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# Quality improvement of exportable fish and prawn through participatory stakeholder-based approach in Kulierchar

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**Abstract**: A participatory stakeholder-based study was carried out to improve the quality of exportable fish and prawn landed in Kulierchar. The raw material fish were found to be minimally washed with clean water immediately after harvest. Ice boxes were not used in any stages from harvest to processing plants. Bamboo split baskets were mostly used to keep or carry fish. Landed fish were found to be dispersed on plastic mat or polythene paper kept on earthen floor of the wholesaler shed, called "Arat". Icing of individual catch soon after harvest was very insignificant, ranging from 2 – 15 % only. Prawn were found to be iced during transport to landing center at little higher rate (32%), but most of other fish were not significantly iced during transport to landing center. Awareness of the beneficiaries on quality deterioration of fish, its impact on export, income and nutrition and improved handling of landed exportable prawn/fish was assessed and developed. Awareness in terms of benefit of good practices known to them was high in factory technicians. Other stakeholders had very shallow or poor knowledge on use of improved handling and processing of fish. Various participatory interventions, like PRA and RRA, personal contacts, brain storming and awareness development training were made to develop the existing awareness of different stakeholders.
**Keywords:** Exportable fish, bamboo basket, ice box, landing centre, quality improvement

## Introduction

Kulierchar of Kishoregonj District is one of the major freshwater fish landing centers of the country. Most of the fishes of *Haor* fisheries of Kishoregonj, Sunamgonj, Sylhet and Mouluvibazar districts are landed in Kulierchar. A significant portion of the landed fish is exported to Europe and Middle-east. But the fishes are not adequately taken care off during harvest and post-harvest handling, preservation and processing. The exporters have often been reported to suffer from great economic loss in the form of rejection in part or full of the consignment. The small freshwater fish are most susceptible to spoilage due to their comparative small size and vulnerability of constituent proteins and lipids (Nowsad, 2004). Since the quality loss of fish is not understood at least up to 50% of deterioration by organoleptic means (Sakaguchi, 1990), consumers generally take it without any complain on quality. This brings about serious catastrophe in the nutrition status of the half-starved and nutrition-deprived people as well as the health conscious one (Nowsad, 2005a, 2005b). On the other hand absence of adequate preservation or storage facilities causing quality deterioration thus exporters suffer from great economic loss year after year due to low price offered by both local and foreign buyers. If such serious quality loss of exportable fish in Kulierchar is not encountered by appropriate means, the livelihood of the poor local fishers and traders will be in stake, common people will be more nutrition-deprived and nation will be deprived from foreign currency. These quantitative and qualitative losses, however, can be minimized in great extent by introducing adequate handling, preservation and processing of fish. Considering such backdrop this study was conducted on the quality improvement of exportable fish and prawn in Kulierchar through participatory stakeholder based approach.

## Materials and Methods

**Selection of study area and beneficiaries:** Kulierchar main fish landing center along with adjacent landing sites, local fish markets and a fish processing plant were taken under investigation. The fishermen, fisher-women and fish traders directly involved in harvest and distribution of exportable fish were selected as the primary target beneficiaries. The middlemen, aratdars, wholesalers and processors /operators of processing plant involved in supply, distribution and processing of exportable fish were selected as the secondary beneficiaries.

**Baseline survey:** A participatory baseline survey was conducted to collect information on existing post-harvest handling situation of exportable prawn/fish, constraints of harvest, handling, icing and their solution options.

**Awareness creation and development:** Awareness of the beneficiaries' was created through PRAs, awareness raising campaigns, personal contacts and through distribution of awareness materials.

**Training and capacity building:**The beneficiaries in different groups were trained to build up their capacity and technical skills. First, the project technical, field staffs and then the project beneficiaries were trained on improved handling and processing of fish highlighting the reduction of post-harvest loss in this sector.

**Transfer of technolog:** Existing methods for handling and preservation of fish were improved at field level with participation of the stakeholders. For this purpose, several method and result demonstration training were conducted. Successful practices and techniques were disseminated to the users of other regions through awareness materials, government and non government extension service like Upazila Fisheries Officer, NGOs, etc.

