SCBRMP- LGED / The WorldFish Center

First round report of the FRSP on Fish Catch and Bio-diversity monitoring

***Haor* fisheries are very hard to quantify, so their importance for food safety and livelihoods is often undervalued; the FRSP of WorldFish works for SCBRMP-LGED to fill the information gap**

The WorldFish Center
Bangladesh and South Asia Office, Dhaka

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Executive Summary

The importance of fisheries, especially *haor beel* fisheries, as a source of nutrition, employment and income for the rural poor can hardly be emphasized enough. Fishing is a key livelihood opportunity for thousands of households in *haor* areas and plays an important part in food security and poverty alleviation. In the past, the management of *haor* fishery has often excluded poor fishers and encouraged leaseholders to effectively 'mine' resources at non-sustainable levels of exploitation. To address these concerns, the SCBRMP is implementing its activities in Sunamganj district of Bangladesh. The Fisheries Research Support Project (FRSP) has been designed to determine the relationship between management practices implemented under the Fisheries component of SCBRMP and impacts on biological growth performance.

Catch monitoring studies have been carried out in 30 SCBRMP sites (waterbodies) where fisheries are important and this report presents a consolidated result of the analysis carried out so far. The main findings include:

- Fisheries production and seasonal variation of production
- Harvesting performance in different upazilas
- Species diversity and major contributing species
- Production values per water body
- Gear efficiency and production
- Leased value and sale value
- Biodiversity
- Length-frequency distribution of important species

Fisheries production was measured in terms of organized catch (bulk cathes made by organized groups) and monitoring catch (individual catches during rainy season) to validate the total catch at each water body. The total fish catch was found at nearly 183 tons in all monitored sites of which organized and monitoring catches comprised 40% and 60% respectively. From monitoring, the main effective factors that positively influence production may be habitat type (e.g., river), water extension during monsoon, tenure effectiveness of restriction in fishing, fish sanctuary, higher species diversity (e.g., Sonduikka, Abua Prokasito, Medi, Baskerkhal), presence of professional fishers around water bodies, fisher's density, good links with other water bodies or big *haor*, no restriction during monsoon & nearby *beel* areas and interruption of organized harvest at some sites. However, this is a one year study. A further study is required to know how it may affect production from organized and monitoring catches.

The common species caught by all types of gears were Jatputi (*P. sophore*), Kalibaus (*Labeo calbasu*), Taki (*Channa punctata*), Meni (*Nandus nandus*) and Kholisha (*Colisa fasciatus*) which contributed 7.84%, 7.76%, 6.82%, 5.7% and 4.7% of overall catches, respectively. Analysis of

annual catch monitoring data reveals that 20 main species all together contributed 74%, and other 76 species contributed only 26% of the catch by weight in 2008.

A single species, the Jatputi (*Puntius sophore*) was found as the highest contributing species towards catches in Sunamganj sadar (13.78%), South Sunamganj (7.47%), Derai (7.04%), Jamalganj (8.86%) and Tahirpur (11.92%) upazilas.

Income derived from fishing activities (organized catches) are influenced by several factors (marketing linkage, high valued species, grading, distance from urban market etc.) which were reflected in variations of average prices (Tk) per kg of fish. The highest value (Tk 98 per kg) was found at Patchgachia *beel* in South Sunamganj; whilst Lalpurer-Jai and Gazariar dair in Sunamganj Sadar had the lowest value (Tk 32 per kg). The average value per kg from all sampled water bodies was found Tk 60±15 and all monitored sites together were worth about Tk 11 million in 2008.

The data generated during the study period also provided an opportunity to explore the response of catch to effort based upon site comparisons. Biodiversity at most water bodies showed higher species richness and the profusion of species appeared somehow higher in haor beel and river habitats. Sites of similar habitats in non-project sites had a lower biodiversity. This data suggests that the majority of SCBRMP sites showed considerably healthier biodiversity than water bodies outside project boundaries.

Recommendations:

- More attention should be taken by the BUGs during marketing of organized catches to get maximum profit from harvested fish.
- Less potential water bodies in terms of production and water extent can be assessed for seasonal stocking with native species. This will create more women involvement in the production process and enhance per capita income of participating households.
- Given the fundamental importance of sustaining fish abundance and biodiversity, the results can be considered as baseline data for comparing to following years.
- The study noted the highest abundance of Kalibaus (*Labeo calbasu*) in the Abua nodhi (river) of Biswambopur upazila (51% of the annual catch by weight). According to IUCN (2003) Kalibaus is an endangered species, so attempts should be made for its conservation, and further study is required to understand abundance variation with time and its effect in recruitment of Kalibaus in this river.

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1. Introduction

Bangladesh is a developing country located in the north eastern part of South Asia between 20° 34' and 26° 38' north latitude and between 88° 01' and 92° 41' east latitude. It has its boundary with India on three sides- east, north and west and with Myanmar on the southeast. The estimated population in 2005 was about 139 million. The 20 million people living in river basins lack basic facilities and therefore do not have any access to information, national laws, regulations and human rights, and lack opportunities to partake in skill development training.

Fish is an essential staple food for the people of Bangladesh and the fisheries sector plays a vital role in the economy through employment generation, nutrition supply and poverty alleviation (Alam 2005 and Nasir Uddin *et al*., 2003).). There are thousands of rural markets in Bangladesh. Data from LGED's upazila based GIS system gives a figure of 17,121 while a survey commissioned by DAM in 2000 recorded 16,476 (Mallorie and Ashraf 2005). This sector provides employment to about 1.2 million full time fishers and 11 million part time/artisanal fishers, fish/shrimp farmers, fish traders and processors, labourers, input suppliers, etc (DoF-FRSS 2005-06). However, almost two-thirds of the rural households get involved in fishing during the monsoon season. Full time equivalent of 5.2 million people or 9% of the labour force were involved in fisheries (FSRFDS 2003a). Several studies, including FAP-17 (1994) and a study conducted by Thompson and Hossain (1998) indicate that about 80% of rural households traditionally catch fish for food or sale. Studies have shown that the many "miscellaneous" small fish caught from the floodplains and lakes by poor people, which have been neglected in official statistics and policies, provide relatively more essential nutrients than do the large fish favoured by fish culture programs (Minkin, 1989).

Bangladesh is the drainage outlet for a vast river basin complex made up of Ganges-Brahmaputra-Meghna River system in the form of rivers and estuaries (brackish water), canals, depressions (*beels*), floodplains and reservoirs. This sub-sector comprises a total of 4.5 million hectares of water areas including rivers, *haors*[1], beels[2] and large medium and small seasonal floodplains. Floodplains are low-lying areas flooded during monsoons. Expansion of fish stocks take place in these plains which are connected to river systems. These plains are food rich breeding, nursery and growth areas. Floodplains contribute to about 31% of the total fish production, followed by rivers, estuaries and *beels*, and the total inland open water fisheries contributes to 41% of the country's total fish production. The inland openwater fisheries of

[1] Deeply flooded saucer shaped depression in the northeast region of Bangladesh
[2] Deepest part of the floodplain, often with permanent area of water

Bangladesh are common property and share two characteristics: it is costly to exclude potential users from gaining access to the resource, and each person's use of the resource subtracts from the potential welfare of others. In inland fisheries, more than half of the fishermen exclusively fish for their own household; very few fishermen deliver more than half of their catch to the market.

1.1. Fisheries Research Support (FRS) project

The FRS project has been designed to monitor fish catch, bio-diversity and livelihoods of the fisheries component of the Sunamganj Community Based Resources Management Project (SCBRMP) in six Upazilas of Sunamganj district (Figure 1). The FRS project is being implemented through a MoA between the WorldFish Center and Local Government Engineering Department (LGED) of Bangladesh and funded through SCBRMP. The core project (SCBRMP) started its operation in 2003 and it is an 11 years project supported by the International Fund for Agricultural Development (IFAD).

The objective of the project is to generate impact information on community based initiatives specially Beel User Groups (BUGs)[3] in the fisheries component of the SCBRMP. This will cover changes in fish catch, improvement of bio-diversity and livelihood gains of the fisher households. Detailed objectives of this project component are:

i) Assess the impact of community based fisheries of SCBRMP on fish catch (by volume and value) and biodiversity through a regular catch survey at 60 sites;
ii) Estimate and simulate sustainable level of yield with corresponding fishing effort and develop management models for scaling up;
iii) Livelihood impact analysis of BUG members in *beel* fisheries in 25 sites; and
iv) Disseminate findings to a wider level of national and international audience.

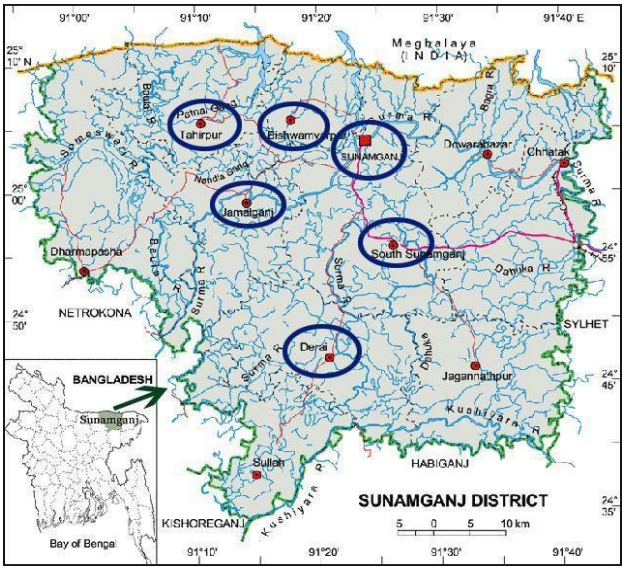


Figure 1. Working sites of FRS project

[3] BUGs - Beel User Groups

2. Methodology

2.1. Site Selection and Waterbody Sampling

The SCBRMP waterbodies are located in deeply flooded areas of the Sunamganj district, so all adjacent waterbodies connected during monsoon were in fact treated as a single cluster. The FRS project targeted to work in 60 randomly selected waterbodies of the SCBRMP. In the first phase SCBRMP started its implementation in 93 waterbodies in 6 Upazilas of Sunamganj district. There are four types of waterbodies included in this list for monitoring i.e. small *beels* (less than 8.09 hectares), bigger *beels* (more than 8.09 hectares) and river sections and confined ponds. Formal and informal meetings were conducted with SCBRMP fisheries component for choosing water body selection criteria and sampling methodology. For monitoring in the FRS project, 31 waterbodies have been randomly selected of which 8 are in Sunamganj-Sadar, 11 in South-Sunamganj, 5 in Biswambharpur, 3 in Tahirpur, 3 in Jamalganj, and one waterbody in Derai Upazila (Table 1). Table 2 shows leasing and management committee information of these water bodies. Waterbody selection was finalized in consultation with the SCBRMP staff assigned for the fisheries management component. Each Research Assistant was assigned a certain number of waterbodies for monitoring work and supervision according to the remoteness and complexity of the waterbody. Fisheries management practices under the Sunamganj Community Based Resource Management Project (SCBRMP) are presented in Table 3.

Table 1. Distribution of water bodies by location, leased and monitoring area, and habitat types.

Upazila	Name of the Beel	Leased area (ha)	Monitoring area (ha)	BUG Member	Haor beel	Single beel	River habitat	Pond
South Sunamgonj	Tedala Hugliya Chatol	21.61	32.37	65	√[4]			
	Chatol Udaytara	19.91	28.33	60	√		-	-
	Moinpur Beel Group	4.75	10.12	25	√		-	-
	Babonpai Beel	12.74	20.23	50	-	√	-	-
	Terazani Balir Dubi	1.72	6.07	27	-	√	-	-
	Pachgachiya beel	1.25	4.86	28	-	√	-	-
	Chinamara beel	1.23	4.86	25	-	√	-	-
	Gozaria Dohor (part of Chinamara beel)		0.00	25	-		√	-
	Nitai Goan	7.66	12.14	33	-		√	-
	Kochua Goan	5.18	10.12	28	-		√	-
	Srinathpurer Dhola	3.56	8.90	27	-		-	√
Sunamganj Sadar	Langol Kata Ojur Beel	5.89	12.14	29	√		-	-
	Boiragimara Beel	18.70	24.28	21	-	√	-	-
	Aung Gung	2.27	4.86	25	-	√	-	-
	Urail Beel	1.85	8.09	32	-	√	-	-
	Aislauni Prokashito Mitar Dubi	1.55	8.09	30	-	√	-	-
	Chota Beel	1.42	8.09	30	-	√	-	-
	Lalpurer Jai and Gozaria Dair	1.38	12.14	16	-		√	-
	Khamartuk Mouzer 860 No.Pukur	1.83	0.00	28	-		-	√
Biswamberpur	Tiar Beel Lomba Beel Gool Beel	2.63	6.07	30	√			
	Ghotghatia Nodhi	6.73	12.14	34	-		√	-
	Sudam khali river	3.48	4.86	17	-		√	-
	Abua Prokashito Nainda Nodhi	34.47	40.47	80			√[4]	
	Moni kamarer Kuri	1.85	3.24	30	-		-	√
Tahirpur	Thapna Group Jolmohal	64.75	80.94	56	√[4]		-	
	Choto Khal –Boro Khal	3.49	8.09	27	-	√	-	-
	Issubpurer Khal	5.19	8.09	28	-	√	-	-
Derai	Boro Medi Beel	51.13	68.80	164	-	√[4]		
Jamalgonj	Sonduikka Group jolmohal	3.90	10.12	19	√			-
	Dewtan Beel	5.50	12.14	30	-	√		-
	Basker Khal	4.70	10.12	83	-	√		-
	Lomba beel Gool beel	19		25				

√[4] - Selected for catch monitoring and length-frequency data collection

Table 2. Distribution of water bodies and information related to management committee.

Name of WB	Leased area (acre)	Area (acre) min-max	BMC formed	BMC/RMC Members			Total BUG members		
				Male	Female	Total	Male	Female	Total
Biswambharpur Upazila									
Ghotghatia Nodhi	16.67	12-30	June-05	07	0	07	21	03	24
Sudamkhali River	8.61	05-12	June-06	05	02	07	13	04	17
Tiar Beel Lomba Beel Gool Beel	6.18	03-15	April-07	05	02	07	17	13	30
Moni kamarer kuri	4.55	03-08	June-05	05	04	09	17	13	30
Abua Prokashito Nainda Nodhi	66.64	60-100	April-07	06	03	09	48	32	80
Tahir Pur Upazila									
Thapna group Jalmohal	160.57	81-200	September-07	09	02	11	38	06	44
Choto khal Boro khal	8.61	07-20	April-06	07	0	07	26	02	28
Issubpurer khal	12.83	05-20	June-07	06	01	07	49	27	76
Jamalgonj Upazila									
Sonduikka Group Jalmohal	9.63	04-25	July-05	05	0	05	19	0	19
Dawtan Beel	13.06	09-30	July-05	07	0	07	31	0	31
Basker Khal	1.62	06-25	November-05	09	03	12	63	10	73
Lomba Beel Gool Beel	19.93	15-35	March-06	05	0	05	25	0	25
Sadar									
Boiragimara Beel	46.20	7 -60	August-05	7	0	7	45	0	45
Langol Kata Ojur beel	14.55	3 -30	March-06	6	3	9	20	9	29
Urail Beel	4.58	1 -20	September-06	7	0	7	28	0	28
Aislauni Prokashito Mitar Dubi	3.84	1.5 -20	March-06	7	0	7	30	0	30
Aung Gung	5.62	3 -12	February-06	7	0	7	30	0	30
Choto Beel	3.5	1 -20	March-06	9	0	9	15	0	15
Lalpurer Jai and Gozaria Dair	3.25	1.25 -30	March-06	9	0	9	15	0	15
South Sunamganj									
Chinamara Beel	3.05	1.5- 12	October-05	5	0	5	30	0	30
Pachgachia Beel	3.1	2- 12	August-05	5	0	5	27	3	30
Moinpur Beel Group	11.73	1.5-25	February-06	7	0	7	25	8	33
Kochua Goan	12.8	3 -25	April-06	9	0	9	28	0	28
Terajani Balir Dubi	4.24	1 -15	March-06	9	0	9	32	4	36
Netai Goan	18.94	8 -30	May-06	5	0	5	17	6	23
Babonpai	31.47	3 -50	July-05	7	0	7	30	0	30
Tedala Hugliya Chatol	53.4	8-80	March-06	9	0	9	60	0	60
Srinathpurer Dhola	8.8	2.5 -22	October-05	5	0	5	23	5	28
Chtol Udaytara	58.2	9-70	July-05	9	0	9	51	9	60
Derai Upazila									
Boro Medi Beel	126.35	40-170	April-07	08	01	09	149	11	160

Table 3: Fisheries management practices under the Sunamganj Community Based Resource Management Project.

