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Coastal Fish Landing Stations in Bangladesh: Present Status and Policy Recommendations

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ABSTRACT

Coastal fish landing stations in Bangladesh play a key role in connecting the sea to the market for collecting, storing, processing, and distributing freshly caught fish. The stations also support other industries, such as boat building, ice production, cold storage, sorting, and packaging. Alipur, Mohipur, Chittagong, and Cox's Bazar fish landing stations were surveyed in May 2024 to evaluate the current facilities and management practices. From the survey result, it is found that the majority of the coastal landing stations in Bangladesh encounter challenges due to inadequate infrastructure, ineffective management practices, and post-harvest losses. The survey results will allow the stakeholders and policymakers to make decisions about implementing new policies, reducing post-harvest loss, improving operational efficiency, and maintaining a sustainable supply of fish throughout the country. It is recommended to invest in modernizing the fish landing stations with improved cold storage and processing facilities, construction of refrigerated transport vessels, and improvement in management practices. Modernized stations can support sustainable fishing methods and even provide financial support as a means to ensure the long-term sustainability and economic gain of the fishing industries.

1. Introduction.

The coastline of Bangladesh is about 710 km long. (CZPo, 2005). Bangladesh has a diverse fish fauna with about 800 species of fresh, brackish, and marine water (Hussain & Mazid, 2001). Fisheries contribute 3.67% to the total GDP and 26.50% to the agricultural GDP, offering 60% of the national animal protein intake to meet the country's health demand. Over 12% of the population relies on the fisheries sector for livelihood (DoF, 2015) .

Bangladesh, an eastern South Asian country, came in fourth in terms of global fish production in FY (Fiscal year) 2022–2023. Out of the total, Bangladesh managed to produce fish of 4.94 million Metric tons during 2022-2023.

The GDP growth in the fisheries sector is 2.43 percent, and the contribution of the fisheries sector in the overall agriculture sector is 22.14 percent in FY 2022-2023 (DoF, 2022-23).

Bangladesh Fisheries Development Corporation (BFDC) in Bangladesh and the local community have been working together to build several landing centers. Landing centers across the nation vary regarding facilities, services, and market accessibility. Qualitative losses occur when fish landing and distribution are delayed in the landing stations. Around 20 percent of marine fish experienced a decline of up to 80% in its original quality just before loading, while around 28% of the fish lost 60-70% of its fresh quality before reaching the consumer. Furthermore, approximately 20-30% of various fish and fishery products lose its quality due to improper post-harvest, and a 50% reduction in these losses could result in savings of Tk. 8,000-10,000 crore annually (Nowsad, 2014).

Currently, fish landing stations in Bangladesh require the continuing modernization of fish landing, preservation, and mar-

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keting infrastructure, especially in coastal areas. Millions of people who depend upon the fishing industry are beneficiaries of these stations, making the fishing industry more productive, enhancing values in the fisheries sector, and minimizing post-harvest losses. Several fish landing stations across the coastal areas of Bangladesh are being upgraded with modern infrastructure, including auction sheds, packing facilities, ice plants, and cold storage units. Key coastal districts like Patuakhali, Pirojpur, Cox's Bazar, Lakshmipur, and Chittagong have seen the establishment of modern fish landing centers since 2021 under various government initiatives. Due to proper handling and storage techniques, it is estimated that a 50% reduction in post-harvest losses has been achieved in some of the upgraded landing stations (Shutradhor, et al., 2023).

Landing fish landing stations are vital to supply freshly harvested fish to the different retail markets of the country and finally to reach consumers. This research aims to assess the current state of coastal fish landing stations in Bangladesh, identify key challenges, and develop policy recommendations to enhance their sustainability and socio-economic impact. Bangladesh's fish landing and distribution situation is complicated because numerous parties are involved in the distributional channel (Rahaman, et al., 2013).

However, the most significant marketing challenges appear to arise in remote communities with inadequate road infrastructure, ice usage, and transportation delays (Kleih, et al., 2001). Over the past few decades, the Bay of Bengal (BoB) has produced more fish, but its proportion in total fisheries production has been decreased. According to a recent research on Bangladesh's coastal fisheries, the number of marine shrimp species and fish stocks are declining, and the amount of catch per unit fishing effort is decreasing (Hussain & Hoq, 2010). There are many laws, guidelines, and policies regarding fisheries management, but their implementation regularly faces conflicts and non-compliance among the stakeholders, which leads to poor management in the landing centers (Islam, et al., 2016).

