4.0. RESULTS

4.1. Field Study

4.1.1. Occupation of the people

The target of the investigation was to assess only the activities of the fishermen and not those involved in other work. Therefore, the first attention was given to identify fishermen only. As such, occupations of the population of the 11 villages were surveyed. Most of the people of the eleven fishermen villages were engaged in fishing in the sea and river (Fig-12a). Fish trading was low (2.36%). There were no fish trading in three villages (Khajura, Goramkholapara and Hossainpara) at all. Amongst the eleven fishermen villages, there were 8.27% of the people engaged in only fry collection. It was therefore, one of the most important fisheries activities in the studied area, as it stood second in position, only after fishing.Those who were involved in both fishing and fry collection in the 11 fishermen villages accounted to 2.64%. However, this job was not observed in eight villages. Main villages where this occupation was found were namely West Kuakata, Panjupara and Mammipara respectively.

Out of 1100 people investigated, 716 (65.09%) were involved in fishing (Fig-12b). It is noted that in each village more than 55% people were involved in fishing. However, as high as 81% people were engaged in fishing in Hossainpara village. Although, a large number of people were involved in fishing, only two people in Goramkholapara were engaged in netting (0.18%).

One of the major emphases of the present investigation was to focus on fish processing (fish drying, salting, icing and smoking) activities. But, the survey resulted in finding fish processing activities only in four villages i.e. West Kuakata, Panjupara, Mammipara and Islampur. Out of 1100 people from 11 villages, 196 worked in other profession (other than fisheries activities) which accounted to 17.82%. It was also observed that more than 20% people worked in different jobs (other than fisheries activities) in four villages namely Kalaiapara, Nabinpur, Goramkhola and Islampur while 37% people of Goramkholapara did not do any work in fisheries activities.

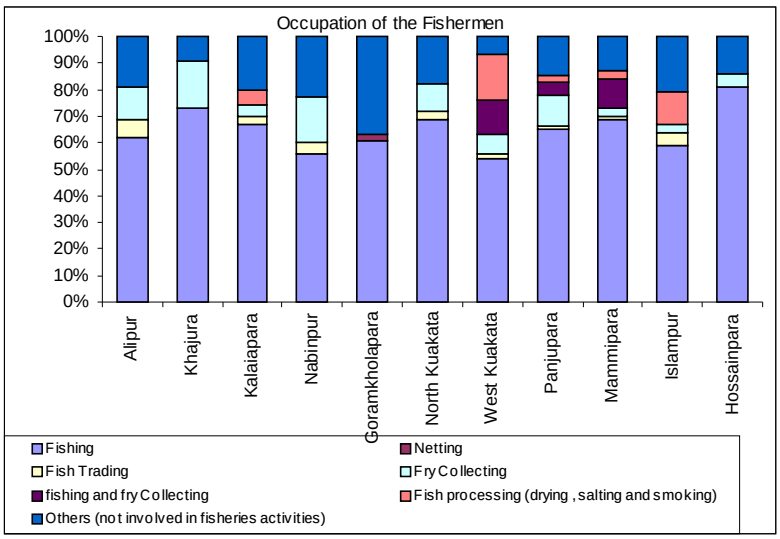

Fig-12a: Occupation of people of eleven fisherman villages

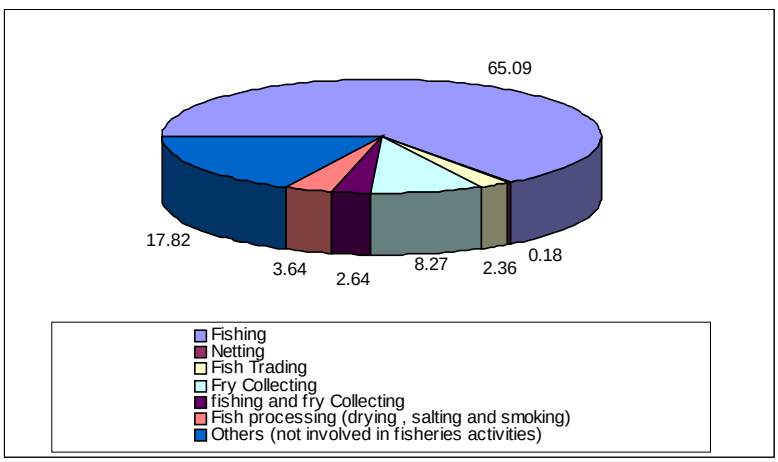

Fig.-12b: Occupation of the people

4.1.2 Fisheries Activities

4.1.2.1 Nature of Fishing Activities

The result of the types of fishing activities in the studied area is illustrated in Table-7. The investigation clearly indicated that majority of the fishermen were involved in fishing in the sea and river (79.20%). All the villages had more than 70% fishermen working in the sea and river for fishing except for West Kuakata where only 58.06% fishermen carried out such type of work. In this village, fish processing (fish drying, salting, smoking etc.) activities were the major work. Probably processing profession of the fishermen in this region provided better income. In addition, fishermen in this village did not take risk for going out in the sea.. 96.83% fishermen of the Goramkholapara were directly involved in fishing while 3.17% in netting. In this village, no processing (fish drying, salting and smoking) was done. As well, this region did not come under fry collection area.

Relatively very low percentages of fishermen (0.22%) were engaged in netting in all fishermen villages studied. 2.88% fishermen of the studied area were engaged in fish trading. As much as 3 villages did not have any fish trading activities (Khajura, Goramkhola and Hossainpara). About 10.07% were engaged in shrimp fry collection. Nabinpur and Khajura had highest number of fishermen carrying out such activity (22.08% and 19.78%) respectively. These two villages were situated adjacent to the sea. As well, the fishermen did not take risk to fish in the sea. It has earlier been mentioned that no fishermen were involved in shrimp fry collection in Goramkholapara.

4.1.2.2. Pattern of Activities

Fisheries activities by the fishermen in different villages were done individually, in partnership or with family member. Such a pattern of fisheries activities in the 11 villages studied is provided in Fig-13a. The result indicated that most of the fisheries activities (69.14%) were done through partnership (Fig-13b). Partnership factor remained highest because most of the fishermen did not have sufficient money. Four of the villages (Khajura, Kalaiapara, Goramkholapara and North Kuakata) had more than 80% fishermen doing fisheries activities in partnership. It was observed that in the fry collection area, fishermen were not engaged in partnership. This was because not much money was required in fry collection. There was also a direct relationship between fry collection and only individual fishermen being engaged in fisheries activities. This was particularly found in Goramkholapara where no fry collection activity was seen. 23.23% fishermen carried out fisheries activities only with their family members. West Kuakata indicated as high as 66.67% fishermen being involved in fisheries activities with their family members. In this village, fishermen did not go for fishing in the deep sea and were only involved in coastal fishing.

Table-7: Nature of Fishing Activities

Villages / Parameters	Alipur		Khajura		Kalaiapara		Nabinpur		Goramkholapara		North Kuakata		West Kuakata		Panjupara		Mammipara		Islampur		Hossainpara		Total	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Fish in the Sea and River	62	76.54	73	80.22	67	83.75	56	72.73	61	96.82	69	84.15	54	58.06	65	76.47	69	79.31	59	74.68	81	94.19	718	79.42
Fish Trading	7	8.64	0	0.00	3	3.75	4	5.19	2	3.17	3	3.66	2	2.15	1	1.18	1	1.15	5	6.33	0	0.00	26	2.88
Shrimp Fry Collection	12	14.81	18	19.78	4	5.00	17	22.08	0	0.00	10	12.20	7	7.53	12	14.12	3	3.45	3	3.80	5	5.81	91	10.07
fishing and fry collection	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	13	13.98	5	5.88	11	12.64	0	0.00	0	0.00	29	3.21
drying , salting and smoking	0	0.00	0	0.00	6	7.50	0	0.00	0	0.00	0	0.00	17	18.28	2	2.35	3	3.45	12	15.19	0	0.00	40	4.42
Total	81	100.00	91	100.00	80	100.00	77	100.00	63	100.00	82	100.00	93	100.00	85	100.00	87	100.00	79	100.00	86	100.00	904	100.00

4.1.2.3 Fishing Distances from the Coast

Table-8 shows the fishing zone of fishing community in the studied area**.** 7.52% of the fishermen did not go for fishing either to the sea or to the river. This scenario was mainly observed in West Kuakata and Islampur where more than 20% of fishermen did not go for fishing. In these areas, fishermen were more involved in fish processing (fish drying, salting smoking etc.) and fish trading. 100% fishermen went for fishing in the sea and river in Khajura, Hossainpara. However, these areas were along the coastal belt and riverside. Moreover, no processing or trading was carried out.

Maximum fishermen were involved in fishing along the sea beach up to 2 km in the studied area. This was particularly observed in four villages such as West Kuakata, Panjupara, Mammipara and Hossainpara respectively where more than 50% fishermen engaged themselves in fishing along the sea beach up to 2 km. These areas were located along the sea beach of the Bay of Bengal. Fishing in 75-100 km and 100-125 km involved approximately 13-14% of fishermen from the eleven villages. Probably these were the areas of fishing ground where fishermen could find their maximum catch.

Very few fishermen went for fishing above 125 km from the sea beach. Again this was due to risk factor and inadequate mechanized boat to fish in such far-flung area.

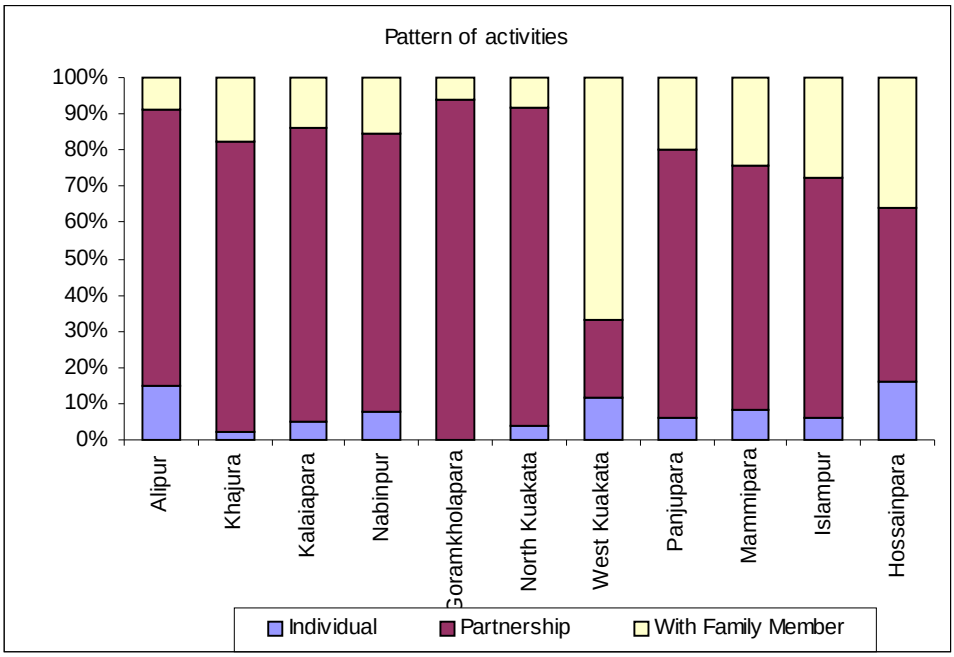

Fig.-13a: Pattern of activities of eleven fisherman villages

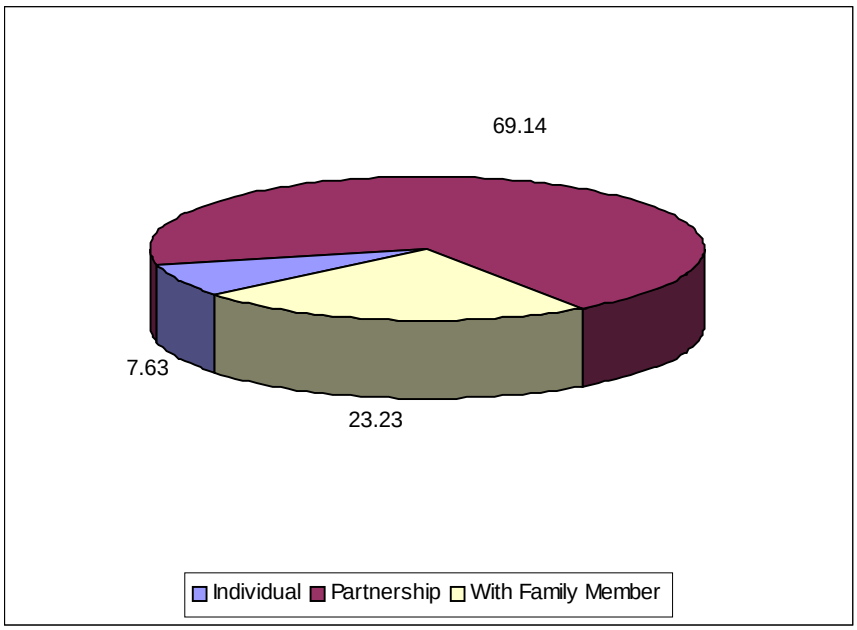

Fig.-13b: Pattern of activities of fishermen

Table-8: Fishing distance from the coast

Villages / Parameters	Alipur		Khajura		Kalaiapara		Nabinpur		Goramkholapara		North Kuakata		West Kuakata		Panjupara		Mammipara		Islampur		Hossainpara		Total	
	f	%	f	%	f	%	f	%	F	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Do not fish in the sea	7	8.64	0	0.00	9	11.25	4	5.19	2	3.17	3	3.66	19	20.43	3	3.53	4	4.60	17	21.52	0	0.00	66	7.30
Beach to 2 Km	12	14.81	18	19.78	4	5.00	17	22.08	0	0.00	10	12.20	47	50.54	43	50.59	54	62.07	38	48.10	44	51.16	287	31.75
02-25	0	0.00	0	0.00	4	5.00	3	3.90	0	0.00	0	0.00	24	25.81	22	25.88	19	21.84	13	16.46	31	36.05	116	12.83
25-50	6	7.41	8	8.79	7	8.75	12	15.58	15	23.81	0	0.00	3	3.23	7	8.24	7	8.05	8	10.13	8	9.30	81	8.96
50-75	3	3.70	12	13.19	2	2.50	31	40.26	7	11.11	12	14.63	0	0.00	4	4.71	3	3.45	2	2.53	3	3.49	79	8.74
75-100	17	20.99	21	23.08	23	28.75	7	9.09	31	49.27	25	30.49	0	0.00	5	5.88	0	0.00	1	1.27	0	0.00	132	14.60
100-125	28	34.57	31	34.07	27	33.75	3	3.90	5	7.94	29	35.37	0	0.00	1	1.18	0	0.00	0	0.00	0	0.00	124	13.72
125-150	7	8.64	1	1.10	3	3.75	0	0.00	3	4.76	3	3.66	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	17	1.88
150-175	1	1.23	0	0.00	1	1.25	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	2	0.22
Total	81	100	91	100	80	100	77	100	63	100	82	100	93	100	85	100	87	100	79	100	86	100	904	100

4.1.2.4 Working Days (Monthly and Yearly)

It seemed that the fishermen in eleven villages were engaged in working most of the days in a month. 53.10% fishermen worked more than 24 days in a month while 39.82% fishermen worked between 20-24 days (Fig-14). Very few percentages of fishermen worked less than 20 days. The working days of the fishermen in different villages varied due to various reasons such as full moon, new moon, availability of catch, weather condition etc.

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 (Fig-15). Again this is attributed to seasonal fry collection, availability of catch, seasonal fish processing activities etc.

4.1.2.5 Major Fish Catch

Twenty-eight species of fish were found to be available in the studied site. Each species are illustrated in the Table-9 with their scientific name, English name, and Local names (the name used by the people of the study site).

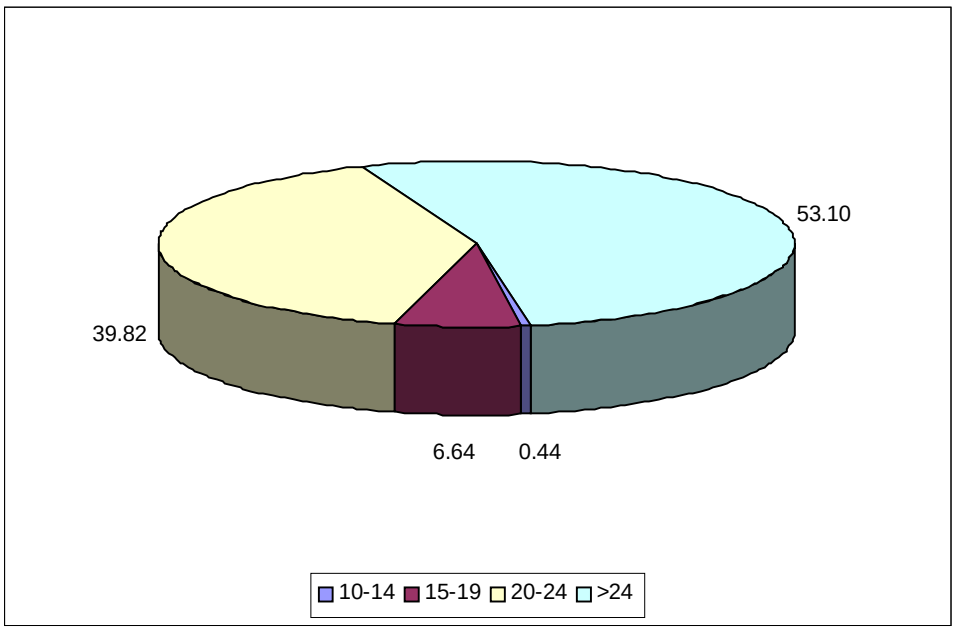

Fig14: Working Days (Monthly)

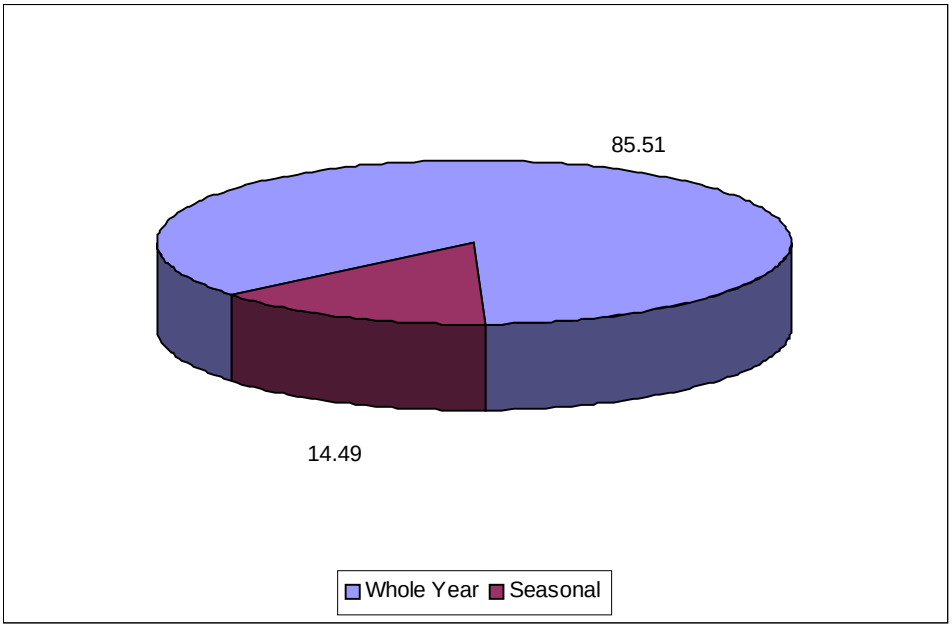

Fig.-15: Working Days (yearly)

Table -9: Major fish catch

No.	Scientific Name	English Name	Local Name
1	*Hilsa ilisha*	Hilsh fish	Ilish
2	*Mugil cephalus*	Mullet	Parshe
3	*Himantura walga*	Stingray	Shaplapata
4	*Scoliodon shorrakowah*	Shark	Kamot
5	*Pama pama*	Drum	Poa
6	*Polynemus paradiseus*	Thread fin	Tapashi
7	*Pampus chinensis*	Chinese pompret	Rupchanda
8	*Euthynnus affinis*	Kawakawa	Kak fish
9	*Muraenesox bagio*	Common pike conger	Samudrik Bain
10	*Pristis cuspidatus*	Sawfishes	Karati Hangor
11	*Harpodon nehereus*	Bombay duck	Loytta
12	*Setipinna phasa*	Anchovy	Phasa
13	*Epinephelus lanceolatus*	Sea bass	Bole
14	*Chorinemus lyssa*	Pompano	Chapa
15	*Trichuirus haumela*	Cutlass fish	Churi
16	*Tetraodon patoka*	Box fish	Potka
17	*Cynoglossus bengalensis*	Tongue fish	kukurjib
18	*Hilsa kanagurta*	Herring	Nooriilish
19	*Hilsa toli*	Herring	Chandailish
20	*Hemiramphus xanthopterus*	Half beaks	Ekthute
21	*Mugil speigleri*	Mullet	Bhangon
22	*Lates calcarifer*	Sea bass	Vetki
23	*Pomadasys hasta*	Pompano	Sada Datina
24	*Argyrops spinifer*	Silver bream	Laldatina
25	*Sparus dtina*	Silver bream	Datina
26	*Scatophagus argus*	Skates	Bistara
27	*Penaeus indicus*	Shrimp	Chaka chingry
28	*Metapenaeus monocerus*	Shrimp	Harina chingry

4.1.3. Crafts and Gears

4.1.3.1. Types and Number of Crafts

Information on different types of crafts used by the fishermen in the studied area is provided in Table-10.

Table 10: Types of crafts

Villages / Gear name	Alipur	Khajura	Kalaiapara	Nabinpur	Goramkholapara	North Kuakata	West Kuakata	Panjupara	Mammipara	Islampur	Hossainpara
Dingi	x		x	x	x	x					
Bachari	x	x		x	x	x					
Engine boat											
Trawler											

It was revealed that the fishermen used four types of fishing crafts such as Dingi (small wooden boat), Bachari (Relatively large wooden boat), Engine boat and Trawler. All fishermen of the eleven villages used Engine boat and Trawler. However, the fishermen in the village of West Kuakata, Panjupara, Mammipara, Islampur and Hossainpara used all types of fishing craft.

89.60% fishermen did not own any fishing craft (Fig-16a). The number of crafts for each owner ranged from 1-3. The number of craft owner in the three fishing villages namely Panjupara (4.70%), Islampur (6.32%) and Kalaiapara (7.5%) were relatively low as these three villages were included in the processing and fry collection zone. Also, the numbers of fish traders in the three villages were relatively high and they did not require any fishing craft.

The number of fishing craft owner in six fishermen villages were relatively high and it amounted to more than 10% of the total fishermen community. These six villages were namely Alipur (16.04%), Goramkholapara (14.28%), North Kuakata (13.41%), West Kuakata (11.82%), Mammipara (11.49%) and Hossainpara (10.46%). Fishermen of these areas were usually involved in deep-sea fishing and Khuta jal fishing.

8.85% fishermen possessed only one fishing craft while 1.33% and 0.22% had two and three fishing crafts respectively (Fig-16b). Only two fishermen of Alipur village had three fishing crafts.

Amongst the fishing craft owners, 84.78% had only one fishing craft whereas 13.05% had two crafts. Very few fishermen (2.17%) had three fishing crafts.

4.1.3.2 Types and Number of Gears

Different types of gear used by the fishermen in the studied area are listed in Table-11.

