Scholar Publishing Group
Frontiers in Ocean Engineering
https://doi.org/10.38007/FOE.2021.020401
ISSN 2790-2706 Vol. 2, Issue 4: 1-8

Government Incentive Mechanism for Pollution Control in Marine Resource Development——Taking Marine Aquaculture as an Example

Wei Di and Luda Xu*

Shandong Yingcai University, Jinan, China

**corresponding author*

Keywords: Marine Aquaculture, Pollution Control, Incentive Mechanism, Marine Resources

Abstract: With the continuous expansion of the scale of marine aquaculture(MA) in my country, the discharge of waste water and residues generated in the aquaculture process has caused serious environmental pollution problems, and due to the lack of environmental protection awareness of farmers, the pollution of pollutants in the process of marine resources development has been caused. The harmless treatment is not in place, which will eventually deteriorate the marine ecological environment. Although government agencies have formulated various marine pollution control policies, farmers are aiming to pursue interests, and the implementation of pollution control measures is not in place. Corresponding incentive measures are needed to promote and respond to MA pollution control policies. This paper investigates farmers' understanding of MA pollution in a certain area and their cognition of government anti-pollution control, studies the causes of MA pollution in this area, and proposes government incentives mechanism such as reforming the governance system, establishing pollution control mechanisms, and updating pollution treatment technologies.

1. Introduction

MA pollution control is to control the ecological pollution problems that occur in the MA area, and achieve the goal of marine ecological balance by improving the environment of the aquaculture area. The main method is to control and prevent pollution and damage caused by MA waste through certain means. In the process of pollution control of MA, it is necessary to take into account not only the actual ecological protection, but also the sound development of the environment. It is necessary to prevent problems before they occur, and at the same time actively control the original pollution, so as to achieve the harmonious coexistence of man and nature [1-2].

At present, experts and scholars have little empirical research on pollution prevention and control of MA and related government incentive mechanisms in my country, and they have achieved good results based on the existing research results. MA wastewater will pollute the aquaculture water environment, cause harm to aquaculture organisms, and seriously affect the economic benefits of the aquaculture industry. In addition, a large amount of nutrient-rich MA wastewater flows into the offshore area, which can cause the proportion of nutrient salts to increase in the relevant offshore areas and aggravate the degree of eutrophication of the water body [3]. Some scholars pointed out in the study of eutrophication in a certain sea area that the proportion of nutrients in this sea area has increased in recent years. The accumulation of nutrients and changes in the ratio of nutrients in the waters will cause changes in aquatic organisms, such as tissue and density, and may cause the rapid reproduction of some phytoplankton that are not conducive to the survival of organisms in the sea area, thereby aggravating the frequent red tide phenomenon [4] . Although some medium-sized MA has introduced related aquaculture pollution treatment technology and related treatment equipment, it is rare in actual use. The government ultimately plays the role of an image project. Without the support of government funds and policies It is difficult to carry out the work of pollution control from aquaculture [5]. Previous studies lacked the analysis of the government incentive mechanism for mariculture. In this regard, the government must increase farmers' willingness to protect the environment, use various modern advanced technologies to popularize legal knowledge to aquaculture owners, and maintain the basic bottom line of farmers.

This paper first expounds the impact of MA pollution on the marine environment and the aquaculture industry itself, then analyzes the effect of microalgae treatment technology on nitrogen and phosphorus in MA wastewater, and then analyzes the current situation of MA pollution in a certain area. In view of the insufficiency of sewage enterprises in the pollution control of MA, several government incentive mechanisms for pollution control of MA are finally proposed.

2. MA Pollution and Its Wastewater Treatment Technology

2.1. The Impact of MA Pollution

(1) Impact on the marine environment

MA pollutes nearby sea areas by changing the physical and chemical factors of the water area and deteriorating the soil environment through emissions. The pollutants brought by mariculture mainly include: a large amount of excrement and residual bait of aquaculture organisms, as well as fishery drugs and unpurified seedling wastewater. The attached bait, fish excrement and fishery drugs enter the sea area near the breeding area. Excluding the necessary consumption of fish and shrimp for ingestion and metabolism, most of them flow directly into the sea, causing severe eutrophication of aquatic plants such as algae, shortening the food chain of some aquatic organisms, and destroying the sea bottom microorganisms and environmental balance [6-7].