Name of Water body	Year of Access	Lease value Tk.	Closed Season	Closed Area	Gear/fishing restriction	Habitat restoration	Sanctuary established
Biswambharpur Upazila							
Ghotghatia Nodhi	Sep-2005	38,000	May -June	Fishing restriction around fish sanctuary	Seine net & Gill net	Earth Work-7566.74 cft. 1865 nos. Swamp tree planted.	Sanctuary of 2000 sqm established in 2008
Sudamkhali River	May-2006	28,320	May -June	Fishing restriction around fish sanctuary	Seine net & Gill net	Earth Work-1980.12 cft. 1420 nos. Swamp tree planted.	Sanctuary of 1500 sqm established in 2007
Tiar Beel Lomba Beel Gool Beel	Sep-2005	10,177	May-July	Restriction about Katha based pile fishery	Seine net & Gill net	Katha based pile fishery (About 1500 sqm.)	-
Moni kamarer kuri	Sep-2005	6090	May-July	Fishing restriction around fish sanctuary	Seine net & Gill net	Earth Work-2988.21 cft. 860 nos. Swamp tree planted.	-
Abua Prokashito Nainda Nodhi	April-2007	88,500	May -June	Fishing restriction around fish sanctuary	Seine net & Gill net	7640 nos. Swamp tree planted.	Sanctuary of 3000 sqm established in 2008
Tahir Pur Upazila							
Thapna group Jalmohal	Nov-2007	225977	May-July	Fishing restriction around Katha.	Seine net & Gill net	-	-
Choto khal Boro khal	June-2006	11137	May-July	Fishing restriction around fish sanctuary	Seine net & Gill net	Earth Work-99876 cft. 1295 nos. Swamp tree planted.	-
Issubpurer khal	June-2007	7080	May-July	Fishing restriction around Katha.	Seine net & Gill net	-	-
Jamalganj Upazila							
Sonduikka Group Jolmohal	April-2005	9660	April-June	Fishing restriction around Katha.	Seine net & Gill net	Earth Work-53769.4 cft. 485 nos. Swamp tree planted.	-
Dewtan Beel	May - 2007	16560	April-June	Fishing restriction around Katha.	Seine net & Gill net	-	-
Basker Khal	May - 2007	2132	April-June	Fishing restriction around Katha.	Seine net & Gill net	-	-
Lomba Beel Gool Beel	Nov-2007	28910	April-June	Fishing restriction around Katha.	Seine net & Gill net	-	-

Name of Water body	Year of Access	Lease value Tk.	Closed Season	Closed Area	Gear/fishing restriction	Habitat restoration	Sanctuary established
Sunamganj Sadar							
Boiragimara Beel	April-2005	7376	Sep-Jan	Fishing restriction around fish sanctuary	Sep-Jan all kind of net	Earth Work -329265.38 cft	Sanctuary of 2000 sqm established in 2008
Langol Kata Ojur beel	August-2006	26170	Sep-Jan	Fishing restriction around fish sanctuary	Sep-Jan all kind of net	Earth Work -16169 cft	Sanctuary of 500 sqm established in 2008
Urail Beel	August-2006	10325	Sep-Jan	Fishing restriction around katha	Sep-Jan all kind of net	Earth Work -49430 cft 2000 nos. Swamp tree planted	-
Aislauni Prokashito Mitar Dubi	August-2006	11316	Sep-Jan	Fishing restriction around katha	Sep-Jan all kind of net	Earth Work -50000	-
Aung Gung	August-2006	11755	Sep-Jan	-	Sep-Jan all kind of net	Earth Work -268956 cft	-
Choto Beel	August-2006	2829	Sep-Jan	-	Sep-Jan all kind of net	Earth Work -38595 cft	-
Lalpurer Jai and Gozaria Dair	August-2006	5234	Sep-Jan	-	Sep-Jan all kind of net	Earth Work -41385.66 cft	-
South Sunamganj							
Chinamara Beel	Sep-2005	9199	June-Oct	Fishing restriction around fish sanctuary	Monofilament gill net restriction	Earth Work -101308 .28 cft 278 nos. Swamp tree planted	Sanctuary of 500 sqm established in 2008
Pachgachia Beel	Sep-2005	2040	June-Oct	-	Monofilament gill net restriction	Earth Work -67466 cft	-
Moinpur Beel Group	Febr-2006	5288	-	Fishing restriction around the pile fisheries	Monofilament gill net restriction	Earth Work -137189 cft	-
Kochua Goan	Sep-2005	16285	-	-	Monofilament gill net restriction	Earth Work -107315 cft	-
Terajani Balir Dubi	Feb - 2006	36790	-	-	Monofilament gill net restriction	Earth Work -46110 cft	-
Netai Goan	Aug-2006	35842	-	-	Monofilament gill net restriction	-	-

Name of Water body	Year of Access	Lease value Tk.	Closed Season	Closed Area	Gear/fishing restriction	Habitat restoration	Sanctuary established
Babonpai Beel	April-2005	9751	-	Fishing restriction around fish sanctuary	Monofilament gill net restriction	Earth Work -109667	Sanctuary of 1200 sqm established in 2008
Tedala Hugliya Chatol	March-2006	78000	April-June	Fishing restriction around fish sanctuary	Monofilament gill net restriction	Earth Work -556607.08 cft 5470 nos. Swamp tree planted.	Sanctuary of 3000 sqm established in 2008
Srinathpurer dhola	Sep-2005	5220	-	-	Not yet	Earth Work -60431 .23 cft 278 nos. Swamp tree planted.	-
Chatol Udaytara	April-2005	56251	April-June	Fishing restriction around fish sanctuary	Monofilament gill net restriction	Earth Work -427471.5 cft 3453 nos. Swamp tree planted.	Sanctuary of 4900 sqm established in 2008
Derai Upazila							
Boro Medi Beel	April - 2007	19126	May-June	Fishing restriction around Katha.	Seine net & Gill net	-	-

2.2. Assignment of monitoring sites to Research Assistants

In order to design a representative sample size the project targeted to work in 60 sample water bodies however, due to scarcity of sufficient number of water bodies in the SCBRMP, the FRSP started fish catch monitoring, biodiversity and livelihood studies with 30 water bodies under six upazilas in 2008. Four Research Assistants were recruited to supervise monitoring activities and subsequently all sampled waterbodies were distributed among the four Research Assistants. The main task of the Research Assistant is to supervise the Community Enumerators day to day activities. The specific responsibilities of the Research Assistants have been described below:

- to oversee the method of collection and ensure data accuracy for all information collected from project participants by respective Community Enumerators;
- to facilitate and conduct relevant training for all Community Enumerators including frequent coaching and mentoring support;
- to coordinate with SMS (Subject Matter Specialist) fisheries of the SCBRMP to get information on fisheries management related activities in the sample water bodies;
- to disburse monthly salary and field expenses fro respective Community Enumerators;
- to verify data sheet, data encoded, data entry, data checking and primary analysis.
- to prepare data tables; and
- to prepare short monthly report issues and events of the assigned water bodies.

All Research assistants were instructed to liaise with assigned Senior Upazila Project Manager (SUPM), Subject Matter Specialist (SMS) and Social Organizer (SO) for ensuring proper monitoring of the water bodies.

2.3. Community Enumerator Recruitment

In 2008, 34 Community Enumerators were recruited for the project, of which 30 have been involved in fish catch monitoring surveys and four in length-frequency data collection. The Community Enumerators were recruited through a guideline that was prepared by the SCBRMP during their CDF (Community Development Facilitator) recruitment.

Recruitment test of Community Enumerators

The guideline contains the following procedures:

- Preparation of appropriate advertisement for the post
- Circulation of recruitment advertisements at the field level through SCBRMP Upazila offices.
- Collection of applications from SCBRMP Upazila offices
- Sorting of applications and short-listing
- Written tests held at four different places in four Upazilas
- Conducting oral/viva for qualified applicants
- Assigning waterbody by location to the selected candidates

2.4. Orientation of Community Enumerators

Induction on project activities consisted of a two day orientation program organized by the FRSP team after the recruitment of the Community Enumerators. At the beginning they were introduced by the Research Assistants to the SMS fisheries of the SCBRMP which allowed for a close collaboration between Community Enumerators and SCBRMP staff. The session was conducted by the Project Leader and Senior Research Scientist of FRSP. In addition to orientation, each Community Enumerator briefed everyone about their assigned work linked with monitoring waterbodies - which are close to the Enumerator's household. Apart from the main orientation program, several feedback sessions were organized by the Research Assistants in the WorldFish Center, Sunamganj office to provide the Community Enumerators with a better understanding about each monitoring activity. A list of the community enumerators assigned to different water bodies is given in Appendix 1.

Orientation of Community Enumerators

2.5. Monitoring framework

Three principals underlying the main monitoring activities are:

- Assessment of fish production trend over time at 30 project sites, extending up to 60 sites depending on the availability of 300 waterbodies in the SCBRMP project;
- Population dynamics for fish and other aquatic animals at four project sites;
- Livelihoods impact monitoring of BUG members' households after a certain interval.

2.5.1. Catch monitoring and biodiversity:

An individual catch monitoring study incorporated data from February 2008 to December 2008. Two biological monitoring programmes were implemented: the Catch and Effort monitoring and the Length-frequency. Catch and effort was monitored to estimate the annual total catch and fishing effort through a catch assessment and a frame survey. The daily catch of every individual fisherman and his gear (CPUE) was monitored for 8 days a month. The numbers and weight of all fish species in the catch were recorded. Furthermore, the gear-type, its mesh size, its owner status and the number of units used per fisherman were recorded 8 days a month through a standardized counting of the number of gears to estimate gear wise fishing effort (f).

2.5.2. Data analysis

Survey sampling covered gear census and catch monitoring. Catch monitoring is an observational process on fishing effort that was done for a duration of eight days per month per site. It recorded species wise catch statistics of each gear type.

Gear survey involves a regular spot survey for a sample of gears in operation and their total catch. In this case, gear census covered all the gears (types and numbers) operating in the study sites.

The total monthly catch for each water body was calculated with;

$$Monthly\ \ Catch\ \ per\ \ site = N * \sum_{i,j=1}^{n} \overline{f}_{i,j} * \overline{cpue}_{i,j}$$

where;

N: number of days per month when fishing was monitored
f: average number of gears used per day (for each gear type)

CPUE: average daily catch per gear type (calculated yield/no of gears).

Average number of gear per day was used to estimate total number of gear-wise fishing effort for that month as well as for the whole year. Simultaneously, mean gear-wise catch rate was used to estimate total catch for that month, as well as for the whole year.

Overall species distributions by gear were calculated using annual catch statistics data. Year wise as well as overall species distribution were calculated using catch statistics data. Overall production was estimated by summing all estimated production of different gear types in each year.

2.5.3. Shannon-Wiener bio-diversity index

The Shannon-Wiener Index (H') is one of several diversity indices used to measure biodiversity. In this study, species wise production rates were used to estimate the Shannon-Wiener diversity index (H'). The function was originally devised to determine the amount of information in a code or signal, and is defined as:

$$H = -\sum_{i=1}^{S_{obs}} pi \log_e p$$

where,

H: Information content of sample (Index of diversity or Degree of uncertainty),

s: number of species

pi: the proportion of individuals in the i^{th} species.

(Species Diversity & Richness calculates the index using the natural logarithm).

2.5.4. Fish catch monitoring

Individual fish catch monitoring is an important task of the present study. FRSP has started fish catch monitoring at randomly selected sample waterbodies to observe fish biodiversity, fishing intensity, fishing activities, gear diversification, species composition, and estimated total catch. At each water body, one Community Enumerator was responsible for catch monitoring and fisheries data collection from the fishers. In addition to catch monitoring, the Community Enumerators also collected information on the gear types used by each fishermen during fishing and landing from fishing. They keep records on types of gears, numbers of gears and length of gears used, etc. Research Assistants who

were assigned to each waterbody, provided the Community Enumerators with logistical and technical support and field orientation. Data collection for fish catch monitoring from all sites started in February 2008 and the status of the data are given in Appendix 2.

2.5.5. Organized harvest or Major fishing

Normally major or organized fishing activities start when the dykes surrounding water bodies appear, which is usually before winter. In the *haor* habitat, major fishing generally starts in late November and continues up to March of the following year.

Major harvesting in Urail *beel*, Sadar Upazila

2.5.6. Monitoring fishing activities

According to the activity plan, organized and monitoring catch data has been collected from 30 water bodies by Community Enumerators. The organized catch records reflect quantity of fish catches (kg), price of fish sales, management costs, species diversity, income from fish sales and consumption during harvesting. These records were also shared with respective SCBRMP staff and Beel User Groups (BUGs) members. A list of the water bodies, the number of BUGs by habitat, and the name of the assigned Research Assistant are given in Appendix 3.

When data was collected for individual catches, the total daily catch had to be estimated from the sample obtained. To verify the robustness of this estimation, responses from fishermen were collected with regards to the previous day's total catch. This was done for all waterbodies, and estimated catch (by waterbody/ by fishermen interviewed) was correlated with the previous day's catch (Figure 2). Correlation between yesterday's catch (as a monthly average) and estimated catch from catch monitoring survey (monthly average as well) showed significance at the 0.01 level (N= 158). This indicates a good estimation value.

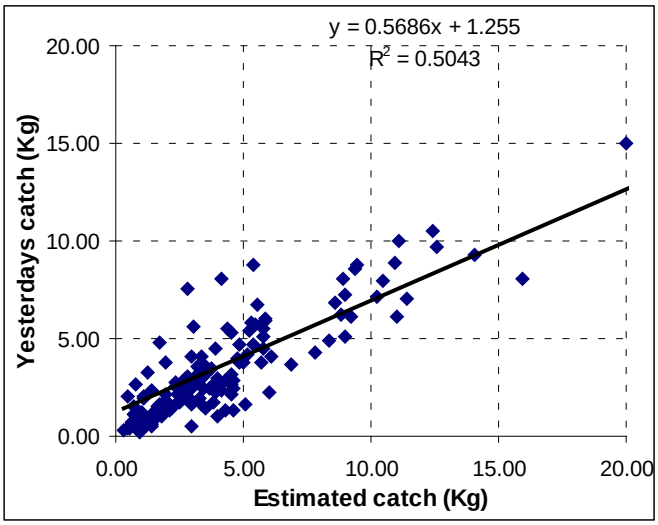


Figure 2. Estimated catch during monitoring plotted as a function of yesterdays catch (response from fishermen) with fitted regression model.

2.5.7. Length-frequency record collecton

In March, 2008, the Project started length-frequency data collection from four assigned water bodies: Abua prokashito nainda nodhi (Bishwambharpur); Thapna group jolmohal (Tahirpur); Tedala Hugliya chatol (South Sunamganj); and Baro medi *beel* (Derai). The purpose of this analysis is to estimate growth parameters, mortality rate, recruitment patterns and exploitation rates of different fish species in a particular habitat, and to calculate the length-based assessment of some important species. Community Enumerators were trained to do this by the WorldFish Senior Research Scientist.

Orientation on length-frequency data collection

Time series of length frequencies are the most common data type collected for population dynamics analysis. The lengths are grouped with a constant interval of 1 cm and 2 cm.

2.6. Gear characteristics

Various types of fishing gear are used in the inland open water bodies of Bangladesh. Their specification differs according to target species, type of water body, labour intensity, fabrication, cost, materials available and profit. There are more than 100 types of fishing gear used by professional fishermen communities. List of most common gears by type is shown in Table 4.