Table 11: Types of gear

Villages / Gear name	Alipur	Khajura	Kalaiapara	Nabinpur	Goramkholapara	North Kuakata	West Kuakata	Panjupara	Mammipara	Islampur	Hossainpara
Hilsa net											
Behundi Jal	x		x		x	x	x	x	x	x	x
Khuta Jal	x	x	x	x	X	x					
Long line											
Tana jal					X						

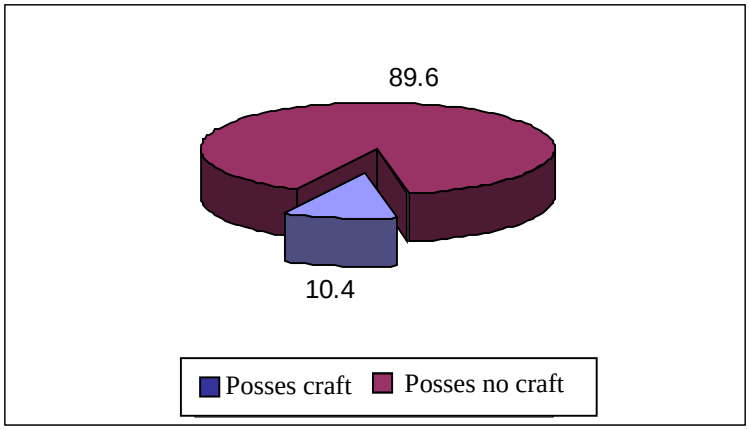

Fig.-16a: Ownership of fishing craft

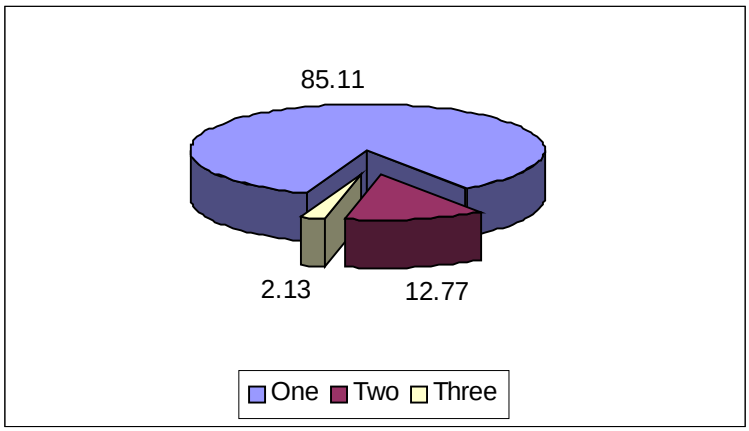

Fig.16b: Number of fishing craft

Fishermen used five 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. The study also showed that no fishermen in any villages used all types of fishing gears.

76.99 % fishermen did not own any fishing gears (Fig-17a). The number of fishing gears for each owner ranged from 1-4. It was observed that generally 1-3 gears were used for deep-sea fishing while 2-4 gears were used for shrimp fry collection. The number of gear owners in the three fishing villages namely Goramkholapara (14.28%), Islampur (13.92%) and Kalaiapara (16.25%) were relatively low. Within this three villages, two (Kalaiapara and Islampur) were in the processing zone while Goramkholapara felt in the deep-sea fishermen zone. For deep-sea fishing, fishermen needed huge amount of gears, which was very expensive. However, some selected fishermen of Goramkholapara possessed many fishing gears.

The number of fishing gear owners in Nabinpur fishermen villages were relatively high (33.77%) This is due to fact that the fishermen of this area were usually involved in fry collection, which needed more than one gear.

8.85% fishermen carried out fisheries activities with two gears while 4.54% and 4.76% fishermen used one and three gears respectively (Fig-17b). Only 0.88% fishermen used four gears

4.1.4. Fish preservation and Processing

Table-12 illustrates the fish preservation and processing activities practiced by the fishermen in the studied area. All fishermen who went to the deep sea for fishing usually used ice for fish preservation. The coastal fishermen did not use ice for preservation but usually carried out subsequent marketing. In the case of fishermen, who were engaged in processing (drying, salting, smoking etc.) and fresh fish arot (fish depot) business, generally used one or more preservation techniques. The investigation resulted that the fishermen practiced four types of preservation and processing techniques namely icing, drying, salted-drying and smoking. Icing was used in fresh fish arot business, in the sea during fish harvesting and in the shutki mahal (drying house).

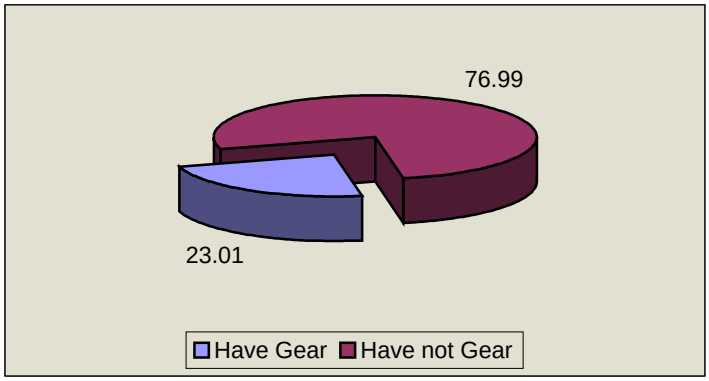

Fig.-17a: Ownership of fishing Gear

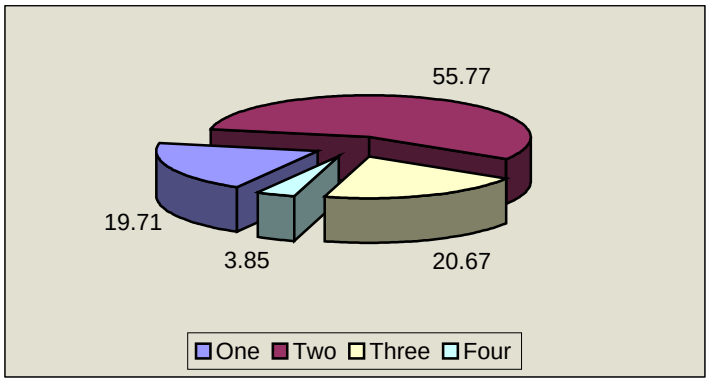

Fig.17b: Number of fishing Gear

Table-12: Fish preservation and processing

Parameters \ Villages	Alipur	Khajura	Kalaiapara	Nabinpur	Goramkhola para	North Kuakata	West Kuakata	Panjupara	Mammipara	Islampur	Hossainpara	Total
Icing	62	73	67	60	63	72	7	10	10	15	7	446
Drying	0	0	6	0	0	6	17	2	3	12	0	46
Salting	0	0	6	0	0	6	17	2	0	12	0	43
Smoking	0	0	0	0	0	0	0	0	3	0	0	3
Fry Preservation/ Quick Marketing	12	18	4	17	0	0	69	16	78	52	79	345
Total	74	91	83	77	63	84	110	30	94	91	86	883

* More than sample number due to multiple answer of the questions Source: Field survey 2001-2002

4.1.4.1. Icing

It was possible to keep fish in a condition close to that of fresh fish using ice for a few weeks at the most. If fish were properly iced and stored in correct way, it was possible to keep it fresh. When fish were sold in the distant markets, ice was generally used. The investigation found that deep-sea fishermen could keep fish in fresh condition for one week while fresh fish arot (depot) for few weeks using ice.

Icing procedure was same for all the fishermen community of the studied area. The common icing procedure is provided in Appendix-7**.** After harvesting, fish were washed with water and placed in icebox. Fish were then covered with crushed ice and kept for certain time. Within this period, fish would be sold to the market.

This investigation observed that the fishermen were not conscious about the quality control of fish. The fishermen did not use ice in proper ratio. In addition, sometime they harvested huge quantity of fish during glut period. However, the ice content in their boat was limited which caused considerable quality losses to fish. It was also observed that the fishermen did not regularly clean iceboxes to maintain the quality of fish. The fishermen in general had no idea about hygiene and sanitation. Table-11 also illustrates the different iced fish species in the studied area.

4.1.4.2. Drying

Fishermen used sun-drying procedure to preserve fish. Drying procedures of different fish species is shown in Appendix-8.

Most of the fish for drying purposes were collected from the local fishermen while small amount from the middlemen or broker.

Fish were transported to drying places with or without ice. Here, pre-processing was done for increasing drying rate and producing good quality products. Pre-processing of fish included splitting, gutting, filleting, and fin cutting.

After pre-processing, fish were washed with water to remove the entire unwanted portion. Fish were then kept for some time to remove extra water from the fish body surface to reduce weight of the fish for hanging on the rope. Fish was then set to dry on hanging ropes, bamboo mats or hogla mats. Drying on hanging rope was done in case of fish that could easily hang on the rope. Otherwise drying on racks or mats were carried out. After some time, fish were transferred on the mats for final drying. Drying on hanging rope was done for quick drying purpose because it provided large surface area to expose fish in the air and in the sun. When drying was completed, fish were taken out left from the racks and mats. These were then piled in the storeroom of drying house (shutki mahal) without any packaging.

The storeroom was a platform of 15-20 cm off the floor. Fish stored for a month were found to have fungal growth in some lots. All the products were then re-dried for 2-4 days in the open sun to remove residual traces of fungus before further testing and storage.

It was observed that fishermen used bamboo baskets and jute bags as the packaging materials for marketing purpose of the dried fish products. Fishermen mentioned that in many cases when the dried product contained relatively higher moisture percentage and packed in polythene bags resulted discoloration of the products.

Fishermen used chemicals to avoid spoilage of fish during drying. Spoilage is mainly caused by the insect infestation in different stages of drying. Fishermen used one disinfectant known as Nagas (agricultural insecticide). However, this disinfectant is harmful for human being. Screening of fish was also done to provide physical protection of fish from various birds, crows and gulls etc. during the early stages of drying.

Fish offal, by-catch, and spoiled fish were discarded within or immediately adjacent to the processing areas; a common practice observed. Open lavoratories were also a common feature in the processing site. This induced additional risk in spreading enteric diseases. It was also observed that numbers of dogs were identified in the pre-processing area of the processing site.

The field researchers in the studied area identified no control measures for good hygiene and sanitation. It was the same for each processing point.

Different Dried Fish Species

Table-13 lists different dried fish species found in the studied area. This investigation revealed that amongst the 28 available fish species, 19 species were dried of which 4 species were found throughout the year. Other dried species were available some or the other time of the year.

Table-13: Dried fish species

No.	Scientific name	English name	Local name
1	*Hilsa ilisha*	Hilsh fish	Ilish
2	*Mugil cephalus*	Mullet	Parshe
3	*Himantura walga*	Stingray	Shaplapata
4	*Scoliodon shorrakowah*	Shark	Kamot
5	*Pama pama*	Drum	Poa
6	*Polynemus paradiseus*	Thread fin	Tapashi
7	*Pampus chinensis*	Chinese pompret	Rupchanda
8	*Euthynnus affinis*	Kawakawa	Kak fish
9	*Muraenesox bagio*	Common pike conger	Samudrik Bain
10	*Pristis cuspidatus*	Sawfishes	Karati Hangor
11	*Harpodon nehereus*	Bombay duck	Loytta
12	*Setipinna phasa*	Anchovy	Phasa
13	*Epinephelus lanceolatus*	Sea bass	Bole
14	*Chorinemus lyssa*	Pompano	Chapa
15	*Trichuirus haumela*	Cutlass fish	Churi
16	*Tetraodon patoka*	Box fish	Potka
17	*Cynoglossus bengalensis*	Tongue fish	Kukurjib
18	*Penaeus indicus*	Shrimp	Chaka chingry
19	*Metapenaeus monocerus*	Shrimp	Harina chingry

4.1.4.3. Salting-drying

Study was made on the traditional salting method used by the fishermen who often used salt in combination with drying. There are many salting procedures in the world but rubbing on the skin was the only method practiced by the fishermen.

Collection of fish and pre-processing techniques were similar to that observed only in drying**.** After pre-processing, fish were washed with water to remove unwanted portions. They were then kept open for sometime to remove excess water. The pre-processed washed fish were transferred to the salting chamber. Fish were arranged in different layers (salt-fish-salt) one after another and kept for sometime (6-36 hr.). Fishermen did not use any specific ratio of salt. Fish were set to dry on hanging rope or on bamboo mats. Drying on hanging rope was done in case of fish that were easy to hang on the rope. Otherwise, drying on racks or mats were carried out. Drying on hanging rope provided large surface area to dry off quickly in the sun along with the wind. When drying was completed, fish were taken out from the racks, mats and ropes and were piled in the storeroom in Shutki Mahal. The common procedure of salted-drying fish is shown in Appendix-8. Hygiene and sanitation practices during storage of salted-dried fish were inadequate. Some common salted-dried species is listed in Table-14.

Table-14: Salted-dried fish species

No.	Scientific name	English name	Local name
1	*Hilsa ilisha*	Hilsh fish	Ilish
2	*Himantura walga*	Stingray	Shaplapata
3	*Scoliodon shorrakowah*	Shark	Kamot
4	*Pama pama*	Drum	Poa
5	*Polynemus paradiseus*	Thread fin	Tapashi
6	*Pampus chinensis*	Chinese pompret	Rupchanda
7	*Muraenesox bagio*	Common pike conger	Samudrik Bain
8	*Pristis cuspidatus*	Sawfishes	Karati Hangor
9	*Harpodon nehereus*	Bombay duck	Loytta
10	*Epinephelus lanceolatus*	Sea bass	Bole
11	*Chorinemus lyssa*	Pompano	Chapa
12	*Tetraodon patoka*	Box fish	Potka
13	*Cynoglossus bengalensis*	Tongue fish	kukurjib

4.1.4.4. Smoking

The investigation on fish smoking revealed that the fishermen in the study area used hot smoking method for fish preservation. Smoking was only carried out in Mammipara Shutki Point.

Generally fishermen smoked small size fish, as they required low amount of smoke for preservation. After harvesting fish were transported to the smoking house with or without ice preservation. They were then washed with water and placed in smoked chamber. Within the smoke chamber, fish were arranged and placed on the bamboo racks. Smoke was generated from the under side of the rack. For the production of smoke, woods were used. After a certain time (3-5 hrs), flow of smoke was stopped. Fish were then taken out from the racks and piled up in storage room. A common procedure of smoking is provided in Appendix-9. No quality control measurement was observed. List of different smoked fish species in the studied area is provided in Table-15.

Table-15: Smoked fish species

No.	Scientific name	English name	Local name
1	*Mugil cephalus*	Mullet	Parshe
2	*Polynemus paradiseus*	Thread fin	Tapashi
3	*Setipinna phasa*	Anchovy	Phasa
4	*Penaeus indicus*		Chingri
5	*Metapenaeus monocerus*		Chingri

Differences in Fish Processing Methods:

Various preprocessing activities were carried out by the fishermen to produce processed product i.e. dried, salted-dried and smoked product. Preprocessing was a common work incase of relatively large fish that needed longer time for drying. Preprocessing of fish included gutting, splitting, cutting of fin, separation of skin etc. and these varied from fish to fish. For example, cutting of fin and separation of skin were done for *Scoliodon shorrakowah* and *Himantura walga* respectively. Besides, splitting was also done for large size species. Preprocessing were not done for small fish such as *Mugil cephalus, Pama pama, Polynemus paradiseus, Harpodon nehereus, Setipinna phasa, Chorinemus lyssa, Trichuirus haumela, Cynoglossus bengalensis, Penaeus indicus* and *Metapenaeus monocerus.* Drying time also varied from species to species and ranged between 2 and 8 days. It wasobserved that maximum and minimum time were required for drying of *Scoliodon shorrakowah* and *Harpodon nehereus* respectively. In salting-drying process, salting time varied between 6 and 36 hours. Salting procedure of *Cynoglossus bengalensis* required minimum time (6 hours)

while *Himantura walga (*meat and skin*), Scoliodon shorrakowah (*meat and fin*)* and *Muraenesox bagio* needed maximum time.

4.1.5 Shutki Point and Shutki Mahal

4.1.5.1. Location, Description and Number of Shutki (Drird) Mahal and Shutki Points

There were six shutki points and 31 shutki mahals observed in the studied area. 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 were done through out the year. There was no selected shutki mahal in Islampur but fishermen of this village were engaged in the other shutki points. The names of different shutki points and mahals are provided in Appendix-1.

Table-16: Location, description, and number of shutki mahal and nature of activities of different shutki points

Name of the shutki point	Location	Number of mahal	Nature of activities	
			Whole year	Seasonal
Gorakhal	Kalaiapara	3	3	0
Nayarypara	Nayarypara	7	0	7
Panjupara	Panjupara	2	0	2
Mammipara	Mammipara	2	2	0
Kuakata	West Kuakata	17	0	17
Islampur	Islampur	Family work	Occasional	

4.1.5.2 Manpower

Manpower engaged in each shutki mahal varied between one and eight. Table-17 illustrates the number of manpower involved in each shutki mahal. Mahal # 1 of Gorakhal shutki point had maximum number of fishermen whereas only one fisherman was found in mahal #8 of Nayarypara and both the mahals of Mammipara. Highest number of fishermen (131) were engaged in Kuakata shutki point while in Mammipara, there were only two. Though the number of shutki mahal in Mammipara and Panjupara were same, yet manpower involved in Panjupara was higher (11) than Mammipara (2). This is because large scale shutki processing was done in Panjupara. The fishermen involvement in Gorakhal and Nayarypara were 19 and 15 respectively.

4.1.5.3. Production

The total production of dried fish (shutki) was 282485 kg found in the investigated area. Kuakata shutki point was found to produce maximum (189025 kg) shutki while the minimum in Mammipara (1205 kg). Kuakata shutki point is situated in Kuakata landing center, which had the highest number (17) of shutki mahals. Fig –18 shows the production of different shutki points and numbers of shutki mahals present in that point. A mahal of Gorakhal shutki point (whole year active point) produced maximum shutki while another mahal of Mammipara (produced shutki through out the year) produced minimum amount of shutki. This was because the mahals of Gorakhal shutki point were situated near Alipur fish-landing center whereas mahals of Mammipara were situated far away from both the fish-landing centers. Therefore, it was observed that source of fish was an important factor for the production of shutki. Besides this, the number of mahals in a shutki point was also responsible for higher production of shutki. Total yearly production of other shutki points such as Panjupara, Gorakhal and Nayaripara were 50101 kg, 12729 kg, and 29425 kg respectively. The investigator could not find out any data on the production of shutki in Islampur shutki point because the fishermen did not maintain any logbook.

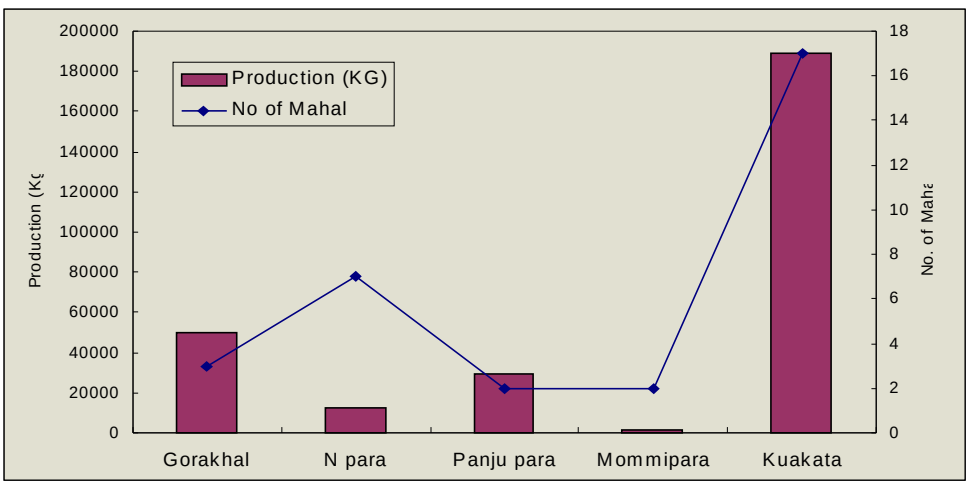

Fig.18: Production of shutki points and number of mahals

The production of shutki mahal of Gorakhal ranged between 15072 kg and 19045 kg. while production was found to vary largely in the different shutki points (Nayaripara 960-3674 kg, Panjupara 14356-15067 kg, Mammipara 575-630 kg and Kuakata 7100- 15345 kg). Though number of mahals in Panjupara was lower than the number of mahals in Nayaripara, production of Panjupara shutki point was much higher. It is also important to note that Mammipara was active shutki point all the year round while Panjupara was a seasonal shutki point. The production of Panjupara was greater than `the production of Mammipara because the supply of fresh fish in Panjupara was much higher compared to Mammipara. Mahal # 1 of Gorakhal showed maximum production while mahal # 14 of Mammipara the minimum and amounted to 1905 kg and 575 kg respectively.

4.1.5.4. Cost-Benefit Ratio

The result of cost-benefit ration of different shutki mahal is provided in Table-17. The investigation found that the cost-benefit ratio of the mahals of the study area varied between 0.27 and 1.68. The highest (1.68) cost-benefit ratio was identified in mahal # 14 and lowest (0.27) in the mahal # 28. Cost-benefit ratio of the mahal depended on total cost of the mahal. The lower the total cost, the higher the cost-benefit ratio.

In Gorakhal shutki point, two mahals indicated cost benefit ratio above 0.50. The cost-benefit ratio of all the mahals of Gorakhal shutki point were found to be above 0.44.

In Nayaripara, it was clearly observed that majority of the shutki mahals indicated a cost-benefit ratio above 0.40. The highest and lowest cost benefit ratio were found to be 0.45 and 0.31 respectively.

Study on the different shutki mahals of the Kuakata shutki point revealed that the cost- benefit ratio varied between 0.27 and 0.54. Only two mahals of this shutki point showed a cost-benefit ratio above 0.50. Majority (10 mahals) of this point indicated a cost benefit ratio between 0.40 and 0.50.

It is interesting to note that both the mahals of Mammipara showed a cost-benefit ratio above 1.50. This was due to the fact that the total cost of these mahals were comparatively lower than other mahals of other shutki points.

This investigation clearly indicated that mahals working all the year round had always better cost benefit ratio.

Table17: Manpower, Production and Cost benefit ratio of shutki mahal

	Gorakhal*			**Nayarypara**							**Panjupara**		**Mammipara***	
	Mahal-1	Mahal-2	Mahal-3	Mahal-4	Mahal-5	Mahal-6	Mahal-7	Mahal-8	Mahal-9	Mahal-10	Mahal-11	Mahal-12	Mahal-13	Mahal-14
Building cost	35000	30000	35000	15000	12000	12000	17000	8000	8000	11000	9000	10500	1000	1000
People involvement	8	5	6	4	2	2	3	1	1	2	5	6	1	1
Yearly production Kg	19045	15984	15072	3674	1630	1220	1980	960	1073	2192	14356	15067	630	575
Yearly sell	3980405	3340500	3180000	808200	358600	272060	417780	201600	224250	458100	3014760	3149000	50000	43400
Cost for goods sold	3671770	3111310	2933900	696000	293825	216000	331500	163450	182300	380800	2841000	2935550	38300	32290
Gross profit	308635	229190	246100	112200	64775	56060	86280	38150	41950	77300	173760	213450	11700	11110
Commercial expanse:														
Marketing and	15808	13425	13100	3850	1795	1450	1960	900	980	1900	12200	13100	315	290
Labour cost	144000	90000	108000	36000	18000	18000	24000	9000	11000	22000	60000	72000	0	0
Chemicals & salt	28567	25575	22600	18400	8100	6180	10770	5450	5980	11350	26534	28300	0	0
Packaging	8760	7190	6865	2755	1180	920	1530	700	970	1970	7100	7550	150	150
Miscellaneous	16500	12000	12000	6000	4000	4000	5000	3000	5000	5000	8000	9000	4000	3700
Total cost	213635	148190	162565	67005	33075	30550	43260	19050	23930	42220	113834	129950	4465	4140
Net benefit	95000	81000	83535	30195	19700	13510	26020	11100	10020	24080	50926	73000	7235	6970
Cost-Benefit ratio	0.44	0.55	0.51	0.37	0.44	0.32	0.43	0.41	0.31	0.45	0.41	0.52	1.62	1.68

- Works through the year

cont….