(3) Impact on the breeding industry itself

The large amount of MA wastewater is discharged into the offshore waters and pollutes the water environment, but also has a bad impact on the MA industry itself. The main reasons are: first, the deterioration of water quality increases the frequency of water injection and drainage, and the discharged sewage is quickly drawn back into the aquaculture tank, reducing the due circulation and self-purification ability, resulting in a vicious cycle chain [8]. The hazards are as follows: First, there are many species, large quantities, and intensive distribution of aquaculture, which leads to deterioration of aquaculture water quality, frequent entry and discharge of aquaculture sewage, and a vicious circle is formed. Second, the repeated exchange of polluted seawater is the medium for the spread of pathogenic microorganisms [9-10].

2.2. MA Wastewater Treatment Technology - Microalgae Treatment

Chlorella utilizes CO2 in the air through photosynthesis, absorbs various nutrients in MA wastewater to grow, and satisfies its own growth and reproduction. In the initial stage of wastewater inoculation with algal cells, the nitrogen and phosphorus content in wastewater is high, the nutrients are sufficient, and the nitrogen and phosphorus concentration decreases rapidly [11]; as the algal cells grow and reproduce, the reaction system does not add foreign nutrients, and the nitrogen and phosphorus content gradually decreases. As shown in Figures 1 and 2, in the MA wastewater with nitrogen and phosphorus as the main pollution source, the four kinds of green algae could degrade nitrogen and phosphorus in the wastewater, and the nitrogen and phosphorus in the wastewater showed a downward trend. However, different types of microalgae have different requirements for various nutrients.

The calculation formula of phosphorus and nitrogen removal effect is as follows:

$$TN\% = TN_n / TN_0 \times 100\% \quad (1)$$

$$TP\% = TP_n / TP_0 \times 100\% \quad (2)$$

Among them, TN% and TP% represent the removal rate of nitrogen and phosphorus, TN_n and TP_n represent the concentration of nitrogen and phosphorus after N days of treatment, and TN_0 and TP_0 represent the initial concentration of nitrogen and phosphorus.

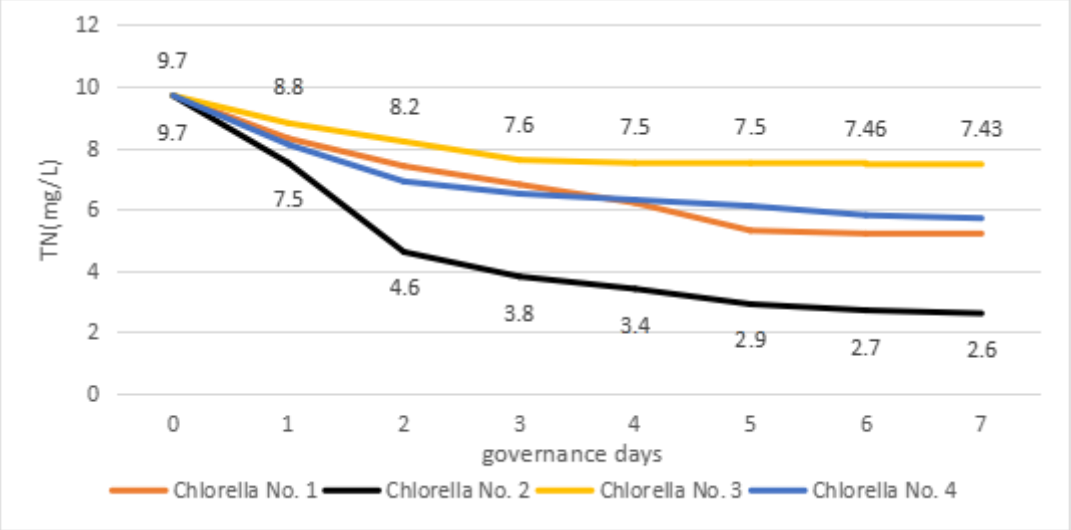

Figure 1. Nitrogen removal effect of microalgae technology on mariculture wastewater

As shown in Figure 1, according to the removal of TN in MA wastewater, the removal rates of TN by Chlorella 1, 2, 3, and 4 were 46.39%, 73.20%, 23.40%, and 41.23%, respectively. It can be seen that Chlorella 4 has the best removal effect among the four strains of microalgae. The inorganic nitrogen in TN is more easily absorbed by microalgae, and most of the organic nitrogen needs to be decomposed into inorganic nitrogen to be utilized by microalgae. Therefore, the rate of organic nitrogen treatment by microalgae is relatively slow. This is also the main reason why the overall TN removal rate is not high.

