used for producing chemical products.

5. **Marine energy**: Potential marine renewable energy resources include tidal energy, temperature difference energy, and wind energy.
   - Tidal energy: available mainly at the north branch of Changjiang Estuary, in the radiate shoal and Haizhou Harbor area. these areas could potentially generate electricity up to 2.64 Billion kwh.
   - Temperature difference energy: available mainly outside of 30m contour line. The estimated energy available for generation in the Autumn months is 1 to 5 billion kwh.
   - Wind energy: available mainly in coastal areas with an average wind speed >3 m/s. At approximately 10 km away from the coastline, the wind increases sharply and effective energy production could be over 300 w/m² with mean value at 200 w/m².

6. **Tourist resources**: The diversified landscape and long history of human existence bestows upon Jiangsu Province a combination of rich natural scenery and cultural relics. There are two important national culture preservation sites open for tourist to visit in Jiangsu Province; there are about 90 tourist points in Lianyugang, 83 in Yanchen and 64 in Nantong.
2.4 Environmental Condition

The coastal natural resource survey of Jiangsu Province in 1985 indicates that the coastal marine environment of the Province contains a diversity of species for different types of organisms. Table 5 shows the total number of species and their abundance in the coastal area. Figure 5 shows the abundance of micro-organisms (Phytoplankton and Zooplankton) in three near shore fishing fields. Three fish in figure 3 stand for three fishing fields, with Haizhouwan fishing field in the north, Changjiangkou fishing field in the south, Liushi fishing field in the middle. Because of the high contents of suspended matters near Changjiang Estuary, the concentration of Phytoplankton is lower in the south than that in the north. The variation of zooplankton is mainly caused by temperature difference. It is much cooler in the north than in the south.

The major sources of marine pollutants are originated from land. Table 6 lists three major sources of land based pollutants and their amounts which entered the coastal

<table>
<thead>
<tr>
<th>Table 5: Biologically Important Species</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Species</strong></td>
</tr>
<tr>
<td>----------------------</td>
</tr>
<tr>
<td>Phytoplankton</td>
</tr>
<tr>
<td>Zooplankton</td>
</tr>
<tr>
<td>Benthic organism</td>
</tr>
<tr>
<td>Intertidal Species</td>
</tr>
<tr>
<td>Benthic Fauna</td>
</tr>
<tr>
<td>Pelagic</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Figure 5: Micro-organisms in Three Major Fishing Fields</th>
</tr>
</thead>
<tbody>
<tr>
<td>I: Phytoplankton (10⁶ indi./m³)</td>
</tr>
<tr>
<td>II: Zooplankton (mg/m³)</td>
</tr>
<tr>
<td>□ Changjiangkou fishing field</td>
</tr>
<tr>
<td>□ Liushi fishing field</td>
</tr>
<tr>
<td>□ Haizhouwan fishing field</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 6: Sources and Amounts of Marine Environmental Pollutants</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Source</strong></td>
</tr>
<tr>
<td>-----------------------------</td>
</tr>
<tr>
<td>Industrial Waste discharges</td>
</tr>
<tr>
<td>Fishing Vessels</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Sources: National Marine Environmental Quality Annual Report, 1989
area. This pollutant inputs have caused water quality deterioration in some near shore regions, harbors and estuaries. Figure 6 shows the water quality change from intertidal zone to deep sea area. It indicates that high polluted water (IV) is limited with intertidal zone, which accounts only 20% of the near-shore waters.

2.5 Legislation and Institutions

In PRC there now exist more than 20 laws and regulations concerning marine resource utilization and marine environment management (Table 7). Most of them authorize one central institution responsible for the management of resource use activities and the environmental problems within one sector. These institutions and their respective responsibilities are listed in Table 8. Except the “Marine Environmental Protection Law of the People’s Republic of China”, which is responsible for marine environmental protection of all sectors. Under this law, Environmental Protection Agency and State Oceanic Administration are chief executive agencies for marine environmental protection. Corresponding to these central institutions, there are similar organizations in provincial and municipal level.
<table>
<thead>
<tr>
<th>No.</th>
<th>Name of Laws or Regulations</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Regulations Governing Supervision and Control of Foreign Vessels by the People's Republic of China</td>
<td>22-Aug-79</td>
</tr>
<tr>
<td>2</td>
<td>Regulation of the People's Republic of China on the Exploitation of Offshore Petroleum Resources in Cooperation with Foreign Enterprises</td>
<td>30-Jan-82</td>
</tr>
<tr>
<td>3</td>
<td>The Marine Environmental Protection Law of the People's Republic of China</td>
<td>23-Aug-82</td>
</tr>
<tr>
<td>4</td>
<td>Regulations of the People's Republic of China concerning Environmental Protection in Offshore Exploration and Exploitation</td>
<td>29-Dec-83</td>
</tr>
<tr>
<td>5</td>
<td>Regulation of the People's Republic of China Concerning the Prevention of Pollution of the Sea by Vessels</td>
<td>29-Dec-83</td>
</tr>
<tr>
<td>6</td>
<td>Maritime Traffic Safety Law of the People's Republic of China</td>
<td>01-Jan-84</td>
</tr>
<tr>
<td>7</td>
<td>Regulation of the People's Republic of China Concerning the Dumping of Wastes at sea</td>
<td>06-Mar-85</td>
</tr>
<tr>
<td>8</td>
<td>Fishery Law of the People's Republic of China</td>
<td>01-Jul-86</td>
</tr>
<tr>
<td>10</td>
<td>Customs Law of the People's Republic of China</td>
<td>22-Jan-87</td>
</tr>
<tr>
<td>12</td>
<td>Regulation of the People's Republic of China Concerning the Prevention of Pollution to the Marine Environment by Ship Breaking</td>
<td>18-May-88</td>
</tr>
<tr>
<td>13</td>
<td>Arbitration Rules of China Maritime Arbitration Commission</td>
<td>12-Sep-88</td>
</tr>
<tr>
<td>14</td>
<td>Regulations on the Taxation and Utilization of Fishery Resources Value Added Taxes and Protection Fees</td>
<td>09-Oct-88</td>
</tr>
<tr>
<td>15</td>
<td>Regulation for the Taxation of Mineral Area Utilization for Offshore Oil and Gas Exploitation</td>
<td>05-Dec-88</td>
</tr>
<tr>
<td>16</td>
<td>Regulations on Management of Laying Submarine Cables and Pipelines</td>
<td>01-Mar-89</td>
</tr>
<tr>
<td>17</td>
<td>Details for the Implementation of the Water Pollution Prevention Law of People's Republic of China</td>
<td>12-Jul-89</td>
</tr>
<tr>
<td>19</td>
<td>Regulations Governing the Investigation and Settlement of Maritime Traffic Accidents of the People's Republic of China</td>
<td>11-Jan-90</td>
</tr>
<tr>
<td>20</td>
<td>Regulation of the People's Republic of China Concerning the Prevention of Pollution to the Marine Environment by Coastal Construction Projects</td>
<td>25-May-90</td>
</tr>
<tr>
<td>21</td>
<td>Regulation of the People's Republic of China Concerning the Prevention of Pollution to the Marine Environment by Land-based Pollutants</td>
<td>01-Aug-90</td>
</tr>
<tr>
<td>22</td>
<td>Territorial and Adjacent Zone Law of People's Republic of China</td>
<td>25-Feb-92</td>
</tr>
<tr>
<td>23</td>
<td>Maritime Commercial Law of People's Republic of China</td>
<td>07-Nov-92</td>
</tr>
<tr>
<td>24</td>
<td>National Regulations Concerning the Management of Sea Use</td>
<td>21-May-93</td>
</tr>
<tr>
<td>Institution</td>
<td>Responsibilities</td>
<td></td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Harbour Superintendency Administration</td>
<td>Safety of maritime transportation and ports, pollution prevention from ships, ports and ship-breaking yards</td>
<td></td>
</tr>
<tr>
<td>Fishery Administration</td>
<td>Fishery and fishing resource management, pollution prevention and management of fishing vessels and fishing ports</td>
<td></td>
</tr>
<tr>
<td>Environmental Protection Agency</td>
<td>Organize, coordinate and supervise marine environmental protection in respective areas, manage pollution from marine engineering and land based sources, and pollution from ship-breaking yards</td>
<td></td>
</tr>
<tr>
<td>Ministry of Petroleum Industry</td>
<td>Responsible for exploration and exploitation of offshore oil and gas, and conducting international cooperation efforts in this fields</td>
<td></td>
</tr>
<tr>
<td>Ministry of Geology and Mineral Resources</td>
<td>Responsible for exploration and exploitation of mineral resources in the coastal areas</td>
<td></td>
</tr>
<tr>
<td>Maritime Arbitration Committee</td>
<td>Arbitration of maritime disputes and maritime affairs</td>
<td></td>
</tr>
</tbody>
</table>

2.6 Introduction to Sustainable Development and Integrated Coastal Zone Management

2.6.1 Sustainable Development Concept

Sustainable development concept evolved from the growing awareness of the problems related with global population growth, uneven economic development, resource depletion and environmental pollution. In 1972, a report named ‘Limits to Growth’ written by a group of 30 scientists pointed that ‘the limit to growth on this planet will come soon if present trends of population growth, industry development, pollution, food production and resource depletion were continue unchanged.’. In 1980, the United States government published ‘Global 2000 Report’, pointed out that ‘the present status of environment, population, resource and their trends towards the year 2000 were disturbing, alarming, and were beyond the carrying capacity of the Earth. It is a global problem and needs international cooperation.’. Also in 1980, the United Nation’s General Assembly adopted ‘World Charter for Nature’, stating the human responsibilities for nature and our moral roles for how to interact with other forms of life. In 1987 the World Commission on Environment and Development published ‘Our Common Future’, formulating the sustainable development concept, i.e., “development that meets the needs of present without compromising the ability
of the future generations to meet their own needs" (page 8). Sven-Olof Ryding summarized the difference between the traditional, inappropriate development activities and sustainable development (1992, pp. 30). Sustainable development will improve the environment, encourage development, improve health, and maintain sustainable development. Inappropriate development will adversely affect the environment, undermine health, slow development, and have adverse impacts on the environment.

2.6.2 Integrated Coastal Zone Management

The interdependent nature of sustainable development activities among different regions of the world, different components of the environment, and different sectors competing for marine resources, requires a high level of integration among these sectors. Agenda 21 (UNCED, 1992) stipulates the necessity of ICZM for sustainable development of the coastal states and outlines its nature, scope, functions and requirements.

ICZM is a continuous, dynamic and holistic decision making process, that recognizes the distinctive character for both current and future generations. Its purpose is to maintain essential ecological processes, life supporting systems and biological diversity. Its management area should include both sides of the shoreline. The optimal area on the land side is within the boundary of the watershed for controlling land-based pollution and freshwater inflow. The sea side includes the territorial sea and EEZ. ICZM is not purposed to supplant, but supplement, harmonize, and oversee sectoral management. It requires a continuing process to collect the necessary information and data on resources, coastal problems and issues, as well as the needs and desires of the public. It also needs a process to formulate a set of goals and policies, to develop planning and management processes and apply them to the management work. To achieve the goals and implement the policies, necessary legal, institutional, technical, financial and human resources should be adopted, developed and/or strengthened.
2.7 Sustainable Development Strategy of PRC

Adopted by the 16th Meeting of the Standing Committee of State Council of PRC in 1994, "Agenda 21 of PRC - White Cover Book on Population, Environment and Development of PRC in the 21st Century" is a manifest of the determination of the PRC for sustainable development. It includes a comprehensive and detailed description of the basis, objectives, and steps for actions in relation to every sustainable development strategy.

Integrated management, as defined by its nature and scope, should include all the related parts of sustainable development strategy, as well as the whole content of the "Agenda 21 of PRC". But for the purpose of this dissertation, it is worthwhile to concentrate on only the three central parts, i.e., economic development objectives and strategy, environmental pollution management, and resource management objectives and strategy.

2.7.1 Economic Development Objectives and Strategy

As a developing country, the priority for sustainable development in the PRC is economic development. The objective of economic development of the PRC before the year 2000 is to maintain a constant increasing rate for the national gross domestic product between 8% and 9% (from 5.760 billion RMB Yuan in 1995 to 8.5 billion RMB Yuan in 2000).

To achieve this goal, and also maintain a sustainable environmental and resource base, "Agenda 21 of PRC" stipulated a set of economic policies, including:

- Establish and develop a socialist market economic system.

This strategy will have a great influence on the sustainability and efficiency of the resource use and environment management. Because of the change of the operating mechanisms of the state-owned enterprises, all the economic components (state, collective, private, joint-venture, etc.) have to be operated...
under the same market system. With the macro-adjustment of the resource market, excessive burden on the resources and environmental stress can be relieved.