Even though Bangladesh has a huge history of fish harvesting, and has a number of fish landing sites, it is still struggling with minimizing post-harvest losses, maintaining quality, and improving the distribution channels. This research will examine and evaluate the existing structures and new measures that can be employed in the stations.

2. Methodology.

This study focuses on coastal fish landing stations in Bangladesh, specifically in Alipur, Mohipur, Chittagong, and Cox's Bazar. These regions were selected as they represent diverse coastal environments and contribute significantly to the country's fisheries sector.

A closed-ended and open-ended structured questionnaire was created and adjusted to accommodate all questions.

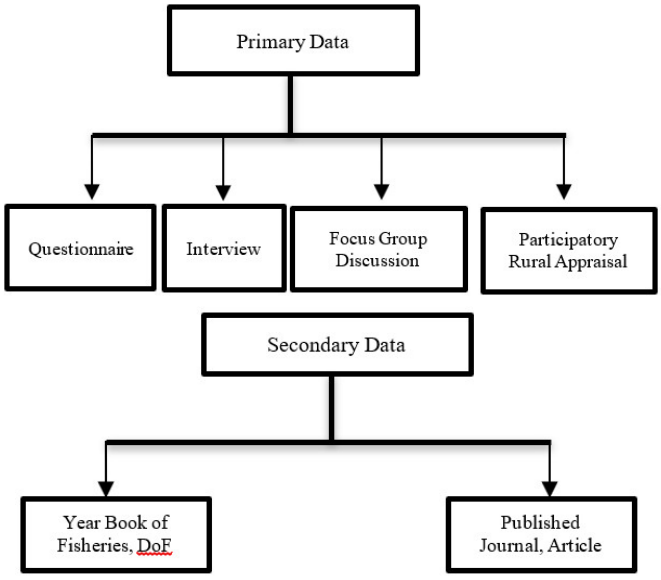
Additionally, individuals and groups of responders were asked a series of free-flowing, unstructured questions that lasted from a few minutes to several hours. Primary data was collected through in-person interviews. Focus group discussions (FGD) were used to collect qualitative and quantitative socioeconomic data as part of the Participatory Rural Appraisal (PRA) process. Secondary Data was collected from various published sources, including the Statistical Yearbooks of the Department of Fisheries, published articles, journals, etc.

Figure 1: Locations of the Study Area.

Source: Google Maps.

The gathered data was meticulously arranged and processed using Microsoft Excel. This involved several stages: Data Organization and Sorting, Data Analysis, and Data Visualization.

Figure 2: Data Collection Methods.



Source: Authors.

3. Overview of Fish Landing Stations.

The section analyzes the facilities that are already used at the fish landing stations. This will help in evaluating the fish handling and processing practice stage. The investigation into the existing facilities will be aimed at determining the scope for enhancement or modification in order to ensure better facilities for fishermen and guarantee the safety and quality of the fish.

3.1. Existing facilities in Fish Landing Station.

Fish Handling Shed is a place where fisherman display their landed catches and negotiate fair prices with the market actors. During peak season, 35 percent of respondents from our survey said fresh fish is handled in the parking area due to the limited capacity of the fish handling sheds.

An access bridge is a crucial structure in the fish landing center to connect the onshore facility and the offshore landing center. This structure guarantees that they are capable and feasible for moving people, tools, and fish from one site to the other safely. This bridge allows the fish landing center to avoid disruption of activities whenever there is bad weather.

Ice-making and storage plants are facilities that are most relevant to the fisheries sector. Due to the consistent availability of ice, they play a big role in reducing losses during storage and enhancing the economic returns of the fisheries. Ice storage facilities are designed to maintain the quality of the ice and ensure its availability when needed.

Fishing boats can land their catches in two ways: They either use the existing pontoon or, transfer the catches to small boats (dingi) for landing. Since there is only one pontoon in Cox's Bazar, with limited mooring facilities available for landing, when fishing boats find the pontoon fully occupied, they have to transfer their fresh fish catches to dingi, which carry them to the landing center (JICA, 2023). Fish landing center plays a vital role in quick and smooth disposal of fresh fish (BFDC, 2001). According to JICA (Japan International Cooperation Agency) fresh fish landed from fishing boats is carried in the landing center from 6:00 a.m. to 12:00 p.m. daily. During the three-hour peak time, from a little past 7:00 a.m. to a little past 10:00 a.m., fish catches are carried into the fish handling sheds at a rate of some 20 tons per hour. The average landing per fishing boat amounted to some 1.5 tons during the survey period. It takes a little over an hour on average for a fishing boat to land catches on the pontoon. The time extends to about 1.5 hours when dingi are used.