**Quality tests:** Quality of the fish in different stages from harvest to processing was analyzed through subjective tests. Fish and frozen fish products were judged by the organoleptic methods. The sensory attributes with numerical scores employed in sensory analyses for freshness of fish have been given in Table 1. General grading of fish obtained through the analysis of defect points (DP) are given in Table 2.

Table 1. Attributes and defect points for freshness test of fish

| Attributes | Defect | Defect points | Grade |
|---|---|---|---|
| 1. Odour at neck when broken | a) Natural odour | 1 | Acceptable |
| | b) Faint or sour odour | 5 | Rejected |
| 2. Odour of gills | a) Natural odour | 1 | Excellent |
| | b) Faint sour odour | 2 | Good |
| | c) Slight moderate sour odour | 3 | Acceptable |
| | d) Moderate to strong sour odour | 5 | Rejected |
| 3. Colour of gills | a) Slight pinkish red | 1 | Excellent |
| | b) Pinkish red to brownish | 2 | Good |
| | c) Brown or grey | 3 | Acceptable |
| | d) Bleached colour, thick yellow slime | 5 | Rejected |
| 4. General appearance | a) Full bloom, bright, shining, iridescent | 1 | Excellent |
| | b) Slight dullness and loss of bloom | 2 | Good |
| | c) Definite dullness and loss of bloom | 3 | Acceptable |
| | d) Reddish lateral line, dull, no bloom | 5 | Rejected |
| 5. Slime | a) Usually clear, transparent and uniformly spread | 1 | Excellent |
| | b) Becoming turbid, opaque and milky | 2 | Good |
| | c) Thick sticky, yellowish or green colour | 5 | Rejected |
| 6. Eye | a) Bulging with protruding lens, transparent eye cap | 1 | Excellent |
| | b) Slight cloudy of lens and sunken | 2 | Good |
| | c) Dull, sunken, cloudy | 3 | Acceptable |
| | d) Sunken eyes covered with yellow slime | 5 | Rejected |
| 7. Consistency of flesh | a) Firm and elastic | 1 | Excellent |
| | b) Moderately soft and some loss of elasticity | 2 | Good |
| | c) Some softening | 3 | Acceptable |
| | d) Limp and floppy | 5 | Rejected |

**Table 2.** Grading of fish on the basis of the defect points

| Grade | Average DP | Comments |
|---|---|---|
| a | < 2 | Excellent/ highly acceptable |
| b | 2 to <3 | Good / acceptable |
| c | 3 to < 4 | Poor/ can be accepted with care |
| d | 4 to 5 | Bad / should be rejected |

Proximate composition of the products was done by the standard Methods of AOAC (1990). Total volatile base nitrogen and peroxide values were determined by the methods of Miwa and Ji (1992). Simple statistics were performed to compare the data according to Shil and Debonath (1992).

## Results and Discussion

**Fish landing and processing in Kulierchar:** Commercial freshwater species are exported through fish processing plants of Kulierchar and packers and exporters through Dhaka-based frozen/chilled product export group to Europe, USA and Middle-east. Major processed products along with local and scientific names of raw materials are presented in Table 3.

**Handling of wet fish:** Fishes were hardly washed with clean water immediately after harvest. In case of small fish like *Puntiuas* sp. only 10% and bigger fin fishes a 20-40% of the hauls were cleaned by thorough washing. A 65% fisherman washed their catch of giant prawn, which was still insignificant. Washing and cleaning efforts of fish and prawn were very low during transport to landing and also immediately after landing (Table 4). However, almost all of the fishes were washed and cleaned in aratders before icing.

Fishermen mostly used small narrow-mouth fine meshed basket made of split bamboo (Table 5), sometimes they used aluminum or steel containers during harvest. After accumulation of the catches the fishes or prawn were transported to the landing center by large mouth split-bamboo basket or bamboo basket inner-wrapped with polythene sheet.

