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Original Research Paper

The Study of Island Natural Disasters and Preventive Measures

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ABSTRACT

Islands tend to be natural disaster-prone areas, and frequently experience meteorological, geological and ecological disasters. Based on an analysis of the characteristics of major natural disasters (storm surge, coastal erosion, red tide, invasive species), the authors provide an evaluation and analysis of China's marine disasters between the years 2000 and 2013. In addition, the following preventive measures are recommended such as perfecting observation and forecasting systems, strengthening the construction of disaster prevention projects and enhancing the level of integrated management for island protection to mitigate the harm caused by natural disasters as well as to promote the socio-economic development of island areas.

INTRODUCTION

China has an abundance of islands, more than 6500, with a land area over 500 m^2 distributed across an area of three million km^2 seas which are under the jurisdiction of China. If islands smaller than 500 m^2 are added, the total number may be over 10,000. So, in one sense, China is an “island country”. As a bridgehead to the development of a marine economy, the islands and especially the uninhabited islands, have characteristics of both land and sea. The protection and management of islands has attracted increasing attention of the CPC Central Committee and State Council and coastal governments, including in the fields of both environmental protection and economic development.

The unique locations of islands expose them to typhoons and storm surges every year; the islands have fragile environments and complex geological conditions. These various factors increase the occurrence of frequent geological, meteorological or ecological natural disasters which have serious impacts on the economic and social development of island regions. Therefore, we need to study the characteristics of island disasters, create a disaster forecasting system and develop scientific and effective control strategies designed to reduce or eliminate natural disasters and hazards. In addition, we need to improve the environmental conditions of the islands and promote the socio-economic development of island regions.

MAJOR DISASTERS OF THE INSULAR AREAS

Natural disasters that occur on islands can be divided into many different types and many such disasters cause frequent and severe damage. More than 20 kinds of island natural disasters have been categorized based on the classification system for marine disasters. Disasters can be divided into three categories: meteorological, geological and ecological disasters based on the nature of each disaster (Table 1).

Meteorological disasters of islands: The meteorological disasters mainly include storm surges, typhoons, rainstorms, droughts and other natural disasters; some of these involve storm surges that pose severe threat to the island environment.

Storm surges are caused by strong atmospheric disturbances such as tropical cyclones (typhoons) which can induce abnormal movements of sea tide that greatly exceed the average tides. The losses caused by storm surges make up the largest percentage of marine disasters because of their tremendous destructive power. According to Dong et al. (2009), the direct economic losses from typhoons amounted for 110.732 billion RMB during 2001 to 2008. From 1997 to 2010, storm surges occurred 176 times and were mostly distributed in the vicinity of the coastal waters of Guangdong, Fujian and Zhejiang provinces. Because islands are generally located in the forefront of coastal waters, the island regions of these provinces are frequently subjected to typhoons and storm surges which pose serious threats.

Table 1: Classification system of islands natural disasters.

First-class Type	Second-class Type
Meteorological disasters	Storm surges, typhoons, drought, heavy rain, cold wave, sea fog
Geological disasters	Coastal erosion, earthquakes, tsunamis, landslides
Ecological disasters	Red tide, invasive species, forest fires, crop pests and diseases

Storm surges induced by typhoon Matsa caused significant damage to Zhoushan city in 2005. Matsa made landfall on Taizhou Yuhuan Island on August 6 and caused a disastrous storm surge because the intensity and size of the typhoon coincided with an astronomical high tide. Storm surges and heavy rainfall have resulted in direct economic losses to the city reaching to 1.912 billion RMB and resulted in the melting of more than 0.33×10^4 hm^2 of crude salt at the city's salt works; in addition, 1200 ships, 18 traffic terminals and 61 seawalls were damaged (Cao et al. 2010). As a result, storm surge disasters have become one of the most serious threats to the economic development of China's island regions.

Geological disasters of islands: Geological disasters include seismic marine disasters and secondary disasters related to earthquakes such as tsunamis, etc. In addition, coastal erosion, seawater intrusion, avalanches and landslides are mainly caused by the internal and external forces of the earth. All of these impact islands and coastal waters.

