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Assessment Method of The Impact of Reclamation on Marine Resources based on PSR Model

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Abstract: The coastal area occupies a pivotal position in the social and economic development, which is of great significance to the development and utilization of the ocean. Reclamation is the main way of the utilization of the coastal area. This paper mainly studies the assessment method of the impact of reclamation on Marine resources based on PSR model. This paper first analyzes the impact of reclamation projects on the environment, and then uses PSR model to construct the Marine resources impact assessment index system. According to the model calculation results, it can be known that the wetland ecological damage caused by reclamation activities in a certain sea area is within the tolerable range.

1. Introduction

The coastal area is the intersection of land and sea, with rich natural resources, convenient transportation, and a large amount of capital and organizations gathered there. At the same time, national and local development policies are also inclined to coastal cities. Under the joint action of the two, regional economy has achieved rapid development [1]. The advantageous resources superiority, livable and comfortable natural conditions, as well as the rapid development of economic trends to attract, a growing number of population migration to coastal cities, the city in order to accommodate the increasing population and capital, need to expand, so people will look from land to sea, coastal countries and regions have started a series of wai reclamation activity, Among them, the Netherlands, Japan and South Korea are the most typical [2-3]. Large-scale reclamation activities not only alleviate land pressure and develop regional economy, but also cause problems such as deterioration of natural environment and sharp decline of ecological resources [4]. In the early stage of reclamation activities, it is of great significance to clarify the existing stock and development potential of reclamation projects and analyze the evolution characteristics and driving factors of reclamation activities. Firstly, it is helpful to realize the balance of reclamation and

reclamation and restore the coastal ecological environment. Second, it helps to improve the capacity of each unit of reclaimed area and optimize the layout of reclaimed industry. Third, it is helpful to formulate a comprehensive and reasonable comprehensive reclamation management system and promote the sustainable development of regional economy [5-6].

With human's large-scale and high-intensity development and utilization of coastal waters, a large number of coastal wetlands have been occupied, resulting in a series of negative impacts such as ecological environment deterioration, sharp decline in biodiversity, frequent Marine disasters, and reduction of natural landscapes. The emergence of these problems has led more and more organizations and scholars to focus on the development and utilization of coastlines and coastal zones [7]. On the one hand, the negative impact brought by the development and utilization of coastal zone cannot be ignored; on the other hand, the government needs theoretical basis and data support to formulate management policies and laws and regulations. Therefore, scholars at home and abroad have conducted a series of studies on the development and utilization of coastal resources [8]. Some scholars studied Eastbourne Town, a famous seaside resort in Britain, and evaluated this area from both economic and ecological aspects, and concluded that the economic benefit assessment combined with ecological benefits is feasible and can provide a basis for public decision-making of coastal environment [9]. Some scholars evaluated the environmental impact of the development of coastal wetlands in Southern California and proposed that reclamation should follow certain rules and regulations during the development of coastal wetlands in Southern California [10].

This paper takes the reclamation area of a certain sea area as the research object, aiming to find out the status quo of reclamation, explore the evolution law of reclamation, analyze the driving effect of natural, social, economic and policy factors on reclamation activities, and strive to provide data support and theoretical basis for the further development of reclamation activities in the bay area.

2. Construct PSR Model for Marine Resource Impact Assessment

2.1. Impacts of Reclamation Works

Almost all the above mentioned Marine resources are affected by reclamation activities to different degrees. The following is an analysis of the impact of reclamation activities on Marine resources from six aspects.

(1) The erosion and silting ability is reduced

The hydrodynamic condition of sea area has a great influence on the environmental quality of offshore, and the hydrodynamic condition of sea area is closely related to the changes of sea area and shoreline. Reclamation projects are bound to change the area of the sea area and the original appearance of the shoreline, thus exerting an influence on the hydrodynamic environment of the reclaimed sea area [11].

(2) The number of bays and islands has decreased sharply

Coastline is a natural boundary between land and sea formed by the long-term interaction of various natural forces. As a basic component of coastal spatial resources, coastline plays an important role in maintaining the balance of coastal ecosystem [12]. For a long time, the use of coastal flat extension is one of the main ways to implement reclamation projects, which has caused serious damage to the coastline resources of China, and the length of the natural coastline has been sharply reduced. The artificial index of the coastline has reached 0.38.

As the reclamation inside the bay can obtain larger reclamation area with the same amount of reclamation work, people are used to the curving and straight reclamation inside the bay, resulting in the reduction or even disappearance of the bay space, with deep negative impact [13]. According

to statistics, the number of bays in China has decreased by more than 100 since the founding of the People's Republic of China, and the actual area of a large number of bays is shrinking.