- Make full use of the economic measures and market mechanisms. Economic measures and market mechanisms will improve the efficiency of any sector. "Agenda 21 of PRC" (pp. 23) requires to include the environmental cost in economical analysis and decision-making process, to evaluate and internalize the cost of environmental goods and services. It also requires to improve sustainability by effective use economic measures and other market oriented methods.

- Establish integrated economic, resource and environmental accounting systems. Traditional GDP indices can not reflect ecological damage, environmental deterioration and the depletion of resources. The indices do not consider the contribution of non-commercial labor and goods. Therefore it does not reflect the true economic growth. To this ends, "Agenda 21 of PRC" (pp. 25) proposed to extend and complete present domestic economic accounting system, so as to include environmental and social factors.

2.7.2 Environmental Protection and Management Objectives

Environment protection and management objectives are established based on the economic development objectives of the PRC. The goals for the environmental protection of the PRC toward the year 2000 are: fundamental control of environmental pollution, improvement of the environment quality of important cities, slow down the deteriorate tendency of natural ecosystem, harmonize environmental protection with social and economic development, form a solid base for the long term objective—maintain a productive ecosystem and a clean, aesthetic and quiet city environment (Environmental Protection Action Plan of PRC from 1991 to 2000). Under this general environmental protection objectives, SOA and NEPA developed the marine environmental protection objectives, which are listed in Table 9 (NEPA, 1994).
Table 9: Marine Environmental Protection Objectives

<table>
<thead>
<tr>
<th>Land source</th>
<th>Oil discharge</th>
<th>COD material discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bohai Sea</td>
<td>&lt;956 thousand tons</td>
<td>&lt;461 thousand tons</td>
</tr>
<tr>
<td>Yellow Sea</td>
<td>Prevent obvious increase of oil pollution and nutrients concentration, emphasizing the control of organic pollution and heavy metals in different areas</td>
<td></td>
</tr>
<tr>
<td>East China Sea</td>
<td>Focus on the input of nutrients, reduce the frequency of red-tides, at the same time control oil pollution in ports and navigation channels, and the pollution level in Changjiang Estuary and Hangzhou Bay</td>
<td></td>
</tr>
<tr>
<td>South China Sea</td>
<td>Focus on oil pollution control and prevent additional nutrient input from the Pearl River.</td>
<td></td>
</tr>
<tr>
<td>Ecological environment Protection</td>
<td>Protect and improve ecological environment in the sea area of Zhoushan Archipelago, Hangzhou Bay, Jianzhou Bay, Taiwan shallow sea area, Daya Bay and the coastal water of the islands in the South China Sea</td>
<td></td>
</tr>
<tr>
<td>Natural Sanctuary Zone</td>
<td>Setup 60-90 marine and coastal natural sanctuaries with a total area &gt;300 thousand km², including about 100 islands and 400-500 km of coastline.</td>
<td></td>
</tr>
</tbody>
</table>

2.7.3 Marine Resource Protection and Management

As a guideline for the sustainable development in PRC, “Agenda 21 of PRC” also provides the sustainable marine resource management objectives, including the following four areas.

1. Build-up the marine resource management system.
With the economic reform in the PRC, a new management system should be established by improving or reforming existing system. The sectoral management practices should be incorporated into the integrated management system at both central and local level. Laws and regulations, and their enforcement measures should be established to provide a legal base for integrated management practices. Gradually complete the marine resource management legal systems and remain abreast of international marine resource management system.

2. Enhance living marine resource management.
Through rationalization of fish catches with mariculture, improve the overall development of the marine fishery. Continue to increase marine fishery production. Direct the fishery industry towards high quality, high efficiency and low energy.
consumption methods. Realize the sustainable exploitation and protection of the marine fishery resources.

3. Protect marine ecosystem.
Establish macro marine ecosystem monitoring and protection systems and marine forecasting system. Strictly control the discharge of land-based pollutants and marine pollution. Prevent, reduce and control degradation and long term adverse effects of marine ecosystems. Maintain the ecological balance of the sea and sustainable use of marine resources. Establish a rationally distributed natural sanctuary network. Take part in the international network of marine natural sanctuaries.

4. Sustainable capacity-building.
Improve the living standards in coastal areas and maintain marine bio-diversity. Development of coastal zones and islands should include in the development of sustainable capacity-building to cope with various kinds of adverse marine environmental event. At the same time minimize the adverse impacts on marine and coastal resources so as to realize sustainable development of coastal zone and islands. Conduct resource surveys in the ocean and arctic areas, exploit and protect resources in the high sea.

The favorable geographical and natural resources provided a basic condition for economic development in the coastal area. The national economic policy and development objectives required Jiangsu Province to develop its economy by improving its marine industry. Therefore, Jiangsu Province proposed a coastal marine industry development program, which will be briefly introduced in chapter 3.

1 The second Euro-Asia Continental Bridge is a proposed railway transportation system which starts from Lianyungang in the Jiangsu Province. It will pass through 6 provinces of the PRC. These are Jiangsu, Anhui, Henan, Shanxi, Ganshuo, Xinjian. It will also pass through about 30 countries on the way to Rotterdam, The Netherlands. Its total length will be about 10,900 km, with 4,131 km within the PRC.

2 Sea water quality ((GB309)-821) is a comprehensive water quality indicator which combines suspended mater, Ph, oil content, COD, BOD, nutrients and heavy metal content.

3 A socialist market economy system is composed mainly by the state-owned economic component, with the coexistence of other economic components. Market function will play the fundamental role in resource allocation. The function of central government is macro-adjustment of the market system.
3. PROPOSED DEVELOPMENT PROJECT IN THE COASTAL AREA OF JIANGSU PROVINCE

Chapter 2 introduced the geographical, economic and environmental conditions in the coastal area of Jiangsu Province. In order to make marine industries contribute more to the provincial economic development, a marine industry development project was proposed. This chapter will describe briefly the overall development objective and the development objectives of each sector.

3.1 Overall Development Objective

After the completion of the 1985 investigation, the Jiangsu Province Scientific Committee and the East Sea Branch of SOA worked together, analyzed the characteristics of the Jiangsu coast, and made a coastal development plan. This plan are presented in Figure 7 (Marine Development Plan of Jiangsu Province, 1993).

The objectives before the year 2000 are to form a firm base for further development through a generally improving marine industrial structure and management system. Proposed annual increase rate of marine industry within this period is 15%. In order to achieve goal, several measures are proposed, including:

- Maintain the development of traditional sectors while improving the development of new and important sectors such as marine transportation and mariculture. Rationalize the structure of marine industry by increasing the value of new sectors.
- Strength environmental and resource survey, prepare for the development of mariculture and offshore oil and gas exploitation.
Figure 7: Marine Development Plan of Jiangsu Province
• Stipulate coastal zone management legislation (including implementation details), establish integrated marine management systems and institutions; establish an environment monitoring and natural disaster forecasting system at provincial level.

The first 20 years of the next century will be the critical period for the economic development of the PRC. The primary prospects for the year 2020 are:

• The marine industry production value will reach 80 billion RMB Yuan if the annual increasing rate after 2000 is 10%. The contribution of marine industry to the provincial GDP will reach 4.18% in 2020.
• Develop multimodal transportation systems centered around the large and middle sized ports. Increase the handling capacity of coastal ports to 290 million tons.
• Continue to optimize marine industrial structure. The rates of fishing to mariculture will be adjusted from 8:1 in 1990, 3:1 in 1995, to 1:1.25 in 2000 and 1:4 in 2020. Salt processing and salt chemical industries will be developed through technical advancement.
• Coastal ports is expected to bring about the development of a number of large scale heavy industries to match the existing light textile industries, food processing facilities, and township enterprises. These will greatly change the undeveloped economy and form a new economic belt in the coastal area.

3.2 Port and Maritime Transportation Development

3.2.1 Before the Year 2000

1. Focus will be on the extension of Lianyungang port and Nantong port.
• Lianyungang port: Plans are to built more than 28 deep water berths (present water depth: 24m) and increase the annual handling capacity to 10.1 million tons.
• Nantong port: Plans are to finish one 25 thousand ton container pier, two 25 thousand ton general cargo piers and a 25 thousand ton bulk cargo piers; increase
two 25 thousand ton berths; increase the handling capacity of the port to 30 million tons per year.
2. Research into the feasibility of building new ports in other areas will be speed up.

3.2.2 Between the Years 2000 and 2020

The form of the second Euro-Asia Continental Bridge, planning to use Lianyungang as its east end, will greatly improve the strategic position of Lianyungang for economic development.
1. The East end port system of the Euro-Asia Continental Bridge centered at Lianyungang will, by the year 2020, be supported by more than 100 berths with 10 thousand ton capacity. The total length of these berths will be over 20 km, and the land area will be more than 11 km$^2$. With the development of port system, a steel factory with an annual production capacity of more than 3 million tons will also be built here.
2. The construction of a tidal channel port group to include Liusi port, Yangkou port, Xiyangwan port will be speed up.

3.2.3 Maritime Transportation

1. The annual maritime transportation capacity of all coastal and riverside ports will increase from 40 million tons in 1990 to 110 million tons in 2000 and 290 million tons in 2020.
2. Domestic and international tramp and liner services will be opened.

3.3 Fishing and Mariculture

Expected increasing from fishing and mariculture from 1995 to 2020 are given in Figure 8.

3.3.1 Fishing

Measures planned to achieve these objectives include: stabilizing and reducing near-shore
fishing to conserve near-shore fishery resources; increasing open sea and high sea fishing by build new fishing vessels with high horse power and-equipped with new fishing gear; providing matching facilities such as the build of new fishing ports or berths and storage facilities.

3.3.2 Mariculture

Jiangsu Province has planned to greatly increase its mariculture industry, to take advantage of its abundant mud flat resources. Species proposed for mariculture include prawns, shellfish, kelp, laver and other valuable sea creatures. The expected increases in production amount and mariculture area are shown in Table 10.

<table>
<thead>
<tr>
<th>Year</th>
<th>A (10^4 acres)</th>
<th>B (10^4 tons)</th>
<th>A (10^4 acres)</th>
<th>B (10^4 tons)</th>
<th>A (10^4 acres)</th>
<th>B (10^4 tons)</th>
<th>A (10^4 acres)</th>
<th>B (10^4 tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>154.8</td>
<td>8.0</td>
<td>834.5</td>
<td>21.0</td>
<td>12.5</td>
<td>1.0</td>
<td>0.1</td>
<td>0.2</td>
</tr>
<tr>
<td>1995</td>
<td>200.0</td>
<td>20.0</td>
<td>1430.0</td>
<td>99.0</td>
<td>50.0</td>
<td>4.0</td>
<td>10.0</td>
<td>25.0</td>
</tr>
<tr>
<td>2000</td>
<td>200.0</td>
<td>30.0</td>
<td>2280.0</td>
<td>70.0</td>
<td>10.0</td>
<td>10.0</td>
<td>20.0</td>
<td>50.0</td>
</tr>
</tbody>
</table>

Note: A=Area (10^4 acres); B=Amount (10^4 tons)

Before the year 2000, the focus of mariculture is on the coastal wetland and near-shore areas with experiments in the development of marine pasture area. After 2000, the scale of marine pasture areas is expected to be greatly increased based on the results of the previous

3.4 Salt Industry

Based on the planned extension of salt production fields and the progress of production technology, the expected annual raw salt production shall increase at a rate of 6% from 1996 to 2000 and 1% from 2001 to 2020 (Table 11). The slow down in the rates of increase speed is due to the limitation of the area which could be expanded into salt fields.

<table>
<thead>
<tr>
<th>Year</th>
<th>1995</th>
<th>2000</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total sea salt production (10^4 t/y)</td>
<td>3.6</td>
<td>4.4</td>
<td>6</td>
</tr>
<tr>
<td>Raw salt production (10^4 t/y)</td>
<td>3</td>
<td>4</td>
<td>5.5</td>
</tr>
<tr>
<td>Production value (RMB 10^4 Yuan/y)</td>
<td>435</td>
<td>580</td>
<td>800</td>
</tr>
<tr>
<td>Percentage of grade A salt</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>NaCl Content</td>
<td>95%</td>
<td>95.5%</td>
<td>96%</td>
</tr>
</tbody>
</table>

Source: Coastal zone Development Plan, 1993
Following measures are suggested to achieve this objective.

1. Complete the unfinished salt field technical reform project; increase production ability by 1 million tons.
2. Adapt 69.5 km² wetland outside of Sheyang salt field into salt field, make 219 new production units, increase production ability to 200 thousand tons per year.
3. Extend Nantong salt field by adding 1884 hectares more salt field; increase production ability by 100 thousand tons per year.
4. Through technological improvements augment the county and township salt fields, production capability to 200 thousand tons per year.
5. Increase the production capability of Qingkou salt field by 100 thousand tons per year through technological improvements and the introducing of high quality sea water.
6. Increase exploration and exploitation of ground salt water in the coastal area to increase salt production capability.