Kuakata																	
	Mahal-15	Mahal-16	Mahal-17	Mahal-18	Mahal-19	Mahal-20	Mahal-21	Mahal-22	Mahal-23	Mahal-24	Mahal-25	Mahal-26	Mahal-27	Mahal-28	Mahal-29	Mahal-30	Mahal-31
Building cost	8000	17200	13700	7000	11000	11400	12500	16400	6500	6000	6500	13500	11000	7000	6500	16000	16500
People involvement	5	7	6	5	5	5	6	7	5	4	5	5	5	4	4	6	5
Yearly production Kg	13700	14560	14200	11290	11100	11400	12050	15345	11025	8110	10875	13920	34770	7100	7375	13990	12985
Yearly sell	2868300	3050000	2971000	2359600	2320100	2383600	2520450	3207100	2315225	1696990	2274875	2912280	2045065	1485900	1543285	2925582	2715700
Cost for goods sold	2671500	2810790	2757480	2188530	2157990	2221160	2336580	2985880	2142400	1565752	2102565	2711630	1860705	1377635	1427410	2704854	2518100
Gross profit	196800	239210	213520	171070	162110	162440	183870	221220	172825	131238	172310	200650	184360	108265	115875	220728	197600
Commercial expanse:																	
Marketing and	23445	25342	23780	19965	19910	20105	23150	25260	19250	14772	19997	24225	16834	11733	13025	24168	22078
Labour cost	60000	86000	72000	60000	48000	60000	72000	86000	60000	48000	60000	60000	60000	43200	43200	72000	60000
Chemicals & salt	25350	27930	25100	21880	21535	21090	23290	28570	21393	15205	21112	25752	18294	12920	13760	26150	24022
Packaging	6350	6980	6730	5220	5200	5550	5730	7280	5180	3800	5300	6740	4690	3230	3390	6610	6480
Miscellaneous	6000	7500	8000	5800	6500	6000	6000	5000	7000	6000	7500	6000	9000	7000	7500	6000	6500
Total cost	129145	170952	149310	119865	112145	124145	142670	168510	119323	93777	120409	136217	119818	85083	87375	150928	135580
Net benefit	67655	68258	64210	51205	49965	38295	41200	52710	53502	37461	51901	64433	64842	23182	28500	69800	62020
Cost-Benefit ratio	0.52	0.40	0.43	0.43	0.45	0.31	0.29	0.31	0.45	0.40	0.43	0.47	0.54	0.27	0.33	0.46	0.46

4.1.5.5 Types of Shutki Product

Nayarypara shutki point produced only one product namely salted-dried product. The production of smoked fish was found only in Mammipara. The others shutki points produced dried and salted-dried products and smoked product (Table-18)

Table-18: Name of shutki points and their products

No.	Name of shutki points	Products name
1	Gorakhal	1. Dried 2. Salted-dried
2	Nayaripara	1. Salted-dried
3	Kuakata	1. Dried 2. Salted-dried
4	Panjupara	1. Dried 2. Salted-dried
5	Mammipara	1. Dried 2. Smoked

4.1.5.6. Packaging Materials

Jute sacks, bamboo baskets and polythene sheets were used for packaging. While for marketing, fish were placed in the jute sacks and sealed; fish were placed in bamboo baskets and sealed with the jute mats; fish were packed with polythene sheets or polythene bags.

4.1.6. Fresh Fish Arot (Depot), Fish Landing Center and Local Fish Market

Most of the fresh fish arots (depot), fish landing centers and local fish markets were located nearby the river, sea and or road and were connected with the high ways. The location of arots (depot) depended on fresh fish-landing centers. The identified landing centers, fresh fish arots (depot) and local fish markets were located in two villages namely Alipur and West Kuakata.

In terms of construction materials, the arots were categorized into *Katcha* (made of bamboo, bamboo-fence, and by Nypa-leafs with earthen floor), *Semi-pacca* (made of bamboo, wood and tin roof with concrete floor), and *Pacca* (made of bricks, RCC and concrete)**.** The number of *Katcha*, *Semi-pacca* and *Pacca* fresh fish arots in study area was estimated to be 1, 9 and 3 respectively.

Table-19: Physical structure of fresh fish arot

Condition	Name of the area		Total	Percentage (%)
	Alipur	West Kuakata		
Katcha	1	0	1	7.69
Semi-pacca	7	2	9	69.23
Pacca	3	0	3	23.08
Total	11	2	13	100.00

There were two fish landing centers, two local fish markets and thirteen fresh fish arots (depot) in the studied area. The study resulted that a landing center and a local fish market were located in Alipur and in West Kuakata. It was also observed that out of thirteen fresh fish arot (depot), eleven were located in the village of Alipur while only two in West Kuakata.

The number of manpower in each fresh fish arot (depot) varied between three and five. Three fresh fish arots (depot) namely Mizan fish, Moyna fish and Mannan fish engaged three people while two fresh fish arots (depot) namely Patharghata fish and Mousumi fish had four person working. The other fresh fish arots (depot) involved five people.

Maximum number of fishermen (47) was engaged in fresh fish arots (depot) of the village Alipur. But in West Kuakata, there were ten fishermen. Both fresh fish arots (depot) of West Kuakata had same number of fishermen (5) working.

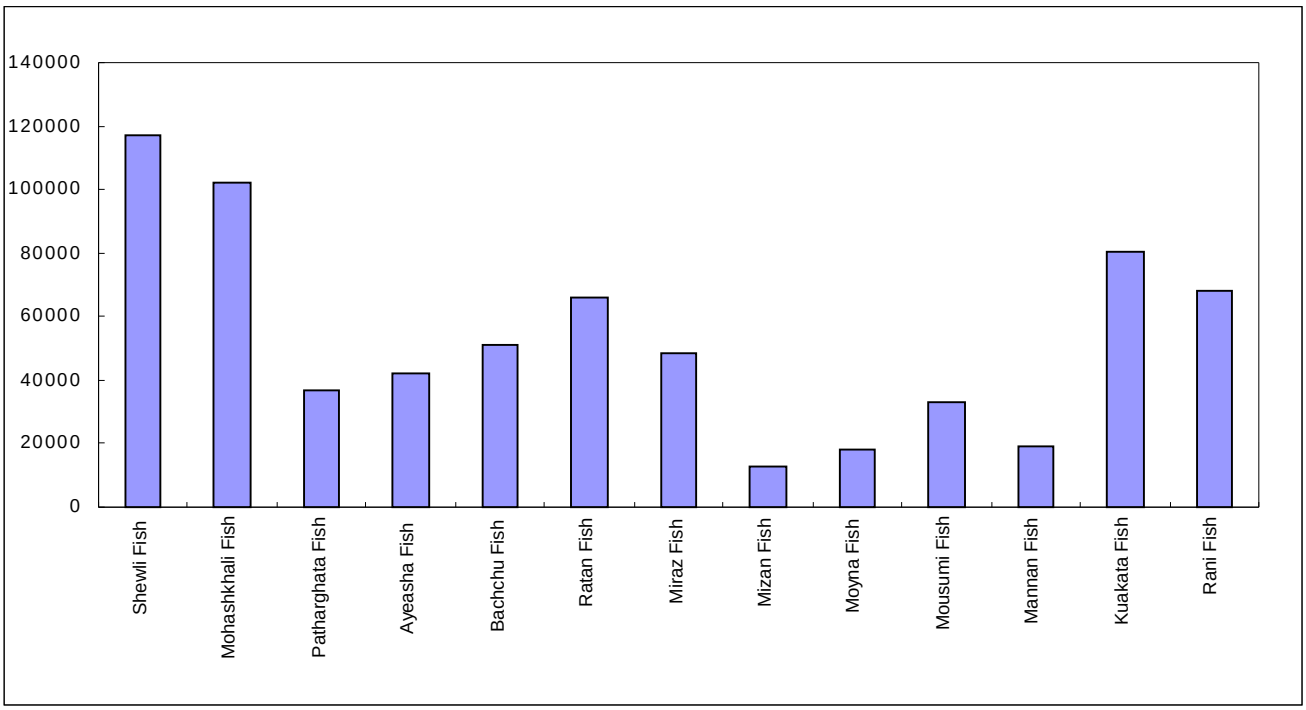

Fig.19: Yearly production of fresh fish arot

Fig-19 illustrates the yearly production of fish of different fresh fish arots (depot). Highest yearly production was recorded in Shewli fish while the lowest Mizan fish (117300kg and 12992 kg). The total production in the studied area was 6,95,475 kg. Monthly production of fish of different arots (depot) is shown in Table-20. Most of the arots (depot) had higher production in the month August.

Cost-benefit ratio of the different fresh fish arots (depot) is listed in Table-21. Arots (depot) working through out the year showed highest cost-benefit ratio. Cost-benefit ratio of the majority of the fresh fish arot (9 out of 13) varied between 0.400 and 0.500. Kuakata and Mannan fish arot (depot) indicated highest and lowest cost-benefit ratio (0.51 and 0.34).

Table- 20: Monthly production of fresh fish arot (Depot).

Depot Name / Month	Shewli Fish	Mohashkhali Fish	Patharghata Fish	Ayeasha Fish	Bachchu Fish	Ratan Fish	Miraz Fish	Mizan Fish	Moyna Fish	Mousumi Fish	Mannan Fish	Kuakata Fish	Rani Fish	Total
January	4220	3127	0	0	0	2430	1560	0	0	0	0	4790	4320	20447
February	4100	2874	0	0	0	1225	0	0	0	0	0	2524	1962	12685
March	1064	850	0	0	0	0	0	0	0	0	0	2365	1885	6164
April	2035	1675	0	0	0	0	720	0	0	0	0	1564	1220	7214
May	8750	7508	1690	1835	2790	3227	1862	0	0	1560	0	1890	1773	32885
June	11375	10775	5248	5872	5565	7016	5495	1342	1168	6876	2156	2960	2458	68306
July	21300	18206	7135	8215	10770	14400	9225	3225	3295	9542	5942	17420	14570	143245
August	25377	23445	7876	8730	11456	13268	8965	3364	3747	8765	5948	19595	15445	155981
September	19245	19110	6420	7100	10285	11340	8480	3680	3842	3222	5364	15452	13367	126907
October	7200	6433	3220	4430	5220	5965	5653	1381	2275	2163	0	5840	4255	54035
November	6930	4162	2828	3145	2686	3986	3946	0	1938	800	0	3245	3864	37530
December	5704	3867	2393	2673	2300	3073	2514	0	1730	0	0	2995	2826	30075
Total	117300	102032	36810	42000	51072	65930	48420	12992	17995	32928	19410	80640	67945	695474

Depot Name	Shewli Fish	Mohashkhal Fish	Patharghata Fish	Ayeasha Fish	Bachchu Fish	Ratan Fish	Miraz Fish	Mizan Fish	Moyna Fish	Mousumi Fish	Mannan Fish	Kuakata Fish	Rani Fish
Production (Kg)	117300	102032	36810	42000	51072	65930	48420	12992	17995	32928	19410	80640	67945
People Involvement:	5	4	4	4	5	5	4	1	2	3	2	5	4
Total Sell:	9426000	8199000	2958000	3431250	4104000	5298000	3891000	1044000	1446000	2646000	1560000	6480000	5460000
Cost for goods sold	8797600	7720725	2750940	3206250	3816720	4927140	3631600	974400	1349600	2467800	1456000	6048000	5096000
Gross Profit:	628400	478275	207060	225000	287280	370860	259400	69600	96400	178200	104000	432000	364000
Commercial expanses													
Marketing Cost	25136	19131	6902	7365	9576	12362	9079	2436	3374	6174	3640	17280	12740
Depot Rent	24000	19200	12000	12000	18000	15600	15000	6000	6000	14400	8000	14400	12000
Labour Cost	93000	48000	32000	32000	48000	60000	32000	8000	12000	24000	16000	52800	44500
Preserving Cost	116254	102490	36975	42560	51300	66225	49940	13050	18075	33075	19760	81000	68250
Packaging Cost	21994	19131	10846	11250	12312	15894	11673	2784	4338	7056	4680	15120	12740
Transport Cost	125680	101121	37468	45000	53352	65342	53177	12876	18316	33516	19240	86400	72800
Micelleneous	24000	16000	8000	8000	12000	18000	12000	5000	6000	7500	6000	17500	17000
Total cost	430064	325073	144191	158175	204540	253423	182869	50146	68103	125721	77320	284500	240030
Net Profit	198336	153202	62869	66825	82740	117437	76531	19454	28297	52479	26680	147500	123970
Cost-Benefit Ratio	0.461177871	0.471284911	0.436012	0.422475	0.404517	0.463403	0.418502	0.387947	0.415503	0.417424	0.345059	0.518453	0.516477

4.1.7. Shrimp Fry Collection

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 from different villages carried out fry collection in these areas.

Fishermen generally preserved shrimp fry in earthen pots with salt water for storage. However, the fishermen did not possess any knowledge to preserve fry in oxygenated water.

4.1.8. Marketing Channel of Fresh, Dried, Smoked Fish and Shrimp Fry

During the survey, the field researchers collected information on marketing channel and prices of fish. The trading pattern of different fish production involved a series of intermediaries between the harvesters, supplier, exporter and the consumers. The price of the final product depended on the marketing network. The marketing channel of different fish and fisheries products was found to vary from place to place. (Fig-20, 21 and 22).

Fig -20. indicates the marketing channel of fresh and iced fish. The channel had three outlets. Firstly, fish from the harvesters would directly go to the consumer through a series of intermediaries. Here, arotdars played vital role and as it involved different phases, prices of fish often rose up. In the other outlet, fish would directly be supplied to shutki mahal. While in the third outlet, arotdars would supply fish to the National markets/processing industries, which would ultimately be exported to foreign countries. Here, arotdars tried to obtain the best quality of fish in order to make a larger profit.

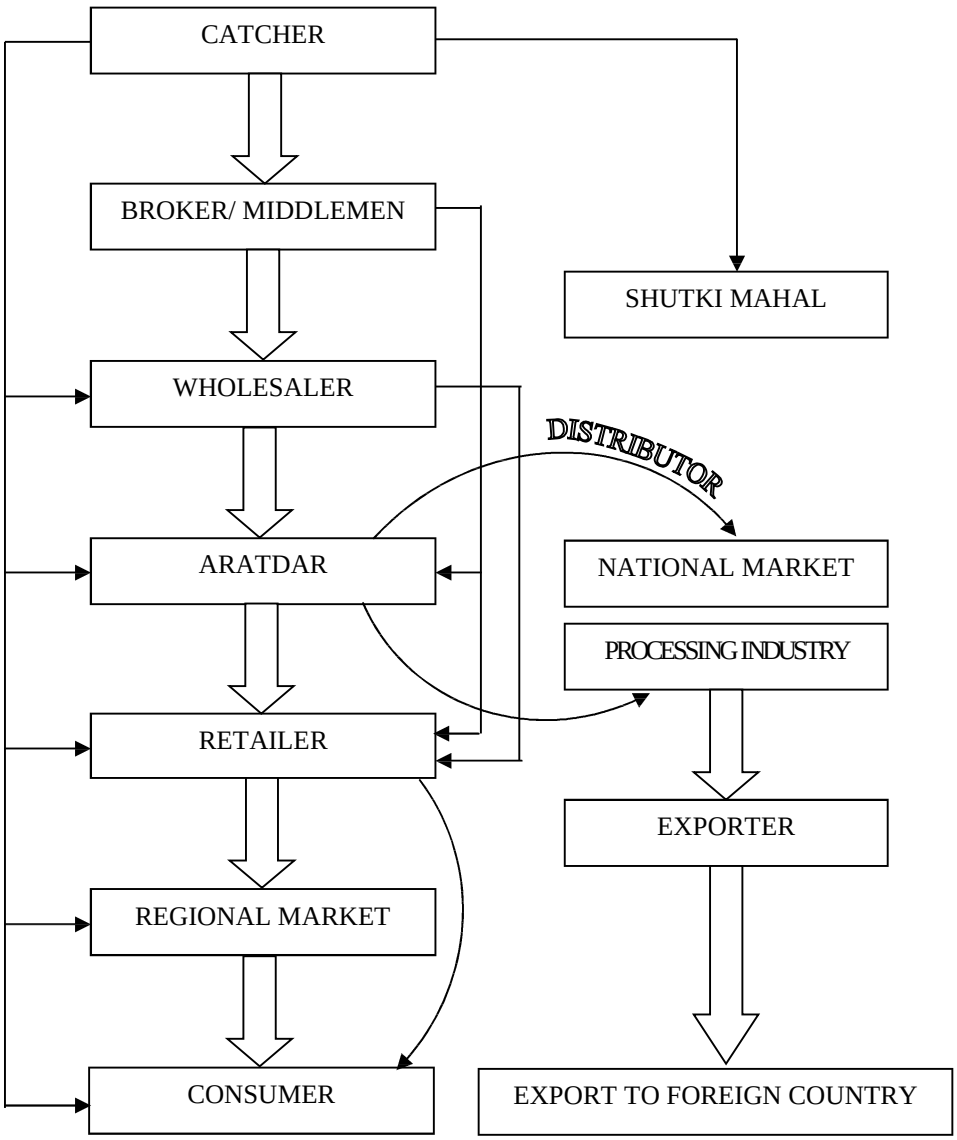

Fig-20: Marketing channel of fresh and iced fish

Marketing channel of dried, salted-dried and smoked fish is shown in Fig -21. Fish harvested would be transported to shutki mahal. Shutki mahal after processing would provide the dried species to arotdars in Chittagong or to the regional market and retailers. Arotdars in Chittagong made necessary arrangement to export to different foreign countries. Arotdars also supplied shutki to various national markets in the country.

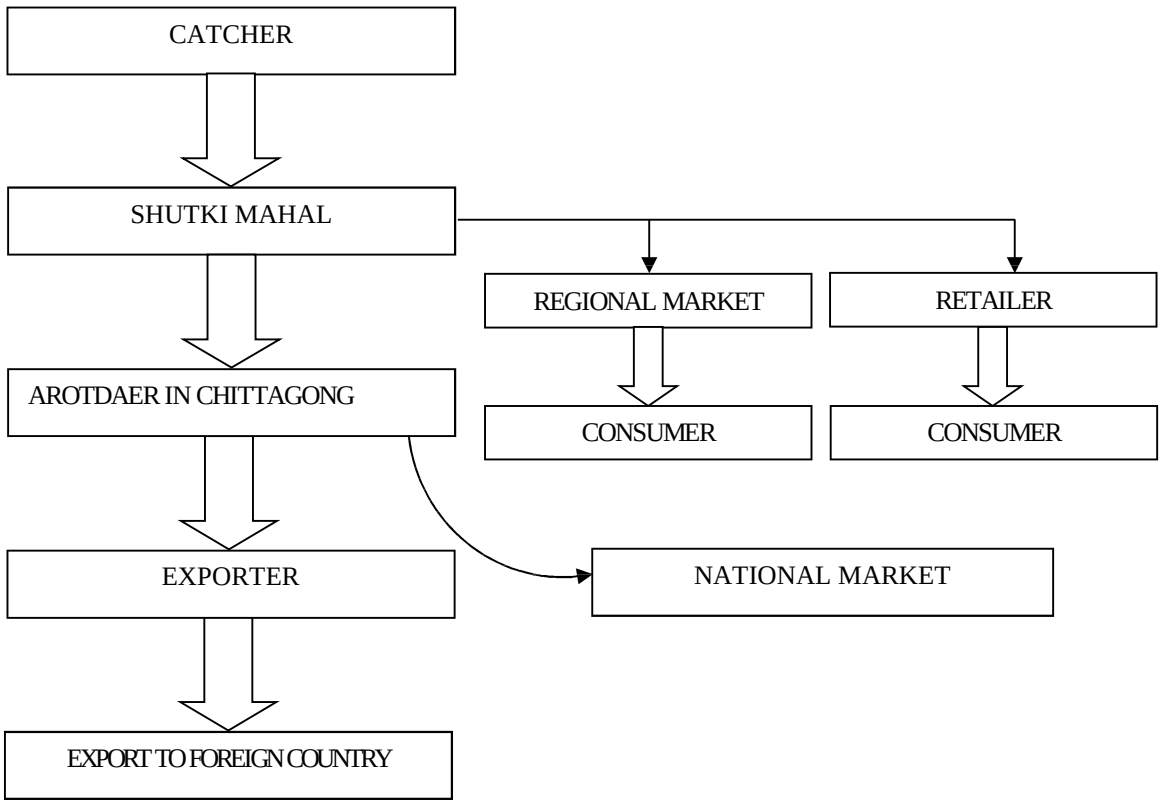

Fig-21: Marketing channel of dried, salted dried and smoked fish

Marketing channel of shrimp fry was observed to be simple (Fig-22). From the catcher, fry would be passed on to the arotdars who played a dominating role in the system. However, sometime, fry would be handed over to the distributors. Ultimately, distributors passed fry to different fish farms. Again, sometime, harvesters directly handed over fry to the fish farms. In this case, the price of fry would remain relatively lower compared to other outlets.

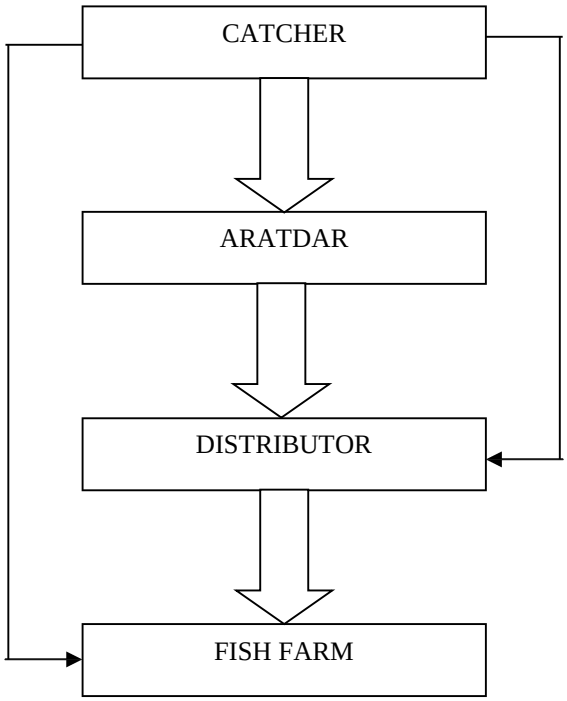

Fig-22 Marketing channel of shrimp fry

4.1.9. Prices of Fresh, Dried, Smoked Fish and Shrimp Fry

Fresh Fish

A detail price analysis of different fresh fish (monthly and average) is provided in Fig. 23. The results indicated that the standard deviation of prices of different fish in different months varied between 1.48 and 12.34 and the variation depended on the prices of fish i.e. highest price showed the maximum standard deviation and lowest price the minimum. Twelve fresh fish species i.e. *Polynemus paradiseus, Harpodon nehereus, Setipinna phasa, Chorinemus lyssa, Tetraodon Patoka, Hilsa kanagur, Hilsa toil, Hemiramphus xanthopterus, Mugil speigleri, Lates calcarifer, Pomadasys hasta* and *Scatophagus argus* showed that the standard deviation of the prices were below 5 taka. This indicated that the market demand of these species were relatively same throughout the year. The investigation also revealed that the 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 high during January, November and December.