Fish are transported from the landing point to the handling sheds using traditional methods, such as bamboo baskets, metal bowls, etc. Transported catches are directly placed on the floor of the fish handling sheds for sorting and grading. After being purchased by distributors from the boat owner, fresh fish packed in Styrofoam boxes or plastic drums are loaded onto large trucks for transportation to distant markets. Some distributors store fresh fish in cold boxes for local hotels and restaurants or process the fish for shipment to export markets.

Ice crushers are used to break large blocks of ice into smaller pieces, which can then be used to pack and preserve fish. By using crushed ice, fish can be kept cool and fresh during transportation and storage. Manual ice crushers are commonly used in smaller-scale operations, while mechanized ice crusher may use electric or diesel-powered machines.

3.2. Existing Equipment Used in Landing Center.

Bamboo baskets are traditional tools used for fresh fish transportation, with a capacity of 40 kg. They are lightweight, durable, and affordable but tend to get damaged in water, have limited capacity, and pose hygienic challenges. Modern storage containers like plastic crates and insulated boxes offer better protection, reduce spoilage, and can be easily cleaned and sanitized. Metal bowls transport fresh fish from the landing area to the weighing station but can be labor-intensive and time-consuming. Modern facilities often employ conveyor systems and automated weighing equipment to improve efficiency and reduce labor costs.

Half-sized plastic drums transport crushed ice and small fresh fish but may be less efficient for long-distance transportation. Styrofoam boxes are used for bulk shipping, maintaining temperature, and preserving fish quality. Storage boxes store fresh fish when large amounts of fish are caught and sold the following day or later. They play a crucial role in preserving the quality and extending the life of fish. Still, their effectiveness depends on construction quality, ice availability, temperature, and humidity conditions.

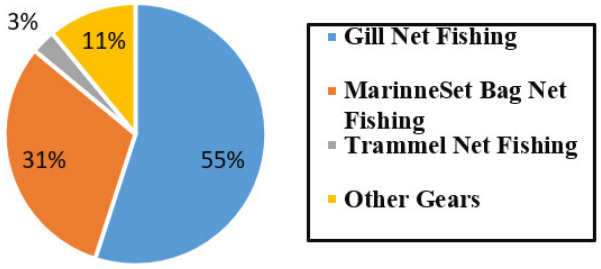
4. Results and Discussion.

In this section, we analyze the information gathered from the survey site. Understanding the overview and present status of the stations is achieved through interviews and questionnaires inside the landing center. Getting feedback from the fishermen and traders will help identify areas where they may require adjustment. Such information will contribute to the landing center's future modernization and strategic planning.

4.1. Dominant Fishing Gear and Fish Production Rate by Fishing Gear.

The pie chart in Figure 3 shows that gill net fishing is the most common fishing gear used by coastal fishermen in Bangladesh, accounting for 55% of total boats.

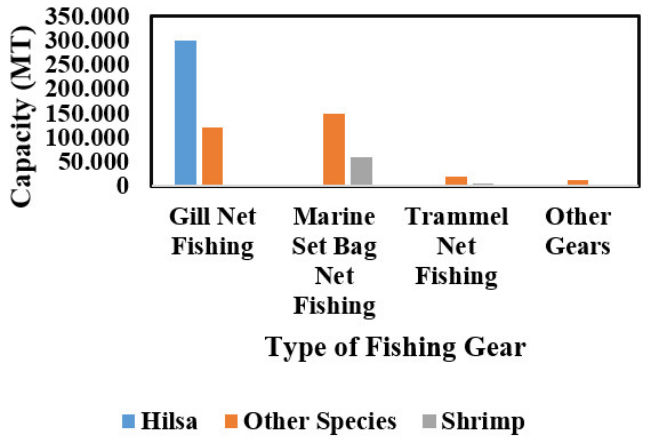
Figure 3: Percentage of Fishing Gear used by Fishing Boats.



Source: Authors.

Marine Set Bag Net Fishing is second, with 31% of boats using this method. Trammel Net Fishing is the least used, accounting for only 3% of boats. Knowing the most used type of fishing gear will help in prioritizing investments for gear-related services like repairs, inspections, and replacement. The gill net is locally known as lal jal, char shuta jal, lakkha jal, illish jal and the marine set bag net is known as behundi jal.

Figure 4: Average Fish Production by Fishing Gear in Metric Ton (Annual).