Icing practiced as soon as harvest was very poor ranging from 2 – 15 % only (Table 6). Prawn were found to be iced during transport to landing center at little higher rate (32%), but most of the other fish were not significantly iced during transport to landing center. Rate of icing was reduced immediately after landing even in case of prawn and some other valued species. But after whole sale in Arat, all most all of the prawns and fin-fishes were iced, because of their transportation to distant places.

**Quality of landed and processed fish in Kulierchar:** Fish and prawn at harvest were excellent as all having a DP (Defect Point) of around 1 (Table 7). But soon after that DP increased showing the maximum value in transporter's iced basket. DP of fish and prawn at the factory was *good* because of immediate icing was done soon after landing or promptly transported to the factory since the distance was very short.

The processing plant in Kulierchar processed and exported more than 30 different types of conventional and value-added fish and shrimp products. Proximate compositions of most of the products were in good range showing no major deterioration of nutrients occurred. Peroxide values of prawn products were significantly

lower, while those for fin-fishes were although little higher but still within the acceptable limit.

TVB nitrogen values were very low in shrimp products. In fish products, the values were comparatively higher (Table 8). But all such values were still lower than those to be considered spoilt. For a good quality fish, less than 35-40 mg of TVBN / 100 g of fish is recommended (Gopakumar, 2002).

**Table 3.** Major fish species exported from Kulierchar region

| No. | Local name | Scientific name | Product type |
|---|---|---|---|
| 1. | Golda, Icha, Chaumma | Macrobrachium rosenbergii | Frozen block, IQF, cooked |
| 2. | Icha, Chaumma | *Macrobrachium malcomsoni* | Frozen block, IQF, cooked |
| 3. | Aair/Guchi | *Mystus aor* | Frozen semi-IQF |
| 4. | Gulsha | *Mystus vittatus* | Frozen block |
| 5. | Tengra | *Mystus tengara* | Frozen block |
| 6. | Pabda | *Ompok pabda* | Frozen block |
| 7. | Raj Pabda | *Ompok bimaculatus* | Frozen block |
| 8. | Silong | *Silonia silondia* | Frozen block |
| 9. | Bacha | *Eutropiichthys vacha* | Frozen block |
| 10. | Boal | *Wallago attu* | Frozen semi-IQF |
| 11. | Rui | *Labeo rohita* | Frozen semi-IQF |
| 12. | Catla | *Catla catla* | Frozen semi-IQF |
| 13. | Mrigal | *Cirrhina mrigala* | Frozen semi-IQF |
| 14. | Calibaush | *Labeo calbasu* | Frozen semi-IQF |
| 15. | Garua | *Clupisoma garua* | Frozen block |
| 16. | Batashi | *Clupisoma atherinoides* | Frozen block |
| 17. | Rita | *Rita rita* | Frozen block, semi-IQF |
| 18. | Elong | *Rasbora elonga* | Frozen block |
| 19. | Mola | *Amblypharyngodon mola* | Frozen block |
| 20. | Sarpunti | *Puntias sarana* | Frozen semi-IQF |
| 21. | Chital | *Notopterus chitala* | Frozen semi-IQF |
| 22. | Foli | *Notopterus notopterus* | Frozen block |
| 23. | Kajali | *Alia coila* | Frozen block |
| 24. | Bele | *Glossogobius giuris* | Frozen semi-IQF |
| 25. | Shing | *Heteropneustes fossilis* | Frozen block |
| 26. | Magur | *Clarias batrachus* | Frozen block, semi -IQF |
| 27. | Koi | *Anabas testedineus* | Frozen block |
| 28. | Baim | *Mustacembelus armatus* | Frozen semi-IQF |
| 29. | Tara baim | *Mustacembelus aculeatus* | Frozen block |
| 30. | Shol | *Channa striatus* | Frozen semi-IQF |

