

The Situation and Countermeasures of Artificial Ocean Disasters in Shandong

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Abstract: Shandong Province has suffered from a lot of artificial ocean disasters(hereinafter referred to as the "AODS"), such as salt water intrusion, coastal erosion, environmental pollution and red tide etc. In this paper, AODS's characteristics, causes and effects on marine ecology and development are discussed. The main causes of aggravating AODS include the long term exploitation of underground water, careless coastal zone development, damming of fresh water, lack of systematic management and due consideration of marine environment. In order to reduce AODS, some countermeasures are suggested. A comprehensive plan to develop the coastal zone and ocean resources should be prerequisite; A systematic management and environmental protection based on ecosystem-approach should be strengthened; A system of coastal protection such as embankments, shelter-forests, etc. should be developed; AODS should be studied more in detail. AODS monitoring system should be designed and well-functioned; The knowledge of environmental protection based on ecosystem-approach should be publicized to the public in Shandong.

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I . INTRODUCTION

Artificial Ocean Disasters(AODS) are defined as the ocean disasters caused and worsened by manmade factors. Shandong is one of the largest provinces in China. In its history, there were many ocean disasters such as windstorm agitation, storm wave, ocean fog, etc. In the past several decades, excessive utilization of coastal zone has also caused many artificial ocean disasters like salt water intrusion, red tide, coastal erosion and so on. They often result in disasters which could be avoided, so that it is worthwhile to study on how to reduce and prevent these avoidable AODS.

II. ANALYSIS OF MAIN ARTIFICIAL OCEAN DISASTERS

1. Salt Water Intrusion

The salt water intrusion is the most serious factor of AODS in Shandong. In the past decade, areas of salt water intrusion have been expanded and the situation is getting worse because of many bad factors. Data in April, 1991 revealed that the eighteen cities and counties along Shandong coast have been intruded by salt water. The total damaged area was around 730.3km², and 333.3km² agricultural land could not be irrigated, among which the area of 33.3km² became a waste salt land. These salt water intrusions also resulted in 100-200 million kg of a grain loss annually and caused difficulties to 445,000 residents in getting fresh water and 450,000 people were suffered from local diseases.

2. Red Tide

Before 1980's, a few cases of red tides were detected in Shandong. During May and June of 1952, red tide mainly consisting of noctiluca

occured in the Yellow River estuary about 70km long and 20km wide, which caused the fish-kills such as perch. In 1974 and 1978, red tides at small-scale appeared around Lu Shan county and Jiaozhou Gulf, respectively. Since 1980, especially in recent years, red tides occurred more often than before. During August-September in 1989, several cities and regions such as Huimin, Weifang, Dongying, Yantai around Bo Hai sea coast experienced the various degrees of red tide which caused a great economic loss. Red tides appeared in coastal waters again in 1990 at large-scale. It was also reported that the coastal waters suffered from seven episodes of red tides from June 12 to September 10. It occurred in 1990 more often, longer, and widely than before.

3. Coastal Erosion

Coastal erosion in Shandong is very serious. About eighty percent of the coastal land in Shandong has been eroded due to various factors. The coastal erosion occurs mainly around Shandong Peninsula and Yellow River Delta. In the Peninsula, wide sandy-shell beach and low-flat sea deposit developed in thousands of years after the Glacial Epoch had shown a serious erosion trend in the past decades, especially Diaolongqui in Laizhou-Linge in Penglai, Yangma Island in Muping-Shuangdao bay in Weihai, Wulei Island in Wendeng-Baishakou in Rushan, Shijinsuo-the mouth of Fenshui River, etc., where the flat and straight sandy coasts were eroded considerably. It is figured out that average erosion rate of these flat-straight sandy coasts is varying from 1.5 to 3.4 meters per year. Coastal engineering projects, coastal zone architectures, roads, fertile farmland were damaged. Now, in north of the Yellow River estuary, Dahekou-Shunjianggou coastal land was eroded annually about one meter per year, Shunjianggou-Shenziangou coastal land 100-150 meters, and Goukou coastal land 300 meters respectively.

III. THE CAUSES OF ARTIFICIAL OCEAN DISASTERS AND ITS TREND

1. Causes of Aods

The natural factors causing AODS in Shandong include the drought, windstorm agitation, topographical conditions and so on. In general, artificial factors are more attributable to AODS. The following are these factors:

1.1 Long-term over-exploitation of underground water : Since the end of 1970's, the long-term drought and increasing demand for fresh water in Shandong have caused the over-exploitation of underground water and resulted in shortage of underground water resource. Statistics showed that Laizhou city exploited total of 838 million tons of underground water from 1976 to 1989, 60 million tons every year, and underground water level decreased by 14.04 meters every year, which resulted in the reduction of the underground water in the region of about 262.05km². Usually, the level of fresh water and salt water is maintained in balance, but if the level of fresh water becomes lower than that of salt water for some reasons, it can lead to salt water intrusion. In case of Shandong, the over-exploitation of underground water was the main reason to cause the intrusion of salt water.