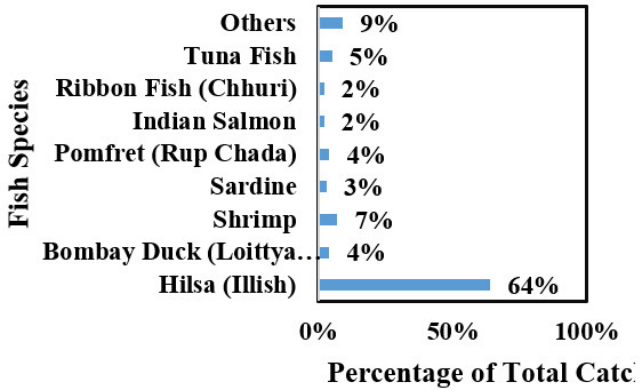
Source: Authors.

Figure 4 illustrates the yearly catch total of fish in Metric tons according to the type of gear. The most commonly used fishing gear is gill net fishing, recorded to have quite an impressive capacity both for Hilsa and other species. The marine set bag method also contributes much to the capture fishes, particularly for other species and shrimp. Trammel net fishing is a relatively low-capacity technique compared to the other two techniques.

4.2. *Species Found at the Landing Center.*

The relative abundance of fish caught at the landing sites. Hilsa (Illish) dominated the catch, making up 64% of the total shown in Figure 5.

Figure 5: Target Species at the Landing site.



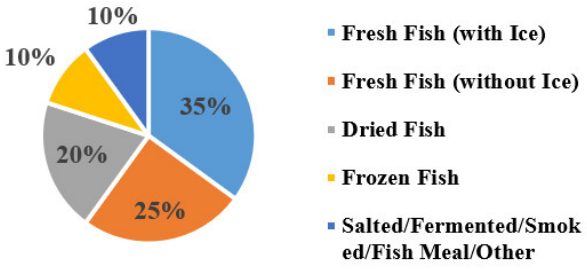
Source: Authors.

Other fish species include Bombay Duck, Shrimp, Sardine, Pomfret, Indian Salmon, Ribbon Fish, Tuna Fish, and others. Policymakers can get a proper idea of the dominant species and their relative abundance and thus can plan to conserve this valuable fish resource sustainably.

4.3. *Fisheries Distribution at the Landing Center.*

The fact that roughly half of fish (55–65 percent) are currently consumed in the form of fresh, wet catch illustrated in Figure 6. The largest portion is (35%) of fresh fish stored with ice to prolong the freshness during transport and storage. Fresh fish without ice (25%) is distributed for immediate consumption. 20% of the total catch was made up of dried fish which goes towards traditional long-term storage.

Figure 6: Fish Distribution After Landing at the Station.



Source: Authors.

This information emphasizes the dominance of fresh fish in the market, reflecting a strong preference for immediate consumption. Nevertheless, the availability of different processed fish products indicates a wide array of consumer preferences and market needs.

4.4. *Ice Usage during Distribution of Fresh Fish by Species.*

Table 1 presents the rate of ice usage during the distribution of various fresh fish species in Bangladesh. The data reveals significant variation in ice usage across different species.

Table 1: Rate of Ice Usage during Distribution of Fresh Fish by Species.

Fresh Fish	Distribution Rate (Per Day)	Percentage of Ice Usage by total catch
Hilsha	85%	95%
Pomfret	50%	92%
Bombay Duck	45%	55%
Ribbon Fish	45%	60%
Tuna/Mackerel	60%	70%
Shrimp	50%	70%
Sardine	40%	65%

Source: Authors.

Hilsha exhibits the highest distribution rate (85%) and ice usage rate (95%). While having lower distribution rates, Pomfret, Bombay Duck, and Ribbon Fish still require substantial

ice usage to maintain freshness. Tuna/Mackerel, Shrimp, and Sardine, despite lower distribution rates, necessitate significant usage of ice to ensure quality.

To distribute 1000 kg of Hilsha, given a distribution rate of 85% and an ice usage rate of 95%, approximately 850 kg of Hilsha would be distributed fresh, and 807.5 kg of ice would be required to maintain its quality during transportation and storage. These findings underscore the importance of effective ice management in distributing fresh fish to maintain quality and prevent spoilage.

4.5. Post-Harvest Loss in Fish.

Every year, significant post-harvest losses affect small-scale fisheries in Bangladesh. According to research, there is a considerable amount of post-harvest loss that occurs when fishery products are pre-processed, processed, stored, and transported (Nowsad, 2015). Transporters and commission agents were responsible for the majority of quality losses, which ranged from 4% to 11% (Nowsad, 2010). Hilsha, shrimp, and other high-value species often experience higher losses due to inadequate preservation practices.

