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Post-harvest Handling and Quality Loss of Indian Major Carps in the Distribution Channel of Noakhali District, Bangladesh

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Abstract

Post-harvest loss of mrigal (Cirrhinus cirrhosus), catla (Catla catla), rohu (Labeo rohita) and kalibaush (Labeo calbasu) in different distribution channel of Noakhali district, Bangladesh were observed during the month of January 2015 to April 2015. Sensory evaluation method was adopted in order to gather information about quality loss of fish and existing handling condition at different stakeholder level. The observed fish were fresh at fisherman level but as the day progress along with temperature variation fish started losing quality and most of their quality found lost at retailer level. Fisherman supplied fish to beparies at 5% quality loss, further 10%, 20% and 22% loss was observed through aratder, retailer and consumer respectively. DPs varied with the month basis, compared to January–February the DPs were higher in March–April which indicates that temperature rise cause more quality loss of fish. Most of the fishes crossed DP 3.0 at retailer level because of long term exposure to open air coupled with unhygienic condition of markets. Different sizes baskets were used for transportation of fish with or without icing. Live fishes were transported with water in gallon or drum and they could retain their shelf lifelong time than that of dead fish or fish with no icing condition. The unsold fishes were preserved in refrigerator and re-icing was adopted by 70% retailer. The ice ratio of fish: ice was 1:1 in March–April and 2:1 in January February. The more quality loss of fish the more ice was used. Bad handling practices due to transportation and in markets also caused quality deterioration of some fishes. Usually post-harvest loss of fish is not taken under the consideration which eventually because economic loss coupled with food insecurity but proper steps to reduce loss can compensate the post-harvest fish loss.

Keywords: *post-harvest loss, Indian major carps, defect points, handling practice*

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INTRODUCTION

Fish is an important source of protein for human and a bulk group of people in Bangladesh directly or indirectly rely on it for their livelihood [1]. A highly diversified resources and species occupying by the country covering an area of about 4.34 million ha in the form of small ponds, *beel* (natural depressions), lakes, canals, ox-bow lake, small and large rivers and estuaries [2]. Fish

circulation and marketing varies from region to region in Bangladesh and fishes are transported all over the country [3, 4, 5]. About 97% of the overall manufacture of fish is promoted within for native consumption although the enduring 3% is shipped to abroad [6]. Marketing scheme in Bangladesh is old-fashioned, compound and less modest, but plays a vigorous part in linking the fish manufacturers and customers. Post-harvest fisheries include every activity that happen from the time of fishing through processing up to the final consumer [7].Value of the reaped fishes landed for ingesting is misplaced during harvesting and post-harvest management [4] due to ignorance and/or negligence of the people during harvest, distribution, processing and trade [8], preservation methods, transportation methods, availability of ice during transportation and selling period, etc. [9]. The study was undertaken to investigate the post-harvest losses of catla (*Catla catla*), rui (*Labeo rohita*), mrigel (*Cirrhinus cirrhosus*) and calibaus (*Labeo calbasu*) in different stages of their distribution and marketing in Noakhali district for getting information on quality deterioration and existing handling and icing conditions.

MATERIALS AND METHODS

Study Area and Period

The study was conducted throughout different markets of Noakhali district namely Sonapur, Dotterhat and Maijdee municipality market. The quality loss of *C. catla*, *L. rohita*, *Cirrhinus cirrhosus*, and *Labeo calbasu* in the different distribution channel of Noakhali was observed in the month of January to April 2015 (Figure 1).

Data Collection and Stakeholder Selection

The questionnaires were administered on the primary, secondary, and the final consumer markets systematically to the fisher folk, *beparies*, transporter, *aratdar* and retailer. Primary data were collected by using questionnaire interviews from the target group. Secondary data were collected from various research project, annual reports, literatures, and from different websites.

Experimented Fish Species

For sampling *Labeo rohita, Labeo calbasu, Catla catla* and *Cirrhinous cirrhosis* Indian major carps were tested thirty pieces (30) for the sensory evaluation for each species.

Method of Evaluation

The method of assessment of fish quality was followed according to the modified method of [10] which was based on fish loss assessment and control tool originally developed by Torry Research Institute, U.K. [11]. Sensory defect points (DPs) of fishes were determined at different distribution channel using Table 1 for assessment of fish quality.

