# Second Round Report of the FRSP on Fish Catch and Bio-diversity Monitoring

**SCBRMP- LGED / The WorldFish Center**

***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 fisheries sector has emerged as an important part of the economy of Bangladesh, as a source of food, nutrition, employment and income for rural people. Fisheries have traditionally been seen as common property in Bangladesh. Conventional revenue-oriented fisheries management interventions of *haor* fishery through the so called 'leasing system' by government have however, often excluded the poorest fishers. Such leasing increases restrictions on the access rights of the poor to resources and ignores biological aspects of fisheries management. To address these concerns, the SCBRMP is implementing its fisheries management activities in Sunamganj district of Bangladesh. The Fisheries Research Support Project (FRSP) has been designed to determine the relationship between fisheries management practices implemented under the Fisheries component of SCBRMP and impacts on biodiversity.

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 water bodies and upazilas
- Major contributing species
- Production values per water body
- Gear efficiency and production
- Leased value and sale value
- Biodiversity
- Biological growth performance

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 more than 74 tons from major fishing and about 71 tons from monitoring catches in all monitored sites. The main effective factors influencing better production at most sites are habitat type (e.g., river), water extension during monsoon, level of compliance in fishing regulation, fish sanctuary, higher species diversity (e.g., Chatol Udai Tara, Medi beel, Abua nodi, Thapna Group Jal Mahal), presence of professional fishers around water bodies, fisher density, good links with other water bodies or big *haor*, no restriction during monsoon & nearby *beel* areas, and interruption of major fishing.

In the study sites the most commonly used gears were gill nets, seine nets, push nets, large lift nets, long lines, cast nets, hook & line, and traps that contributed 40.31%, 19.84%, 10.63%, 7.51%, 6.74%, 6.24%, 5.16% and 2.99% respectively.

Income derived from fishing activities (major fishing) are influenced by several factors (marketing linkage, high valued species, grading, distance from urban market etc.) which were

reflected in the variations of average prices (Tk) per kg of fish. From the organized fishing data of 2008-09 it has been observed that the average price (Tk. per kg) of fish has been increased (37%) from that of the 2007-08. The highest per kilogram value of harvested fish was found Tk. 118 and lowest value of Tk. 50 throughout the study period. The average value per kg from all sampled water bodies was found Tk. 80 and all monitored sites together were worth Tk. 11.56 million in 2009.

The present study reveals that water body lease value (Tk. per hectare) could be easily achievable through fish sale value (Tk. per hectare). Simultaneously, the fish sale value (Tk. per hectare) also shows a positive correlation with the leased area which reveals that larger areas produced higher benefits.

The number of species caught in the monitored sites revealed that the maximum number of species (70) was found in the Thapna group jalmohal, Sonduikka group jalmohal (66), Basker khal (64), Abua prokashito nainda nodi (63), Langolkata ojur beel (63), Chatal Udaytara (57), Boro medi beel (54), Boiragimara (52), and and Terajani balir dubi (47), Chotokhal boro khal (47) and total number of species varied from 28 to 70. The study reveals that the majority of waterbodies is habitat to 36-45 species. Study also reveals that in 2007-08 the range of species found was 56-65, at 3 sites. Species number increased in 6 sites in 2008-09. Similarly, in 2007-08 the range of species found was 46-55 at 5 sites which also increased in 6 sites in 2008-09.

The common species caught by all types of gears were Jatputi (*P. sophore*), Meni (*Nandus nandus*), Taki (*Channa punctata*), Koi (*Anabas testudineous*) and Kalibaus (*Labeo calbasu*) which contributed 10.28%, 8.37%, 8.27%, 6.46% and 5.38% of overall catches, respectively. Analysis of annual catch monitoring data reveals that 20 main species all together contributed 77.56%, and other 80 species contributed only 22.44% of the catch by weight in 2009.

A single species, the Jatputi (*Puntius sophore*i) was found as the highest contributing species towards catches in Sunamganj sadar (13.78%), South Sunamganj (15.43%), Derai (14.45%), and Jamalganj (16.48%) upazilas. However, Kalibaus (*Labeo calbasu*) and Rui (*Labeo rohita*) were the most abundant species in Biswambopur and Tahirpur upazilas and contributed 18.2% and 18.94% of the total catches, respectively.

Fish Sanctuary under SCBRMP has been established to protect *haor* fisheries resources and ensure more catch for fishers**.** The present study reveals that fish biodiversity increased in water bodies with fish sanctuary. Fish sanctuaries had established12 of the 30 study sites and from

major fishing data, fish biodiversity was found to be significantly higher ($p<0.05$) in 2009 when compared to 2008. Average number of species in the 12 fish sanctuary sites was 33 in 2008. This number increased to 41 in 2009, and to 50 in 2010. Significant increase was found by ANOVA ($p=0.0046$). Results also indicated that species diversity correlated with periods of sanctuary in the *Haor* habitat.

## Recommendations:

- Less potential water bodies in terms of production and water extent should be assessed for seasonal stocking with native species. This will create opportunity for women and enhance per capita income, consumption and nutritional demand of participating households.

- The study noted the significant increase of fish biodiversity in water bodies with fish sanctuary. It is crucial to establish and maintain sanctuaries for the protection of indigenous species and for promoting open water stocking. Tree branches should be refilled again into the sanctuary during post-monsoon.

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# 1. Introduction

Bangladesh is fortunate enough having huge water resources scattered all over the country in the form of ponds, beels, lakes, canals, rivers and estuaries covering an area of about 4.57 million ha. The fish produced and caught in these waterbodies contribute to 60% of the animal protein consumed by people in Bangladesh (Z. Karim, 2010).

The fisheries sector is vibrant and contributed about 20% of agricultural GDP. The sector contributed 3.74% to GDP and 4.04% of the national export earnings. The growth rate in the fisheries sector has increased from 2.33% in 2002-03 to 4.11% in 2007-2008 (Z. Karim, 2010). The growth is largely from inland open water fisheries and pond fish production. Fish production in the inland open water, particularly in the rivers and flood plains has declined significantly during the last three decades due to degradation of water bodies.

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). 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).

Fish production in the inland open water, particularly in the rivers, haor and flood plains has declined significantly during the last three decades and its production during 2007-08 was found to be only 41.36% of the total country's fish production. The downward trend in the late 1970s showed a 20-25% decrease in contribution to production from inland open water sources (Z. Karim, 2010). This decline has been comparatively high in

the case of important and valued fish like major carp which contributed about 30% of the total fish production but now has dropped to 5-6% (Tsai and Ali, 1987).

The inland water fishery 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 and haors 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. 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.

