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Current Study on Estuarine Coastal Ecological Environment and Its Development

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Abstract

The paper, referring to the documents on estuarine coastal ecological problems at home and abroad, states the researches on coastal erosion recovery, water quality of estuarine areas, and the recovery and reconstruction of estuarine wetland, and, according to the study situation and real demands of Chinese estuarine coastal researches, analyzes several future popular focuses on estuarine coastal ecological researches, including researches on sediment flux, water quality and wetland protection.

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1. Introduction

As far as Chinese estuarine coastal areas are concerned, they are provided with developed urbanization, concentrated population and prosperous outlook. To sum up, the estuarine coastal areas of China, as a coastal economic band, cover 13% of the total national territory, support 42% of the total population and create over 60% of GDP. However, as the development of social economy greatly depends on coastal band resources and environment, the coastal areas also suffer heavy environmental pressure[1].

Chen Jiyu, a famous Chinese estuarine coast expert proposed the challenges on resources and environment confronted with Chinese estuarine coast in his paper Estuarine and Coastal Challenges in China in 2002. In his opinion, the challenges included sharp reduction of sediment flux, growth of pollutant, wetland shrinking, sea level rising, etc[2]. The paper, according to the study situation and real

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demands of Chinese estuarine coastal researches, analyzes several future popular focuses on estuarine coastal ecological researches.

2. Ecological problems of estuarine coastal areas

2.1. Serious shore erosion

Shore erosion at estuarine coastal areas, as a common ecological problem for global coastal areas, has been more and more serious in each coastal country in recent decades. Over 50 years ago, except for several river deltas which suffered from erosion, most shores of China were stable without serious erosions. However, since the end of 1950’s, the situation has been reversed. More and more shores have been eroded, so have the sand, mud or coral reef shores. Particularly, the erosion area has been increasing fast in the recent over 10 years. Coastal erosion has brought great damages to the economic development of Chinese coastal areas, increased the risks of flood and soil salinization, and damaged the coastal ecological system.

2.2. Serious water pollution of offshore

In recent years, water eutrophication has been more and more serious in the world. As far as surface water is concerned, China is suffering from serious water pollution. For instance, over 70% of the rivers have been polluted; the total sewage from urban areas has reached 58.4 billion m^3; serious agricultural non-point source pollution has affected the offshore water. According to the reports, the water worse than class 1 sea water has been expanded for 10-30 km from the coast in most coastal areas, and even 120-200 km in Jiangsu, Shanghai, Zhejiang and east Liaoning. The water around the Yangtze delta is worse than class I with serious SS pollution. As a result, red tide has been occurring more and more frequently. From Sep. 18th to Oct. 15th, 1998, serious red tide happened in Bohai Sea, over 5,000 km^2 water in Liaodong Bay, Bohai Bay, Laizhou Bay and Central Bohai Sea affected and 500 million RMB lost. In Jul., 1999, 6,300 km^2 of water in Bohai Sea was affected by red tide. In early summer of 2000, thousands of km^2 of water around Hangzhou Bay suffered from a large area of red tide. From middle Mar. to early Aug., 1998, a red tide at the Zhujiang River mouth caused 31.5 billion RMB of economic loss for fish breeding industry of Guangdong and Hong Kong. The blue-green algae happened in Tai Lake in 2008 even polluted the drinking water of human beings.

2.3. Damage to wetland and biodiversity

According to the Report on Marine Environmental Quality, about 50% of coastal wetland, 70% of mangroves and nearly 80% of coastal coral reef in the world have lost or been destroyed. In recent years, the ecological environment along the Yangtze River has been greatly destroyed. For example, about 1. 72 $\times 104$ hm^2 of mudflat in Yangtze Delta was cultivated each year, including 16. 28 $\times 10^4$ hm^2 of mudflat in Zhengjiang from 1950 to 1999 (namely 3,256 hm^2 /a). As a result, the wetland of Yangtze Delta has been greatly reduced or even gone, with many natural habitats for wide animals gone together. The Yellow River Delta, as a broad origin estuarine wetland which is the most complete, largest and youngest wetland ecological system in warm temperate climate of China as well as one of the areas with most diversified creatures in the world, has also been eroded with climate warming, water and soil conservation project in the middle reach, water demand for human beings and irrigations, and less water and sand to the sea. What’s more, the ecological environment of Zhujiang River Delta has also been worsening with more frequent red tide, less diversified creature, less mudflat wetland, etc.