Table 1: *Quality grading of fish against DPs.*

Grade	DP	Grade Characteristics
A	<2	Excellent, highly acceptable
B	2 to 3	Good, acceptable
C	>3to<4	Deteriorating, not acceptable
D	4 to 5	Spoiled, rejected

A quality loss index (QLI) model was followed to estimate the percent quality loss of fish at any state of distribution channel. The following equation was used for quality loss index:

$$\text{QLI (\%)} = \frac{Pi}{\text{N}} \times 100$$

QLI = Quality loss index

N = Number of observations

Pi = Number of calculated DP crossed quality breaking point (QBP)

$$\text{Pi} = \frac{P1+P2+Pn}{\text{n}}$$

Where, 'p' is the number of DP (Defect points) crossed QBP point in different lots (up to n numbers) of same species under different distribution channel in different fishery regions [10].

RESULTS

Fish Quality Loss through the Marketing Channel

Quality loss of fish was observed through the different stakeholder level because of improper handling, and transportation procedure. Fisherman supplied fish to *beparies* at 5% quality loss, further 10%, 20% and 22% loss was observed through *aratder*, retailer and consumer respectively (Figure 2).

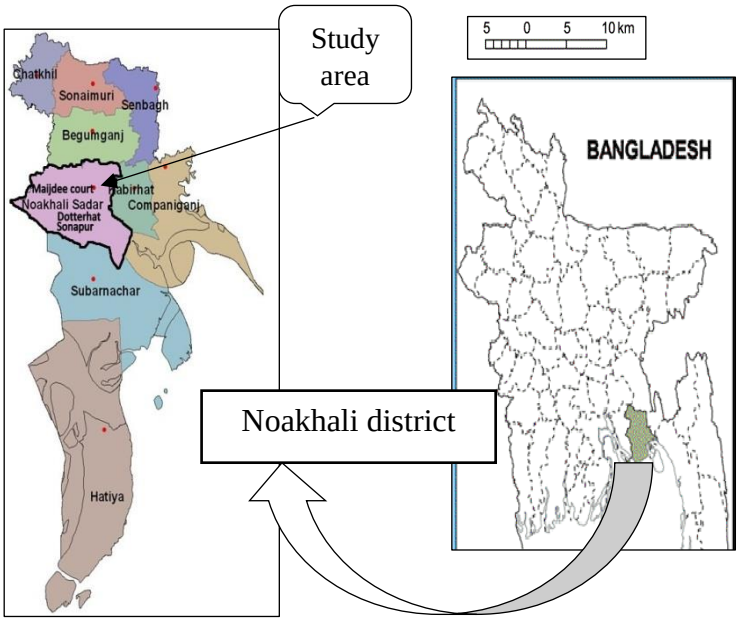

Fig. 1: *Study Area.*

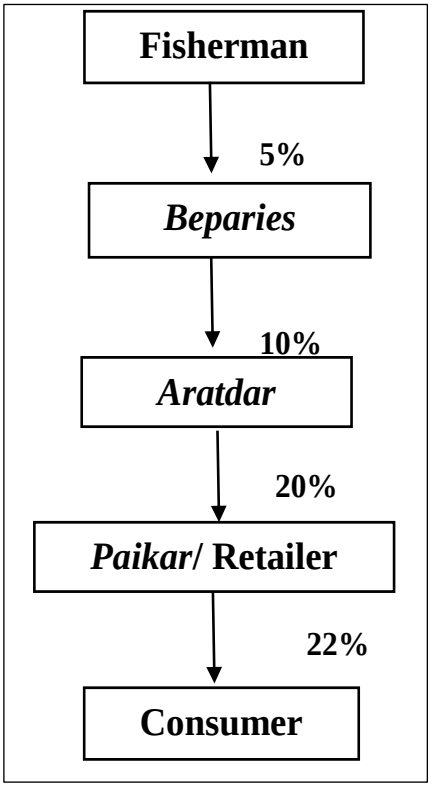

Fig. 2: *Flow Diagram for Fish Quality Loss through the Marketing Channel.*

Utilization of Ice

Among the fisherman, only 30% adopted icing during transporting because fish remained fresh at this level. Whereas *aratdar* never used ice because fish sold by auctioning and remained a short period. 100% *beparies*, 60% wholesaler, 80% retailer used ice (Table 2).

Utensils Used in Fish Transportation

Various utensils were used by fisher during transporting fish to nearest markets such as plastic baskets, plastic drum and craters whose carrying capacity were 15–20 kg, 30 kg and 80–100 kg respectively. Live fish were transported by plastic drums with water.

Utensils Used in Fish Handling
Bamboo baskets, plastic baskets, plastic bucket, plastic drum metallic gallon, plastic drum, aluminum tray were used for handling purposes in the markets. Banana leaves were used with some baskets.

