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It has been no easy task to put together a report covering such a wide number of sources. Each of the chapter titles and indeed subtitles presented could on their own form the title of a report. Much has had to be grossly abbreviated and summarised and some topics only briefly mentioned. However, I have tried to give a reasonable balance in covering the major issues.

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July, 2002 Professor Khairul Azam

ABSTRACT

An in-depth investigation was carried on the fisheries activities of the fishermen communities of Laatachapali Union, popularly known as Kuakata. The study involved both field survey and quality assessment of dried fish. It was found from the field survey that there were 31 villages of which 11 were considered as fishermen villages. The target of the investigation was to assess only the activities of the fishermen (harvesters, traders, processors and net makers). Therefore the field survey was done in 11 villages. Out of 1100 people investigated from the 31 villages, 716 (65.09%) were engaged in fisheries activities. More than 55% people carried out fisheries activities in each of the 11 fishermen villages. However, in the Hossainpara village, as high as 81% people was engaged in fisheries. Although, a large number of people were involved in fishing, only two were engaged in netting (0.18%) in Goramkholapara village. 3.64% people of the total study area were directly involved in fish processing activities (Icing, drying, salting-drying, and smoking).

Majority of the fishermen was fishing in the sea and river (79.20%). However, in the Goramkholapara village, 96.83% fishermen were directly involved in fishing. Relatively very low percentages of fishermen (0.22%) were engaged in netting. 2.88% fishermen were fish traders. About 10.07% and 4.42% fisherman were shrimp fry collectors and processors (Icing, drying, salting-drying, and smoking) respectively. In Goramkholapara village, no fry collection activity was observed.

69.14% fishermen carried out fisheries activities in partnership. Four of the villages (Khajura, Kalaiapara, Goramkholapara and North Kuakata) had more than 80% fishermen involved in partnership. 23.23% fishermen carried out fisheries activities only with their family members. All fishermen went for fishing in the sea and river from Khajura and Hossainpara villages. Most fishermen were fishing along the sea beach up to 2 km in the studied area.

53.10% fishermen worked more than 24 days in a month while 39.82% fishermen between 20-24 days. Most of the fishermen in all the villages worked through out the year (85.51%). Comparatively small number of fishermen (14.49%) carried out their fisheries activities seasonally. 28 species of fish were available of which 19 were dried, 13 salted-dried and 5 smoked.

4 types of fishing crafts such as dingi (small wooden boat), bachari (relatively large wooden boat), engine boat and trawler were observed. 89.60% fishermen did not own any fishing craft. Amongst the fishing craft owners, 84.78% had only 1 fishing craft whereas 13.05% had 2 crafts. Very few fishermen (2.17%) had 3 fishing crafts.

Fishermen used 5 types of fishing gears such as Hilsa net, Behundi jal, Khuta jal, Long line and Tana jal. All fishermen of the eleven villages used Hilsa net and long line for fishing. 76.99 % fishermen did not own any fishing gears. 8.85% fishermen carried out fisheries activities with 2 gears while 4.54% and 4.76% fishermen used 1 and 3 gears respectively. Only 0.88% fishermen used 4 gears.

All fishermen who went for fishing usually used ice for preservation. However, fishermen did not use ice appropriately. Four types of preservation and processing techniques namely icing, drying, salted-drying and smoking were carried out. Preprocessing was a common work in case of relatively large fish that needed longer time for drying. Drying time varied from species to species between 2 to 8 days. But for salting-drying procedures, duration remained between 6 to 36 hours. Rubbing on the skin was the only method of salting.

6 shutki points and 31 shutki mahals were identified. Kuakata shutki point had the largest number of mahals (17) while Panjupara and Mammipara the least (2). In two shutki points namely Gorakhal and Mammipara, shutki processing was done through out the year. Manpower engaged in each shutki mahal varied between 1 and 8. Total production of dried, salted-dried and smoked fish (shutki) was 282485 kg as observed during the study period.