Hilsa ilisha, the national fish of the country indicated a maximum price of 110 Tk/kg and minimum price of 85 Tk/kg in December, June and September respectively. The average price of *Hilsa ilisha* were 91.67± 7.49 Tk./kg. The fluctuation of the prices depended largely on the market demand and supply. During the peak season of Hilsha (June to September), the price were low whereas in dull season (November to February), it fetched very high price. *Mugil cephalus*, another available important species of the study area indicated a maximum price (50 Tk/kg) in the month of October- December and minimum (30 Tk/kg) in June. The average price was 42.58± 6.47 Tk./kg. *Himantura walga* were important species for the production of dried and salted dried fish in the study area. The average price of this species were 28.33± 6.85 Tk./kg. Fish were found to fetch higher prices during the winter season because this was the time for drying. Lowest prices were observed in the rainy season when minimum drying was carried out. The highest price of *Himantura w*alga was at the rate 35 Tk./kg and lowest was 20 Tk./kg. *Scoliodon shorrakowah* another important species for drying were found at the rate of 20 Tk. and 35 Tk. The calculated average price of

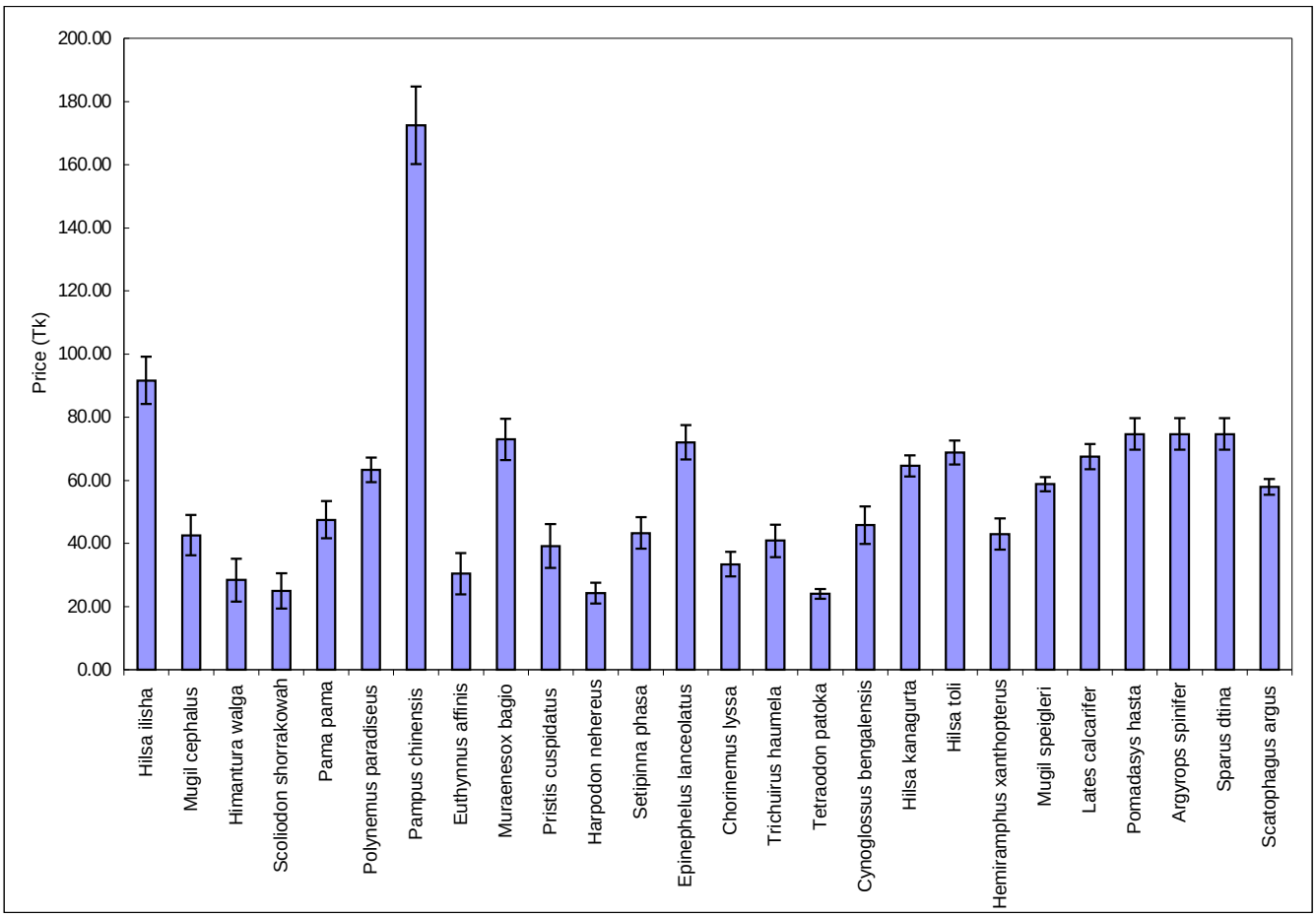

Fig.23: Price of fresh fish

this species was found to be 25± 5.64 Tk./ kg. The average price of *Pama pama* was 47.50± 5.84 tk/kg. The maximum price of this species was found in the month of November- January when the supply were relatively low while minimum in the month of June- August when the supply were very high. The supply of *Polynemus paradiseus* was nearly the same throughout the year and the average price was 63.33± 3.89 tk/kg. Highly valuable species, *Pampus chinensis* fetched a

very high price ice (190 tk/kg) during the November and December. The monthly average price of this species was 172.50± 12.34 tk/kg.

Dried Fish Species

Fig 24 illustrates the monthly average price of different dried fish product available in the studied area. The maximum monthly average price 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 skin of *Himantura walga* were relatively higher than the meat.. As well, the price of fin of *Scoliodon shorrakowash* was higher than the price of the meat .The demand for skin and meat were very high in the export market of these species.

Hilsa ilisha fetched maximum price in the month of February while lowest in March. In the month of February, the supply of fresh fish was nearly zero while the demand of the dried fish increased. In March, the supply of fresh Hilsa increased but the price of dried Hilsa decreased. During the study period, the maximum and minimum prices of dried Hilsa were found to be 320 and 250 Tk/kg. The monthly average prices of *Hilsa ilisha* was 291.66±16.42 tk/kg.

Salted -dried Fish Species

Table 22 illustrates the monthly average price of different salted-dried fish product. There were fifteen products of thirteen fish species available in the studied area. The maximum monthly average price was found to be highest in *Scoliodon shorrakowah* (fin) and lowest in *Chorinemus lyssas*. The price of fin of *Scoliodon shorrakowah was* high compared to meat of the species. Similar price pattern was observed for

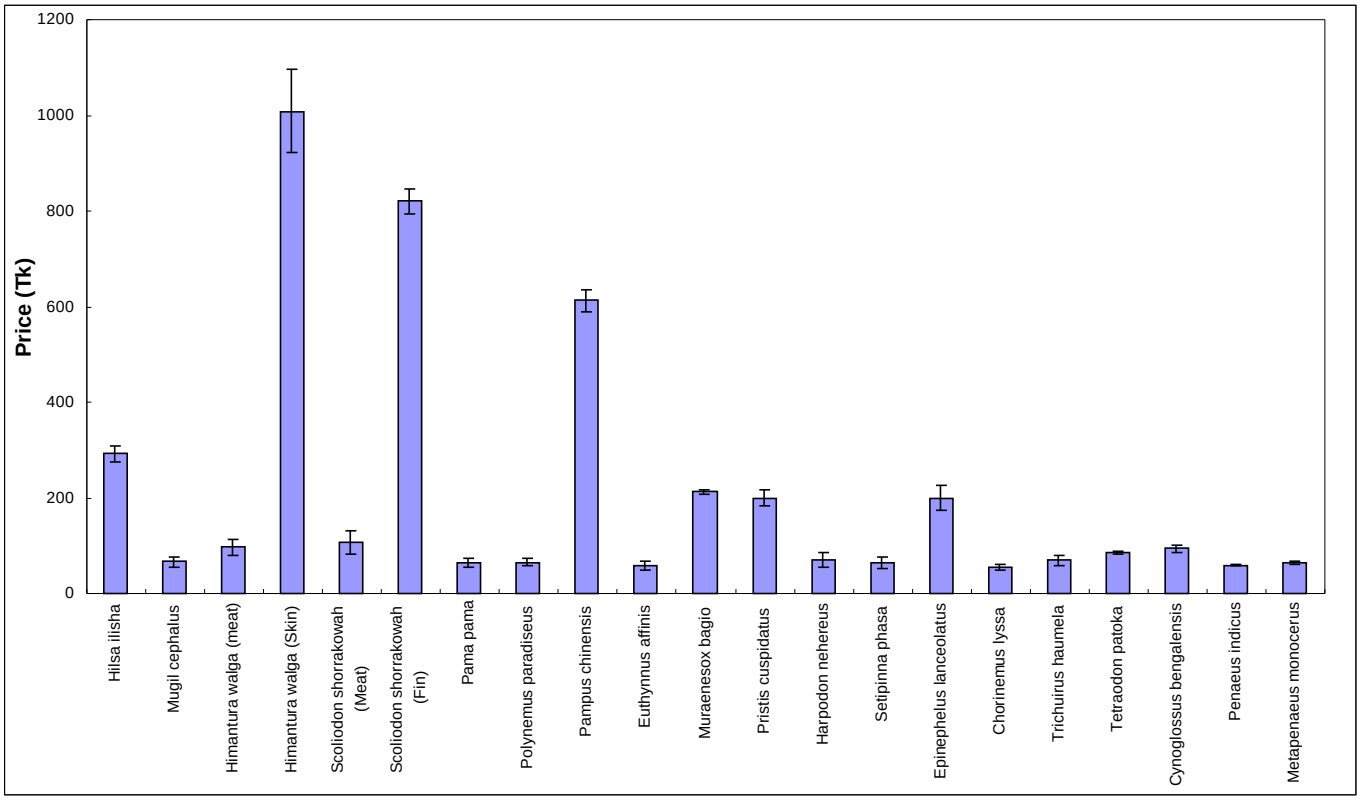

Fig.24: Price of dried fish

Himantura walga. The standard deviation of the prices of majority of salted-dried fish product was below five that indicated a balanced supply and demand of the species.

Salted-dried *Hilsa ilisha* fetched monthly average price of 199.16±15.64 tk/kg. The prices of salted-dried fish species raised in the rainy season (low availability of salted-dried fish in the market) and were lower during the winter season except for few species i.e. Hilsa. Rainy reason was the peak period of hilsa harvesting which induced people to consume more hilsa and less salted-dried species.

Smoked fish

Price fluctuation mainly depended on the demand of product. Fig-25 illustrates the monthly and average prices of different smoked fish species that were available in the studied area. The maximum monthly average price 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. All the smoked fish species showed a standard deviation of price below tk. 0.5. This deviation indicated that the demand

of smoked fish remained constant throughout the year i.e. the demand and price of smoked fish did not depend on production.

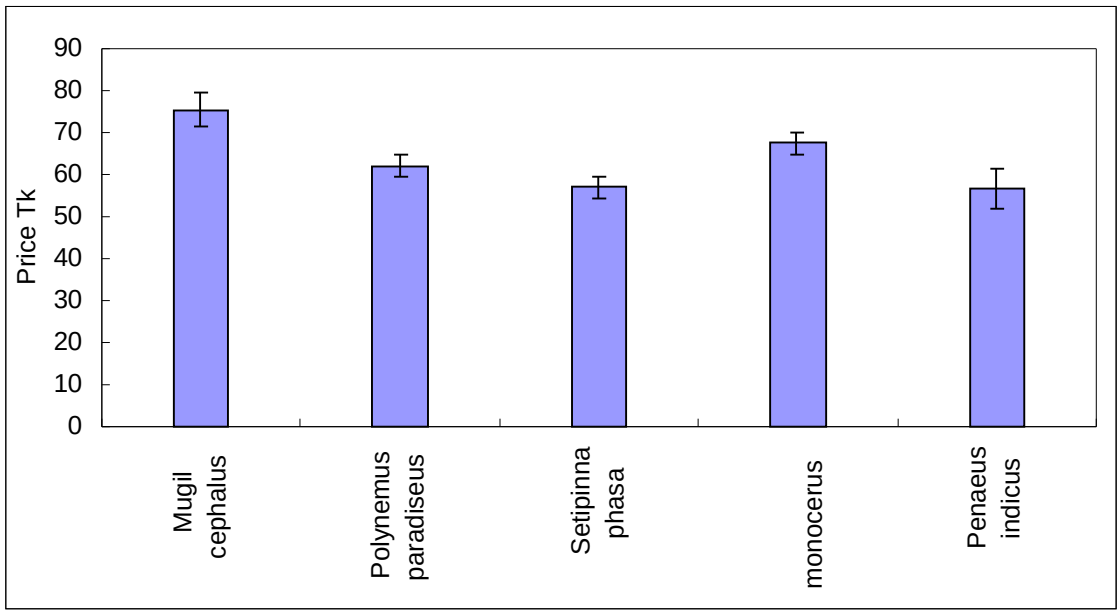

Fig. 25: Price of smoked fish

Table- 22: Price of salted- dried fish species

Month Species	*Hilsa ilisha*	*Himantura walga*	*Himantura walga (Skin)*	*Scoliodon shorrakowah (Meat)*	*Scoliodon shorrakowah (Fin)*	*Pama pama*	*Polynemus paradiseus*	*Pampus chinensis*	*Muraenesox bagio*	*Pristis cuspidatus*	*Harpodon nehereus*	*Epinephelus lanceolatus*	*Chorinemus lyssa*	*Tetraodon patoka*	*Cynoglossus bengalensis*
January	220	90	900	95	1100	55	55	550	200	170	65	160	50	95	110
February	220	90	900	90	1100	55	50	550	200	170	60	155	45	90	105
March	220	90	950	90	1100	50	50	600	225	165	60	155	45	90	105
April	210	85	950	85	1050	50	50	600	225	160	60	150	45	90	100
May	200	85	950	85	1050	50	55	600	225	160	60	150	45	85	100
June	190	85	950	85	1050	50	55	600	225	165	60	145	40	85	100
July	180	85	950	80	1050	50	55	600	210	165	60	140	40	85	105
August	180	95	900	80	1050	45	55	600	210	165	65	150	45	80	105
September	180	95	900	85	1050	45	50	600	210	165	65	150	45	80	105
October	190	95	900	85	1100	45	45	600	210	170	65	155	45	85	105
November	200	95	900	90	1100	55	45	550	200	170	65	160	50	85	110
December	200	90	900	95	1100	55	50	550	200	170	65	160	50	90	110
Mean	199.1667	90	920.8333	87.08	1075	50.41667	51.25	583.3333	211.6667	166.25	62.5	152.5	45.41667	86.66667	105
SD	15.6428	4.26401	25.7464	4.98	26.1116	3.96481	3.76889	24.6183	10.7309	3.76889	2.61116	6.21582	3.34279	4.43813	3.69274

4.1.10. Daily Fish Consumption

Out of eleven fishermen villages studied, more than 40% fishermen of ten villages took 1-500 gm fish daily whereas only 5.75% consumed 1500-2000 gm. Fishermen of these ten villages were relatively poorer and sold their fish to the market for earning extra money. Most of the fishermen families (53.16%) of Islampur consumed 500-1000 gm fish daily since the income of fishermen of this village was relatively higher. The observation revealed that a few fishermen families (5.75%) of the studied area consumed 1500-2000 gm fish daily whereas 34.51% and 14.16% consumed 500-1000 gm and 1000-1500 gm (Fig. 26) fish per day respectively.

4.1.11. Level of income

The present investigation found out that the fishermen in eleven villages were amongst the poorest of the poor. Level of income of the fishermen community is shown in Table-23. Most of the fishermen earned Tk. 500-1000 (25.88%) and Tk. 1000-1500 (38.38%) per month respectively. 10-12% of fishermen earned Tk. 1500-2000 and Tk.2000-2500. Only 1.77-% fishermen had earned higher than 4000 taka per month. Here, the fishermen belonged to the processing zone and fish trading business particularly Islampur, which represented 15.19%.

3.1.12. Credit Sources

Credit was provided to the poor fishermen of the eleven fishermen villages either through NGOs or Arotders (Depot owners). Some of the fishermen did not take any credit (Fig-27).

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. It was also observed that arotders had the maximum contribution in fisheries business (40.82%). While 21.90% fishermen carried out their fisheries business with their own capital. The survey indicated that the village of North Kuakata engaged maximum number of fishermen (62.20%) with NGO's providing credit. This is due to the fact that the fishermen in the village did not maintain compatible relationship with the other credit sources (arotder/ moneylenders). Also fishermen of this village lived far away from the arotders. In addition, fishermen felt that they did not have any bindings with NGO's so that they could work independently although interest rate was relatively higher. Amongst the eleven fishermen villages, Islampur had minimum number of fishermen (15.19%) engaged with NGO credit system. Five villages namely Alipur, Khajura, Kalaiapara, Goramkholapara and Hossainpara of the eleven fishermen villages engaged more than 40% fishermen with NGOs. The study showed that in the village of West Kuakata and Islampur about 80% fishermen were not in any way connected to NGO's. This is attributed to the fact that these two villages were situated in the processing zone. NGO's were not interested to provide substantial amount of loan to fishermen of the processing zone where more money were required. Also, generally NGO's were interested to provide loan only to the harvesters. Therefore, most of the fishermen in the two villages obtained credit from arotders who could provide relatively a larger amount of credit. This study also revealed that in the village Khajura, minimum percentage of fishermen (5.49%) carried out their work on their own investment. The fishermen community of this village was relatively poorer than other villages. Above 50% of the fishermen of three villages namely Alipur, Khajura and Kalaiapara were engaged with arotders (depot owners). The minimum involvement of fishermen with arotders (depot owners) were observed in North Kuakata.

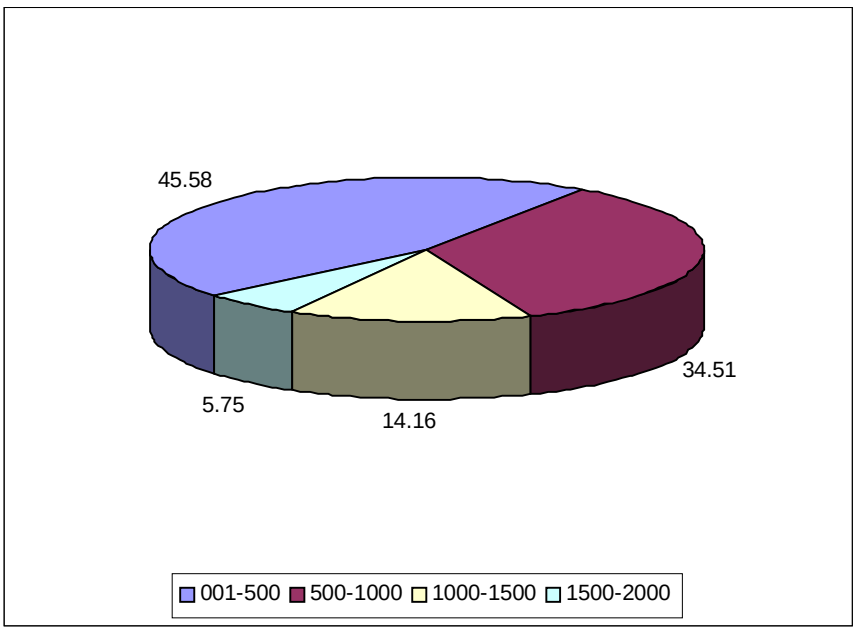

Fig.26: Daily fish consumption level

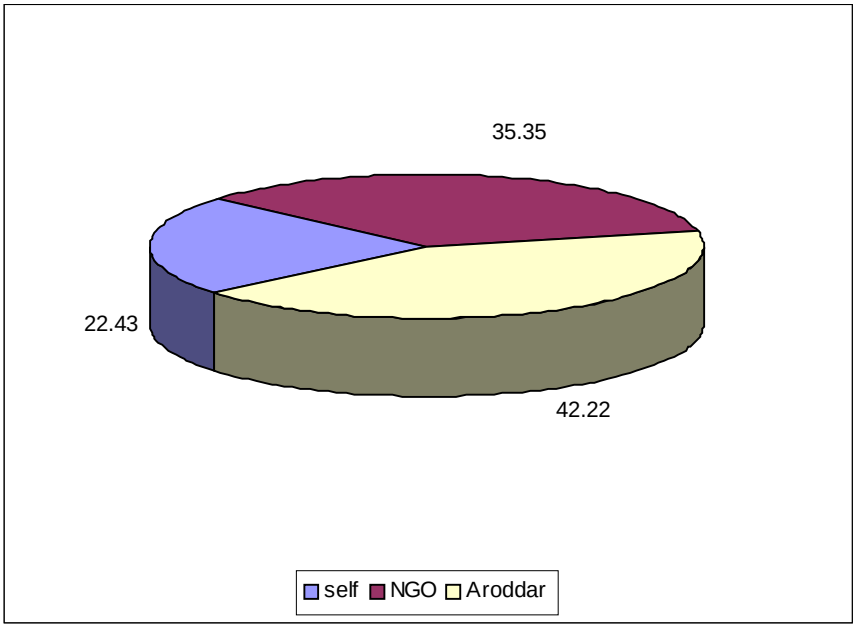

Fig.27: Credit sources

Table-23: Level of Income

Villages / Parameters	Alipur		Khajura		Kalaiapara		Nabinpur		Goramkholapara		North Kuakata		West Kuakata		Panjupara		Mammipara		Islampur		Hossainpara		Total	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
500-1000	23	28.40	31	34.07	22	27.50	14	18.18	0	0.00	31	37.80	29	31.18	26	30.59	24	27.59	7	8.86	27	31.40	234	25.88
1000-1500	38	46.91	42	46.15	29	36.25	23	29.87	33	52.38	39	47.56	31	33.33	29	34.12	33	37.93	16	20.25	34	39.53	347	38.38
1500-2000	5	6.17	8	8.79	11	13.75	9	11.69	12	19.05	7	8.54	22	23.66	7	8.24	9	10.34	5	6.33	15	17.44	110	12.17
2000-2500	1	1.23	3	3.30	5	6.25	13	16.88	11	17.46	3	3.66	8	8.60	5	5.88	11	12.64	27	34.18	4	4.65	91	10.07
2500-3000	1	1.23	4	4.40	8	10.00	9	11.69	3	4.76	1	1.22	3	3.23	8	9.41	3	3.45	6	7.59	2	2.33	48	5.31
3000-3500	11	13.58	1	1.10	2	2.50	5	6.49	4	6.35	1	1.22	0	0.00	7	8.24	4	4.60	4	5.06	3	3.49	42	4.65
3500-4000	1	1.23	1	1.10	3	3.75	3	3.90	0	0.00	0	0.00	0	0.00	3	3.53	2	2.30	2	2.53	1	1.16	16	1.77
>4000	1	1.23	1	1.10	0	0.00	1	1.30	0	0.00	0	0.00	0	0.00	0	0.00	1	1.15	12	15.19	0	0.00	16	1.77
Total	81	100.00	91	100.00	80	100.00	77	100.00	63	100.00	82	100.00	93	100.00	85	100.00	87	100.00	79	100.00	86	100.00	904	100.00

Source: Field survey 2001-2002

4.1.13. Case studies

Name: Md. Yusuf Ali:
Age: 26 years
Profession: Fish harvesting and fish marketing in Arot
Village: Alipur
Union: Latachapali
Upazilla: Kalapara
District: Patuakhali

I was born in the house of Hazi Abul Kashem, of Alipur under Kalapara Upzilla of Patuakhali district. My father was a tea staler by profession. We had nothing of our own. I am the third among six children of my parents. I have three brothers and two sisters. Both of my brothers and sisters are already married. Sisters are staying away from our family. Our family is a joint family where my father is the head. On account of numerous crises in childhood, I could not continue my studies. When I was 12 years old, my father advised me to do something for extra income because he was unable to bear family expenses and education. I along with my elder brothers started fishing in the sea and the business secured us solvency. My two elder brothers and I continued this business up to 5 years as a zero partnership pattern (zero partnership patterns was meant to obtain a percentage of profit through giving physical labor instead of investing money). In 1993, my family decided to buy a fishing boat but were unable to do so. Lastly, my father took DADON (imprest) from a fish trader and bought a small fishing boat and few nets. This investment resulted in earning good profit. We paid back the entire DADON (imprest) within two years. After that, we again bought a large size fishing boat and numerous nets. Now, we have 7 fishing boats and 2000 meter fishing nets, 2800 fishing hooks and about 30 acre agricultural land. We have also a fish Arot (depot). My father had to live a subhuman life earlier but at present, he is a happy man. He also performed Holy Haj (Pilgrimage) in Meccaduring the year 1997. Now, he looks after all the family problems.