Vehicles Used
Fisher who had a small portion of fish was seen transporting fish by the cycle and the percentage was 3%. Besides, rickshaw, van, CNG and pickup were used for transportation and the percentages were 5%, 9%, 37% and 40% respectively (Figure 3). When there was remote distance and much supply of fish by large scale farm, pickup was used.

Time of Harvesting
Time of catching of fish varied from mid night to early morning. 35% observed fish were caught at 3am, 37% at 4am, 21% at 5am and 7% at 6 am (Figure 4).

Elements used when Transporting Fish
At the very early morning distant areas fishes were transported to local market by plastic drums with water. In this way, live fish could survive 1 hour. 29% fish were transported by this way. Fishes which were dead due to harvesting or lost bloom were seen transported with icing at a rate of 39%. 32% fisher used nothing for the transportation to near market (Figure 5).

Storage
About 70% of fish seller adopted re-icing and rest 30% were not for the unsold fish. Normally retailers have no unsold fish; in case of unsold fish they preserve them in the refrigerator (Figure 6).

Post-harvest Loss Assessment
Post-harvest Loss Assessment of C. cirrhosus
Average DPs at this level was 1.2±0.3. At *aratder* DP increased from fisherman level but here DP also not varied from January–February to March–April and the DP was 1.8±0.2 at January-February and 1.8±0.3 at March-April. The variation noticed at wholesaler level where 2.4±0.3 DPs in January–February increased to 2.6±0.3 in March–April. In March–April average DP for *mrigel* was 3.2±0.3 but it was 2.8±0.4 in January–February, an increased amount due to increased ambient temperature (Figure 7).

Post-harvest loss assessment of L. calbasu
Average DPs at this level was 1.1±0.2 and 1.2±0.2 January–February and March–April respectively. At *aratder* DP increased from fisherman level but here DP varied from January–February to March–April and the DP was 1.6±0.2 in January–February and 1.7±0.2 in March-April. The variation noticed at wholesaler level where 2.3±0.3 DPs in January–February increased to 2.5±0.2 in March–April. In March–April average DP for *calibaush* was 3.2±0.2 but it was 2.8±0.3 in January–February, an increased amount due to increased ambient temperature (Figure 8).

Average DPs at this level was 1.1±0.2 and 1.2±0.1 respectively. At *aratder* DP increased from fisherman level but here DP not varied from January–February to March–April and the DP was 1.6±0.2 at both the season. The variation noticed at wholesaler level where 2.3±0.2 DPs in January–February increased to 2.4±0.2 in March–April. In March–April average DP for *rui* was 3.1±0.2 but it was 2.6±0.2 in January–February, an increased amount due to increased ambient temperature (Figure 9).

Average DPs at this level was 1.1±0.2. At *aratder* DP increased from fisherman level but here DPs not varied from January-February to March-April and the DP was 1.5±0.2 in January-February and in March-April. The variation noticed at wholesaler level where 2.2±0.3 DPs in January–February increased to 2.3±0.2 in March-April. In March-April average DP for *catla* was 3.0±0.2 but it was 2.6±0.3 in January–February, an increased amount due to increased ambient temperature **(**Figure 10**)**.

Grading of Quality of Indian Major Carps
Organoleptic behavior witnessed excellent at around 7am at different markets but the same lot begun to lose their quality at around 11 am. Some lot of *C. cirrhosus* and *L. calbasu* observed deteriorating their quality at 3 pm (Table 3).

Fish Condition at Different Stakeholder Level
Fish condition of at different stakeholders is shown Table 4.

Table 2: *The Ice Ratio used by Different Stakeholder Level.*

Stakeholder level	Ice used		Ice ratio (fish:ice)		Source of ice	Water source of ice
	Yes	No	Winter	Summer		
Fisherman	30%	70%	2:1	1:1	Nearby market	Deep tube well
ratdar		100%		1:1		
Bepary	100%		2:1	1:1	Nearby market	Deep tube well
Wholesaler	60%	40%	2:1	1:1	Nearby market	Deep tube well
Retailer	80%	20%	2:1	1:1	Nearby market	Deep tube well

Table 3: *Grading of Quality of Fish as the day Progress at Different Markets.*

Species/time	7 am	9 am	11 am	1 pm	3 pm
L. Rohita	Excellent, highly acceptable	Good, acceptable	Deteriorating	Deteriorating, not acceptable	Deteriorating, not acceptable
C. Cirrhosus	Excellent, highly acceptable	Good, acceptable	Deteriorating	Deteriorating, not acceptable	Deteriorating, not acceptable, spoiled (in some case)
L. Calbasu	Excellent, highly acceptable	Good, acceptable	Deteriorating	Deteriorating, not acceptable	Deteriorating, not acceptable, spoiled (in some case)
L. Catla	Excellent, highly acceptable	Good, acceptable	Deteriorating	Deteriorating, not acceptable	Deteriorating, not acceptable

