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Harvest and post-harvest management of fish for local piscators of Odisha coast

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Abstract

Odisha, the fourth-largest fish-producing state in India, has significant inland, brackish, and marine fisheries potential. The state has witnessed a fourfold increase in fish production over the past two decades, driven by various government interventions, advanced fishing techniques, and improved post-harvest management. This paper provides an in-depth analysis of harvest and post-harvest management strategies adopted by local piscators along the Odisha coast. Key aspects of harvest management, including fishing methods, gear selection, and government policies, are discussed. Post-harvest management focuses on handling, preservation, quality control, transportation, and waste management. Sustainable fishing practices, infrastructure development, and value-added processing are emphasized as crucial factors in enhancing fish quality, reducing post-harvest losses, and improving the livelihood of coastal fishing communities. The study highlights the role of government initiatives like PMMSY and MMKY in strengthening fisheries management. The findings suggest that an integrated approach to harvest and post-harvest management can contribute to sustainable fisheries development and economic growth in Odisha.

Keywords: Harvest management, post-harvest handling, Odisha fisheries, sustainable fishing

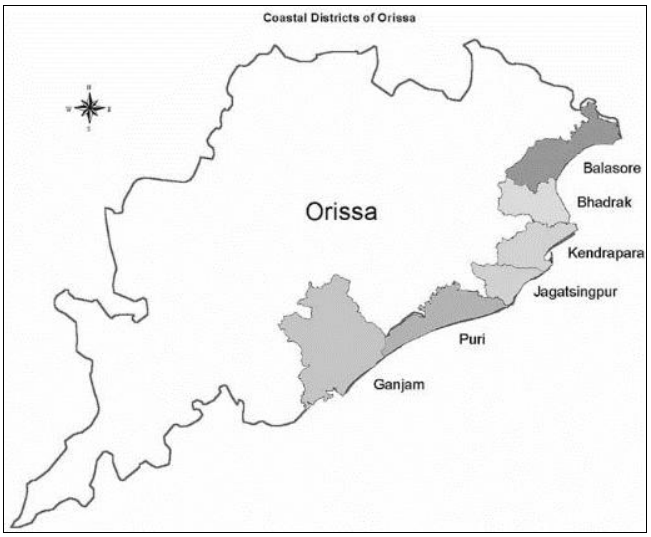
Introduction

Odisha is a maritime state and 4th largest fish producer in the Country. It provides immense scope for the development of inland, brackish and marine fisheries. Its coastline & continental shelf are 480 km and 24,000 sq. km respectively *(ICAR, 2006)* [7] which has copious potential for marine fisheries development. Freshwater and brackish water resources of the State are estimated to be 6.76 lakh ha & 4.18 lakh ha respectively. The total fish production of the state from inland & marine fisheries is 11.24 lakh MT in 2023-24 by the utilization of available resources (GoO, 2024) [4]. It helps not only the export increment but also creates employment, generates income for the rural poor, enhance their food, nutritional and livelihood security. There are 17,973 fishing crafts used in the State's coastline for marine fishing. Out of which 1,754 are mechanized, 6,734 are motorized and 9,485 boats are non-motorized. Trawlers account for 85% of the mechanized boats. There is 1 major fishing harbor, 3 minor fishing harbors and 69 fish landing centers in Odisha. The major fishing harbour is situated at Paradeep and 3 minor fishing harbours are Gopalpur, Astarang and Dhamara (*GoO, 2015*) [3]. This paper reviews various harvest and post-harvest management initiatives in Odisha, India, providing a comprehensive analysis and representation for enhanced understanding and evaluation.