Since, we have a joint business, it is not possible for me to calculate my actual monthly income. But the total monthly income of my family from various sources tends to be around 25,000 taka. The monthly expenses of my family is about 15,000 taka and monthly savings about 10,000 taka. Our main activities are fish harvesting in the sea and marketing of fish in the Arot.

I am unmarried and relatively less responsible to my family. Due to this, I am engaged in various social oriented well being of the community. Now, I am a member of the "Mazi Samittee (fishermen's association)" and " a Madrasa Committee". My father is also a member of the "Mosque Committee". I am not involved in any NGOs at present nor was I earlier.

Through fishing activities, we earn satisfactory profit and now we are economically viable. Our family is running fairly well.

Name: Mosaya:
Age: 50 years
Profession: Fish harvesting and fish marketing in Arot
Village: Alipur
Union: Latachapali
Upazilla: Kalapara
District: Patuakhali

I am the youngest among three children of my parents. My father's name is Taisi and died when I was 8 years old. My father was a weaver.

After my marriage, I am living away from own family and staying in the family of my father in law. Once upon a time, my maternal grandfather was a landlord who bequeathed some properties to my father. Since our family is maternal type, all children are recognized by the mother's identification.

I got married at the age of 27 years. Though I was born in Taltali, I am living in Alipur after my marriage. Now I have 3 daughters. During my early age, I never went to school. I started my profession as a weaver with my family member and continued until my marriage. As it was less profitable, I wished to change my profession. Thus, I decided to concentrate in fishing activities. I thought, though fishing was a lower class job at that time it required low investment. I could not

continue it individually and again returned to my first profession i.e. in weavers business. Again in 1996, I started fishing business in partnership pattern and am continuing it till to-date.

My income is about 1500 taka per month which I feel is satisfactory for my family expenditure. Fisheries activities provide satisfactory return through which my family is now running fairly well.

Name: Md. Abdul Kader
Age: 42 years
Profession: Fisherman
Village: Kalaiapara
Union: Latachapali
Upazilla: Kalapara
District: Patuakhali

Md. Abdul Kader was born in the house of late Abdul Zabbar Master in 1959. His birthplace was in Patherghata upzilla under Barguna district. His father was a teacher by profession. They had nothing in their own. His grandfather's profession is completely unknown to him but information from an old man gives an idea that he was a day labor. His father had died when he (Abdul Kader) was 5 or 6 years old. After death of his father, his mother was unable to maintain their family expenses. Due to this problem, in 1966, he with his family members migrated from Patherghata to Kalapara and then to Kalaiapara. He is the fourth among six children of his parents and he has two brothers and three sisters. All of them have got married. He passed his childhood with enoromous crisis. When he was eight or nine, he started fishing as a helping hand of fishermen. After that he started fishing in the sea individually which he continued till to-date.

In 1977, when he was 18 years old, his mother had died due to diarrhea. Before the death of his mother, they had a joint family. In 1981, he got married at the age of 22. Now he has a single family. He has 4 children; 2 daughters and 2 sons and all of them are school going. At the early age, he had nothing in Kalaiapara but through hard working in the sea, he bought 66 dc. agricultural land. Besides this, he has 5,500 meter long net and two fishing boats. All of his fishery business is in partnership and he has invested half of total investment.

He never goes to the field for agricultural activities. Due to inadequate qualifications, he was forced to do something in the fishery business. Now economic condition of his family is sound. For better earning he always investment high in fishing activities. He has invested about 4,00,000 taka this year for buying and repairing of fishing boats and nets.

Now his monthly average income is about 10,000 taka while monthly average expenditure of his family is about 6,000 taka. Now he is a member of "Mazi Samity" and has involved himself with Fish Traders. They give credit support during the peak season of fishing at the rate of 2,00,00 taka as loan. This will be paid by giving fish to the traders of Arot. He has taken no loan from any organization or NGOs. He thinks Government can easily solve various problems of fishermen and help to increase their working activities. Although the fishery business is much profitable, he is not interested to involve his sons in this profession since it is very risky work. Besides this, many schools and colleges are available in this area where he could educate his sons. He is determined not to encourage his sons to engage in fishing activities. He hopes that they will be a doctor or engineer.

Name: Md. Shahjan
Age: 30 years
Profession: Owner of Shutki Mahal
Village: Kalaipara
Union: Latachapali
Upazilla: Kalapara
District: Patuakhali

Md. Shajahan, son of Arfan Mia, owner of a Shutki Mahal involved in drying. He is a Muslim and was born in a village of Amtali Upazila in 1971. Now he lives in the village Kalaiapara of Kuakata. His father was a farmer. He is now 30 years old and can sign. There are 7 members in his family and they are living single. He got married when he was 918 in 1988. He has 2 children and both of them are boys. His children are having their education in Madrasa. He did not want to involve his children in this work.

He is the 2nd child of his parent and has one brother. Limited agricultural land forced him to take this profession. Spending a straggling childhood, now his economic condition is apparently sound and family is now running well. At present, he is an owner of a house and Shutki Mahal.

He invested near about 1,50,000 taka in fishing activities. This year he took loan of 20,000 taka from two NGOs e.g. CODEC and Grameen Bank. He is involved with Grameen Bank and his family is involved in social activities with CODEC.

At present his monthly average income is about 4000 taka, which is less than last year while monthly average expenditure of his family, is about 2000 taka. He has saved 2000 taka every month. This was due to the poor performance in the export business. He is attached with a Fish Trader but feels that this creates mental pressure as well as give binding in his livelihood activity.

Name: Mrs Fatema Begum
Age: 25 years
Profession: Fry collector
Village: West Kuakata
Union: Latachapali
Upazilla: Kalapara
District: Patuakhali

Her father is engaged in fisheries activities and is about 45 years old. She is second among 3 children of her parents. Her father has no mentionable property except household. Due to lack of other qualifications, her father was forced to do fishing. She also stated that due to availability of fish in the sea, her father was encouraged to do fishing.

When Mrs. Fatema Begum was 16 years old, she got married with a shopkeeper. Her husband is the owner of a small grocery shop. Now, she has three children. She is happy with her family. Miss. Fatema mentioned that due to low income of her husband, she was forced to collect shrimp fry giving strong support to her family. In the beginning of her conjugal life, she had lots of problems particularly as she had love affair marriage.

Mrs. Fatema stated that she collects shrimp fry occasionally and it is done when she has lot of time after finishing her family work. When the demand and price of shrimp fry is found to be higher in the market, she collects shrimp fry. Through shrimp fry collection, she earns about 6000 taka per year.

She mentioned that she along with her husband earns about 1500 taka per month and now they are economically sound. All of the income sources from her and her husband is spent on family purpose. Mrs. Fatema is engaged with a Non Governmental Organization (NGO). She received about 5000 taka from the NGO (BRAC). She invested this money for her husband's shop. Besides this she is not involved in other NGO's or GO's.

Name: Md. Abdul Aziz
Age: 50 years
Profession: Fishing in the sea but occasionally fry collector
Village: West Kuakata
Union: Latachapali
Upazilla: Kalapara
District: Patuakhali

Md.Abdul Aziz son of late Azhar Munshi, is a fisherman lived in Adarsha village of Kuakata. His father died almost 40 years ago. He was a seasonal fisherman. His grandfather was a landlord but due to coastal erosion, his grandfather lost everything.

He is now 50 years old and does not know how to read and write. He has been involved in fishing profession for 25 years. Considering every thing, fishing is an easy means of livelihood. The availability of fish in the sea encouraged him to engage in fishing. When the price of shrimp is high and demand is also high, he collects fry from the sea otherwise he goes for fishing all throughout the year.

He lived in a joint family having 8 members. He has four children i.e. three sons and one daughter. He got married at the age of 25. He has about 1000 meters net and one engine boat through which he carries his fishing activities. All of his sons are engaged in fishing in various ways. They give a mentionable amount of money to Mr. Aziz. Mr. Aziz stated that he had worked as a cowboy in a *Jamidar* family and passed his childhood with crisis. But after starting fishing activities, he became economically solvent and now he is happy.

He monthly income is about 2000 taka. He mentioned that since fisheries resources are provided by Almighty ALLAH, every one should be kind to them. For sustainable management of fish in the sea, current jal should be avoided as much as possible. He has no savings .He invested about 5000 taka for buying and repairing boat and net. For fishing, he took about 4000 taka loan form Arotdar.

In his family there is a secondary income source. His wife works in an NGO and earns about 1000 taka/ month. He stated that though they do not have enough money, they are happy.

Name: Md. Delwar Hossain
Age: 47 years
Profession:
Village: Hossainpara
Union: Latachapali
Upazilla: Kalapara
District: Patuakhali

I am a traditional fisherman and continuing this activity since I was 7 years old.. I was born in poor family having 7 members. My father was a daily labor and my mother was a housewife. As, income of my father was extremely limited, I passed my childhood with lots of problem. I had passed many days without any food. When I was eight years old, my father was paralysed.. When I was ten years old my father died and then my mother also died within three months.

I am the 3rd among the five children of my parents. I have three brothers and two sisters. Since, my father was unable to work and my brothers wished to do something to live. There was no alternative ways other than fishing because fishing needs physical labor only.

During the initial period of my profession, I harvested fish using *Jaki Jal.* At that time, the abundance of fish was very high in the beach area. After sometime, when I was nineteen, I got married. In the mean time, two of my sister also got married. Both the sisters had been married to my cousins.

My grandfather's house was in the Patuakhali but he migrated to this place in 1939 due to various problems in their native home. At first, they were living in Alipur but in 1969 we were all settled in Hossainpara.

Now I am a father of two daughters and both of them are married. Both of my sons in laws are fishermen and they also stay with me. I am happy with my family members. I have 3 children.

I continued fishing until I was 35 years old. After an accident in the sea, I stopped fishing. From that time, I engaged myself in fish trading. Fish trading is a high investment business. It needs extra effort and extra money. For extra money, I cannot do this work properly. Now my daily income is about 40 Taka by selling fish in the local market. Though, this income is little compared to fishing and is treated as surplus income. I am not engaged with any organization. But in 1975, due to flood, I had taken a loan about 2000 Taka from an NGO.

Name: Malek Khan
Age: 35 years
Profession: Fishing
Village: Hossainpara
Union: Latachapali
Upazilla: Kalapara
District: Patuakhali

I was born in a poor family having six children and I am the second. In 1982, when I was 17 years old my father died of typhoid. Before my father's death, two of my sisters got married. In 1985, my third sister also got married. My father was a marginal fisherman and mother was a housewife. Since fishing activity of my father was the only source of our family income at that time, we passed our days having numerous problems.

I got married in 1988 and now have three children of whom two are sons and the remaining one is daughter. None of them are married as yet as they are all school. However, one of my sons help me in my business. Professionally, I am a fisherman and go to fish in the sea as a zero partnership pattern to the fishing boat and net owner. I work with an NGO (CODEC). I have no agricultural land.

Now, my monthly income is about 1500 taka that is not sufficient to maintain my family. My son earns about 500 taka per month that gives some support. But today there is great economic crisis in my family due to higher expenditure and educational expenses of my children.

Since, I have no alternative qualification, I am forced me to engage myself in fishing business. I am not interested to involve my children in this business because it is a very risky job but I need some money for which I asked one of my sons to help me in this business.

In the past, my family was never involved in any social oriented work. But, now I am involved in a social committee "Mazi Sammittee (fishermen association)". I can obtain many opportunities from this organization. Besides this, the NGO (Non Governmental Organization) CODEC help me by giving credit support for different purposes. I am not involved in any Government organization.

Since fishing business is profitable, it needs much supervision by higher authority. Government should take extra care to improve the socio-economic condition of the people related to fisheries both directly and indirectly.

Name: Md. Zakir Hossain
Age: 32 years
Profession: Harvesting fish in the sea and fry collection
Village: Panjupara
Union: Latachapali
Upazilla: Kalapara
District: Patuakhali

I was born in the house of Md. Abdul Kader in 1970. My father is a poor farmer. When I was four years old, suddenly my mother died of diarrhoea. My family fell in great problem. Since I was a little child, my father got second married second time in order to look after me. Though my father was very kind to me, stepmother could not tolerate me. For this, I engaged myself in work from childhood. Besides this, my father's family was not economically solvent and we all lived from hand to mouth. As well, my grandfather's family was also poor. My father did not get anything from my grandfather. But now, my father has one-acre agricultural land and three cattle for agricultural activities.

In 1982, when I was 12 years old, I left my parent's house for which my stepmother became very happy. In the mean time, they had two children. After separation from my father's family, I never communicated with them. Now, I am very happy with my family. I got married when I was 16 years old but my first child was born after 8 years of my marriage. I have two sons. Both of them are school going. Sometimes, they help me in my work.

I am a poor fisherman and harvest fish in the sea daily. Sometimes I go to the shrimp fry collection area when the demand and price of fry become very high. This year I have invested about 20,000 taka for fishing activities and major of

it is spent in repairing nets and boat and buying new nets. Sources of this capital or money are fish arotdar. For fishing activities, I have one engine boat, 1000 meter khuta jal (one kind of Hilsa net) and four pieces of tana jal (fry collection net) for fry collection.

My monthly income is about 2000 taka and expenditure about 1800 taka. A few savings cannot give me better livelihood. I am not engaged in any social organization. Sometime I get good support from my father in law. If it is possible for me to invest more capital in fishing activities, I will get satisfactory profit.

Name: Md. Chan Miah Mridha
Age: 60 years
Profession: Marginal fisherman
Village: Panjupara
Union: Latachapali
Upazilla: Kalapara
District: Patuakhali

I was born in the house of late of Intali Mridha in 1942. I am the first child of my parents and have two sisters and two brothers. All of my brothers and sisters have got married. They are all living separately. My mother died of snakes bite in 1969 when I was 29 years old. My father died in 1999 due to old age ailments. Other than my youngest rest were living away from them (parents) after marriage. I was the first to leave my parents. My father had about 10-acre agricultural land in Panjupara but lost everything due to storm and floods. Thus my father sold agricultural land.

My family migrated from my birthplace of Mathbaria, Pirojpur District in 1956. There were some family problems with my cousin which forced us to leave the place. Though we had some properties, we never went there after leaving that place.

I got married in 1962. I have three sons and two daughters. All of them are now married. All of my sons and son in laws are involved in fishing business. From the beginning of my life, there were various problems in my family. My children could not get any facilities for their education and thus willingly are involved in fishing business. Though fishing business is much risky, it gives satisfactory profit with low investment. Fishing business is the only profession which do not need any investment because labour in fishing provide earning.

Now, I earn about 1500 taka per month. All my earning is spent on family expenditure. Sometimes I cannot maintain my family with this income particularly related to having diseases in my family member and showing to the doctor. The help of my sons solve this problem to certain extent. I am not involved in any social organization but I think social organization can give support for better life.

Name: Md. Ruhul Amin Mazi
Age: 33 years
Profession: Owner of a fishing boat and net
Village: Goramkholapara
Union: Latachapali
Upazilla: Kalapara
District: Patuakhali

He was born in 1972 in the district of Barguna under Barisal dvision. I was four years old. His family had migrated from Barguna to Goramkholapara due to family contradiction. Though his father was an old farmer in Barguna, he (his father) started his life as a marginal fisherman in Goramkholapara. Mr. Amin lives in a joint family and his father is the head of their family. From early age, Mr. Amin engaged himself in the fishing activities with his father. When he was ten years old, he went to the sea for the first time. Now he is continuing his life as a fisherman.

He got married at the age of twenty-two and now have four children of whom three are daughters and the remaining one is son. He does not know how to read and write but all of his children are school going students. He stated that due to his enoromous family crisis during his childhood, he was forced to do fishing. But he is hopeful to provide his children higher education. He is an owner of a fishing boat and about 500 meters fishing net that is operated by him and ten other

ten fishermen. His family also possess 200 dc. agricultural land and a grocery shop. His father looks after all properties. He described that initially hard working was the only capital in their business. He also stated that though his profession is very much risky and uncertain, it gives him economic solvency. He wants to continue it through out his life. Besides this, it gives higher profit against lower investment. He is a seasonal fisherman and only fish during peak season (mid May to mid October) and spends the remaining time in agricultural work.

His monthly income is about four thousand (4000) taka and he spends all of his income for his family. Majority of his income is spent on educational expenses of his children. He also stated that income of this year was lower than the last year because fish catch was lower than previous year. He took one lac taka (100,000/-) loan from arotder for buying net and repairing net and fishing boat. Mr. Amin is a member of a "Mazi Samitee (fishermen association)". He is regular and reliable in his organization and work hard for the development of his organization and work as a messenger.

Lastly, he stated that loan or DADON (imprest) from any arotder gives binding to do work and induce mental pressure. He thinks Government organization should give credit support to fishermen to do fishing business.

Name: Anower Mollah
Age: 32 years
Profession: Marginal Fisherman
Village: Goramkholapara
Union: Latachapali
Upazilla: Kalapara
District: Patuakhali

I am a marginal fisherman and was born in the house of Joynal Abedin. My father is a farmer and has 100 decimal agricultural land and 6 cattles. My parents have 6 children and I am the 4th. I have 3 brothers and 2 sisters and all of them have got married. My father's family is single family. Due to limited income of my father, he forced me to do something other than education. Therefore, from the age of 10, I started fishing business. My grandfather died when my father was a child.

I started my fishing activities at the early age and have got married when I was 17 years old. After my marriage I have been staying separately from my parent's family. After 3 years of my marriage, our first child was born. Now I have 4 children; two sons and two daughters. Fishing is the only work of mine through which I earn money to maintain my family.

I invested about 20000 taka for buying and repairing nets and boats. Non Governmental Organization (NGO) CODEC and arotder are the sources of my capital in fishing business. I have received 10000 taka from CODEC and 1000 taka from arotder. My monthly income is about 4000 taka and my monthly family expenses are about 3500 taka. Most of my family expenditures are due to my children's educational expenses. All of my children are school going students.

I have about 2000 meters Hilsa net, 12000 fishing hooks and one Bachary boat for fishing business. I am not engaged in any social organization but recently selected as a member of a registered primary school. I am happy with my work and family members. I think my child will be a doctor or a teacher.

Name: Md. Abdul Kuddush Ali
Age: 54 years
Profession: Seasonal Fisherman and farmer
Village: Mammipara
Union: Latachapali
Upazilla: Kalapara
District: Patuakhali

Md. Abdul Kuddush Ali was born in the house of late Md. Abdul Ali in 1948. His birthplace was in Bamna under Barguna district. His father was the only child of his grandparents. After death of his grandfather, various family problems forced them to migrate here. His grandfather was day labor. His father was also involved in working with his grandfather during his childhood. But in 1968, after migrating here, his father took fishing profession. His father died in

1973 when he was 4 years old. He is the 2nd among 5 children of his parents. His has two sisters and two brothers. Before the death of his father, his both sisters and one brother got married. Now, all of them are married. He passed his childhood with serious problems. When he was ten, he started his work as a day laborouer with his father. He started fishing activities after migrating to Mammipara in 1968.

In 1970, he got married at the age of 22 years. In 1974, when he was 26, his mother died of cholera. Before the death of his mother, they had a joint family. From 1975, he was staying separately from the joint family. Now, he has 4 children of whom two are sons and two are daughters. All of his children had got married. But all of them are staying separately from him. All of his sons are engaged in fishing.

At the early age in Mammipara, he had nothing. But after his parent's death, he bought about 100 decimal agricultural land. Half of his land is used as his residence and the rest half is used for agricultural work. Fishery is seasonal profession and he goes to fish during peak season. He worked in the agricultural land during other period.

Due to lack of other qualifications, he was forced to do fishery business. But after a certain time, he understood that fishing activities give higher profit in comparison to other tasks. Now, economic condition of his family is sound. He is willing to continue the fishery business because it gives better profit from lower investment. He worked in the fishing boat as a zero partnership.

Now, his monthly average income is about 1500 taka. But in the fishing season, he earns about 2500 taka per month. This income is nearly equal to last year. He is not attached to any social work or any social organization. Before three years ago, he was a member of BRAC. He mentioned many problems in the fishing business such as inadequate ice supply, credit support etc. He also mentioned that since the fishery business can give easy economic solvency to the poor fishermen, Government should take proper care in this business.

Name: Nur Hossain
Age: 55 years
Profession: Marginal fisherman
Village: Mammipara
Union: Latachapali
Upazilla: Kalapara
District: Patuakhali

I am a fisherman from my childhood and am continuing my work till to date. I was born in Patuakhali District in 1947 in the family of Sonamia. I am a Muslim and always maintain the rules and regulations of Holy Quran and Hadis. My parents are alive. In my childhood, I worked with an NGO. I am the 2nd child among the four children of my parents. I married at the age of 20 in the year 1964. After two years of my marriage, our first son was born. Now I have four children; two are sons and two are daughters. All of my children are married and living with me at present. Total number of my family member is six.

I am illiterate and do not know how to read and write. I have only ten decimal agricultural lands, five cattles and a house. After liberation, I had difficulty time and therefore took huge loan. To pay that loan, I was involved in secondary work at that time such as netting, daily labor, pulling van etc. Now, I have received 12000 taka from an arotdar and will be pay him back when I work in the peak season and earn better income. I think fishing is a good profession that can give quick economic solvency. Two of my sons are now involved in fishing activities along with me and I believe that my sons will continue it in future.

At present, my monthly average income is about 5,000 taka and my family expenditure around 4500 taka. In peak season, income is higher. But in this year, my income was relatively less than last year because of insufficient availability of fish in the sea. In peak season, I go for fishing in the sea and stay for 10 days at a time. I work with a fishing boat owner. Half of the total profit will be taken by the owner while the remaining will be paid to the fisherman of that boat. Although fishing is very risky, yet it gives better profit. I want to say that the government should take care of the fisherman like us through providing credit and making arrangement in removing robbery from the sea.

Name: Md. Sayed Faqir
Age: 42 years
Profession: Fishing and Trading
Village: Nabinpur
Union: Latachapali
Upazilla: Kalapara
District: Patuakhali

I was born in 1958 in the village of Kalaipara under the district of Potuakhali. From my childhood, I was pious. I have two wives at present. I married first at the age of 17. In this family, I have 4 children; two daughters and two sons. All of them are married. My second marriage was held in 1988 at the age of 30 and in this family I have a son and two daughters. All of them are school going students. I am a fisherman by profession. I am the first among the 15 children of my parents. My father also has 2 wives and both of them are alive.

During my childhood, I had lots of problems because of the second marriage of my father. At the age of 15, I was staying separately from my father's house and engaged myself in fishing business. Now, my monthly income is about 5,000 taka. I did not get anything from my father during separation. First, I was a day worker in my father's business. However, after a certain period, I tried to start partnership fishing business but I failed. After that I took some money from my father as loan and started fishing business individually. Now, I am a successful fisherman. Along with fishing business, I have some agricultural land. The quantity of my agricultural land is about 200 dc. At present, I have 2 fishing boats and 800 m net.

Today I am not physically involved in fishing or in agricultural business. But I give all monetary support to the business. For fishing business, I individually invested taka 2,50,000 for buying and repairing fishing boats and net. The profit margin of this year is not good compared to the last year due to small catches during the peak fish catching time.