Erosion of China's coasts, including both mainland and island shoreline erosion, has become increasingly serious; erosion is causing a widening of the shoreline in some areas. Currently, almost all the open muddy coastline and about 70 percent of the sandy coastline is subject to erosion. Coastal erosion hazards are severe and coastal erosion can reduce the area of beaches and wetlands as well as shorten the length of coastline. Such erosion increases the pressure placed on governments to improve coastal protection and seawall construction. Two main factors result in coastal erosion. First, natural causes, such as changes in the supplies of beach sediment can cause erosion; other things include the enhancement of coastal water-power, including storm surges, waves, river flowing into sea diversions, and sea level rise. Secondly, man-made causes, such as excavation of sand, indiscriminate deforestation of coral reefs and mangroves, beach reclamation and so on can also cause erosion.

Eyu Islet in Xiamen City, Fujian Province presents a typical case of island shoreline erosion (Lin et al. 2010). The changes of oceanic hydrodynamic conditions, the effects of storm surges and wave disasters, anthropogenic sand mining activities and the destruction of the mangroves have led to the following consequences. Eyu Islet's coastal erosion rate was as high as 2.0 m/a, with a maximum erosion width of 42 m; a total erosion area of 14,000 m^2 was observed in the southeast. In addition, shoreline erosion has been observed on Guangdong's Xiachuan Island, the islands of Luodousha and Weizhou in Guangxi. These conditions should be seriously reviewed and analysed.

Ecological disasters of islands: Ecological disasters related to islands mainly include red tides and invasions of non-native invasive species which occur around or on islands.

***Red tide*:** A sudden increase of various tiny phytoplankton, protozoa or bacteria in coastal waters may cause a red tide when serious water pollution or eutrophication leads to sea colour anomalies. Red tide not only causes the death of microscopic marine plants and animals, but also brings serious harm to marine fishery resources and coastal aquaculture. Today, red tides have created serious marine disasters for oceanic countries worldwide.

In China, coastal red tide disasters have become increasingly frequent, increasing from ten times a year in the 1980s to 20 times in the 1990s. Especially, since the beginning of the 21st century, the number of red tide outbreaks has increased dramatically, occurring 119 times in 2003. In April 1991, a red tide occurred in Suao, Aoqian, Baiqing which is associated with Hai Tan Island; it led to an extensive kill of grass shrimp and scallops as well as caused significant damage to local fisheries.

***Species invasion on islands*:** When alien species invade an island, they will occupy the niche of a native species, causing extirpation or extinction of native species while endangering the stability of the local ecosystem. Because islands tend to have a homogeneous distribution of species, a simple ecosystem and closed environment, when an invasion occurs it will often cause irreversible harm to an island's ecological system. Species invasion poses a serious threat not only to the local environment but also results in huge losses to the local economy and may even threaten the survival of mankind with incalculable consequences. The harm is mainly reflected in the three aspects. First, invasive species tend to destroy the ecosystem, cause wanton pollution and destroy pre-existing ecosystems. Second, invasive species can create pollution to the environment, endangering human, animal and ecosystem health. Third, invasive species often result in a loss of biodiversity and a collapse of the food web structure.

Consider Snake Island, located in Bohai Bay, as an example (Luo et al. 2007). Invasive species now pose a serious threat to the island's environment and biodiversity. According to field surveys, alien species causing problems on Snake Island include five kinds of plants and three kinds of animals. Six kinds of non-native invasive species have established stable populations on Snake Island. Invasive and native species compete strongly. Invasive species have been seriously crowding out native species niches and causing severe damage to the natural landscape and biological diversity of Snake Island.

EVALUATION AND ANALYSIS OF CHINA'S MARINE DISASTERS (2000-2013)

China is a marine disaster-prone country; various natural disasters have adversely affected the socio-economic development of coastal areas as well as people working and living in that environment. China does not have separate statistical data for disasters involving islands; the island data are included in the marine disaster data. So we used marine disaster data for this evaluation and analysis.

Many assessment methods can be used to analyse natural disasters. Jin et al. (2012) used an approach based on triangular fuzzy numbers and stochastic simulation to give an evaluation for the natural disaster system of China. Ji et al. (2011) established a storm surge disaster evaluation model based on an artificial neural network. Huang et al. (2010) built a comprehensive flood disaster loss evaluation model based on optimization support vector machine. Because the Analytic Hierarchy Process (AHP) has great advantages, we use AHP to analyse the status and trends of marine disasters in China as an alternative to island disaster analysis.