Nowsad (2010) found that post-harvest factors such as rough handling (15%), compactness (3%), delayed icing (10%), absence of icing (45%), marketing processes (15%), and transportation (7%) contribute significantly to the degradation of overall quality. Approximately 5-7% of the total collected fish are lost due to inadequate transportation systems, lengthy distances, bamboo baskets, unclean plastic containers, fish compactness, and bulk handling.

The analysis classified fish losses in Bangladesh into two distinct categories: quantitative and qualitative. The quantitative losses were mainly linked to fishermen, while the qualitative losses were predominantly experienced by traders at fish landing stations.

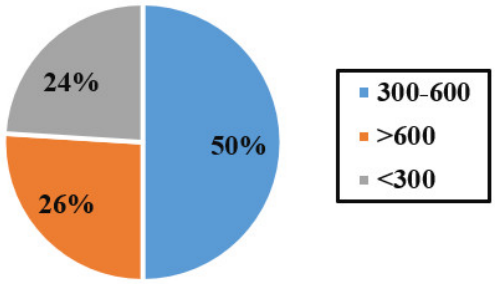
4.6. Quantitative Post-Harvest Loss by Fishers.

A significant variation in post - harvest loss among fishers is shown in Figure 7. A substantial proportion (50%) of fisher's experience moderate losses, ranging from 300 to 600 kg annually. A concerning 26% of fishers face even higher losses exceeding 600 kg annually. While 24% of fishers report relatively lower losses below 300 kg per year.

The overall trend highlights the pressing issue of post-harvest losses in the fisheries sector. These losses have detrimental impacts on both economic and environmental sustainability.

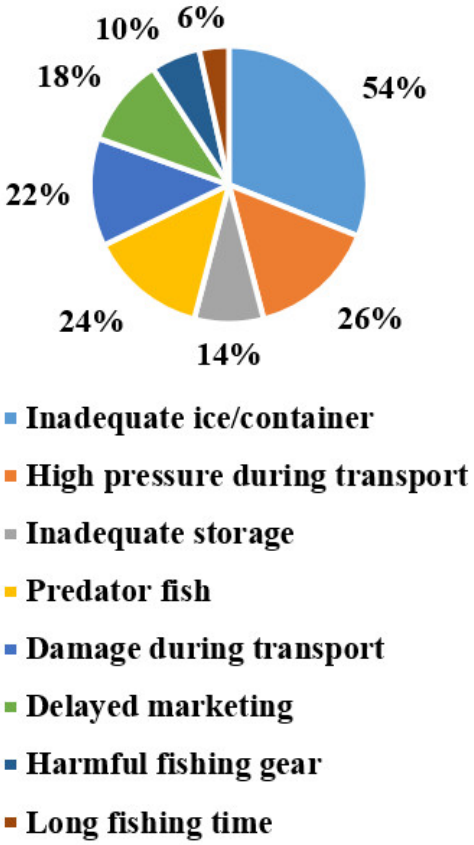
In this study 54% fish spoiled due to inadequate ice and insulated container, 26% fish spoiled due to high pressure during transportation, 14% fish spoiled because of inadequate storage facility. 24% spoiled by predator fish, 22% spoiled for damage during transportation, 18% for delay marketing, 10% fish spoiled for harmful fishing gear and 6% for long time fishing. These findings highlight the critical need for improved handling, storage, and transportation practices to minimize post-harvest losses by the fisherman.

Figure 7: Quantitative Post-Harvest Loss by Fishers.



Source: Authors.

Figure 8: Reasons of damage/Spoil of Fish by Fishers.



Source: Authors.

Table 2: Price Loss of Spoiled Fish by Fishers.

Price Loss of Spoiled Fish (USD/kg)	Percentage of Fishers
1.67-3.35	62%
>3.35	22%
<1.67	16%

Source: Authors.

Table 2 presents the economic impact of fish spoilage on fishers in terms of price loss per kilogram. A significant majority (62%) of fishers experience a price loss of 1.67-3.35 USD/kg due to spoilage. A smaller proportion (22%) faces even higher losses exceeding 3.35 USD/kg. Only 16% of fishers report relatively lower losses below 1.67 USD/kg. These findings underscore the substantial financial burden imposed by fish spoilage on fishers, highlighting the urgent need for effective post-harvest management practices to mitigate losses and improve their livelihoods.

