ISSN 2582-6441 [Online]
RESEARCH JOURNAL OF PHARMACY AND LIFE SCIENCES
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An International Peer Reviewed Journal
RJPLS

Research Article

DECLINE OF HILSA FISHES IN AND AROUND THE MAHANADI RIVER ESTUARY, ODISHA, INDIA

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ARTICLE INFO

Date of submission: 18-05-2024
Date of Revision: 02-06-2024
Date of acceptance: 09-07-2024

Key Words:
Hilsa, Mahanadi Estuary, Odisha, Conservation of Fishes

ABSTRACT

The nutritional benefits of Hilsa have led to a high demand in the Indian fish market. This species is commonly found in estuaries, rivers, and coastal waters. The Mahanadi estuarine system is one of the major estuaries in India and the largest estuary in Odisha. During our research, we found that in the last 7 years, the population of Hilsa has drastically declined in the Mahanadi estuary where the river meets the Bay of Bengal. The Hilsa is a prized food fish found in the coastal and estuarine waters of South Asia known for its delicate flavor and nutritional value, the Hilsa is an important part of the regional cuisine and economy. They have a wide range of distribution and occur in marine, estuarine, and riverine environments. The main cause of decline of Hilsa is overfishing, habitat degradation and climate change. It can be restored by sustainable fishing practices, international cooperation, habitat protection, and public awareness.

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1. INTRODUCTION

A member of the Clupeidae family, Hilsa (*Tenualosa ilisha*, Hamilton) travels the Indo-Pacific area, from the Arabian Gulf and South Vietnam to Bangladesh, India, Pakistan, and Burma, following a systematic life cycle. Hilsa is a premium table fish in eastern and northeastern India, especially among the Bengali community [1]. Hilsa (Figure 1) is also important for the artisanal fishing industry's socioeconomic elements. It is prized for having a high concentration of vital nutrients, such as DHA, EPA, omega-3 PUFAs, and premium proteins [2].

Figure 1: Hilsa fish catch from the Mahanadi estuary

The nutritional benefits of Hilsa have led to a high demand in the Indian fish market. This species is commonly found in estuaries, rivers, and coastal waters. The Mahanadi estuarine system is one of the major estuaries in India and the largest estuary in Odisha. It is spread over a wide area about 165 kilometers of coastline along the coast of Bay of Bengal. The estuarine environment is characterized by a constantly changing mixture of salt and fresh water and is typically dominated by fine sedimentary material carried into the estuary from the sea and from rivers which accumulates in the estuary to mud-flats. The mixture of salt and fresh water present challenges to the physiology of the fishes. Estuaries serve as a dynamic habitat for a large number of marine fisheries species during a part of their life span, which are characterized by large fluctuations in environmental conditions as these are meeting place of freshwater from river and salt water from sea [3, 4]. Their importance is best understood in many parts of the world as breeding and nursery grounds for

a large variety of fishes and aquatic animals. For marine trophic chain nutrient in the dissolved state are the basic raw materials and their entry are from continental drainage through the estuaries [5, 6]. The nutrients supply is greater in estuaries due to entry of anthropogenic wastes and agricultural effluents and this causes several environmental modifications which may affect increase in productivity and fish yields [7, 8].

During our research, we found that in the last 7 years, the population of Hilsa has drastically declined in the Mahanadi estuary where the river meets the Bay of Bengal. The Hilsa is a prized food fish found in the coastal and estuarine waters of South Asia known for its delicate flavor and nutritional value, the Hilsa is an important part of the regional cuisine and economy. They have a wide range of distribution and occur in marine, estuarine, and riverine environments. The northern Bay of Bengal and its associated river systems contribute to 90% of Hilsa catch in the country. The major portion of Hilsa (about 90%) is captured by Bangladesh, India, and Myanmar [9].

There are several regions for reduction of Hilsa populations in the Mahanadi estuary. Numerous species will be vanished from the Mahanadi River as a result of untreated municipal and industrial garbage [10]. Reducing pollution, better controlling fishing operations, and maintaining places with robust native fish populations should be the main goals of conservation initiatives for Hilsa. This article aims to review the current status and threats facing Hilsa in the Mahanadi estuary. It will also explore the implications for water biodiversity conservation.