Table 4. List of common gears used in *haor* areas.

Name of gears	**Local Bengali name used in different district of Bangladesh**
Gill net	Pata Jal, Fash Jal, Poa Jal, Current Jal, Dacon Jal
Seine net	Ber jal, Jagat ber jal, Moia jal, Katha ber jal, Gamcha jal
Set bag net	Bada jal
Lift net	Bheshal jal, Dharma jal
Cast net	Utar jal, Khepla jal, Toira jal, Jhaki jal
Push net	Thela jal, Hanga jal
Trap	Kholsun, Anta, Polo, Charai, Ghuni, Fala, Bair
Long-line	Chara Barshi, Taja Barshi
Hook and Line	Barshi, Dati Barshi, Shola borshi
Spear	Achra, Aro, Jutya, Koch, Teta
Others	Bana, Katha, Kua, by Hand

Cast nets, spears, lift nets and gill nets are operated both day and night. The trap units, long-lines and hooks and lines are operated only at night time while the push net and seine net are operated only during the daytime. Operation of spears and lift nets are occasional and seasonal. English names and local names of all gears used in the survey are given in Appendix 4. The common gears operated in this sector are briefly described as follows:

2.6.1. Push net (*Thala jal*)

Push net is a small net mounted on a triangular bamboo frame. The bottom crosspiece of the frame is 1.0-1.2 m long, while the two vertical pieces are longer; 1.3-1.5 m long. The netting is of nylon mosquito net (usually bright blue in color) with 2 mm bar mesh size. It is widely used in open beels and flood plain beels. The push net is used in the late monsoon and the dry season. The low cost of initial capital investment has made the push net the most popular fishing equipment for

subsistence fishers. One person is involved in its operation and fishing duration varies from 5-6 hrs in open beels and 7-8 hrs in the rivers.

2.6.2. Cast net *(Khapla jal)*

These are very common and primitive gears used all over the country and limited in their efficiency. They are operated by a single person very near the bank or low level water or from a boat in the open area. It is a circular net made of 1-1.5 cm mesh (stretched) multi-filament twine, with a leash line attached at the center and a series of weights along the circumference of the foot rope. The net in collapsed position is 3-4 m long, and the foot rope circumference is 8-12 m. Generally one person is involved in its operation and fishing duration varies from 7-8 hrs.

2.6.3. Gill net (*Fash jal*)

The gill net is a rectangular net with weights on the ground rope and floats on the head rope. It hangs vertically in water. Total length size class ranges between 150-250 m, height ranges between 0.75-1.25 m and mesh size varies from 2-3 cm. The head rope is fitted with plastic floats, and the foot rope is weighted with closely spaced clay disks. Its mesh size varies with types and sizes of target fish. It is often set on the migration route of fish. There are many types of gill nets used in inland water. Common gill nets are Punti jal, Koi jal, Current jal, Fash jal, Ilish jal, Dacon jal, Pata jal, Poa jal, etc. Generally one person is involved in its operation and fishing duration varies from 5-7 hrs. Recently introduced mono-filament gill net (current jal) is the most effective gear for catching fishes. Current jal is a small mesh mano-filament gill net for catching small fish.

2.6.4. Seine net (*Ber jal*)

Seine nets are of medium length (150-550 m) and a height of 1.8 to 4.5 m with fine mesh. The mesh size is small (0.5-1.0cm stretched) and the netting is multi-filament fiber. More fish are caught by seine net than any other basic methods. A seine is a form of an encircling net having a line at the bottom attached to the net. Generally 7-8 people operate this gear. Fishing duration lies between 7 to 8 hrs. Seine net contains large, medium and very small meshes.

2.6.5. Lift net (*Bhel jal*)

Lift net is a large multi-filament triangular net used to catch fish and is operated from a bamboo platform built in Khals (canals) in areas with gentle flowing water in flood plains. The net is mounted on a bamboo frame. There are different sizes of veshal jal and they vary from 8m by 5m to 15m by 14m. The mesh sizes are ±5 mm in the conical end and 10-20mm in the front portion. Alternatively 2 people are involved with this gear during operation, and fishing duration varies from 8-9 hrs. Generally the small lift net is known as Dharma jal, and large lift net as Vheshal jal. Dharma jal is operated from river banks. Vheshal or Khora jal is a large lift net with a bamboo frame.

2.6.6. Spear

Several types of spears are used in the open water fishery such as fulkuchi, jhupi, konch, etc. Fulkuchi is a cluster of 12-22 sharply pointed steel wires at the end of a bamboo pole. Jhupi consists of a detachable iron fork

with 5-13 barbed points and a bamboo handle. Konch has 8-14 pieces of split bamboo firmly bound together. Spears are used during early and late monsoon.

2.6.7. Long line (*Borshi*)

This gear consists of a heavy main line (ranging up to 500 ft long) to which short leader lines with hooks are tied. The line can have 300 to 800 hooks. Hook size is 2.0-2.5 cm high.

2.6.8. Hook & line

Hook and line is a common fishing practice in inland open water in the form of Chhip, Barshi, Don Barshi, Barshi chara, and Nol barshi. This practice is used all year round.

2.6.9. Trap

Traps are common fishing devices of the inland openwater fisheries. There are many types of traps used in this sector and are mostly made of bamboo and pieces of old net. Vair, Dugair, Ghuni, Charai, Polo, Billa, Tubo, etc are the most common types of traps used all over the country. Each trap unit consists of 40-50 traps set one after another at an interval of about 2-3 m. Fish/mollusk meat (usually decayed flesh) is used as bait and is kept inside the trap. The traps are generally set in the water body during evening and carefully pulled up during early morning when the fish are collected.

Chai

Gui

Ronga

Polo

3. Results and discussion

3.1. Fisheries production

The total fish production at each water body was obtained by combining harvests from organized catch and monitoring catch. The total fish catch was found at nearly 183 tons in all sites of which organized and monitoring catches comprise 40% and 60% respectively. The study indicates that six water bodies namely: Thapna Gourp Jolmohal, Abua Nodhi, Medi Beel, Chatol UdaiTara Beel, Tedala Beel, and Langol Kata Beel contributed to more than 52% of the overall production in all monitored sites. Of the six water bodies, five are large water bodies (except Langol Kata Beel) with Thapna Group Jolmohal as the largest water body (nearly 65 hectares) and contributing to about 13% of the overall production. On the other hand, Boiragimara beel which is also one of the largest beels (nearly 19 hectares) in Sunamganj sadar upazila only contributed to 1.91% of the overall production. The main factors responsible for a lower production may be the early rain this year which interrupted the harvests, the unavailability of sufficient water level on time, lack of professional fishermen for fishing, and BUG imposed restriction for fishing within beel area. A short remark regarding production through organized catch is given in table 7. However, this is a one year study. Further study is required to know how it may affect total production. Total catch including the organized catch in the 29 project sites are given in Table 5.

During the reporting periods, organized catch has been completed in all water bodies. However, harvesting from “Srinathpurer dhola” was interrupted due to conflict between BUG members and some local influential people who used to exploit this resource before this project.

Variation of catch (%) for two types of harvest systems in water bodies is shown in Figure 3. The figure shows the percentage of variability in the total production and the majority of water bodies (23) show higher catch from monitoring which has revealed the significance of open catches during monsoon.

Table 5: Total harvests from organized catch and monitoring in all monitored sites in 2008.

Name of Upazila	Name of waterbody	Organized Catch (kg)	Est. catch from monitoring (kg)	Total prod. (kg)
Sunamganj Sadar	Langol Kata ojur *Beel*	3528	8446	11974
	Boiragimara *Beel*	1716	1778	3494
	Aung Gung	516	1525	2041
	Urail *Beel*	837	4817	5654
	Aislauni Prokashito Mitar Dubi	777	1755	2532
	Chota *Beel*	668	1509	2177
	Lalpurer Jai and Gozaria Dair	895	2084	2979
South Sunamganj	Babonpai *Beel*	1284	5366	6650
	Tedala Hugliya chatol	11806	3041	14847
	Chatol Udai Tara Beel	10626	4431	15057
	Netai Goan	1511	3420	4931
	Pachgachiya *Beel*	1315	1610	2925
	Moinpur *Beel* Group	1748	4135	5883
	Srinathpurer Dhola	12	309	309
	Kochua Goan	1728	2244	3972
	Chinamara *Beel*	621	2485	3106
	Terajani Balir Dubi	2024	3686	5710
Derai	Boro Medi *Beel*	2722	9481	12203
Jamalganj	Sonduikka Group jolmohal	1019	7261	8280
	Dewtan *Beel*	1949	4647	6596
	Basker Khal	175	6334	6509
Biswambharpur	Monikamarer kuri	772	444	1216
	Sudamkhali River	2223	311	2534
	Ghotghotia *Nodhi*	1386	715	2101
	Tiar *Beel* Lomba *Beel* Gol *Beel*	104	1095	1199
	Abua Prokasito Nainda Nodhi	4869	13482	18351
Tahirpur	Thapna Group Jolmohal	14878	8420	23298
	Choto Khal Boro Khal	1723	3995	5718
	Issubpurer Khal	165	335	500

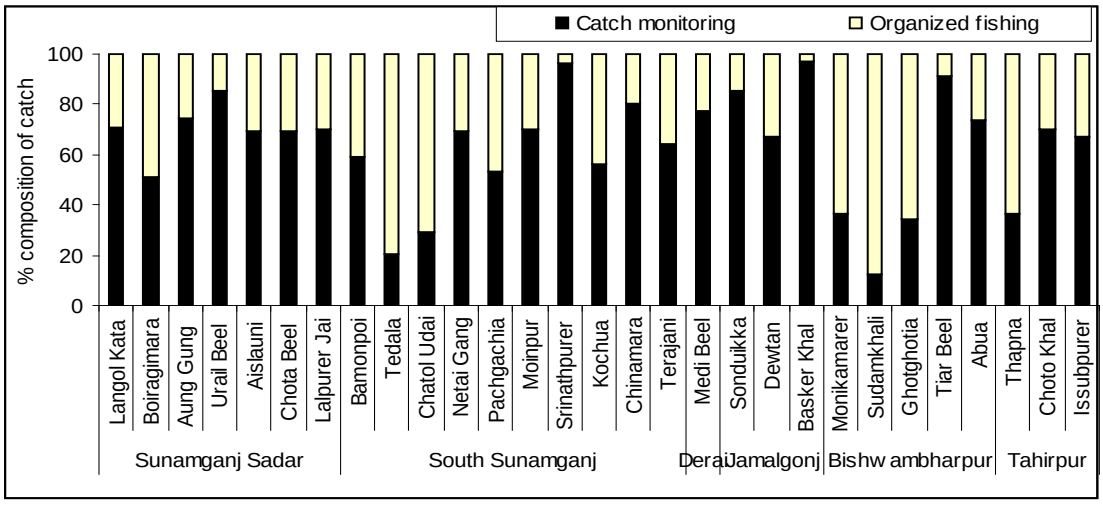


Figure 3. Contribution of fish production (% by weight) from two sources (catch monitoring and organized catch) in all monitored sites.

Among the six upazilas, the number of water bodies sampled in South Sunamganj, Sunamganj Sadar, Jamalgaj, Biswambharpur, Derai and Tahirpur were 10, 8, 3, 5, 1 and 3 respectively.

Fish production through organized catch and monitoring catch varied considerably and the ratios 1.1:1, 0.4:1, 0.2:1, 0.6:1 0.3:1 and 1.3:1 were observed in South Sunamganj, Sunamganj Sadar, Jamalganj, Biswambharpur, Derai and Tahirpur respectively. Monitoring catch was found higher in Sunamganj Sadar, Jalamganj, Biswambharpur and Derai. However, organized catch were found higher in South Sunamganj and Tahirpur. The main effective factors that influence better production performance by catch monitoring at most sites may be habitat type (e.g., river), water extension during monsoon, tenure effectiveness of restriction in fishing, fish sanctuary, higher species diversity (e.g., Sonduikka, Abua Prokasito, Medi, Baskerkhal), presence of professional fishers around water bodies, fisher's density, good link with other water bodies or big *haors*, no restriction during monsoon & near by *beel* areas and interruption of organized harvest at some sites etc. Variations in production through organized catch and monitoring catch in the six upazilas are shown in Figure 4a. Regression analysis reveals a positive correlation between organized catch and monitoring catch (Figure 4b).

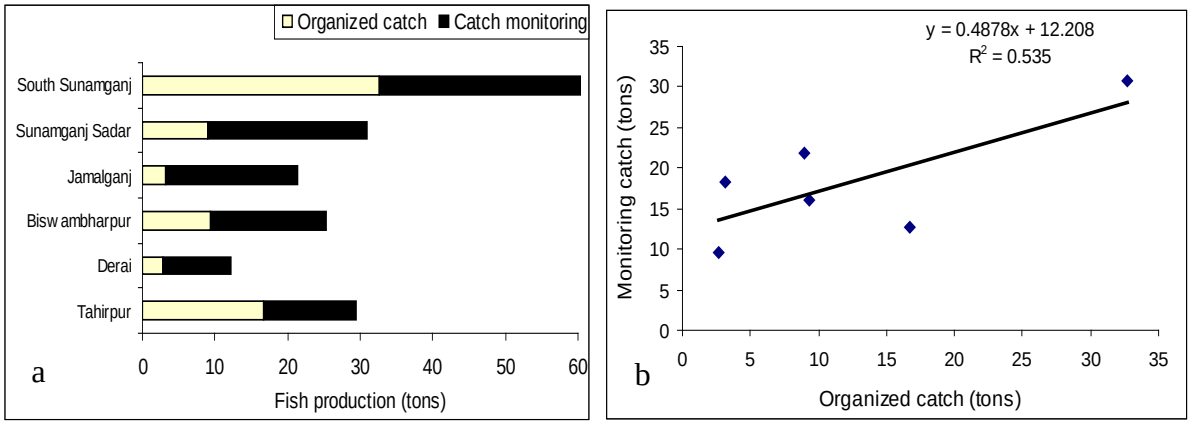


Figure 4a) Fish production through organized fishing & monitoring, and 4b) Regression between organized catch versus monitoring.

There was substantial variation in production (kg/ha) through organized catch at most sampling sites and production varied from 32 to 1177 kg/ha with average production of 370 kg/ha (Figure 5). Variation in production (Kg/ha) was lower among eleven water bodies (Urail beel, Aislauni, Chota beel, Tedala, Chatol Udaitara, Moinpur, Kochua, Chinamara, Dewtan, Monikamarer kuri and Choto khal). Two water bodies (Pachgachiya and Terajani) stand away from this general production value and have highest production from organized catch (1052 and 1177 kg per hectare respectively). In contrast, another six water bodies Boiragimara, Babonpai, Medi Beel, Basker Khal, Tiar beel and Issubpurer khal also have the lowest production values: 92, 101, 53, 37, 40 and 32 kg/ha respectively.

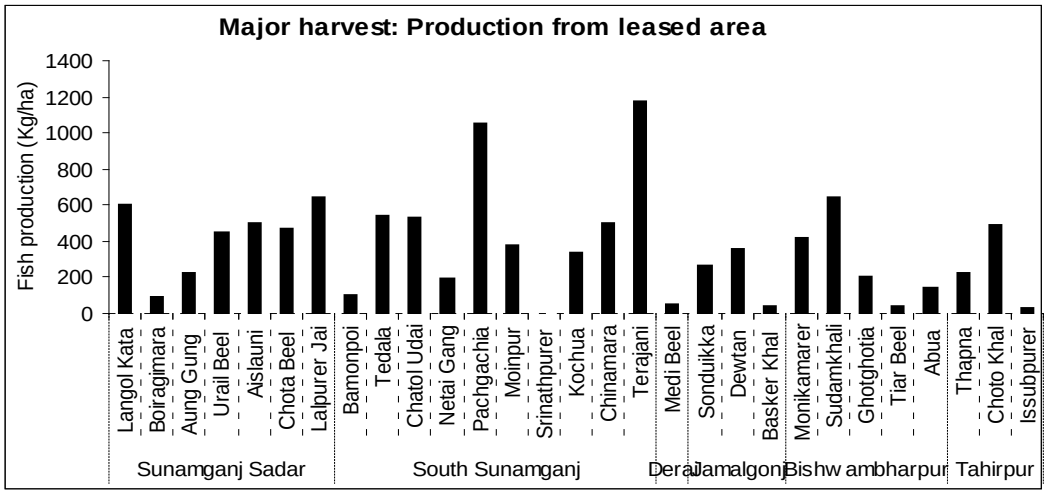


Figure 5. Estimated production (kg/ha) based on organized catch records in all studied sites.