Table 4: *Condition of Fish at Different Stakeholders.*

Stakeholder	Species	Hygienic condition	Organoleptic quality	Overall quality
Fisherman	*L. rohita*	Hygienic	Full bloom, bright, shining	Excellent
	L. calbasu	Hygienic	Full bloom, bright, shining	Excellent
	C. cirrhosus	Hygienic	Full bloom, bright, shining	Excellent
	C. catla	Hygienic	Full bloom, bright, shining	Excellent
Wholesaler	*L. rohita*	Unhygienic	Slight dullness, loss of bloom	Good
	L. calbasu	Unhygienic	Slight dullness, loss of bloom	Good
	C. cirrhosus	Unhygienic	Slight dullness, loss of bloom	Good
	C. catla	Unhygienic	Slight dullness, loss of bloom	Good
Retailer	*L. rohita*	Unhygienic	Definite dullness and loss of bloom	Poor
	L. calbasu	Unhygienic	Definite dullness and loss of bloom	Poor
	C. cirrhosus	Unhygienic	Definite dullness and loss of bloom	Poor
	C. catla	Unhygienic	Definite dullness and loss of bloom	Poor

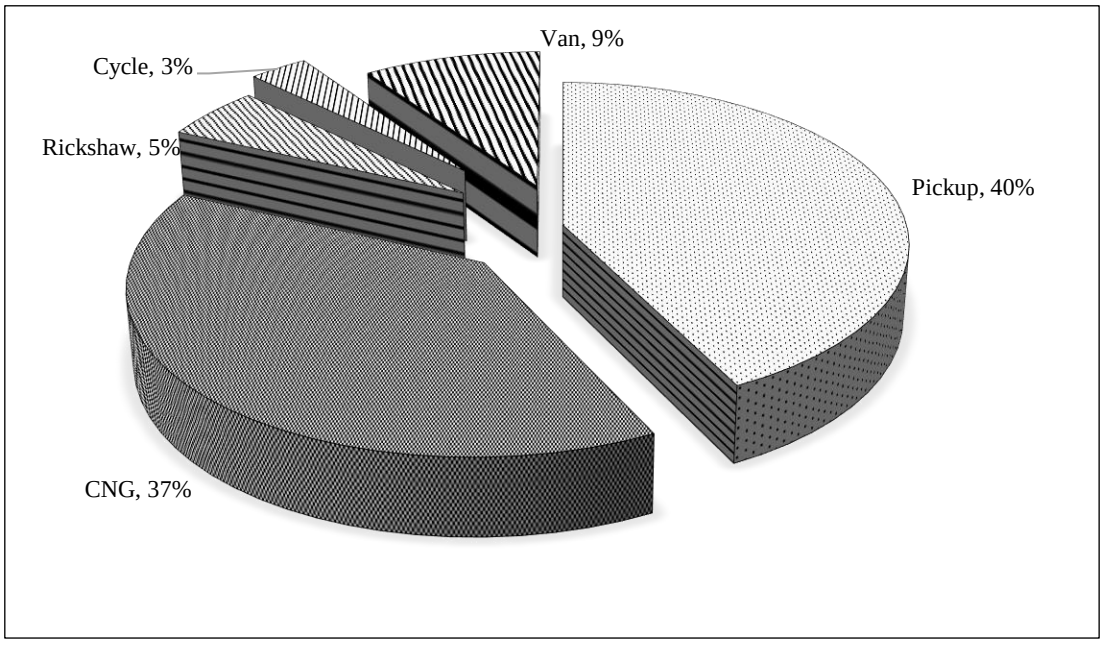

Fig. 3: *Vehicles Used for Transportation of Fish.*