AHP Theory

The AHP is a multi-objective decision-making method used for quantitative analysis which was first proposed by T. L. Saaty in the 1970s (Zhang 1998).

The basic idea of AHP uses to solve complex problems is to break decisions down into different levels in the order of overall objectives, sub-objectives and evaluation criteria. Then, by determining the eigen vectors of the matrix, the elements weights of each level are determined and compared with an upper element. Finally, the AHP uses a summary weighted method to determine all the weights of the index relative to the overall objective.

The application of AHP generally can be carried out based on the following four steps:

Established a hierarchical model: First, we should group the system elements and construct a hierarchical model when using AHP to analyse a problem. The previous level elements, as criteria, should play a dominant role for the next level elements. Generally, a hierarchical model fall into one of three categories: goals, criteria and indicators.

Construct judgment matrix: When constructing a judgment matrix, we should judge the relative importance of the elements on every level and then give these judgments numerical values.

Table 2: The judgement matrix *B*.

A_k	B_1	B_2	B_j	B_n
B_1	b_{11}	b_{12}	…	b_{1n}
B_2	b_{21}	b_{22}	…	b_{2n}
B_i	…	…	b_{ij}	b_{in}
B_n	b_{n1}	b_{n1}	…	b_{nn}

By comparing the relative importance of each underlying element, such as B_i and B_j, with a top element A_k, we can prepare a judgment matrix B (Table 2).

Hierarchy single ranking and uniformity inspection: Hierarchy single ranking can be attributed to calculate the largest eigenvalue $\lambda_{\max}$ and eigenvector W. For judgment matrix B, we need to calculate the eigenvector W which meets the following formula, $BW = \lambda_{\max} W$. $W = (w_1, w_2, _{\dots}, w_n)$ is the value of hierarchical single ranking which is relative to the previous levels of A_k. If you want to determine whether the matrix B is consistent, you should compare the consistency index with a mean random consistency index (Table 3).

$$CI = \frac{\lambda_{\max} - n}{n-1} \quad ...(1)$$

$CR = CI/RI$ is the consistency ratio. If $CR < 0.1$, it has satisfied consistency with the judgment matrix; otherwise it does not.

Hierarchical general ranking and uniformity inspection: Using the hierarchical single ranking results of elements in the same level, you can calculate the weight compared with the previous level. The hierarchical general ranking should be finished from top to bottom level. If the hierarchical general ranking of all the elements $(A_1, A_{2,\ \dots}, A_m)$ which were compared with previous level have been finished and the weighted results calculated $(a_1, a_2, _{\dots}, a_m)$, the hierarchical single ranking results of all the elements $(B_1, B_2, _{\dots}, B_n)$ in this level is $(b_{1i}, b_{2i}, _{\dots}, b_{ni})$. Then, you can use the calculation method and find the result of B level hierarchical general ranking from Table 4.

$$CR = \frac{CI}{RI} = \frac{\sum_{i=1}^{n} a_i (CI)_i}{\sum_{i=1}^{n} a_i (RI)_i} \quad ...(2)$$

The hierarchical general ranking also need uniformity inspection. As the consistency ratio of hierarchical general ranking, if $CR < 0.1$, it has satisfied consistency with the judgment matrix.

China's Marine Disasters Evaluation

Selection of evaluation factors: Considering the characteristics of marine disasters, the loss evaluation index of marine disasters can be divided into two categories; economic losses and casualties (Fig. 1).

Data selection: First, choose the types of damage caused by marine disasters from 2000 to 2013 in China as the research object; then assess the losses caused by the marine disasters, and analyse the trends of China's marine disasters (Table 5).

Standardization of data processing: In order to eliminate the variables of different orders of magnitude or dimension, the original data need to be standardized. Assuming x_{ij} represents the index value of *j* in *i* year, then the standardized value of x_{ij} is:

$$x_{ij}^{'} = \frac{x_{ij}}{\sum_{i=2000}^{2013} x_{ij}} * 100 \quad (j = 1, 2, 3\ldots 7) \qquad \ldots(3)$$

Loss data of China's marine disasters after standardization (2000-2013) are given in Table 6.