Another part of salt industry is the salt chemical extraction, which includes multiple uses of bittern and alkali production. Total production value is expected to increase from 600 million RMB Yuan in 1995 to 750 million RMB Yuan in 2000. After 2000, plans are to develop new technologies for the alkali chloride industry and for extracting chemicals from sea water. To achieve this goal, following measures were suggested.

1. Technically reform and develop multiple uses of bittern from the Huanghai Chemical Plant, produce new products like potassium, bromine, magnesium and medical products.
2. Produce 1500 tons of sodium metal, and 2000 tons of liquefied chloride for the Dongshan Electro-Chemical Plant.
3. Establish a new factory in Binghai County to produce 500 tons of high purity magnesium sand.
4. Extend the Lianyungang Alkali Factory.
5. Establish a potassium factory with production capacity of 10 thousand tons per year.
3.5 Coastal Tourism Development

The starting point for the tourist industry in the coastal area of Jiangsu Province is relatively low, so the potential for development is great. Before 2000, the annual increase in the rate of tourists and tourism incomes in three coastal municipalities should reach 15%; after 2000, this rate of increase should remain high.

- Tourism income: If there are 60 thousands foreign tourists and 8 millions domestic tourists in 2000, then tourism incomes will be USD $20 million and RMB 200 million Yuan.
- High grade hotels: A total of 15 high grade hotels are to be provided: 7 in Lianyungang, 2 in Yanchen, and 6 in Nantong.
- Tourist service personnel training: Total service personnel in the tourism sector is projected to be over 5000; all of them will need to pass through a training program and obtain the qualifications for their job.

Apart from improving the quality and facilities for existing tourist sites, the development of the tourist resources in the coastal area will take advantage of its marine tourism resources, building up a number of tourism sites centered at the coast.

- Lianyungang: Scenery construction is to be completed at Huaguoshan and Kongwangshan, at the same time established as a coastal tourist area, making it a major marine tourist, entertainment, recuperation and international meeting center. Major development projects include: coastal swimming area and international meeting center at Dongxiliandao, sea tourist facilities at Qinshandao.
- Yanchen: The restoration of the historical sites will be emphasized. In the coastal area, the establishment of tourist sites will centered at two natural sanctuaries, to merge natural environmental protection with tourist activities.
- Nantong: Apart from the important tourist sites construction at Langshan and Haohe, it is planned to establish some tourist sites with typical coastal scenery, with recuperation function and exhibition of local culture and customs at some of the coast areas of Rudong and Qidong.
3.6 Coastal Land Reclamation

From Table 5 in chapter two, it can be seen that there are vast coastal wetland areas above high tidal mark, which is not reclaimed. This project plans to reclaim this area for other use. The sustainability of this land reclamation will be analyzed in the next chapter. The plan for land reclamation are:

- 2001-2020: Reclaim all the wetland above the high tidal mark. Plans are to reclaim 1.02 million acres of wetland to generate 730 thousand acres of farm land.

3.7 Offshore Oil and Gas Exploitation

Offshore oil and gas exploitation is the most promising large scale marine industry in Jiangsu Province. It is expected to make the South Yellow Sea Oil & Gas Field the offshore oil production base of Jiangsu Province by strengthening the exploration activity, researching and manufacturing oil exploitation equipment for middle and small scale offshore oil and gas fields.

3.8 Marine High-tech Industry Development

The objectives of the development of marine high technology is to add new sectors to the marine industry. Plans are to form marine high-tech industry in four areas, including the development of new medicine, development of marine bio-technology, development of marine engineering technology, upgrading instruments used in marine development, and the development of the sea water use technology.

The foregoing has been a general introduction to the coastal development program of Jiangsu Province. However, there are still some problems which may impede the success of this program, or will affect the sustainability of the development program if not solved. It is necessary to point out and analyze these problems and this will be done in the following chapter.
4. EXISTING PROBLEMS IN THE PROPOSED COASTAL ECONOMIC DEVELOPMENT PROGRAM OF JIANGSU PROVINCE

Realization of the economic development program in the coastal area of Jiangsu Province will undoubtedly promote the success of the national marine economic development plans and improve the national economy of the whole country. However, all development will have to be derived from the present economic condition, the natural environment and resource base. Future development potential is also affected by existing management mechanisms, economic system and public opinion. In order to attain rapid development and at the same time maintain a sustainable basis for future development, existing problems in the socio-economic field, as well as the management policy and mechanisms, governing environmental issues must be carefully examined. Further, existing problems related to the requirements of the socialist market economy development strategy should be considered.

4.1 Socio-economic Factors

Present socio-economic conditions in the coastal area of Jiangsu Province are a major factor which will impede the further development. These include the low start point for economic development, insufficient infrastructure, inadequate energy supply, lack of funds and qualified personnel, and ill-structured marine industry.

4.1.1 Low Start Point for Economic Development

Comparatively speaking, the economic development level in most of the coastal area in the PRC is higher than that of the inland areas. But the coastal area of Jiangsu Province, especially the central part, is the low valley in the landscape of economic development for the whole province. It forms a "fault" within the coastal economic belt of the whole country.
In the past, this area suffered in poverty with frequent natural disasters, unstable agriculture, undeveloped industry and inconvenient transportation. Although the agricultural and industrial production in this area have improved a lot through the more than 40 years of construction after the establishment of PRC, it is still far below the whole provincial level, especially in the southern part of the province. In 1990, the Total Agricultural and Industrial Production Value (TAIPV) of the three coastal municipalities was only 49.28 billion RMB Yuan, which only accounts for 20% of the TAIPV of the whole province (refer to Figure 9). The TAIPV of Lianyungang municipality is only 5.59 billion RMB Yuan, which accounts for only 40% of the TAIPV of Wuxi Municipality (one of the municipalities in South part of Jiangsu Province). In terms of TAIPV per capita, the three coastal municipalities was only 2609.9 RMB Yuan, 52.4% of the whole province (Figure 10). A comparison between these three coastal municipalities and that of three other inland municipalities in the southern part of Jiangsu Province is shown in Figure 11. It shows that the economic development in the coastal municipalities is far below that of the inland ones. This means the natural advantages of coastal area have not been fully employed. There are even 5 counties in Yanchen and Lianyungang Municipalities which still live on government subsidies. Their ability to extend production is very limited. Therefore, it becomes obvious that the present inadequate economic development level will act as an impediment to further development.
4.1.2 Insufficient Infrastructure Facilities

Because of the persistent poverty in the coastal area of Jiangsu Province, there are great infrastructure insufficiencies which will further impede development. Along more than 400 km of coastline, there is no single railway in the North-South direction which could link the three coastal municipalities together. The only railway lies in the East-West direction which cannot linked with other coastal municipalities. The surface condition of the highway that passes through the 3 coastal municipalities is not fit for high speed transportation, and nearly half of the approximately 200 bridges along this road are of poor quality. This region also lacks main inland waterways in North-South direction. The condition of the existing canal is not good. It does not effectively connect the river, sea and lake systems. Most of the maritime transportation cargoes are in transit, and only a very low percent of them are started or terminated within this area. The amount of air transportation is small. Its facilities are not completed and liner services are very few. Communication facilities are not developed. The capacity of telephone service is limited with only a few long distance lines. Direct communication with abroad is still impossible in quite a few counties. Contacting and exchanging information with foreign countries is not convenient. All of these insufficiencies will hinder the economic development of the coastal area of Jiangsu Province.
4.1.3 Inadequate Energy Supply

The energy supply in the coastal area of Jiangsu Province is not adequate. There are no coal resources in this area. Oil and gas resources are just under exploration. At present, only a few oil wells have been drilled and are producing. All the coal and oil are bought from other areas. The energy available cannot meet the needs of construction and production due to shortage of funds and transportation problems.

Electric power supply is also insufficient. The coastal area is located at the end of the Eastern China and Northern Jiangsu electric power supply network. The maximum output of the electric power plant within this area is only 1.74 million Kwh. However, this can rarely reach the maximum production capacity because of insufficient coal supply. The percentage of total electric power consumption and electric consumption per capita of the coastal area compared with the whole Province are given in Figure 12. Presently with a new electric power plant being put on line, the shortage of electric power supply has eased; but it still cannot meet the needs of proposed economic development for the coastal area.

4.1.4 Lack of Funds and Qualified Personnel

The amount of capital required for coastal development is very high. Because of the limitation of both national and provincial funding, there is very little investment in the construction and agriculture infrastructure in Jiangsu Province. The financing ability from local sources is rather weak. So, shortage of funding is a prominent difficulty and problem facing the economic development of this region.

The educational level of the people in the coastal area is rather low. One quarter to one third of the population is illiterate. Population in these three coastal
municipalities accounts for 28% of the total population of the whole province, but the number of the technical personnel in this area represents only 16% of those in the whole province. This is 12% lower than the provincial average. The shortage of qualified personnel will be one of the main factors which hamper the economic development of coastal area.

4.1.5 Ill-structured Marine Industry

Up to now, the major marine industry of Jiangsu Province has been the marine fishery. In 1990, the production value of traditional sectors (include fishery and salt industry) represented 78% of the marine industry total. Newly formed industries like sea transportation and coastal tourism account for only 21% and 1% respectively (refer to Figure 13). Other marine industries are either not yet started or just begin. Maritime transportation and port activities have not served as a basis to support regional economic development. Value added processing activities of raw resources are very low in traditional sectors of the fisheries and salt production industries. In order to improve the marine industries in Jiangsu Province both in quality and quantity, it is necessary to fundamentally change the traditional marine industrial structure, develop the important sectors, and increasing the value added rate for natural resources.

4.2 Management Mechanisms and Policy

Existing management mechanism and policy are another factor which will cause problems in the coastal development process of Jiangsu Province. These problems
mainly include lack of integrated management mechanisms and policies, and a lack of coordination between development and protection.

4.2.1 Lack of Integrated Management Mechanism

The present management system is basically sectoral management. An effective, unified management mechanism has not yet formed for the coastal development of Jiangsu Province. Increasing conflicts and competition for resources/space are prevailing among different localities, departments, and sectors. For example, the needs for expansion of the port conflicts with the development of mariculture, agriculture and salt industries over the use of coastal land. These developments also conflicts with other coastal industries and fisheries through the environmental pollution. The Marine Management Bureau of the Provincial Scientific Committee is established for the integrated management of all these development activities. However, since it was just established, the management responsibilities and working procedures have not yet been clarified, and the necessary management strategies have not been developed. Therefore, these development activities are still managed by sectoral institutions. These institutions include: the Beach and Wetland Management Bureau, the Fishery Administration, the Forest and Agriculture Department, the Land Use Bureau, the Water Resource Utilization Bureau, the Transportation Department, the Environmental Protection Department, the Salt Business Bureau, and the Financial Department. There are also different resource users engaged in the development and utilization of coastal resources, such as private and public fishing teams, and mariculture ponds developers. Apart from the activities for sectoral development and construction, some administrative units also conduct development activities with the purpose of establishing their own food supply base or for their own benefits. There are no unified plan for these activities. Therefore, it has caused chaos with multiple leadership, each going its own way, developing at will, with no consideration for the consequences. Serious problems such as blind development,
duplicate construction, environmental damage, and waste of human, material and financial resources exist.

4.2.2 Lack of Integrated Policy

Legislation is the fundamental basis for the integrated coastal zone development management. National legislation for coastal zone management does not exist. Provincial regulations and implementation details have just been up proved, but have not been enforced. Present management policies are still sectoral based. Although these laws and regulations also provide, in principle, for a sectoral agency to ensure that the permitted projects within its own sector minimize the adverse impacts on other uses, experience shows that an agency's attitude tends to be dominated by its sectoral interest when it is conflicting with other sectors. Besides, level of public participation in sectoral management is very low. Local people often know nothing about what is going on unless they are in the particular business. Further, with the national economic reform, the intense economic activities will have unprecedented demand for natural resources. However, compatible economic policies regarding marine resource use are far from mature at both the national and provincial level. All these factors will affect the progress of the coastal development project of Jiangsu Province.

4.2.3 Lack of Co-ordination Between Development and Environment Protection

There are conflicts between development and environment protection in the coastal area of Jiangsu Province. Take the fisheries for example, in the past, the Liusi Fishing Field was abundant with economic finfish species like different kinds of yellow croakers and silvery pomfret. These resources are steadily decreasing or have even depleted in some areas due to over-exploitation in the absence of protective measures. There are no more harvest season for large yellow croaker, and the production of silvery pomfret has decreased significantly. The proportion of small
sized fish and juveniles has increased (94’ Jiangsu marine development and IOM symposium). The depletion of near-shore fish resources have been worsened by the increasing number of small individual fishing boats and fishing nets with small net sizes. Some coastal protective constructions have caused serious damage to the habitats for anadromous fish and crab species. There are no longer crab fry in abundance, and eel fry have shown a similar tendency. The dominant beach species, clams, in the coastal area of Jiangsu Province has decreased noticeably in recent years because of over exploitation for export, and inadequate protection measures.