(3) Destruction of natural landscape

There are numerous cases of natural landscape damage caused by coastal reclamation projects. Qingdao Jiaozhou Bay has a unique geographical location, which has attracted the favor of the local government and enterprises. Many coastal wetlands have been developed into real estate and industrial and mining enterprises, which has seriously damaged the local ecological characteristics and lost the value of natural landscape.

(4) Loss of sea space

With the expansion of land reclamation, the tendency of decreasing tidal wetland resources will continue. The thorough transformation of coastal tidal wetlands by reclamation has changed the natural characteristics formed by their long-term evolution, resulting in irreversible ecological environment damage and potential negative impact on economic and social development [14].

(5) Decline of fishery resources

25% of animal proteins consumed by humans are provided by Marine fishery resources, and the sustainable development and utilization of Marine fishery resources is directly related to the national economy and people's livelihood [15]. At present, the situation of fishery resources in China's coastal waters is not optimistic. The fishery resources in Liaodong Bay, Luanhekou, Bohai Bay, Laizhou Bay, Haizhou Bay, Yangtze River Mouth, Zhoushan, Pearl River Mouth and other famous fishing grounds are nearly exhausted. Many economically important fish, shrimp, crab and shellfish have completely disappeared and can only be preserved in people's memory. The accelerated decline of offshore fishery resources seriously threatens the sustainable development of Marine fishery and the quality of life of coastal residents in China [16].

(6) Decreased biodiversity

Organisms can only adapt to some specific natural conditions, so the natural condition of a region has a decisive impact on the ecological population structure in the region. By reshaping the comprehensive effects of tidal flat elevation, hydrodynamic force, sediment characteristics, vegetation succession and other environmental factors, reclamation projects will change the natural environment on which Marine organisms live, reduce the biodiversity around reclamation areas, and change the dominant species and community structure [17-18].

2.2. PSR Model Construction

Based on the PSR model, this paper sets the indicator types from three dimensions, namely pressure (P), state (S) and response (R).

(1) Construction of pressure dimension indicators

Stress, as the name suggests, is the pressure exerted by human activity on the oceans. Human life and production cannot be separated from the ecological environment. With the progress of productivity, the impact on the ecological environment is becoming more and more obvious. The rational utilization of Marine resources is indispensable to the ocean management. In the process of developing Marine economy, human beings exert multiple pressures on the ocean. Therefore, the Marine resources and environment are mainly affected by human beings in two aspects: the pressure brought by economic development, the demand for Marine resources and the pressure of pollution to the Marine environment. Therefore, the resource and environment bearing pressure (P1) is set under the pressure layer in this paper, and the specific index setting is shown in Table 1 below:

(2) Construction of state dimension indicators

The state is the final state of the ocean after the comprehensive effect of pressure and response,

which can directly reflect the local governance results. As a big Marine country, China has abundant Marine resources. In this paper, the measurement difficulty of the indicators and the applicability principle of the indicators are analyzed and selected from the Marine environment status (S1) level to analyze the existing problems in the Marine environment and the target status of the Marine functions. Specific indicator Settings are shown in Table 2 below:

Table 1. Pressure dimension index (P)

Project layer	Index layer	Index code
Pressure(P1)	Loss of biological resources	P11
	Loss of fishery resources	P12
	Loss of species resources	P13
	Loss of tourism resources	P14
	Loss of wetland resources	P15

Table 2. State dimension index(S)

Project layer	Index layer	Index code
State(S1)	Shoreline utilization rate	S11
	Wetland space utilization rate	S12
	Intertidal biodiversity	S13
	Zooplankton diversity	S14
	Primary productive force	S15

(3) Construction of response dimension indicators

The response is the government's treatment of Marine pollution and other problems. In recent years, our country has paid greater attention to the problem of Marine pollution and is increasingly aware of the importance of developing Marine economy and consolidating Marine power. Therefore, various protection policies have been introduced, and local governments are supposed to comply with compliance. At the same time, according to their own development situation and the characteristics of local Marine resources, local rules and regulations have been formulated to restrict the development of the ocean. Therefore, the response dimension is mainly from the system response level and economic investment response level to evaluate the performance of the government's entrusted responsibility for Marine resource management. Specific indicator Settings are shown in Table 3 below:

Table 3. Response dimension index (R)

Project layer	Index layer	Index code
Response(R1)	Wetland resources protection funds	R11
	Waste disposal fund	R12
	Increase the efficiency of land resources	R13

3. PSR Model Evaluation Experiment

3.1. Data sources

The analysis of sea reclamation area change and coastline extraction and transition is based on Landsat5, Landsat7 and Landsat8, which has a spatial resolution of 30 meters in visible light band.