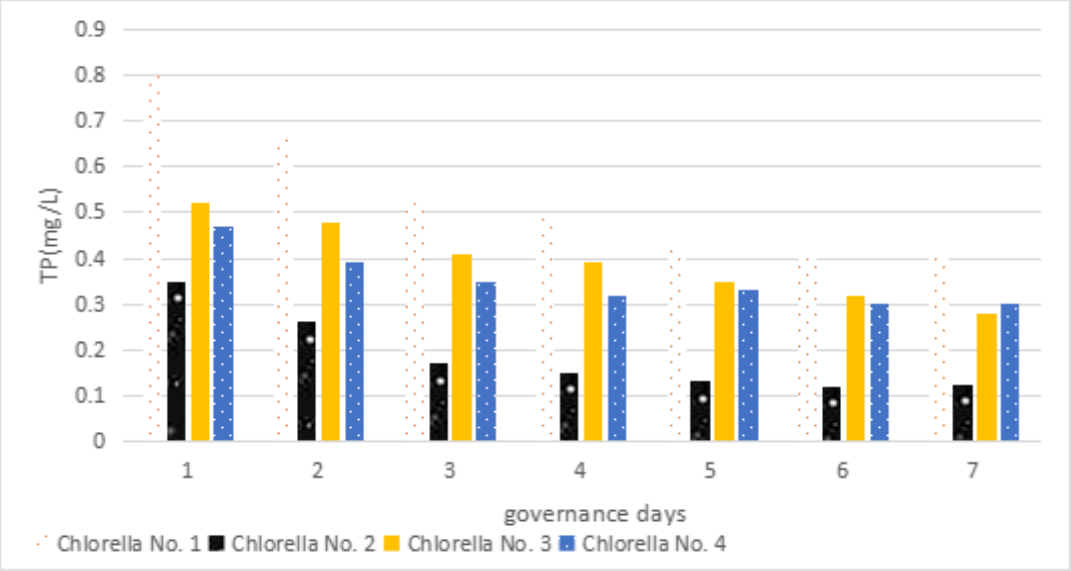

Figure 2. The effect of microalgae technology on phosphorus removal in MA wastewater

It is generally believed that excessive phosphorus content in the water body will cause eutrophication of the water body, so the degradation of phosphorus becomes particularly important. As shown in Figure 2, the initial phosphorus concentration in the seawater sample was 1.5 mg/L. For the removal of TP in the MA wastewater, the removal rates of TP by Chlorella No. 1, No. 2, No. 3, and No. 4 were 73.33%, 91.67%, 81.33%, 80%. According to the TP removal rate, it can be seen that Chlorella No. 2, No. 3 and No. 4 have good TP removal effects, and Chlorella No. 2 has the most prominent effect. Therefore, it can be seen from Figure 1 and Figure 2 that Chlorella No. 2 has the best effect on removing nitrogen and phosphorus from MA wastewater.

3. Analysis of the Current Situation and Causes of MA Pollution Control in a Certain Area

3.1. Analysis of the Status Quo of MA Pollution Control

Table 1. Farmers' knowledge of seawater pollution

	Serious	Generally	Nothing serious	Don't understand
Number of people	89	124	56	31
Proportion(%)	29.67	41.33	18.67	10.33

Through on-the-spot investigation on the pollution control of mariculture in a certain area, and a questionnaire survey of farmers in that area, we can understand the current situation of pollution control of mariculture in this area. We have learned that farmers have a lack of environmental awareness as a whole, and the lack of environmental awareness is a huge obstacle to the governance of aquaculture pollution. As shown in Table 1 and Figure 3, according to the survey results of 300 farmers' understanding of seawater pollution in my country, 10.33% of the respondents lacked sufficient understanding of seawater pollution, while 41.33% of the respondents believed that my country's seawater pollution is in general, 18.67% believe that seawater pollution is not serious, and the remaining 29.67% of people think that my country's seawater pollution is very serious. From the questionnaires and visits, we can clearly see that the pollution of MA in this area is not optimistic

and the environmental protection awareness of farmers is weak.