**Table 4.** Washing and cleaning of fish landed in Kulierchar

| Fish | Frequency of washing/cleaning ( % of unit practice) | | | | |
|---|---|---|---|---|---|
| | After harvest | | On way to landing | Immediately after landing | After wholesale in Arat |
| | River | Beel/pond | | | |
| Golda | 65 | - | 25 | 7 | 100 |
| Pabda | 37 | 26 | 10 | 5 | 100 |
| Gulsha | 40 | 27 | 10 | 6 | 98 |
| Baim | 20 | 18 | 15 | 2 | 100 |
| Major carp | 26 | 15 | 5 | 0 | 96 |
| Sarpunti | 10 | 17 | 8 | 5 | 98 |
| Punti | 10 | 5 | 11 | 6 | 97 |
| Boal | 27 | 19 | 5 | 2 | 85 |
| Bele | 34 | 20 | 6 | 8 | 95 |

Table 5. Container used to keep/transport fish landed in Kulierchar

| Fish | On board vessel/ during harvest | On way to landing | During sale at Arat | During transportation |
|---|---|---|---|---|
| Golda | SBB, Aluminium container | Polythene inner wrapped SBB | Plastic mat on earth | Plastic crate, Polythene inner wrapped SBB |
| Pabda | SBB | SBB | Plastic mat on earth | Polythene inner wrapped SBB |
| Gulsha | SBB | SBB | Plastic mat on earth | Polythene inner wrapped SBB |
| Baim | SBB | SBB | Plastic mat on earth | Polythene inner wrapped SBB |
| Major carp | SBB | SBB | Plastic mat on earth | Polythene inner wrapped SBB |
| Sarpunti | SBB | SBB | Plastic mat on earth | Polythene inner wrapped SBB |
| Punti | SBB | SBB | Plastic mat on earth | Polythene inner wrapped SBB |
| Boal | SBB | SBB | Plastic mat on earth | Polythene inner wrapped SBB |
| Bele | SBB | SBB | Plastic mat on earth | Polythene inner wrapped SBB |

SBB= Split bamboo basket

**Table 6.** Icing of fish landed in Kulierchar

| Fish | % Practice of Icing | | | |
|---|---|---|---|---|
| | After harvest | On way to landing | Immediately after landing | After wholesale in Arat |
| Golda | 7 | 32 | 23 | 100 |
| Pabda | 15 | 18 | 13 | 100 |
| Gulsha | 5 | 7 | 14 | 98 |
| Baim | 2 | 2 | 7 | 88 |
| Major carp | 2 | 5 | 8 | 97 |
| Sarpunti | 5 | 3 | 9 | 95 |
| Punti | 5 | 2 | 4 | 89 |
| Boal | 3 | 5 | 5 | 88 |
| Bele | 4 | - | 14 | 94 |

**Table7.** Freshness quality of landed fish in Kulierchar during the start of intervention

| Fish | Quality at harvest | | Quality at landing | | Quality at Aratders | | Quality at Transporters | | Quality at Factory Window | |
|---|---|---|---|---|---|---|---|---|---|---|
| | DP | Condn | DP | Condn. | DP | Condn | DP | Condn. | DP | Condn. |
| *Macrobrachium rosenbergii* | 1.0 | Excel | 2.0 | Good | 2.2 | Good | 2.6 | Good | 2.3 | Good |
| *Ompok Bimaculatus* | 1.1 | Excel | 2.1 | Good | 2.3 | Good | 2.8 | Good | 2.2 | Good |
| *Alia coila* | 1.1 | Excel | 2.1 | Good | 2.5 | Good | 2.9 | Good | 2.3 | Good |
| *Mystus vittatus* | 1.6 | Excel | 2.0 | Good | 2.6 | Good | 2.9 | Good | 2.0 | Good |
| *Mystua aor* | 0.9 | Excel | 2.2 | Good | 2.7 | Good | 3.1 | Good | 2.5 | Good |
| *Glossogobius giuris* | 1.0 | Excel | 2.5 | Good | 2.9 | Good | 3.0 | Poor | 2.5 | Good |
| *Eutropiichthys vacha* | 1.0 | Excel | 2.7 | Good | 2.9 | Good | 3.0 | Poor | 2.5 | Good |

