Scientific and Social Research, 2024, Volume 6, Issue 2
https://ojs.bbwpublisher.com/index.php/SSR

Analysis of the Problems and Suggestions for Ecological Protection and Restoration of Coastal Zones in China

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Abstract: This paper analyzes the existing problems of ecological protection and restoration of coastal zones in China, and puts forward corresponding suggestions and solutions. In terms of technology, it is necessary to strengthen scientific and technological innovation and upgrading, develop repair technologies suitable for different coastal habitats, and strengthen the application of monitoring and evaluation technologies to ensure the effectiveness and sustainability of restoration work. In terms of management and policy, it is necessary to establish a comprehensive management mechanism, clarify the responsibilities and powers of various departments, and strengthen the formulation and implementation of laws and regulations. In addition, financial support should be enhanced, social participation should be encouraged, and international cooperation should be strengthened to jointly meet the challenges of ecological restoration. In terms of social economy, we should pay attention to sustainable development and achieve a win-win situation between economic growth and ecological protection by promoting the development of green industries and other ways. At the same time, it is also necessary to improve the public's awareness and participation in coastal ecological restoration, strengthen environmental education and publicity work, cultivate the public's awareness of the environment and responsibility for scientific and technological innovation, change economic factors and improve public education awareness, and achieve the effectiveness of coastal protection and restoration work to realize marine ecological safety and sustainable development.

Keywords: Coastal zone; Ecological regulation; Ecological protection and restoration

Online publication: February 26, 2024

1. Introduction

The coastal zone is one of the most species-rich ecosystems in the world, carrying a large number of terrestrial and marine organisms, and providing important ecosystem services for human beings, including coastal protection, food chain support, carbon storage, water purification, etc. [1]. However, due to human activities and environmental pressures, many coastal zones are at risk of erosion and species are facing threats. Through the restoration of damaged coastal ecosystems, the quality of the ecological environment can be improved, important ecological services for human society can be provided, and local development and sustainable social

prosperity can be promoted.

Coastal zone ecological restoration refers to the process of restoring and repairing damaged or degraded coastal zone ecosystems [2]. The coastal zone is the junction between the ocean and the land, including coastal islands, coastal wetlands, coastal zones, and other areas [3]. Due to human activities, natural disasters, and other reasons, coastal ecosystems may suffer from pollution, shoreline erosion, wetland degradation, species loss, and other problems [4]. The goal of coastal zone ecological restoration is to restore and improve the coastal zone ecological environment and improve the stability and ecological function of the ecosystem.

Coastal zone ecological restoration is a comprehensive work that needs to take into account ecology, hydrology, land use, human activities, and other factors, and requires the joint participation and cooperation of the government, scientific research institutions, social organizations, and the public. Through effective ecological restoration, the coastal zone ecosystem can be restored and protected, ecological balance can be maintained, and sustainable development can be promoted.

2. Development of ecological protection and restoration of coastal zones in China

Marine ecological protection and restoration is an important measure to strengthen the construction of marine ecological civilization. The report of the 19th National Congress of the Communist Party of China once again stressed that we should adhere to the overall planning of land and sea and accelerate the construction of a maritime power. After years of exploration and practice, the implementation of ecological protection and restoration projects in China's coastal zones has gradually shown results. The diversity, stability, and sustainability of typical marine ecosystems such as mangroves and coastal wetlands have been continuously improved, and the ecological safety barrier of coastal zones has been further consolidated.

China has carried out a series of major projects, including 58 Blue Bay improvement projects, 24 coastal belt protection and restoration projects, and 61 Bohai Sea comprehensive management and ecological restoration projects, which have initially curbed the degradation of typical ecosystems such as mangroves, salt marshes, and seagrass beds in local waters, and significantly improved the regional marine ecological environment.

Nearly 30% of China's coastal waters and 37% of China's mainland coastline are under the control of the ecological protection red line. On 18,000 kilometers of mainland coastline and 14,000 kilometers of island coastline, more than 240 species of waterbirds breed, migrate, and winter every year, and three of the world's eight migratory bird migration routes pass through China. At the same time, China has become one of the few countries in the world with a net increase in the area of mangroves, and more than 28,000 species of marine organisms have been recorded, making it one of the countries with the richest marine biodiversity in the world. The number of national marine protected areas has increased to more than 50, and a marine biological protection system dominated by nature reserves and marine parks has been established [5].

The research on ecological protection and restoration of coastal zones in China mainly focuses on using mathematical modeling to simulate the changes in hydrodynamic conditions after coastal erosion and restoration, analyze and summarize the experience of remediation projects of coastal zones and islands, and carry out the evaluation of the effect of restoration projects. There is still a lack of further research and discussion on the evolution characteristics, restoration measures, effects, and problems of coastal zone ecological restoration policies [6].

3. Problems existing in coastal zone ecological protection and restoration

Coastal zone ecological restoration faces multiple technical challenges, and interdisciplinary and cross-field research and cooperation are needed to achieve effective and sustainable ecological restoration.

3.1. Technical problems

At present, China has put forward detailed technical guidelines for marine ecological restoration to regulate the ecological restoration measures and basic requirements of typical marine ecosystems such as mangroves, salt marshes, seagrass beds, seaweed fields, coral reefs, and oyster reefs, as well as comprehensive ecosystems such as shoals, estuaries, bays, and islands [7]. However, the following aspects still need to continue to be explored and enriched.

(1) Habitat restoration technologies: For different types of coastal habitats (such as sandy beaches, seagrass beds, coral reefs, wetlands, etc.), it is necessary to study and develop restoration technologies suitable for various habitats. These technologies may include artificial reef construction, vegetation restoration, sediment management, etc.