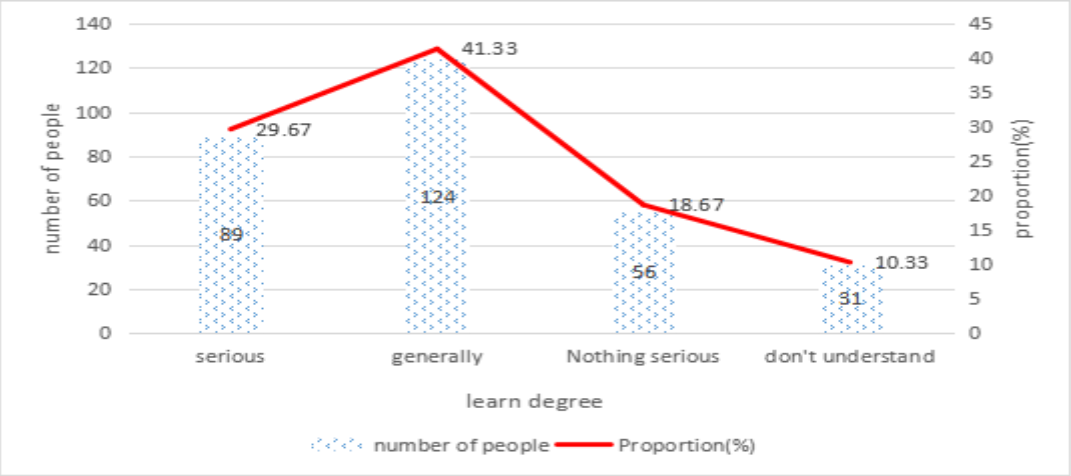

Figure 3. Survey results of seawater pollution awareness

Table 2. A survey of farmers' perception of the help of government agencies on breeding pollution

	Establish a government accountability mechanism	Strengthen the incentive mechanism	Optimizing the concept of aquaculture pollution control	Establish an information feedback mechanism	Strengthen communication
Number of people	216	185	163	127	88
Proportion (%)	72	61.67	54.33	42.33	29.33

As shown in Table 2, the results of the survey on the awareness of MA farmers on the assistance of relevant government agencies to the MA pollution in the region are as high as 72% of the farmers believe that the control of aquaculture pollution should be achieved by strengthening the incentive mechanism and compensation mechanism. 61.67% of farmers believe that a corresponding government accountability mechanism should be established, and the government's understanding of breeding pollution should be continuously improved through the government accountability mechanism. 54.33% of farmers believe that it is necessary to optimize the concept of their breeding pollution control from the perspective of breeding individuals, and 42.33% of farmers believe that transparent and effective channels should be established to achieve information feedback, only 29.33% of farmers believe that it should be To strengthen communication and exchanges with the parties. The survey results also reflect the indisputable fact that farmers have low sensitivity to the government's pollution control effect and the government's insufficient catalytic ability to a certain extent.

3.2. Causes of MA Pollution in the Region

(1) Lack of government functions

Although the government in this region has formulated relevant laws and regulations on mariculture, it is still unable to solve the complex and changeable new situations and new problems brought about by the rapid development of mariculture. The existing laws and regulations need to be improved. The missing laws and regulations are formulated and implemented [12]. These include formulating the details of MA regulations, effectively implementing a long-term permit

mechanism, training professional farmers, strictly maintaining the ecological balance of the aquaculture environment, and implementing quality supervision of aquaculture products.

(2) The fishermen's cooperative organization lacks legal status, and the rights of the organization cannot be guaranteed

Throughout the history of MA development, due to the limitations of the objective environment, even if a few marine fisheries associations have achieved staged development, it is difficult to achieve a climate in general. There are very few national fishery cooperative organizations, and local fishery cooperative organizations are also scattered and operated [13-14].

