

# Analysis of The Impact of Fisheries on Marine Ecology

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**Abstract.** The marine ecosystem is now a noticeable topic in the worldwide range, affecting the lives of billions of people as well as the entire environment of the planet. The fishing industry, which is closely combined with the marine ecosystem, might have a wide negative impact on the marine ecosystem, such as the destruction of marine biodiversity, destruction of biological habitats, biological invasions, and seawater pollution. The purpose of this paper is to conduct a clear study on the structure of fisheries and to find out the exact negative impacts of fisheries on the marine environment in order to discuss the need to protect the marine ecosystem and resources. Based on the results of this paper, it is clear that there are various need of fishing industry, including seafood fishing, seafood processing, seafood circulation, and aquaculture. And it could have a negative influence on marine ecosystems through the destruction of marine habitats, biological invasion as well as water pollution. Therefore, human beings should conserve marine biodiversity and protect the marine environment by reducing the use of plastic products, garbage sorting, recycling and treatment of discharged wastewater. These methods are eco-friendly and conducive to maintaining the balance of the ecosystem and the sustainable development of the economy in the future.

**Keywords:** Fishing industry, Aquatic animals, Marine ecology.

## 1. Introduction

Fishery refers to the activities of humans in obtaining food raw materials and various other industries through fishing, processing, breeding, and harvesting of biological resources in water bodies. According to the type of waters, fish can also be divided into marine fisheries and inland fisheries. Marine fish mainly use marine resources for fishing and breeding, while inland fisheries cover the use of resources in rivers, lakes, reservoirs and other freshwater waters. With the advancement of technology, the production methods of fisheries are becoming increasingly diverse, including traditional fishing, modern aquaculture, deep-sea aquaculture, and other forms, which together constitute the diverse pattern of modern fisheries. Fisheries can promote economic development, ensure national food security, play a huge role in maintaining ecological balance, provide impetus for rural economy, and increase employment opportunities. With the growth of population, fishing has become an important way to alleviate the food crisis. At the same time, the cultivation of fisheries has prevented people from extensively fishing for marine organisms and maintained the natural environment. The overall growth rate of China's marine fishing industry is relatively low. Faced with complex and ever-changing domestic and international markets and environmental pressures, China is also expanding into broader waters. This structural adjustment helps alleviate the resource pressure in nearshore areas. The foam economy in foreign countries, such as Japan, has seriously affected the social development, making the fishery decline rapidly from 1990 to 1995, and then slowly declined year by year. This article explores the relationship between fisheries, the state, and ecology. It not only studies the use of fisheries to promote the economic development of a country and make it prosperous and strong as soon as possible, but also aims to protect biological resources through fisheries, China's marine natural ecology, and conservation of biological resources, while maintaining the utilization value and potential utilization value of organisms to humans.

## **2. Impacts of Fishing Activities on Marine Ecosystems**

### **2.1. Characteristics of Marine Fisheries**

Market demand for fisheries encompasses several areas, including seafood fishing, processing, distribution, and aquaculture. Aquatic product fishing involves utilizing various tools and techniques to capture marine organisms in natural water bodies, such as deep-sea fishing, nearshore fishing, and inland water fishing. The species targeted include wild fish, crustaceans, and shellfish.

Aquatic product processing refers to transforming captured or farmed aquatic organisms into different food items, feed products, or other goods. This process includes primary methods like cleaning and slicing as well as more advanced techniques such as pickling and canning. The circulation of aquatic products covers the entire journey from production to sale—encompassing wholesale distribution, retailing, imports, exports—and all related activities. Aquaculture consists of both freshwater and marine farming practices aimed at cultivating fish, shellfish, crustaceans, algae among others through artificial means. This sector is a vital part of the fisheries industry.

The industrialization of fishery aquaculture operates on a five-in-one three-dimensional model focused on sustainable economic growth. The five key components are environmental capital (the foundation for sustainability), resource capital (essential support), human capital (the driving force), social capital (the fundamental guarantee), and monetary capital (serving as the trading mechanism). By leveraging these elements effectively within the industry can significantly advance the industrialization of fisheries while promoting sustainable economic development.

Moreover, the fishing industry plays an important role in boosting economies by creating job opportunities—particularly for fishermen along coastlines—as advancements in technology lead to new aquatic farms and processing facilities that generate additional employment options. Furthermore, the output value from fisheries constitutes a significant portion of many coastal economies; with ongoing technological improvements contributing to its growth which stimulates domestic markets.

Lastly, international trade represents another crucial aspect within this sector; China's export volume for aquatic products has been steadily increasing over the years, enhancing market share while benefiting both local economies where these resources originate from the domestic economy [1].