The coastal area of Jiangsu Province was not heavily polluted and the environmental quality was quite good in the past. With increasing industrial waste discharges, agriculture pesticides and fertilizer runoff, and waste water drainage from shrimp cultivation ponds into the sea, together with the increase of oil pollution from small fishing vessels, the sea water quality is getting worse (refer to chapter two for definition of water quality). The contamination levels in sediments and the frequency of red-tide occurrences are increasing. These indirectly impact the interests of the fisheries and mariculture because of the negative effects of environmental pollution. At presently, some chemical factories have transferred from inland areas to the coastal area or newly established there. Waste treatment facilities have not been established. This will intensify existing conflicts and cause further environmental threats to the coastal area.

The land reclamation plan in the proposed coastal development project for Jiangsu Province will also cause conflicts between development and protection. The main source for land reclamation is in the coastal wetland above the high tide mark. However, coastal wetland represent a very important food source for the marine ecosystem. From table 5 in chapter 2, the total unreclaimed coastal wetland above high tide mark is 1.14 million acres. This project proposed to reclaim 350 thousand acres between the year 1996 and 2000 and 1.02 million acres between 2001 and
2020. This means that not only the total wetland area above the high tidal mark but also some of the areas of the intertidal zone will be reclaimed (Figure 14). This will seriously affect the basis for natural resource conservation.

**Figure 14: Available wetland resources and proposed land reclamation plan**

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### 4.3 Environmental Problems

Environmental pollution is nearly always one of the indirect conflicts caused by the impact of one sector’s activities upon another sector. As mentioned in chapter two, the general level of environmental pollution in this area is not very serious except at some Estuaries, and in certain port and harbor areas where the water quality has dropped below the acceptable standard. However, with the continuation of the proposed development, together with the potential global environmental changes, environmental problems will become an important factor to be considered for the sustainable development of this coastal area. These problems include the general trends of environmental pollution, ground water problems, and the effects of natural disasters.

#### 4.3.1 Environmental Pollution

As previously estimated, the Total Industrial Production Value of the three coastal municipalities will arrive at 103.8 billion RMB Yuan at the year 2000 and 415.3 billion RMB Yuan by 2020, while the total population will reach 20.87 million at 2000 and 22.96 million by 2020. Based on this estimation and considering the technological progress, pollutants levels are projected.

- Industrial waste discharges.
Apart from the planned marine industry developments, there are also other kinds of industries like textile industries and chemical plants, that will establish at the coastal area. Therefore, industrial waste discharges will increase along with the economic development. Under the influence of the largest economic and commercial center of the PRC—Shanghai, the industrial development in Nantong Municipality will likely move at a pace much faster than that of the other municipalities. Therefore, expected industrial waste discharges will also be higher than for the other coastal cities. Industrial waste discharge are predicted in Figure 15 (94’ Jiangsu marine development and IOM symposium). Among the three coastal municipalities, Nantong will account for the largest contribution, reaching 53.98% of the total pollutants in 2000 and 44.48% by 2020.

Figure 15: Prediction of Industrial Wastes and COD Wastes Discharges

<table>
<thead>
<tr>
<th>Industrial Waste Discharges</th>
<th>COD Wastes</th>
</tr>
</thead>
<tbody>
<tr>
<td>(millions of tons)</td>
<td>(thousands of tons)</td>
</tr>
<tr>
<td>2000</td>
<td>2020</td>
</tr>
<tr>
<td>□ Total</td>
<td>□ Nantong</td>
</tr>
</tbody>
</table>

This estimation does not include the pollutants from inland areas and other provinces.

- Municipal Sewage Discharge.

<table>
<thead>
<tr>
<th>Table 12: Prediction of Municipal Sewage Discharges</th>
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</thead>
<tbody>
<tr>
<td>Based on the present sewage treatment ability, the total amount of treated</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>Municipal sewage (10^3 tonnes)</td>
</tr>
<tr>
<td>COD wastes (10^3 tonnes)</td>
</tr>
<tr>
<td>BOD wastes (10^3 tonnes)</td>
</tr>
<tr>
<td>Nutrients (10^3 tonnes)</td>
</tr>
</tbody>
</table>
municipal sewage discharges are predicted in Table 12. This table shows that the amount of municipal discharges will double between 2000 and 2020. Nantong Municipality is again the largest among all three municipalities of the coastal area.

- Tendency of the sea water quality in near shore areas.

Planned economic development and population growth, together with estimated increases of industrial and municipal waste discharges will greatly increase the total pollutant load within the near-shore region. A review of the water quality of the near shore region indicates that the pollution level increased during the first 5 year of the 1980's, slowing down in the next 5 years due to increased waste treatment and environment controls. The present water quality in the near shore area is basically of high quality according to the national water quality standard described in chapter two. High pollution levels only occur at some local areas such as estuaries and harbors, and especially in the coastal area near Lianyungang city. It is foreseeable that the overall sea water quality will remain good until the year 2000, but local pollution levels will likely increase. However, by the year 2020, the overall water quality will likely have decrease, and pollution will become a serious problem in the near shore region if pollution control measures are not increased and effective sewage treatment facilities not established.

4.3.2 Ground Water

The ground water is an important resource both for industrial development, agriculture activities and human consumption. Present problems in the coastal area related to the increase of ground water depth, earth subsidence and ground water quality deterioration.

- Over exploitation of ground water.
At presently, ground water resources are facing depletion. The original ground water depth was less than 1 meter in the coastal area during the 1960's and the 1970's. However, this depth increased significantly due to the over exploitation from the 1980's. As a result, the daily ground water production in a well have decreased from 100-120 m$^3$ in the 1960's to 30-50 m$^3$ now (94' Jiangsu marine development and IOM symposium). This project still proposed to use ground salt water in the coastal area to increase salt production ability. It will exacerbate the problem of ground water depletion.

- **Earth subsidence.**
  
  As the consequence of over exploitation of ground water, the water contents in the ground decreased, and thus has resulted in earth subsidence. For example, the extent of one subsidence centered at Dafeng County during the 1980's was 530 mm, and the area of subsidence covered nearly 11 km$^2$ (94' Jiangsu marine development and IOM symposium). Earth subsidence was present wherever concentrated ground water exploitation occurred. It will exacerbate the effects of future sea level rise on the coastal environment.

- **Deterioration of ground water quality.**
  
  Regional increasing of ground water depth increases the mixing of different vertical water layers and the lateral supply of ground water. It has caused salt water intrusion into this complex coastal area. For example, in the 1960's the mineral content in the ground water of Rudong County was only 0.65 grams per liter, but it reached 1.28 grams per liter in the 1980's (94' Jiangsu marine development and IOM symposium), having an adverse effect on ground water quality.

### 4.3.3 Natural Disasters

The main natural disasters in the coastal area of Jiangsu Provinces include tropical cyclones, coastal erosion, sea level rise.

- **Tropical cyclones.**
Tropical cyclones have high potential to damage property because of their sudden appearance and accompanying events such as high tides, large swells, storm surges and floods, and resulting heavy coastline erosion. Within the most recent 40 years, there have been an average 3.5 tropical cyclones per year affecting the coastal area of Jiangsu Province. The highest frequency of 8 tropical cyclones occurred in 1985. Jiangsu is one of the provinces that has suffered the most serious effects of tropical cyclones in the PRC. The maximum surge of sea water caused by tropical cyclones in the coastal area of Jiangsu Province reached 3.1 meters in Xiaoyangkou in 1984, the largest in the most recent 30 years (94’ Jiangsu marine development and IOM symposium). The tropical cyclones pose serious threats, especially to coastal areas because the coastal elevation is generally less than one meter above sea level. In a single large flood in 1991, direct damage was estimated as high as 25 billion RMB Yuan.

- Coastal erosion.

Coastline erosion also poses serious threat for some area. There is totally 155 km of erosion prone coastline in Jiangsu Province along the old Yellow River Delta and the coastline of Liusi. The old Yellow River Delta is the most seriously eroded coastline in the PRC. The total erosion of this coastline has been 18 km land-ward after the Yellow River changed Northward in the year 1855. This averages out to be 147 meters per year.

- Sea level rise.

Global warming and sea level rise have attracted great concern all over the world. In 1993 the Geological Department of the Science Academy of the PRC organized an investigation of the areas sensitive to future sea level rise. These included the Pearl River delta region, the Changjiang delta region, the Yellow River delta region and the old Yellow River delta region. This investigation revealed the extent of sea level rise:

<table>
<thead>
<tr>
<th>Region</th>
<th>Estimated Relative Sea Level Rise (cm)</th>
</tr>
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<tbody>
<tr>
<td>Old Yellow River Delta Region</td>
<td>70-100</td>
</tr>
<tr>
<td>Changjiang Delta Region</td>
<td>50-70</td>
</tr>
<tr>
<td>Pearl River Delta Region</td>
<td>40-60</td>
</tr>
</tbody>
</table>

Table 13: Estimated Relative Sea Level Rise in 3 Sensitive Regions
(relative to the regional earth crust movements) in the three different regions (Table 13) if the global sea level rise in the year 2050 were 20 to 30 cm and earth subsidence was strictly under control. The sea level rise in the coastal area of Jiangsu Province would be similar to that of Shanghai. Sea level rise would cause various kinds of coastal disasters, inundate vast areas of tidal land and wetland, damage various kinds of coastal constructions, and produce a series of adverse impacts on the social and economic development of the coastal area. For the coastal area of Jiangsu Province, the major possible effects include:

a) exacerbate the inundation of wetland and erosion of coastline.
There are about 7 million acres of wetland along the coastal area of Jiangsu Province, 1.2 million of these are above the high tidal mark and reclaimable. The future sea level rise will first inundate these wetlands which have no protective constructions around it. Based on the estimation made by Nanjing Geographical Institute (94' Jiangsu marine development and IOM symposium), if the sea level rises 50 cm, 10% of the provincial wetland and 1/3 of the wetland above the high tidal line would be lost in the coastal area of Jiangsu Province. That would cause encroachment upon the wetland resources.
Sea level rise will also increase the water depth, strengthen the coastal wave and aggravate the effect of storms. It will exacerbate the erosion of the coastline at the old Yellow River Estuary and Liusi. The 700 km of sea wall along the coast would also be threatened because most of them are made of earth which can be easily destroyed.

b) Make the drainage more difficult in low-lying land.
The two low-lying land areas - Taihu region and the Lixia river system area - are two of the most important areas for the economic development of the whole province. Flooding and high water tables are always the two factors limiting the economic development of these two areas. The rise of the sea level will make it even worse - drainage will be more difficult due to the rise of tidal levels, and increase the losses through inundation.

c) Intrusion of salty water.
Sea water intrusion would have two effects on the coastal area. First, it would permeate into the fresh ground water system, especially where the ground water was heavily exploited (such as in Dafeng and Dongtai County). It would pollute the ground water resources and make the coastal land non arable, changing the land’s properties. This phenomenon has already been observed in the coastal area of Laizhou Harbor and Loading Peninsula (in Shandong Province) (94' Jiangsu marine development and IOM symposium). Second, sea water will travel further up the estuary. It will increase the salinity of the down stream river section, thus affecting the utilization of water for farming, industry and living purposes.

4.4 Requirements of Socialist Market Economy Development Strategy

Since 1978, the economic system of the PRC experienced a fundamental reform from the highly central planned economic system to the socialist market economic system. This brought about remarkable economic achievements. From 1980 to 1990, the mean annual increasing rates of GDP and domestic income reached 9.0% and 8.7% respectively. With the transformation to the socialist market economy, under the macro adjustment of the government, the market value system has the potential to play an increasingly important role in regulating and normalizing the attitude and behavior towards the environment. The relationship among exploitation of resources, environment protection and economic development should be harmonized in order to achieve rapid development and at the same time maintain a sustainable resource and environmental base.

There are three major characteristics for the socialist market economy system. First, there are multiple economic components (private, joint venture, state owned) coexisting in the same system. The presence of only one component has ended. The new economic components have invigorated the market, but this calls for equal treatment among the different components. This equal treatment includes an equal resource allocation policy. Second, the operation mechanism of state owned
enterprises, which is still the main body of the economic system, will adopt the management system of corporate enterprises. The manager responsible for the operation has the right to decide what to do and how to do it like other enterprises. Thus the vigor of the state owned enterprises could be activated. Third, the function of government in the nation's economic affair will also be changed. The governmental control over resource allocation will only be made through macro controls of the market system in order to achieve maximum and optimum use of the natural resources and maintain a sustainable environment.

However, the present market economic system in China is still far from mature. A complete set of economic policies regarding resource management and environmental protection have not been formulated. The deficiencies include a lack of integrated economic analysis measures for project decision making, and a lack of sustainable economic control mechanisms.