(3) Pollutant enterprises lack corporate self-discipline and social responsibility

Breeding enterprises have an imperfect information exchange system for dealing with crisis events, lack of open, transparent and timely communication channels with the public, and lack of multi-channel, multi-level and multi-faceted pollution information disclosure mechanisms. Rapid pollution control information transmission channels are the cornerstone of scientific decision-making on pollution control of MA [15]. The external information exchange system is not perfect, and it is unable to transmit the relevant information of seawater pollution incidents and the pollution control situation in a timely manner, which makes the public question the performance of pollution control responsibility of aquaculture enterprises.

4. Government Incentive Mechanism for MA Pollution Control

(1) Comprehensive reform of the governance system. Since the implementation of MA pollution control involves many departments and the improvement of laws and regulations, as well as the innovation of management methods of relevant social groups, it is a comprehensive and complex environmental protection project. The government needs to make overall plans, start from the source, comprehensively promote the reform and innovation of the fishery development model, take into account economic interests and environmental interests, and lay a solid foundation for aquaculture pollution control [16].

(2) Establish a long-term pollution control mechanism. For the limited water tidal flats, we cannot just ask for them without protection, and realize the continuous unity of utilization and investment. The environmental carrying capacity of the water and tidal flats should be strictly planned, the overall situation should be coordinated, and the aquaculture area and density should be rationally planned. At the same time, to change the current chaotic unlicensed state, improve the efficiency of the issuance of breeding licenses in accordance with established standards, and maintain a stable and orderly breeding market order [17].

(3) Establish an incentive mechanism for MA pollution control. The government plays a leading and commanding role in the incentive mechanism. At the same time, it adopts political, economic, market and other means to advocate aquaculture enterprises to actively participate in the pollution control of MA [18]. For example, MA ecological compensation, economic compensation or the implementation of support policies and minimize the impact of fishery disasters on the income of fishermen, create good external conditions for them. The government can mobilize the enthusiasm of the breeding owners to actively cooperate by improving the pollution control efficiency of the breeding owners. At the same time, it is also necessary to supplement the corresponding supervision mechanism and information feedback mechanism, and finally achieve the purpose of enabling relevant parties to participate in the control of aquaculture pollution.

(4) Update aquaculture pollution treatment technology

In response to MA pollution, relevant governments need to increase the promotion of aquaculture pollution treatment technology, popularize relevant technologies and knowledge, and promote farmers to update and maintain decontamination equipment. In order to ensure the

improvement of pollution treatment technology for livestock and poultry breeding, the local government should take different solutions according to different situations. For enterprises whose pollution exceeds the standard, rectification is ordered and reasonable rectification suggestions are put forward [19]. In addition, the relevant government departments have also refined and implemented the breeding access households, registered the rectified farms, signed relevant letters of commitment, and controlled the annual breeding volume.

5. Conclusion

With the favorable guidance of the government and relevant departments for MA and the continuous improvement of people's awareness of environmental protection, the pollution control of aquaculture enterprises has been controlled step by step today. But we can see that although farmers have a high willingness to control pollution, their actions do not match the specific behavior of pollution control. In their subconscious, although the concept of green environmental protection is very advanced, but under the constraints of traditional thinking and driven by economic interests, farmers only seek to maximize economic interests, and the government's catalytic leadership is insufficient. There is also a lack of timeliness. Whether it is the treatment of MA wastewater, or the promotion and application of new technologies and infrastructure to transform aquaculture pollution treatment measures, there is a lack of corresponding enthusiasm. In this regard, this paper proposes a corresponding government incentive mechanism to help local governments. The MA industry has actively responded to the call for pollution control from MA.

Funding

This article is not supported by any foundation.

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.

References

[1] Alam A . Marine spatial planning for Bangladesh: a critical analysis of the legal and institutional regimes. Asia Pacific Journal of Environmental Law, 2019, 22(2):277-288. https://doi.org/10.4337/apjel.2019.02.05

[2] Okafor-Yarwood I . Illegal, unreported and unregulated fishing, and the complexities of the sustainable development goals (SDGs) for countries in the Gulf of Guinea. Marine Policy, 2019, 99(JAN.):414-422. https://doi.org/10.1016/j.marpol.2017.09.016

[3] Wardoyo W A , Mudzakir A K , Haerudin. Empowerment Strategy for Community Surveillance Groups (POKMASWAS) in Marine and Fisheries Resource Surveillance Activities to Prevent Illegal and Destructive Fishing Activities through Interpretive Structural Modeling (ISM). International Journal of Applied Environmental Sciences, 2019, 14(4):307-324.