Calculate weight and uniformity inspection: After developing the importance of marine disaster assessment indices through expert advice and construction of the judgment matrix, we were satisfied with the uniformity inspection. Then we obtained the weight for each index value (Table 7, Fig. 2). The consistency ratio (*CR*) of economic losses is 0.0061 and the weight is 0.3543. The consistency ratio (*CR*) of casualty losses is 0.0000 and the weight is 0.6457. The consistency ratio (*CR*) of hierarchical general ranking is 0.0000. Because the $CR < 0.1$, we had satisfactory results.

Calculate composite scores of annual marine disaster losses: According to standardized data of China marine disaster losses and the weights of each index, we can calculate

Table 3: Mean random consistency index.

Matrix Order	1	2	3	4	5	6	7	8	9
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45

Table 4: The method for hierarchical general ranking calculation

A B	A_1 a_1	A_2 a_2	… …	A_m a_m	(B Level Hierarchy General Ranking)
B_1	b_{11}	b_{12}	…	b_{1m}	$\Sigma a_i b_{1i}$
B_1	b_{21}	b_{22}	…	b_{2m}	$\Sigma a_i b_{2i}$
…	…	…	…	…	…
B_n	b_{n1}	b_{n2}	…	b_{nm}	$\Sigma a_i b_{ni}$

the composite scores *T* of annual marine disaster losses from 2000 to 2013. The formula is:

$$T_i = \sum_{j=1}^{7} x_{ij}^{'} * W_j \qquad \ldots(4)$$

Where, i = 2000, 2001… 2013; W_j is the weight of *j* index)

Table 8 shows the composite scores and the rank of annual marine disaster losses from 2000 to 2013 and Fig. 3 shows the trends of marine disasters in China for the same time period.

Analysis of Marine Disasters Situations in China

The marine disasters index weights indicate that the casualty loss index is weighted heavier than the economic loss index. This demonstrates that how China puts people first in their thoughts related to disasters. In any disaster, protecting people's lives should be the first priority and disaster relief and mitigation should basically strive to reduce the number of deaths and injuries as much as possible.

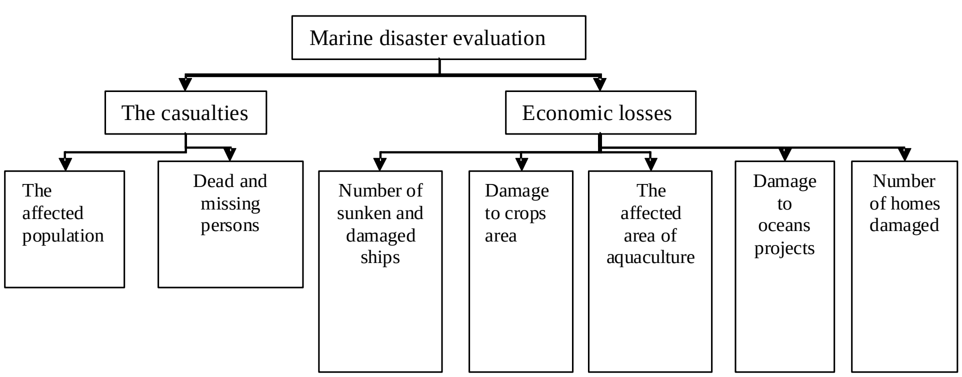

Fig. 1: Marine disaster assessment index system.

Table 5: Loss data from China marine disaster from 2000 to 2013.

Year	The affected population ($\times10^4$)	Damage to crop areas (ha$\times10^4$)	The affected area of aquaculture (ha$\times10^4$)	Number of homes damaged ($\times10^4$)	Damage to ocean projects (km)	Number of sunken and damaged ships	Dead and missing persons
2000	1003.2	39	3.9	18.1	406	941	79
2001	1336	30.8	6.04	4.2	108.3	10848	401
2002	1059.5	37.1	4.5	4.4	355.2	1986	124
2003	2080.5	79.8	15.99	3.97	159.81	2171	128
2004	1614.2	167.2	14.3	2.27	607.1	4082	140
2005	2316.9	147.1	38.9	7.95	600.7	6342	371
2006	2688.3	95.4	12.14	14.97	711	6980	492
2007	428.32	4.82	10.87	116	71.6585	8560	161
2008	1762.18	30.359	7.0885	5.4	1181.69	5107	152
2009	872.12	43.632	11.633	0.89	294.95	3047	95
2010	437.07	3.841	4.7848	1.31	124.63	1108	137
2011	234.68	10.627	4.3621	0.08	58.1	2121	76
2012	752.18	17.43	44.358	3.6006	335.45	3153	68
2013	1380.34	35.466	55.46	0.6308	286.38	14342	121

Note: Data from the Bulletin of Marine Disasters in China (2000-2013).