Variation in production (kg/ha) at most sampling sites also occurred from catch monitoring and production ranged from 35 to 717 kg/ha with an average production of 291 kg/ha (Figure 6). Lowest production (kg/ha) was found in Aislauni, Chota beel, Lalpurer Jai, Chatol Udaitara, Kochua and Tiar beel. Simultaneously lower variation in production (kg/ha) was found among seven water bodies (Aung Gung, Babonpai, Netai Goan, Pachgachia, Moinpur, Dewtan and Abua nodhi). Concurrently, less variation in production (kg/ha) was found among seven water bodies (Langol Kata, Urail beel, Chinamara, Terajani, sonduikka, Basker khal and Choto Khal).

The main effective factors that may cause a lower production in monitoring (individual) catches at some sites may be the beel owner restricting fishing in and around beels (Boiragimara, Tedala), only a small number of fishermen catching fish due to legal case by other community people and action by police (Srinathpurer dola), a lower fisher density and restricted fishing with seine net (Sudamkhali, Ghotghotia) and high abundance of aquatic vegetation (Thapna).

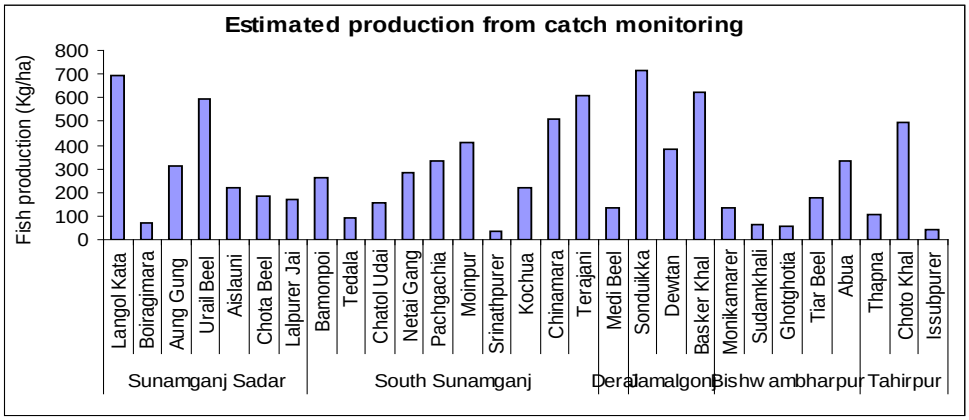


Figure 6. Estimated production (kg/ha) based on catch monitoring data in all studied sites.

3.2. Seasonal variations of fish production

The seasonal variation of fish production is very high in the *haor* habitat and is mainly affected by flooding and fluctuation of water level. Assessing seasonality and production reveals that the highest production occured between July and October. *Haor* habitat showed higher catch at the middle, and end of the flood season. Thus seasonal variation of fisheries production showed a peak production period between July and October and, a minimum between February and June, and Novermber to December of the same year (Figure 7).

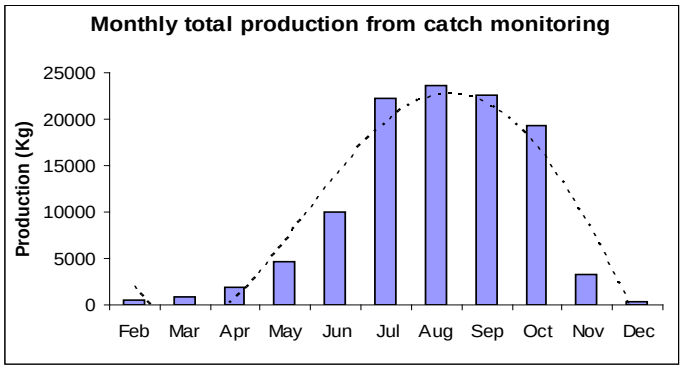


Figure 7: Monthly variation of total estimated production (kg) from catch monitoring in all survey sites.

It was observed from the seasonality of production that as a general pattern for the Sunamganj Sadar, the highest production occurred between May and October, with a peak in July. The highest production for the South Sunamganj was observed between May and November with a peak in September. Similarly, highest production for Bishwambpur was observed between July and October with a peak in October, Tahirpur had highest production between June and October with a peak in September, and Jamalganj and Derai's highest production was observed between July and October with a peak in August. Upazila wise monthly variation of fish production in all catch monitoring sites are presented in Figure 8.

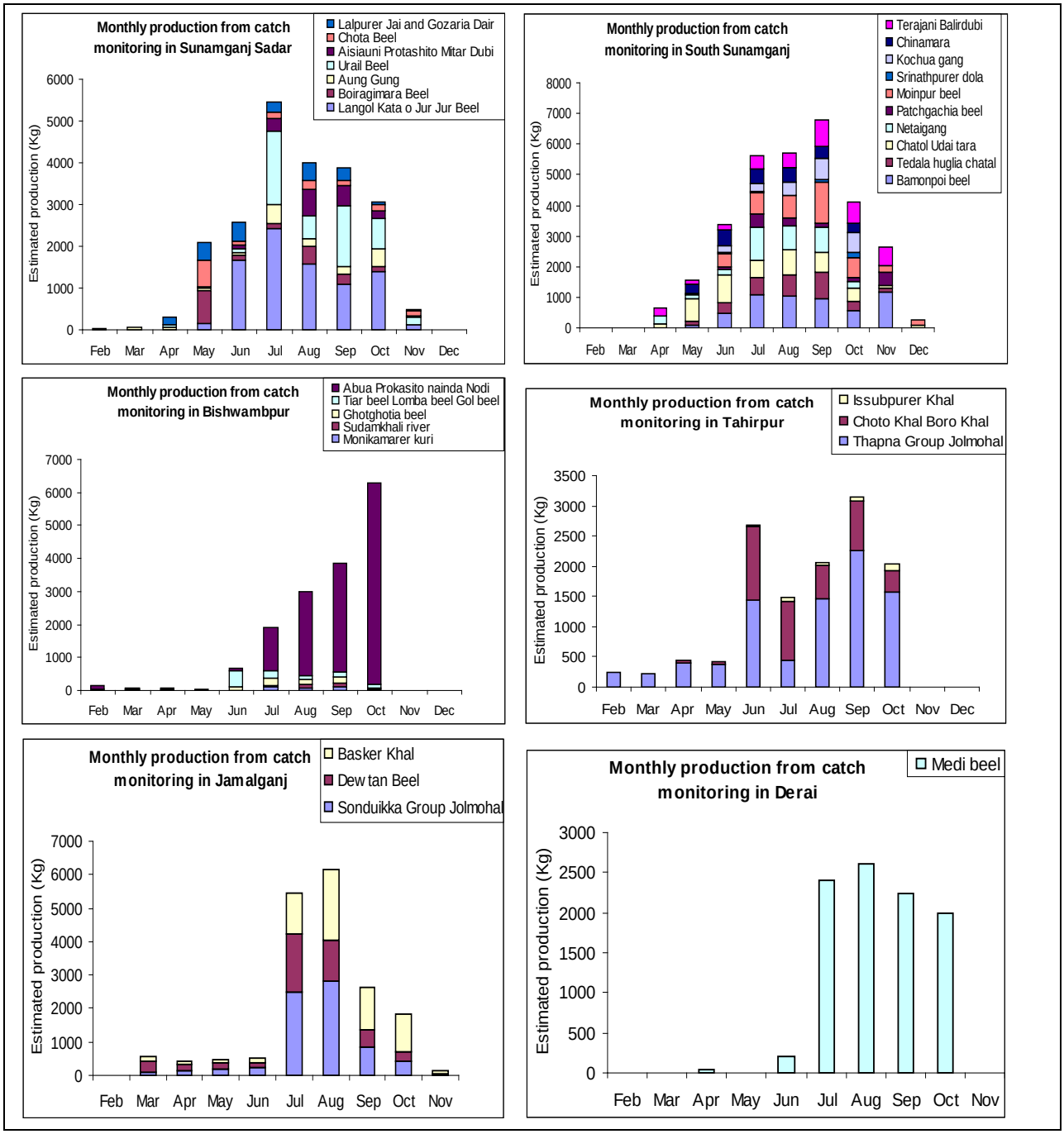


Figure 8. Estimated monthly production (kg) based on catch monitoring in six upazilas of Sunamganj district.

3.3. Harvesting performance and water bodies in different Upazilas

Analysis of the overall harvesting performance between organized catches and monitoring catches reveal that fish production through catch monitoring is weakly correlated with organized catches for seven water bodies in Sunamganj Sadar, ten water bodies in South Sunamganj and five water bodies in Bishwambhpur upazilas. Figure 9 shows a positive correlation between organized and monitored catches in three upazilas and only one Jamalganj, with the smallest sample size (n=3) shows a slight negative correlation. However, the positive correlations found are not strong and their sample size is not large enough for a conclusive statement. Furthermore, this is a 1 year survey and further research is required to study how such a production pattern varies between years.

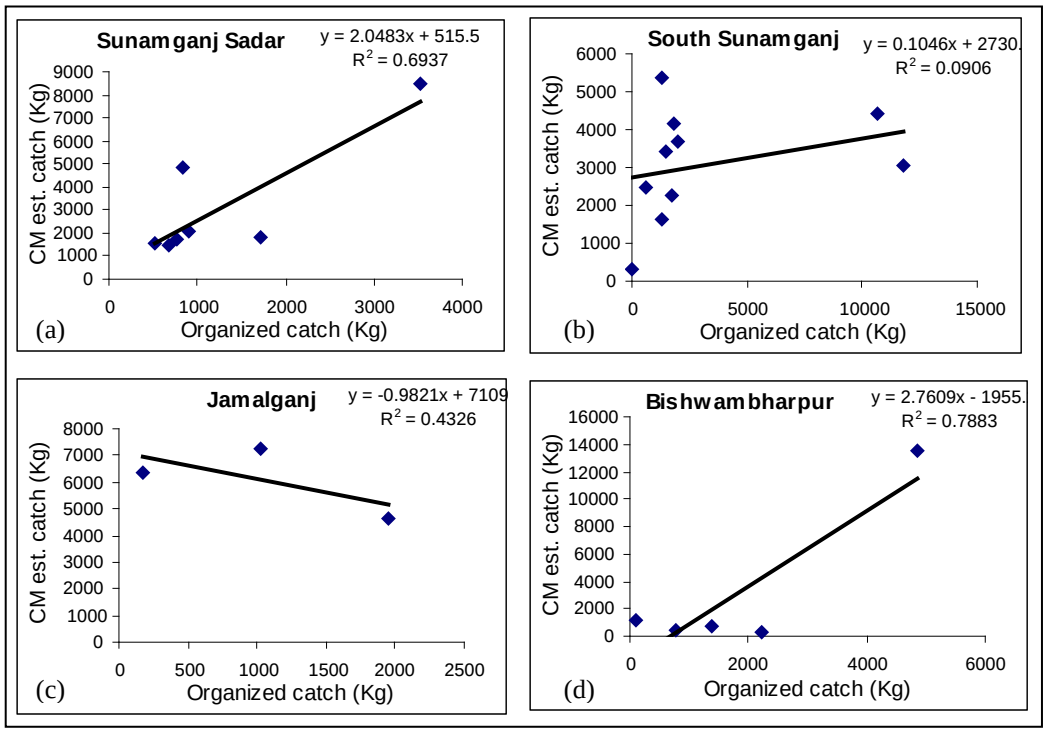


Figure 9. Relationships between monitoring and organized catches at 7, 10, 3 and 5 sites, in Sunamganj sadar (a), South Sunamganj (b), Jamalganj (c) and Bishwambharpur (d) upazilas respectively.

When combining all organized catch (kg/ha) and catch monitoring (kg/ha) data, a regression analysis does show that production from organized catch positively correlates with production from catch monitoring (Figure 10). Again, this is a one year study; further study is required to know how it may affect production from two sources.

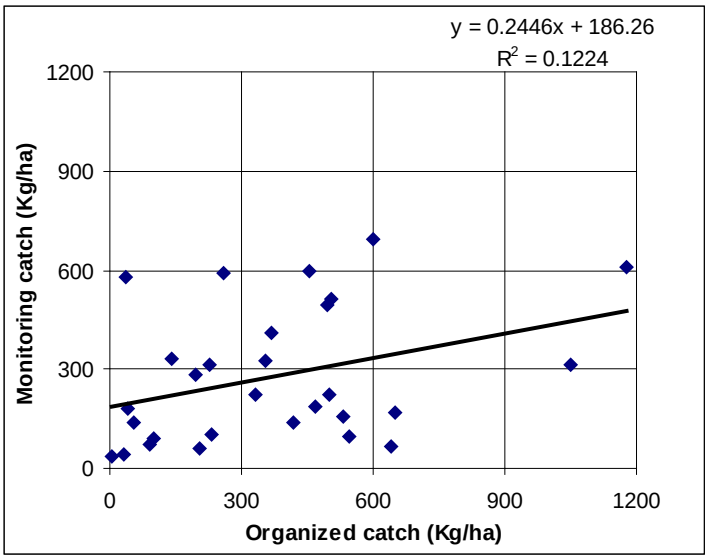


Figure 10. Correlation between organized catch (kg/ha) and catch monitoring (kg/ha) at all studied sites.

3.4. Catch composition based on catch monitoring data

The common species caught by all types of gear were Jatputi (*P. sophore*), Kalibaus (*Labeo calbasu*), Taki (*Channa punctata*), Meni (*Nandus nandus*) and Kholisha (*Colisa fasciatus*) contributing to 7.84%, 7.76%, 6.82%, 5.7% and 4.7% of overall catches, respectively. Analysis of annual catch monitoring data reveals that 20 main species contributed to 74% of the catch by weight in 2008. The annual contribution of the other 76 species was 26% of the catch by weight. The percentage compositions of the 20 main species in annual production are presented in Figure 11. *Puntius sophore* is the species making the highest contribution in five upazilas, the highest abundance of Kalibaus (*Labeo calbasu*) occurred in Biswhambapur Upazila, and Taki (*Channa punctata*) made its second highest contribution in both Sunamganj Sadar and Biswhambpur Upazilas. The main catches of Meni (*Nandus nandus*) occurred in Sunamganj Sadar and Derai Upazilas. Among the main five contributor species of Biswhambapur upazila, the highest abundance (51% by weight) of Kalibaus (*Labeo calbasu*) appeared in the Abua nodhi, and very high catches of Kalibaus was also observed in this river during catch monitoring. According to IUCN (2003) Kalibaus is an endangered species, so attempts should be made to conserve this species. Although this assumption would require further research to study how such abundance varies between years and how it may affect Kalibaus (*Labeo calbasu*) recruitment in this river.