1.2 Unreasonable coastal zone development: One of the factors causing AODS was unreasonable layout of salt water ponds. Along the Shandong coast, especially in Laizhou bay, many salt water ponds and aquaculturing ponds have been developed rapidly since the end of 1970's. And salt water was channeled to the inland area of distance from sea, about 5-15km, which caused salt water to seep into ground. Second, seaside's sand-mining has been incurred rapidly in the past twenty years. Of course that also caused the beach to lose its sand balance significantly, and thus worsened the coastal erosion. The third was to implement unreasonable coastal development projects. For example, the Ports of Lanshan and Shijiusuo built in 1970 was designed without due

consideration. After 4 years passed, low-tide line pressed on towards the seashore obviously and the high-tide line beach became eroded gradually. As a result, some coastal buildings and houses were collapsed and salterns in the back were often flooded.

1.3 Ocean environmental pollution : During the last decade, the socioeconomic development and the ocean exploitation in Shandong coast caused environmental pollution in some sea areas. There are four major sources of marine environmental pollution. First, the coastal-based industries have poured a lot of waste water into ocean without proper treatment. Second, the oil exploitation in the coastal area and the increase of marine transportation have often resulted in marine pollution. Third, the excessive number of salt water ponds also are blamed for environmental pollution in the sea. Last, the chemical materials and fertilizers used for agriculture have been another main sources to contaminate the ocean in Shandong. All of these factors seem directly or indirectly relevant to the red tides occurring frequently in Shandong coastal area.

2. Trend of Artificial Ocean Disasters

The degree of ocean disasters mainly depends on the improvement of natural and artificial condition. An analysis of various natural factors showed that the lithosphere, hydrosphere, aerosphere and biosphere would have another new active period from the present until the beginning of next century and the earth is expected to get into a period of severe natural disasters. At the same time, CO₂ discharge will keep the temperature of the earth going up and sea level rising. Certainly, the sea level rise will result in ocean disasters such as coastal windstorm agitation, great wave, severe salt water intrusion, coastal erosion, etc. So far, unreasonable marine and coastal zone development have caused as artificial factors the marine environment deterioration or harmful change which cannot be rehabilitated in a short time. The ocean-related economic activities will become more active and intensive in the future because of

the plan to carry out "Marine Shandong". If the unreasonable development of ocean resources continues to take place, the AODS will become more frequent and serious, so that the economic loss will be greater. Unless some effective remedies are adopted, the AODS in Shandong coast is predicted to become worse in the future. Besides, some other AODS including coastal land subsidence and extinction of marine living resources will also happen. So it is imperative to monitor the trend of AODS in order to effectively prevent them in Shandong.

IV. Countermeasures and Suggestions to Remedy AODS

1. Reducing unreasonable Exploitation by Improving Coastal Management

The basic cause which results in AODS is unreasonable exploitation of the coastal area, so that the important measures available to ease AODS are to stop or at least reduce the unreasonable exploitation. Considering the situation in Shandong, the following two aspects should be kept in mind for management of control of AODS: First, a proper management system for marine and coastal development should be established. So it is suggested that comprehensive ocean management organization, or ocean management bureau should be set up to organize and coordinate the ocean-related institutions and local marine economic activities; Second, marine and coastal resource exploitation should be implemented on the basis of comprehensive plan made in advance.

2. Strengthening Protection Measures to Improve Function of Marine Ecosystem

The primary measures to avoid damages caused by red tides and the

other disasters are to improve function of marine ecosystem. In terms of marine ecosystem in Shandong, the ocean management should be enforced as follows: 1. Controlling the discharge of land-based pollutants; 2. Strengthening the management of discharging waste produced in making salts; 3. Strengthening the management of oil exploitation, ship-dismantling and ship-originated waste material; 4. Strict regulation of leakage of oil and oil mixtures and dumping of material and other harmful materials especially into fishing grounds and sea-farming area.

3. Speeding up Development and Construction of High Grade of Coastal Structures

The construction of coastal structures such as tidal barrage, floodgate and bank revetment is an important measures to prevent not only natural disasters but also AODS such as salt water intrusion and coastal erosion caused by human activities. In this regard, there are two essential aspects considered in coastal engineering to accomplish these purposes: High-quality of tidal barrage, floodgate and bank revetment projects should be executed quickly according to topographic features and disasters of the regions considered; Construction standards should be strictly applied and upgraded enough to bear the raid of greater ocean disasters.

4. Monitoring and Forecasting System of AODS

Another important measures to reduce AODS is monitoring of dynamic changes in all kinds of factors associated with AODS and making scientific forecasts. Data from relevant sources can be used for scientific study of AODS. Presently, the immediate red tide monitoring system has been set up in Shandong in order to ease red tide, but so far, there is no completely systematic network to monitor and forecast AODS. So monitoring system should be redesigned and made complete step by step in the future in order to effectively forecast and control AODS.

5. Strengthening Scientific Study on AODS

On the basis of AODS features, recent AODS study would focus on the following aspects: 1. The processes, the frequency of occurrence and the change of AODS; 2. Systematic countermeasures for marine environmental protection; 3. The relationship between AODS and other disasters; 4. marine ecosystem related with ocean disasters; 5. information database for ocean disasters.

6. Educating the Public to Reduce Ocean Disasters

In order to effectively ease AODS, all coastal users should take part in cooperative actions for environmental protection. Propagation and popularization of disaster -easing knowledge can motivate all users to pay attention to controlling AODS. It is certain that educating of the public for strong motivation and active participation is essential to be successful in avoiding AODS.

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