### **2.2. Impacts of Marine Fishing on Marine Life**

Marine fishing activities mainly include traditional marine fishing production and marine recreational fishing. Although the world fishery production shows an upward trend with the increase of fishery effort, if factors such as technological progress and the increase in fishing vessels lead to an increase in fishing capacity, as well as a decrease in the trophic level status of fishing targets, are taken into account, the fishing unit effort shows a significant decrease trend, which means a decrease in fishery resource density and a decrease in total resource quantity[2]. Studies have shown that most of the world's marine fishing grounds show signs of overexploitation, and according to the Food and Agriculture Organization of the United Nations, 10% of the world's more than 200 major fishery resources are severely depleted, 18% are overexploited and declining, 47% are fully utilized, and 25% are moderately developed or underutilized[3]. Almost all fully utilized species are developing towards overexploitation. The ecological and economic sustainability of marine fisheries worldwide is receiving increasing attention. In the current marine fishing catch, there are few large-bodied and high-quality fish, while young and low-value fish account for 80% or even more than 90% of the total catch. It can be said that the world's marine fishery production has undergone tremendous changes and is almost on the brink of collapse.

## **2.3. The Effects Made by the Fishing Industry on the Habitats of Aquatic Animals**

### **2.3.1. Marine habitats**

The flexibility of the geological structure of the ocean provides marine animals with a suitable place to live and heightens the ability of the ecosystem to keep the balance of the ecosystem through feedback effects. These habitats are the environments on which the creatures rely, so the conversion of marine structures is the basic factor that leads to the immediate distinction between aquatic animals and the decrease in biodiversity in the sea[4].

### **2.3.2. The adverse impacts of fisheries on marine environments**

In recent years, the rapid expansion of the fishing industry has significantly altered both the shape and physical characteristics of marine animal habitats. This change is largely due to the diverse range of fishing tools employed by fishermen, such as bottom trawls[4].

For instance, operations utilizing bottom trawls inflict severe immediate and cumulative damage across extensive habitats. These types of equipment cause substantial disruption that can compromise biogeochemical cycles. Additionally, towed nets can disturb sediments at the ocean floor, altering sediment particle dynamics and leading to pollution from suspended particles while increasing nutrient flows. Such disturbances can adversely affect essential processes within benthic ecosystems, including carbon fixation and nutrient cycling[5].

### **2.3.3. Negative effects of the fishing industry on particular species**

Fisheries have a significant impact on various marine species. For instance, nearly all visible cold-water coral reefs in the northeast Atlantic Ocean suffer varying degrees of damage from bottom trawling. Furthermore, the seaweed found on the ocean floor is adversely affected by these trawls, leading to a substantial reduction in the hatching rate of *Navodon modestus*[5].

## **2.4. Biological Invasion**

### **2.4.1. The concept of biological invasion**

Biological invasion describes a situation where non-native species, which emerge outside their natural environments, gain a competitive edge over indigenous species. This can result in reduced populations and even extinction of local species, ultimately causing alterations and harm to the structure of the native ecosystem[6].

### **2.4.2. The causes and ways the invasive species transport**

There are two primary methods through which species invasions occur. The first involves human activities, where certain fishery operators introduce specific organisms that have greater adaptability or higher economic value into local waters for short-term gains. The second method occurs when these species are transported by boats[6].

### **2.4.3. The harmful effects the biological invasion has on local ecosystems**

Initially, people introduce those alien species to defend the waves and winds to protect the coasts or to keep some productive ones with strong fecundity to grab more benefits. However, some of them could develop wild populations and extend or expand with their advantages, which enables them to take up local species' living areas and food, damaging the structure of ecosystems of local sea areas as well as biodiversity, even causing genetic contamination through hybridization[6].

## **2.5. The Effects on Marine Ecosystems Made by Pollution**

Marine pollutants encompass a broad range of substances that humans release into the ocean, which can have either direct or indirect detrimental effects on marine ecosystems. Common examples of these contaminants include petroleum and its derivatives, such as gasoline, various metals and acid-base solutions, organic chlorine compounds, nutrient salts, and radioactive materials[7].

Marine pollution can be classified into four main categories based on the sources of contaminants: land-based pollution, marine industrial pollution, air-related pollution, and impacts from fishing and nearshore aquaculture. Land-based pollution encompasses industrial waste, everyday garbage, and agricultural runoff produced by human activities. In contrast, marine industrial pollution primarily arises from offshore oil extraction, shipping operations, and related accidents. Air-related pollution refers to pollutants that are deposited into the ocean via precipitation[8]. Regarding fishing and nearshore aquaculture practices, excessive exploitation of coastal areas leads to overuse of marine resources. The fishing industry relies heavily on numerous vessels that contribute significantly to contamination levels. Discarded fishing gear such as nets, ropes, and hooks pose direct threats to aquatic life as they can drift with ocean currents[9]. Additionally, various chemical substances are released or spilled into the sea during vessel operations; examples include BTEX compounds (Benzene, Toluene, Ethylbenzene, Xylene). These chemicals exhibit biotoxic properties that not only disrupt marine food chains through biomagnification but also harm the balance of marine ecosystems. Furthermore, they negatively impact air quality along coastlines when they enter the atmosphere[10].