DP= Defect point; Condn.= Condition

**Table 8.** Biochemical qualities of fish and shrimp products taken from the processing plant

| Product | Proximate Composition | | | | Peroxide Value | TVBN (mg/100g) |
|---|---|---|---|---|---|---|
| | Moisture | Protein | Lipid | Ash | | |
| Golda IQF | 77.67 | 20.60 | 0.95 | 0.38 | 2.1 | 18.16 |
| Golda P&D | 77.05 | 21.00 | 0.96 | 0.55 | 3.5 | 16.04 |
| Golda PUD | 78.10 | 19.89 | 1.25 | 0.49 | 2.3 | 20.74 |
| Chital S-IQF | 81.05 | 20.81 | 2.20 | 1.37 | 8.2 | 28.67 |
| Aair S-IQF | 80.27 | 19.85 | 1.34 | 1.67 | 7.5 | 26.17 |
| Gulsha | 81.00 | 20.02 | 1.90 | 1.11 | 10.4 | 33.49 |
| Koi S-IQF | 80.40 | 19.66 | 1.86 | 1.23 | 7.8 | 27.03S |
| Pabda Block | 79.90 | 19.78 | 1.75 | 1.08 | 8.4 | 25.27 |

IQF= Individual quick frozen; P&D= Peeled and deveined; S-IQF= Semi-IQF; TVBN= Total volatile base nitrogen

**Awareness creation and transfer of technology among the stakeholders:** The stakeholders existing awareness level was assessed and then several awareness development interventions were brought to them. Awareness in terms of benefit of good practices known to them was justifiably high in factory technicians. Other stakeholders had very shallow or poor knowledge on use of improved handling and processing of fish to keep the quality standard high (Table 9). Benefit of washing of fish after harvest was known to only 28% of fishermen and 37% fish mongers. The knowledge was off course higher among wholesalers and transporters (around 50%). Benefit of adequate icing in maintaining the quality was known to only 35% fishermen, 32% fish monger and 40% fisher-women. Use of appropriate ice box for transporting fish was made mandatory by the government regulation but it was known to only 41% fishermen and fisher-women. Wholesalers and transporters were more aware to use good practices of fish handling and processing.

Various interventions were made to improve the existing awareness level of different stakeholders. They were brought under PRA and RRA, personal contacts, brain storming sessions and awareness development training programmes (Table 10). Training programmes were completely participatory and method or result demonstrations were mainly done to make such novice people understand the new things fully. Such participatory interventions, although lengthy and time consuming, made the transfer of technologies easier, smoother and timely.

**Improvement of awareness level at the close of intervention:** Follow-up monitoring and survey were conducted to observe the improvement of knowledge on improved fish processing practices among the stakeholders. A tremendous increment of awareness level in all 5 sectors had been noticed. Previous knowledge of fishermen on these five sectors were 28,

35, 34, 41 and 39 % respectively in the above order (Table 7), which was increased to 68, 76, 80, 85 and 80% respectively in the same order (Table 11). All other stakeholders except processing factory operators and technician had significantly improved their awareness and skills. Processing factory personnel either studied the fish processing course or had training on such subjects before. The range of percent improvement was significantly higher in fishermen, fisher-women and fish monger (mostly above 100%) but comparatively lower in wholesalers and transporters (14 – 71%) (Table 11). Freshness quality of the landed fish was assessed once again (Table 12) at the close of intervention after 16 month to see the practical implication of such awareness improvement. Comparatively better quality of fish was noticed in all five stages when compared to the quality of fish assessed during the start of intervention.