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

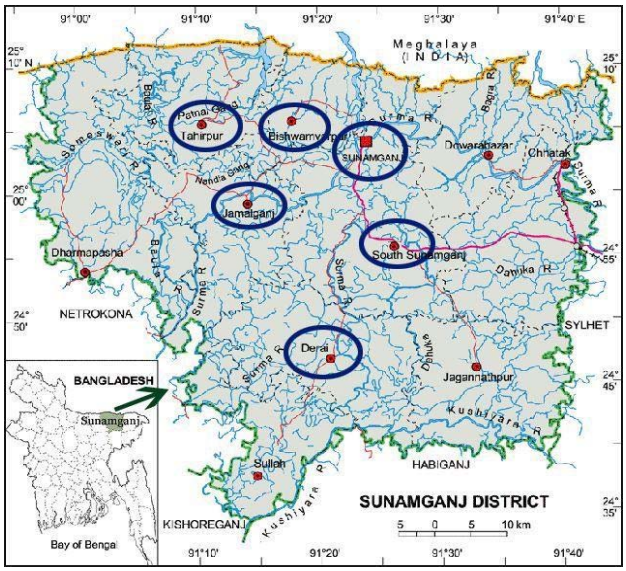

Figure 1. Working sites of FRS project

# 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, 30 waterbodies had 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 in 2008 and continued in 2009 (Table 1). Catch monitoring expanded in 45 sample water bodies in June 2010. 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 | 48 | √[4] | | | |
| | Chatol Udaytara | 19.91 | 28.33 | 60 | √ | | - | - |
| | Moinpur *Beel* Group | 4.75 | 10.12 | 25 | √ | | - | - |
| | Babonpai *Beel* | 12.74 | 20.23 | 36 | - | √ | - | - |
| | Terazani Balir Dubi | 1.72 | 6.07 | 26 | - | √ | - | - |
| | Pachgachiya *beel* | 1.25 | 4.86 | 27 | - | √ | - | - |
| | Chinamara *beel* and Gozaria Dohor | 1.23 | 4.86 | 28 | - | √ | - | - |
| | Nitai Goan | 7.66 | 12.14 | 23 | - | | √ | - |
| | Kochua Goan | 5.18 | 10.12 | 28 | - | | √ | - |
| | Srinathpurer Dhola | 3.56 | 8.90 | 37 | - | | - | √ |
| | 84/8 Surma River* | - | 35.66 | - | - | | √ | |
| Sunamganj Sadar | Langol Kata Ojur *Beel* | 5.89 | 12.14 | 29 | √ | | - | - |
| | Boiragimara *Beel* | 18.70 | 24.28 | 51 | - | √ | - | - |
| | Aung Gung | 2.27 | 4.86 | 30 | - | √ | - | - |
| | Urail *Beel* | 1.85 | 8.09 | 19 | - | √ | - | - |
| | Aislauni Prokashito Mitar Dubi | 1.55 | 8.09 | 24 | - | √ | - | - |
| | Chota *Beel* | 1.42 | 8.09 | 30 | - | √ | - | - |
| | Lalpurer Jai and Gozaria Dair | 1.38 | 12.14 | 15 | - | | √ | - |
| | Kaima beel koiya Beel | 9.55 | 22 | 32 | | √ | | |
| | Noldegha Bandor Kona* | 5.05 | 15.03 | - | | √ | | |
| Biswamberpur | Tiar *Beel* Lomba *Beel* Gool *Beel* | 2.63 | 6.07 | 27 | √ | | | |
| | Ghotghatia Nodhi | 6.73 | 12.14 | 21 | - | | √ | - |
| | Sudam khali river | 3.48 | 4.86 | 18 | - | | √ | - |
| | Abua Prokashito Nainda Nodhi | 34.47 | 40.47 | 80 | | | √[4] | |
| | Moni kamarer Kuri | 1.85 | 3.24 | 30 | - | | - | √ |
| | Pondua Beel* | 2.76 | 8 | - | | √ | | |
| | Tin bila Beel | 7 | 15 | 38 | | √ | | |
| Tahirpur | Thapna Group Jalmahal | 64.75 | 80.94 | 50 | √[4] | | - | |
| | Choto *Khal* –Boro *Khal* | 3.49 | 8.09 | 28 | - | √ | - | - |
| | Issubpurer *Khal* | 5.19 | 8.09 | 41 | - | √ | - | - |
| | Horuar Beel o lomba beel* | 22.47 | 40.5 | - | √ | | | |
| | Digha Kochma Beel | 7.21 | 15.25 | 27 | | √ | | |
| | Matian Hour Jolmohal | 102.38 | 25.1 | 231 | √ | | | |
| Derai | Boro Medi *Beel* | 51.13 | 68.80 | 117 | - | √[4] | | |
| | Guza Beel | 2.5 | 6.1 | 23 | | √ | | |
| | Najar Dighi | 12.14 | 20.6 | 27 | | √ | | |
| | Medha Prokashito Kachma Beel | 9.51 | 18.3 | 116 | | √ | | |

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

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Juripanjuri Beel | 23.16 | 37.21 | 42 | | √ | | |
| **Jamalgonj** | Sonduikka Group jolmohal | 3.90 | 10.12 | 19 | √ | | | - |
| | Dewtan *Beel* | 5.50 | 12.14 | 30 | - | √ | | - |
| | Basker *Khal* | 4.70 | 10.12 | 30 | - | √ | | - |
| | Lomba *beel* Gool *beel* | 8.06 | 15.00 | 30 | | | | |
| | Basker Beel O Jolsuker Beel | 24.45 | 50.21 | 43 | | √ | | |
| | Dhola Pakna Jolmohal | 42.51 | 72.35 | 40 | √ | | | |
| | Kaldohor* | 2.02 | 5.21 | - | | √ | | |

**Control sites*

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 | 03 | 2 | 05 | 15 | 06 | 21 |
| Sudamkhali River | 8.61 | 05-12 | June-06 | 05 | 02 | 07 | 12 | 06 | 18 |
| Tiar *Beel* Lomba *Beel* Gool *Beel* | 6.18 | 03-15 | April-07 | 04 | 03 | 07 | 14 | 13 | 27 |
| 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 |
| Tin bila Beel | 17.28 | 10-50 | April-09 | 6 | 1 | 7 | 28 | 10 | 38 |
| Pondua Beel* | 6.83 | 2-20 | - | - | - | - | - | - | - |
| **Tahir Pur Upazila** | | | | | | | | | |
| Thapna group Jalmohal | 160.57 | 81-200 | Sept-07 | 07 | 0 | 7 | 42 | 8 | 50 |
| Choto *khal* Boro *khal* | 8.61 | 07-20 | April-06 | 06 | 01 | 07 | 25 | 03 | 28 |
| Issubpurer *khal* | 12.83 | 05-20 | June-07 | 06 | 01 | 07 | 29 | 12 | 41 |
| Digha Kochma Beel | 17.81 | 04-200 | Aug-2009 | 07 | 00 | 07 | 20 | 7 | 27 |
| Matian Hour Jolmohal | 252.9 | 125-2000 | Aug-2006 | 19 | 02 | 21 | 170 | 61 | 231 |
| Horuar Beel o lomba beel* | 55.52 | 20-150 | - | - | - | - | - | - | - |
| **Jamalgonj Upazila** | | | | | | | | | |
| Sonduikka Group Jalmohal | 9.63 | 04-25 | July-05 | 09 | 0 | 09 | 19 | 0 | 19 |
| Dawtan *Beel* | 13.06 | 09-30 | July-05 | 09 | 0 | 09 | 23 | 7 | 30 |
| Basker *Khal* | 1.62 | 06-25 | Novem-05 | 09 | 0 | 09 | 22 | 8 | 30 |
| Lomba *Beel* Gool *Beel* | 19.93 | 15-35 | March-06 | 09 | 0 | 09 | 20 | 10 | 30 |
| Basker Beel O Jolsuker Beel | 60.4 | 20-150 | March-09 | 09 | 02 | 11 | 30 | 13 | 43 |
| Dhola Pakna Jolmohal | 105 | 20-250 | July-07 | 11 | 0 | 11 | 30 | 10 | 40 |
| Kaldohor* | 5 | 2-12 | - | - | - | - | - | - | - |
| **Sunamganj Sadar** | | | | | | | | | |
| Boiragimara *Beel* | 46.20 | 07 -60 | August-05 | 7 | 0 | 7 | 51 | 0 | 51 |
| Langol Kata Ojur *beel* | 14.55 | 03 -30 | March-06 | 5 | 2 | 7 | 22 | 7 | 29 |
| Urail *Beel* | 4.58 | 01 -20 | Sept-06 | 7 | 0 | 7 | 19 | 0 | 19 |
| Aislauni Prokashito Mitar Dubi | 3.84 | 1.5 -20 | March-06 | 7 | 0 | 7 | 19 | 5 | 24 |
| Aung Gung | 5.62 | 03 -12 | Feb-06 | 7 | 0 | 7 | 26 | 4 | 30 |
| Choto *Beel* | 3.5 | 01 -20 | March-06 | 7 | 0 | 7 | 27 | 3 | 30 |
| Lalpurer Jai and Gozaria Dair | 3.25 | 1.25 -30 | March-06 | 7 | 0 | 7 | 15 | 0 | 15 |
| Kaima beel koiya Beel | 23.59 | 3-40 | Nov-09 | 7 | 0 | 7 | 32 | 0 | 32 |
| Noldegha Bandor Kona* | 12.48 | 2-36 | - | - | - | - | - | - | - |
| **South Sunamganj** | | | | | | | | | |
| Chinamara *Beel* | 3.05 | 1.5- 12 | October-05 | 5 | 0 | 5 | 23 | 5 | 28 |
| Pachgachia *Beel* | 3.1 | 02- 12 | August-05 | 5 | 0 | 5 | 15 | 12 | 27 |
| Moinpur *Beel* Group | 11.73 | 1.5-25 | Feb-06 | 7 | 0 | 7 | 16 | 9 | 25 |
| Kochua Goan | 12.8 | 03 -25 | April-06 | 9 | 0 | 9 | 22 | 06 | 28 |
| Terajani Balir Dubi | 4.24 | 01 -15 | March-06 | 9 | 0 | 9 | 26 | 0 | 26 |
| Netai Goan | 18.94 | 08 -30 | May-06 | 5 | 0 | 5 | 17 | 6 | 23 |
| Babonpai | 31.47 | 03 -50 | July-05 | 7 | 0 | 7 | 30 | 6 | 36 |
| Tedala Hugliya Chatol | 53.4 | 08-80 | March-06 | 9 | 0 | 9 | 47 | 1 | 48 |
| Srinathpurer Dhola | 8.8 | 2.5 -22 | October-05 | 5 | 0 | 5 | 29 | 8 | 37 |
| Chtol Udaytara | 58.2 | 09-70 | July-05 | 9 | 0 | 9 | 51 | 9 | 60 |
| *84/8 Surma River | 88.09 | 70-100 | - | - | - | - | - | - | - |
| **Derai Upazila** | | | | | | | | | |
| Boro Medi *Beel* | 126.35 | 40-170 | April-07 | 09 | 0 | 09 | 116 | 1 | 117 |
| Guza Beel | 6.19 | 1.54-10 | April-09 | 07 | 02 | 09 | 14 | 9 | 23 |
| Najar Dighi | 29.99 | 2.85-45 | Aug-09 | 15 | 0 | 5 | 20 | 7 | 27 |
| Medha Prokashito Kachma Beel | 23.5 | 5.5-85 | Aug-09 | 09 | 0 | 09 | 79 | 37 | 116 |
| Juripanjuri Beel | 57.21 | 10.58-110 | Aug-09 | 05 | 04 | 09 | 27 | 15 | 42 |