Now I am engaged in some social work such as school committee, mosque committee and Mazi Samitee (fishermen's association). I am not engaged in any NGOs. Today economic status of my family is sound and I am satisfied. Though I have two wives staying separately, they are all cordial and loving to each other. There is no major problem in my family. I am also a village leader

Name: Md. Abdur Rahman Gazi
Age: 54 years
Profession: Fish trading
Village: Nabinpur
Union: Latachapali
Upazilla: Kalapara
District: Patuakhali

Md. Abdur Rahaman Gazi was born in the house of late Md. Dholu Gazi in 1952 is birth place was Nabinpur, Kuakata. His father was farmer. They had eight-acre agriculture land, some cattle and buffaloes. His grand father was also a farmer. His father had died in 12 years ago. He was the fourth among five children of his parents. One of his brother and sister has got married. He has completed primary education. He passed his childhood with happiness. For trading purposes, first he was attached with a fish depot but different problems forced him to leave from that business

Md. Abdur Rahaman have got married in 1972 when he was 20 years olds. Now he is a businessman. He has a joint family. He has three sons and one daughter. All of them have got married. Total family members are eight. One of his sons is shopkeeper, one hotel manager and other farmer. He has a house of his own. He was four acre agricultural land, some cattle, one machine, a shop and some cash for business. Before starting the business he was a fisherman. He was omitted fishing activities before three years ago. Besides the business, he has another income source i.e. agriculture. He has invested 20,000 taka in his business namely sanitary latrine business and 30,000 taka in shop. Now his monthly income is 6500 taka that is higher than last year and monthly average expenditure is 6000 taka. The reason of higher income is high working efficiency. He took lone 5000 taka in this year from local people. He expends his loan for family expenditure. He is not attached with any traders. He is not involving any social activity. His father and grandfather were also not involving any social activity. He thinks that fisheries business gives higher profit within a short time and it

should considered as maximum profitable business. If I will have any opportunity to back in fisheries business, I will do this.

Name: Nur Mohammad Hawlader
Age: 45 years
Profession: Marginal fisherman
Village: Khajura
Union: Latachapali
Upazilla: Kalapara
District: Patuakhali

He is a fisherman from his childhood and is continuing this till to to date. He was born in Barguna District in 1956 in the family of late Amin Uddin Hawlader. He is a Muslim by religion and always maintains the rules and regulation of the Holy Quaran and Hadish. In his childhood, he lost his parents within 6 months differences. After that he migrated to Khajura unintentionally and stayed for long time. In his childhood, he went from door to door for food and cloths but no one helped him. After migration, he never went back to his parent's house. He does not know about his father's occupation and his properties. He is the only child of his parent's. He got married at the age of 24 in 1980. After three years of his marriage, his first son was born. Now he (his son) is also married and stays with him. He has three sons and two daughters. One of the daughters got married. During his daughter's marriage about 30,000 taka were spent. Now he has a family of 7.

He is completely illiterate and does not know how to read and right. He has no agricultural land but has a house of his own. After liberation, he had crisis and took loan. He did some subsidiary work at that time i.e. netting, day worker in order to pay his loan. Now he has received 50,000-taka loan from an arotder and will pay him back. He thinks fishing is better than other agricultural profession that has economical viability.

Now his monthly average income is about 2,000 taka and family expenditure is about 2,000 taka. He has therefore no savings. In peak season, he goes for fishing in the sea and stay for 7-15 days at a time. He works with a fishing boat owner as zero partnership. Although fishing in the sea is very risky, it gives better profit. Thus, he is interested to continue it.

Name: Mr Alamgir Mazi
Age: 41 years
Profession: Head of the fishermen in a fishing boat
Village: Khajura
Union: Latachapali
Upazilla: Kalapara
District: Patuakhali

He was born in 1961 in a poor family of 10. His father was also a fisherman. In 1988, his father died when he was 27. His father's family initially had various problems. His father did not get any property from his grandfather because his grandfather had nothing. He is staying here from 1973 after migrating from Patuakhali. All of his relatives are in Patuakhali.

He is 41 years old fisherman. He got married in 1981. He has 4 children; 2 sons and 2 daughters. Two of them have got married and the remaining two are school going students. He stated that during the marriage of his two daughters, he spent about 20,000 taka by taking loan from arotdar. For this reason, he is now in great crisis. Now his monthly income is about 4,000 taka but most of it is given to the moneylender. He has nothing of his own. He thinks fisheries activities will provide him economic viability.

Name: Motaleb Hossain
Age: 32 years
Profession: Poor Fisherman
Village: North Kuakata
Union: Latachapali
Upazilla: Kalapara
District: Patuakhali

Mr. Motaleb Hossain was born in 1970. His father's name is Abdur Rahman. His father then stayed with his grandfather's family. In 1973, his father started living away from his grandfather's house. At that time, there were four members in their family. Though his father stayed separately from his grandfather's family, yet he contimued his fishing business with his grand father. His father and grandfather were fish traders. After liberation war, many Rakhain (Buddhist) families left their residence and his father brought small amount of agricultural land from them. His father's family was large (6 children). He was the eldest.

He was forced him to involve in many family works due to numerous problems. When he was twelve years old, he started fishing in the coastal area with his father. He mentioned that insolvency of his family destitute him from education.

He got married at the age of twenty-two with his cousin. Before his father died, he stayed with his father's family but in 1998 when his mother also died, he stayed away separately from their joint family. Now he has three children; two sons and one daughter. Professionally, Motaleb Hossain is a poor fisherman. He has nothing of his own. His elder son work in the sea with him and the other two is school going students. He stated that fishing in the sea is uncertain and risky work. He is not interested to keep his sons in this business.

Mr. Motaleb Hossain earn about 1500 taka per month which is very low to maintain his family expenses He stated that in this year his income is lower than the last year because the availability of fish in the sea was lower.

Mr. Motaleb is involved in Community Development Center (CODEC). He and his wife took 12,000 taka loan from the NGO. He spent his entire loan for making net and fishing boat. Generally, he goes for fishing in coastal area and his other family members harvest shrimp fry during the peak season. He stated that Government should take better care for their development and should give monetary support for their business.

Name: Md. Nur Shaid Sikder
Age: 60 years
Profession: Farmer
Village: North Kuakata
Union: Latachapali
Upazilla: Kalapara
District: Patuakhali

Md. Nur Shaid Sikder son of late Abdul Sikder was born in 1942. His birthplace was in Kalaiapara village. He lives in Nabinpur. His father was a landlord and had 30 acre land and a house of their own. His grandfather was a director of a social organization. His father has 13 children and he was the 11th child. Total family members were fifteen. His father died before 25 years ago. He spent his childhood relaxing. All of his brothers and sisters have got married.

Md. Nur Shaid Sikder got married in 1966 when he was 24 years old. He was a teacher of primary school. Now, he is a retard person. At present he sped his time in agricultural activity. He has five sons and two daughters. All of them have got married. He has a single family and numbers of family members are six. One of his sons is working in an NGO, one in primary school and the other one is a boatman in a fishing boat

He has 7 acre agriculture land and a house of his own. Now his average income is about 11000 taka, which is less then last year and monthly average expenditure of his family is about 10000 taka. He stated that one of his son who works in fishing boat earn about 4000 taka per month. Recently he is will going to start a fresh fish arot. He took loan of 8300 taka

in 1988 from Bangladesh Krishi Bank. He used this money for family expenditure. He is not involved in any social activity. His grand father was a member of a School, Madrasha and Mosque committee.

Name: Miss Fatema Begum
Age: 22 years
Profession: Fry collector
Village: Islampur
Union: Latachapali
Upazilla: Kalapara
District: Patuakhali

Her father's name is Abdul Gaffer Hawladar and he is 45 years old. Her father is engaged in fisheries activities. She is the second among 2 children of her parents. Her father has no mentionable property except household. Due to inadequate qualifications, her father forced to her to get herself in fishing activities.

When Miss. Fatema Begum was 13 years old, she got married with a fisherman. Her husband is the owner of a small fishing boat. Now, she has two children and happy in her family. Miss. Fatema mentioned that due to low income of her husband, she collects shrimp fry from the sea and also dry fish in her house. She stated that she collects shrimp fry occasionally when she has plenty time after finishing her family work. Also, when the demand and price of shrimp fry is found to be higher in the market, she collects fry from the sea. She also dries fish through out the year. Through shrimp collection and fish drying, she earns about 10,000 taka per year. She mentioned that she and her husband earns about 2,000 taka per month and now they are economically sound. She spends all her money for her family and educational expenses of her children. Miss Fatema did not engag in any social organization. She stated a problem; the governmental rules on shrimp fry collection prevented her from earning substantial profit and also think that her family will fall in great problem.

Name: Md. Hazi Ismail Khan
Age: 56 years
Profession: Businessman
Village: Islampur
Union: Latachapali
Upazilla: Kalapara
District: Patuakhali

Md Hazi Ismail Khan son of late Md. Ali Asim Khan was born in 1949 in Islampur village of Latachapali Uunion under Patuakhali District. His father was a fisherman and continued until he was 70 years old. He was third among five children of his parents. Total family members of his father's family were seven. His father had a single family. His grandfather was also a fisherman. His father had 8-acre land and some cattles. His father died eight years ago.

In 1979, when he was twenty-seven years old, he got married. He has five sons and six daughters. Total members of his family are fourteen. He lives in extended family with his grandchildren together. He is a farmer and also he looks after a sawmill. He has 4.5 acre land and a sawmill. He invested 25000 taka for installing the sawmill. Now his average income is about 10000 taka per month. His monthly average expenditure is about 9000 taka. He took loan of about 20000 taka from Bangladesh Krishi Bank. He is also engaged with a shutki mahal to obtain a secondary source of income.

Now he is the President of a primary school, secretary of a mosque and a member of high school. In the past, he was a member of the Union Council. He mentioned that he is not physically involved in fisheries business but gives a major investment in partnership pattern.

4.2.1. Organoleptic Assessment of Dried and Fresh Fish

4.2.1.1. Organoleptic Assessment of Four Common Dried Fish in Summer

Organoleptic score of four dried fish (Parshe, Shark, Bombay duck and Phasa) in summer were found to be more or less the same (Table 24). The scores varied between 6.4 to 6.8 in 10 point scale. However, the four samples in summer were accepted as 'Like Slightly' by the panellists. Thus, the four common dried fish were just at the boarder line of acceptability.

Table 24: Organoleptic score of four common dried fish in summer

ID	Species	Acceptability	Remarks
S_1	Parshe	6.4	LS
S_2	Shark	6.8	LS
S_3	Bombay duck	6.8	LS
S_6	Phasa	6.8	LS

LS = Like slightly

4.2.1.2. Organoleptic Assessment of Four Common Dried Fish in Winter

The quality of two species, Parshe and Bombay duck (S_8 and S_{12}) were same with regard to score (8.0) and accepted as ' Like Very Much' by the panellists. While, Phasa (S_{14}) indicated the best quality dried product with acceptability score of 9.2 (Like extremely). Shark showed relatively poorer standard but was within the boarder line of acceptability (Table 25).

Table 25: Organoleptic score of four common dried fish in winter

ID	Species	Acceptability	Remarks
S_8	Parshe	8	LVM
S_{10}	Shark	6	LS
S_{12}	Bombay duck	8	LVM
S_{14}	Phasa	9.2	LE

LVM = Like Very Much; LS = Like slightly; LE = Like extremely

4.2.1.3. Organoleptic Assessment of Other Dried Fish

Some of the dried fish products showed very poor quality (score 4.8 and 4.4) which was indicated as 'dislike slightly' by the panellists. These species were Churi fish (S_{11}) and Saplapata (S_{15}) respectively. While, for Kukurjib (S_{18}) an extremely high score (9.6) was provided by the panellists. Three species i.e. Tengra (S_5), Rupchanda (S_{13}) and Sea eel (S_{16}) were marked as'Like very much' and were of high quality. Other dried products were of average quality (Table 26).

Table 26: Organoleptic score of other dried fish sample

ID	Species	Acceptability	Remarks
S_5	Tengra	8.8	LVM
S_7	Ilish	7.2	LM
S_9	Taposhi	7.6	LM
S_{11}	Churi	4.8	DS
S_{13}	Rupchanda	8.0	LVM
S_{15}	Saplapata	4.4	DS
S_{16}	Sea eel	8.0	LVM
S_{17}	Bole	7.6	LM
S_{18}	Kukurjib	9.6	LE
S_{19}	Potka	7.2	LM

LE =Like extremely; LVM = Like very much; LM = Like moderately; LS = Like slightly; DS = Dislike slightly

4.2.1.4. Organoleptic Assessment of Fresh Fish

All the fresh fish brought showed an average quality having a remark of ' Moderately acceptable' by the panellists. The score of the different fresh fish species varied between 7.00 to 7.57 in a 10-point scale (**Table 27**).

Table 27: Organoleptic score of fresh fish

ID	Species	Acceptability	Remarks
FS_1	Parshe	7.29	MA
FS_2	Phasa	7.29	MA
FS_3	Boiragi	7.14	MA
FS_4	Bistara	7.57	MA
FS_5	Tular danti	7.28	MA
FS_6	Gang tengra	7.57	MA
FS_7	Ilish	7.00	MA
FS_8	Taposhi	7.57	MA
FS_9	Chat baila	7.14	MA
FS_{10}	*Kankon*	7.28	MA

MA= Moderately Acceptable

4.2.2. Microbiological Assessment

18 dried sample of 14 species and 10 fresh samples of 10 species were studied for microbiological analysis. During the total investigation period it was not possible to collect same dried species. However, through the field investigation, it was decided that 4 common species, which were available both in summer and winter, would be evaluated for comparison. Enumeration of Standard Plate Count (SPC), quantification of Total Coliform (TC) and Faecal Coliform (FC), detection of *Salmonella* & *Vibrio* species were the parameters analyzed.

4.2.2.1. Standard Plate Count (SPC) of Four Common Dried Fish in Summer

Table 28 illustrates the result of SPC of four common dried fish in summer. Amongst the four dried samples, S_1, S_2 and S_3 showed microbial load of 3.2 to 4.8x10^4 cfu/gm while Bombay duck (S_3) had one log cycle lower spread plate count (7.8 x 10^3 cfu/gm).

4.2.2.2. Standard Plate Count (SPC) of *Four* Common Dried Fish in Winter

The results revealed that parshe (S_{10}) and shark meat (S_8) carried bacterial load of 8.9 x 10^4 cfu/gm and 6.0 x 10^4 cfu/gm respectively. Spread Plate Count in the other two samples were 4.23 x 10^3 cfu/gm and 7.1 x 10^3 cfu/gm (Table-29).

4.2.2.3. Standard Plate Count (SPC) of Other Dried Fish

SPC of 6 dried samples (S_7, S_9, S_{13}, S_{16}, S_{17} and S_{19}) varied between 2.11 to 7.8 x 10^4 cfu/gm. 2 samples i.e. churifish (S_{11}) and string ray (S_{15}) had SPC of 2.77 to 7.8 x 10^5 cfu/gm and 2.11 to 2.26 x 10^5 cfu/gm respectively. While gang tengra (S_5) and kukurjib (S_{18}) showed lower count and their values were 2.11 to 7.8 x 10^3 cfu/gm and 2.89 to 7.8 x 10^3 cfu/gm (Table-30) respectively.

4.2.2.4. Standard Plate Count (SPC) of Fresh Fish

Out 10 fresh fish sample, total count of 7 sample (FS_2, FS_4, FS_5, FS_8, FS_9 and FS_{10}) ranged from 4.25 to 7.9 x 10^4cfu/gm while the remaining 3 fish samples (FS_1, FS_6, and FS_7) showed a total microbial load of 1.32 to 5.6 x 10^5cfu/gm (Table-31).

Table 28**:** Standard plate count (SPC), total coliform (TC) and faecal coliform of four common dried fish in winter

Sample ID	Standard Plate count cfu/gm	Number of tubes giving positive reaction out of 3 in each dilution						EMB plate	IMViC				Total coliform MPN/gm	Remarks	Number of tubes giving positive reaction out of 3 in each dilution			EMB plate	Indole	Faecal Coliform MPN/gm
		LST broth (37^0 C)			BGLB broth (37^0 C)				Indole	MR	VP	Citrate			BGLB broth (44 C)					
		10^{-1}	10^{-2}	10^{-3}	10^{-1}	10^{-2}	10^{-3}								10^{-1}	10^{-2}	10^{-3}			
S_1	3.2 x 10^4	3	3	3	0	0	0	NA	NA	NA	NA	NA	<3		0	0	0	NA	NA	<3
S_2	4.8 x10^4	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	<3			NA	NA	NA	NA	<3
S_3	7.8 x10^3	3	2	0	1	0	0	'+' atypical	-	-	+	+	4	Enterobacter	0	0	0	NA	NA	<3
S_6	3.7 x10^4	1	0	0	0	0	0	NA	NA	NA	NA	NA	<3		0	0	0	NA	NA	<3

Table 29: Standard plate count (SPC), total coliform (TC) and faecal coliform of four common dried fish in winter

Sample ID	Total count cfu/gm	Number of tubes giving positive reaction out of 3 in each dilution						EMB plate	IMViC				Total coliform MPN/gm	Remarks	Number of tubes giving positive reaction out of 3 in each dilution			EMB plate	Indole	Faecal Coliform MPN/gm
		LST broth (37^0 C)			BGLB broth (37 C)				Indole	MR	VP	Citrate			BGLB broth (44 C)					
		10^{-1}	10^{-2}	10^{-3}	10^{-1}	10^{-2}	10^{-3}								10^{-1}	10^{-2}	10^{-3}			
S_8	3.2 x 10^4	2	1	0	1	0	0	'+' AC	-	-	+	+	4	**Enterobacter**	NA	NA	NA	NA	NA	<3
S_{10}	6 x10^4	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	<3		NA	NA	NA	NA	NA	<3
S_{12}	4.23 x10^3	3	3	3	0	0	0	NA	NA	NA	NA	NA	<3		0	0	0	NA	NA	<3
S_{14}	7.1 x10^3	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	<3		NA	NA	NA	NA	NA	<3

4.2.2.5. Total Coliform (TC) and Faecal Coliform (FC) of Four Common Dried Fish in Summer

For the quantification of total and faecal coliform counts, "**Three Tube MPN***"* method was followed. In summer, out of four samples, three samples (Parshe, Bombay duck and Phasa) produced gas in Larayl Sulfate Triptose Broth (LSTB) and were considered for confirmatory tests for total and faecal coliform. From the positive LSTB tubes, a loopful of

suspension was inoculated in two sets of Brilliant Green Lactose Bile Broth (BGLB). One set was incubated at 37^0 C and while the other set at 44.5 ± 0.5^0 C for 48 hours. It was observed that only S_3 (Bombay duck) produced gas in one tube of 10^{-1} dilution in BGLB tube at 37^0 C and was therefore, considered for presumptive positive. S_3 underwent for further confirmatory tests. Gas production in confirmatory test plated on Eosin Methyline Blue (EMB) agar produced mostly **atypical colony** (colony without dark center and metallic sheen). Isolates from EMB were subjected to IMViC test that produced *Enterobacter* like reaction, a coliform of non-faecal origin. It was concluded that Bombay duck had MPN of total coliform 4 /gm. While the other two samples (S_1, and S_6) of this category (positive in the presumptive test) were found to produce no gas in BGLB broth at 37^0 C. This indicated that gas production in LST broth was due to non-coliform lactose fermenter organism. However, MPN for total coliform of the two were same (MPN value of < 3 / gm). The remaining one, shark meat (S_2) was excluded in the presumptive test (no gas in LST broth) and indicated absence of even non- coliform lactose fermenter group. This suggested excellent status regarding sanitary condition and Good Manufacturing Practice (GMP). (Table-28).

BGLB tubes were incubated in triplicate for each dilution at 44.5 ± 0.5^0 for 48 hours. No positive reaction was detected in either of the sample. This indicated showed the presence (if any) of <3 faecal coliform per gram of sample. The results further confirmed that isolates producing gas in BGLB at 37^0C were of non-faecal origin.

Table 30: Standard plate count (SPC), total coliform (TC) and faecal coliform of other dried fish

Sample ID	Total count cfu/gm	Number of tubes giving positive reaction out of 3 in each dilution						EMB plate	IMViC				Total coliform MPN/gm	Remarks	Number of tubes giving positive reaction out of 3 in each dilution			EMB plate	Indole	Faecal Coliform MPN/gm
		LST broth (37^0 C)			BGLB broth (37 C)				Indole	MR	VP	Citrate			BGLB broth (44 C)					
		10^{-1}	10^{-2}	10^{-3}	10^{-1}	10^{-2}	10^{-3}								10^{-1}	10^{-2}	10^{-3}			
S_5	7.8 x10^3	1	0	0	1	0	0	'+' AC	-	-	+	+	4	*Enterobacter*	0	0	0	NA	NA	<3
S_7	3.7x10^4	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	<3		NA	NA	NA	NA	NA	<3
S_9	6.07 x10^4	3	0	0	1	0	0	'+' AC	-	-	+	+	4	*Enterobater*	0	0	0	NA	NA	<3
S_{11}	2.77 x10^5	3	3	2	3	0	0	'+' AC	-	-	+	+	23	*Enterobater*	0	0	0	NA	NA	<3
S_{13}	3.9 x10^4	1	0	0	1	0	0	'+' AC	-	-	+	+	4	*Enterobater*	0	0	0	NA	NA	<3
S_{15}	2.26 x10^5	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	<3		0	0	0	NA	NA	<3
S_{16}	7.8 x 10^4	2	0	0	0	0	0	NA	NA	NA	NA	NA	<3		0	0	0	NA	NA	<3
S_{17}	5.55 x10^4	1	0	0	0	0	0	NA	NA	NA	NA	NA	<3		0	0	0	NA	NA	<3
S_{18}	2.89 x10^3	1	0	0	0	0	0	NA	NA	NA	NA	NA	<3		0	0	0	NA	NA	<3
S_{19}	2.11 x 10^4	3	1	0	0	0	0	NA	NA	NA	NA	NA	<3		0	0	0	NA	NA	<3

AC = atypical colony; NA = not applicable

4.2.2.6. Total Coliform (TC) and Faecal Coliform (FC) of Four Common Dried Fish in Winter

Total coliform counts were based on the ability of presumptive positive culture to produce gas in BGLB broth at 37^0 C. However, subcultures were also made on EMB plate for the presence of typical coliform colonies. In winter, 2 samples (shark meat and phasa) were excluded in the presumptive test (no gas in LST broth) indicating absence of even non-coliform lactose fermenter group. The remaining two samples (S_{10} and S_{12}) produced gas in LSTB tube and sub-cultures were made to carry out confirmatory tests for total and fecal coliform. Bombay duck (S_{12}) was also excluded due to non-production of gas in BGLB tube. Only S_{10} (parshe) produced gas in one tube of 10^{-1} dilution. Sub-cultures plated on EMB agar produced mostly atypical colony. Isolates from EMB were subjected to IMViC test produced *Enterobacter* like reaction, a coliform of non-faecal origin.

No positive reaction (Table 29) was detected in tubes of BGLB incubated at 44.5 ± 0.5^0 for 48 hours. This indicated the presence (if any) of <3 faecal coliform per gram of sample. The results further confirmed that isolates producing gas in BGLB at 37^0C were of non-faecal origin.

4.2.2.7. Total Coliform (TC) and Faecal Coliform (FC) of other Dried Fish

Out of 10 other dried fish sample total coliform count for 6 was <3/gm. While in the remaining 4 dried fish sample, total coliform varied between 4 to 28 /gm. Sub-cultures of this 4 sample produced characteristic (atypical) colony on EMB plate. These colonies were subjected to IMViC test and showed *Enterobacter* like reaction.