Four stations (S1-S4) were set up for environmental monitoring, and two stations (A1-A2) were

set up for biological monitoring in nearshore waters. In nearshore waters, eight stations were set up for environmental monitoring (S1-S8), and five stations were set up for plankton, benthic and fishery resources monitoring (A1-A5). Field sampling, sample preservation and laboratory monitoring are carried out in accordance with the Code for Coastal Sea Environment Monitoring (HJ442-2008), Code for Marine Investigation (GB/ T122763-2007) and Code for Marine Monitoring (GB17378-2007). Environmental monitoring indicators mainly include water temperature (T), salinity (S), dissolved oxygen (DO), pH, inorganic nitrogen (TIN), active phosphate, chlorophyll, etc. The main indicators of biological monitoring are zooplankton, benthic organisms, fishery resources and intertidal resources.

3.2. Shoreline Extraction

Urban construction, development of coastal enterprises, wharves and aquaculture have gradually changed the type of coastline. By comparing two kinds of multi-color composite images, namely, band 3, band 2 and band 1, band 5, band 4 and band 3, the images have been stretched in order to improve the contrast of different landforms. Then the shoreline types are screened and extracted. Shoreline types are defined according to the following criteria:

(1) Artificial shore

Artificial shorelines refer to the changes made to the natural coast by human construction activities, including town edges, offshore enterprises, wharves, and unfinished engineering facilities, which appear as gray or white patches on remote perception maps.

(2) Natural shore

Natural shorelines refer to the edges of trees and vegetation that have not been affected by human construction activities or built for ecological protection. Patches of green landforms can be observed in remote sensing images. In addition, they also include the bedrock coast without vegetation coverage, which is grayish-black in remote sensing maps and has irregular shorelines.