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 | 38400 | May -June | Fishing restriction around fish sanctuary | Seine net & Gill net | -Earth Work-9078.82 cum(Previous year)<br>-1865 nos. Swamp tree planted(Previous year) | Sanctuary of 2000 sqm established in 2008 |
| Sudamkhali River | May-2006 | 28800 | May -June | Fishing restriction around fish sanctuary | Seine net & Gill net | -Earth Work-4048.15 cum (previous year).<br>-1420 nos. Swamp tree | Sanctuary of 2000 sqm established in 2007 |
| Tiar *Beel* Lomba *Beel* Gool *Beel* | Sep-2005 | 10350 | May-July | Restriction about Katha based pile fishery | Seine net & Gill net | -Earth work-2065 cum(09-10). Total-5800.41 cum.<br>- 961 nos. swamp tree | 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 Wor-2988.1 cum (previous year.<br>-860 nos. Swamp tree planted (Previous year). | - |
| Abua Prokashito Nainda Nodhi | April-2007 | 93010 | May -June | Fishing restriction around fish sanctuary | Seine net & Gill net | -7640 nos. Swamp tree planted. | Sanctuary of 3000 sqm established in 2008 |
| Tin bila Beel | March 2010 | 22680 | April-June | - | Seine net & Gill net | - | - |
| Pondua Beel* | January -2010 | | - | - | - | - | - |
| **Tahir Pur Upazila** | | | | | | | |
| Thapna group Jalmohal | Nov-2007 | 225977 | May-July | Fishing restriction around Katha. | Seine net & Gill net | -Earth work2162.25 cum (09-10). Total 6911.835 cum<br>-2000 nos. swamp tree planted | Sanctuary of 3000 sqm established in 2009 |
| Choto *khal* Boro *khal* | June-2006 | 11137 | May-July | Fishing restriction around fish sanctuary | Seine net & Gill net | -Earth Work-3183.58 cum(previous year)<br>-1295 nos. Swamp tree planted. | Katha based pile fisheries of 300 sqm established in 2009 |

| Name of Water body | Year of Access | Lease value Tk. | Closed Season | Closed Area | Gear/fishing restriction | Habitat restoration | Sanctuary established |
|---|---|---|---|---|---|---|---|
| Issubpurer *khal* | June-2007 | 7080 | May-July | Fishing restriction around Katha. | Seine net & Gill net | - | - |
| Digha Kochma Beel | Aug-2009 | 36295 | April-June | Fishing restriction around Katha. | Senie net | Earth Work-1790.99 cum | - |
| Matian Hour Jolmohal | Aug-2008 | 418482 | April-June | Fishing restriction around Katha. | Seine net | Earth Work-818.7 cum | - |
| Horuar Beel o lomba beel* | 2010 | | - | - | - | - | -- |
| **Jamalganj Upazila** | | | | | | | |
| Sonduikka Group Jolmohal | April-2005 | 9660 | April-June | Fishing restriction around Katha. | Seine net & Gill net | -Earth Work-6250cum(previous year) -485 nos. Swamp tree planted. | - |
| Dewtan *Beel* | May - 2007 | 16260 | April-June | Fishing restriction around Katha. | Seine net & Gill net | -Earth work 1922cum(09-10) | - |
| Basker *Khal* | May - 2007 | 2132 | April-June | Fishing restriction around Katha. | Seine net & Gill net | - Earth work 2433 cum (cum) (09-10). Total 8566 cum | - |
| Lomba *Beel* Gool *Beel* | Nov-2007 | 29400 | April-June | Fishing restriction around Katha. | Seine net & Gill net | -Earth work 1757 cum(09-10) | - |
| Kaldohor* | | | - | - | - | - | - |
| Basker Beel O Jolsuker Beel | 2009 | 171201 | April-June | Fishing restriction around Katha. | Seine net & Gill net | -Earth work 7794cum - 6150 swamp tree planted | - |
| Dhola Pakna Jolmohal | 2009 | 145448 | April-June | Fishing restriction around Katha. | Seine net & Gill net | Earth work 6942.cum | |
| **Sunamganj Sadar** | | | | | | | |
| Boiragimara *Beel* | April-2005 | 7376 | Sep-Jan | Fishing restriction around fish sanctuary | Sep-Jan all kind of net | -Earth Work – Total 5495.55 cum (Previous year. -1000 nos. swamp tree planted | 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 -3363.52 cum - 500 nos (09-10)) Total 2500 nos. swamp tree | Sanctuary of 500 sqm established in 2008 |

| Name of Water body | Year of Access | Lease value Tk. | Closed Season | Closed Area | Gear/fishing restriction | Habitat restoration | Sanctuary established |
|---|---|---|---|---|---|---|---|
| | | | | | | planted | |
| Urail *Beel* | August-2006 | 10325 | Sep-Jan | Fishing restriction around katha | Sep-Jan all kind of net | -Earth Work -3093.93 cum -325 nos. Previous) nos. Swamp tree planted | Katha based pile fishery (About 500 sqm.) |
| Aislauni Prokashito Mitar Dubi | August-2006 | 11316 | Sep-Jan | Fishing restriction around katha | Sep-Jan all kind of net | -Earth Work -2858.96 cum | Katha based pile fishery (About 500 sqm.) |
| Aung Gung | August-2006 | 11755 | Sep-Jan | - | Sep-Jan all kind of net | -Earth Work -3392.39cum -700 nos swamp tree planted. | - |
| Choto *Beel* | August-2006 | 2829 | Sep-Jan | - | Sep-Jan all kind of net | -Earth Work -2559.52 cum(previous year) - 800 nos swamp tree planted | - |
| Lalpurer Jai and Gozaria Dair | August-2006 | 5234 | Sep-Jan | - | Sep-Jan all kind of net | -Earth Work -1020 cum(Previous year) | - |
| Kaima beel koiya Beel | 2009 | 16250 | April-June | Fishing restriction around katha | Monofilament gill net restriction | Earh work 848.25 cum | - |
| Noldegha Bandor Kona* | 2010 | | - | - | - | - | - |
| **South Sunamganj** | | | | | | | |
| Chinamara *Beel* | Sep-2005 | 9700 | June-Oct | Fishing restriction around fish sanctuary | Monofilament gill net restriction | -Earth Work -2836.64Cum(Previous year) -300 nos. Swamp tree planted | Sanctuary of 500 sqm established in 2008 |
| Pachgachia *Beel* | Sep-2005 | 2128 | June-Oct | - | Monofilament gill net restriction | -Earth Work – 1889 Cum(Previous year) | - |
| Moinpur *Beel* Group | Febr-2006 | 5682 | - | Fishing restriction around the pile fisheries | Monofilament gill net restriction | -Earth Work -4102.5 cum (09-10)) total- 7987.75 cum. | Katha based pile fisheries of 300 sqm established in |
| Kochua Goan | Sep-2005 | 16760 | - | - | Monofilament gill net restriction | -Earth Work -4624.2 cum (09-10)total 7663.42 cum | - |
| Terajani Balir Dubi | Feb - 2006 | 36950 | - | - | Monofilament gill net restriction | -Earth Work -2065.8 cum (09-10). Total 3371.67 cum - 500 nos. swamp tree planted | - |

| Name of Water body | Year of Access | Lease value Tk. | Closed Season | Closed Area | Gear/fishing restriction | Habitat restoration | Sanctuary established |
|---|---|---|---|---|---|---|---|
| Netai Goan | Aug-2006 | 36899 | - | - | Monofilament gill net restriction | -Earth work-7512.03 cum(09-10) | - |
| Babonpai *Beel* | April-2005 | 10548 | - | Fishing restriction around fish sanctuary | Monofilament gill net restriction | -Earth Work -8265.2cum (09-10)total-11371.03 cum -2580 nos.swamp tree | Sanctuary of 1200 sqm established in 2008 |
| Tedala Hugliya Chatol | March-2006 | 85015 | April-June | Fishing restriction around fish sanctuary | Monofilament gill net restriction | -Earth Work -7498.3 cum (09-10).Total-23261 cum - 550(09-10) & total 6020 nos. Swamp tree planted. | Sanctuary of 3000 sqm established in 2008 |
| Srinathpurer dhola | Sep-2005 | 5730 | - | - | Not yet | -Earth Work -2247.9 cum (09-10). Total -6250.28 cum - Total278 nos. Swamp tree planted(previous year) | - |
| Chatol Udaytara | April-2005 | 61052 | April-June | Fishing restriction around fish sanctuary | Monofilament gill net restriction | -Earth Work -2339.7 cum(09-10) total 14915.91 cum -3453 nos. Swamp tree planted.(Previous year) | Sanctuary of 4900 sqm established in 2008 |
| 84/8 Surma River* | 2010 | | - | - | - | - | - |
| **Derai Upazila** | | | | | | | |
| Boro Medi *Beel* | April - 2007 | 19126 | May-June | Fishing restriction around Katha. | Seine net & Gill net | -Earth work 938.37 cum(09-10) -4000 nos swamp tree planted | Katha based pile fisheries of 300 sqm established in 2009 |
| Guza Beel | June-09 | 11101 | April-June | Fishing restriction around Katha. | Seine net & Gill net | Earth work-801.72 cum | - |
| Najar Dighi | Jan-10 | 5000 | April-June | Fishing restriction around Katha. | Seine net & Gill net | - | - |
| Medha Prokashito Kachma Beel | Jan-10 | 45000 | April-June | Fishing restriction around Katha. | Seine net & Gill net | - | - |
| Juripanjuri Beel | Dec-09 | 24000 | April-June | Fishing restriction around Katha. | Seine net & Gill net | Earth woek-1629 cum | - |

## 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 and continue in 2009. Catch monitoring expanded in 45 sample water bodies in June 2010. 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. A list of the community enumerators assigned to different water bodies is given in Appendix 1. A list of monitoring sites by habitat types and assigned Research Assistant in 2009 and 2010 are given in Appendix 2.

## 2.3. 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.

### 2.3.1. Catch Monitoring and Biodiversity

An individual catch monitoring study incorporated data from April 2009 to December 2009. 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).

### 2.3.2. Data Analysis

Survey sampling covered gear census and catch monitoring. Catch monitoring is an observational process on fishing effort that was done for 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.