None of BGLB tube produced gas at 44.5 ± 0.5^0 for 48 hours indicating the absence of faecal coliform (Table-30).

Table 31: Standard plate count (SPC), total coliform (TC) and faecal coliform of fresh fish

Sample ID	Description	Total count cfu/gm	Number of tubes giving positive reaction out of 3 in each dilution						EMB plate	Total Coliform MPN/gm	Number of tubes giving positive reaction out of 3 in each dilution			EMB plate	Indole	Faecal Coliform MPN/gm
			LST broth (37^0 C)			BGLB broth (37 C)					BGLB broth (44 C)					
			10^{-1}	10^{-2}	10^{-3}	10^{-1}	10^{-2}	10^{-3}			10^{-1}	10^{-2}	10^{-3}			
FS_1	Parshe	3.1×10^5	3	1	0	2	0	0	+	9	2	0	0	+	+	9
FS_2	Phasa	5.6×10^4	2	1	0	1	1	0	+	7	1	0	0	+	+	4
FS_3	Boiragi	4.8×10^4	3 2	2 2	01 2	02	02	1	+	28	02	02	0	+	+	21
FS_4	Bish tara	3.6×10^4	3 3	3 3	3 3	3	2	2	+	210	3	2	0	+	+	93
FS_5	Tular danti	3.1×10^4	2 2	2 1	0 0	2	1	0	+	15	2	0	0	+	+	9
FS_6	Gang tengra	1.08×10^5	3 2	1 1	0 0	2	0	0	+	9	2	0	0	+	+	9
FS_7	Ilish	1.62×10^5	3 3	3 2	3 2	2	2	1	+	21	2	1	1	+	+	20
FS_8	Gangra	8.2×10^4	3 2	1 1	0 0	3	1	0	+	43	3	01	0	+	+	<3
FS_9	Chat baila	7.1×10^4	3 3	2 2	1 2	2	2	1	+	28	1	1	0	+	+	11
FS_{10}	Kankon	4.8×10^4	3 3	2 2	2 1	2	1	1	+	20	2	1	0	+	+	15

4. 2. 2.8. Total Coliform (TC) and Faecal Coliform (FC) of Fresh Fish

Out of 10 fresh fish sample, total coliform counts for 9 were in the range of 7 to 43 per gm. TC of the remaining sample (FS_4) was 210 / gm (Table-31).

For estimation of faecal coliform, a second set of BGLB broth was inoculated with presumptive positive culture and incubated at 44.5^0 C. Gas production in BGLB at 44.5^0C was indicative of the presence of coliform which was further confirmed by indole test. According to MPN table (Marvin, 1984), faecal coliform count of FS_3, FS_4, FS_7, FS_9 and FS_{10} were 21, 93, 20, 11 and 15 respectively while WHO allowable limit is 10 per gm. Three other samples (FS_1, FS_5 and FS_6) showed a faecal coliform load of 9 per gm. which was very close to the upper limit. However, faecal count of the rest two fresh fish samples, FS_2 and FS_8 were 4 and < 3 per gram respectively. It was therefore evident that most of the fish samples under tests were heavily exposed to coliform contamination of both faecal and non-faecal origin.

4.2.2.9. *Vibrio cholerae* and *Salmonella sp.* of Dried Fish

25 gm portion of 18 dried fish samples (pooled) were tested for the presence of *Vibrio sp.* Alkaline peptone water enrichment step was followed by plating on TCBS agar. Six (6) samples (S_2, S_3, S_6, S_7, S_{15} and S_{17}) produced no characteristic colony. It is important to note that among six- (6) species five (5) were those, which gave, negative presumptive reaction in coliform estimation. However, colonies were picked up from rest of the 12 samples but all of them were screened out on the basis of reaction they produced in KIA and urea tube, sometimes coupled with a negative oxidase test (Table-32).

25 gram of pooled fish samples from each specimen was tested for presence of *Salmonella sp.* After pre-enrichment (buffered peptone water) and selective enrichment (selenite and tetrathionate broth), they were plated on XLD and SS agar. Table 35 showed that nine (9) samples (S_2, S_3, S_6, S_7, S_{10}, S_{13}, S_{15}, S_{16} and S_{18}) produced no characteristic colony. It is important to note that these nine (9) included those five (S_2, S_3, S_6, S_7 and S_{15},) excluded in presumptive test for coliform estimation.

Table 32: Isolation and Identification of *Vibrio sp.* from dried fish samples

Specimen ID	Plating on TCBS	Kliglers Iron Agar (KIA)				Urease	Indole	Oxidase	Citrate	Motility	Results/ remarks
		Slant	Bult	H_2S	Gas						
S_1	Picked (1)	A	A	-	+	+	NA	NA	NA	NA	Negative
S_2	No colony	NA	NA	NA	NA	NA	NA	NA	NA	NA	Negative
S_3	No colony	NA	NA	NA	NA	NA	NA	NA	NA	NA	Negative
S_5	Picked (2)	A A	A A	- -	+ +	- -	NANA	– -	NA NA	NA NA	Negative Negative
S_6	No colony	NA	NA	NA	NA	NA	NA	NA	NA	NA	Negative
S_7	No colony	NA	NA	NA	NA	NA	NA	NA	NA	NA	Negative
S10	Picked (2)	K K	K K	_ _	_ _	- -	NA NA	_ _	NA NA	NA NA	Negative Negative
S13	Picked (2)	A A	A A	_ _	+ +	+ _	NANA	NANA	NA -	NA NA	Negative Negative
S14	Picked (2)	K A	K A	_ -	_ +	- -	NA NA	- -	NA NA	NA NA	Negative Negative
S15	No colony	NA	NA	NA	NA	NA	NA	NA	NA	NA	Negative
S16	Picked (2)	A A	A A	+ +	- -	+ +	NA NA	NA NA	NA NA	NA NA	Negative Negative
S17	No colony	NA	NA	NA	NA	NA	NA	NA	NA	NA	Negative
S18	Picked (1)	K	K	-	-	-	NA	-	NA	NA	Negative
S19	Picked (1)	K	K	-	-	-	NA	-	NA	NA	Negative

Table 33: Isolation and Identification of *Salmonella sp.* from dried fish

Specimen ID No.	**Plating XLD/SS**	**KIA**				**Urease**	**Indole**	**Motility**	**Glycerol fermentation**	**Citrate utilization**	**Remarks**
		Slant	**Butt**	**H_2S**	**Gas**						
S_1	Picked	K	K	-	-	-	NA	NA	NA	NA	Negative
S_2	No colony	NA	NA	NA	NA	NA	NA	NA	NA	NA	Negative
S_3	No colony	NA	NA	NA	NA	NA	NA	NA	NA	NA	Negative
S_5	Picked (2)	A A	A A	- +	+ +	+ +	NA NA	NA NA	NA NA	NA NA	Negative Negative
S_6	No colony	NA	NA	NA	NA	NA	NA	NA	NA	NA	Negative
S_7	No colony	NA	NA	NA	NA	NA	NA	NA	NA	NA	Negative
S_8	Picked 1	A	A	-	+	+	NA	NA	NA	NA	Negative
S_9	Picked (2)	A A	A A	- +	+ +	+ +	NA NA	NA NA	NA NA	NA NA	Negative Negative
S_{10}	No colony	NA	NA	NA	NA	NA	NA	NA	NA	NA	Negative
S_{11}	Picked (1)	K	A	-	-	-	+	_	+	-	Negative (*Citrobacter* like reaction)
S_{12}	Picked (2 colonies)	A A	A A	_ _	+ +	+ _	NA NA	NA NA	NA NA	NA NA	Negative Negative
S_{13}	No colony	NA	NA	NA	NA	NA	NA	NA	NA	NA	Negative
S_{14}	Picked (2 colonies)	K A	K A	_ _	- +	- +	NA NA	NA NA	NA NA	NA NA	Negative Negative
S_{15}	No colony	NA	NA	NA	NA	NA	NA	NA	NA	NA	Negative
S_{16}	No colony	NA	NA	NA	NA	NA	NA	NA	NA	NA	Negative
S_{17}	Picked (2 colonies)	A A	A A	_ _	+ +	_ _	NA NA	NA NA	NA NA	NA NA	Negative Negative
S_{18}	No colony	NA	NA	NA	NA	NA	NA	NA	NA	NA	Negative
S_{19}	Picked (1)	A	A	-	+	+	NA	NA	NA	NA	Negative

Colonies were selected for remaining 9 dried fish samples. All of them were screened out on the basis of reaction in KIA and urease tube except S_{11}, which produced Citrobacter (a soil inhabitant genus of the family enterobacteriace), like reaction. Thus, *Salmonella* were not detected in either of the eighteen fish sample (Table-33).

4. 2. 2.10. *Vibrio cholerae* and *Salmonella sp.* of Fresh Fish

Alkaline peptone water was used for selective enrichment for the detection of *Vibrio cholerae.* Colonies were picked up for biochemical characterization in case of all ten samples studied except FS_6, which produced no colonies on TCBS agar.

All the isolates characterized were screened out on the basis of unlike reaction in KIA tube (i.e. K/K or A/A), positive urease and negative oxidase test. However, 25 gm of fresh fish sample from all ten species found to contain no *Vibrio cholerae* (Table-34).

25 gm of pooled sample from each species were processed for detection of *Salmonella.* XLD plate and SS agar plate were streaked following selective enrichment in selenite and tetrathionate broth. One or more colonies were picked up from all the fish species for biochemical characterization. Few of them (e.g. FS_1, FS_2, FS_3, FS_4 etc.) were excluded on the basis of reaction they produced in KIA and Urease test. However, those showed alkaline slant, acid butt (K/A) reaction in KIA and negative urease test, were screened out for their non-motility, negative indole test and positive glycerol fermentation test. This is illustrated in Table-35. Thus, *Salmonella* was not detected in fish samples studied.

Although *Vibrio* and *Salmonella* were not detected from the ten fish species under investigation, it was evident that the fish species were exposed to faecal contamination. We know that, presence and dynamics of pathogenic bacterial population in open water system is not constant and is associated with the onset of pathogenic diseases in the adjacent localities. Therefore, if sampling covers the year round biweekly and sampling number is increased possibility of the detection of *Vibrio* and *Salmonella* can't be overruled.

Table 34: Isolation and Identification of *Vibrio sp.* from fresh fish

Sample ID	Description	Plating on TCBS	Kigler's Iron Agar (KIA)				Urease Urease	Indole Indole	Oxidase	Motility	Citrate	Serology	Remarks
			Slant	Butt	H_2S	Gas							
FS1	Parshe	Picked (2)	A A	A A	- -	+ +	- -	+ +	_ _	NA NA	NA NA	NA NA	Negative Negative
FS_2	Phasa	Picked (2)	A A	A A	- -	+ -	- -	+ +		NA NA	NA NA	NA NA	Negative negative
FS_3	Boiragi	Picked (2)	A K	A A	- -	- -	- -	+ +	- +/-	NA NA	NA NA	NA NA	 Negative
FS_4	Bish tara	Picked (2)	A A	A A	- -	+ -	_ _	_ +		NA NA	NA NA	NA NA	Negative Negative
FS_5	Tular danti	Picked (2)	A A	A A	- -	- +	_ _		_ _	NA NA	NA NA	NA NA	Negative Negative
FS_6	Gang tengra	-	NA	NA	NA	NA	NA	NA	NA	NA NA	NA NA	NA NA	Negative Negative
FS_7	Ilish	Picked (2)	K/K K	A/AA	- -	- -	- +		-	NA NA	NA NA	NA NA	Negative Negative
FS_8	Gangra	Picked (2)	K A	A A	- -	- --	- -	+ +	- -	NA NA	NA NA	NA NA	Negative Negative
FS_9	Chat baila	Picked (2)	K A	K A	_ _	_ +	_ _		- -	NA NA	NA NA	NA NA	Negative Negative
FS_{10}	Kankon	Picked (3)	A A K	A A A	+ + -	- - +			-	NA NA	NA NA	NA NA	Negative Negative Negative

Table 35: Isolation and Identification of *Salmonella sp.* from fresh fish

Sample ID	Description	Plating x LD/SS	Triple sugar iron (TSI)				Urease	Indole	motility	Glycerol fermentation	Citrate utility	Serology	Remarks
			Slant	Butt	H2S	Gas							
FS1	Parshe	Picked 1 colony	A	A	-	+	+	NA	NA	NA	NA	NA	Negative
FS_2	Phasa	Picked (2 colonies)	A A	A A	- -	+ +	+	NA	NA	NA	NA	NA	Negative Negative
FS_3	Boiragi	Picked (2 colonies)	A A	A A	- +	+ +	+	NA	NA	NA	NA	NA	Negative Negative
FS_4	Bish tara	No colony	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Negative
FS_5	Tular danti	Picked (3 colonies)	K K A	K K A	_ _ +	_ _ _	NA NA _	NA NA _	NA NA +	NA NA +	NA NA _	NA NA NA	Negative Negative Negative
FS_6	Gang tengra	Picked (3 colonies)	K A	A A	_ +	_ _	_ +	+ NA	_ NA	_ NA	_ NA	NA NA	Negative Negative
FS_7	Ilish	Picked (1 colony)	K	A	-	-	-	+			-		Negative
FS_8	Gangra	Picked (4 colonies)	K K K K	K K A A	_ _ + +	_ _ _ _	_ _ _	NA NA _ _	NA NA + +	NA NA + +	NA NA + +	NA NA NA NA	Negative Negative Negative Negative
FS_9	Chat baila	Picked (3 colonies)	K K	A A	_ _	_ _	_ _	+ +	_ _	NA NA	_ _	NA NA	Negative Negative
FS_{10}	Kankon	Picked (2 colonies)	K K	K A	+ +	- +	- +	NA NA	NA NA	NA NA	NA NA	NA NA	Negative Negative

4.3.3. Biochemical Assessment

4. 3.3.1. Proximate Composition of Four Common Dried Fish in Summer

Proximate composition of four common dried fish in summer is shown in Table-36. The moisture content of four dried fish varied between 19.32 % to 24.22 %. The highest moisture content (24.22 %) was found to be in Phasa (S_6) while lowest in Bombay duck (S_3).

Table 36**:** Proximate composition of four common dried fish in summer

ID	Species	Moisture (%)	Ash (%)	Protein (%)	Fat (%)
S_1	Parshe	21.19	10.35	60.58	8.22
S_2	Shark	23.81	8.12	64.06	2.97
S_3	Bombay duck	19.32	15.27	59.27	5.12
S_6	Phasa	24.22	16.02	55.25	4.5

Ash content in Parshe (S_1), Shark (S_2), Bombay duck (S_3) and Phasa (S_6) were 10.35%, 8.12%, 15.27% and 16.02% respectively in summer. However, S_2 (shark) sample indicated a much lower content of ash (8.12%) in comparison to the rest of the three samples. Protein content varied between 55.25 to 64.06%. S_6 (Phasa) indicated a lower content of protein (55.25%) in comparison to the rest three samples (Table-36). Results of the proximate composition showed relatively lower content of fat (2.97% to 8.22%). S_1 indicated highest fat content (8.22%) while S_2 lowest (2.97%).

4. 3.3.2. Proximate Composition of Four Common Dried Fish in Winter

Moisture content varied between 19.93 to 24.46 % in 4 dried fish species studied. The moisture content in Parshe was only 19.93% indicating satisfactory drying. Ash content of the four samples ranged from 7.45 to 19.51 %. However, Parshe indicated a much lower content of ash (7.45%) in comparison to the remaining three samples (S_8, S_{12} and S_{14}) where the values varied between 13.31 to 19.51% (Table-37).

Table 37: Proximate composition of four common dried fish in winter

ID	Species	Moisture (%)	Ash (%)	Protein (%)	Fat (%)
S_8	Shark	23.49	11.32	58.35	7.84
S_{10}	Parshe	19.93	7.45	68.09	4.87
S_{12}	Phasa	24.46	9.51	62.36	3.67
S_{14}	Bombay duck	21.26	15.02	61.25	3.5

Protein content of four common dried fish i.e. Shark (S_8), Parshe (S_{10}), Phasa (S_{12}) and Bombay duck (S_{14}) were 58.35%, 68.09%, 621.36% and 61.25% respectively in winter. The highest (68.09%) and lowest (58.35%) protein content were found in Parshe and Bombay duck.

It was observed that sample; S_8 (shark) indicated comparatively higher fat content (7.84%). While, the rest of the three samples i.e. Parshe, Bombay duck and Phasa (S_{10}, S_{12} and S_{14}) had almost similar fat percentage varying between 3.5% to 4.87%. (Table-37)

4. 3.3.3. Proximate Composition of Other Dried Fish

Table-38 summarises the results of proximate composition of other dried fish species collected from the project site. Moisture content of the samples varied over a large range, from 18.23% to 23.61%. Likewise, protein (40.69% to 66.52%), fat (7.10% to 26.13%) and ash (5.08 to 12.14%) content also varied widely.

Table 38: Proximate composition of other dried fish

ID	**Species**	**Moisture (%)**	**Ash (%)**	Protein **(%)**	Fat **(%)**
S_5	Tangra	19.22	5.08	66.52	9.03
S_7	Hilsha	23.9	9.11	40.69	26.13
S_9	Topsha	21.65	12.14	57.25	8.95
S_{11}	Churi fish	23.61	10.78	53.85	11.71
S_{13}	Rupchanda	18.23	10.91	63.49	7.1
S_{15}	Shaplapata	21.08	11.01	54.19	25.3
S_{16}	Sea eel	20.98	9.98	56.77	11.19
S_{17}	Sea bass	23.19	6.32	61.24	7.94
S_{18}	Kukurjib	21.7	11.85	54.86	11.44
S_{19}	Potka	23.31	7.22	57.51	9.69

4. 3.3.4. Proximate Composition of Fresh Fish

Table-39 provides the results of proximate composition of 10 fresh fish samples of 10 different species.

Moisture content of 10 fresh fish varied between 65.33% to 78.99%. Out of 10 fresh samples, FS_6 (Gang tengra) and FS_2 (Ilish) showed comparatively lower moisture content (65.33% and 67.21%). While FS_2 (Phasa) indicated much higher content of moisture (78.99%).

Table 39**:** Proximate composition of fresh fish

ID	**Species**	**Moisture (%)**	**Ash (%)**	**Protein (%)**	**Fat (%)**
FS_1	Parshe	70.83	1.7	21.38	6.12
FS_2	Phasa	78.99	2.78	8.58	9.65
FS_3	Boiragi	76.61	2.97	11.75	8.67
FS_4	Bistara	75.74	2.42	15.58	6.26
FS_5	Tular danti	72.46	2.39	14.19	10.96
FS_6	Gang tengra	65.33	8.41	19.06	6.79
FS_7	Ilish	67.21	1.9	17.6	12.99
FS_8	Taposhi	76.02	1.07	15.97	6.94
FS_9	Chat baila	74.31	2.12	17.03	6.54
FS_{10}	Kankon	77.57	2.35	10.05	10.03

Ash values of all 10 fresh fish studied ranged from 1.07 to 8.41%. Sample, FS_6 (Gang tengra) showed highest ash content (8.41%) in comparison to other fresh fish (Table-39).

The value of protein content in 10 fresh fish samples (FS_1, FS_2, FS_3, FS_4, FS_5, FS_6, FS_7, FS_8, FS_9, and FS_{10})) were 21.38%, 8.58%, 11.75%, 15.58%, 14.19%, 19.06%, 17.6%, 15.97%, 17.03%, and 10.05% respectively. Amongst the 10 fresh sample, FS_1 (Parshe) showed higher amount of protein (21.38%).

Fat content of 10 fresh fish studied varied between 6.12% to 10.96%. It was evident that Ilish showed maximum fat content (10.96%).

4.3.3.5. Total Volatile Basic Nitrogen (TVB-N), Trimethyl Amine Nitrogen (TMA-N) and pH of Four Common Dried Fish in Summer

Table 40 illustrates the biochemical changes in four dried fish in summer. TVB-N values varied between 48.28 m 0.87 to 70.73 m 0.22 mg-N/100g. However, shark (S_2) indicated a much lower content of TVB-N (48.28 m 0.87 mgN/100g) in comparison to the other three samples (S_1, S_3 and S_6) where the values were higher than 55.0 mg/100g.

Table 40: TVB-N, TMA-N and pH of dried fish in summer

ID	Species	TVB-N (mgN/100g)	TMA-N (mgN/100g)	pH
S_1	Parshe	57.82 ± 0.69	43.5 ± 0.46	8.07 ± 0.20
S_2	Shark	48.28 ± 0.87	34.14 ± 0.69	8.07 ± 0.06
S_3	Bombay duck	70.73 ± 0.22	56.17 ± 0.29	8.13 ± 0.05
S_6	Phasa	59.86 ± 0.61	44.15 ± 0.96	7.37 ± 0.21

As with TVB-N value, S_2 (shark) showed a much reduced amount of TMA-N (34.14 ± 0.69 mgN/100g). While Parshe, Bombay duck and Phasa (S_1, S_3 and S_6) had TMA-N content of 43.5 ± 0.46, 56.17 ± 0.29 and 44.15 ± 0.96 mg-N/100g respectively (Table-40).

pH did not follow a similar pattern to that observed for TVB-N and TMA-N in the samples. The pH of Phasa (S_6) was observed to be much lower (7.37 ± 0.21). The rest of the other samples (S_1, S_3 and S_6) indicated a pH value ranging between 8.07 ± 0.06 to 8.13 ± 0.05. This is shown in Table-40.

4.3.3.6. Total Volatile Basic Nitrogen (TVB-N), Trimethyl Amine Nitrogen (TMA-N) and pH of Four Common Dried Fish in Winter

TVB-N values varied between 33.31 ± 0.75 to 62.23 ± 0.71 mg-N/100g in the four dried fish species studied in winter. Bombay duck (S_{12}) and Phasa (S_{14}) indicated much lower content of TVB-N (33.31 ± 0.75 and 46.21 ± 0.49). While samples (S_8 and S_{10}) had value that were lower than 62.0 mgN/100g (Table-41).

TMA-N content of the four samples in winter ranged between 22.81± 0. 08 to 51.13 ± 0.45 mg- N/100g. S_8 (shark) had highest (51.13 ± 0.45) while S_{12} (phasa) the lowest (22.81 ± 0.08) of TMA-N content (Table-41).

Table-41: TVB-N, TMA-N and pH of 4 common dried fish in winter

ID	Species	TVB-N (mgN/100g)	TMA-N (mgN/100g)	pH
S_8	Parshe	62.23 ± 0.71	51.13± 0.45	7.93 ± 0.09
S_{10}	Shark	62.40 ± 0.52	43.96 ± 0.33	8.27 ± 0.04
S_{12}	Bombay duck	33.31 ± 0.75	22.81 ± 0.08	8.07 ± 0.05
S_{14}	Phasa	46.21 ± 0.49	37.53 ± 0.30	8.03 ± 0.05

pH in the three samples ($S_{10,}$ S_{12} , and S_{14}) was almost same while for S_8 (Parshe), the value was found to be little lower (Table-41).

4.3.3.7. Total Volatile Basic Nitrogen (TVB-N), Trimethyl Amine Nitrogen (TMA-N) and pH of Other Dried Fish

The results revealed that TVB-N content of other dried fish ranged from 26.84 ± 0.38 to 72.11± 0.69 mg-N/100g (Table-42). Tengra indicated maximum content of TVB-N (72.11 ± 0.69) while Kukurjib the minimum (26.84 ± 0.38). Ilish, Taposhi, Churi, Saplapata and Sea eel showed TVB-N content higher than 50 mgN/100g. The minimum content of TMA-N were in accordance with that of TVB-N, the value being 19.87 ± 0.43 for Kukurjib. While the maximum was found in Taposhi (48.87 ± 0.69). The other samples which had greater than 40.0 mgN/100g were Tengra, Ilish and Saplapata. All fish samples showed pH value greater than 8.00 except for Saplapata (7.63 ± 0.06).