4.4.1 Lack of Integrated Economic Analysis

Presently the integrated economic analysis method to evaluate true economy growth in both Jiangsu Province and the whole country is not complete. For example, the consumption of natural resources and associated environmental costs have not been incorporated in the national or provincial accounting system. This is partly caused by the past monopoly of the central planned economic system. Since at that time all the businesses were operated by the central or local government, it was not necessary to put the cost of the state owned properties into monetary terms. However, with the progress of economic reform, economic components, other than the state owned, will play an increasingly important role in economic development activities. The operation mechanism of the previously state owned enterprises will also be changed. The manager will responsible for the business operation. It would be beneficial to price the state owned resources, such as land, beaches and marine resources, and to include them in the cost of production. However, it is not so easy to do this with all of the natural resources, and much work remains to be done to achieve this end.
4.4.2 Inadequate Sustainable Economic Mechanism

Due to the effects of the past central planned economy, the economic mechanisms for environment control and resource management are not developed. These can be generalized as follows:

- Lack of mechanisms which could be used to assist in environmental protection enforcement and resource management. For example, the discharge fees are fixed with the amount of waste discharged. It does not increase with the time, nor does it vary with different types of waste discharged. Therefore, this policy does not force polluters to solve their pollution problem in certain time, or to reduce the contents of harmful substances in their wastes.

- Lack of mechanisms to build up the economic capability for environmental management, such as establishing environmental protection fund, coastal natural resource conservation and compensation funds.

- Lack of mechanisms for proactively preventing coastal environmental deterioration and resource depletion. Such mechanisms include the establishment of measures for economic compensation of natural resource consumption and determining the environmental impacts at the very beginning of development project. For example, there are no compensations for the losses of the coastal habitats due to the reclamation of intertidal wetlands.

All of these are not compatible with the national economic reform and the national sustainable development strategy.

Therefore, successful completion of the coastal development project means that it is necessary to set up an integrated coastal zone management system for such coastal development programs. This will be addressed in the next chapter.
5. INTEGRATED MANAGEMENT STRATEGY FOR ECONOMIC DEVELOPMENT IN THE COASTAL AREA OF JIANGSU PROVINCE

Form the present economic condition in the coastal area of Jiangsu Province, it is evident that fast and stable economic development should be the first priority. It is the only way to improve the living standards of the local people, to increase economic capability for further development, to build-up capacity to minimize the effects of natural disasters, and to increase the ability to deal with environmental problems. Proposed development programs and expected population growth will have much higher demands on natural resources and cause more serious environmental stress. Therefore, maintain a sustainable environmental and resource bases will be the critical issue for continuing development. Further, existing problems in the coastal area of Jiangsu Province will make it even harder to coordinate economic development with environment protection and resource uses. To address these issues will require a comprehensive and efficient ICZM system.

One of the responsibilities of the State Oceanic Administration (SOA) is Coastal Development Planning and Integrated Coastal Zone Management. The East Sea Branch of SOA assumes the responsibility of regional (the coastal area of the Yellow Sea and Eastern China Sea) ICZM. Since ICZM is relatively new in the PRC, there are no ready-made patterns to follow, and no existing management mechanisms to employ. Besides, with the new situation of economic reform and market economy, new economic methods for environmental and resource management need to be developed as an integral part of ICZM. Therefore, setting up a comprehensive ICZM is very important for keeping the coastal development activities on the right track.
This presents a challenge to all people involved in development and management activities.

Based on the description and analysis in the previous chapter, it is obvious that a complete and efficient ICZM strategy has not been formed for the proposed development program. Based on the knowledge acquired at WMU and the experience of ICZM practices in other countries, this paper will suggest some important and efficient management strategies which could be employed in the management of the coastal development program for Jiangsu Province.

5.1 Purpose of ICZM

Throughout the evolution of sustainable development concepts, emphasis has been laid on the ICZM strategy, and this has produced a number of results. For example, Charles N. Ehler and Blair T. Bower (1995) explained the framework of ICZM based on a series of societal demands, products and services that provided through human activities with the coastal ecosystem. Adalberto Vallega (1992) proposed a management system based on the analysis of coastal use structure. These two research of ICZM strategy are focused on the classification of interactions between human activities environment and organized management over these interactions.

However, ICZM in the Jiangsu coast should have special characters.

- **Coordination and harmonization.** Management systems for different sectors have already existed for a long time. Radical change of the existing system could only cause total disorder to the development activities, and it needs much more efforts and time than necessary. Besides, not all sectoral management activities are problematic and hence need to be changed. There are also some valuable management experience from previous sectoral management practices which could be used in ICZM.

- **Emphasize on the overall balance between development and protection.** ICZM in this area should monitor the overall development activities, solve conflicts among
different sectors, improve the efficiency of natural resources, and reduce environmental costs.

- Establish a complete and healthy ICZM mechanism. As ICZM in this area has just started, a process for identifying problems, generating management alternatives, evaluating the efficiency of the alternatives should be established for a complete and healthy ICZM system.

- Finally, ICZM should emphasize on capacity building for sustainable development. Typically, in the coastal area of Jiangsu Province, it should include sustainable policy, management mechanism, financial basis, human resources and infrastructures.

In short, the ICZM in the coastal area of Jiangsu Province should be developed around these four central points, to manage the development project towards the sustainable development direction.

5.2 Measures of Integrated Management

Since natural resources are interrelated in the complex ecosystem of the coastal area, the use of one natural resource will affect the condition of others. It is evident that sector-interested management can no longer solve the problems arising from coastal development activities. It is also obvious that no single department has the ability and professional skill to manage all the development activities alone. Therefore it is necessary to manage the coastal area and the activities in an integrated way, considering all the resource exploitation activities under the overall development objective. It is also necessary to treat ICZM as a common task of the whole local society. All elements in this society should be motivated to participate in this management practice. The development of ICZM strategies should be directed towards coordination and negotiation among different sectors, to achieve harmonization over all development activities.
5.2.1 Integration of Present Laws, Regulations and Policies

Presently the laws and regulations related with the management of the development activities in the coastal area of not only Jiangsu Province, but also the whole country, are sectoral based. Due to the weaknesses of sectoral management, such as the lack of concern for other sectors and for the overall development effects, it no longer meets the needs of an aggressive development scenario. A high level integrated management system stressing macro guidance and integral coordination should be established.

According to Zhou Rongru (1994, pp. 27), the basic legal requirements for integrated coastal zone management are:

"Enhance integrated coastal zone management; rationalize marine resource development; protect marine ecological environment; fully increase the importance of coastal areas in the social and economic development of the country."

This specifies the central task of ICZM, i.e., rationalize marine resource development and protect marine ecological environment. Therefore, ICZM should concentrate on integrated planning of the overall development program, careful coordination and harmonization among sectoral activities, eliminating sectoral conflicts, reducing environmental pollution and resource depletion.

The integrated law should define the nature and responsibilities of the marine management organization, stipulate overall coastal development plan, set up permitting procedures for development, exploitation, rehabilitation and protection activities. Besides, it should also stipulate rules for collecting and managing marine development funds. These will provide a legal base for integrated management to minimize sectoral conflicts existing in the coastal area of Jiangsu Province by coordinating the relationship among different sectors and departments. By fully
employing the function of ICZM, i.e., macro guidance, integral coordination and adjustment, the coastal development activities could be gradually normalized, and the ICZM itself could be systematized and legalized.

5.2.2 Integration of Public Involvement

Public involvement is one of the very important aspects of an ICZM program. It is also a weakness in the present management system of Jiangsu Province. Both Agenda 21 of UNCED and the Agenda 21 of the PRC have emphasized the importance of public involvement in both the decision-making processes and implementation activities (UNCED Agenda 21 chapter 23 and Agenda 21 of PRC chapter 20). Coastal development is a common endeavor of the whole society within this area, so every elements of the whole community should participate this activity. In this sense, the Key Largo National Marine Sanctuary Management Program set up a very good example for get as much public involvement as possible. (Florida Key National Marine Sanctuary, 1995). They created a sanctuary advisory council, which consists of representatives from diving, fishing, boating, research, education, environmental groups and private citizens, to make the management plan for the sanctuary. This action makes the sanctuary management more efficient.

In the coastal area of Jiangsu Province, getting more public involvement in the ICZM program is especially important because:

1. ICZM requires participation. At present the ICZM management system is not fully developed. There is only one marine management agency—the Provincial Marine Management Bureau under the Science Committee, and has only 9 personnel. In order to carry out initial management work, as well as to gradually establish an efficient management system, it is important to get broad public participation from within the region. By doing so the first benefit is solving the problem of insufficient personnel. The second benefit is establishing a network for the ICZM system, which can be of great benefit for future management work.
The third benefit is to have a chance to select qualified management personnel for the establishment of a complete management system.

2. Motivating as much public participation as possible also helps the public to understand more about the unique characteristics of the coastal area. Through organized management activity, the local people will better realize the abundance of the natural resources, understand their importance to the economic development, and acknowledge the relationship of environment protection, resource management and economic development. It will help to establish a social ethos that protecting the environment is the responsibility of each person.

3. Public participation is the most important part of the decision making process. However, the level of participation is not enough at present in the coastal area of Jiangsu Province. The importance of ICZM has not been fully understood by the local people. In order to carry out ICZM, and to guide the development activities in this area in a more coherent and efficient direction, it is important to get more public participation in the decision making process.

In order to get more public involvement, and to make the ICZM strategies and policies understood by more people, the following measures should be carried out:

1. Through various kinds of measures such as public meetings, educational programs and news media, proliferate broadly the importance of the ICZM program to coastal economic development. Let the local people at all levels know the ICZM strategy, its purposes and its relationship with every individual.

2. Get people from every sector involved in the development project of the coastal area to participate in the implementation process. Let them understand the comprehensives of ICZM strategies, and its wide involvement with each sector within this region, to help them comprehend the interrelationship that exists among the different development activities. This will help to minimize the conflicts among different sectors.
5.2.3 Integration of Economic Measures

With the development of the economic reforms and the market economy in the PRC, increased coastal economic activities place a heavy burden on the natural resources and environment that are exist in the coastal area of Jiangsu Province. Therefore, the integration of economic measures in the ICZM have become increasingly important for the improvement of the management efficiency. First, economic principles are the underlying driving force for all the development activities. Since there is only a short development history to the market economy in PRC, the related measures regarding market control of resource allocation and environmental protection have not be formed. Especially, the prices for natural resources, environmental services and goods are not adequately evaluated nor considered in the coastal development activities. This has caused excessive demand on natural resources as well as wastes of natural resources. It has even lead to resource depletion, and the transfer of the effects of environmental pollution, habitat damage and environmental costs to the society. Therefore, for the sustainable development of the coastal area of Jiangsu Province, economic measures, such as project analysis and permit mechanisms, market adjustment for project development and resource allocation, and economic measures for environment protection and resource management, should be developed and incorporated into the ICZM.

5.2.3.1 Establish Project Analysis and Permit Mechanisms.

Project analysis and permit mechanism should be developed as an integrated part of ICZM. There already exists much literature explaining the use of such methods in integrated management of development projects, such as Project Cycle (1994) of the World Bank for financial support of development project in developing countries, and the Environmental and Economic Appraisal by Ian Bateman in 1995.
Conventional Cost and Benefit Analysis (CBA) methods do not include environmental impacts as a cost of the project. There are two consequences related with this problem. First, environment impacts are often give non-monetary terms in the feasibility research of a proposed project, although EIA (Environment Impact Analysis) is required for every proposed project. Consequently environmental impacts often are not given equal monetary weight when compared to other costs, and then, these impacts will often not be adequately considered by the decision maker. Second, with non-monetary expression of environmental cost, it is often the case that the environmental impacts are not included in the cost of the project, which lead to the situation that the whole society must bear the cost of the project. Third, Conventional CBA does not include a "sustainability criteria", i.e., intergeneration equity, as a built-in mechanism, which would lead to the negligence in resource conservation and environmental protection.

One of the management objectives for sustainable development of the PRC regarding economic management strategy of natural resources and environment protection was stated in the Agenda 21 of PRC in page 23 as:

"incorporate environmental cost into economic analysis and decision making procedure, change the previous method that use the environment free of charge thereby transferring environmental costs to the society."

According to this, the conventional CBA method should be modified and environmental costs should be included as an integral part of the project cost, so as to enable the decision makers to evaluate objectively the profitability of a proposed project. It will encourage the project operator to reduce its cost in order to improve its competitiveness. In doing so, it is necessary to appraise the environmental assets or external costs in the project and to establish a meaningful CBA structure.

1. Evaluation of the external cost.
External cost is the cost of the project to the society. The discharge of industrial waste will cause damage to the natural environment which is considered to be the common property of the society. Some external costs can be easily appraised while others are difficult. Environmental impacts fall into the later category. Bateman (1995) proposed a set of monetary assessment methods to address this category, which can be used in the integrated management strategy to evaluate the value of external costs in order to fully consider the environmental costs.