### 2.3.3. 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).

### 2.3.4. Fish Catch Monitoring

*Fish catch monitoring by Community Enumerator(CE)*

A total of 34 Community Enumerators are involved in data collection of which 30 have been involved in fish catch monitoring surveys and four in length-frequency data collection in 2009. 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. Present study incorporates data from April 2009 to December 2009 for catch monitoring study and major harvest data from October 2008 to April 2009 and also October 2009 to April 2010.

### 2.3.5. 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 October and continues up to March or April of the following year.

*Major harvesting by BUG members*

### 2.3.6. Monitoring of 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 Beel User Groups (BUGs) members and respective SCBRMP staff.

*Monitoring of catch by CE*

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 and estimated catch from catch monitoring survey showed $R^2$=0.6432, y = 0.6663x + 0.7561, and results from F-test reveals that the variance in todays and yeastardays catch are not significantly different. This indicates an acceptable data quality and good estimation value.

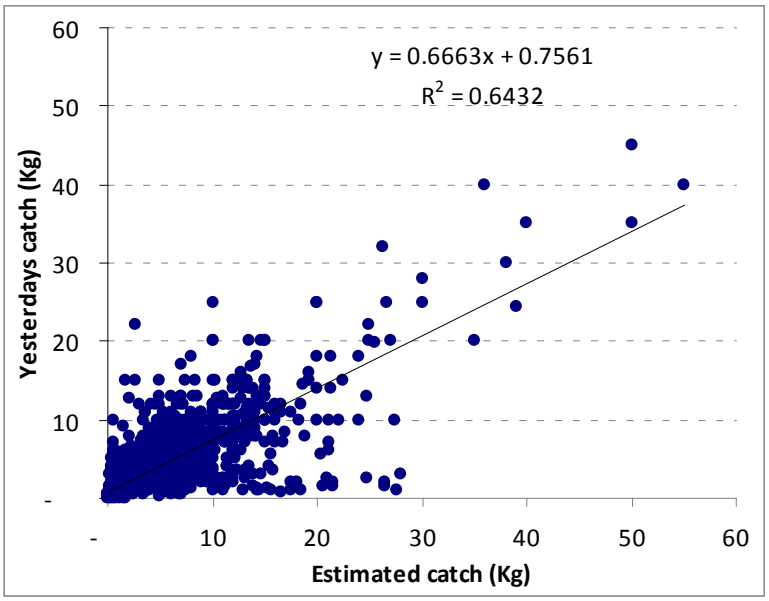


Figure 2. Monitoring catch plotted as a function of yesterdays catch (response from fishermen) with fitted regression model.

### 2.3.7. Length-Frequency Record Collecton

The project continues collecting length-frequency data of important species from four assigned water bodies: Abua prokashito nainda nodhi (Bishwambharpur); Thapna Group Jalmahal (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. 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. Population dynamics analysis were performed for 8 common species in four sites.

## 2.4. 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, material availability 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.

*Gill net*

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 hook 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 3.

# 3. Results and Discussion

## 3.1. Fisheries Production

Total fish production at each waterbody was obtained by combining harvests from organized catch and monitoring catch (Table 5). The total fish production was found over 74 tons from organized catch and nearly 71 tons from catch monitoring. Total production of each of these harvest systems also responsible for the catch at each waterbody is represented in figure 3. The figure shows a rather higher catch from organized catch (51%) than from catch monitoring (estimated catches) (49%) during monsoon. Estimated production from catch was lower than in the previous year. The main reasons responsible for this lower production from catch monitoring is flood duration and timing, and unavailability of sufficient water level on time which interrupted the recruitment and harvests. Besides, BUGs also imposed firm restriction on open fishing within and around beel areas. A majority of fish species depend on flooded areas for food, reproduction and growth. In 2009 flood started with delay and with a shorter duration compared to the previous years.

The main factors influencing better production at most sites were habitat type (e.g., river), water extension during monsoon, tenure effectiveness of restriction in fishing, fish sanctuary, higher species diversity (e.g., Chatol Udai Tara *beel*, Boro Medi *beel*, Abua Prokasito Nainda Nodi, Thapna Group Jalmahal), presence of professional fisher around water bodies, fisher density, good link with other water bodies or big *haor*, no restriction during monsoon & near by *beel* areas, and major fishing interrupted at some sites.

Table 5. Total harvest (organized and monitoring) in all monitored sites in 2009.

| Name of Upazila | Name of waterbody | Organized Catch (Kg) | Est. catch from monitoring (Kg) | Total prod. (Kg) |
|---|---|---|---|---|
| Sunamganj Sadar | Langol Kata ojur *Beel* | 1873.43 | 3902.06 | 5775 |
| | Boiragimara *Beel* | 2325.30 | 243.64 | 2569 |
| | Aung Gung | 410.80 | 2282.54 | 2693 |
| | Urail *Beel* | 1342.75 | 346.00 | 1689 |
| | Aislauni Prokashito Mitar Dubi | 665.00 | 1280.20 | 1945 |
| | Chota *Beel* | 414.00 | 2526.42 | 2940 |
| | Lalpurer Jai and Gozaria Dair | 410.50 | 1332.91 | 1743 |
| | Babonpai Beel | 1063.48 | 4065.25 | 5129 |
| | Tedala huglia *Beel* | 6945.00 | 1886.80 | 8832 |
| | Chatol Udai Tara Beel | 10609.83 | 2203.43 | 12813 |
| | Netai Gang | 1179.27 | 4670.79 | 5850 |

| | | | | |
|---|---|---|---|---|
| South Sunamganj | Pachgachia *Beel* | 864.91 | 2175.85 | 3041 |
| | Moinpur *Beel* Group | 1192.03 | 2630.70 | 3823 |
| | Srinathpurer Dola | 101.42 | 2657.71 | 2759 |
| | Kochua Gang | 1366.64 | 2801.81 | 4168 |
| | Chinamara *Beel* | 449.35 | 1176.41 | 1626 |
| | Terajani Balir Dubi | 2545.77 | 3654.44 | 6200 |
| Derai | Medi *Beel* | 6619.01 | 4184.58 | 10804 |
| Jamalganj | Sonduikka Group jolmohal | 1274.58 | 1678.48 | 2953 |
| | Dewtan *Beel* | 964.34 | 875.54 | 1840 |
| | Basker Khal | 666.92 | 1646.45 | 2313 |
| | Lomba beel Gol beel | 1342.85 | 1509.00 | 2852 |
| Biswambharpur | Monikamarer kuri | 560.70 | - | 561 |
| | Sudamkhali River | 1221.95 | 341.09 | 1563 |
| | Ghotghotia *Beel* | 777.95 | 508.93 | 1287 |
| | Tiar *Beel* Lomba *Beel* Gol *Beel* | 970.00 | 835.91 | 1806 |
| | Abua Prokasito Nainda Nodi | 8460.84 | 8933.15 | 17394 |
| Tahirpur | Thapna Group Jolmohal | 16504.95 | 6563.90 | 23069 |
| | Choto Khal Boro Khal | 988.35 | 3181.08 | 4169 |
| | Issubpurer Khal | 0.00 | 327.77 | 328 |

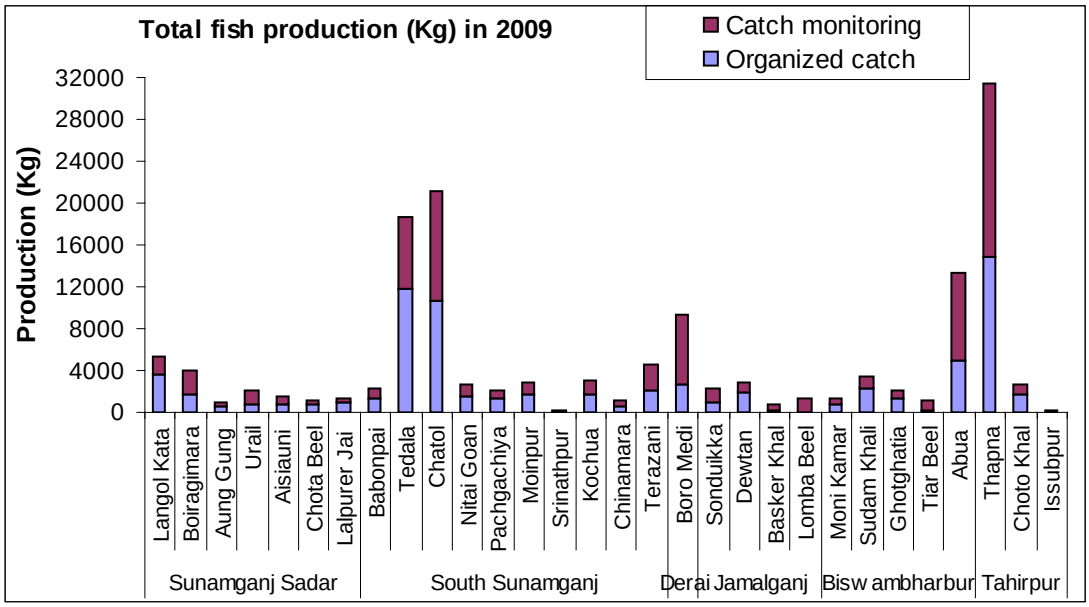


Figure 3. Fish productions (Kg) in all monitored sites from two sources (catch monitoring and organized fishing).