[4] Said A , Macmillan D . 'Re-grabbing' marine resources: a blue degrowth agenda for the resurgence of small-scale fisheries in Malta. Sustainability science, 2020, 15(1):91-102.

https://doi.org/10.1007/s11625-019-00769-7

[5] Touwe S . Local Wisdom Values of Maritime Community in Preserving Marine Resources in Indonesia. Journal of Maritime Studies and National Integration, 2020, 4(2):84-94. https://doi.org/10.14710/jmsni.v4i2.4812

[6] Khan A . Commentary 8 to the manifesto for the marine social sciences: fishery resources in a development African context. Maritime Studies, 2020, 19(2):1-2. https://doi.org/10.1007/s40152-020-00187-x

[7] Shekhar S , Kumaresan S , Chakraborty S , et al. Total Organic Carbon Profile in Water and Sediment in Coral Reef Ecosystem of Agatti Island, Lakshadweep Sea. Indian Journal of Geo-Marine Sciences, 2019, 48(6):936-942.

[8] Damayanty S , Kamal M , Muhammad A P . Identification of Causes and The Existence of Mercury and Chromium in Sediment and Sea Water in Kendari Bay. Jurnal Kesehatan Masyarakat, 2020, 15(3):344-355. https://doi.org/10.15294/kemas.v15i3.21871

[9] Czeczeli V , Kutasi G , E Szabó. The assessment of government incentives on savings, Hungary 2006–2019. Acta Oeconomica, 2021, 71(4):569-585. https://doi.org/10.1556/032.2021.00040

[10] Anwar M , Khattak M S , Popp J , et al. The Nexus Of Government Incentives And Sustainable Development Goals: Is The Management Of Resources The Solution To Non-Profit Organisations?. Technological and Economic Development of Economy, 2020, 26(6):1284-1310. https://doi.org/10.3846/tede.2020.13404

[11] Young N , President A . Government Incentives for Traineeships within the NDT Industry. Non Destructive Testing Australia, 2019, 6(3):30-30.

[12] Lange S J , Moore L V , Galuska D A . Local government retail incentives for healthier food retailers in the USA, 2014. Public Health Nutrition, 2019, 22(13):2521-2529. https://doi.org/10.1017/S1368980019000983

[13] Gulas S , Downton M , D'Souza K , et al. Corrigendum to 'Declining Arctic Ocean oil and gas developments: Opportunities to improve governance and environmental pollution control' [Mar. Pol. 75 (2017) 53-61]. Marine policy, 2019, 105(JUL.):177-179. https://doi.org/10.1016/j.marpol.2019.03.002

[14] Cong T T , Nguyen P . Some Main Causes of Marine Pollution in Vietnam. European Journal of Engineering Research and Science, 2019, 4(3):170-175. https://doi.org/10.24018/ejers.2019.4.3.1214

[15] Jusufovski D , Saavedra C , Kuparinen A . Competition between marine mammals and fisheries in contemporary harvested marine ecosystems. Marine ecology progress series, 2019, 627(Sep.26):207-232. https://doi.org/10.3354/meps13068

[16] Almroth B C , Eggert H . Marine Plastic Pollution: Sources, Impacts, and Policy Issues. Review of Environmental Economics and Policy, 2019, 13(2):317-326. https://doi.org/10.1093/reep/rez012

[17] Sahoo B P , Sahu H B . Assessment of metal pollution in surface water using pollution indices and multivariate statistics: a case study of Talcher coalfield area, India. Applied Water Science, 2021, 12(9):1-19. https://doi.org/10.1007/s13201-022-01743-y

[18] Englander G . Property rights and the protection of global marine resources. Nature Sustainability, 2019, 2(10):981-987. https://doi.org/10.1038/s41893-019-0389-9

[19] Haq M , Suraiya S . A review on the bio-functional roles of phospholipids from marine resources. Food Research, 2021, 5(5):1-16. https://doi.org/10.26656/fr.2017.5(5).677