Materials and Methods

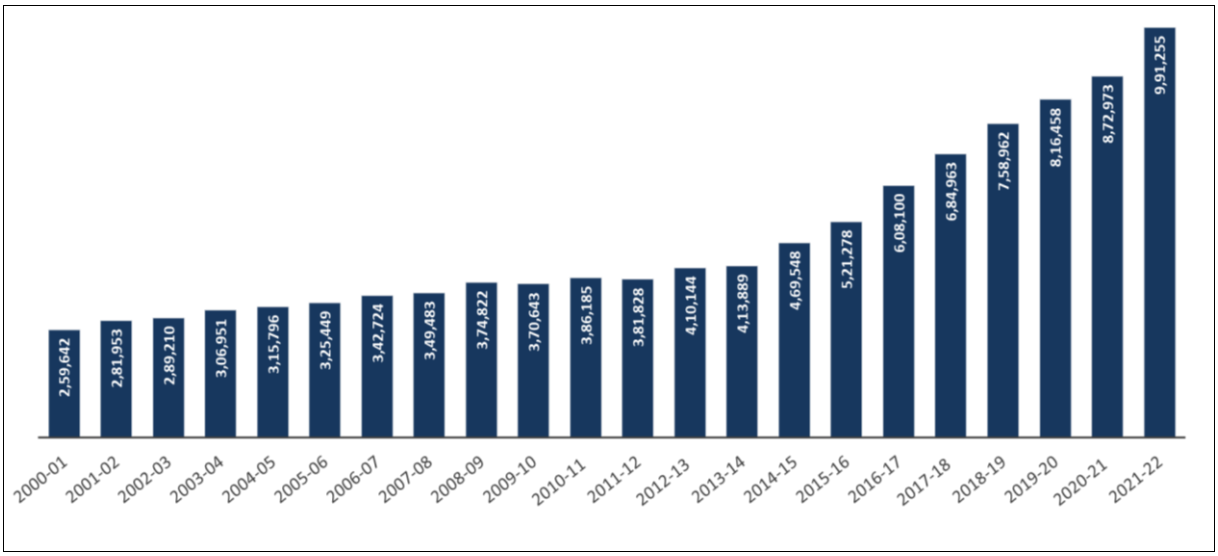
The data and information were obtained from various secondary sources, including government reports, archival records, and relevant scientific publications, complemented by direct non-structured observations and primary data collection.

Results and Discussion



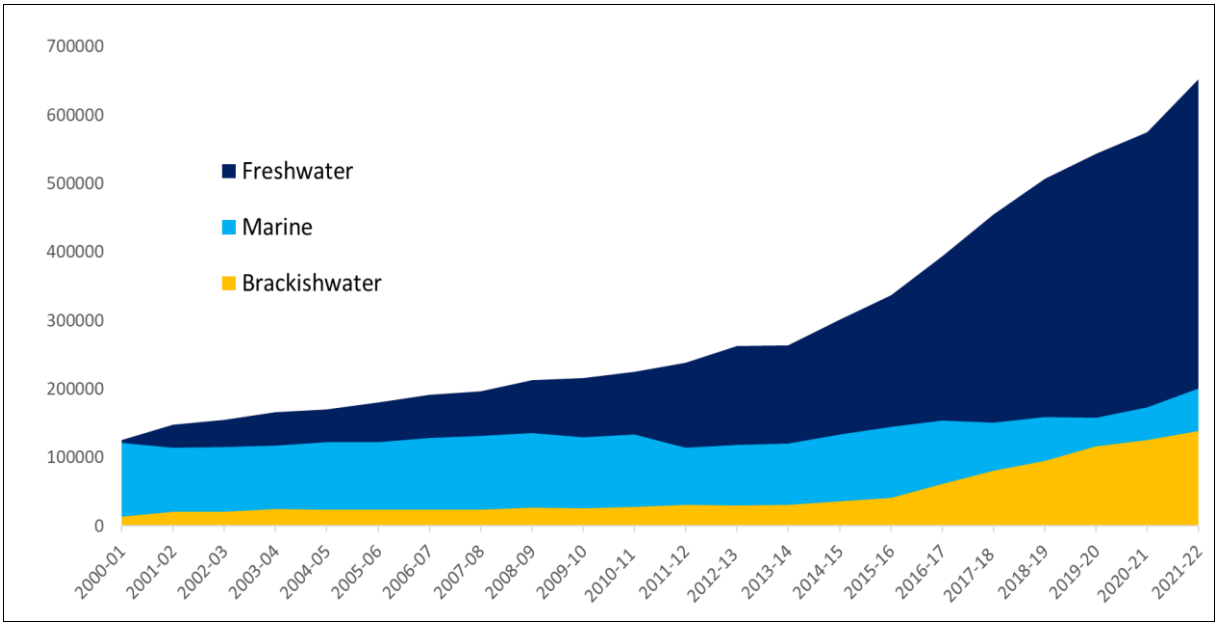
4 times increase in fish production over 2 decades from 2.60 Lakh Metric Tons in 2000-01 to 9.91 Lakh Metric Tons in 2021-22. Fast growth in last 6 years – CAGR of 11.31%

Coastal Districts of Odisha (Total 06)



(**Source:** Directorate of Fisheries, Govt. of Odisha)

Fig 1: Annual Fish Production in Odisha (in MT)



(**Source:** Directorate of Fisheries, Govt. of Odisha)