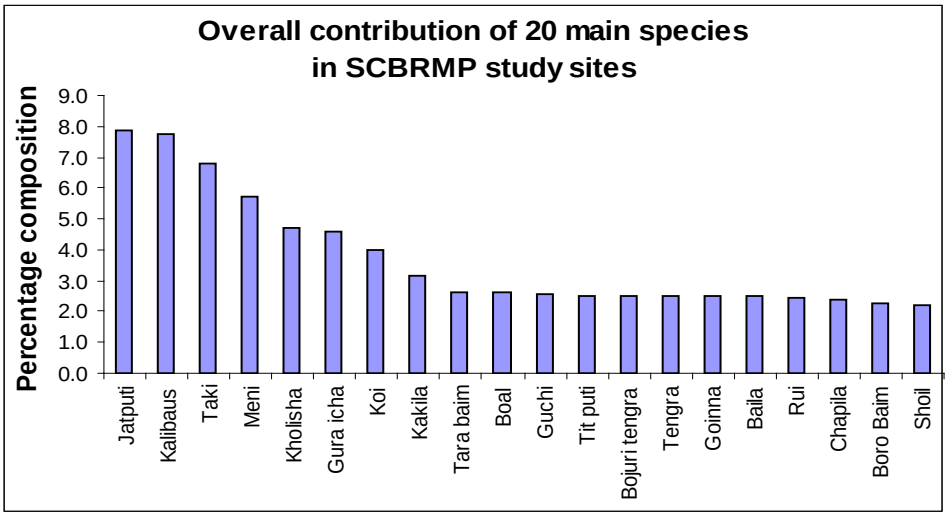


Figure 11. Species composition by weight (20 main species) in SCBRMP study sites.

Among these main 20 species, 14 species together contributed to 54.37% of total catch with their average weight ranging between 0.5g and 13g. Ten most important species, Gura Icha, Titputi, Bojuri tengra, Baila, Chikra baim, Chapila, Jatputi, Kholisha, Tangra and Kakila were found with an average weight of 4.37g per fish, and these may be the main contributing species to the poor people's diets in *haor* areas explicitly during flood season. Of the 20 main species, six species, Shol, Boro biam, Goinna, Kalibaus, Rui and Boal were found with their average weight being between 34g and 570g. These species contributed to 19.8% of total catch. The average weights (g) of the twenty main species are presented in Figure 12.

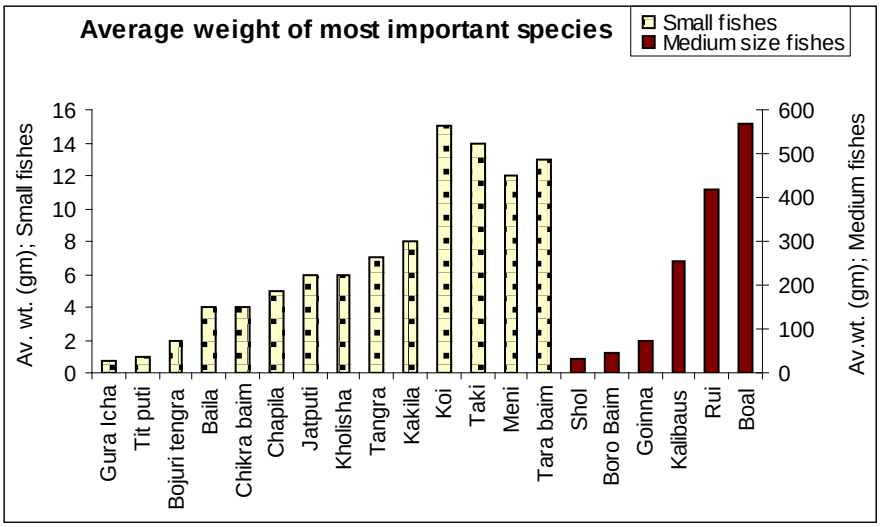


Figure 12. Average weights (g) of main 20 species based on catch monitoring.

3.5. Catch composition based on organized catch data

A total of 73 species of fish and prawn were recorded from organized catch during the study period. The common species caught were Jatputi (*P. sophore*), Carpio (*Cyprinus carpio*), Teriputi (*Puntius terio*), Chapila (*Gudusias chapra*), Mola (*Amblypharyngodon mola*), Rui (*Labeo rohita*) and Boal (*Wallago attu*) contributing to 11.6%, 6.29%, 5.29%, 5.01%, 5.01, 4.98% and 3.62% of overall catches, respectively. Analysis of organized catch data reveals that 20 main species contributed the maximum proportion of the catches, all together contributing about 73% by weight in 2008. The annual contribution of other 53 species was only 27% of the catch. The percentage compositions of 20 main species in catches are presented in Figure 13. Jatputi (*Puntius sophore*) also represents as the highest contributing species in organized harvest. However, the highest abundance of exotic species (Carfu - *Cyprinus carpio*) appeared in the *haor* habitat expressly from South Sunamganj upazila. The maximum production of carfu occurred in Tedala (--%), followed by Langol Kata, Medi, Kochua, Chatol Udai tara, Boiraigimara, Dawtan, Terajani, Chinamara, Sudamkhali, Monikamarer kuri, Aislauni, Urail, Pachgachia, Aung Gung, Basker khal and Ghotghotia. Although this assumption would require further research to study how such exotic species spread over in the *haor* region, how production varies between years and how recruitment occurred in the *haor* areas.

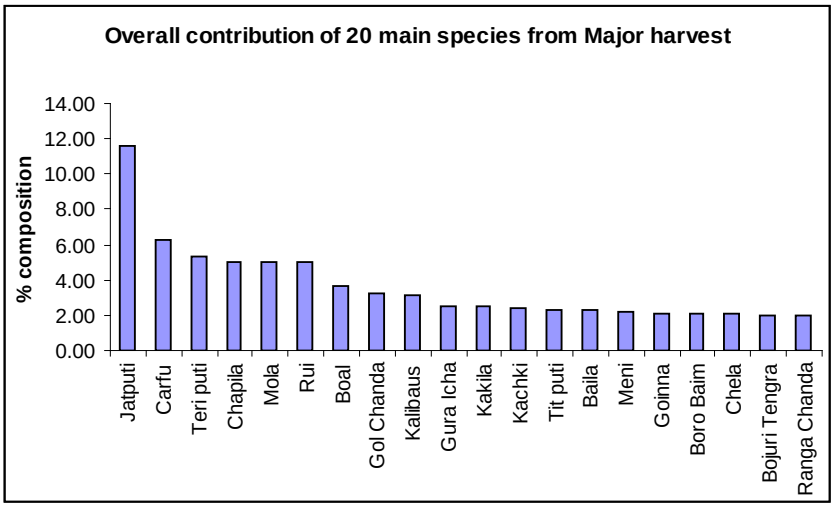


Figure 13. Species composition by weight (main species) based on organized harvest.

Among these main 20 species, 14 species together contributed to 50.48% of total catch with their average weight ranging between 0.33g and 56.36g. Eight of these twenty species; Kachki, Ranga chanda, Gura icha, Titputi, Gol chanda, Bojuri Tengra, Chela and Mola were found with

an average weight of only 2.11g, and these are the main species in organized harvest. Of the 20 species six species, Shol, Boro biam, Goinna, Kalibaus, Rui and Boal were found, with their average weight being between 152g and 830g. These species contributed to 22.27% of total catch. The average weights (by species) of the main species are presented in Figure 14.

Species compositions were calculated for each Upazila by combining annual organized catch and catch monitoring data. The five most abundant species at each Upazila contributed to approximately 30% of the total catch in each onea. The percentage composition (by weight) of the top five species and total catches (including organized catch) in the six upazilas are given in Table 6. A single species *Puntius sophore* (Jatputi) was found as the highest contributing species towards catches in Sunamganj sadar (13.78%), South Sunamganj (7.47%), Derai (7.04%), Jamalganj (8.86%) and Tahirpur (11.92%) upazilas. Species wise production from catch monitoring and group fishing during the study period are given in Appendix 5. Photograph and key taxonomy of some main contributing species are given in Appendix 6.

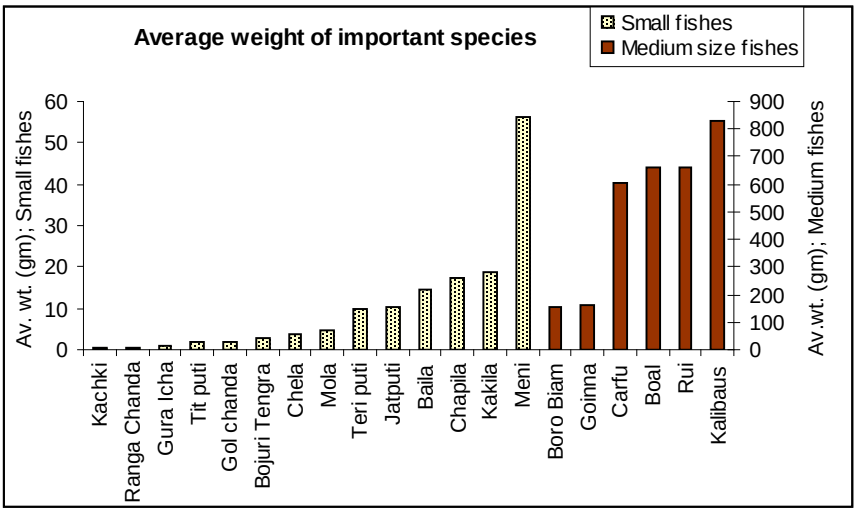


Figure 14. Average weights (g) of main species based on organized harvest.

Major harvesting in Lalpurer Jai & Gozaria dair

Table 6. Total fisheries production of main species (top five), and their % composition by weight.

Upazila & no. site	Name of species		Total Wt (kg) (CM+GF)	Weight (%)
Sunamganj Sadar (7 waterbodies)	**Local Name**	**Scientific Name**		
	Jatputi	*Puntius sophore*	4254	13.78
	Taki	*Channa punctatus*	2100	6.80
	Meni	*Nandus nandus*	1948	6.31
	Kholisha	*Colisa fasciatus*	1943	6.30
	Koi	*Anabas testudineus*	1826	5.92
	Other Species	(68 species)	18791	60.89
South Sunamganj (10 waterbodies)	Jatputi	*Puntius sophore*	4739	7.47
	Teri Puti	*Puntius terio*	3763	5.94
	Gura Icha	*Nematopalaemon tenuipes*	3513	5.54
	Karfu	*Cyprinus carpio (specularis)*	3497	5.52
	Kholisha	*Colisa fasciatus*	2873	4.53
	Other Species	(69 species)	45009	71.0
Derai (one water body)	Jatputi	*Puntius sophore*	861	7.04
	Meni	*Nandus nandus*	980	8.01
	Koi	*Anabas testudineus*	826	6.75
	Taki/Ladi	*Channa punctatus*	764	6.24
	Kholisha	*Colisa fasciatus*	609	4.98
	Other Species	(45 species)	8199	66.99
Jamalganj (3 waterbodies)	Jatputi	*Puntius sophore*	1895	8.86
	Taki	*Channa punctatus*	1868	8.74
	Mola	*Amblypharyngodon mola*	1610	7.53
	Baila	*Glossogobius giuris*	1133	5.30
	Shol	*Channa striatus*	892	4.17
	Other Species	(75 species)	13988	65.39
Bishwambharpur (Five waterbodies)	Kalibaus	*Labeo calbasu*	7742	30.48
	Kachki	*Corica soborna*	2344	9.23
	Rui	*Labeo rohita*	1857	7.31
	Jatputi	*Puntius sophore*	1831	7.21
	Boal	*Wallago attu*	1821	7.17
	Other Species	(74 species)	9807	38.61
Tahirpur (3 waterbodies)	Jatputi	*Puntius sophore*	3517	11.92
	Chapila	*Gudusias chapra*	2843	9.63
	Rui/Ruhit	*Labeo rohita*	2767	9.37
	Kakila	*Xenentodon cancila*	1703	5.77
	Goinna	*Labeo gonius*	1614	5.47
	Other Species	(59 species)	17072	57.84

3.6. Sale prices

Income derived from fishing activities is influenced by several factors, such as catch rates of different species, presence of high priced species in the catch, partial harvest of fish, ownership of gears, the number of active fishing days, distance from a city market or marketing system and fish prices. Variations of average prices (Tk.) per kg of fish in the monitored sites indicates that Patchgachia *beel* in South Sunamganj has the highest per kilogram value of harvested fish (Tk 98); whilst Lalpurer-Jai and Gazariar dair in Sunamganj Sadar have the lowest per kilogram value (Tk. 32). The average value from all sampled water bodies was Tk 60±15 per kg. However, throughout the study period, there were variations in fish sale prices (Tk. per kg) for

catches from the organized catch. Sale values (Tk. per kg) in all monitored sites are shown in Figure 15. Total production (kg) and total sales value (Tk.) from organized fishing are presented in Table 7.

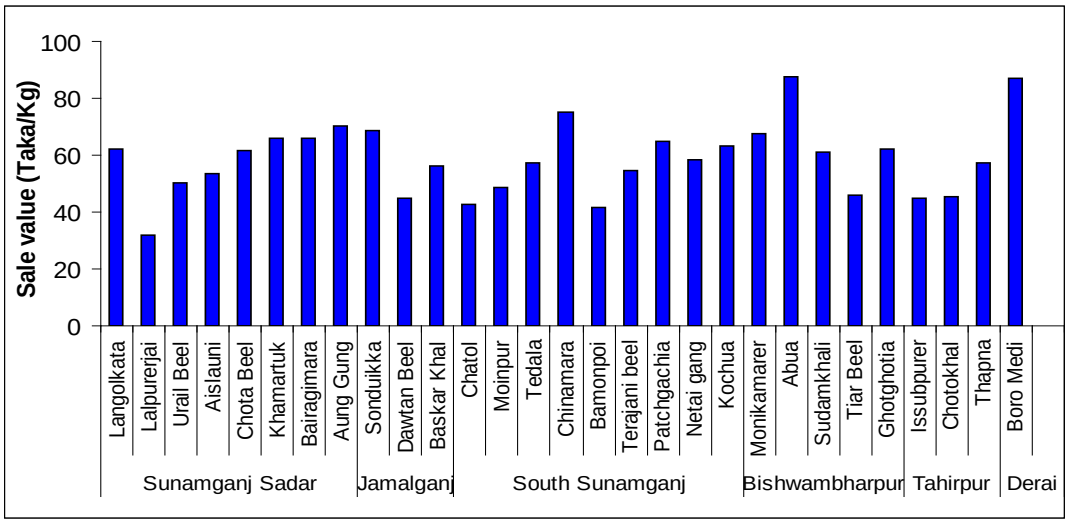


Figure 15. Sale prices (Tk./kg) of harvested fish (organized catch) at different water bodies.

Table 7. Total production (kg) and sales value (Tk) at all sampled water bodies.

Name of Waterbody	Year 2007- 08		Remarks
	Production (kg)	Total Amount (Tk)	
Sunamganj sadar			
Urail *beel*	837	42184	Harvesting interrupted by early rainfall and couldn't complete in this year.
Langol kata Ojur *beel*	3528	218567	Harvesting Completed by 18.03.08
Lalpurer Jai & Gozariar dair	895	28561	Harvesting Completed by 24.02.08
Khamartuk mouzar 860 no. pukur	1786	118282	Harvesting Completed by 15.04.08
Chota *beel*	668	41072	Harvesting Completed by 26.02.08
Bairagimara *beel*	1715	112834	Complete Harvesting interrupted by rain and couldn't complete in this year.
Aung Gung	516	36310	Harvesting Completed by 25.02.08
Aislauni prokashito mitar dubi	776	41500	Harvesting Completed by 12.03.08
Jamalganj			
Sonduikka group Jolmohal	1018	69708	Harvesting Completed by 09.03.08
Dewtan *beel*	1949	87337	Harvesting Completed by 10.04.08
Basker khal	175	9847	Harvesting interrupted by rainfall and couldn't complete in this year.
Tahirpur			
Choto khal baro khal	1723	78287	Harvesting Completed by 26.02.08
Issubpurer khal	165	7387	Harvesting interrupted by internal conflict of BUG members
Thapna group jolmohal	14878	854298	Harvesting Completed by 29.03.08
Bishwambharpur			
Moni kamarer kuri	772	52312	Harvesting Completed by 21.03.08
Sudamkhali river	2223	135896	Harvesting Completed by 06.03.08
Ghotghotia *Nodhi*	1385	86382	Water level was increased by rain and complete harvesting was interrupted
Lomba *beel* Gol *beel*	104	4802	Harvest interrupted by early rainfall. Only one part was harvested fully out of three.
Abua prokashito nainda nodhi	4869	427520	Harvesting Completed by 25.03.08
South Sunamganj			
Tedala Hugliya chatol	11806	676752	Harvesting Completed by 05.03.08
Chinamara *beel*	621	46712	Harvesting Completed
Moinpur *beel* group	1748	85068	Harvesting Completed
Babonpai *beel*	1284	53496	Harvesting Completed by 26.02.08
Chatol udaytara	10626	454168	Harvesting Completed by 30.03.08
Terajani balirdubi	2024	110982	Harvesting Completed by 09.03.08
Patchgachia *beel*	1315	85110	Harvesting Completed by 17.03.08
Netaigoan	1510	88417	Harvesting Completed by 10.03.08
Srinathpurer dhola	-	-	Not harvested due to confliction
Kochua goan	1728	109279	Harvesting Completed by 29.03.08
Derai			
Boro medi *beel*	2722	236206	Harvesting interrupted by Police case

3.7. Gear efficiency and production

The main fishing gears operated in the SCBRMP sites harvested most of the available species in the *haor* habitat. Some species are caught selectively with different gears and some gears are selective such as gill nets, traps, hook and line and long line. The fisheries production through catch monitoring mostly comes from gill nets (39.5% of the total estimated production). The seine net contributed to 24.2% of the production. Moreover, cast nets, push nets, hook & line and long line together contributed to 29% of the total production. Finally, the remaining gears (traps, large lift net, small lift net, spear, set bag net) contributed to only 7.3% of the production. Figure 16 reprensents the distribution of fisher intensity and catch by gear, i.e. the percentage of the total catch each gear caught, and the percentage of fisher intensity each gear required for the obtaining that catch. Seine nets, push nets, hook & line and long line require higher fishers' days, while gill nets and cast nets require a lower fishing intensity in contrast to their contribution of catch.

