Discussion on the Environmental Quality and Ecological Restoration Technology of Seawater Aquaculture

Kaiyuan Liu*, Hao Cheng, Yongjie Duan, Mengdi Li
School of Fisheries, Zhejiang Ocean University, Zhoushan 316022, China.

Abstract: This article explores the environmental quality of mariculture and its ecological restoration techniques. On the one hand, from three dimensions: external environmental pollution, frequent industrial diseases, and the impact of the mariculture industry on the environment, this paper explores the current environmental quality of mariculture in China. On the other hand, based on the current status of seawater aquaculture environmental quality in China, ecological restoration technologies for seawater aquaculture environment are proposed to effectively promote the improvement of seawater aquaculture environmental quality and achieve environmental protection goals while implementing economic benefits.

Keywords: Mariculture; Bioremediation; Physical Repair; Chemical Remediation

1. Introduction

Seawater aquaculture has made important contributions to the social economy, providing a rich supply of seafood, creating employment opportunities, and promoting the economic development of coastal areas. However, the aquaculture industry also brings negative impacts to the ecological environment. Excessive aquaculture has led to Eutrophication and pollution of water bodies, led to the proliferation of algae, and endangered Balance of nature. At the same time, the pollution of the external environment has also brought many negative impacts on the mariculture environment.

2. Current status of environmental quality in marine aquaculture in China

2.1 External environmental pollution is becoming increasingly severe

The marine aquaculture environment in China is currently facing the problem of increasing external pollution. External pollution mainly includes industrial wastewater discharge, Urban runoff with high nitrogen content, and pollutants such as pathogens, oils, organic wastes and heavy metals. Firstly, industrial wastewater discharge is an important source of pollution faced by the marine aquaculture environment.

Urban runoff with high nitrogen content is also one of the main sources of environmental pollution in mariculture. In the process of urban development, incomplete or direct discharge of sewage treatment leads to an increase in nitrogen content in water. High nitrogen content is easy to cause Eutrophication of water body, which leads to the massive reproduction of cyanobacteria and other algae in the water body, forming red tide, and has a negative impact on the survival and growth of cultured species.

Finally, pathogens, oils, organic waste, and heavy metals also have an impact on the marine aquaculture environment. The presence of pathogens may lead to disease outbreaks of cultured species, causing significant economic losses. For example, oil pollution will affect the oxygen content of water bodies and the stability of ecosystems.

2.2 Environmental degradation leads to frequent occurrence of diseases in the mariculture industry

In recent years, the problem of frequent diseases in the mariculture industry caused by environmental degradation has become increasingly prominent. Mainly due to the following two major factors. On the one hand, it is water pollution. The discharge of industrial wastewater, agricultural waste, and urban sewage pollutes the water quality of mariculture waters. These pollutants may contain chemicals, heavy metals, organic compounds, and pesticides, which can cause toxicity and increase pathogens to cultured species, leading to the occurrence of diseases. On the other hand, there is a problem of high breeding density.

2.3 The pollution caused by mariculture to the marine environment is becoming increasingly severe

In recent years, the pollution caused by seawater aquaculture in China has become increasingly serious. Mainly manifested in the following aspects. The first issue is the discharge of aquaculture waste. During the process of mariculture, a large amount of aquaculture waste is generated, such as feed residue, feces, and urine. These wastes are rich in nitrogen, phosphorus and other nutrients, and excessive discharge into the sea will lead to Eutrophication of water bodies, promote the growth of large algae, and form alkalization and red tide.

Secondly, there is the widespread use of aquaculture drugs. In order to prevent and treat diseases of aquaculture species, the aquaculture industry generally uses chemical agents such as antibiotics and anti-parasitic drugs. These drugs may remain in the aquaculture environment and have toxic effects on other organisms, disrupting the balance of marine ecosystems.

Finally, the feed, additives, and aquaculture equipment used during the aquaculture process may cause water pollution. The additives in feed and the discharge of garbage and wastewater will introduce harmful substances, which will affect the Balance of nature and water quality of the water body.

3. Research on Ecological Restoration Technology for Marine Aquaculture Environment

With the increasing attention paid to the environmental pollution caused by mariculture, ecological restoration technology is becoming increasingly widely used due to its ability to reduce pollution and restore environmental health. It mainly includes Bioremediation, physical remediation and chemical remediation technologies.

3.1 Bioremediation technology

The main principle of Bioremediation technology is to adjust and improve the marine ecological environment by using the self purification mechanism of organisms. Specific methods include microbial remediation, Phytoremediation, etc.

3.1.1 Microbial remediation

Microbial remediation technology is to recover the polluted water by screening microorganisms with the ability to efficiently degrade pollutants and using them to degrade organic substances and pollutants.

3.1.2 Phytoremediation

Phytoremediation technology is mainly to plant some plants with high tolerance to salt, heavy metals, etc., such as reeds, seaweeds, etc., to achieve the purpose of pollution remediation by absorbing harmful substances.