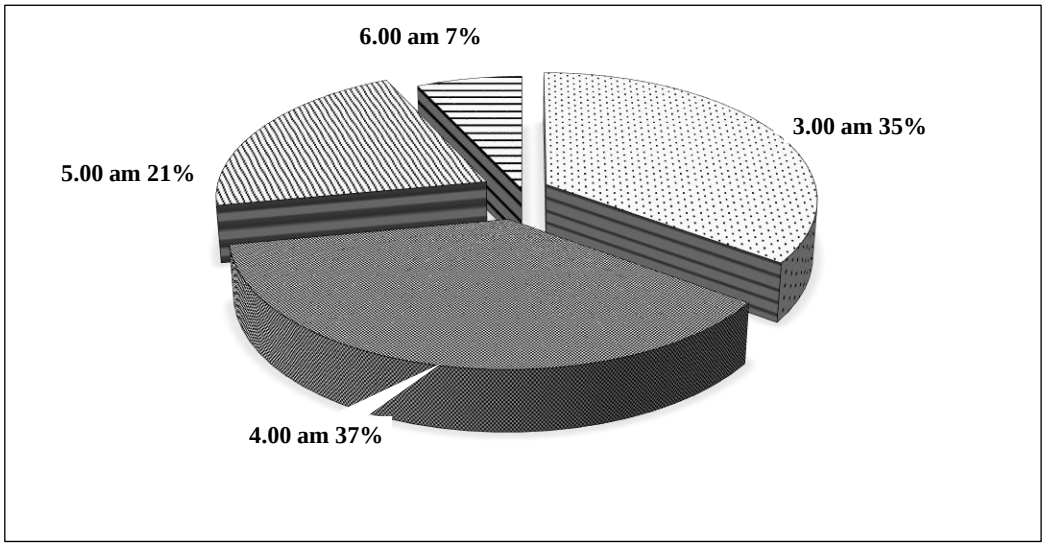

Fig. 4: *Time of fish harvesting.*

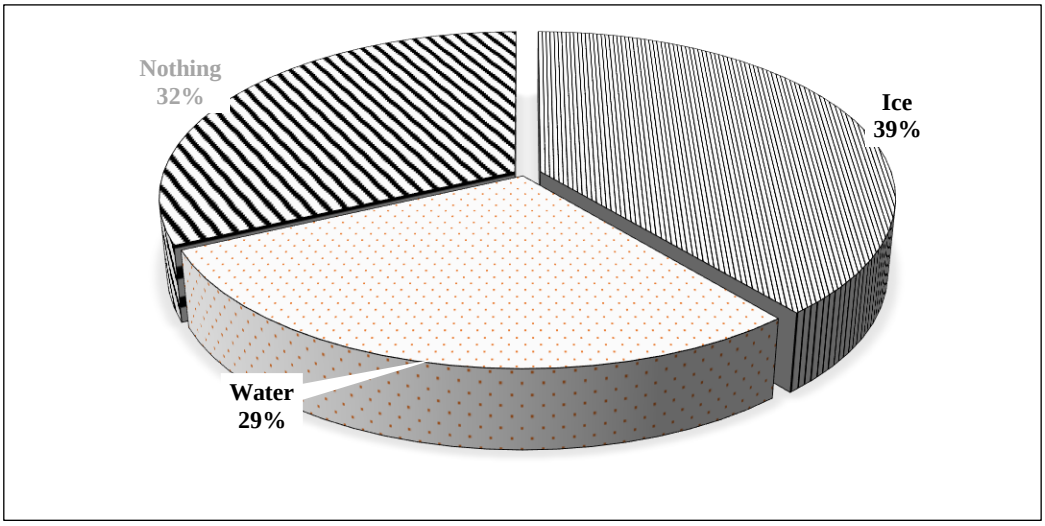

Fig. 5: *Elements Used when Transporting Fish.*

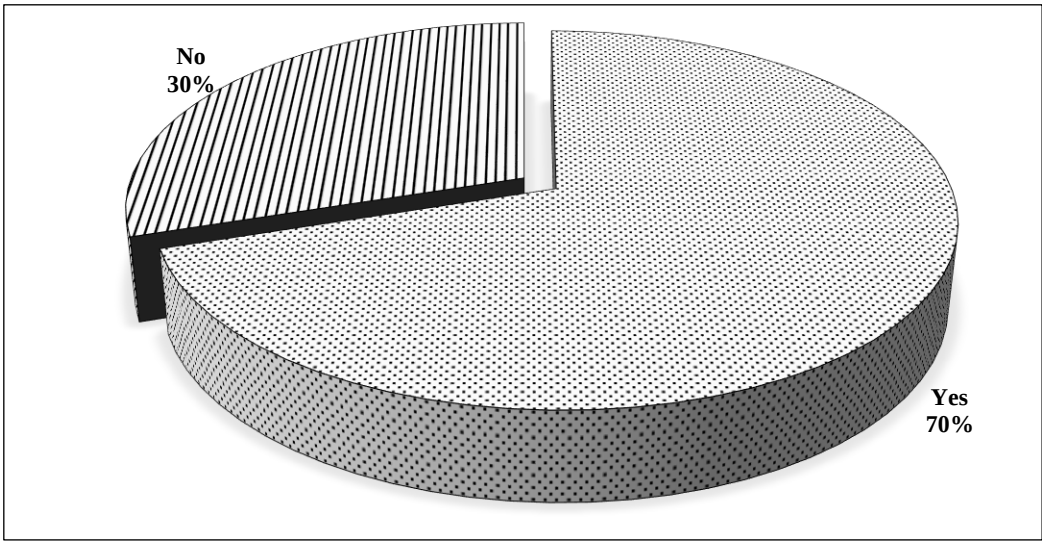

Fig 6: *Re-icing in fish*

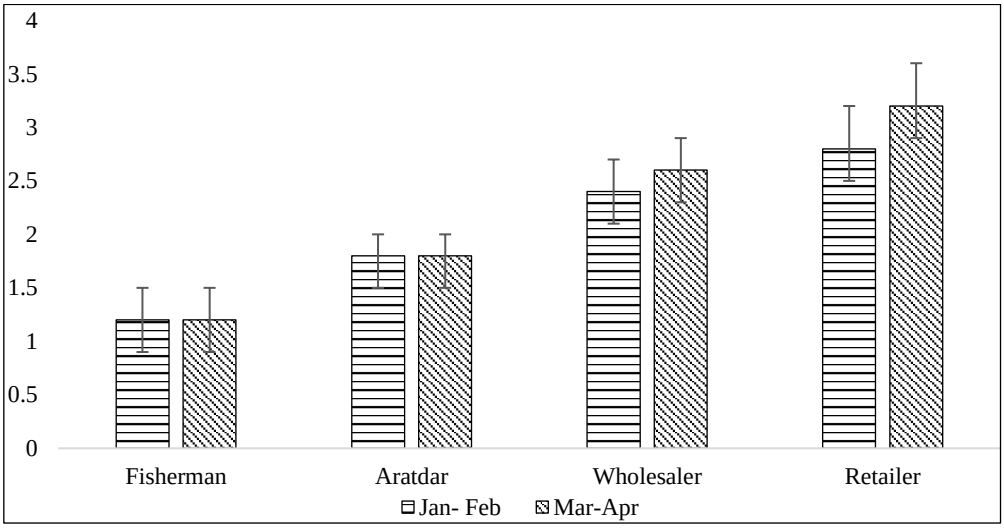

Fig. 7: *Comparison of average DP of C. cirrhosus in January-February and March-April.*

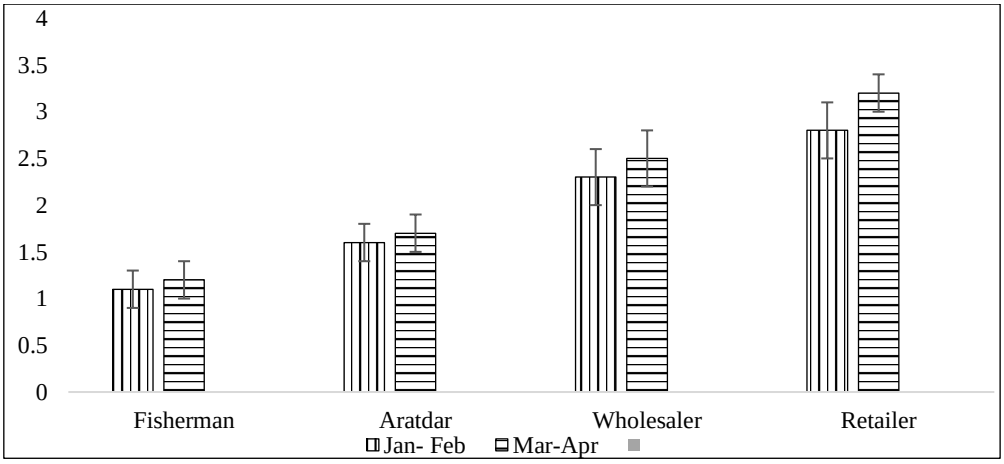

Fig. 8: *Comparison of Average DP of L. calbasu in January–February and March-April.*