**Table 9.** Awareness levels of stakeholders on good practice at the start of intervention

| Stakeholders | Benefit known to % people | | | | |
|---|---|---|---|---|---|
| | Washing after catch | Icing after catch | Use of clean container | Use of ice-box | Keeping fish in cool place |
| Fishermen | 28 | 35 | 34 | 41 | 39 |
| Fish mongers | 37 | 32 | 42 | 64 | 39 |
| Wholesalers/Aratders | 55 | 48 | 66 | 70 | 57 |
| Fish transporters | 51 | 62 | 79 | 76 | 67 |
| Fisher-women | 36 | 40 | 38 | 41 | 40 |
| Factory technicians | 89 | 92 | 96 | 98 | 86 |

**Table 10.** Skill development training of the stakeholders

| Types of training | *Modus operande* | No of training | Types of beneficiary | No of beneficiary trained |
|---|---|---|---|---|
| Awareness creation | PRA/RRA | 9 | Fishermen/women/fish monger/fish traders | 265 |
| Improved fish handling | Participatory MD | 3 | Fishermen/women/fish monger/transporters/aratders | 92 |
| Appropriate icing of fish | Participatory MD | 2 | Fishermen/women/fish monger/transporters/aratders | 90 |
| Improved fish processing | Participatory MD | 1 | Fisher-women/ fishermen | 22 |
| Preparation of low-cost ice-box and drying tunnel | MD & RD | 2 | Fishermen/transporters/ wholesalers | 32 |
| Fish quality improvement/ HACCP | PRA / Group Exercise | 1 | Processing Technologist/Microbiologists/Factory Operators | 14 |

PRA= Participatory rapid appraisal; RRA= Rapid rural appraisal; MD= Method demonstration; RD= Result demonstration

**Table 11.** Awareness level of stakeholders on good practice at the close of intervention

| Stakeholder | Benefit known to % people | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Washing after catch | % Dev | Icing after catch | % Dev | Use of clean container | % Dev | Use of ice-box | % Dev | Keeping fish in cool place | % Dev |
| Fishermen | 68 | 142 | 76 | 117 | 80 | 135 | 85 | 107 | 80 | 105 |
| Fish mongers | 63 | 72 | 68 | 113 | 85 | 103 | 85 | 33 | 83 | 128 |
| Wholesaler/ Aratders | 83 | 51 | 82 | 71 | 89 | 35 | 84 | 20 | 86 | 51 |
| Fish transporters | 85 | 67 | 86 | 39 | 90 | 14 | 95 | 25 | 95 | 42 |
| Fisher-women | 80 | 123 | 88 | 120 | 89 | 134 | 91 | 122 | 92 | 130 |
| Factory technicians | 97 | 9 | 98 | 7 | 97 | 1 | 100 | 2 | 100 | 16 |

**Table 12.** Freshness quality of landed fish in Kulierchar at the close of intervention

| Fish | Quality at harvest | | Quality at landing | | Quality at Aratders | | Quality at Transporters | | Quality at factory window | |
|---|---|---|---|---|---|---|---|---|---|---|
| | DP | Condn. | DP | Condn. | DP | Condn. | DP | Condn | DP | Condn |
| *Macrobrachium rosenbergii* | 1.0 | Excel | 1.9 | Excel | 2.1 | Good | 2.2 | Good | 2.0 | Good |
| *Ompok Bimaculatus* | 1.0 | Excel | 2.0 | Good | 2.1 | Good | 2.3 | Good | 2.1 | Good |
| *Alia coila* | 1.1 | Excel | 2.0 | Good | 2.2 | Good | 2.5 | Good | 2.0 | Good |
| *Mystus vittatus* | 1.1 | Excel | 1.9 | Excel | 2.5 | Good | 2.5 | Good | 1.9 | Excel |
| *Mystua aor* | 1.0 | Excel | 2.0 | Good | 2.5 | Good | 2.8 | Good | 2.1 | Good |
| *Glossogobius giuris* | 1.0 | Excel | 2.3 | Good | 2.5 | Good | 2.7 | Good | 2.3 | Good |
| *Eutropiichthys vacha* | 1.0 | Excel | 2.4 | Good | 2.5 | Good | 2.7 | Good | 2.4 | Good |

DP= Defect point; Condn= Condition

Any technology to be used by rural poor should be developed and improved with full participation of the ultimate users. Considering the dwindling situation in the post harvest sector of exportable fish and prawn in kulierchar, participatory stakeholder based technique was use in the study area where all beneficiaries were involved in the improvement of the handling and icing of fish so that sustainable transfer of technology was made easy.

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