One of the abnormalities of the coastal zone development activities in the Jiangsu Province is that there is essentially "no cost" for the environmental services and natural resources. These abnormalities are partly caused by the common and persistent confusion over prices and values. Environmental goods and services are commonly dictated by their prices rather than their values. The true value of these goods and services can only be recognized when replaced by more precious ones. For example, the dumping of waste materials or discharges of municipal and industrial wastes into the sea does not cost very much for the operator. However, with the prohibition of dumping of such waste materials in the sea in certain regions, alternative disposal methods must be found in land which often are at very high costs to the operator. Only then the true value of the environmental services is recognized.

For the use of some natural resources, the abnormalities come partly from the illusion that the supply of the natural resource is endless, that it can never be depleted, and that the demand on this natural resource is negligible compared with its supply. So the prices marked on these natural resources is very low. But, it is already evident that some marine resources are being depleted under excessive exploitation and the price of these natural resources has become very high within the past 20 years. Without suitably addressing the external costs, together with the inadequate preservation of the marine environment and the offhanded practices of wastes discharges a huge burden have been placed on the society. So it is important to include these external costs in the project analysis procedure, objectively estimate the costs.
and benefits of a project, and internalize the external cost for the purpose of sustainable development of the coastal area. Let the industry and enterprises incur the cost of their own environmental problems.

2. Sustainable CBA structure.

Table 14 shows the basic structure of the costs and benefits of a project (Bateman, 1995). As mentioned before, traditional CBA analysis does not include environmental Cost ($C_E$). So assuming that a project will generate profit $P_t$ with internal costs $C_t$ in $t$ years, the $NPV_t$ (Traditional Net Present Value) of a project is calculated by the function bellow:

$$NPV_t = \sum_{i=1}^{n} \frac{(P_t - C_t)}{(1 + r)^t}$$

$r$: interest rate

which does not reflect the true profit of the proposed project, because it does not consider the $C_E$ factor which is the burden on the whole society.

For the purpose of sustainable project analysis, the actual benefits and costs for a project should be established. The $C_E$ should be included as part of the total cost. The NPV function should be modified as:

$$NPV = \sum_{i=1}^{n} \frac{(P_t - C_t - C_E)}{(1 + r)^t}$$

$r$: interest rate

As said before, some external costs can usually be evaluated by reference to their market prices. For example, if the wetland which was previously being used for clam bed is planned for port construction, then this external cost could be estimated by the market price of clams multiplied by the annual production amount. However, some of the external costs are not so easily evaluated in monetary terms. For example, if
the wetland area was not previously used for economic purposes, and it now is planned to reclaim this area as port storage area. The monetary loses of these wetlands is very difficult to estimate. This problem could be solved by a series of monetary assessment methods, as suggested by Bateman(1995, 48). Since some of this wetland may have very important value in flood control, storm protection, fish spawning habitat, or other ecosystem functions. It is this part of the cost in a proposed project that needs to be carefully examined in an integrated coastal zone management procedure.

3. Establish project permitting procedure.

Economic measures for ICZM should also be emphasized in the overall decision making process of the development project in the coastal area. In the project permitting process the role of ICZM should be an additional requirement apart from the original project permitting procedure. Such additional requirements should include:

1. Maximum benefits per natural resource consumption. The importance of this requirements is to improve the efficiency of natural resource use, to get maximum economic benefits based on the present available natural resources, and to change the traditional production methods that require high resource consumption. It will help to improve the sustainability of the regional economic development.

2. Minimum waste and pollution generation within the life-cycle of the product. This requirement will eliminate as much as possible of the environmental hazards generated by this development project. This requires life-cycle assessments (LCA) or the “from cradle to grave” method as expressed by Seven-Olof Ryding in his book named Environmental Management Handbook (1992, page 434).

3. The importance of the project in improving the overall sustainable development capacity. Great priority should be given to the projects which improve infrastructure facilities so as to improve the ability for further development. The
projects which can facilitate the environmental management, such as the research or production of equipment used for environmental protection purposes, should also be given high priority to improve the environmental sustainability of the whole region.

5.2.3.2 Market Adjustment for Project Development and Resource Allocation.

According to the principle of socialist market economic theory, there are two aspects in market adjustment for project development and resource management. First, project development and resource allocation should subject to the principle of market economy. This will help to make full use of the present natural resources, increase efficiency and improve competition by market mechanism. The significance of this economic reform is that it will basically change the old method in which all development projects and resources are under the control of the central government. It will also change the attitude of the people towards natural resources and their environment. On the other hand, governmental macro adjustments will play their role when the market force is not controlling or unable to ensure maximum resource use proficiency and unable to maintain a sustainable resource base for continuing development.

The role then of the government is mainly to modify unsuitable market mechanisms, rationalize resource uses, and prevent the occurrence of natural resource depletion. From the experience of some developed countries, it is commonly accepted that market forces alone could not solve the problem of sustainable resource uses, and in some parts cannot even prevent serious environmental pollution. The LCP Chemicals site, Brunswick, Georgia, USA, is a good example of the fail of the market control for environmental protection (NOAA, 1995). Due to the lack of environmental control methods, wastes containing PCB, lead, and brine-mud residues were disposed of in on-site impoundment. At this abandoned site, there are also high mercury
pollution due to the leakage from the abandoned mercury cells once were used for
producing caustic soda and. The local ecosystem was totally damaged.
So, for the successful completion of the economic development objective in the new
socialist market system, it is important to combine these two methods in the same
integrated management strategy.

As stated in the previous chapter, in the coastal area of Jiangsu Province, there are
some problems such as duplicated construction, waste of resources, and use of
natural resources free of charge. These problems can be best solved by incorporating
market adjustment into the ICZM strategy. Following steps can be taken to establish
such a mechanism:

1. Investigate the abundance of the present resources, their replenishing rate and
   their allowable exploitation, so as to know the supply capability of these
   resources. Presently there is not a unified price system for natural resources. Even
   the coastal land was not necessary to have a price, since the owner and the user
   were always the same one. However, when the increase of private companies and
   joint-ventures participate in the economic activities, and the change of the operate
   mechanism for state-owned enterprises, the owners and the users are always
different. Therefore, it is necessary to setup the price system for all the natural
   resources. Since it is impossible to set up price without knowing their ability to
   supply, such investigations are obviously the first step towards optimum market
   allocation of natural resources.

2. Investigate the demand for the natural resources. Demand is one of the two
   important factors in the market system. It is decided by the requirement of the
   present development project under the overall economic development objective.

3. Establish an initial price system for natural resources based on the investigated
demand and supply, and also the use and non-use value for certain natural
   resources. This will provide a basis for the start up of market operations.
4. Market monitoring and analysis. To prevent the occurrence of over exploitation and resource depletion, it is necessary to constantly monitor the change of the resource market, analyze the impacts of market allocation on the sustainability of natural resources.

5. If there are any unfavorable effects predicated upon the results of the monitoring process, then macro-adjustment should be employed to re-evaluate the demand and supply, establish the new price system, and adjust the market allocation.

5.2.3.3 Economic Measures for Environment Protection and Resource management.

Economic measures could be a great assistant to the implementation of laws and regulations. For environmental protection and resource management it is also a powerful tool. For example, as cited by Daniel D. Chiras in his book Environmental Science - Action for a sustainable future, a research project called Project 88 argues that economic measure 'could help supplement traditional laws aimed at regulating pollution and resource use.' (Page 475).

There are various kinds of economic measures which can be used for environmental protection and resource management. Such measures include economic incentives and disincentives, the permit system, and create market barrier by new laws and regulations for economically inefficient and environmentally destructive practices (Chiras, 1991); environmental pollution control cost and benefit analysis; and ITQ method used for marine fishery resource management (Ian N. Clark, Philip J. Major and Nina Mollett, 1989). For example, the permit system has been used in Colorado to control eutrophication in the Dillon reservoir caused by agricultural runoff and sewage treatment plants. A study showed that additional controls in treatment plants would cost ten times more than the control of non-point sources. Therefore the legislature and the EPA approved a tradable permit plan, allowing the sewage treatment plants to pay for non-point pollution controls. This measure not only
controlled the pollution level in the reservoir, but also saved money in pollution control activities.

With the development of the market economy in the PRC, economic measures will have broader and broader applications in all cycles, including the management of environmental pollution and resource use. The employment of the economic methods in the management of pollution control and resource use must first of all meet the requirements of the socialist market economy. As stipulated in the *Chinese Environmental Protection Action Plan*, one of the economic policy reforms to take place before the year 2000 is the establishment of a tax policy that improves environmental pollution control. This means that economic policy will play an important role in environmental protection.

Second, supplementary economic instruments, such as charging systems, subsides, deposit-refund systems, and credit and quota systems suggested by Sven-Olof Ryding(1992, pp. 568), will improve the efficiency of environmental protection and resource management regulations. As mentioned before, economic benefits are the driving force in all development activities. Economic incentives or disincentives will thus have stronger influences on the operation of a business. The operators or the managers will be more sensitive towards economic measures, such as the change of the tax policy or the change of the pollution discharge fees.

Third, the purpose of environmental pollution prevention and resource management is to promote sustainable development. The use of economic measures often make business operators comply more with environmental pollution control and resource conservation regulations. This will at least reduce the need for huge enforcement efforts, and hopefully will also rationalize the degree of allowable discharge rates to decrease the environmental pollution control costs.

5.2.4 Integration of Sectoral Management.

Sectoral management should also be an integrated part of ICZM. As mentioned before, it is neither wise nor possible to replace the existing sectoral management
system. The successful management experience in individual sector should still be used in the integrated management strategies.

The relationship between ICZM and sectoral management is well expressed by Biliana in her paper ‘Sustainable development and integrated coastal management’ (p. 25 and p. 31). On page 25 she mentioned:

'(1) Not every interaction between different sectors is problematic and therefore in need of management. Hence, adequate study of relations among sectors and uses is imperative to understand the extent to which such interactions are mutually harmful, beneficial, or neutral.

(2) Integrated management does not generally replace sectoral management, but instead supplements it. Generally, different individuals and institutions will be involved in sectoral management vs in-policy integration.

(3) Policy integration is often best performed at a higher bureaucratic level than sectoral management to insure that an overall, rather than a fragmentary, perspective is pursued.

(4) The costs of policy integration should be kept in mind: since policy integration will often be difficult and costly to put into effect, sometimes the costs of integration may outweigh the benefits - such a prospect, of course, should be guarded against.’

On page 31 she also said:

‘In most cases, integrated coastal management would not supplant such specialized sectoral management but instead would supplement and, in some respects, harmonize and oversee sectoral management.’

In short, ICZM should focus on identifying conflicts that exist between different resource users and their impacts on natural resources and environment. Then, according to an integrated policy, ICZM should concentrate on coordinating and harmonizing the development activities, to make the regional economic development
more sustainable. Individual sector managers should continue to mind their part of business under the coordination of ICZM policy.

It is therefore very important to incorporate sectoral management into the ICZM for the coastal development of Jiangsu Province. First, the ICZM in this area is just beginning. At present, the ICZM policy is not complete, experience and management personnel are not sufficient. Therefore, it is necessary to take sectoral management as one of its components. Second, the proposed development program is based on the development proposals of individual sectors. The interrelationship of different sectors and their effects on marine resources and the environment are not fully considered. Therefore, ICZM should investigate these relationships and effects. This requires cooperation between the ICZM and sectoral management. Third, the strategy of ICZM is coordination and harmonization. However, the best coordination and harmonization always has to be based on professional management experience of the individual sectors. This again calls for the integration of sectoral management. Finally, integration of sectoral management into the ICZM will help managers in individual sectors understand their relationships with each other and their effects on the environment and resources used by these sectors. This understanding will greatly help the implementation of ICZM strategy.

5.2.5 Integration of Environmental Protection Criteria

Environmental protection criteria includes the degree of resource conservation, and the allowable limits of municipal and industrial waste discharges. The purpose of ICZM is to maintain sustainable development through environmental protection and resource conservation. However, there is no development project that has no environmental impacts. Therefore, problems related to the extent of environmental protection and resource conservation must be solved. These solutions can only be obtained through environmental research and monitoring activities. Furthermore,
under the market economy system, the cost and benefit of environmental protection should also be considered. It is necessary to incorporate these two factors into the ICZM environmental protection criteria.

Under the present development stage of ICZM in the coastal area of Jiangsu Province, it is also necessary to integrate environmental criteria into ICZM because:

1. Establishing environmental protection criteria will provide a scale for maintaining the balance between environmental protection, resource conservation and coastal development. For example, wetland is an important source of nutrients for marine life. It is also a very important resources for land reclamation. There are vast mud flats along the coast of Jiangsu Province, it is planned to reclaim these areas for other uses. However, there exists no quantitative evaluation on the amount of coastal wetland needed to maintain the present level of marine biological system. This is the major difficulty in maintain the balance between development and conservation as far as land reclamation is concerned. This problem can only be solved by establishing an environmental protection criteria.