3. 1.3 Animal restoration

Animal remediation technology is a method of using specific animal populations to participate in the remediation of marine ecosystems, which usually adopts two ways: Ecological niche competition and biological filter effect. Ecological niche competition is the introduction of species adapted to the marine environment to reduce the number and impact of pests

by competing for resources and space. For example, in coral reef restoration, the introduction of the Blue Serpentine worm competes with coral competitors to protect coral growth.

3.2 Physical repair technology

Physical restoration technology is aimed at restoring damaged ecosystems and improving environmental conditions in marine aquaculture environments through physical means. Generally, physical remediation technology mainly focuses on water quality treatment and water circulation.

3.2.1 Water quality treatment technology

Usually, water quality treatment technology mainly adopts biological filtration technology, aeration technology, liner technology, and algae treatment technology.Biofiltration technology utilizes biofilters and aquatic organisms to convert harmful substances such as ammonia nitrogen and nitrate in wastewater into relatively harmless substances. Common applications include the use of bacteria, benthic animals, and plants to treat organic and nutrient substances in wastewater. Aeration technology refers to the use of aeration devices and oxygenation equipment by mariculture enterprises to provide sufficient oxygen supply and promote the oxidation of harmful substances such as ammonia nitrogen and sulfides in wastewater. This helps to reduce the concentration of toxic substances in water bodies and improve water quality. Sedimentation technology refers to the process of settling suspended and particulate matter in wastewater by setting up sedimentation tanks or using sedimentation agents in a reasonable manner, in order to reduce the turbidity and concentration of harmful substances in the wastewater. Algae treatment technology utilizes the growth and metabolic characteristics of microalgae to absorb and transform organic and nutrient substances in wastewater, achieving wastewater purification and resource utilization.The application of the above water quality treatment technology can effectively remove or reduce harmful substances in aquaculture wastewater, improve water quality, and alleviate environmental pollution caused by seawater aquaculture.

3.2.2 Water cycle technology

Water recycling technology, mainly through the construction of a reasonable water recycling system, to ensure the full circulation of aquaculture water and oxygen supply, so as to reduce environmental pollution.Generally, water circulation technology for mariculture system includes pump system, waterway design, discharge management and water oxidation treatment.

3.3 Chemical remediation technology

For the ecological restoration of marine aquaculture environment, chemical remediation technology can be used as a supplementary means in certain specific situations. Chemical remediation technology mainly involves adding, injecting, or spraying chemicals to alter the chemical composition of water bodies, in order to reduce pollutant concentrations or degrade harmful substances. The following are some common chemical remediation techniques:

3.3.1 Precipitator and activated carbon adsorption

By adding appropriate precipitants, pollutants such as organic matter and heavy metal ions in wastewater can be precipitated, thereby reducing their concentration in the water. Common precipitants include Magnesium hydroxide, Iron(III) sulfate, etc. At the same time, utilizing the large specific surface area and good adsorption performance of activated carbon, organic matter, odorous substances, heavy metals, etc. in water can be adsorbed onto activated carbon to achieve the goal of purifying water quality.

3.3.2 Oxidation-reduction agents and pH regulators

By adding redox agents, organic substances, sulfides, and other substances in water can be oxidized and decomposed, reducing their pollution to water quality. Common redox agents include Permanganate, hydrogen peroxide, etc. Under the background of using pH regulators, by adjusting the pH value of water, the degree of ionization of organic matter in water

can be changed, thereby affecting its solubility and activity. For example, the dissolved organic matter in acidic wastewater can be precipitated or degraded by alkaline treatment.

3.3.3 Precautions for chemical remediation

Although chemical remediation can effectively improve the quality of seawater aquaculture environment, chemical remediation technology should be carefully operated during use to avoid adverse effects on aquatic organisms. Based on comprehensive analysis, the best way to improve the environmental quality of mariculture is to combine chemical remediation technology with other ecological remediation technologies to achieve better results. In practical applications, appropriate chemical remediation technologies should be selected based on factors such as environmental pollution, aquaculture type, and scale, and detailed research and evaluation should be conducted.

Conclusion

To sum up, this paper analyzes the current environmental quality of mariculture in China, and studies the bioremediation technology, physical remediation technology, and chemical remediation technology for the environmental quality of mariculture. Strengthen composite monitoring and environmental risk assessment of aquaculture sites, reduce pollutant emissions from the source, further optimize the quality of China's marine aquaculture environment, and promote the protection of the ecological environment while promoting the development of the marine economy.

References

[1] Li CH, Wang XF, Wang XW, et al. Research progress on environmental quality and ecological restoration technology of marine aquaculture in China [J]. Journal of Agricultural Environmental Science, 2006 (S1): 310-315.

[2] Zhu JZ, Yang R. Research on integrated management of marine aquaculture environment in the South China Sea [J]. Hebei Fisheries, 2016 (02): 47-52+68.

[3] Wu RF. Research on Environmental Pollution and Control Measures of Seawater Aquaculture [J]. Rural Staff, 2019 (02): 129.

Author Introduction: Liu Kaiyuan (1997-), male, Han nationality, Zibo, Shandong Province, education: master's degree, research direction: deep sea aquaculture, unit: School of Fisheries, Zhejiang Ocean University Corresponding author: Kaiyuan Liu