Among the six Upazilas the number of waterbodies sampled in Sunamganj Sadar, South Sunamganj, Derai, Jamalganj, Biswambharpur and Tahirpur were 7, 10, 1, 4, 5 and 3 respectively. There was variation in organized and monitoring catches. Fish production through organized catch and monitoring catch varies considerably and ratios were observed to be 1:0.62, 1:0.94, 1.58:1, 0.74:1, 1.13:1 and 1.74:1 in the Sunamganj Sadar, South Sunamganj, Derai, Jamalganj, Biswambharpur and Tahirpur respectively. Variations in production through organized catch and monitoring catch in the six upazilas are shown in figure 4. Proportions of catch per unit effort (catch ranges) from catch monitoring are shown in figure 5. Highest

proportions of catches; 45.52% and 26.15% were observed within range species 0-5 kgs, and 5-10 kgs respectively. The present study reveals that a large portion of catches comes from fishers whose daily catch is between 0 and 5 Kg per day. Changes of production (Kg/ha) from catch monitoring in year 1 and 2 are given in figure 6. Simultaneously changes of production (Kg/ha) from organized catch in year 1, 2 and 3 are given in figure 7.

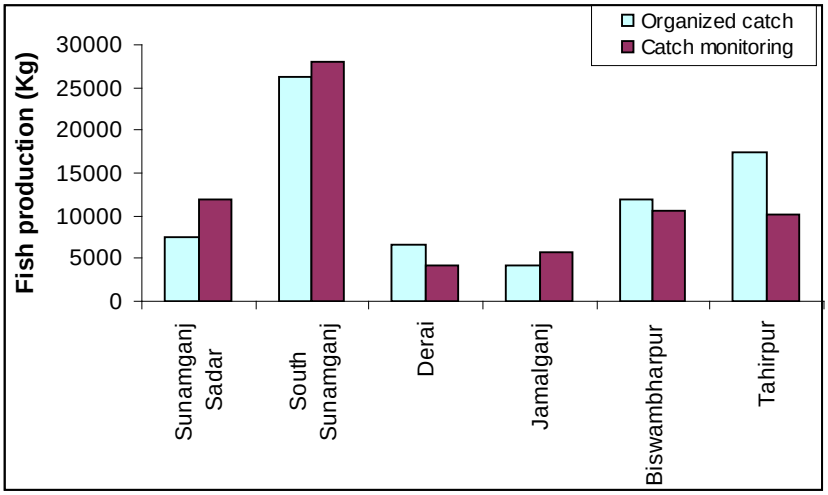


Figure 4. Fish production through organized and monitoring catches in the six upazilas.

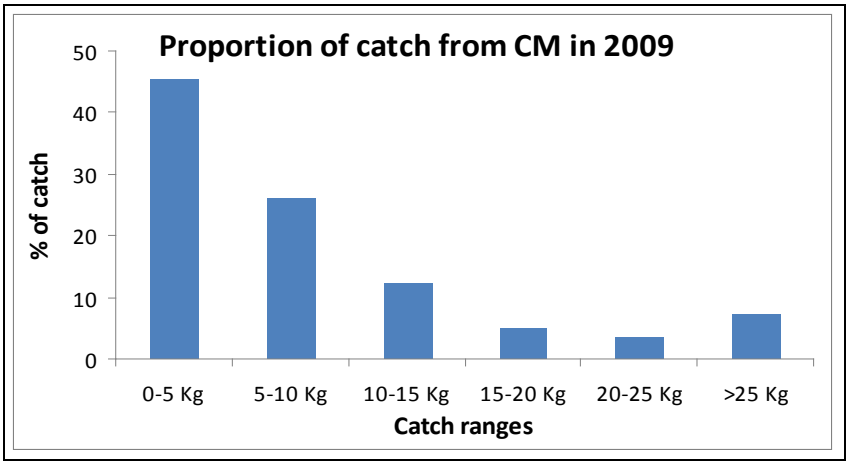


Figure 5. Proportion of catch per unit effort (catch ranges) from catch monitoring in 2009

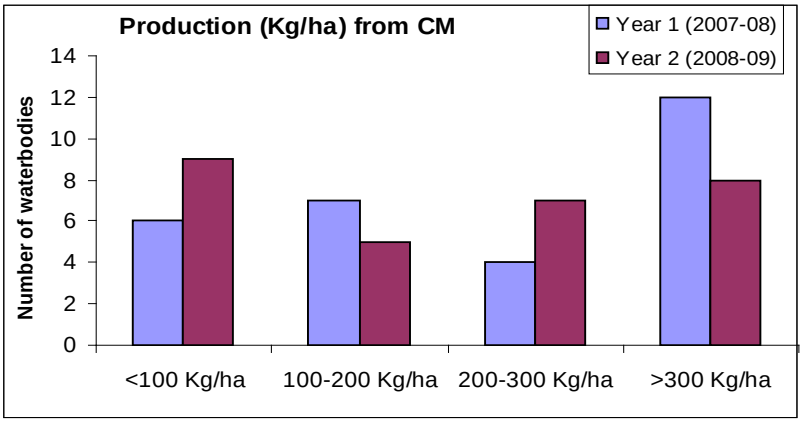


Figure 6. Changes of production (Kg/ha) from CM during study period.

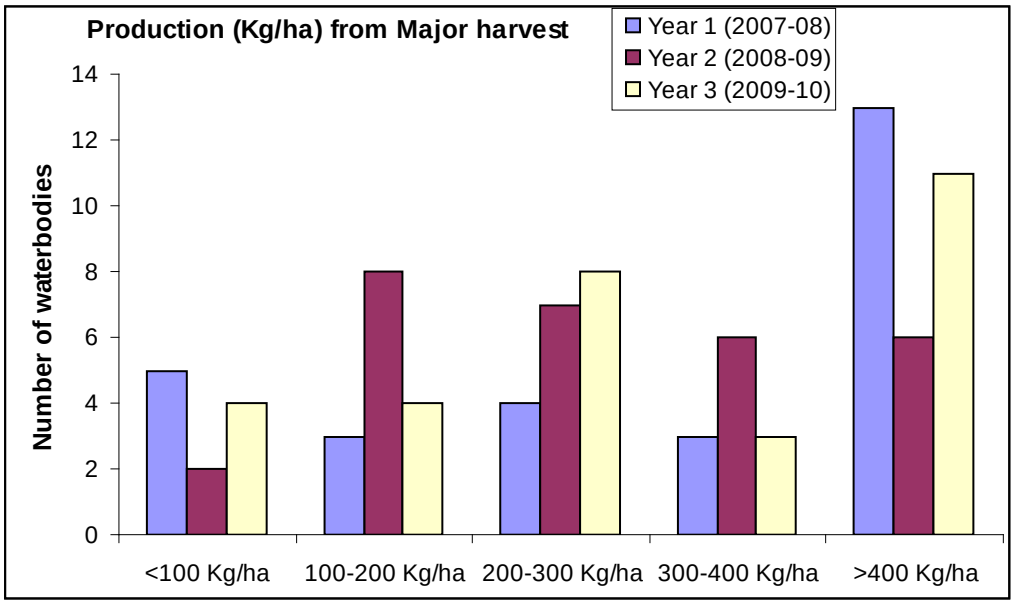


Figure 7. Changes of production (Kg/ha) from major fishing during study period.

**Contribution by different gears**

Various types of fishing gear are used in haor areas of Bangladesh. Their specification varies according to target species, type of water body, labour intensity, cost, available materials and profitability. There are nine major types of fishing gear used by fishermen communities in SCBRMP water bodies. The most common gears in operation, abundance of fish and prawn species

*Fishing by seine net*

caught by different types of gears, and their annual percentage contribution towards catches are given in figure 8. In the study sites the most commonly used gear types were gill nets, seine nets, push nets, large lift nets, long lines, cast nets, hook & line and traps which contributed respectively to 40.317%, 19.84%, 10.63%, 7.51%, 6.74%, 6.24%, 5.16% and 2.99%.

The annual average daily catch rates by fishers by gears are given in figure 9. This data can be an indicator of abundance and shows a significantly higher annual average daily catch with lift nets in haor areas.

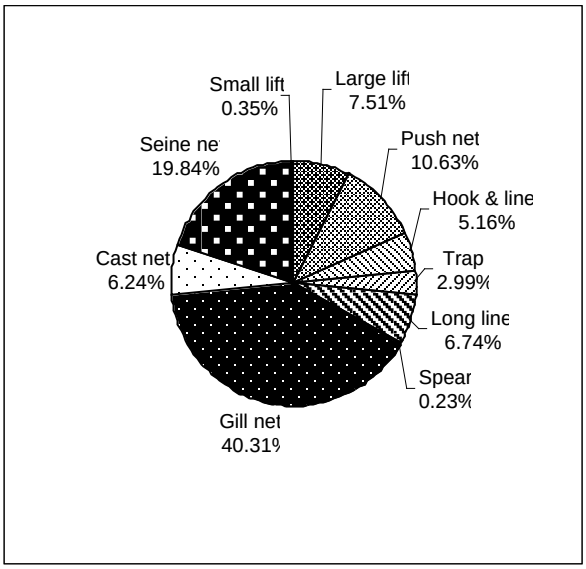


Figure 8. Proportion of catch by different gears

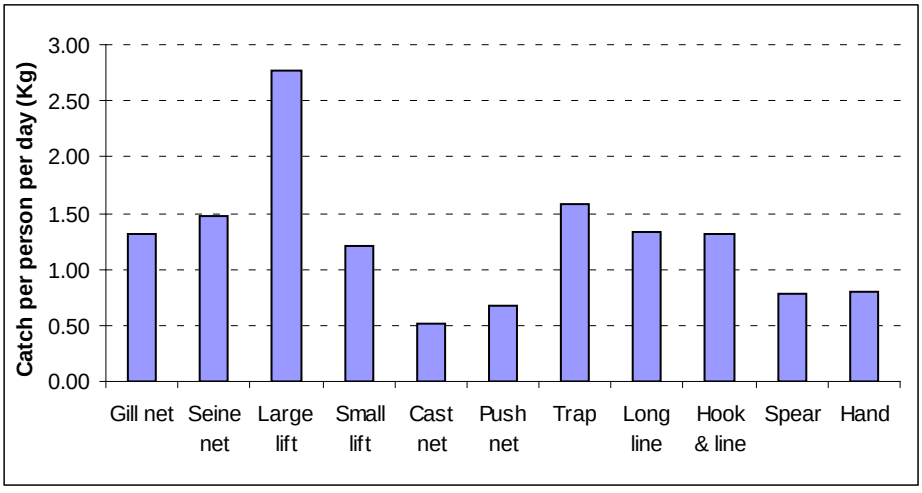


Figure 9. Catch per person per day by different gears in 2009.