2. Establishing environmental protection criteria will also help in the development of complete ICZM management strategies in the coastal area of Jiangsu Province. By setting up this criteria, ICZM and sectoral management will have a common objective to attain. The enterprise will try to find a better way to meet this criteria at lower cost. The environmental consultants will also have a firm basis when providing services such as EIA, environmental auditing, SIA, for development projects, which are much needed in the coastal area of Jiangsu Province.

In order to achieve this, the following steps should be taken in the coastal area of Jiangsu Province.

1. To obtain data for setting up the criteria, coastal environmental monitoring ability should be enhanced by establishing local marine environmental monitoring
stations along the coastal line. This is especially needed for certain heavily polluted area and at some water quality control areas.

2. Conduct marine environmental research by cooperation with local fishery groups, national fishery institutes and marine environmental protection organizations, to know clearly the present marine environmental conditions, present availability of marine biological resources, the importance of coastal wetlands to the overall fishery resource base, and to evaluate the effects of coastal wetland reclamation on marine resources.

3. Establish an environmental consultant company, to provide EIA and environmental auditing services for the coastal development activities, so as to improve the cost effectiveness of environmental protection.

5.2.6 *Integration of Different Management Areas.*

Integration of different sections (land and sea) is also one of the important aspects of ICZM. According to one estimation, Land-based Marine Pollution (LBMP) contributed more than 75% of the pollutants entering the sea (Mary Schumacher, Porter Hoagland and Arthur Gaines, 1996). Therefore, control of land based pollution should be integrated as an important part of ICZM. Although there is no commonly accepted definition of the area constituting the “Coastal Zone” (Rhoda et al, 1994, pp. 71), in practice the management area of ICZM includes the whole watershed. It is referred to as “watershed management” by Charles et al (1995, pp. 4).

Integration of the management of different sectors is also very important in the coastal area of Jiangsu province. First, LBMP is also the biggest marine environmental problem within these area. The degradation of water quality along the major Estuaries has proven this. Second, as mentioned before, the marine environmental pollution problem will increase with the development project. Without proper control of the land based waste discharge, the environmental quality in the
coastal area will be degraded and ultimately risk the health of human beings, impeding the possibility for further development.

In the coastal area of Jiangsu Province, local EPA responsible for land environmental protection, and SOA responsible for marine environmental protection. In order to control the LBMP problem, these two agencies must cooperate closely and set-up integrated management strategies, to control the pollution discharges.

5.2.7 Integration of Social Impact Assessment

The coastal area is an integrated social, economical, and environmental aggregation. The development activities in this area will have broad effects on every aspects of life. Therefore, Social Impact Assessment (SIA) should also be included as an important element of the EIA.

As stated in a research report made by the Canadian Environmental Assessment Research Council (CEARC) (CEARC, 1985):

'Social considerations have become a progressively more important element of environmental assessments. In the case of major projects referred for public review, social issues often drive the process and can exert an important bearing on final decisions.'

As regarding to the nature of SIA, CEARC states that:

'SIA is considered primarily to be an area of systematic inquiry, which seeks to investigate and understand the social consequence of planned change and the processes involved in that change. It involves the application of various methods of analysis and the documentation and communication of findings. The SIA statement may be used as a basis for decision making and as a source of public information.

SIA, above all, is about people, it should be community based, rooted in the problems and needs of those who are faced by change or dislocation.

...... The rationale for the emergence of SIA is to make their concerns
clearly understood and so make the decisions which affect them both responsive and responsible.

They also stated that SIA should include demographic, economic, resource and cultural changes.

Since the SIA is an important measure to evaluate the social effects of the development project, it will have great influence on the decision making process. Presently it has not received the same weight as the EIA in the PRC. So, to complete an integrated management strategy, SIA method should also be developed and applied to assist in the decision making process.

5.3 Evaluation of Integrated Management Mechanism.

As noted by Biliana (1993, pp. 29), ICZM “represents a continuous and dynamic decision-making process”. First, as a decision making process, it should depend on the selection of the efficacious, practicable, ethical and “optimal” alternatives from a thorough set of alternatives (Richard A. Chechile, 1991, pp. 5). The selection of these alternative calls for an evaluation process. Second, “continuous and dynamic” means that the ICZM decisions are not made once and for all. The best alternative at one time may not be the best later. Therefore, to complete the ICZM system, evaluation of the management strategies should be established and incorporated within the system.

Establishing an evaluation process is especially important for ICZM in the coastal area of Jiangsu Province. First, as mentioned before, ICZM in this area is just beginning. Most of the present management decisions have to be based on previous experience. They are neither complete nor optimal. They can only be completed and optimized through the implementation process. Second, the understanding about the environment, the resources and their relationships with development, are changing with time. Therefore, it is also necessary to modify the management strategies for the changed situation. This also calls for an evaluation process.
There are four main parts in the evaluation process. They are information collection, information analysis, problem identification and generation of new management alternatives. The flow chart for this process and its relation with the main ICZM are illustrated in Figure 16.

5.3.1 Information Collection

Information collection is the first step for evaluation after the installation of the management alternatives. The following information should be collected in this step:
1. Basic information about the start up time, location of the action and the efforts spent on the implementation of the management action.

2. The results of the action, and its differences from expected results.

3. Public response of this management action.

The following measures could be used in the information collection step.

1. Monitoring. Regular monitoring of the management action together with its results should be conducted to obtain timely and accurate management information.

2. Establish a public hearing system. Public opinion is a very important factor to evaluate the successfulness of the management action, especially the response of the local community towards the management action. This is the key factor for the successful implementation of ICZM strategy.

3. Designate persons responsible for keeping track of the management action. It can be done by establishing a regular reporting system on the management action to the regional ICZM officer.

In order to collect related information in a timely and correct manner, advanced monitoring technology, together with the recent development of computer application for data communications, should be applied.

5.3.2 Information Analysis

After information collection has been completed, then follows the information analysis step. First, for all the information gathered in the previous process, it is necessary to identify what is true or possible and what is false. In this case, if the same information is coming from many different channels, then its credibility should be high. Second, information analysis should be able to find out the underlying facts for the superficial information. This will help to identify real problems in the next step. Third, this information analysis should also take the most latest developments
into consideration, to predict what the results would be if the new management policies or environmental protection methods were used.

In order to carry out information analysis, the following tools or technologies should be developed.

1. Information coding system. Since ICZM decisions are a multidisciplinary science, the information analyst will normally be faced with huge amounts of information. It is only possible to handle these with the modern computer technology. However, in order for the computer to accept and analyze this for you, it is necessary to codify every piece of information. This principle is referred to as a coding system. For example, any kind of computer language compiler is a information coding system. Programming language should first be changed into a machine code that a computer can recognize. Then the computer can do certain action according the code.

2. Information analysis system. The computer based special purpose Information System should be developed for information analysis. The success of this Information System is again dependent upon:

3. The establishment of the coastal area ICZM database.

5.3.3 Problem Identification

Problem identification is based on the previous collected information and the analyzed results. The purpose of this step is to pinpoint the present problems in the ICZM strategy, predicate the consequences if these problems remain unsolved, and to set up priorities among identified problems. Some times the problems are extremely difficult to identify because they may be related to many sectors, and they may have effects on all other related management policies. So, it is necessary to set up an expert group to assist in the identification process. This group should be composed of experts coming from all related sectors of the coastal development activities. They can be linked with a computer network to save time and provide the possibility for discussing with each other over the concerned matters.
5.3.4 Generate New Alternatives

Upon the completion of the above process, the ICZM organization should be able to decide what are the necessary and most urgent modifications for the existing management strategies and what possible additional management strategies could help to achieve the overall management objectives. In considering modification of the existing policies or in generating new policies, the following criteria should be set up:

1. Promptness. Some identified problems may require quick reaction to prevent the occurrence of serious consequences. Such problems need to be responded quickly. The ICZM manager should focus on the most urgent and high priority problems as soon as the results from previous steps reach him.

2. Accuracy. It should be admitted that any mistake in the set up of ICZM policies could have serious consequences to the overall management process and even to the overall development process. Accurate decisions on the modification of the existing policies is therefore a very important part in the ICZM system. Thus, the information base should be complete, and various opinions on the management policies should be taken into account. In addition, some theoretical simulations or predictions of the intended new management alternatives should carried out to help to validate the possible results of the modification.

3. The generated new management alternatives should meet with the requirements of the overall economic development and environmental protection objectives.

4. An approval mechanism for the new ICZM policies should be established to guarantee the appropriateness of the proposed new policies.

5.4 Capacity Building

Capacity building is the most important part of the ICZM. It is especially important for the coastal region as it was pointed out in Noordwijk in its statement of the International Conference on Coastal Zone Management (1993, Annex 4/5, pp. 4):
• the current trends of increasing poverty in the coastal community are resulting in degradation of the coastal zone and deterioration of the quality of life;

• current pressures from development and population are increasing land-based sources of marine pollution and human intervention with river basins, adversely affecting coastal process.

These pressures include:

- Accelerating the decline of habitat and natural resources, including beaches, mangroves, wetlands, corals and sea grasses, as well as fisheries and other coastal and marine resources; and

- increasing vulnerability to pollution, beach loses, natural hazards and long-term impacts of global climate change.

The changes may, in turn, limit options for future development:

• many degraded and threatened coastal resource and ecosystems are in need of rehabilitation and restoration;

• efforts to develop capabilities for integrated coastal zone management and implement national programs may take 10 years or more; and

• implementing strategies for adapting to and mitigating the impacts of global climate change may require lead times of several decades and longer even if immediate measures to reduce greenhouse gas emissions are taken.

The importance to strengthen the sustainable capacity build-up in the coastal area of Jiangsu Province is decided by the present economic conditions, the planned development program and the problems that exist within the development process.

1. The coastal area of Jiangsu Province has suffered from poverty over a long time. Its economic condition is still low at present. Stable and continuous economic development is essential to get rid of poverty, while stable and continuous economic development must be based on sustainable capacity.
2. There are rich natural resources in this area and its geographical location is advantages for development. However, its infrastructure is inadequate for large scale development. Some of these inadequacies have already impeded the speed of development in this area.

3. Present environmental protection capabilities are not compatible with the planned economic development and the accompanying waste discharge increases.

4. Sustainable capacity to minimize the impacts of natural disasters and long term environmental changes should also be established. In Jiangsu Province such natural disasters include tropical cyclones and long term environmental changes that include coastline erosion and potential sea level rise.

5. Ability to coordinate and harmonize the sectoral development and management activities should be built-up for the coastal development program. Therefore, it is necessary to commence the sustainable capacity building along with the initiation of the coastal development activities. The most urgent capacities for the coastal area of Jiangsu Province include four aspects: policy, management mechanisms, human resources and infrastructure.

5.4.1 Sustainable Policy

Sustainable policy is the key to sustainable development. The sustainable policy building should take the predominant position among all others. However, sustainable policy can not be built overnight, it involves a long and complicated process. In the PRC, the sustainable policy building has been strongly emphasized in the national sustainable development strategy. It is the main strategy to ensure and realize the national economic development and environmental protection objectives, as stated in the chapter 2 of the Agenda 21 of PRC (p. 5):

'Strengthen sustainable capacity building, especially policies, laws, regulations, and strategic objectives that regulate social and economic sustainable development; integrated resource and environmental monitoring and management system; socio-economical development
Coastal development is also a long term and comprehensive endeavor. It should not only make the full use of the marine resources for the present needs of economic development, but also should take care of the long term needs and the needs of the coming generations. Besides, the coastal area is a social, economic and environmental aggregation; coastal development is closely related with the environmental condition, economic development activities and natural resource availability. There are various kinds of sea use activities in the coastal area, that represent multiple aspects of the social, economic and scientific interests, which are all closely bounded by the environment and its resources. So, it is necessary for the management of the coastal development activities to have the overall and long term interests in mind; it is necessary to transcend the interests of individual sectors, to conduct macro coordination among the different sectors, to achieve the overall and long term economic development and environmental protection objectives. For the coastal area of Jiangsu Province, it is necessary to:

1. Establish provincial integrated management policies that are compatible with related national policy and centered on the economic development.

2. Clarify the relation of the integrated management policy with other sectoral management laws and regulations. Emphasize the coordination function of integrated management policy over the existing sectoral management policies.

### 5.4.2 Sustainable Management Mechanisms

Integrated management policy needs compatible integrated management institutions and implementation force. Otherwise it is just a piece of paper no matter how good it is. Considering the previous sectoral management system in the coastal area of Jiangsu Province, the biggest problem is the lack of coordination and harmonization in their individual development activities. So, for the ICZM it is urgently needed to
strengthen sustainable management capacity. The following measures should be
developed in order to strengthen this capacity.