Post-harvest Loss Assessment of L. rohita

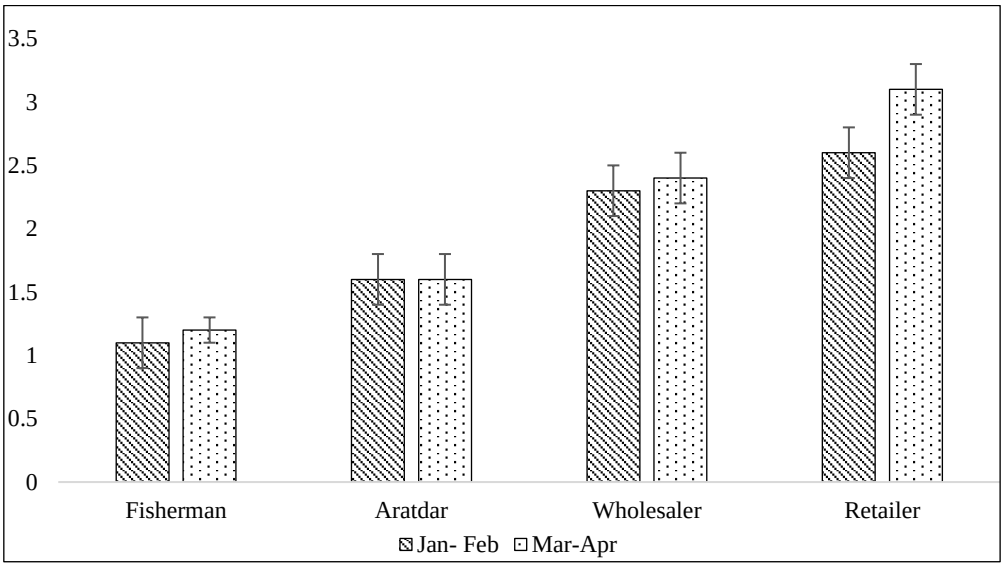

Fig. 9: *Comparison of average DP of L. rohita in January–February and March–April.*

Post-harvest Loss Assessment of C. catla

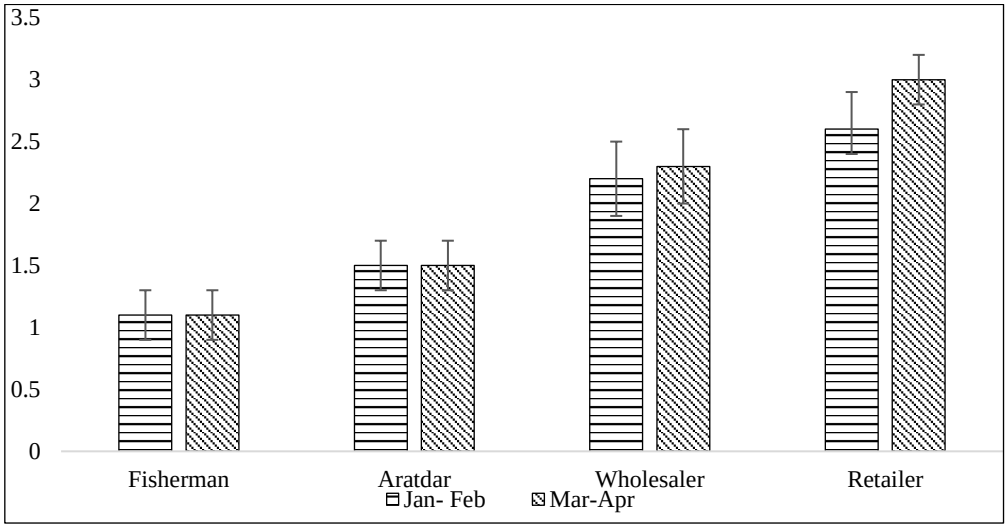

Fig. 10: *Comparison of Average DP of C. catla in January–February and March–April.*

DISCUSSION

Post-harvest loss of Indian major carps at Maijdee, Dotterhat and Sonapur markets estimated that fisherman supplied fish to *beparies* at 5% quality loss, further 10%, 20% and 22% loss observed through *aratder*, retailer and consumer respectively. Similar marketing channel was shown by the study of [12, 5]. Fishes found good qualities which were taken care of during transportation. The loss was due to bad handling practice during transportation, unhygienic condition of landings and markets, long time exposure of fish during selling to consumer, improper icing etc. which is more or less similar with the study of [13, 14]. At the market's retailers had a least portion of unsold fish and 70% of them adopted re-icing. During field survey some constraints observed like bad handling practices and unhygienic condition, also witnessed by [15]. In world fisheries post-harvest loss estimated around 10%. Fish loss to the tune of 40% in some developing countries including Bangladesh [16]. Post-harvest losses in the traditional fishing sector at landing center were estimated as 4.30% for the period under study. The loss in the sector was mainly due to landing of low valve fish and juveniles of oil sardine that was used for manufacture of animal feed [17]. The percentage of past-harvest loss for motorized sector was 5.16 and losses occurred in this sector mainly due to discard of juveniles in large quantities and spoilage due to improper icing. Pre-processing and processing channels were crucial for fisheries sector as all fish items meant for export marketing pass through these channels. The overall percentage of loss in pre-processing channel was 0.26% for fresh fish and 0.14% for frozen fish. The loss occurred due to faulty handling and discard of small size fish. Loss also occurred in the shrimp meat while washing, grading and packing. The pre-processing centers handled shrimp from different places outside the state and in such a stock, black spot and discoloration were frequently observed [18]. In the present study it was noticed that fish remained fresh at the very beginning of the day but as the day progress various organoleptic changes were observed at different fishes of major carp. Majority portion of fish quality found good quality at the fisherman level but when these were at wholesaler level observed deteriorating quality due to organoleptic changes and eventually retailer found them almost lost their bloom or freshness and some portion got spoiled at this stakeholder level. At the very early morning distant areas fishes were transported to local market in plastic drums or gallon with water [19]. In this way live fish could survive 1 hour. 29% fish were transported by this way. Fishes which were dead due to harvesting or lost bloom were seen transported with icing at a rate of 39%. 32% fisher used nothing for the transportation to near markets. Rapid deterioration of quality noticed during the month of April than February [20]. It was because rise of temperature in summer.