Fig 2: Trend of fish growth rate in Freshwater, Brackish water Marine Fisheries (in MT)

In Odisha, fish has been played an important role in the diet of Odia people. The state has 589 marine fishing villages and 3289 inland fishing villages with just over 1 million fishermen population (Panda *et al*. 2022) [10]. The fisher's population in the state is 15,89,042 and per-capita fish consumption in the state has increased from 7.71 kg in 2000 to 18.33 kg in 2023-24. It shows the demand for fish consumption in Odisha State is increasing day by day. Moreover, fish are excellent sources of high-quality animal protein, fat, minerals and vitamins (Kawarazuka and Bene 2011) [8]. Fish contains omega-3 polyunsaturated fatty acids-Eicosa Pentaenoic acid (EPA) and Docosahexaenoic Acid (DHA), that are known to have functions in reducing low-density lipids, helps brain function during development and helps to reduce pain of arthritis (Calder, 2016; Tilami and Sampels 2018; Horn *et al*. 2019) [2, 12, 6]. But due to the presence of high non-protein nitrogenous (NPN) substances, neutral pH, and high-water content, fish are extremely prone to bacterial contamination. During harvesting of fish, skin, gill, gut carry a high microbial load, which quickly spreads to the other parts causing deterioration of the fish quality and simultaneous consumer repulsions (Ovissipour *et al*., 2014) [9]. On the other hand, wastes generated from fish should be utilized to prevent environmental pollution and add to the income of the fish processor. Therefore, a practical harvest and post-harvest management of fish could lead to minimum waste and maximum utilization of resources available in Odisha.

Harvest Management

Fishermen follow the harvesting techniques in different ways in inland as well as marine sector as it is an important parameter taken into consideration which leads to better profit, less waste generation and resource conservation of

fishers.

- Harvesting at right size
- Availability of basic materials for handling of harvest
- Maintenance of Hygienic during harvesting.
- Optimal utilization of resources.
- Use of low-cost technique for harvesting

Fishing methods

Selection of fishing methods and gears is greatly influenced by type of the fishing ground, nature of fish stock, availability of gear materials with their characteristics and nature of consumption. Fishing operations of local fishers are complex socio-technical processes. But still, this article can provide an overall idea to understand the craft & gear used (harvesting methods) by coastal piscators of Odisha. Some methods practiced are traditional technology by local fishers are described below.

Fishing methods followed in Inland Sector

Some of the existing fishing methods which is commercially followed are, using cast nets & gill nets. Cast nets are locally called as *phinga jaal* which have a mesh with an opening on the upper side. Fishermen would throw it onto a school of fish swimming on waters by hand in such a manner that it spreads out in the water and sinks (Plate 1). It is then slowly hauled in by hand. These are very common means of harvesting. They are used for small scale harvest from flowing and static waters with smooth bottom. This gear, apart from being made of cotton or nylon twine, can be made of indigenous fiber. The popular mesh size of gillnet are 20-120 mm & mostly used to harvest fishes from open water bodies like ponds, rivers, and lakes. Nets made of synthetic fibers are floated for several hours to capture fishes of size. Such nets offer great selectivity and can be very large. Fishermen position these nets in such places where they knew fish passed through frequently. Harvest from such gear may need adequate facility like provision of ice, transportation till the market.

Plate 1: Cast net used by local fishers in inland sector, Khordha District, Odisha

Various types of craft are also used along the Mahanadi River stretches. The most dominant one is plank-built boat of varying sizes, locally called as 'donga'. Trap fishery, locally called 'benda'/'baja', is mainly used in the rocky areas of Mahanadi River stretch. Bag nets and seine nets are also used by fishermen. A type of drag net "Khadi jal" with a long wall of netting supported vertically by bamboo sticks are also used. A hook and line with multiple hooks and inside baits used in riverine fishery called Sola-kontai fishing. Similarly, a type of hand lift net called 'Chhinajaal' operated usually by women and children in fishing villages. The Oula donga (locally named *dingy*) is used extensively in the estuarine system of the state. These boats are commonly used for fishing within the river using both gill nets and tidal nets called *Behundi jaal* (GoO, 2024) [4].