Table 42: TVB-N, TMA-N and pH of other dried fish

ID	Species	TVB-N (mgN/100g)	TMA-N (mgN/100g)	pH
S_5	Tengra	72.11± 0.69	45.61 ± 0.61	8.27 ± 0.06
S_7	Ilish	53.16 ± 0.58	41.99 ± 0.28	8.03 ± 0.07
S_9	Taposhi	59.18 ± 0.1	48.87 ± 0.69	8.23 ± 0.15
S_{11}	Churi	53.19 ± 0.47	36.40 ± 0.30	7.67 ± 0.05
S_{13}	Rupchanda	41.65 ± 0.28	28.27 ± 0.30	8.13 ± 0.12
S_{15}	Saplapata	62.88 ± 0.24	45.07 ± 0.54	7.63 ± 0.06
S_{16}	Sea eel	54.48 ± 0.01	36.01 ± 0.05	8.17 ± 0.02
S_{17}	Bole	38.09 ± 0.23	27.35 ± 0.51	8.03 ± 0.03
S_{18}	Kukurjib	26.84 ± 0.38	19.87 ± 0.43	8.33 ± 0.05
S_{19}	Potka	41.86 ± 0.76	26.13 ± 0.91	8.17 ± 0.23

4.3.3.8. Total Volatile Basic Nitrogen (TVB-N), Trimethyl Amine Nitrogen (TMA-N) and pH of Fresh Fish

Table 43: TVB-N, TMA-N and pH of Fresh Fish

ID	Species	TVB-N (mg-N/100g)	TMA-N (mg-N/100g)	pH
FS_1	Parshe	20.50 ± 0.48	13.51 ± 0.30	6.77 ± 0.15
FS_2	Phasa	24.67 ± 0.51	17.98 ± 0.43	6.7 ± 0.07
FS_3	Boiragi	23.27 ± 1.34	16.33 ± 0.68	6.83 ± 0.06
FS_4	Bistara	16.30 ± 0.77	12.58± 0.77	6.93 ± 0.06
FS_5	Tular danti	12.15 ± 0.67	9.93 ± 0.67	6.73 ± 0.05
FS_6	Gang tengra	25.75 ± 0.80	18.50 ± 0.77	7.03 ± 0.05
FS_7	Ilish	22.17 ± 0.75	17.35 ± 0.81	6.93 ± 0.05
FS_8	Taposhi	10.92 ± 0.23	7.70 ± 0.67	6.8 ± 0.12
FS_9	Chat baila	12.92 ± 0.96	8.90 ± 0.54	6.77 ± 0.05
FS_{10}	Kankon	19.02 ± 0.67	14.42± 0.67	6.73 ± 0.05

The result of TVB-N, TMA-N and pH of fresh fish is listed in Table-43. TVB-N content of 10 fresh fish varied between 10.92 m 0.23 to 25.75 ± 0.80 mg-N/100g. Parshe, Phasa, Boiragi and Ilish had TVB-N content greater than 20 mgN/100g. The minimum and maximum amount of TVB-N were in Taposhi and Gang tengra (10.92 m 0.23 to 25.75 ± 0.80). Similar pattern of result was observed for TMA-N content (7.70 m 0.67 and 18.50 ± 0.77). Amongst the 10 fresh sample, FS_6 (Gang tengra) showed highest pH (7.03 m 0.5.) while FS_2 (phasa) the lowest (6.7 m 0.7).

4.3.4. Water Reconstitution Behavior

4. 3.4. 1. Water Reconstitution Rate of Four Common Dried Fish in Summer

The reconstitution rate (%) of the dried products soaked in water at normal room temperature and hot water (80^0C) in summer of four common dried fish are presented in Fig. -28. The dried samples were allowed to soak in water at temperature for 150 minutes and in hot water (80^0C) for 60 minutes and water reconstitution rate (%) were found to be 79.74%, 58.77%, 72.15% & 72.5% and 74.78%, 62.27%, 67.15% & 72.5% respectively. The water reconstitution rate at hot water was found to be faster than water at room temperature except for the sample S_3 that indicated a lower water reconstitution rate (74.78%).

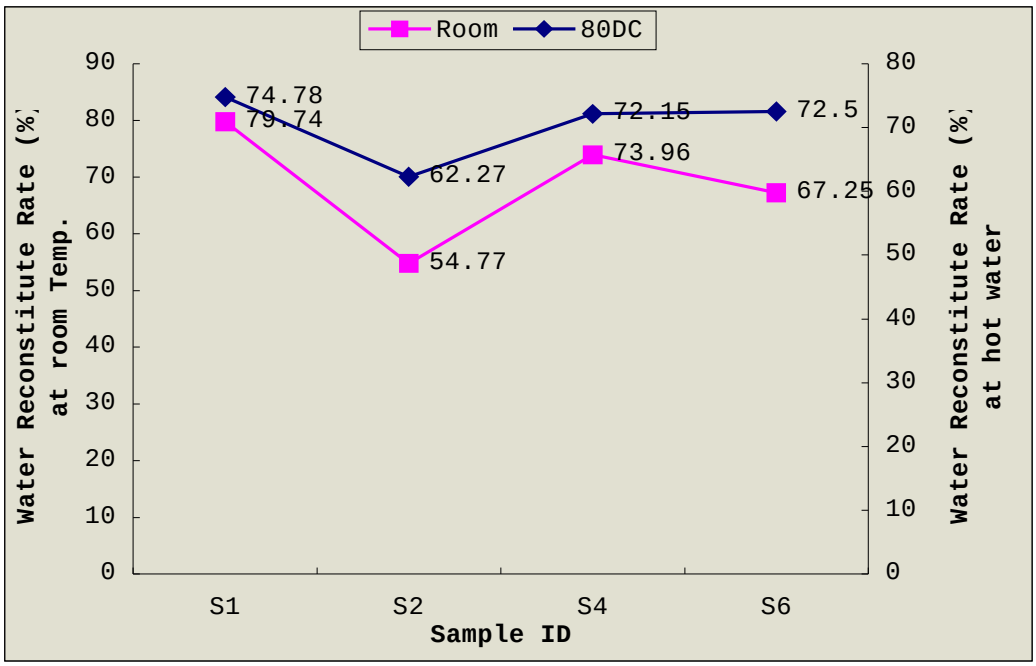

Fig.28: Water reconstitution rate of four common dried fish in summer

4. 3.4. 2. Water Reconstitution Rate of Four Common Dried Fish in Winter

Figure 29 shows the water reconstitution rate (%) of four common dried fish in winter. The values were found to be 78.16%, 48.26%, 65.01% & 65.61% and 74.01%, 55.67%, 69.32% & 69.86% in room temperature and at 80^0C respectively. The water reconstitution rate at hot water was found to be faster than water at room temperature except for the sample S_{10} that showed a reduced percentage (74.01%).

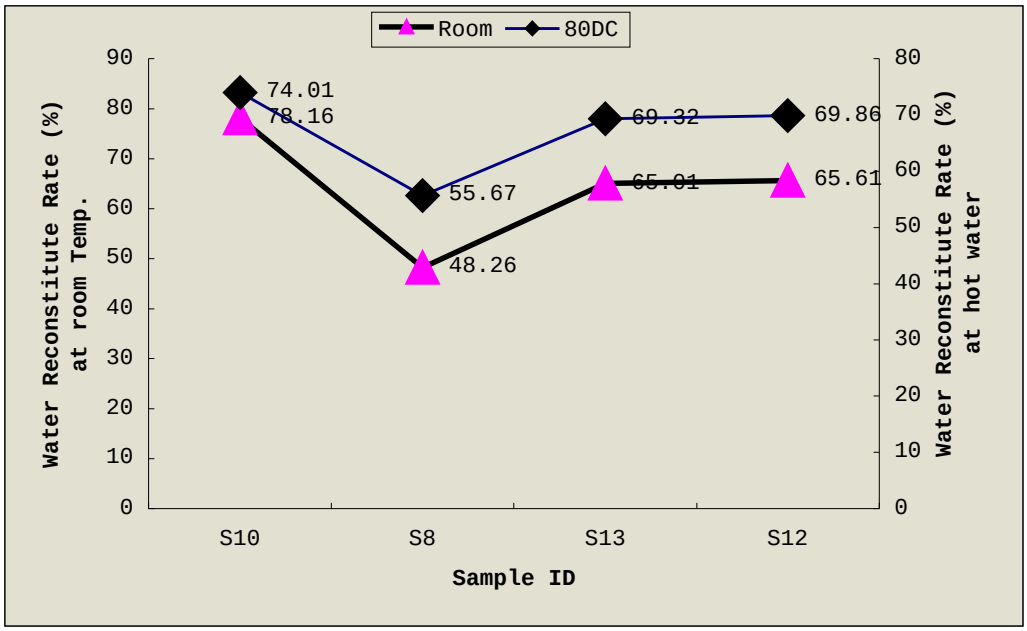

Fig.29: Water reconstitution rate of four common dried fish in winter

4.3.4. 3. Water Reconstitution Rate of Other Dried Fish

Table-44: Water reconstitution rate (%) of other dried fish

ID	Water Reconstitution Rate (%)	
	At room temperature for 150 minutes	At 80^0 C for 60 minutes
S_5	58.68	66.48
S_7	46.85	55.03
S_9	53.90	60.05
S_{11}	70.48	74.99
S_{13}	64.25	68.94
S_{15}	46.34	54.91
S_{16}	57.26	62.17
S_{17}	65.87	68.91
S_{18}	73.22	78.58
S_{19}	45.98	53.63

The results of the water reconstitution rate of other dried sample are represented in Table-44. It was observed that all the samples had shown a similar pattern. The reconstitution rate at hot water (80^0C) was found to be faster compared to the rate at room temperature. Sample S_{11} (churifish) was found to have the highest water reconstitution rate both at room temperature and hot water temperature while sample S_{19} (Potka fish) the lowest.

4.4. Comparative Study of Four Common Dried Fish between Summer and Winter

4.4.1. Organoleptic

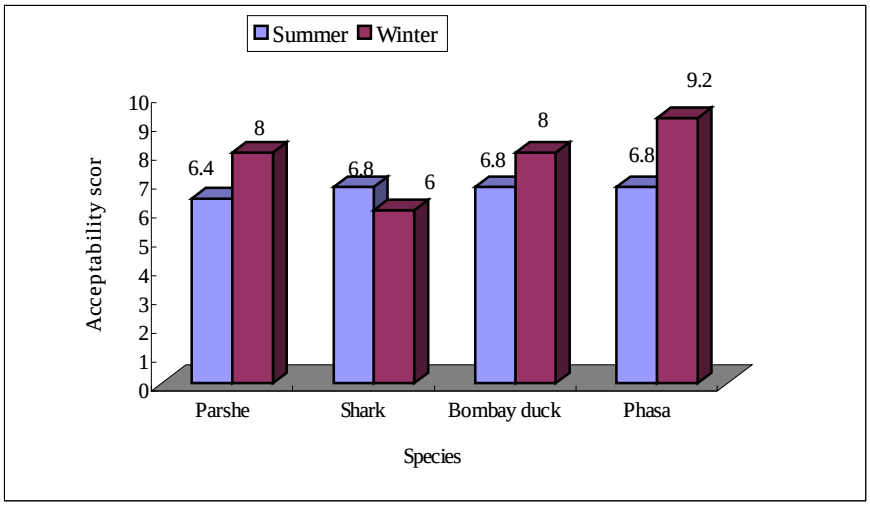

Figure 30: Comparative study of the organoleptic assessment of four common dried fish in summer and winter

The organoleptic evaluation of food products to any processing technology is very important in determining the consumer acceptability. The organoleptic parameters that are important include colour, texture, odour and taste. A three-member panel individually judged each parameter. For simplicity of evaluation only overall acceptability was compared. Figure 30 gives a comparative study of organoleptic status of four common dried fish sample collected from Kuakata in summer and winter. The results showed that the organoleptic score of samples collected in winter were higher than summer season. All the winter samples were provided a score of 8 and higher except for Shark (S_{10}) which was given a score of only 6.0. While the summer sample had a score ranging between 6.4 to 6.8 with a remark of ' Like slightly' by the panellists. Winter samples were better as they were brought immediately for assessment while summer samples were stored for a longer period before being processed.

4.4.2. Microbiology

Table 45 shows the comparative study of microbiological parameters of four common (collected twice) dried fish observed in summer and winter. The standard plate count (SPC) of different samples in summer and winter indicated an acceptable microbial load. For dried fish sample collected in summer season, the SPC counts varied between a range of 3.2×10^4 cfu/gm to 4.8×10^4 cfu/gm while the SPC of the other sample, Bombay duck, S_3 was 7.8×10^3 cfu/gm (Table 45). SPC of these three samples had little variation while S_3 showed one log cycle difference compared to the three samples. In winter, S_1, S_2 and S_3 (Parshe, Shark and Bombay duck) indicated similar pattern. Sample S_6 also showed a one-log cycle difference in SPC in summer.

Table-45: Comparative study of microbiological assessment of the four common dried fish between summer and winter.

Sample ID	Species	Total count cfu/gm		Total coliform MPN/gm		Faecal Coliform MPN/gm		*Salmonella* and *Vibrio*	
		Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
S_1	Parshe	3.2×10^4	6.07×10^4	<3	4	<3	<3	ND	ND
S_3	Shark meat	4.8×10^4	7.7×10^4	<3	<3	<3	<3	ND	ND
S_5	Bombay duck	7.8×10^3	4.23×10^3	4	<3	<3	<3	ND	ND
S_7	Phasa	3.7×10^4	7.1×10^3	<3	<3	<3	<3	ND	ND

ND = Not Detected

Total Coliform (TC) counts of dried fish sample in summer and winter were in the acceptable limit and had no differences except for S_1 (4 in winter) and S_3 (4 in summer). Total Coliform (TC) counts of rest of the samples were <3 MPN/gm. The faecal coliform counts of all the samples were also < 3 MPN/gm. *Vibrio sp.* and *Salmonella sp.* were not detected in any of the dried fish sample studied.

4.4.3. Biochemical

Comparative study of proximate composition of four common dried fish between summer and winter is shown in Figure 31, 32, 33 and 34.

It is evident that a slight variation was observed in moisture, ash, protein and fat content of four common dried fish in summer and winter. Moisture content of Parshe was higher in summer (21.19%) rather than winter (19.93%). It may be attributed to the fact that it was processed in winter and investigated immediately as winter was the season of processing. In summer this fish was stored at ambient temperature and probably it absorbed moisture from the atmosphere. Ash, protein and fat content of Parshe were also higher in summer. The values were 10.35%, 60.58% and 8.22% (summer) and 7.45%, 68.09% and 4.87% (winter) respectively (Fig.-31).

Proximate composition of Shark, Bombay duck and Phasa followed a similar pattern to that observed in Parshe between summer and winter (Fig.-32, 33 and 34).

In case of Parshe and Shark, TVB-N was higher in winter than summer. The value of TVB-N of the two dried fish in winter were 62.23 ± 0.71 and 62.40 ± 0.52 mg-N/100g which decreased in summer (57.82 ± 0.69 mg- N/100g and 48.28 ± 0.87) (Fig.-35).

TMA-N content of the two species (Parshe and Shark) showed a similar pattern to that of TVB-N (Fig.-36). TVB-N and TMA-N content of the remaining two species i.e. Bombay duck and Phasa showed a reverse pattern in comparison to Parshe and Shark. (Fig.35 and 36).

Fig. 37 illustrates a comparative study of pH of the four common dried fish between summer and winter. Parshe and Bombay duck showed higher pH in winter (8.03 and 8.13) than summer (7.93 and 8.07) while, Shark and Phasa showed higher pH in summer. The values of this two-dried fish were 8.27 and 8.03 in summer and 8.07 and 7.37 in winter respectively.

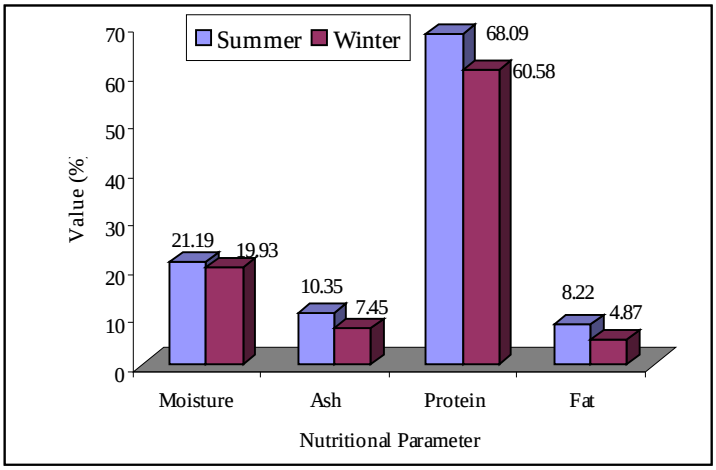

Figure-31: Comparative study of proximate composition of Parshe between summer and winter

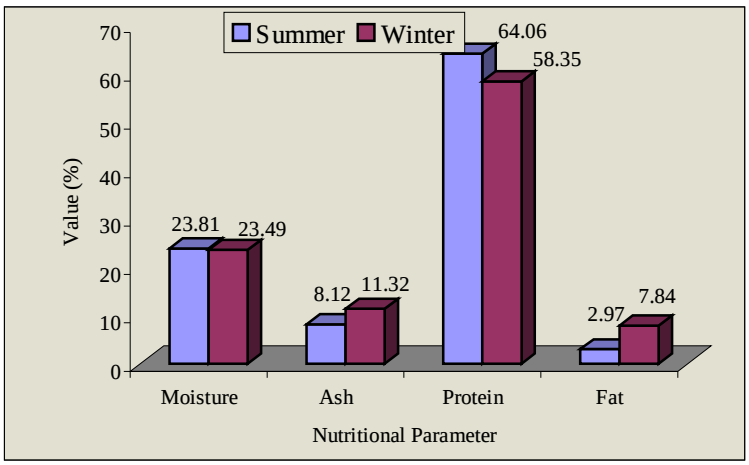

Figure-32: Comparative study of proximate composition of Shark between summer and winter

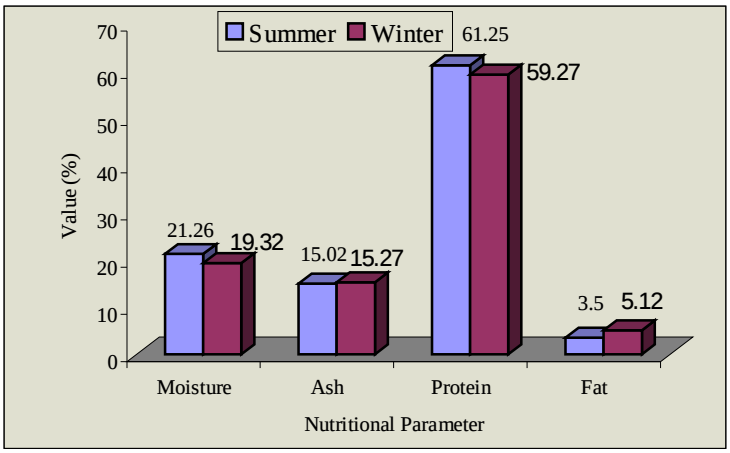

Figure-33: Comparative study of proximate composition of Bombay duck between summer and winter

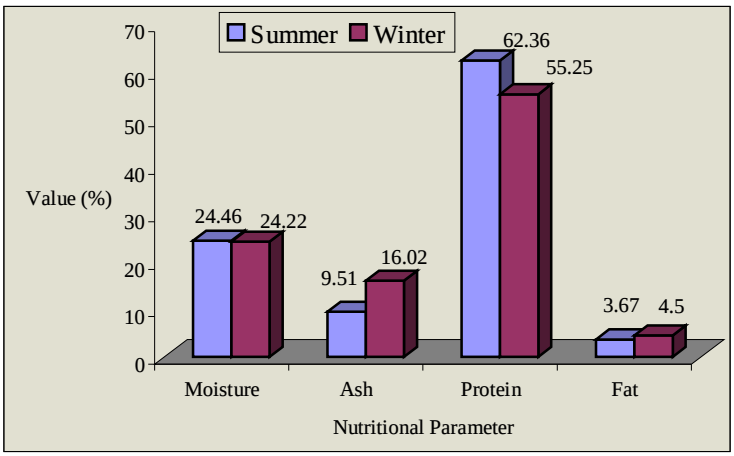

Figure-34: Comparative study of proximate composition of Phasa between summer and winter

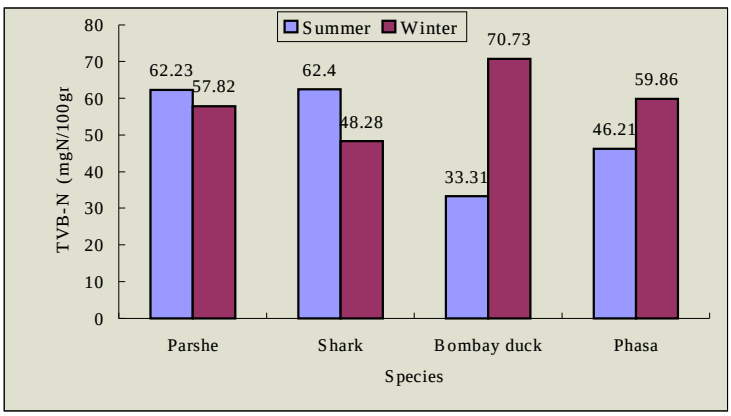

Figure-35: Comparative study of TVB-N content of four common dried fish between summer and winter dried fish between summer and winter

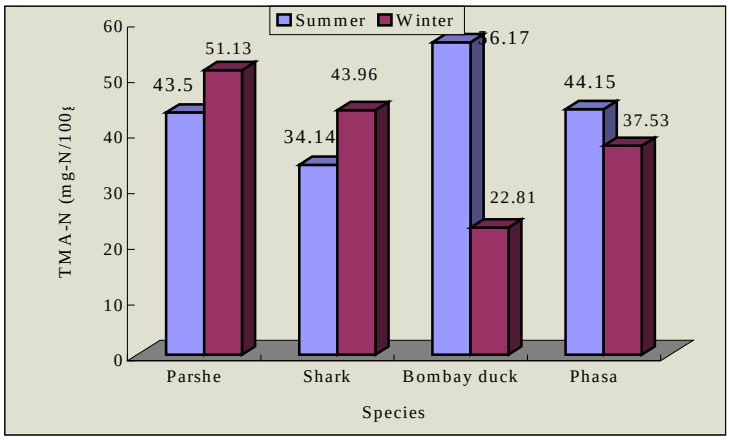

Figure-36: Comparative study of TMA-N content of four common dried fish between summer and winter

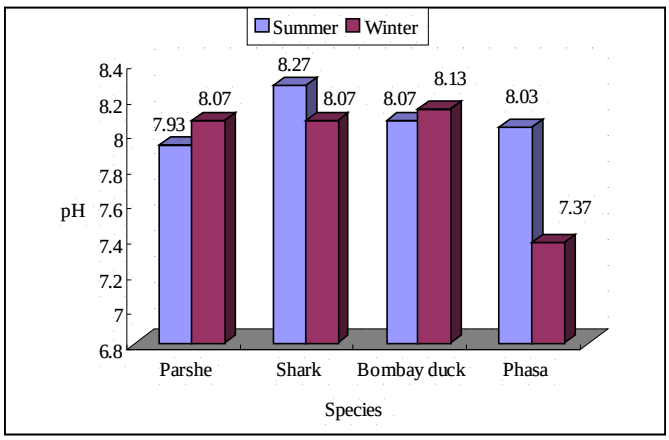

Figure-37: Comparative study of pH of four common dried fish between summer and winter