Whereas 90% of fish arrived at the Visakhapatnam auction market was of good quality. The remaining 10% was of poorer quality. The seer fish arriving at the market, 30% was in poor condition and were also sold for between 45 and 75% of the price of good quality fish. This was salted and sundried. At Chatrapathi Shivaji Maharaja Market in Bombay they were informed that out of the total amount of fish brought to the market, 5–6% was downgraded for salting. In general terms, the fish were downgraded for salting was sold for 50% of the best quality price. The degree of the downgrading varied according to season, with a higher percentage of downgrading occurred in the summer months markets [21]. Most of the fishes lost their quality acceptance level at the retail fish shops. The fishes those were well taken care off during transportation were found in good quality. Temperature gradually increased as the sunshine became intense. Obviously, the rate of deterioration was accelerated by the higher ambient temperature that resulted higher oxidation. Organoleptic behavior witnessed excellent at around 7am at different markets but the same lot begun to lose their quality at around 11am. Some lot of *C. cirrhosus* and *L. calbasu* observed deteriorating quality rapidly at 3pm though water sprinkled over fishes at retail sale [22] also found similar results. The initial temperature was 33.0°C at 8.00 pm and reached to 34.0°C at 5.00 pm of the day. Preliminary ice to fish proportion throughout the start of circulation path was 1:3. Re-icing was not done during transportation or auctioning. Ice was found to be completely melted down by the time the fish reached auction center in Dhaka. After auction, a very little amount of ice was used by the retailers. During retail sale, however, re-icing and sprinkling of cold water over fish were done [23, 24]. It was observed that fishes were in good condition with DPs less than 3 up to *aratder* and wholesalers. But when the fish reached the retailers, DPs of many fishes crossed the level (DP 3.0) [23]. Also found the same result. DPs of fish varied from February to April. Different prime distribution channel was observed in fishes at Noakhali and found the scenario of fish losses. Floodplain, canal and *beel* were used for collection of fish but a minute amount compared to pond. The percentages for pond, floodplain, canal and *beel* were 80%, 17%, 2% and 1% respectively. Quality defect points of catla (*Catla catla*), rohu (*Labeo rohita*), mrigal (*Cirrhinus mrigala*), silver carp (*Hypophthalmichthys molitrix*), grass carp (*Ctenopharyngodon idella*) and sarpunti (*Puntius sarana* at different steps in a single distribution chain from harvest in Mymensingh to retail sale Rangpur town which were determined using a sensory based quality assessment tool. Percent quality loss of fish at each step of distribution was calculated from the number of cases that crossed sensory quality cut-off points. Neither of the fish lost their quality when they were in the farm gate, during transportation and in wholesale markets in Rangpur but most of the fishes lost their quality at the retail fish shops. The quality loss was 8, 12, 8, 6, 10 and 14% in case of *C. catla*, *C. mrigala*, *L. rohita*, *H. molitrix*, *C. idella* and *P. sarana* respectively in the retail markets [10].

CONCLUSIONS

Major carp transportation to the city markets from Noakhali is very minute amount and not frequent due to inadequate supply and inadequate facilities. Not the table size fish but the small sizes *L. rohita* and *C. cirrhosis* were seen transported to the city markets at a very minute amount. Initial and final markets actors (fishermen and retailers) have very low level of awareness on quality loss of fish. Mid-level actors like transporters, wholesalers and commission agents are comparatively better aware of fish quality. People involved in fishing, handling, processing, selling and transporting should have knowledge about fish quality loss and awareness buildup among them may ultimately compensate the post-harvest loss.

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