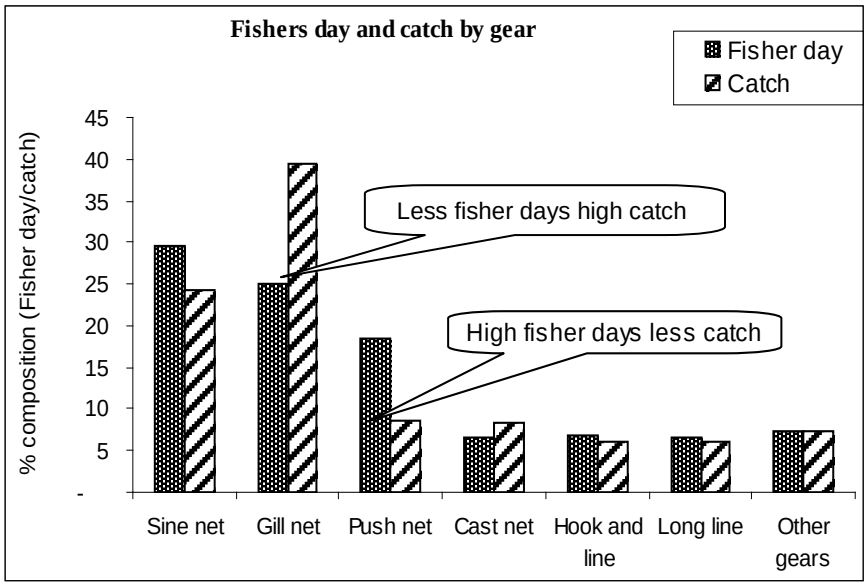


Figure 16. Percentage composition of fisher's day by gear and catch (% by weight) by gears in SCBRMP study sites.

Assessing the gear efficiency (% of fisher's day by gear) and fish production (% catch by gear) it was observed that the highest catch occurred through gill nets and seine nets in Sunamganj Sadar, and the highest catch occurred with gill nets, seine nets and push nets in South Sunamganj. Similarly the highest catch was observed by the cast nets, gill nets and seine nets in Bishwambpur; by seine nets, gill nets and long line in Tahirpur and by the seine nets, gill nets

and hook & line in Jamalganj and Derai. Variation of gear efficiency (% of fisher's day by gear) and fish production (% catch by gear) was calculated for each Upazila using data from all monitored sites (Figure 17).

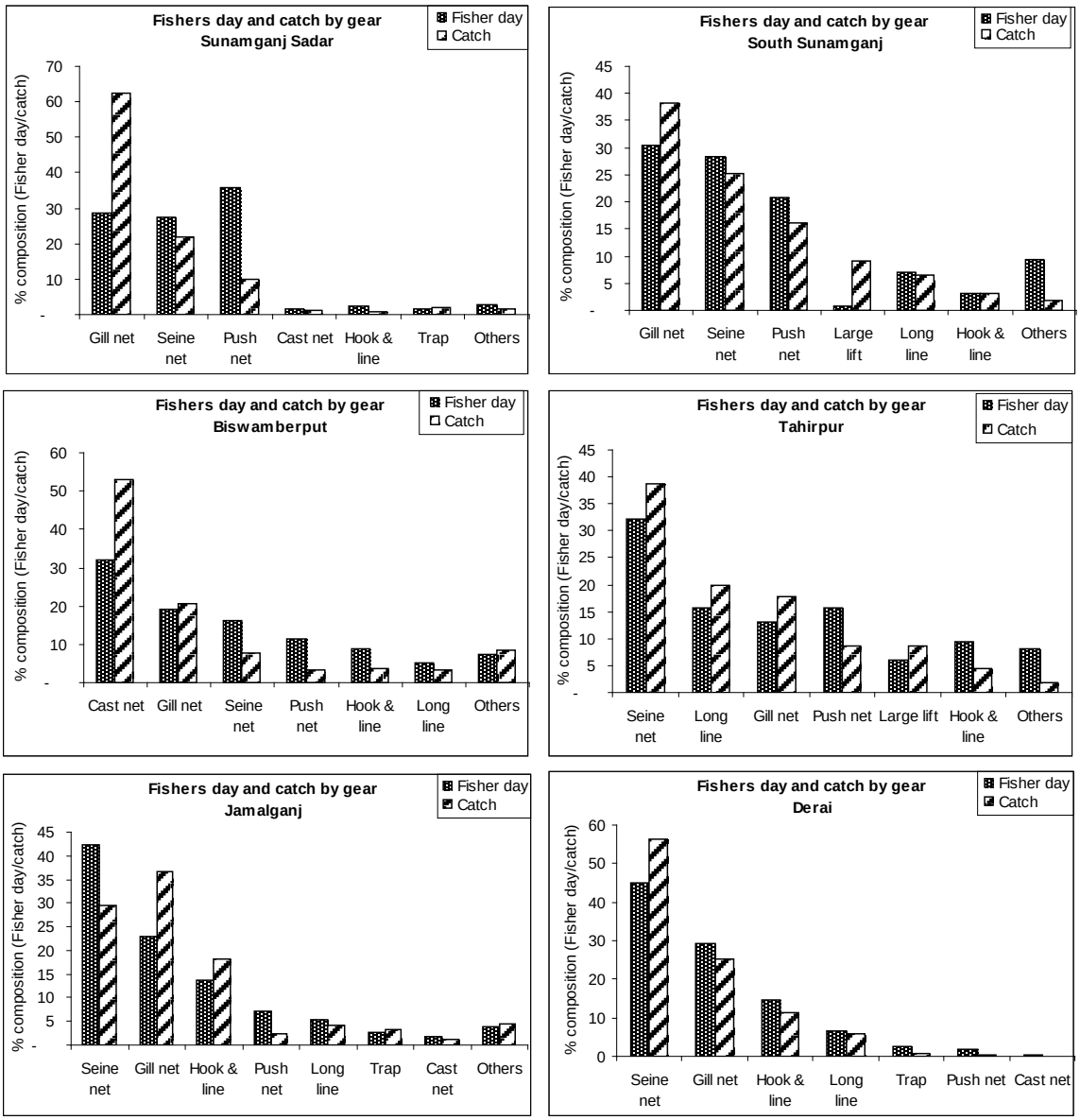


Figure 17. Upazila wise percentage composition of fisher's day and catch (% by weight) by gears in study sites.

3.8. Relationship between water bodies leased value and fish sale value

The amount of annual leased value across the project water bodies varied enormously from Tk.183 to Tk. 8677 per acre with an average value of Tk.1636 per acre at 95% confidence limits. At the same time,, fish sale value (potential income from catch) also varied to a great extent across the project water bodies from around Tk 576 to Tk 27633 per acre with an average sale value of Tk 8814 per acre at 95% confidence limits. Regression analysis between leased value (Tk. per acre) and fish sale value (Tk. per acre) shows significance at 95%CL (P-value was found 0.0008 and F-statistic was 14.49) (Figure 18). This reveals that lease value (Tk. per acre) could be achievable through fish sale value (Tk. per acre). However, the fish sale value (Tk. per acre) shows an inverse correlation with leased area which reveals that small area is more beneficial than large area (Figure 19). However, for waterbodies with a high lease value but few opportunities of obtaining the money required for such lease value, the BUGs should focus on income generation to assure the payment and these watarbodies could be used for seasonal stocking with native fish species.

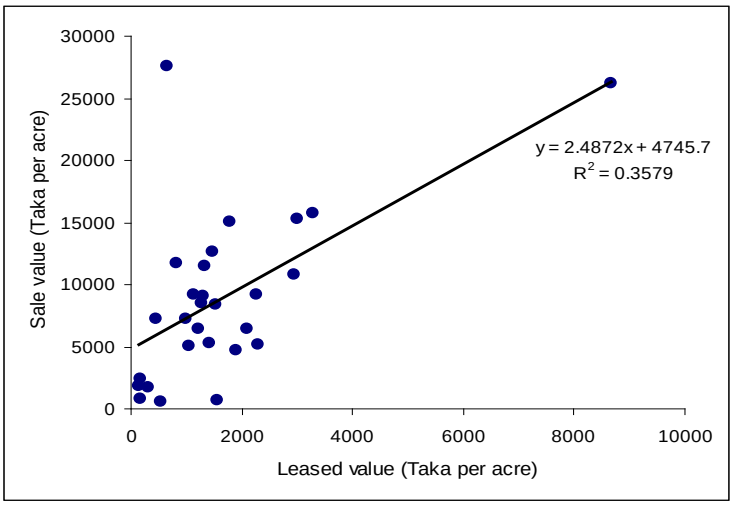


Fig 18. Regression analysis between Leased value (Tk/acre) and Sale value (Tk/acre).

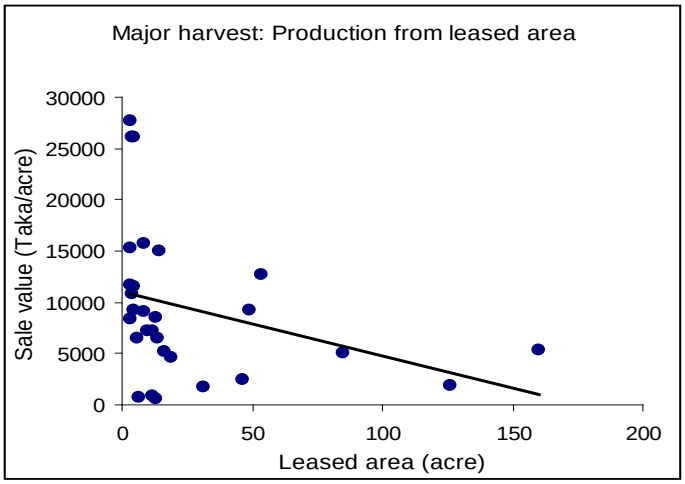


Figure 19. Sale value (Tk/acre) plotted as a function of leased area at all studied sites.

3.9. Biodiversity based on catch monitoring data

A total of 96 species of fish and prawn were recorded during the study period. The number of species caught in the monitored sites revealed that the maximum number of species (74) was found in the Sonduikka *beel*, Abua nodhi (65), Basker khal (63), Chatal Udaytara (59), Boiragimara (54) and Thapna (53) and Langolkata (47). However, total number of species varied from 25 to 74. Ranges of species: 25 to 35, 36 to 45, 46 to 55, 56 to 65 and 66 to 75 were found in 7, 13, 5, 3 and 1 site respectively. This reveals that the maximum number of water bodies are the habitat of 36 to 45 species. There was substantial variation in species in each upazila and among water bodies. Total number of species in each sampled water body is shown in Figure 20.

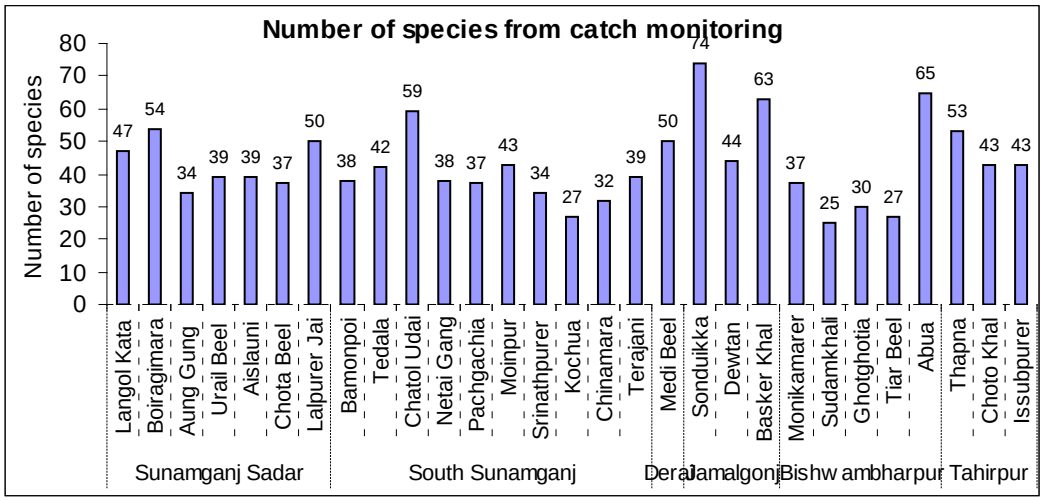


Figure 20. Total numbers of species recorded from catch monitoring at all studied sites.

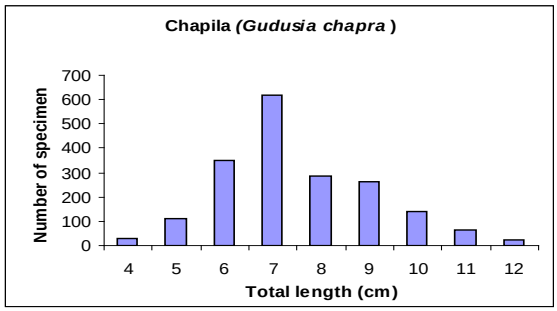
Biodiversity of self-recruiting indigenous species using the Shannon-Weiner index (H') in the study sites ranged from 1.346 to 3.531 in 2008. The biodiversity monitoring research programme has demonstrated optimum level of biodiversity at most water bodies. However, the project management needs to focus very clearly on increasing biodiversity at some water bodies (H'>2.5), since *haor* and *beels* generally depend on what is happening in other surrounding water bodies. A comparision of biodiversity index (H') for 25 sites, based on natural species proportions is shown in Figure 21.

Fig. 21. Estimate of mean H' with 95% confidence limits has been plotted for each water body, with one year observation through catch monitorig.

3.10. Length-frequency distribution

Length-frequency data was summarized for the two most important species in the Abua Prokasito Nainda Nodhi, Thapna Group Jolmohal, Tedala Hoglia and Boro Medi beel. The pooled length-frequency showed the length-frequency distribution of Chapila and Kalibaus in the Abua Prokasito Nainda Nodhi, Meni and Kakila in the Thapna Group Jolmohal, Taki and Tengra in the Tedala Hugliya; and Jat puti and Gol chanda in the Boro Medi beel (Figures 22, 23, 24 and 25).

Calculated mean length ($x = \sum f_i x_i / \sum f_i$, where x_i is the mid length and f_i is the frequency) for Chapila, Kalibaus, Meni, Kakila, Taki, Tengra, Jatputi and Gol chanda were found to be 8.0, 27.64, 12.67, 18.42, 13.36, 9.4, 9.3 and 7.15 cm respectively. Status of length-frequency data are given in Table 8.