Cost-benefit ratio of the mahals was found to range between 0.27 and 1.68. Both mahals of Mammipara showed a cost-benefit ratio above 1.50. Mahals where work was done though out the year indicated always a better cost benefit ratio.

Fish products in different shutki points were dried, salted-dried and smoked. In Nayarypara shutki point, only salted-dried product was observed while smoked product was found in Mammipara. Jute sacks bamboo baskets and polythene sheets were used for packaging.

There were 2 fish landing centers, 2 local fish markets and 13 fresh fish arots (depot). 1 landing center and 1 local fish market was located in Alipur and West Kuakata respectively. Out of 13 fresh fish arot (depot), 11 were located in the village of Alipur while only 2 in West Kuakata.

The total production of fresh fish in the studied area was 6,95,475 kg. Cost-benefit ratio of the majority of the fresh fish arot (9 out of 13) varied between 0.400 and 0.500. Arots (depot) working through out the year had better cost-benefit ratio.

Kuakata sea beach area and the estuary of Shibbaria river near the Khajura and Gorakhal were identified as the fry collection zone in the investigated area. Fishermen generally preserved shrimp fry in earthen pots with salt water for storage. However, they did not possess any knowledge to preserve fry in oxygenated water.

The trading pattern involved a series of intermediaries between the harvesters, suppliers, exporters and consumers. The price of the final product depended on the marketing network. Fresh and iced fish channel had three outlets. The dried species were sold mainly to arotdars in Chittagong or to the regional market and retailers. Marketing channel of shrimp fry was observed to be simple.

The investigation revealed that maximum monthly average price was found to be highest for *Pampus chinensis* and lowest for *Tetraodon patoka*. (172.50 ± 12.34 and 24 ± 1.48 taka) respectively. The prices of fish varied from month to month and were higher during the month of January, November and December.

The maximum monthly average price of dried fish was found to be highest in *Himantura walga* (skin) and lowest in *Penaeus indicus* (1008.33 ± 87.47 and 58.75 ± 2.26 tk/kg) respectively. The price of fin of *Scoliodon shorrakowah was* high compared to meat of the species. Similar price pattern was observed for *Himantura walga*.

The maximum monthly average price of smoked fish was found to be highest in *Mugil cephalus* and lowest in *Metapenaeus monocerus* (75.42 ± 3.96 and 56.67 ± 4.92 tk/kg) respectively.

Out of 11 fishermen villages studied, above 40% fishermen of 10 villages took 1-500 gm fish daily whereas only 5.75% consumed 1500-2000 gm. While 34.51% and 14.16% consumed 500-1000 gm and 1000-1500 gm fish daily.

Fishermen of the study area were amongst the poorest of the poor. Most of the fishermen earned Tk. 500-1000 (25.88%) and Tk. 1000-1500 (38.38%) per month respectively.

Credit was provided to the poor fishermen of the 11 fishermen villages either through NGOs or Arotders (Depot owners). Some of the fishermen did not take any credit. 37.28% fishermen were engaged with the NGO's for obtaining credit while rest received credit either from arotders or did their business by themselves. Arotder had maximum contribution in fisheries business (40.82%). While 21.90% fishermen carried out their fisheries business on their own capital.

18 dried fish samples of 14 species and 10 fresh fish samples of 10 different species had undergone laboratory analysis. The samples were assessed by organoleptic, biochemical, (pH, total volatile basic nitrogen, tri-methyl amine) and microbiological parameters (standard plate counts, total and faecal coliform *Salmonella* and *Vibrio* species). In addition, proximate composition and water reconstitution behaviour was also studied.

The organoleptic properties such as colour, odour, texture, toughness etc. of the 18 dried fish samples were of better quality except for Churi (S_{11}) and Saplapata (S_{15}). As judged by the panelists, *Mugil cephalus*, *Scolidon shorrakowah, Harpodon neherus*, and *Setipinna phasa*, were 'like slightly'; *Mugil cephalus* (winter sample), *Pampus chinensis, Setipinna phasa* (winter sample) and *Muraenesox bagio* were 'like very much'; *Hilsa ilisha, Polynemus paradiseus*, *Epinephelus lanceolatus* and *Tetradon potka* were 'liked moderately' while only *Harpodon neherus* (winter sample) and *Cynoglossus bengalensis* were 'liked extremely'. It is also showed that all the ten fresh fish were fairly good and were moderately acceptable with acceptability score ranging from 7.0 to 7.57.

