SUMMARY

All the information gained from this investigation was presented earlier in this report. On consideration of the findings it is apparent that our general understanding of fish preservation and processing activities have advanced considerably with this research. In particular, our knowledge of fishermen and their activities such as fishing, fish preservation and processing fish marketing and fish handling in the studied area have significantly increased. As well, the quality aspect of dried fisheries products have been understood to some extent.

Through this research we have gained a better understanding of the fisheries activities of the study area. This knowledge is essential for the application and development of any improved technique relating to research purposes. Information relating to occupation indicated that 82.18% people of the study area were directly or indirectly involved in fisheries activities. 79.20% fishermen carried out their work directly in fishing whereas only 0.22 % in netting business.

Partnership fishing pattern involved majority (69.14 %) of the fisherman. While a small number (7.63 %) of fisherman were engaged in individual pattern. Certain types of fishing activities may inadvertently influence the individual pattern (fry collection, trading) whereas some were considered important factos for partnership pattern (deep-sea fishing).

Until recently, it has generally been observed that high power mechanised fishing boat is preliminary consideration for deep-sea fishing. Fishermen faced numerous problems due to lack of high power mechanised fishing boats for deep-sea fishing. For this reason, most fishermen in the study area carried out fishing activities near the shoreline. Above 50% of fishermen worked more than 24 days in a month and above 85 % fishermen through out the year.

Fishermen used four or five types of gears. The number of crafts and gears varied between 1-3 and 1-4 respectively. Majority of fishermen i.e. 89.60 % and 76.99 % had no crafts and gears.

Four types of preservation and processing activities were observed. In case of deep-sea fishing, all fishermen were found to use ice for preservation. They had little knowledge in using ice appropriately. Besides this, factories could not supply adequate quantity of good quality ice. Fishermen practised obsolete method of drying and salting which resulted in substantial quantity of loss due to spoilage. Smoking, in a small-scale was another process used by fishermen mainly in the rainy season. In processing procedures, fishermen did not maintain any standard of sanitation and hygiene. Certain poor processing techniques used by the fishermen influenced quality of the products particularly during rainy season. Salting procedure reduced microbial activity but improper salt ratio provided poor quality food product. In addition to salt, the application of agricultural pesticide (Nagas) was also practised by fishermen as a control measure for insect infestation. The agro-chemical was highly hazardous to the human health. Screening was a good control manure used by some fish processors for preventing birds, crows etc. Storage losses of processed product were a common sign in the study area. Fish piled up on racks and stored openly in the storeroom enhanced fungal growth. Besides, fisherman could not properly identify the end point of drying, which influenced fungal growth in the later stage due to high water content. The research finding indicated that the processing procedures of different fish were relatively same but variation was identified related to the time period required for drying, salting and smoking. Research result on Shutki Point and Shutki Mahal indicated a balanced cost benefit relationship. Shutki Mahal that worked through out the year earned higher profit. The activity of Shutki Mahal also depended on the availability of fish in the processing area. Fish production and manpower of Shutki Mahal were also positively related to each other. Out of thirty-one Mahals and five Shutki points, only five Mahals and two Shutki points carried their work though out the year.

It was also found that the whole year active arots earned better profit. Two landing centers and two local fish markets were identified as high production areas particularly for the month of month of July and August.

8.27%of the total population and 10.07% of the total fishermen were directly involved in shrimp fry collection. Fry collection was usually done individually. Besides this, 3.21% of the total fishermen were involved in fry collection and fishing simultaneously.

Marketing channel and prices of product provided an idea on the total distribution system of the study area. Most fishermen were directly involved in fish arot (depot) for selling their fish. The information on the prices of fish indicated that fresh fish fetched higher prices from the month of November to January. While prices of dried fish were higher during June-September.

Most of the fishermen were very poor and earned 500-1500 TK per month. Majority fishermen were engaged with arotders and NGO's. Only few carried out fishing activities on their own investment.

The present investigation was conducted to assess the quality standard of some selected commercially available dried fish species. In addition, the study evaluated fresh fish quality. Eighteen dried fish samples of fourteen species and ten fresh fish samples of ten different species had undergone laboratory analysis. The samples were evaluated by examining the organoleptic characteristics, chemical composition (proximate composition, pH, total volatile base nitrogen, tri-methyl

amine), microbiological parameters particularly the public health micro-organisms (standard plate counts, total and faecal coliform *Salmonella* and *Vibrio* species), and water reconstitution behaviour.