Table 6: Loss data of China's marine disasters after standardization (2000-2013).

Year	The affected population ($\times10^4$)	Damage to crop areas (ha$\times10^4$)	The affected area of aquaculture (ha$\times10^4$)	Number of homes damaged ($\times10^4$)	Damage to ocean projects (km)	Number of sunken and damaged ships	Dead and missing persons
2000	5.58	5.25	1.66	9.85	7.66	1.33	3.10
2001	7.44	4.15	2.58	2.29	2.04	15.32	15.76
2002	5.90	5.00	1.92	2.39	6.70	2.81	4.87
2003	11.58	10.75	6.82	2.16	3.01	3.07	5.03
2004	8.99	22.52	6.10	1.24	11.45	5.77	5.50
2005	12.90	19.81	16.60	4.33	11.33	8.96	14.58
2006	14.96	12.85	5.18	8.15	13.41	9.86	19.33
2007	2.38	0.65	4.64	63.12	1.35	12.09	6.33
2008	9.81	4.09	3.03	2.94	22.29	7.21	5.97
2009	4.85	5.88	4.96	0.48	5.56	4.30	3.73
2010	2.43	0.52	2.04	0.71	2.35	1.57	5.38
2011	1.31	1.43	1.86	0.04	1.10	3.00	2.99
2012	4.19	2.35	18.93	1.96	6.33	4.45	2.67
2013	7.68	4.78	23.67	0.34	5.40	20.26	4.75

The large weights given to the number of sunken and damaged ships, the area of aquaculture affected also reflects the characteristics of marine economy. As a means of survival for most people who live by the sea, aquaculture and fisheries are also important pillars of the Chinese economy in coastal areas. In addition, marine engineering is very important for coastal residents and seawalls are called a "lifeline" or "a means of survival" by the masses. Damage to crops area has the lowest weight, which also provides evidence that farming is in a relatively weak position in the coastal economy.

Table 8 showing the composite scores and the rank of annual marine disaster losses from 2000 to 2013 and Fig. 3 showing the trends of marine disasters in China from 2000 to 2013 indicate that 2006, 2007, 2005 and 2001 had the highest composite scores (greater serious marine disaster loss) and 2011, 2010 and 2000 had the lowest scores (fewer marine disaster losses), respectively. Based on the staggered appearance of the high and low composite scores, marine disasters appear to occur periodically, probably on a 4 to 5 year cycle.

ISLAND DISASTER PREVENTION STRATEGY

Improving the Island Disaster Forecasting System

Island disasters bring great harm to the socio-economic aspects of island regions. If island disasters can be forecasted accurately, the forecasting system will play a key role in disaster prevention and mitigation. Therefore, we must strengthen scientific research related to island disasters, seek

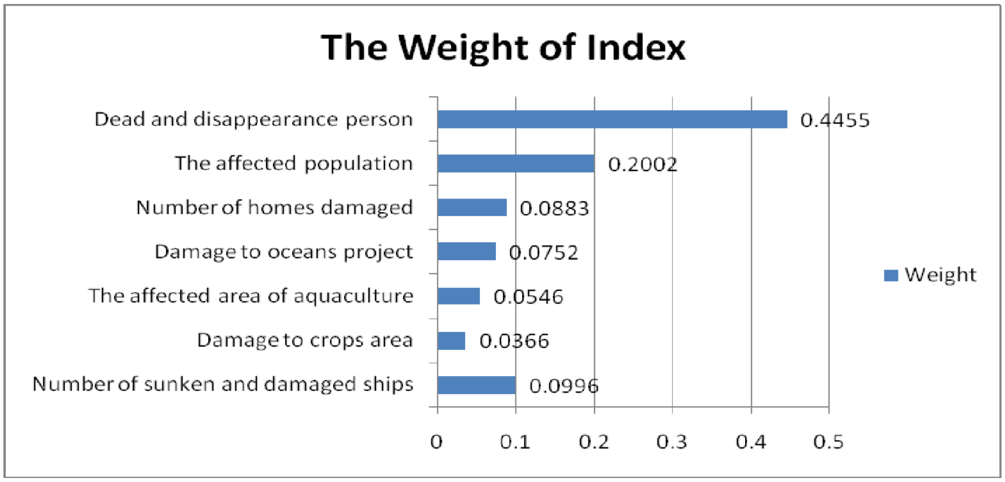

Fig. 2: The weight of indices.