3. Current researches

The current researches on estuarine coast area are focused on the effects of human activities on environmental changing, resource protection and development, with a great many research achievements born at home and abroad, which can generally be concluded into three aspects:

3.1. Research on coast erosion

At present, shore erosion for estuarine coastal areas has been a common disaster for global coasts. The U.S., Japan, UK, Australia, Soviet Union had invested a lot to estuarine coast erosion observation and theoretical researches since 1960’s, presenting many valuable research achievements. In recent 10 years, the researches on estuarine coastal erosion treatment at abroad have been focusing on shore protection engineering planning and protection management. Omran E. Frihy (1996) believed that the 260km long coastal line of Nile Delta was eroded and shrank. He suggested that coastal and oceanic management shall be implemented with remote-sensing data and observation data combining with the database management system and geographic information system[3]. Solomom Makoloweka (1997), etc. stated the management method applied to Tanga Coast of Tanzania[4]. In UK, loss-benefit analysis on coastal protection plan helped the government a lot. David Whitmash, etc.(1999), adopting the method based on accidental value method, targeting at a famous coastal resort of UK, analyzed the benefits deriving from different coastal protection plan[5]. Arved J. Raud-kivi, etc. (2002), through the analysis on observed data and physical model, discussed the methods for shore protection, including artificial sand addition, dam construction, integrated diaphragm, etc[6].

Researches on coastal erosion were started after 1980’s in China. Wang Wenhai etc.(1991), through analyzing the characters of Chinese coastal erosion, stated the necessity and fundamental methods to establish coastal erosion information system, and presented related conclusions[7]. Chen Xueying, etc. (1998) stated several basic works on coastal erosion disaster management[8]. Wang Wenhai etc.(1991) also discussed the evaluation methods for coastal erosion disaster, the selection of evaluation index and division of disaster class, especially the suggestions on disaster evaluation with comprehensive index[9]. Sheng Jingfen (2002) etc., based on the analysis on Chinese coastal erosion, proposed several concepts on coastline erosion management, technologies and theoretical supports on coastline management, and coastal band legislation, etc[10]. Feng Aiping (2003) etc. analyzed disaster strength element and disaster degree element of coastal erosion, and proposed the coastal erosion disaster strength division plans, which provided guidance for disaster prevention and reduction of coastal band[11]. Wang Yuguang (2005) etc., through spot investigation and monitoring, analyzed the features of sand coast erosion at eastern and western sides of Liaodong Bay, believing that material loosing and strong coastal power are basic conditions and human activities are key elements for coastal erosion of the area[12]. Zuo Shuhua and Li Jiufa (2006) etc., directing against the erosion status of the coastlines of the Yellow River Delta and Yangtze River Delta, analyzed the main elements of Chinese coastline erosion and the protection measures adopted in China, and proposed related solutions[13].

3.2. Water quality research of estuarine area

Growing agricultural fertilizers and accelerating urbanization bring more pollutants to the sea, which greatly aggravates the water quality of the near sea, including frequent red tides causing 1 billion RMB economic loss. A lot of money has been invested to spot observation and theoretical researches at home and abroad, presenting many valuable research achievements.

Chaurasua A etc. (1994) researched the nutrient salt monitoring system[14,15], while Wuseng Lung

(2004) studied on the eutrophication model of estuarine water quality, getting conclusions on the establishment of the model and its calibration, simulation method and the relations among different parts of the model, and discussing the main parts of the estuarine model[16].

Liu Cheng etc. (2003), according to the analysis on the content of heavy metal, arsenic, nitrogen and phosphorous of 12 water samples collected at the estuarines around the Bohai Sea Bay, found out that the water of the area had been seriously polluted mainly by Hg, N and P, making the water surpass standard V of surface water and the other pollutant content within standard II of surface water. For instance, the content of Hg at the estuarine of Hai River was over 10 times higher than that 20 years ago. The content of N and P of each estuarine had reached the bottom line of water eutrophication, with land pollution sources found to be the main reasons for eutrophication and red tide of Baihai Sea which were more and more serious[17]. Jiang Weiwu etc. (2004), with Chinese first nutrient salt consistent monitor for successive and automatic examination on water quality of estuarines, analyzed the elements including light wave length, salty degree of samples, ingrain agent saving time, bubbles in measurement, etc., which are able to stabilize the results as controlled. Compared with the national standard, the result was proved to be accurate. All the researches above are significant to the treatment of estuarine water[18,19]. Li Yingjie, etc. (2008), through analyzing the water quality differences before and after floating bed establishment and removal at the estuarine of Tai Lake, investigated the purification effect of floating bed on estuarine water quality and analyzed the purification mechanism. According to the results, ecological floating bed is proved to be with strong purification capability[20].