1. Establish marine management institutes at provincial, municipal and county
   level; adopt management system which combine national and local management.
   Consider the needs of increasing development activities and their increasing
   pressure on the environment and natural resources, it is not possible for a small
   number of people to manage all the activities in the whole region. Completing the
   staffing of management system is an urgent task to ensure a sustainable
   management mechanism.

2. Establish, complete and emphasize the responsibility, function and management
   strategy of the integrated marine management organization. It should be
   emphasized that the role of integrated management is to safeguard the balance of
   overall benefits among resources, environment and development, to realize the
   unification of social, economic and ecological interests, and to achieve
   sustainable use of marine resources through policy-making, implementation and
   coordination of marine development activities.

3. Clarify the relationship of integrated management organizations with previously
   established sectoral management institutions; stress the predominate role of
   integrated management in coordinating and harmonizing overall coastal
   development activities.

5.4.3 Human Resource Building

One of the problems that exists in the coastal area of Jiangsu Province is the general
low education level and lack of qualified personal for economic development and
management. Therefore, human resource capacity building is one of the important
aspects of sustainable capacity build-up.

For this purpose, the following steps are suggested:

1. Strengthen the present educational system, especially primary education, to
   improve the general education level. Increase the school attendance rate at
primary and secondary schools. Open a access to environmental science studies from the primary school through high school. Make environmental protection a obligatory course for every university student. By doing so not only the general educational level will be increased, but also the scientist, as well as business managers in all part of society will have a strong environmental awareness in the future.

2. Conduct cooperation with universities to train qualified integrated management personnel. Since integrated management for coastal development activities needs broad multidisciplinary knowledge which often exceeds the ability of any existing department of a university, a comprehensive interdepartmental program is needed for training students who then can work in the integrated management posts.

3. Open environmental protection and sustainable development training courses for decision makers and managers at different levels, to improve their environmental protection and sustainable development consciousness, awareness of theoretical standards and implementing abilities.

4. Conduct international cooperation: remain abreast with advanced management experience and technologies in the world.

5.4.4 Sustainable Infrastructure

In the coastal area of Jiangsu Province, one of the existing problems is the lack of a sufficient infrastructure. Some of these inefficiencies have already impeded the coastal development process. For example, insufficient transportation often causes inadequate coal supply for thermal power plants, making the electric power generation always below its maximum capacity. This in turn, causes unnecessary delays in the overall process of coastal development. It is necessary to build-up a sustainable infrastructure for the achievement of the proposed coastal development project.

There are three kind of infrastructures which are highly imperative for strengthen.
1. Increase of transportation ability. This includes increasing the railway transportation capability within the three coastal municipalities, upgrading the express road conditions which link the three municipalities, and opening at least one international airport to accommodate international businessman and travelers—to provide better condition for further investment.

2. Increase the energy supply capacity. Not only the electric power supply should be guaranteed, but also the supply of other forms of energy, such as coal and fuel oil.

3. Increase the telecommunication capacity. Information is very important in modern business operations. Information transmission relies on telecommunication capacity. Telecommunication capacity building is one of the important aspects which should be considered in order to improve the coastal investment environment.

4. Another important aspects of sustainable infrastructure capacity building is to minimize the vulnerability of the coastal area from the impact of natural disasters. Typically the coastal area of Jiangsu Province is very vulnerable to the effect of coastal erosion and show inundation from the probable sea level rise in the future. So coastal protective construction is necessary to guard off the possible effects of the sea’s intrusion, to safeguard the coastal community and to protect the results of coastal development activities.

Since the development of the coastal area is a long term strategy of the whole society, and it involves different interests of different sectors, the management of these development activities should be conducted so as to reach the overall development goal and at the same time maintain a sustainable basis for further development. Therefore, it is necessary to establish a complete integrated management system which should incorporate many different management strategies, and to establish evaluation mechanism for these management strategies. Besides, due to the current situation in the coastal area of Jiangsu Province, it is necessary to build up sustainable capacities to improve the possibility for continuous development.
6. SUMMARIES AND RECOMMENDATIONS

Sustainable development is the national strategy of PRC. It is especially important for the development of the coastal area of Jiangsu Province based on its present socio-economic condition, its geographical advantages, its natural resources, its environmental condition and the estimated effects of the proposed development. However, in order for the development to be sustainable, not only the previous mode of development should be modified in order to obtain maximum production efficiency and make full use of the existing resources, but also the management strategies should be made more efficient and compatible with the requirements of the socialist market economy. The previous sectoral methods have been proven inefficient in managing the development activities in this complex coastal system. Therefore, it is necessary to develop an integrated management strategy for the proposed development project. Having stated the present economic condition, geographical and natural resource conditions in the coastal area of Jiangsu province, this paper analyzed the problems that exist in the proposed development project, examined the problems according to sustainable development requirements, and proposed a series of integrated management strategies. A summary of the main points of this paper is given below, and recommendations for the integrated management of the coastal development project will follow.

6.1 Summaries

1. As the present economic conditions in the coastal area of Jiangsu Province are still very low, the prerequisite for sustainable development is to obtain fast and stable economic increase. Without economic development, not only the present
living standard of the local people could not be improved, but also the ability to prevent marine environmental pollution, minimize the effects of natural disaster, and improving infrastructure conditions could not be attained, thus the possibility for further development could not be increased. The natural marine resources and geographical condition in the coastal area of Jiangsu Province provides an advantageous basis for the development of marine industry. The overall economic development objectives of the PRC also require economic development in the coastal area of Jiangsu Province.

2. Fast economic development will definitely bring unprecedented pressure on the present natural resources and the marine environment. Therefore, in order for the development to be sustainable, a number of actions are needed. First, the management of proposed development should focus on increasing the efficiency of resource exploitation, pursuing maximum production at minimum resource consumption and less environmental cost. Second, the balance between development and protection should be found and maintained. Both of the extremes will undermine the success of the sustainable development objective.

3. Considering the weakness of the previous sectoral management approach for coastal development, the overall development objectives of the PRC and Jiangsu Province, and the requirements of the national economic reform, it is necessary to establish a integrated management system for the proposed coastal development project. This integrated coastal management system is by no means proposed to replace the previous sectoral management. It is both unreal and unnecessary to abolish all existing sectoral management policies and institutions. The focus of the integrated coastal zone management is on the coordination and harmonization of the economic activities, minimizing the conflicts among them and their environmental impacts, leading them to work together towards the overall development objectives of Jiangsu Province.
4. Due to the complex and interdependent nature of the coastal zone development activity, the management of these activities should be looked upon as a common task of the whole society. Therefore, the integrated management strategy should include as much as possible all the related factors. First, the setting up of the integrated management regulations and institutions should take into account all the existing sectoral management regulations and institutions. The relationship of the integrated management regulations and institutions with previous management regulations and institutions should be established so as to enable the implementation of integrated coastal zone management. Second, with the development of the socialist market economy of the whole country, in order to make the integrated management strategy more efficient under this new situation, it is necessary to establish and incorporate economic measures into the integrated management strategy. Third, the role of public involvement in the integrated management should not be neglected. As the present level of public involvement in the management of coastal development is relatively low in the coastal area of Jiangsu Province, the measure to increase the level of public awareness, and a mechanism to incorporate it into ICZM should be developed. Finally, with the development of the ICZM, the advanced management strategies from other parts of the world should be studied and incorporated into the ICZM, such as the techniques of Environmental Auditing, Social Impacts Assessment.

5. The performance of the integrated management strategy should be subject to regular evaluations so as to safeguard the correctness and efficiency of the output of the management strategies. The necessity of this evaluation process is derived from the following reasons. First, every management strategy is made under certain conditions, which include the understanding of the natural ecosystem, the relationship between development and environmental effects, and present available economic and technological conditions. All these factors will change
over time. Therefore, any management decision made at one time should also change in order to adapt for the change situation of subsequent times. Second, ICZM itself is a continuous and dynamic process, it is a integral part of ICZM to evaluate the performance of its management strategies, to correct previous management alternatives or generate new management alternatives whenever necessary.

6. Sustainable capacity build-up is especially important in the coastal area of Jiangsu Province during its present economic development stage. Four main areas for sustainable capacity building are identified in this paper, which include sustainable policy building, establishing sustainable management mechanisms, personnel resources building, and sustainable development infrastructure capacity. This leads not only to increasing the ability to minimize the effects of natural disasters and to deal with environmental problems, it also improves the possibility for development both in the present and the future.

6.2 Recommendations

The national economic development objectives of the PRC require Jiangsu Province to improve its marine industry. Therefore, the development of the coastal area through full and optimal use of the natural marine resources is its first important task. However, considering the effects of increased development activities on the natural resource base and upon the marine environment, and given the complex nature of the whole coastal ecosystem, it is urgent to establish an integrated management system with complete management strategies for the overall coastal development program. Hence, as a conclusion of this paper, the following actions are recommended for the integrated management of the coastal development program of Jiangsu Province.
1. Establish and complete the integrated management system at different levels of the whole province.

After the approval of the "Coastal Zone Management Act of Jiangsu Province", it is necessary to establish a complete set of integrated management mechanisms to bring these regulations into action. It should include three basic parts. 1. A sub-system responsible for environmental monitoring and surveillance. The environmental changes around the coastal area should be closely monitored in order to evaluate the effect of the human activities on the natural environment. This can be set up jointly with existing marine environmental monitoring and protection organizations in order to make full use of the available resources. 2. A sub-system responsible for enforcement of laws and regulations related with sea use management, environmental protection management and coordination among conflicting sectors. 3. A sub-system responsible for the evaluation of the overall integrated management strategies. This mechanism should be established at the different levels within the whole province. Apart from the provincial marine management department, which is supposed to assume the responsibility of the overall ICZM, it is necessary to establish such management departments at the county level. This will facilitate the reduction in the scope of the management area, focus the management efforts, and make the implementation of ICZM more efficient.

2. The function of ICZM.

The working procedures and scope of the ICZM department should also be stipulated at the same time when establishing its management systems. First, the role of ICZM in the decision making process of the coastal development plan should be established. This will allow the sustainable criteria and ICZM strategy to be incorporated into the development plan at the very beginning. Second, the position of the ICZM department in relation to other sectoral management departments should be defined, so as to enable the ICZM department to perform its function as a coordinator over the various development activities.
3. **Urgent issues related with development and protection.**

There are three urgent issues which need to be dealt with in the coastal area of Jiangsu Province. The first important issue is the land based marine pollution. Land based marine pollution is the most important source of pollutants in the coastal area of Jiangsu Province. Its impact will increase with the proposed coastal development project. Therefore, in order to prevent the deterioration of the coastal marine environment, and to protect marine resources, the first important task for the ICZM is to control the industrial discharges, and modify the use of fertilizers and pesticides in agriculture, to address the eutrophication and oil pollution in the coastal waters. The second important issue is the protection of fishery resources. As a result of overfishing in the last 30 years, the fishery resource in the coastal area of Jiangsu Province is facing depletion. The stock of the fishery resource is diminishing, its quality is deteriorating, and its economic worth is devaluing. Therefore, protection of fishery resources is also an urgent task for ICZM. The third important problem is coastline protection and groundwater conservation to prevent further coastline erosion, over-exploitation of groundwater, and earth subsidence.

4. **Increase public awareness and involvement.**

Public awareness and public involvement is a very important part of ICZM. Since the present level of public awareness and public involvement is not high, it is also one of the urgent tasks for ICZM in the coastal area of Jiangsu Province. Improving the overall educational level and increasing the awareness of sustainable development of the whole society is a long term strategy. It should be started as early as possible. In addition, the problem related to the lack of qualified ICZM personnel could also be solved through the public educational programs.

5. **Conduct sustainable development research.**

Since the present ICZM management strategies are not completed in the coastal area of Jiangsu Province, it is important to conduct investigations and research on the
optimum use of natural resources and its impacts on the marine environment, and to establish a scientific basis for natural resource conservation and environmental protection. In order to meet the needs of a developed market economic system, new and efficient economic management measures should be investigated and adopted. A price or value system for natural resources and environmental goods and services should be established on the basis of such research and the overall development objectives should be clearly established in the context of their real economic value, adjusted for environmental considerations.

6.3 Conclusion Note

The development of the coastal area is a very complex process, related to many scientific areas, and will have a significant influence on the sustainability of the region. Therefore, the management over the development at this region needs thorough study, careful planning, and efficient implementation. Based on the existing problems, national sustainable development strategies of the PRC and the sustainable development principle, the author established a preliminary model of an integrated management system for sustainable development in the coastal area of Jiangsu Province. However, to employ this system in the real situation, it is necessary to carry out further detailed investigation and research. It is desired that this preliminary ICZM system will serve as a guide for future works, and will make contribution to the sustainable development of the coastal area of Jiangsu Province.
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