Fishing methods followed in Marine Sector

Broadly in Odisha, out of 30 districts fishers of only 6 coastal districts follow kinds of gears & crafts for fishing. In Odisha, the crafts and gears vary from South to North region with the diversity of the ecology. South Odisha includes Ganjam, Puri and Jagatsinghpur district which has a narrow continental shelf and open sandy beaches. On the other hand, North Odisha includes Kendrapara, Bhadrak and Balasore district with an extended continental shelf, inter-tidal flats, and extensive river delta. Marine fishery of Odisha is mainly carried out by means of mechanized boats, medium size trawlers, traditional crafts (Catamarans), motorized canoes (FRP and Wooden) fitted with OBMs and Beach landing crafts fitted with IBM. The mechanized sector mostly use set gillnets and disco-nets. However, in mechanized sector trawl nets are widely used. Pelagic fishery is predominant in Southern Odisha and demersal fishery is prevalent in Northern Odisha (Sridhar & Muralidharan, 2013) [11].

Two kinds of trawlers are found in Odisha

1. Day Trawler: It is a smaller vessel using a 6-cylinder engine with a 60 hp capacity. These boats are largely found in the Devi River mouth area.
2. Sona Trawler: They are operated largely from the northern harbours of Balaramgadi, Dhamra and Nehru Bangla at Paradeep.

Artisinal fishing boats Kattumaram found along the east coast of the country simply referred as teppa (*Chhota teppa*, *Medium teppa* & *Bada teppa*) in Odisha coast. It is seen along the state's sandy beaches, i.e. from Paradip to Sonepur. Fishing using the kattumaram is done up to 10 km from the shore throughout the year, mainly during monsoons. FRP (Fibre Reinforced Plastic) boat is designed to accommodate larger gill nets, ring jaal, and for longer durations of fishing. In the Northern part of Odisha, trap fishing & different forms of passive fishing are followed. Encircling ring jaals are seen in many major fishing villages of Southern region. Trammel nets locally called as *disco net* is used for prawn catching by local fishermen. Bhut bhuti/1-Cylinder gill netter are used by fishers of northern region for estuarine fishing (Sridhar & Muralidharan, 2013) [11].

Govt. interventions for harvest management of fishers of coastal areas of Odisha

- There is provision to provide boats and nets under the component: fisheries management regulatory framework under the central sponsored scheme "Pradhan Mantri Matsya Sampad Yojana (PMMSY)" to support the traditional fisherman.
- To increase the marine fish production of the state, there is provision of motorization of traditional craft under the State Plan Scheme "Mukhya Mantri Matsyajibi Kalyan Yojana (MMKY)" for the marine fisher folk.
- There is financial assistance for new boat, engine, and lifesaving equipment under MMKY to improve the welfare of coastal communities in the state.

- To sustainably increase the productivity and production of fish and shrimp, there is provision to supply of fishing net/harvesting drag net (Plate 2) under MMKY "Popularization of Fisheries Machinery/Equipment / implement for Intensive Aquaculture in Odisha".

Plate 2: Supply of fishing net to the entrepreneurs under MMKY, Khordha District, Odisha

Table 1: Assistance to Coastal Fishermen under MMKY

Financial Year	No. of Beneficiaries Benefitted		
	Fishing Net with all fittings (Drag Net)	Trawl Net	New Boat, Net & Engine
2022-23	1260	Nil	191
2023-24	1782	115	634

Post Harvest Management

Postharvest handling means moving of a commodity from the producer to the consumer which includes harvesting, handling, cooling, curing, packaging, branding, storing, shipping etc. Fish post-harvest management along Odisha coast involves several important practices to ensure the quality, safety, and value of fish after it is caught. Here are key aspects of effective post-harvest management.

1. Handling during harvesting

When the fish are caught, proper handling starts in the boat. But preparations for proper handling should begin before craft goes for fishing ensuring that fish are handled with utmost care to prevent physical damage and contamination. In river and lake fishing are not as lengthy as in the case of sea, use of ice could keep the fish quality better, resulting in better price. Fish can be taken ashore within few hours of harvest, or they must be chilled to the temperature of melting ice as soon as possible. Generally, use of ice is not necessary in small crafts harvesting for a short duration. But after some time, it needs ice to keep the fish fresh.