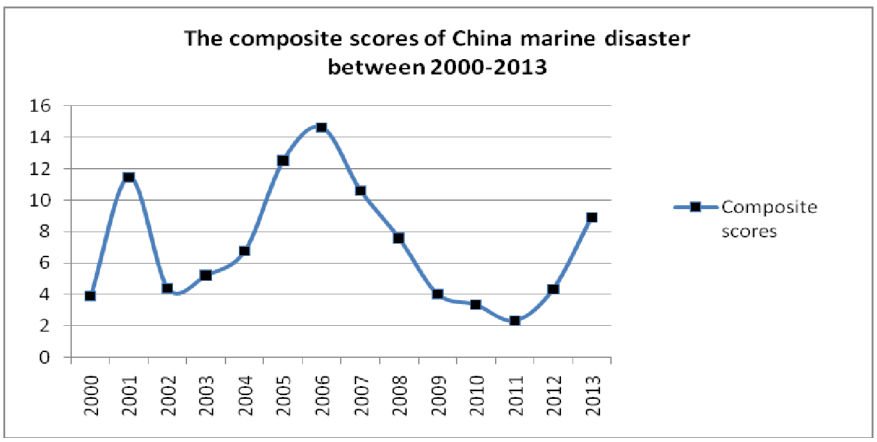

Fig. 3: Trends of marine disasters in China from 2000 to 2013.

appropriate laws related to marine disasters and improve the island disaster forecasting system.

Improve island disaster statistical tracking system: The collection of island disaster statistics and the related information channels in China mainly including island disaster summary information regularly released by the State Oceanic Administration, the "Chinese National Bureau of Statistics, Yearbook of Environmental Statistics" which includes island disaster information and authoritative statistical data released by local civil affairs departments. However, data collection related to island disasters suffers from a lack of systematic data gathering processes. So China should improve the methods used to collect data so that data collected is scientifically and statistically and so that subsequent data analysis related to disasters and disaster losses from island related disasters is done appropriately.

Strengthen new research technologies and increase investment in disaster forecasting: New methods and technology must be employed in disaster research, and greater investment in island disaster forecasting will be required, to establish island-disaster surveillance monitoring systems and to collect reliable, accurate island disaster related information. Monitoring the dynamic environmental processes involved in these disasters should make full use of RS, GIS and GPS technology to provide early prediction of storm surges and other potential disasters. The predictions can allow island regional governments and residents to be prepared to minimize losses caused by disasters.

Strengthen the Construction of the Island Disaster Protection Projects and Improve Disaster Prevention Standards

Reinforce awareness of disaster prevention: Island disaster prevention should be mainly used to forecast disasters and for related disaster prevention and mitigation work; this "soft" investment has a very important practical significance. Making full use of television, newspapers, the internet and other media is required to get island disaster prevention and mitigation knowledge into individual households. The general public as well as staff engaged in island operations and research should take training based on the fundamentals of island disaster mitigation. The Japanese government has organized the Voluntary Disaster Preparedness Organization in a coastal town in Kochi Prefecture of Shikoku Island. The Voluntary Disaster Preparedness Organization has proven to contribute to improving awareness of disaster preparedness (Mimaki et al. 2009).

Increase investment and improve the standards for island disaster prevention projects: Islands typically have poor infrastructure, so their ability to withstand natural disasters is low. Multi-party funding will be required to improve disaster prevention and the construction of much needed infrastructure. Some islands constantly stay in a state of long-term drought and water shortage, restricting economic development. For inshore areas, China can divert water from the continent to build the backbone of water diversion and storage projects providing a solution to the needs for drinking or agricultural irrigation water but this is impossible for island communities. Seawalls should be constructed on islands and should be designed to protect the residents from the highest historical storm surges and should be built to high standards to provide coastal protection. Old dams should be maintained to reach provide a high level of protection. Beach reclamation, shrimp pool digging and dam construction should all be considered as parts of economic development and disaster prevention. So China should take a comprehensive look at the long-term interests and benefits of disaster mitigation to protect the local environment.