2. MATERIALS AND METHODS

Study Area

Within latitudes 19°47' N and 20°30' N and longitudes 85°33' E and 86°49' E is the Mahanadi estuary system (Figure 2 & 3). It reaches the north-eastern tip of Chilka Lake in the south in Puri district and the northern end of Hukitola Lake in the north in Cuttack district. For hydrological investigations and fish species collection, the study area was separated into three (03) sampling stations: 1. Nehru Bangala Paradeep; 2. Delhila Fishing Harbour Paradeep; and 3. Bali Plot Fishing Harbour Paradeep (Figure 4, 5 & 6). Nearly every location within the estuary is inaccessible by road. Therefore, mechanised boats have surveyed the majority of the sites. The whole region is covered with mangrove forest, and mud flats are crossed by a system of tidal

Figure 2 & 3: Showing the study area through a Google satellite map

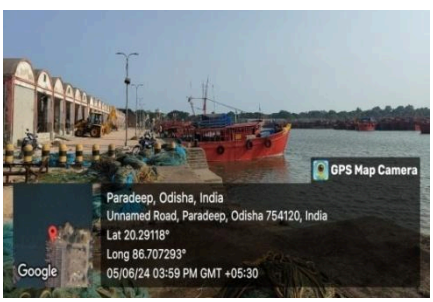

Figure 4, 5 & 6: Showing the study sites through a Google map

Methodology

Primary data

This manuscript was prepared using both primary and secondary data. The main set of data was gathered during July 2023 to August 2024. At three sampling stations, water samples were taken twice a month from a depth of 30-35 cm while fish samples were also being taken. Samples of fish were obtained from nearby fishermen who had been notified beforehand. The fishes were classified by the guidelines of Nelson [11] in this investigation. The scientific name, most recent synonyms, digital HD photos, length, and weight of each species were listed, all of which were also noted for further study. The following information was sequentially recorded under the material: total number of fish, range, collector name, collection date, locales, area temperature, water temperature, water pH, and DO. Fish that are infected or exhibit any abnormal symptoms were brought to the laboratory for identification of pathogens. For the laboratory study, fish were collected from each station during the study period and cleaned and frozen in an icebox. In the laboratory, samples were identified at the species level [12].

Secondary data

The secondary data was collected from different research articles, books, OMFPA (Odisha Marine Fish Producers Association), Paradeep, Odisha and MPEDA (Marine Products Export Development Authority), Bhubaneswar, Odisha for preparation of this manuscript.

3. RESULT AND DISCUSSION

Result

The Hilsa catch from the Mahanadi estuary from 2016 to 2023 is displayed annually in metric tonnes in Table No. 1. A total of 2560.5 metric tonnes of Hilsa fish were taken from the Mahanadi estuary throughout the course of the six-year fishing season. In 2020–21, fishing was prohibited due to the COVID-19 epidemic. The greatest amount of Hilsa (1100 metric tonnes, or 43%) was caught in the years 2016–17, while the least amount (125 metric tonnes, or 5%) was caught in the years 2022-23. The Hilsa catch dropped dramatically from 43% to 17% in 2017–18. Hilsa fish harvesting decreased gradually after 2017 and continued to do so until 2023.

Table No. 1 Showing Hilsa Fish-Catch Year Wise

Year	Hilsa Catch (Metric Ton)	Average	Percentage
2016-17	1100	1100	43
2017-18	400-500	450	17
2018-19	300	300	12
2019-20	450	450	18
2020-21	Fishing was closed due to covid-19 pandemic (Very small amount caught)	No Record	0
2021-22	121-150	135.5	5
2022-23	100-150	125	5
	Total	**2560.5**	**100**

Discussion

Hilsa catch declines gradually in between 2016 and 2023 are shown in Figure 7 and 8. Based on our observations, there could be multiple reasons for the decline in the Hilsa population in the Mahanadi estuary. The primary cause of the problem is overfishing, which is defined as excessive and uncontrolled fishing that result in the capture of many young fish before they can spawn. It is evident from these settings that Hilsa overfishing has turned into one of India's most unsustainable and worrisome aquaculture problems [13]. But because there is less of it due to overfishing, the market value of Hilsa has been rising quickly in India, particularly in

West Bengal. India's economy and ecology are suffering from the careless overfishing methods used in Hilsa production and management. Since there may be gaps in the laws now in place, effective legal action is required to remedy these unsustainable activities. Even with the present regulations in place, overfishing is still a serious problem. India contributed 14,000 tonnes to the average 583,000 tonnes of Hilsa produced worldwide in 2021[14]. The Ganga Estuary's Hilsa ecosystem is being harmed by the overfishing of young Hilsa. The ecosystem's overall balance is upset by this activity [15]. Because of this, the entire water ecology is harmed, which causes Hilsa's population to be decreasing daily [16].