4.7. Qualitative Post-Harvest Loss by Trader.

A significant proportion of traders (48%) reported losses ranging from 500 to 1000 kg. Approximately 22% of traders faced losses below 500 kg, while 18% experienced losses exceeding 1500 kg. The estimated fish weight loss experienced by traders in a given year represented in Table 3.

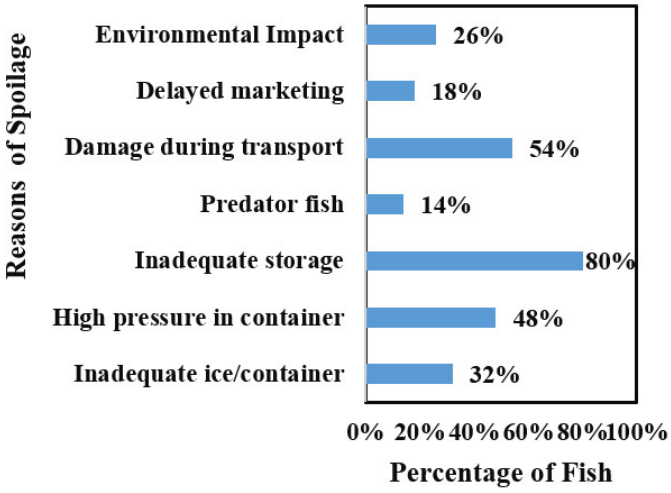
Table 3: Loss of Fish Weight (Kg/Year) by Traders.

Fish Spoilage (kg/year)	Percentage of Traders
500-1000	48%
<500	22%
>1500	18%
1000-1500	12%

Source: Authors.

A smaller group of traders (12%) reported losses between 1000 and 1500 kg. This significantly impacts the profitability of the traders.

Figure 9: Reasons of damage/Spoil of Fish by Traders.

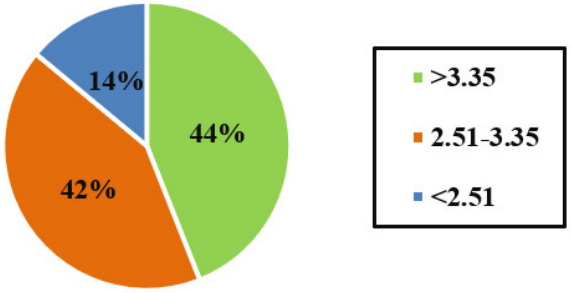


Source: Authors.

There are so many reasons for spoil or quantity loss of fish. Figure 9 shows, 32% of fish spoiled due to inadequate ice and insulated containers, 48% of fish spoiled due to high pressure in containers, 80% of fish spoiled because of inadequate storage facilities. 14% spoiled by predatory fish, 54% spoiled for damage during transportation, 18% for higher marketing time and 26% of fish spoiled for use of harmful fishing gear. Most of the traders (90%) sell at lower prices.

Figure 10 shows that most traders (44%) estimate a price loss of over 3.35 USD per kg for damaged or spoiled fish, while 42% report losses between 2.51-3.35 USD per kg, and 14% face losses under 2.51 USD per kg. Strengthening cold chain systems and adopting advanced technologies can enhance the quality and shelf life of fish products.

Figure 10: Price Loss of Spoiled Fish (USD/Kg) by Traders.



Source: Authors.

By addressing these issues, the fisheries sector can reduce post-harvest losses, increase profitability for stakeholders, and ensure the availability of fresh and high-quality fish for consumers.

4.8. Ice Usage in Fish Landing Stations.

According to JICA (Japan International Cooperation Agency), when the demand conditions are normal a standard block of ice size is 2.5 $feet \times 1.5 feet \times 1$ $feet$. It weighs somewhere between seventy and eighty kg. The weight, however, may range anywhere between 12 to 125 kg. During peak fishing seasons, the demand for ice increases, leading to price increases of up to four times the normal rate. A 125 kg block of ice can cost anywhere between 1.51 to 2.76 USD, based on the quality of the ice. Block ice is produced in large blocks and then crushed when required.

Ice production and distribution play a vital role in maintaining the quality of fish products. A significant portion of these blocks, ranging from 26-48%, is untempered (which is not fully frozen). However, untempered ice can significantly reduce the quality and shelf life of fish. To address this issue, the implementation of insulated ice warehouses is recommended. By optimizing ice production, distribution, and usage, the fishery sector can enhance the quality of fish products and minimize post-harvest losses.