Enhance the Quality of Island Management and Conduct Island Renovation and Repair

Enhance island management and reduce the incidence of man-made disasters: To avoid additional man-made disasters caused by poor land management, China should strengthen the island's integrated management system and develop relevant laws and regulations. The implementation of an island management system and the use of scientific and rational development of islands should be done according to the "National Island Protection Plan." China should strengthen the monitoring of islands related to water pollution prevention and control as well as strengthen supervision of environmental protection work on islands. Improving the integrated management of island-related sewage disposal would minimize pollution of islands and the surrounding waters. Several things should be done to maintain the overall balance of the island environment. First, ecological and environmental protection of island wetlands and tidal flats should be strengthened, a comprehensive wetland protection program should be launched, the construction of tidal flat grasslands and the introduction of sea buckthorn and other salt-tolerant plants should be fostered. Mudflat ecology structure should be maintained and biological diversity should be restored through analysing the ecological functions of various species and through control of non-native, invasive species such as *Spartina alterniflora*.

Table 7: Weight of indices.

Assessment objective	Index	Index weight
The marine disasters evaluation	Number of sunken and damaged ships	0.0996
	Damage to crops area	0.0366
	The affected area of aquaculture	0.0546
	Damage to oceans project	0.0752
	Number of homes damaged	0.0883
	The affected population	0.2002
	Dead and disappearance person	0.4455

Table 8: Composite scores and the rank of marine disaster losses from 2000 to 2013.

Year	Composite scores	Rank	Year	Composite scores	Rank
2000	3.91	12	2007	10.62	4
2001	11.47	3	2008	7.59	6
2002	4.38	9	2009	4.02	11
2003	5.20	8	2010	3.35	13
2004	6.76	7	2011	2.31	14
2005	12.53	2	2012	4.32	10
2006	14.63	1	2013	8.91	5

Carry out ecological improvement projects and repair/restore island environments: Because islands are fragile and vulnerable to damage, restoration of island ecology has proved to be difficult once destruction occurs. In order to improve island environments and enhance the value of islands, the government of China began to financially support the implementation of island renovation/restoration projects starting in 2010. During 2010-2012, a total of 25 island renovation repair projects were implemented with the total investment capital of about $500 million. The projects mainly include four aspects. One is the restoration and protection of island terrain, such as the restoration of island slope damage caused by collapses and landslides. Another is the protection and restoration of island ecosystems and species such as sea turtles, Chinese white dolphins and other species in need of protection and monitoring, and the repair of artificial coral reefs. The third is island infrastructure improvements, including the management of garbage, sewage and related waste disposal, the conservation of freshwater resources and the construction of island breakwaters. The fourth is the maintenance for some landscape scale archeological sites, such as the maintenance of the ancient fort on Qinshan Island. Island ecological restoration will play an active role designed to mitigate the trauma disasters cause to island ecosystem. In addition, projects involving the planting and restoration of coastal vegetation can also protect infrastructure and human lives. Coastal vegetation acts as a natural barrier against extreme natural and anthropogenic disasters (Tanaka et al. 2011).

CONCLUSION AND RECOMMENDATIONS

The combination of the "Island Protection Law," promulgated and implemented in 2010, the formal establishment of the Island Management Division in 2011 and the approval of "National Island Protection Plan" in 2012 initiated the establishment of the island surveillance monitoring system that includes the island natural disasters monitoring system; all of the above reflect the increased attention the state is giving to island-related natural disasters. These measures are conducive to the tracking of island statistics, and launching of forecast and natural disaster prevention methods and related work.

At present, the theoretical study of island natural disasters has made significant progress, such as the evaluation of uninhabited islands related to storm surge research. A number of disaster prevention measures on islands, such as dam construction, greatly reduce storm surges and wave hazard risks. But a mitigation system designed to protect islands and even the ocean in China is still lagging when compared with other regional and global maritime countries such as Japan and the United States. Therefore, China needs to grasp a fundamental understanding of the characteristics and distribution of island disasters; this will allow China to strengthen research related to new technologies that can provide island disaster forecasting and prevention. China needs to increase investments in island disaster prevention and mitigation as well as develop island-related economic development policies to support improved development of regional island economies and improve the standard of living of island people.

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