4. Analysis of Experimental Results

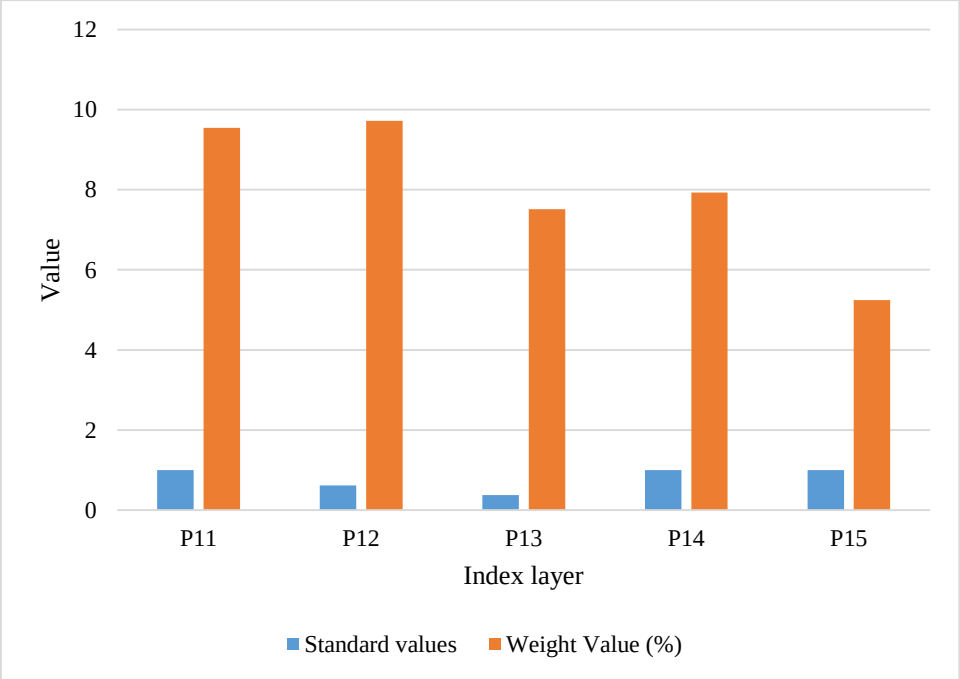

Figure 1. Stress dimension evaluation results

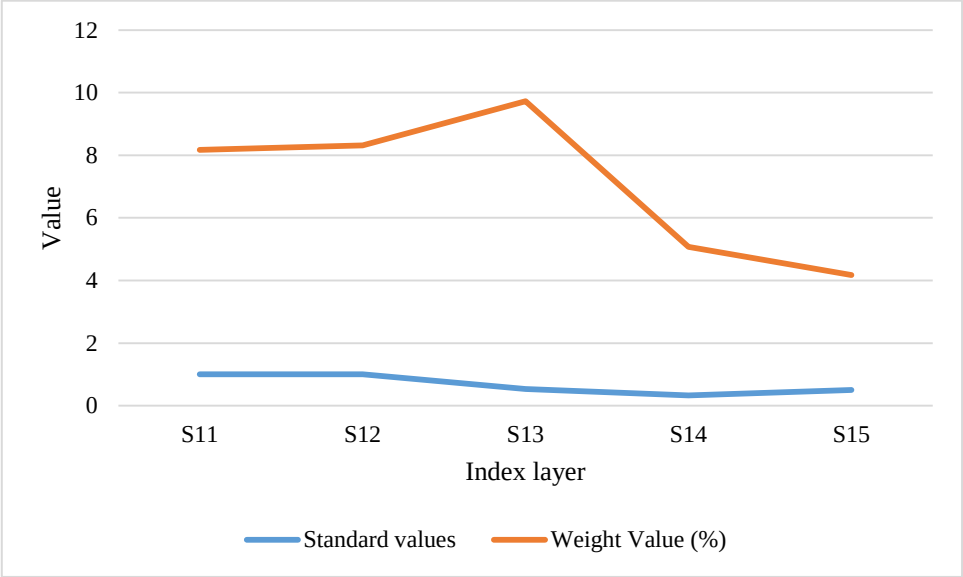

Figure 2. State dimension evaluation results

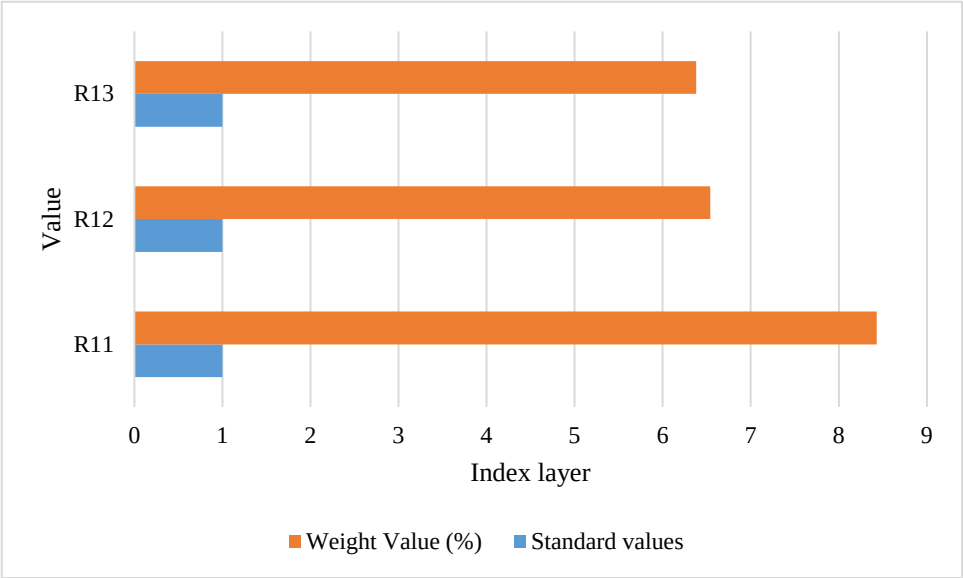

Figure 3. Response dimension evaluation results

As shown in Figure 1, Figure 2 and Figure 3, the impacts of reclamation on sea ecosystem are constructed according to the PSR model. From the results of the three figures, it can be seen that the reclamation and development activities have little impact on the Marine ecosystem, and the wetland ecological damage caused by the reclamation and development activities is still within the tolerable range while promoting the land demand brought by the rapid economic development. The reclamation and development activities of the Marine ecosystem can better maintain the state of sustainable development.

5. Conclusion

In this paper, the influence of reclamation activities on Marine ecosystem is expounded by using the interaction relationship between pressure, state and response in PSR model. Based on the

subsystem of pressure, state and response, an evaluation index system with 3 levels of 13 indicators is proposed. The evaluation index system of the impact of reclamation activities on wetland biological resources and environment was established. In this paper, PSR model is applied to the quantitative assessment of the impact of reclamation on Marine ecosystem, and a full coverage index system is constructed to fill the research gap.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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