The organoleptic properties such as colour, odour, texture, toughness etc. showed that all the ten fresh fish sample were fairly good and were moderately acceptable while dried fish samples showed different acceptable pattern. 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.

Eleven dried fish samples showed standard plate count (SPC) of 2.1 to $7.8x10^4$ cfu/gm while five dried fish sample contained 2.89 to 7.8 x 10^3 cfu/gm and the remaining two fish samples (*Trichuirus haumela* and *Himantura walga*) had microbial load of 2.26 $x10^5$ cfu/gm. and 2.77 $x10^5$cfu/gm. respectively. SPC of traditional dried samples were also found to vary highly probably reflecting the different degree of contamination. The minimum and maximum total viable counts noted were 2.89 x 10^3 and 2.77 $x10^5$cfu/gm in the samples. Although the present level of moisture content were quite unsuitable for the growth of bacteria, yet in the tropical region like Bangladesh, it was almost impossible to pack well enough to prevent uptake of water without proper packaging material, and some degree of spoilage was almost inevitable during storage. It was noted that dried fish products even with low moisture content stored under no protection against high humidity could be vehicle for bacteria responsible for food spoilage.

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

Among the eighteen dried fish samples, 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 MPN/gm. Out of 10 fresh fish sample, total coliform count for 9 were in the range of 7 to 43 MPN per gram, the remaining one (*Scatophagus argus*) sample had 210 / gm. which exceeded acceptable limit for total Coliform count (<100 /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.

Investigations were carried out on proximate composition of both dried and fresh fish. Moisture, ash, protein and fat contents of four common dried fish (Parshe, Shark, Bombay duck and Phasa) in summer ranged from 19.31 to 24.22% and 19.93% to 24.46%, 8.12% to 16.02% and 7.45% to 15.02%. While in winter, it varied between 55.25% to 64.06% and 58.35% to 68.09%, 2.97% to 8.22% and 3.35% to 7.84% respectively. Amongst the four parameters, greatest variations were observed in protein content followed by moisture content. Moisture and protein content was higher in all the four species in both summer and winter.

Proximate composition of ten other dried samples of ten species followed similar pattern with the four common dried fish in summer and winter. It was observed that moisture (18.23% to 23.61%), protein (40.69% to 66.52%), fat (7.1% to 26.13%) and ash (5.08 to 12.14%) varied widely over the 10 other dried species.

Moisture content of fresh samples 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 10 fresh fish analysed.

The results of TVB-N of four dried fish in summer varied 48.28 **m** 0.87 to 70.73 **m** 0.22 mg-N/100g. While, TMA-N of this four dried fish were 43.5 **m** 0.46, 34.14 **m** 0.69 mgN/100g, 56.17 **m** 0.29 and 44.15 **m** 0.96 mg-N/100g respectively. In winter, TVB-N and TMA-N of the four common dried fish varied over a range of 33.31 **m** 0.75 to 62.23 **m** 0.71 mg-N/100g and 22.81**m** 0. 08 to 51.13 **m** 0.45 mg- N/100g.

The results revealed that TVB-N content of other dried fish ranged from 26.84 **m** 0.38 to 72.11**m** 0.69 mg-N/100g. The values of TMA-N of other dried fish showed a similar pattern with the TMA-N content of four common dried fish both in summer and winter. Amongst 10 other dried fish sample, lowest pH value was observed in *Himantura walga* while highest pH values was found in *Cynoglossus bengalensis* and this values were 7.63 ± 0.06 and 8.33 ± 0.05 respectively.

In case of fresh fish TVB-N content varied between 10.92 **m** 0.23 to 25.75 ± 0.80 mg-N/100g. Similar pattern of result was observed for TMA-N content (7.70 **m** 0.67 and 18.50 ± 0.77). It is observed that out of 10 fresh samples 7 showed

comparatively higher TVB-N (16.30 ± 0.77 to 25.75 ± 0.80 mg-N/100g). ***Polynemus paradiseus*** indicated a much lower content of TVB-N (10.92 ± 0.23mg-N/100g) in comparison with the other fresh fish.

The pH of dried fish ranged from 7.37 to 8.9 while and in fresh fish varied between 6.7 to 7.03.

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 that at room temperature except S_3. The dried product, S_3 showed an inverse relation. Reconstitution rate was found to be slower in the products with poor texture such as tough, rubbery and compact structure with few interfibrillar spaces. However, toughness and fibrous character of the studied samples were a common observation.