## 3.2 Sale Prices

From major fishing data of 2008-09 it is observed that Srinathpurer dhola in South Sunamganj was found to have the highest per kilogram value of harvested fish (Tk. 118 per kg); whilst Lalpurer-Jai and Gazariar dair in Sunamganj Sadar had the lowest per kilogram value (Tk. 50 per kg). The average value from all sampled waterbodies was Tk. 80 per kg. However, throughout the study period, there were variations in fish sale prices (Tk. per kg). This was due to factors such as the partial harvest of fish, mentioned above; the presence of high priced species in the catch; and distance from a city market or marketing system. Table 6 shows the total production (kg) and total sale value (Tk.) from organized fishing in 2008-09. From the major fishing data of 2008-09 it has been also observed that the average price (Tk. per kg) of fish has increased from that of 2007-08. A comparison between sale values (Tk. per kg) in 2007-08, 2008-09 and 2009-10 of all monitored sites from organized catch are presented in figure 10.

*Selling of fish by open bidding on beel side*

Table 6. Total production (Kg) and sale value (Tk) during 2008-09 at all sampled waterbodies

| Name of Waterbody | Year 2008-09 | | Species found | Remarks |
|---|---|---|---|---|
| | Quantity in Kg | Sale Tk. | | |
| **Sunamganj sadar** | | | | |
| Langol kata Ojur beel | 1873.43 | 203754 | 48 | Harvesting completed by 05.03.09 |
| Bairagimara beel | 2325.30 | 261313 | 60 | Harvesting completed by 16.02.09 |
| Aung Gung | 410.80 | 36127 | 35 | Harvesting completed by 04.03.09 |
| Urail beel | 1342.75 | 119018 | 52 | Harvesting completed by 25.02.09 |
| Aislauni prokashito mitar dubi | 665.00 | 42566 | 42 | Harvesting completed by 23.02.09 |
| Chota beel | 414.00 | 24105 | 34 | Harvesting completed by 10.02.09 |
| Lalpurer Jai & Gozariar dair | 410.50 | 20650 | 35 | Harvesting completed by 15.02.09 |
| **Sub total** | **7441.78** | **707533** | | |
| **South Sunamganj** | | | | |
| Babonpai beel | 1063.48 | 72426 | 39 | Harvesting completed by 03.02.09 |
| Tedala huglia chatol | 6945.00 | 413551 | 43 | Harvesting completed by 19.03.09 |
| Chatol udaytara | 10609.83 | 816647 | 54 | Harvesting completed by 24.03.09 |

| | | | | |
|---|---|---|---|---|
| Netai Gang | 1179.27 | 83347 | 27 | Harvesting completed by 03.03.09 |
| Patchgachia beel | 864.91 | 77954 | 31 | Harvesting completed by 10.02.09 |
| Moinpur beel group | 1192.03 | 76979 | 32 | Harvesting completed by 27.02.09 |
| Srinathpurer dhola | 101.42 | 11935 | 20 | Harvesting completed by 03.03.09 |
| Kochua Gang | 1366.64 | 140003 | 35 | Harvesting completed by 11.03.09 |
| Chinamara beel | 449.35 | 26280 | 33 | Harvesting completed by 14.04.09 |
| Terajani balirdubi | 2545.77 | 187707 | 50 | Harvesting completed by 27.02.09 |
| **Sub total** | **26317.7** | **1906829** | | |
| **Derai** | | | | |
| Baro medi beel | 6619.01 | 445623 | 39 | Harvesting completed by 12.04.09 |
| **Sub total** | **6619.01** | **445623** | | |
| **Jamalganj** | | | | |
| Sonduikka group Jalmohal | 1274.58 | 85329 | 45 | Harvesting completed by 03.03.09 |
| Dewtan beel | 964.34 | 72249 | 42 | Harvesting completed by 03.04.09 |
| Basker khal | 666.92 | 63186 | 48 | Harvesting completed by 13.04.09 |
| Lomba beel Gool beel | 1342.85 | 101590 | 30 | Harvesting completed by 05.04.09 |
| **Sub total** | **4248.69** | **322354** | | |
| **Biswambharpur** | | | | |
| Moni kamarer kuri | 560.70 | 48842 | 38 | Harvesting completed by 28.02.09 |
| Sudamkhali river | 1221.95 | 108137 | 32 | Harvesting completed by 23.03.09 |
| Ghotghotia nodi | 777.95 | 46079 | 32 | Harvesting completed by 07.03.09 |
| Tiar beel Lomba beel Gol beel | 970.00 | 68715 | 27 | Harvesting completed by 25.02.09 |
| Abua prokashito nainda nodi | 8460.84 | 864803 | 48 | Harvesting completed by 12.04.09 |
| **Sub total** | **11991.44** | **1136576** | | |
| **Tahirpur** | | | | |
| Thapna group Jalmohal | 16504.95 | 1643901 | 53 | Harvesting completed by 30.03.09 |
| Choto khal baro khal | 988.35 | 76827 | 44 | Harvesting completed by 23.02.09 |
| Issubpurer khal | 0.00 | 0 | 0 | No harvest due to confliction |
| **Sub total** | **17493.3** | **1720728** | | |
| **Grand total** | **74111.92** | **6239643** | | |

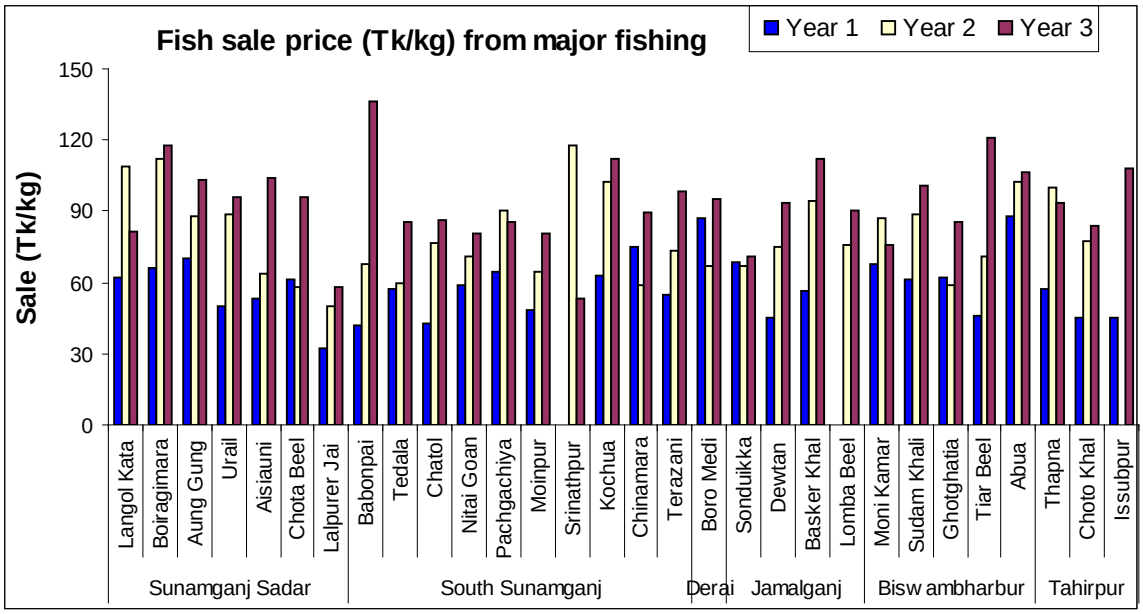


Figure 10. Sale prices (Tk per kg) of harvested fish (organized fishing) at different water bodies in Year-1 (2007-08), Year-2,(2008-09) and Year-3 (2009-10).

### 3.3 Biodiversity Based on Catch Monitoring Data

A total of 105 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 (70) were found in the Thapna group jalmohal, Sonduikka group jalmohal (66), Basker khal (64), Abua prokashito nainda nodi (63), Langolkata ojur beel (63), Chatal Udaytara (57), Boro medi beel (54), Boiragimara (52), Terajani balir dubi (47), and Chotokhal boro khal (47). However, in 2008-09 the total number of species varies from 28 to 70. At 5, 11, 6, 6 and 1 sites, ranges of species number were 25 to 35, 36 to 45, 46 to 55, 56 to 65 and 66 to 75 respectively (Figure 11). This reveals that the majority of waterbodies is habitat to 36 to 45 species. Study reveals that in 2007-08 the ranges of species number 56-65 was found at 3 sites which increased in 6 sites in 2008-09. Similarly in 2007-08 ranges of species number 46-55 was found in 5 sites which also increased in 6 sites in 2008-09.