The loss of habitat is yet another area where Hilsa catch is declining in the Mahanadi estuary. Rainwater carries pollutants and debris released by a number of industries, including cement plants, into bodies of water. The population of fish is being impacted by this pollution. The adjacent water quality is impacted by the presence of numerous immobile ships at Paradeep Port. The fish population is impacted by the oil spilt from these ships as well as the rust on their metallic components.

Hilsa fish loss is also a result of climate change. Their reproduction, migration, and survival are adversely affected by rising temperatures and changing weather patterns, which also cause unpredictable catch seasons and disturb their breeding cycles [17].An important part of fish life cycles, reproduction is impacted by a number of internal and external variables. The environmental cycles of many aquatic environments are closely linked to the reproductive cycle. As a result, any unfavourable environmental factors have the potential to interfere with marine fish's natural reproductive processes, which could affect spawning and lower fish population recruitment.

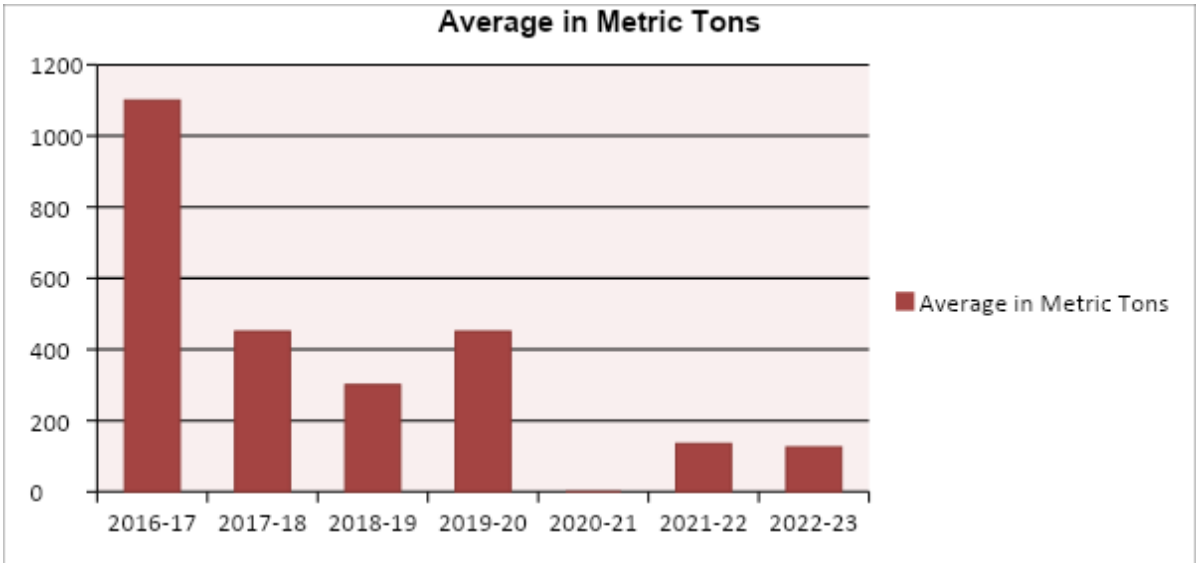

Figure 7: Showing the Hilsa catch in metric tons from 2016 to 2023

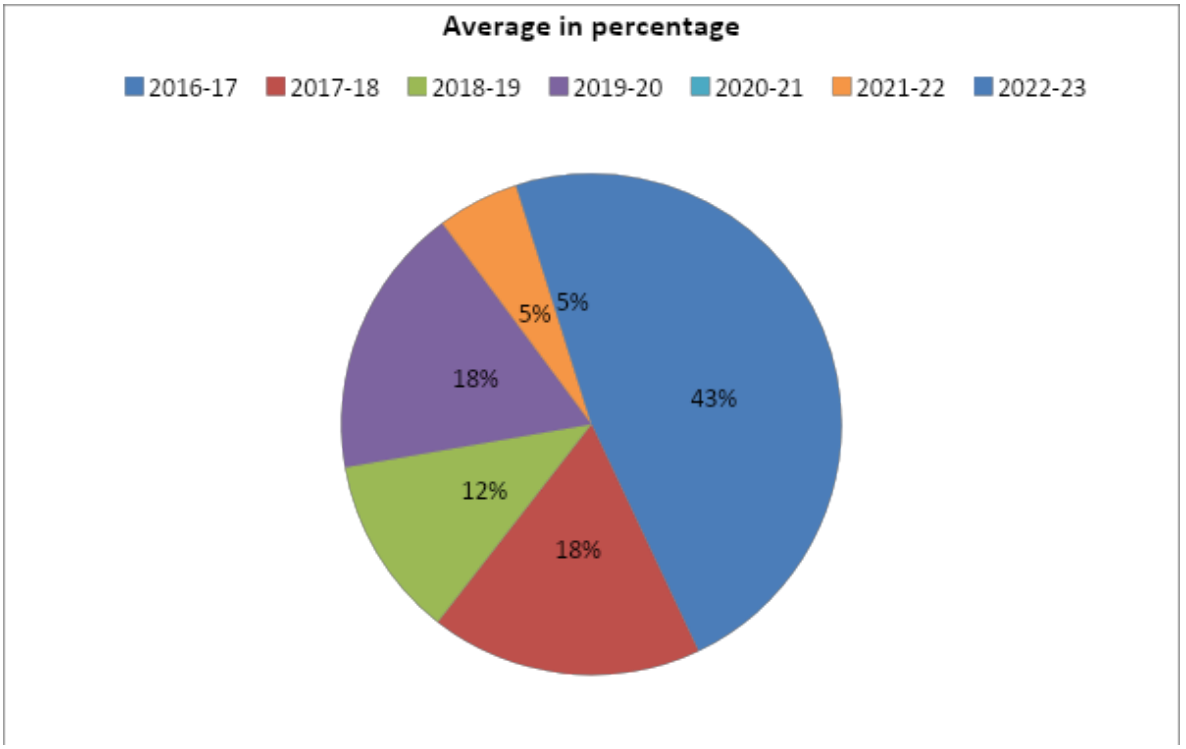

Figure 8: Showing the Hilsa catch in percentage from 2016 to 2023

Numerous crucial tactics have been the focus of efforts to preserve and rebuild the Hilsa population in the Mahanadi estuary. To enable Hilsa to spawn effectively, temporary fishing limits have been put in place during the busiest breeding season. Second, efforts to restore natural spawning grounds and migratory paths are known as habitat restoration projects. Examples of these include restoring mangroves and revitalising rivers. Third, in order to keep pollutants out of aquatic habitats,