2. Post-harvest handling

Post Harvest handling involves following steps

a. Cold chain Management

After catching, immediately ice can be used which can preserve the fish freshness. So, icing & freezing may be followed based upon the situation. Icing is a method of short-term preservation ideally termed as portable refrigeration system. The objective of icing is to cool the fish as quickly as possible, to as low a temperature as possible, without freezing. Ice increases the shelf life of the fresh fish by 8 times when iced after being caught at a temperature of 30°C. It reduces the bacterial and enzyme activity, keep the surface of the fish wet & glossy which prevents dehydration. If harvested fish quantity is large and fish is meant to be transported to a long distance, then freezing method is practiced. In such cases the heat is removed till the temperature is subzero. Cold storage facilities can be established to ensure an unbroken cold chain from catch to market.

b. Processing & Preservation

Various preservation methods like drying, smoking, salting/pickling, freeze-drying & freezing are being implemented to extend the shelf life of fish. Promoting modern processing technologies & techniques to add value and improve the product quality.

c. Transportation

Insulated & refrigerated vehicles are used for transporting fish to minimize the spoilage during the transit.

d. Quality Control & Quality management

Quality of a fish product is a combination of such characteristics as wholesomeness, integrity and freshness. Quality basically affects the food value of the product and embraces intrinsic composition, nutritive value and presence of undesirable materials (Balachandran, 2001) [1]. Regular quality checking should be done to ensure that fish meet safety standards and consumer expectations. Hazard Analysis and Critical Control Points (HACCP) protocols are implemented to identify and control potential hazards in the production process. Personal hygienic practices play an important role in maintain high hygiene standard. Necessary training must be given to those responsible for hygiene and to produce wholesome food.

e. Infrastructure Development

Development of fish markets with proper facilities for handling, storing & selling of fish is needed. Infrastructure for fishing harbour, fish landing centres (FLC) and processing units must be required.

f. Market Linkage/Traceability

Establishment of strong linkages between fish producers and markets are required to ensure efficient and fair trade. Quick disposal of the fish is most essential after catch. However, market may not have control over quick disposal. So, quick disposal of the fish can be done in market area, the fish kept for display may deteriorate evenly. So, it is required to keep the fish for display in rotation basis. Also, it should be replaced in ice regularly and uniformly. If fishes need to be dressed, cut and sold, the waste generated from it should be taken away and should not be allowed to contaminate the fresh lot. The surfaces should be cleaned with 100 ppm chlorine and should be made up of impervious materials which do not allow the broken pieces of fish to spoil and contaminate fresh lot. Exploring new markets for value added fish products must be required to increase the income of fishing communities or individual fishers.

g. Training and Capacity Building

Providing training to fishermen, processors & fish traders on best practices for post-harvest handling, hygiene and quality control is important. Promoting awareness about the economic benefits of reducing post-harvest losses and improving the fish quality is a major concern.

h. Research & Development

Supporting research on improved post-harvest technologies and practices is one of the major sectors. Similarly, encouraging the women in fish processing, packaging & marketing are good approach.

Govt. Interventions for post-harvest management of fishers of coastal areas of Odisha

- There is provision for construction of Modern Fish Retail Market under the central sponsored scheme "Pradhan Mantri Matsya Sampad Yojana (PMMSY)" to keep the fish in a fresh condition by preventing fish loss during vending period.
- There is provision for construction of cold storage/ice plant under PMMSY to ensure supply of quality ice to the fish / shrimp farmers for maintaining proper cold chain facility during transportation,
- To transport and market the fish/shrimp in local or distant market, there is provision for Motor cycle with icebox (Plate 3), auto with icebox, insulated van & refrigerated van under PMMSY.

Plate 3: Supply of Motorcycle with icebox for fish marketing under PMMSY

Waste management

Fish processing generated wastes are found in 2 forms i.e. solid form (fish carcasses, viscera, skin, and heads) and liquid form (washing and cleaning water discharge, blood water from drained fish storage tanks, brine). This waste should be stored to prevent the contamination in the processing environment and disposed of in such a way that is not detrimental to the receiving environment. Bones of fishes are the rich source of calcium which has been already reported by Xavier *et al*. (2003) [13] and Gopal *et al.* (2008) [5]. Fish Bones and offal can also be used for preparation of fish meal which is an animal feed. Similarly, fish silage can be prepared from the trace fish or small fish. Shrimp & prawn shells can be used for the preparation of chitin & chitosan. However, the fish waste can be simply converted into fertilizers.

Conclusion

Fish harvest management along Odisha coast involves several strategies and practices. Sustainable fishing and conservation of marine biodiversity is one of the major aims of this coast. There are regulatory measures such as size limits, catch limits, use of selective fishing gears, practicing responsible fishing techniques and seasonal restrictions which are followed to prevent overfishing and allow fish populations to replenish. Marine Protected Areas (MPAs) are also established where fishing activities are restricted or prohibited to protect critical habitats and marine species. At the same time, post -harvest management, fish processing & quality control of fish in the Odisha state also need effective implementation of the above practices so that livelihood of fishing communities can be improved as well as high quality fish can be supplied to the consumers. Overall, it leads to the economic development of the Odisha coast.

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