### **3. The Importance of Protecting Marine Ecosystem and Resources**

#### **3.1. Environmental Protection**

Biodiversity includes genetic diversity, species diversity, and ecosystem diversity. Genetic diversity refers to the sum of genetic information carried by all living things on earth. Any species or an individual organism preserves a large number of genetic genes, and the diversity of these genes is based on the evolution of life and species differentiation. Marine biodiversity encompasses all levels of complexity of life in the sea, from within species to across ecosystems. At all levels, marine biodiversity has naturally exhibited a general, slow trajectory of increase, punctuated by mass extinctions at the evolutionary scale and by disturbances at the ecological scale. In historical times, a synergy of human threats, including overfishing, global warming, biological introductions, and pollution, has caused a rapid decline in global marine biodiversity, as measured by species extinctions, population depletions, and community homogenization. The consequences of this biodiversity loss include changes in ecosystem function and a reduction in the provision of ecosystem services. Global biodiversity loss will continue and likely accelerate in the future, with potentially more frequent ecological collapses and community-wide shifts. However, the timing and magnitude of these catastrophic events are probably unpredictable[11]. The concept of ecological balance pertains to the stability of various life forms. In the context of marine environments, it implies that populations exist in a delicate equilibrium between overpopulation and severe decline. Factors influencing this balance include chemical composition, catastrophic events, storms, overfishing, pollutants, and even population density itself. When these elements overpower natural restorative processes, significant changes occur in the ecosystem, leading to a new state of balance. Safeguarding the marine ecological environment is crucial for ensuring national ecological security, fostering sustainable development at sea, and achieving harmonious coexistence within marine ecosystems[12].

#### **3.2. The Development of Economy**

Tropical fisheries play a significant role in enhancing the well-being of communities both within tropical regions and beyond, particularly through "telecoupling," which refers to connections between distant human and natural systems. However, tropical marine environments and fish populations are at risk due to physical and biogeochemical changes in the ocean linked to increasing greenhouse gas levels. These alterations in fish stocks, along with their effects on fish production, have important consequences for the UN Sustainable Development Goals.

In this review, we examine how climate change impacts tropical marine fisheries, emphasizing the socio-economic repercussions for both tropical and extratropical countries while exploring possible adaptation strategies. Due to factors such as ocean warming, acidification, deoxygenation, and rising sea levels, it is estimated that the maximum catch potential of certain tropical fish stocks within

exclusive economic zones could decrease by up to 40% by the 2050s compared to levels from the 2000s under the RCP8.5 emissions scenario. The decline in fisheries production driven by climate change will also lead to shifts in species composition, heightening vulnerability for tropical nations with limited capacity for adaptation.

Given that billions of individuals rely on tropical marine fisheries in various ways, it is essential to consider how climate change affects these resources and identify effective adaptations when developing sustainable pathways resilient to climate challenges[13]. For marine tourism to achieve sustainable development, it requires a robust foundation of support. Currently, the growth of marine tourism appears to be lacking this essential driving force. The recent rapid expansion of the yacht industry may soon face stagnation. Additionally, without a strong marine tourism sector to foster growth, it becomes susceptible to various challenges. If there is insufficient innovation and optimization in developing marine tourism resources, creating products that satisfy consumer demands will be impossible. Even with an increase in available tourism resources, they risk becoming stale as consumers gradually lose interest[14].

#### **4. Suggestions for Protecting Marine Ecosystems**

Firstly, Plastic products are one of the main sources of marine debris. Reducing the use of plastic can lower pollution to the marine environment and reduce the occurrence of fatalities to marine life, such as reducing the use of disposable plastic products (shopping bags, plastic bottles, and straws), reusing plastic products, or choosing biodegradable materials for shopping bags. Secondly, Proper garbage classification and recycling methods can reduce the amount of garbage entering the ocean. By recycling reusable materials such as waste paper, glass, and metal, the demand for natural resources can be reduced while minimizing marine pollution. Thirdly, it is necessary to restrict the use of chemicals. Many chemicals can cause serious damage to marine ecosystems, and the use of products containing harmful chemicals such as detergents, cleaning agents, and insecticides should be minimized as much as possible. The fourth step is to treat the discharged wastewater in accordance with standards and conduct strict control and supervision. The discharge of industrial and urban wastewater is one of the main causes of marine pollution. The government should strengthen the supervision of wastewater discharge and advocate the use of environmentally friendly wastewater treatment equipment. Finally, various protection measures should be implemented for marine biodiversity. The ocean is home to many rare species, and marine protected areas should be established to restrict fishing and damage marine ecosystems, in order to protect and restore marine biodiversity.

#### **5. Conclusion**

This paper mainly focuses on the impact of foliage on the marine ecology, analyzes the basic situation of fishery and the necessity of protecting Marine ecology and resources, and studies and highlights several suggested measures to protect Marine ecology. This paper clearly studies the structure of fisheries, analyze the exact negative effects of fisheries on the marine environment and discusses the need to protect the marine ecosystem and resources. It also gives various feasible suggestions to restore the marine ecology. Reducing the use of plastics, segregation of garbage, recycling, treatment and discharge of wastewater, and preservation of marine biodiversity are ecologically beneficial to maintain the balance of the ecosystem and promote sustainable economic development in the future.

#### **Authors Contribution**

All the authors contributed equally and their names were listed in alphabetical order.

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