A sustainable fish production is possible only through a coordination effort encompassing – flood level, flood duration, flood plain environment, refuges, migration and fishing intensity. A longer duration of flood provides a longer growth period for fish, and therefore a higher yield. This year flood duration was shorter in the *haor* areas, as well as delayed, therefore a

comparatively lower estimated yield was found from catch monitoring. Though the total estimated catch from catch monitoring was lower in 2008-09 compared to 2007-08, the species diversity was more or less same in the sampled waterbodies. There was substantial variation in species in each Upazila and among water bodies. A comparison of total number of species in each 2007-08 and 2008-09 of sampled waterbodies is shown in figures 12a (from catch monitoring) and 12b (from major harvest).

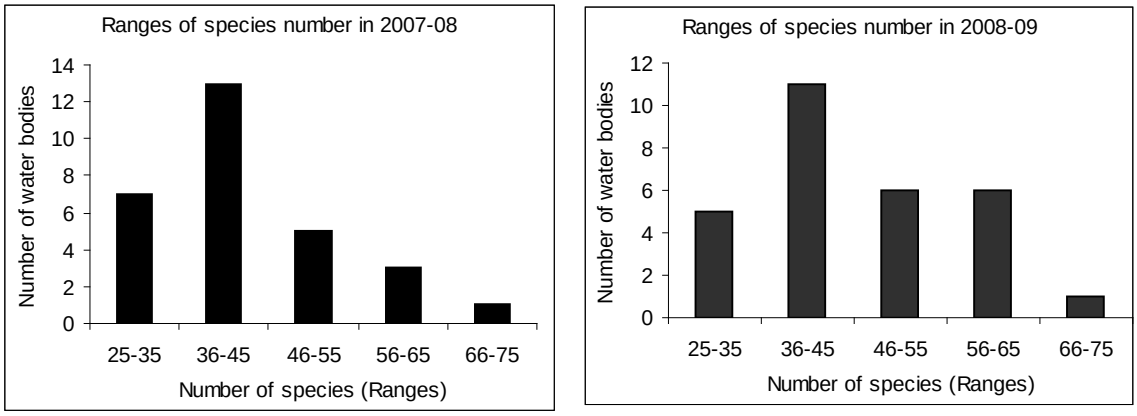


Figure 11. Comparison between ranges of species number and number of water bodies in 2007-08 and 2008-09 in the study sites.

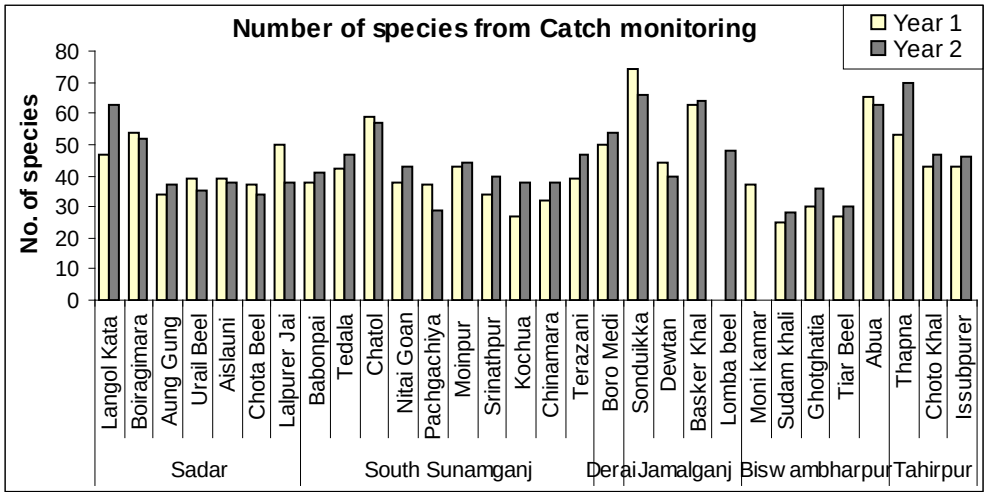


Figure 12a. Total numbers of species recorded from catch monitoring at all monitored sites in year-1 (2007-08) and year-2 (2008-09).

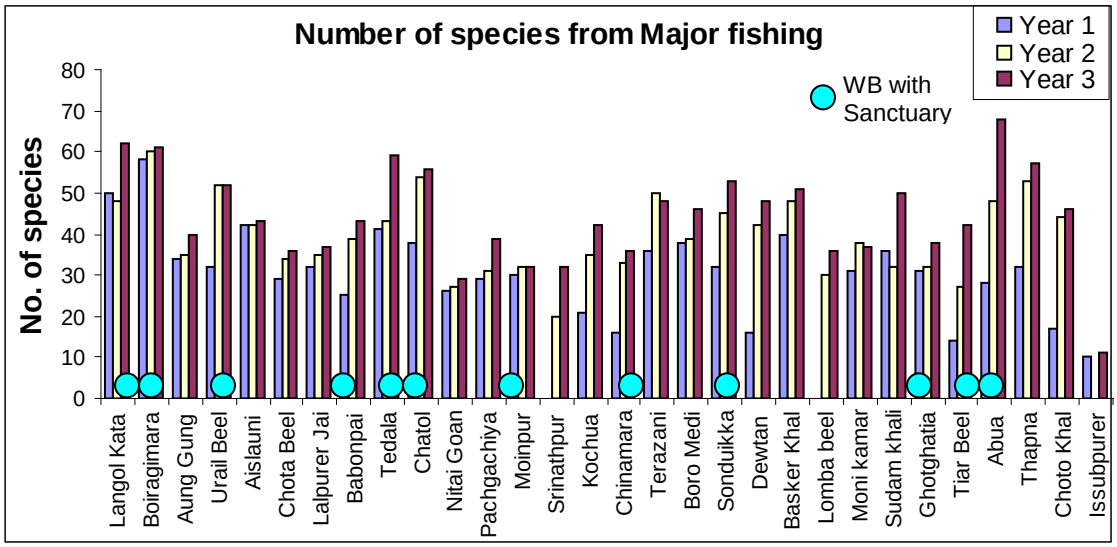


Figure 12b. Total numbers of species recorded from major harvest at all monitored sites in year-1 (2007-08), year-2 (2008-09) and year-3 (2009-10).

**Impact of Fish Sanctuary on Biodiversity:** The present study reveals that fish biodiversity increased in water bodies with fish sanctuary. Of the 30 study sites, 12 of them had fish sanctuaries established. Of the 12 fish sanctuary sites, 6 of them showed an increased of fish biodiversity in 2009 and, these were found from both catch monitoring and major fishing. Of the remaining 6 sites, 4 of them also showed an increas in fish biodiversity in 2009 and, this was found from major fishing. Simultaneously the remaining two sites also showed an increase in biodiversity in 2009 from catch monitoring. From major fishing it was found that fish biodiversity was significantly higher ($p<0.05$) in 2009 than in 2008. Average number of species was found to be 33 in 2008 and increased to 42 in 2009 from major fishing. Species abundance in all fish sanctuary sites was richer and more abundant in 2009 than 2008. Considered together, this evidence suggests that fish sanctuary also benefits biodiversity in *haor* areas. The increasing trend of species suggest that fish species are likely to benefit from the establishment of sanctuaries in the water bodies, as they are protected during vulnerable parts of their life cycle. A comparison of total number of species in each 2008, 2009 and 2010 (major fishing) of waterbodies with fish sanctuary is shown in table 7.

*Sanctuary in SCBRMP waterbody*

An Analysis of Variance (ANOVA) was performed for these 12 water bodies through incorporating number of species in 2007-08, 2008-09 and 2009-10 respectively. The analysis reveals that average number of species were 33, 41 and 50 in 2007-08, 2008-09 and 2009-10 respectively, and significant increase was found ($p = 0.0046$).

Table 7. Number of species found in each water body in 2008 and 2009 with fish sanctuary and, from both catch monitoring and major fishing.

| Name of Water body | Type of Sanctuary | Number of species in CM | | Number of species in Organized Fishing | | | Remarks |
|---|---|---|---|---|---|---|---|
| | | 2008 | 2009 | 2008 | 2009 | 2010 | |
| Langal Kata Ojur Beel | Permanent | 47 | 63 | 50 | 48 | 62 | Significant increased of species both in Catch Monitoring & OF |
| Boiragimara | Permanent | 54 | 52 | 58 | 60 | 61 | Species increased in Major Fishing & minor decreased in CM |
| Urail Beel | Katha-based | 39 | 35 | 32 | 52 | 52 | Significant increased of species in Major Fishing and minor decreased in CM |
| Babonpai Beel | Permanent | 38 | 41 | 25 | 39 | 43 | Species increased in Catch Monitoring and significant increased in Major Fishing |
| Tedala Hugliya Chatol | Permanent | 42 | 48 | 41 | 43 | 59 | Significant increased both Catch Monitoring and Major Fishing |
| Chatol Udaytara | Permanent | 59 | 57 | 38 | 54 | 56 | Species increased in Major Fishing & minor decreased in CM |
| Moinpur Beel Group | Katha-based | 43 | 44 | 30 | 32 | 32 | Species increased both Catch Monitoring and Major Fishing |
| Chinamara beel | Permanent | 32 | 38 | 16 | 33 | 36 | Significant increased both Catch Monitoring and Major Fishing |
| Sudamkhali River | Permanent | 25 | 29 | 36 | 32 | 50 | Species increased both in Catch Monitoring & and Major fishing |
| Ghotghatia Nodi | Permanent | 30 | 36 | 31 | 32 | 38 | Species increased both Catch Monitoring and Major Fishing |
| Tiar Beel Lomba Beel Gool Beel | Katha-based | 27 | 30 | 14 | 27 | 42 | Species increased both Catch Monitoring and Major Fishing |
| Abua Prokashito Nodi | Permanent | 65 | 63 | 28 | 48 | 68 | Significant increased of species in Major Fishing and minor decreased in CM |

### 3.4. Catch Composition Based on Catch Monitoring Data

The analysis shows that the best part of the catch (38.76%) consists of only five species and the common species caught by all types of gear were *P. sophore* (Jatputi), *N. Nandus* (Meni), *Channa punctata* (Taki), *Anabas testudineous* (Koi) and *Labeo calbasu* (Kalibaus) contributing 10.28%,8.37%, 8.27%, 6.46% and 5.38% of overall catches, respectively.