Microbiological parameters (standard plate count, total and faecal coliform, *Vibrio* and *salmonella sp.*) of both dried and fresh fish was investigated. Amongst the eighteen dried fish, five dried fish (*Harpodon neherus*, *Arius caelatus*, *Harpodon neherus* (winter sample), *Setipinna phasa* and *Cynoglossus bengalensis* showed standard plate count (SPC) of 2.89 to $7.8x10^3$ cfu/gm, eleven dried sample did contain $2.11x\ 10^4$ cfu/gm while, the remaining two fish samples (*Trichuirus haumela* and *Himantura walga*) had SPC of $2.26\ x10^5$ and $2.77\ x10^5$ cfu/gm. respectively.

Out of ten fresh fish sample, SPC of seven samples ranged from 4.25 to 7.9×10^4cfu/gm while the remaining three samples (*Mugil cephalus, Arius caelatus*, and *Hilsa ilisha*) showed a SPC of 1.32 to 5.6×10^5cfu/gm.

Total coliform count for thirteen were <3/gm. Count for remaining five dried fish sample varied between 4 to 28 / gm. Faecal coliform of all dried samples were <3 /gm. In case of fresh fish, total coliform count for nine were in the range of 7 to 43/gm, the remaining one (*Scatophagus argus*) had 210/gm. Faecal coliform count for *Coilia dussumieri*, *Scatophagus argus*, *Hilsa ilisha, Platicephalus indicus* and *Pelamys chiliensis* were 21, 93, 20, 11 and 15 respectively and three samples (*Mugil cephalus*, *Sillanopsis panijus* and *Arius caelatus*) showed a faecal coliform load of 9/gm. While, the rest two, *Setipinna phasa* and *Polynemus paradiseus* showed faecal coliform of 4 and < 3 per gm respectively. However, it is evident that most of the fresh fish samples under tests were heavily exposed to coliform contamination of both faecal and non-faecal origin.

No *Vibrio* and *Salmonella* were detected both in dried and fresh fish.

Analytical data on proximate composition showed that the dried products had moisture content ranging from 18.23 to 24.46%. Protein varied between 40.69 to 68.09%. Ash and fat content were in the range of 5.08 to 16.02% and 2.97 to 26.13% respectively. Moisture content of fresh fish varied over a range from 65.33% to 78.92%. Likewise, protein (8.58% to 19.06%), fat (6.12% to 12.99%) and ash (1.07 to 8.41%) content varied widely in ten fresh fish analysed.

TVB-N and TMA-N values of eighteen dried fish varied between 26.84 ± 0.76 to 72.11± 0.69 mg-N/100g and 19.87 ± 0.43 to 56.17 ± 0.29 mg-N/100g. The TVB-N content of present investigation was much lower than that of standard limit (<138 mg-N/100gm) of acceptability. However, TMA-N content of the present investigation exceeded the limit (<18 mg-N/100gm). TVB-N and TMA-N values of fresh fish were found to vary between 10.92 ± 0.23 to 25.75 ± 0.80 mg-N/100g and 7.70 ± 0.67 to 18.50 ± 0.77 respectively. pH values of eighteen dried fish were in the range of 7.37 ± 0.21 to 8.33 ± 0.05. While, the values of pH of fresh fish ranged from 7.03 ± 0.05 to 6.7 ± 0.07.

Water reconstitution rate (%) at room temperature and hot water varied between 45.98% to 79.74% and 53.63% to 78.58%. The studies on the reconstitution rate (%) of the dried products soaked in water at normal room temperature and hot water (80^0C) demonstrated that reconstitution rate was comparatively faster at hot water compared to samples kept at room temperature except for Bombay duck.