(2) Water quality improvement technology: The deterioration of water quality in coastal zones is an important problem in ecological restoration. There is a need for research and development of technologies that can effectively remove pollutants, reduce excess nutrition, and improve water quality, such as biodegradation, adsorption, precipitation, etc.

(3) Biodiversity conservation technology: Protecting and restoring coastal biodiversity is the key to ecological restoration. There is a need for research and development of technologies that can effectively protect and restore species diversity, such as species introduction, habitat improvement, reproduction, and release.

(4) Protection and shore strengthening techniques: Coastal landforms and soils are often subject to erosion and destruction. There is a need for research and development of effective techniques to prevent erosion, immobilize dunes, and protect coastlines, such as bioengineering, artificial structures, and vegetation cover.

(5) Monitoring and evaluation techniques: Monitoring and evaluating the effectiveness and impact of coastal ecological restoration is the key to ensuring the success of restoration. There is a need for research and development of technologies that can effectively monitor indicators such as ecosystem health, water quality changes, and biodiversity, such as remote sensing, biological indicators, and model simulation.

(6) Climate change adaptation technologies: Climate change has a significant impact on coastal ecosystems. There is a need for research and development of technologies that can help ecosystems adapt to climate change, such as sea level rise protection, ecosystem restoration, and species migration.

3.2. Management and policy issues

The coastal ecosystem involves multiple sectors and stakeholders, such as oceans, fisheries, transportation, environmental protection, etc. Achieving effective ecological restoration requires the establishment of comprehensive management mechanisms and the promotion of coordination and cooperation among various sectors. It is crucial to formulate and implement regulations and policies for coastal zone ecological restoration, including laws and regulations for the protection and restoration of ecosystems, pollutant discharge standards, and ecological compensation mechanisms. It is also necessary to establish and improve the monitoring and evaluation system for coastal zone ecological restoration and carry out supervision and management before and

after the event [8] to ensure the effectiveness and sustainability of the restoration work. This includes monitoring and assessment of ecosystem health, water quality changes, biodiversity, and more.

Coastal zone ecological restoration needs a lot of capital investment. The government needs to formulate corresponding fiscal policies to provide financial support for ecological restoration projects while encouraging enterprises and social organizations to participate in investment. The ecological restoration of the coastal zone may have some impacts on the local economy. Therefore, it is necessary to conduct an adequate socioeconomic impact assessment and formulate corresponding compensation and adjustment policies to ensure the coordination of ecological restoration and economic development.

To increase public awareness and participation in coastal zone ecological restoration, the government and relevant departments need to strengthen publicity and education, and encourage non-governmental organizations and volunteers to participate in ecological restoration work. The government needs to increase support for scientific research projects related to coastal ecological restoration, promote technological innovation and the transformation of results, and strengthen international cooperation to jointly meet the challenges of ecological restoration.

4. Strategies and suggestions

4.1. Technological innovation and upgrading

The research and development of technologies related to coastal zone ecological restoration will be intensified, and the application of innovative materials, technologies, and methods will be promoted.

(1) Monitoring technology: Strengthening the application of monitoring technology in the process of coastal zone ecological restoration, and using advanced remote sensing technology, sensor technology, geographic information system, etc., to carry out real-time monitoring of water quality change.

(2) Environmental treatment technology: Strengthening the research and application of pollutant prevention and control, developing and promoting comprehensive treatment programs and technologies, such as coastal wastewater treatment and marine garbage recycling and treatment.

(3) Ecological restoration technology: Developing and applying ecological restoration technology, including coastal wetland restoration, vegetation reconstruction, biological control technology, etc., to restore the self-recovery ability of the ecosystem through various restoration means and improve the effect of ecological restoration.

(4) Data sharing and exchange: Promoting the collection and sharing of coastal zone ecological data resources, promoting the application of scientific research results, and improving the scientific accuracy of results.

(5) Talent support: Strengthening international cooperation, cooperating and exchanging with international organizations, research teams, and technical institutions in the field of coastal zone ecological restoration, learning from international advanced works, and jointly solving the problems of coastal zone ecological restoration.

4.2. Policy and management reform

According to the management needs of different stages, relevant laws and regulations should be formulated and improved, and the powers and responsibilities and management bodies of coastal zone ecological restoration should be clarified to ensure the legality and sustainability of coastal zone ecological restoration [9]. It is necessary to have unified planning and management of coastal ecological restoration-related management system, clarify the responsibilities and authority of governments at all levels and relevant departments,

ensure the coordinated promotion and efficient implementation of restoration work, and accelerate the unified management and systematic protection and restoration of natural resources such as mountains, rivers, forests, fields, lakes, and grasslands.

Additionally, it is imperative to establish and improve the funds for coastal ecological restoration, including national and local financial support, ecological compensation mechanisms, etc., to ensure that restoration work can be reasonably assessed and supervised; provide mechanisms and channels for public participation to increase public awareness and participation in restoration work; strengthen the cooperation between different departments, jointly solve the overall cooperation and exchange of restoration work, and promote the sustainable development of conservation and restoration.

5. Conclusion

Coastal zone ecological restoration is an important means to maintain marine ecological security and an essential ecological guarantee for building maritime power. At present, China has implemented a series of major projects such as 58 Blue Bay improvement projects, 24 coastal protection and restoration projects, and 61 ecological restoration projects for the comprehensive management of the Bohai Sea, which have initially curbed the degradation of typical ecosystems such as mangroves, salt marshes, and seagrass beds in local waters, and significantly improved the regional marine ecological environment. However, along with the achievements, there are still many problems and challenges, and we need to continuously improve the level of conservation and utilization of marine resources, optimize the production, living, and ecological space of the coastal zone, strive to achieve the organic unity of strict protection and efficient use of marine resources, and promote the construction of beautiful oceans.

Disclosure statement

The authors declare no conflict of interest.

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