4.9. Challenges in Coastal Fish Landing Centers in Bangladesh.

There is no map or data on the locations of landing centers along the coast, not even those built by Bangladesh Fisheries Development Corporation (BFDC). The number of fishes

landed in various centers at various time scales, such as monthly, annually, during peak seasons, dominating species, commercial species, etc., was not accessible (CNRS, 2022).

Each landing station included in the study has a lack of rooms, making it difficult to hold an auction during busy times, sort or grade fish, load fish for transportation, or accommodate buyer and visitor seating arrangements. With a few exceptions, most landing centers do not have quality water, which is essential for preserving fish in fresh condition. Bangladesh has a lot of coastal fish landing facilities that are susceptible to erosion and flooding, especially during the monsoon season.

The power outage also impacts ice production; prices have raised up, and transportation and fish preservation expenses have also increased due to this issue.

The majority of venues are too small to hold fish auctions beneath sheds. Our study revealed that more than 35% of fish sales occur outside, and the fish's quality is impacted by sunlight and rain, which also has a detrimental effect on both consumers and sellers. Insufficient waste management systems are a great concern for fish landing stations. A significant amount of solid trash is produced daily in each landing center; however, none of the centers have the infrastructure or processes to handle solid waste safely; instead, they dump the untreated waste into rivers and canals.

4.10. The Need for Comprehensive Support for Coastal Fishermen.

Coastal fishermen with "fishers' ID cards" receive safety net payments, which include 60 kg of rice, 10 liters of oil, and 21 USD per household, which the fishermen said was insufficient to support their families during ban periods. Many Bangladeshi fishermen do not have the necessary documentation to get these benefits, such as ID cards. The fish market needs good administration to guarantee fair prices for the fisherman's hard-earned fish and reduce middlemen's involvement in the marketing chain.

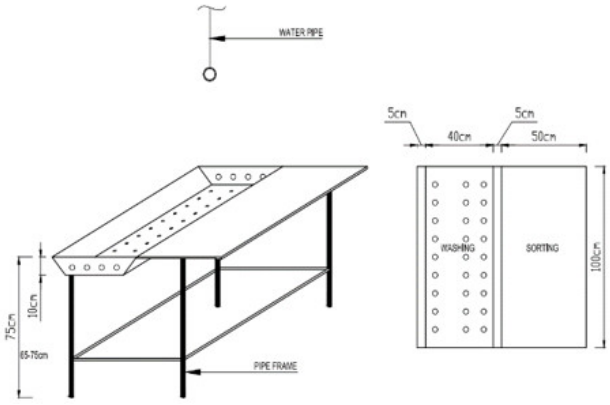
5. Policy Recommendations.

According to our survey, fish lose their quality up to 10-15 percent due to the onboard handling of fish after harvesting from the ocean. It is essential to ensure that the fish hold and equipment are carefully cleaned with fresh water before and after each fishing trip. The handling area must be designed without sharp edges or projections to prevent physical harm to the fish. Fish should be protected from dangerous materials such as fuel oil, grease, smoke, drainage and other solid or semi-solid materials in order not to contaminate them. The fish should be handled with care, without being thrown, stepped on, or left in the sun. Conserving the quality of preserved fish is greatly dependent on keeping the temperature at a certain level. The rate of spoiling doubles when the temperature rises by 5°C. To keep fish from spoiling, it is crucial to quickly lower its temperature to about 0°C. Fish quality during the post-harvest process depends on timing and temperature control. Fish that the fisherman collects at different times need to be preserved individually since they are in varying stages of spoiling. Crushed ice with sharp edges must be avoided because it can injure the fish physically.

A significant challenge Bangladesh's fisheries industry faces is the need for adequate post-harvest treatment, particularly the shortage of ice and the lack of cold storage facilities for preserving fish for longer periods. As a result, there are substantial post-harvest losses, which lowers the amount and quality of fish that are sold. Improving the distribution and accessibility of ice is essential to resolving this problem, as well as educating fish handlers on safe handling and storage practices. Investing in refrigerated transportation and cold storage facilities can also help to preserve the freshness of fish and minimize spoiling. To improve fish quality, policy implementation should include general awareness, improved local planning for ice factory locations, ongoing efforts for rural electrification and regular power supply, and improved ice use.

At landing sites, fish should be unloaded, washed, and sorted by species. Simple, durable tables made from materials like stainless steel or aluminum can help streamline washing and sorting, ensuring the removal of blood, debris, and germs. After sorting, the fish should be processed according to market requirements, such as gutting or packaging, before being chilled and sent to market. The tables should be made of non-corrosive, easy-to-clean materials and designed for ease of use and maintenance.