3.3. Recovery and reestablishment of estuarine wetland

Estuarine wetland is not only the region with concentrated human and animal activities, but also the area with concentrated natural ecological processes. It plays a key role in rare animal protection, biodiversity maintenance, coast protection, etc. Since 1960's, under the effect of global climate change and social-econmic development, the natural wetland has been shrinking, so does its functions, benefit and biodiversity. Therefore, a series of ecological and environmental problems are aroused, making the governments of the world realize the importance of wetland protection strengthening.

Simenstad etc. (2005), taking Duwamish estuarine of western Pacific as an example, believed that estuarine ecological environment had to be evaluated while recovering estuarine ecology[21]. Weinstein etc. (2005) emphasizes that different ecological environments and microfeature of the estuarine area had to be both taken into consideration while recovering the coast status of estuarine, so that the ecological system of estuarine wetland could be maintained dynamically balanced with better material and energy exchange[22].

In China, the studies on estuarine wetland recovery is still in theoretical period. For instance, Fan Hangqing, etc. (2001) analyzed the main difficulties on secondary mangrove recovery at Beicang River estuarine, proposing that the elevation of shores through projects was favorable for mangrove recovery[23]. Xing Shangjun etc. (2005), researching the ecological function and ecological recovery of the Yellow Delta Wetland, believed that ecological recovery should take actions that suit local circumstances, guarantee water source protection, protect origin vegetations, introduce salt-proof plants, increase vegetation variety and coverage[24]. Wang Shugong etc. (2005), taking advantages of large plant growth control model of Zhujiang River Delta wetland, controlled the competition relations between sonneratia apetala and spartina alterniflora[25].

4. Prospects

According to the four challenges (including sediment reduction, pollutant growth, wetland shrinking

and sea-level rising) for Chinese estuarine coast proposed by professor Chen Jiyu, and the reports of the 2nd and 3rd estuarine coast international conference, the future researches on Chinese estuarine coast shall focus on the following aspects:

4.1. Research on sediment reduction

Compared with the annual sediment of the Yellow River which was 1.2 billion tons and the Yangtze River which was nearly 0.5 billion tons in the 1950’s, the current sediment has been reduced for nearly 50%, which may bring negative impacts on coastal ecology. For instance, the U.S. governments decided to divert the water from Sundy River to Kobe River at the east foot of Mountain Appalachia in 1940’s, which then greatly blocked the course of the port. The water diversion project was then abandoned in 1980. After the establishment of water diversion project of Luan River, the sediment was accumulated in the reservoir, which greatly reduced the sediment to the delta. Today, the effect of the South-to-North Water Diversion Project on Yangtze River’s ecology still waits to be evaluated, aiming at reducing negative effect as much as possible.

4.2. Estuarine water quality recovering research

With the development of industrialization and urbanization, the growth of pollutants to the sea has seriously polluted the water. Though there have been many researches on estuarine water quality at home, there are few researches on how to purify water. ecological floating bed, as a practical technology on water environmental treatment and ecological recovery, has been widely applied to the projects[26-28], receiving satisfactory effects. There are also some reports on the purification effect and working mechanism of ecological floating bed, but the reports are mainly on the closed water like ponds rather than estuarine[29-32]. More researches shall be done on how to purify water and how to apply the bed to projects.

4.3. Wetland protection

The research on wetland recovering at estuarine is still at the beginning in China, mainly focusing on the recovery of wetland vegetation system and habitat function recovery. The researches on mangrove recovery hves been well applied, but the other researches, especially the researches on wetland recovery are still at the beginning. However, there have been some research achievements on wetland recovery at abroad[33-34]. Chinese coastal provinces and cities have also done something like spartina anglica planting and various ecological projects. In the future, more works should be done to wetland recovery, guaranteeing the effect of wetland recovery.

5. Conclusion

The areas at the river mouth or kissing the sea are usually economically developed and population concentrated, so their ecological environmental changes directly limit the economic and social development and natural sustainable development of the country. Today, coastal erosion, recovery of river mouth water quality and wetland protection are the key to the study on coastal ecological environment. However, the study is just at the beginning at our country, with the related theroies and systems waiting for improvement. As the pressure on river mouth and coastal environment protection increasing, the study on their protection has aroused wide attention in the country, with great achievements realized both theoretically and practically. Though there is still a long way to go, we, on the

basis of harmony and sustainable development between human beings and the nature, have been determined to take advantages of the foreign achievements on river mouth and coastal ecological development, improve our research as well as our river mouth and coastal ecological environment, relieve the environmental pressures and promote the environmental protection on river mouth and coastal areas.

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