industries have been urged to implement efficient waste treatment systems and embrace green infrastructure. Stakeholder interaction has been highlighted in this regard. Ensuring compliance necessitates rigorous enforcement of regulations and frequent monitoring. Furthermore, maintenance should be performed on stationary ships, environmentally friendly lubricants should be used, and containment devices should be installed to handle oil leaks, all of which should be backed by suitable port infrastructure. Cooperation between fishers, legislators, and conservation organizations has played a crucial role in developing and implementing effective management strategies.

4. CONCLUSION

In the end, we draw the conclusion that reviving the Hilsa population and its environment can be achieved by the use of sustainable fishing techniques, which include adopting more selective fishing gear, reducing by catch, and enforcing size limitations. The second is international cooperation, by working together regionally among nations that share the Hilsa's migratory range; we can guarantee the resource's long-term sustainability. The next step is to protect the Hilsa's vital spawning and nursery habitats by improving land-use planning and reducing pollution. The public's participation in raising public awareness through educating customers and the general public about the value of Hilsa conservation and promoting responsible consumption is also crucial.

5. ACKNOWLEDGEMENT

The Odisha Marine Fish Producers Association (OMFPA) in Paradeep, Odisha, and the Marine Products Export Development Authority (MPEDA) in Bhubaneswar, Odisha, are acknowledged by the authors for their data and assistance in the compilation of this publication.

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