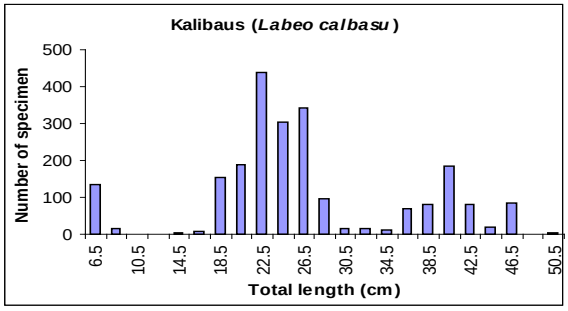
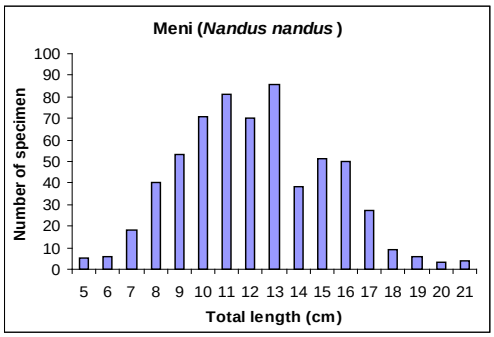


Figure 22. Length (cm) frequency distribution of Chapila (*Gudusia chapra*) and Kalibaus (*Labeo calbasu*) caught in the Abua nodhi.



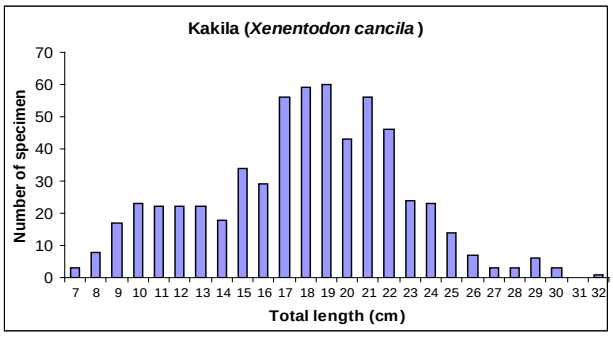
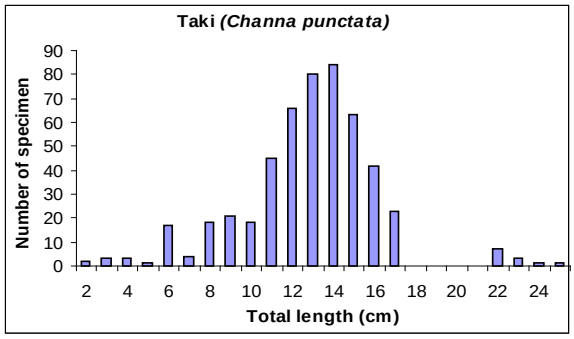


Figure 23. Length (cm) frequency distribution of Meni (*Nandus nandus*) and Kakila (*Xenentodon cancila*) caught in the Thapna Group *jalmohal*.



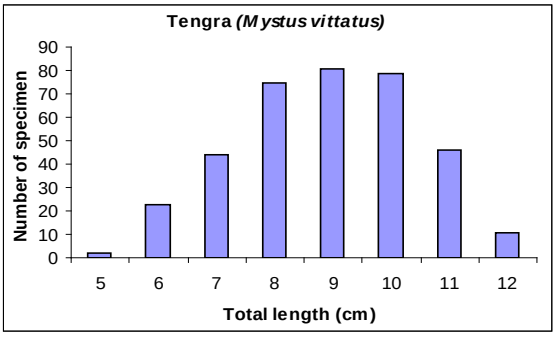
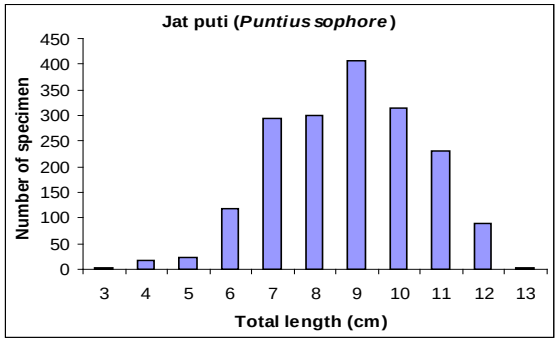


Figure 24. Length (cm) frequency distribution of Taki (*Channa punctata*) and Tengra (*Mystus vittatus*) caught in the Tedala Hoglia.



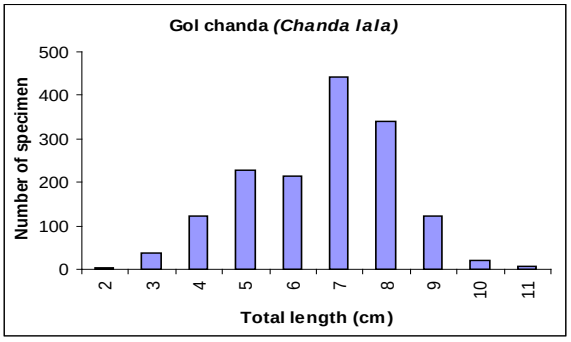
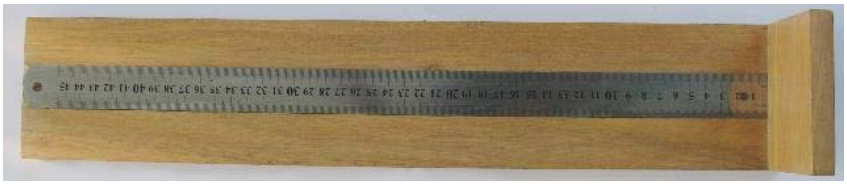


Figure 25. Length (cm) frequency distribution of Jatputi (*Puntius sophore*) and Gol chanda (*Chanda lala*) caught in the Boro Medi.

Table 8. Status of length-frequency data

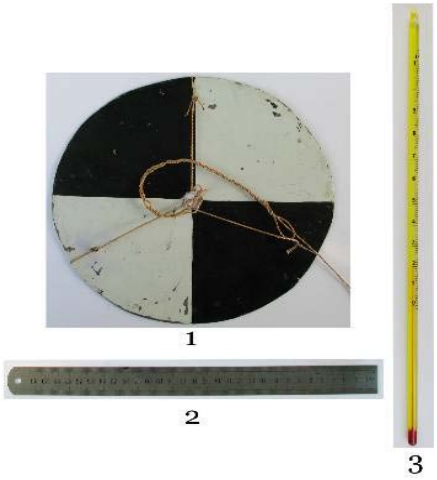
Upazila	Water-body	No. of sheet collected	Total no. of species found
South Sunamganj	Tedala Hugliya	873	57
Bishwambharpur	Abua prokashito nainda nodhi	1469	85
Tahirpur	Thapna group jolmohal	380	47
Derai	Boro medi *beel*	2058	60



Length-frequency measuring board

3.11. Water quality parameters record collection

Water quality parameters are directly related with the productivity of the waterbody. In order to observe the productivity of the waterbody, the Community Enumerators collected biweekly temperature, transparency, depth records, etc. from the waterbody.



Equipments used for water quality parameters collection
(1) Secchi disc (2) Measuring scale (3) Thermometer

4. Additional Support

4.1. Training on Open water Fisheries Management

The WorldFish Center facilitated an eight days training on “Open water fisheries management” for SCBRMP staffs. Eight ‘Subject Matter Specialists (SMS Fish)’ and seven ‘Social Organizers (SO Fish)’ participated in the training. The main objective of the training was to develop the

trainees' knowledge on open water fisheries management. Training was conducted by WorldFish key trainer, Senior Research Scientist, Team Leader (FRSP) and two Research Assistants.

The following issues were discussed during the training:

- Community based fisheries management
- Ecology of *Haor*
- Fish culture in open water
- Fisheries act
- Fisheries technology (statistics, harvesting, preservation)
- Fish conservation (sanctuary, excavation, gear restriction)
- Schematic Diagram of Effective Fisheries Management
- Marketing
- Leadership development

4.2. Capacity Building of FRS and CBRMP staff

Based on experience of project staff, it was realized that they need training on Access based data set management and analysis. In this regard, a two days training session was organized by WorldFish at the Sunamganj Office. One contracted trainer performed the two days session. Four Research Assistants from WorldFish and three staff from SCBRMP participated in the two days session.

5. Work plan 2009

Key Activities/Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fish Catch Monitoring												
Length Frequency												
Major Fishing												
Livelihood Mon. (BUG)												
Livelihood Mon. (CO)												

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Appendix 1. List of community enumerators assigned in different water bodies

Sl. No.	Name of Community Enumerator	Name of water body
Sunamganj Sadar		
1	Md. Imam Hossain	Aung Gung
2	Rajat Roy	Langolkata ojur beel
3	Sabikun Nahar	Lalpurer jai & Gozariar dair
4	Md. Nurul Amin	Bairagimara beel
5	Farid Uddin	Urail Beel
6	Md. Jillur Rahman	Aislauni Prokashito Mitar dubi Beel
7	Md. Ziaur Rahman	Chota beel
Jamalganj		
8	Golam Sarjious	Gool beel Lomba beel
9	Md. Enamul Haque	Basker Khal
10	Md. Shahid Mia	Dewtan Beel
11	Md. Sahjahan Alam	Sonduikka group Jolmohal
South Sunamganj		
12	Md. Ataur Rahman	Netai Goan
13	Shuvash Ranjon Das	Patchgachia Beel
14	Gopal Chondra Das	Moin pur Beel group
15	Abdur Rashid	Srinath Purer Dola
16	Md. Monwar Hussain	Kochua Goan
17	Samor Chakraborti	Chinamara Beel
18	Md. Numan Miah	Terazani balir dubi
19	Md. Iqbal Hossen	Babonpai Beel
20	Md. Ramjan Ali	Tedala Hugliya Chatol
21	Shoiful Alom	Tedala Hugliya Chatol
22	Md Johur Islam	Chatol Udai Tara Beel
Derai		
23	Rantu Ranjan Das	Medi Beel
24	Md. Humayun Kabir	Medi Beel
Biswambharpur		
25	Mst. Roksana Akter	Moni Kamarer Kuri
26	Mst. Kamrnnahar	Tiar Beel Lomba Beel Gool Beel
27	Mst. Mashoda Khatun	Sudam khali River
28	Subal Chandra Barman	Ghotghatia Nodhi
29	Sunil Barman	Abua Prokashito Nainda Nodhi
30	Pradip Chandra Talukder	Abua Prokashito Nainda Nodhi
Tahirpur		
31	Chhoyful Alam.	Thapna Group Jolmohal
32	Nayan Manik Talukdar	Thapna Group Jolmohal
33	Rafiq Ahmed	Issbpurer Khal
34	Ali Akbar	Choto Khal-Boro Khal

Appendix 2. Catch monitoring data collection status till September 2008.

Name of the waterbody	No. of Format Collected	Data Entry Status
Sunamganj sadar		
Bairagimara *Beel*	76	100%
Urail *Beel*	203	
Lalpurer Jai	164	
Aislauni Prokashito Mitar Dubi	105	
Chota *Beel*	59	
Aung Gung	180	
Langolkata Ojur *Beel*	252	
Sub-Total	**1039**	
South Sunamganj		
Terajani balir dubi	199	100%
Tedala Hugliya chatol	179	
Babonpai beel	155	
Moin pur beel group	201	
Chinamara	166	
Chatol Udai Tara	235	
Kochua Goan	149	
Patchgachia	217	
Srinath purer dhola	94	
Netai Goan	151	
Sub-Total	**1746**	
Bishwambharpur		
Abua prokasito Nainda Nodhi	532	100%
Moni kamarer Kuri	77	
Ghotghotia	92	
Tiar *Beel* Loma *Beel* Gool *Beel*	107	
Sudam Khali River	138	
Sub-Total	**946**	
Tahirpur		
Thapna Group Jolmohal	182	100%
Isubpurer Khal	248	
Choto Khal Boro Khal	181	
Sub-Total	**611**	
Jamalganj		
Dewtan *Beel*	187	100%
Sonduikka Group Jolmohal	175	
Basker Khal	175	
Lomba *beel* Gol *beel*	62	
Sub-Total	**599**	
Derai		
Boro Medi *Beel*	194	100%
Sub-Total	**194**	
Grand Total	**5135**	

Appendix 3. List of catch monitoring sites by habitat types and assigned Research Assistant

Upazila: Sunamganj Sadar				
Sl. No.	**Name of *beel***	**BUG Member**	**Water body types**	**Assigned WorldFish Research Assistant**
1	Chota beel	30	SB	Balaram Mahalder
2	Khamartuk Mouzar 860 no. pukur	26	P	
3	Langolkata o jur beel	29	SB	
4	Lalpurer jai & Gozariar dair	18	SB	
5	Bairagimara beel	45	LB	
6	Urail Beel	29	SB	
7	Aislauni Prokashito Mitar dubi Beel	30	SB	
8	Aung Gung	30	SB	Md. Mahadi Hasan
Upazila: Jamalganj				
9	Basker Khal	72	K	Md. Mahadi Hasan
10	Dewtan Beel	31	SB	
11	Sonduikka group Jolmohal	19	SB	
Upazila: South Sunamganj				
12	Netai Goan	17	SB	Md. Kamrul Islam
13	Patchgachia Beel	30	SB	
14	Srinath Purer Dhola	35	SB	
15	Kochua Goan	28	SB	
16	Chinamara Beel	30	SB	
17	Terazani balir dubi	36	SB	
18	Babonpai Beel	30	LB	
19	Tedala Hugliya Chatol	60	LB	
20	Moinpur Beel group	25	SB	Md. Mahadi Hasan
21	Chatol Udai Tara Beel	60	LB	
Upazila: Derai				
22	Medi Beel	161	LB	Md. Mahadi Hasan
Upazila: Biswambharpur				
23	Moni Kamarer Kuri	30	P	Md. Mizanur Rahman
24	Tiar Beel Lomba Beel Gool Beel	28	SB	
25	Sudam khali River	17	R	
26	Ghotghatia Nodhi	25	R	
27	Abua Prokashito Nainda Nodhi	80	R	Balaram Mahalder
Upazila: Tahirpur				
28	Thapna Group Jolmohal	58	LB	Md. Mizanur Rahman
29	Issbpurer Khal	76	K	
30	Choto Khal-Boro Khal	29	K	