Figure 11: Metal fish washing and sorting table.

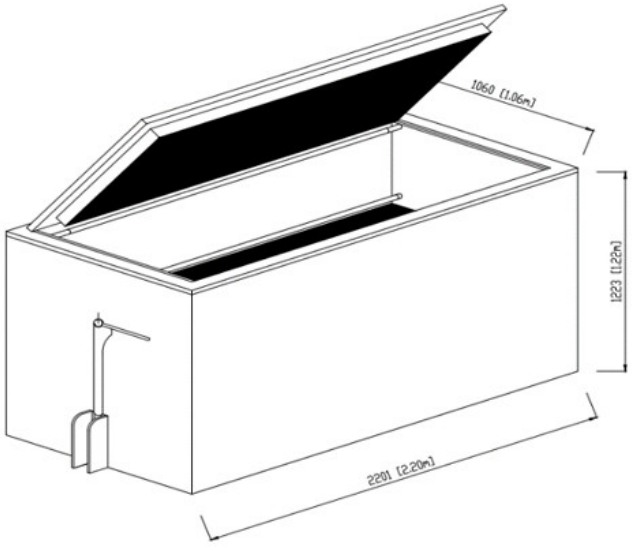


Source: Medina Pizzali, 1998.

Mechanized fishing boat owners should be encouraged to transport larger amounts of ice to fishing grounds, and alternative uses of ice should be identified and promoted. These measures will help ensure the quality of fish and reduce physical and qualitative losses in the market. To improve the existing post-harvest care, make investments to update current landing centers with sufficient infrastructure, such as cold storage, ice plants, and processing facilities. Build new landing centers in regions with high fishing activity. Create better waterways and road access to landing centers to make it easier to transport fish. Plan and build infrastructure that can stand up to the effects of climate change. Invest in cold chain infrastructure, such as refrigerated transport and cold storage facilities.

Chill rooms should be designed based on the total fish weight, handling methods, temperature, and resources like electricity, water, and labor. Backup refrigeration should always be available in case of system failure. For small-scale operations, alternatives like insulated rooms, refrigerated seawater containers, or cargo containers can also be used. Chilled seawater (CSW) containers, especially for high-value or small-scale fisheries, offer advantages over traditional methods, keeping fish fresh with minimal handling. These containers can be used on fishing vessels or at landing sites, often made from fiberglass or aluminum for portability and efficiency.

Figure 12: View of the CSW tank.



Source: Medina Pizzali, 1998.

Encourage the fish processing industry to add value to the fish and enhance its market value. Promote scientific fisheries management strategies (stock assessments and catch limits). Establish health insurance, old-age pensions, and disaster assistance programs for fishermen. Create awareness and capacity building for fishermen and stakeholders through training programs. Improve access to credit and financial services for small-scale fisheries enterprises.

To stop theft fishing by other countries in Bangladesh's marine waters during the ban period, it is essential to align the fishing restriction period with that of neighboring nations.

Conclusions.

The issues identified in the fish landing sites of coastal districts should be immediately taken into consideration by the responsible policy parties. This research shows the importance of post-harvest management to maintain the quality and value of fish products in Bangladesh. Gill nets are the most commonly used fishing gear, used by 55% of boats, with Hilsa making up 64% of the total catch in the landing centers. Fresh fish is the primary form of consumption, with 35% stored with ice to preserve freshness, while 25% is consumed immediately due to the lack of proper storage. Hilsa, being economically vital, has the highest ice usage rate at 95% during distribution.

However, post-harvest losses are a major issue, with 54% of spoilage caused by inadequate ice and containers, 26% by damage during transport, and 14% due to poor storage on boats. These losses lead to significant economic impacts. Fishers lose 300-600 kg annually and face price reductions of 1.67-3.35 USD/kg, while traders report losing 500-1000 kg each year, largely due to inadequate storage and transport damage. Mainly post-harvest losses arise due to inadequate ice supply, improper handling and suboptimal storage conditions. Hence, the study recommends investments in modern ice-making facilities, enhancement of handling methods, better cold storage facilities, efficient transportation systems and technology enhancement should adequately solve these challenges. By implementing these strategies, the fisheries sector can enhance the quality and value of fish products, reduce economic losses, and contribute to sustainable fisheries development. It is strongly recommended that the challenges identified in the present study should be addressed as per the stated recommendations to upgrade the fish landing centers to acceptable standards in terms of hygiene, environment-friendly way of fish handling activities, and ease of operations.

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