Note: SB - Small *beel*; LB-Large *beel*; R- River; K -*Khal*; P- Pond

Appendix 4. Gear list – Local name of gears

GEAR TYPE:1	**GILL NET**		Uttar	উত্তার জাল	202
Local Name	স্থানীয় নাম	Code (কোড)	Goira jal	গইরা জাল	203
Pati Jal	পাতি জাল	101	Horhori jal	হরহরি জাল	203
Pata Jal	পাতা জাল	101	Jangla jal	জাংলা জাল	203
Tana jal	টানা জাল	101	Kate jal	কাটি জাল	203
Vel jal	ভেল জাল	101	Kati jal	কাতি জাল	203
Chandi jal	চান্দি জাল	102	Kona ber jal	কোনা জাল	203
Chapila jal	চাপিলা জাল	102	Moi jal	মই জাল	203
Chatka jal	চাটকা জাল	102	Moia jal	মইয়া জাল	203
Fash jal	ফাঁস জাল	102	Kamor jal	কোমার জাল	204
Ghaita Jal	ঘাইতা জাল	102	Katha ber jal	কাঠা বেড় জাল	204
Ilish Jal	ইলিশ জাল	102	Gamcha jal	গামছা জাল	205
Koi Jal	কৈ জাল	102	**GEAR TYPE-3**	**SET BEG NET**	
Phass Jal	ফাস জাল	102	Local Name	স্থানীয় নাম	Code (কোড)
Pie Jal	পাই জাল	102	Bada jal	বাঁদা জাল	301
Kajoli Jal	কাজলি জাল	102	Beddi jal	বিদাই জাল	301
Puti jal	পুটি জাল	102	Behundi jal	বিহুন্দি জাল	301
Poa Jal	পোয়া জাল	103	Binti jal	বিন্তি জাল	301
Current Jal	কারেন্ট জাল	104	Behuti jal	বিহুতি জাল	301
Dacon jal	দাকোন জাল	105	Bendi jal	বেন্দি জাল	301
			Bhem jal	ভীম জাল	301
GEAR TYPE-2	**SEINE NET**		Bhim jal	বাহিম জাল	301
Local Name	স্থানীয় নাম	Code (কোড)	Door jal	ডোর জাল	301
Bacha pine jal	বাঁচা পাইন জাল	201	*GEAR TYPE: 4*	**LIFT NET**	
Badai Jal	বাঁদাই জাল	201	Local Name	স্থানীয় নাম	Code (কোড)
Ber jal	বেড় জাল	201	Behal jal	বিহাল জাল	401
Choto Ber Jal	ছোট বেড় জাল	201	Bheel jal	বিহিল জাল	401
Ghai Ber Jal	ঘাই বেড় জাল	201	Bheshal jal	ভেসাল জাল	401
Khuiya Jal	খইয়া জাল	201	Jali jal	জালি জাল	401
Kochal jal	কোচাল জাল	201	Sitki jal	শিটকি জাল	401
Moshari jal	মশারী জাল	201	Veshal jal	ভেসাল জাল	401
Jet jal	জোট জাল	201	Bua jal	বুয়া জাল	402
Pine Jal	পাইন জাল	201	Dharma jal	ধর্ম জাল	402
Baro ber jal	বড় বেড় জাল	202	Jhar/Jhait jal	জার/জাইত জাল	402
Ghona ber jal	ঘোনা বেড় জাল	202	Khalla jal	খল্লা জাল	402
Ghoni jal	ঘনি জাল	202	Shib jal	শিব জাল	402
Jagat ber jal	জগৎ বেড় জাল	202	Tak jal	টাক জাল	402
Tana ber jal	টানা বেড় জাল	202	Tani jal	টানি জাল	402

Gear List Continue:

GEAR TYPE: 5	**CAST NET**		Local Name	স্থানীয় নাম	Code (কোড)
Local Name	স্থানীয় নাম	Code (কোড)	Don Barshi	ডোন বরশি	801
Doon jal	ডোন জাল	501	Hazari Barshi	হাজারি বরশি	801
Othar jal	অথার জাল	501	Lar Barshi	লার বরশি	801
Utar jal	উতার জাল	501	**GEAR TYPE: 9**	**HOOK & LINE**	
Dhundi jal	ধুন্ধি জাল	502	Barshi	বারশি	1001
Cast jal	কাষ্ট জাল	502	Borshi	বরশি	1001
Jhanki jal	ঝাংকি জাল	502	China Borshi	চিনা বরশি	1001
Khafla jal	খাফলা জাল	502	Chip Borshi	চিপ বরশি	1001
Kheo jal	খেয়ো জাল	502	Hat Borshi	হাত বরশি	1001
Khepla jal	খেপলা জাল	502	Koi Borshi	কৈ বরশি	1001
Koni jal	কনি জাল	502	Nal Borshi	নাল বরশি	1001
Mutha jal	মুথা জাল	502	Dati Borshi	দাতি বরশি	1002
Sakki jal	সাকি জাল	502	**GEAR TYPE:10**	*SPEAR*	
Teora jal	তেওড়া জাল	502	Achra	আচরা	1101
Toira jal	তৈরা জাল	502	Aikra	আইকরা	1101
GEAR TYPE: 6	**PUSH NET**		Bollom	বোলম	1101
Felun	ফেলুন জাল	601	Borsha	বড়শা	1101
Hanga jal	হাঙ্গা জাল	601	Ek Katya	এক-কাথা	1101
Thela jal	ঠেলা জাল	601	Ek Nala	এক-নালা	1101
Jali jal	জালি জাল	601	Reksha	রেকশা	1101
GEAR TYPE 7:	**TRAP**		Aro	আরো	1102
Khadon	খাদুন	701	Chal	চাল	1102
Kholsun	খুলছুন	701	Jhupi	জুপি	1103
Anta	আনতা	702	Juti	জুটি	1103
Boichna	বইচা	702	Jutya	জুইত্তা	1103
Dhiar	ডাইর	702	Koch	কোচ	1104
Doair	ডইর	702	Kuch	কুচ	1104
Doar	ডর	702	Ring	রিং	
Chara	চারা	703	**GEAR TYPE: 11**	**OTHER**:(pen, katha,	pencing etc)
Charo	চারো	703	Bajna	বাজনা	1201
Polo	পলো	703	Bana	বানা	1201
Thui	থুই	703	Banna	বানা	1201
Bashan	বাসন	704	Chachi	চাচি	1201
Charai	চাড়াই	704	Pati	পাতি	1201
Darki	ডারকি	704	Pen	পেন	1201
Ghuni	ঘুনাই	704	Katha	কাঠা	1202
Bakshokal	বাকসোকল	705	Katha Jhati	কাঠা জাতি	1202
Chai	চাই	705	Keo	কিও	1202
Chonga	চোঙ্গা	705	Kheo	খিও	1202
Icha chai	ইচা চাই	705	Komor	কোমড়	1202
Koi chai	কৈ চাই	705	Kom	কোম	1203
Fala	ফালা	705	Kua	কূয়া	1203
GEAR TYPE: 8	**LONG LINE**		Pagar	পাগার	1203
Borshi	বরশি	801	**GEAR TYPE 12**	**By hand**	
Chara Barshi	ছড়া বরশি	801	Hath	হাত	1301

Appendix 5. Species wise production from Catch monitoring and Group fishing during study period.

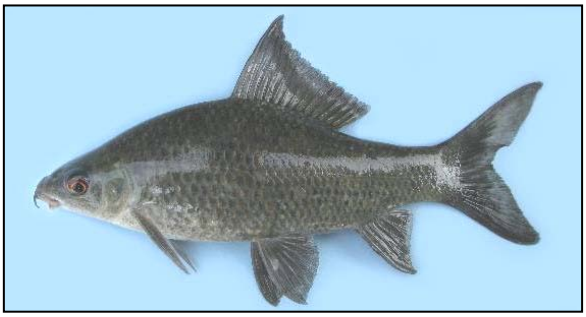
Serial No.	Local name	Scientific name	Estimated Catch (kg)	Group Catch (kg)	Total (kg)
1	Jatputi/Vadi Puti	*Puntius sophore*	8561	8535	17097
2	Kalibaus/Baus/Kalla Mach	*Labeo calbasu*	8467	2299	10767
3	Taki/Ladi/Saitan/Voskol/Sati	*Channa punctatus*	7449	1164	8613
4	Meni/Veda/Royna	*Nandus nandus*	6223	1648	7871
5	Kholisha/Pata Kholisha	*Colisa fasciatus*	5131	1073	6204
6	Gura Icha/Isla/Jal Mach	*Nematopalaemon tenuipes*	4993	1848	6841
7	Koi/Gachua Koi	*Anabas testudineus*	4371	1015	5386
8	Kakila/Kaikla/Kakla/Kaikka	*Xenentodon cancila*	3448	1842	5290
9	Tara Baim	*Macrognathus aculeatus*	2893	403	3296
10	Boal	*Wallago attu*	2888	2661	5550
11	Guchi Baim/Chikra/Chirpa/Chipra	*Mastacembelus pancalus*	2785	655	3440
12	Tit Puti	*Puntius ticto*	2751	1674	4425
13	Bojuri Tengra/Choto Tengra	*Mystus tengara*	2723	1468	4191
14	Tengra/Guinga	*Mystus vittatus*	2719	429	3148
15	Goinna	*Labeo gonius*	2710	1574	4284
16	Baila/Bele/Vangla	*Glossogobius giuris*	2704	1672	4376
17	Rui/Ruhit/Vuitta	*Labeo rohita*	2692	3664	6356
18	Chapila/Korti/Chalpa/Chopra	*Gudusias chapra*	2626	3690	6316
19	Boro Baim/Shal Baim	*Mastacembelus armatus*	2473	1564	4036
20	Shol/Shoil	*Channa striatus*	2384	1116	3500
21	Ranga Chanda/Lal Chanda	*Chanda ranga*	2317	1465	3782
22	Shing/Jiol Mach/Kanuch	*Heteropneustes fossilis*	1757	191	1948
23	Lal Kholisha/Boicha	*Colisa lalius*	1509	404	1913
24	Gazar/Gazal	*Channa marulius*	1341	1052	2393
25	Lomba Chanda/Nama Chanda	*Chanda nama*	1327	119	1446
26	Mola/Maya/Moa/Mousi	*Amblypharyngodon mola*	1312	3690	5001
27	Chela/Katari/Narkeli Chela	*Salmostoma bacaila*	1261	1555	2816
28	Gol Chanda	*Chanda lala*	1110	2409	3519
29	Gutum/Gutumi/Butkuni/Pia	*Lepidocephalus guntea*	1104	696	1801
30	Teri Puti	*Puntius terio*	1088	3891	4980
31	Gachua/Cheng/Raga/Laua	*Channa orientalis*	1054	45	1098
32	Guji Ayre/Guji Kata/Guji Aol	*Mystus bleekeri*	896	432	1328
33	Kachki/Kechki/Suborna	*Corica soborna*	855	1762	2617
34	Dimua/Kathali Icha	*Macrobarchium villosimanus*	823	1449	2271
35	Golsha/Golsha Tengra	*Mystus seenghala*	822	421	1243
36	Mrigal/Mirka	*Cirrhinus mrigala*	797	284	1081

37	Tepa/Potka	*Tetraodon cutcutia*	729	787	1515
38	Foli/Kanila/Fotol/Vali/Foloi	*Notopterus notopterus*	686	1122	1808
39	Magur/Mojgur	*Clarias batrachus*	642	192	834
40	Sarputi/Sheron Puti/Puti tor	*Puntius sarana*	492	567	1059
41	Ayre	*Mystus aor*	470	36	506
42	Common Carp/Carfu/Japani Rui	*Cyprinus carpio (specularis)*	451	4627	5078
43	Darkina/Dakkan/Chukkuni	*Esomus danricus*	421	-	421
44	Kani Pabda/Boali Pabda	*Ompak bimaculatus*	343	573	916
45	Kabashi Tengra	*Mystus cavasius*	310	756	1066
46	Jhili Puti/Gini Puti	*Puntius gelius*	293	26	319
47	Modhu Pabda/Paiva/Pabda	*Ompak pabda*	272	327	598
48	Ekthota/Subol	*Hemiramphas gaimardi*	252	45	297
49	Raek/Nora/Lachchu/Taita/Bogna	*Cirrhinus reba*	247	358	606
50	Grass Carp	*Ctenopharyngodon idellus*	247	1212	1458
51	Mirror Carp	*Cyprinus carpio (communis)*	201	59	260
52	Rita/Ritha	*Rita rita*	200	-	200
53	Chitol	*Notopterus chitala*	200	455	655
54	Darkina	*Rasbora daniconius*	157	112	269
55	Bacha	*Eutropiichthys vacha*	133	1	134
56	Katla/Katol/Fega	*Catla catla*	118	289	407
57	Ghaura	*Clupisoma garua*	115	-	115
58	Dhela/Lohasur	*Rohtee cotio*	105	86	191
59	Batashi/Batai/Aluni/Gilakani	*Pseudeutropius atherinoides*	102	1	103
60	Bagha Ayre/Bagair	*Bagarius bagarius*	95	-	95
61	Telapia/Telapata	*Oreochromis mossambica*	93	354	448
62	Silver Carp	*Hypophthalmichthys molitrix*	93	20	113
63	Cheka/Bou	*Botia dario*	88	-	88
64	Chuna Kholisha/Chata	*Colisa sota*	85	-	85
65	Chhatka Chingri	*Macrobrachium malcolmsonii*	84	-	84
66	Kali Koi/Napit/Koi Bandi	*Badis badis*	77	8	85
67	Illish	*Hilsa ilisa*	76	-	76
68	Kajoli	*Ailia coila*	67	-	67
69	Bichi Guinga/Jol Guinga	*Chandramara chandramara*	67	18	85
70	Naftani/Naptani	*Ctenops nobilis*	64	255	319
71	Rani/Cheka/Bou	*Botia dayii*	60	2	62
72	Fesha/Fefri/Fasha	*Setipinna phasa*	56	-	56
73	Pabda	*Ompok pabo*	56	-	56
74	Thai Sarputi/Raj Puti	*Puntius gonionotus*	55	994	1049
75	Chekbeka/Cheka/Kotkoti	*Chaca chaca*	55		55
76	Golda Icha	*Machrobrachium rosenbergii*	48	37	85
77	Khorshola/Kholla/Khorshuna	*Rhinomugil corsula*	48	-	48

78	Kuichcha/Kuichcha Baim	*Monopterus cuchia*	46	-	46
79	Chhep Chela	*Chela cachius*	44	27	70
80	Kanchon Puti/Taka Puti	*Puntius conchonius*	41	-	41
81	Gutum	*Somileptes gongota*	38	1	39
82	Chola Puti	*Puntius chola*	37	18	56
83	Bata	*Labeo bata*	34	-	34
84	Nilotica	*Oreochromis niloticus*	24	39	63
85	Mohashol/Mohal/Mohasher	*Tor tor*	20	-	20
86	Elong	*Rasbora elanga*	20	-	20
87	Tinchokha/Kanpona/Chokhpona	*Aplocheilus panchax*	12	3	15
88	Ghora Dhela	*Oxygaster gora*	12	-	12
89	Ghora Mach/Longu/Ghora Mukh	*Labeo pangusia*	9	-	9
90	Baus/Bamus/Bonehara	*Anguilla bengalensis*	8	-	8
91	Bashpata/Kajoli	*Aillichthys punctata*	3	1	4
92	Chanda	*Chanda beculis*	2	-	2
93	Gang Tengra/Gongra/Ghagot	*Gagata gagata*	2	-	2
94	Goni Chapila/Bori	*Gonialosa manminna*	0	-	0
95	Kholisha/Pata Kholisha	*Colisa labiosus*	0	-	0
96	Kakra	*Stylla sp.*	0	-	0
97	Thai Pangas	*Pungasius hypophthalmus*	-	2	2
98	Gagor	*Mystus menoda*	-	315	315
99	Piranha	*Pygocentrus nattereri*	-	0	0
100	Shilong/Shilon	*Silonia silondia*	-	2	2
	Total		**109170**	**73585**	**182756**

Appendix 6. Main contributor species in the waterbodies

Family: Cyprinidae
Genus: *Puntius*
Species: *Puntius sophore*
Local name: Jat Puti



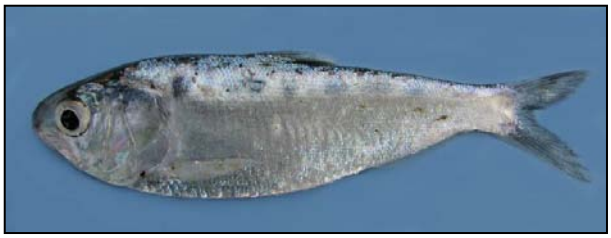
Family: Cyprinidae
Genus: *Labeo*
Species: *Labeo calbasu*
Local name: Kalibaus

Family: Channidae
Genus: *Channa*
Species: *Channa punctatus*
Local name: Taki

Family: Nandidae
Genus: *Nundus*
Species: *Nundus nundus*
Local name: Meni

Family: Palaemonidae
Genus: *Nematopalaemon*
Species: *Nematopalaemon tenuipes*
Local name: Gura Icha

Family: Cyprinidae
Genus: *Labeo*
Species: *Labeo rohita*
Local name: Rui



Family: Clupeidae
Genus: *Gudusia*
Species: *Gudusia chapra*
Local name: Fuka

Family: Anabantidae
Genus: *Colisa*
Species: *Colisa fasciatus*
Local name: Pata kholisha

Family: Siluridae
Genus: *Wallago*
Species: *Wallago attu*
Local name: Boal

Family: Anabantidae
Genus: *Anabus*
Species: *Anabus testudineus*
Local name: Koi