Analysis of annual catch statistics reveals that 20 main species contributed to the maximum proportion of the catch, all together contributing 77.56% in 2009. The annual contribution of other 80 species was 22.44%. The percentage compositions of catches of 20 main species in 2009 are presented in Figure 13. Meni (*Nandus nandus*) was the species making the highest contribution in Sunamganj Sadar (17.16%) and Tahirpur upazilas (8.3%). Jatputi (*Puntius sophor*e) was the highest contribution in South Sunamganj (15.14%) and Taki (*Channa punctata*) was the highest contributor species in Jamalganj (12.65%). However, the highest abundance of Kalibaus (*Labeo calbasu*) occurred in Biswhambapur Upazila (29.73%), and Koi (*Anabas testudineus*) made its highest contribution in Derai Upazila (16.49%). Most catches of Meni (*Nandus nandus*) occurred in Sunamganj Sadar in 2008 as well as in 2009. Among the main five contributor species, abundance of Kalibaus (*Labeo calbasu*) appeared in Abua nodi, and very high catches of the Kalibaus was also recorded in this river. The study revealed that the river Abua is one of the important rivers for the conservation of Kalibaus. Jatputi, Koi, Taki, Gura icha and Meni were the species making highest contribution in 6, 6, 6, 5 and 3 study sites respectively (Figure 14). However, the highest abundance of Guchi biam, Titputi and Boro biam occurred in one site each.

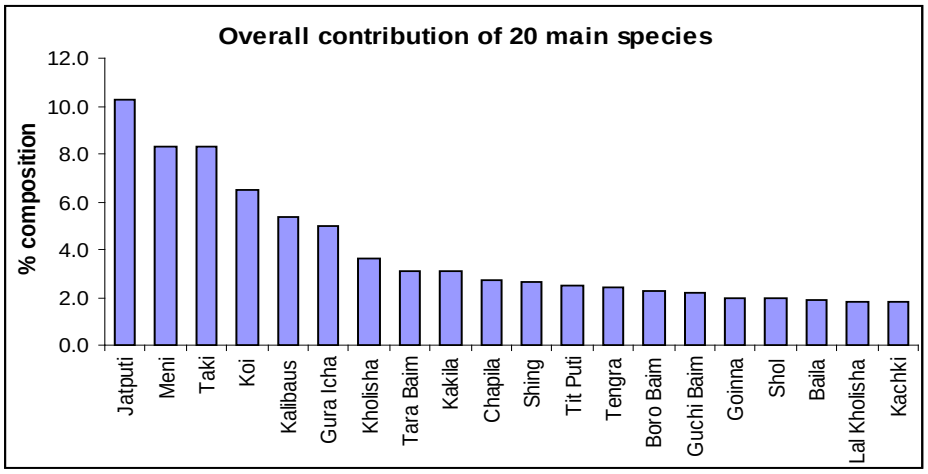


Figure 13: Species composition by weight (main species) in SCBRMP study sites.

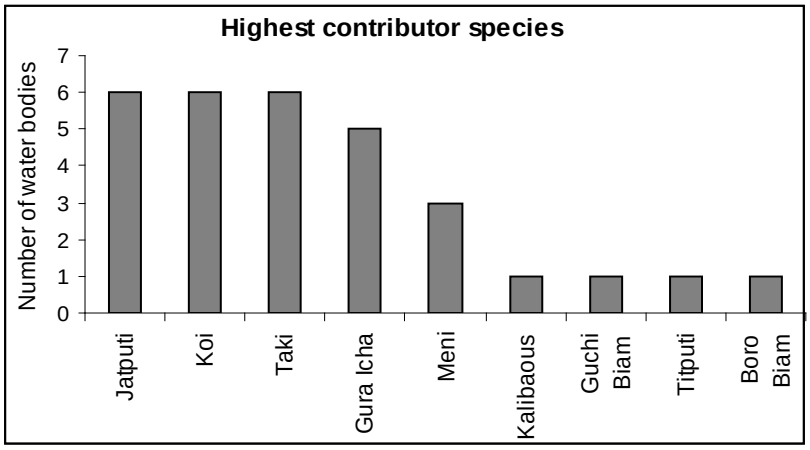


Figure 14. Highest contributor species from catch monitoring in SCBRMP study sites

## 3.5. Amount of Fish Catch up to December 2009

Overall species composition was calculated from annual major harvest and catch monitoring for each upazila. The most abundant species (combined of five species) have been contributed more than 38% of the total catch in each Upazila at all monitored sites. The contributions of the five most important species and of total catches (including major harvest) in the six upazilas are given in Table 8. A single species *Puntius sophore* (Jatputi) was found as the one that mostly contributed to catches in Sunamganj sadar (13.78%), South Sunamganj (15.43%), Derai (14.45%), Jamalganj (16.48%) and Tahirpur (11.92%) upazilas. However, *Labeo calbasu* (Kalibaus) was the most abundant species in Biswambopur upazila and contributed 18.2% of the total catch and *Labeo rohita* (Rui) was the most contributed species in Tahirpur upazila and contributed 18.94% of the total catch.

Table 8. 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 (%) |
|---|---|---|---|---|
| | Local Name | Scientific Name | | |
| **Sunamganj Sadar (Seven waterbodies)** | 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 (Ten waterbodies)** | Jatputi | *Puntius sophore* | 8367 | 15.43 |
| | Meni | *Nandus nandus* | 3508 | 6.47 |
| | Taki | *Channa punctatus* | 3198 | 5.90 |
| | Kakila | *Xenentodon cancila* | 2631 | 4.85 |
| | Koi | *Anabas testudineus* | 2606 | 4.80 |
| | Other Species | (88 species) | 33930 | 62.55 |
| **Derai (One water body)** | Jatputi | *Puntius sophore* | 1561 | 14.45 |
| | Meni | *Nandus nandus* | 1298 | 12.01 |
| | Koi | *Anabas testudineus* | 1102 | 10.25 |
| | Taki/Ladi | *Channa punctatus* | 520 | 4.81 |
| | Guchi Baim | *Mastacembelus pancalus* | 491 | 4.54 |
| | Other Species | (54 species) | 5831 | 54 |
| **Jamalganj (Three waterbodies)** | Jatputi | *Puntius sophore* | 1641 | 16.48 |
| | Taki | *Channa punctatus* | 766 | 7.69 |
| | Koi | *Anabas testudineus* | 558 | 5.60 |
| | Baila | *Glossogobius guiris* | 400 | 4.02 |
| | Chapila | *Puntius sophore* | 382 | 3.84 |
| | Other Species | (79 species) | 6212 | 62.29 |
| **Bishwambharpur (Five waterbodies)** | Kalibaus | *Labeo calbasu* | 4154 | 18.2 |
| | Kachki | *Corica soborna* | 2747 | 12.05 |
| | Gura Icha | *N. tenuipes* | 1861 | 8.14 |
| | Chapila | *Puntius sophore* | 1711 | 7.51 |
| | Jatputi | *Puntius sophore* | 1125 | 4.9 |
| | Other Species | (78 species) | 11184 | 49.2 |
| **Tahirpur (Three waterbodies)** | Rui/Ruhit | *Labeo rohita* | 5222 | 18.94 |
| | Goinna | *Labeo gonius* | 3647 | 13.23 |
| | Meni | *Nandus nandus* | 2712 | 9.84 |
| | Chapila | *Gudusias chapra* | 1055 | 3.83 |
| | Kakila | *Xenentodon cancila* | 1040 | 3.77 |
| | Other Species | ( 76 species) | 13890 | 50.38 |

*CM= Catch Monitoring, GF= Group Fishing.

Average weight of large sized fish from catch monitoring was found higher in Bishwambharpur and Tahirpur. Ayre, Mrigal, Rui and Boal were the larger sized species in Biswambharpur with an average weight of 1,963g, 1,211g, 877g and 800g respectively. Simultaneously Grass carp (exotic species), Mirror carp (exotic species), Katla and Chital were the larger size contributor species in Tahirpur with average weight of 1,856g, 1,625g, 1,500g and 1,177g respectively. However average weight of larger sized fish was found lower in Sunamganj Sadar, South sunamganj, Derai and Jamalganj upazilas. The average weights (g) of the larger sized species from catch monitoring in different Upazilas are presented in Figure 15. Simultaneously average weight of large sized fish from organized fishing was found higher in Sunamganj Sadar, Bishwambhpur, Tahirpur and Jamalganj Upazilas. The average weights (g) of the larger sized species from organized fishing in different Upazilas are given in figure 16.

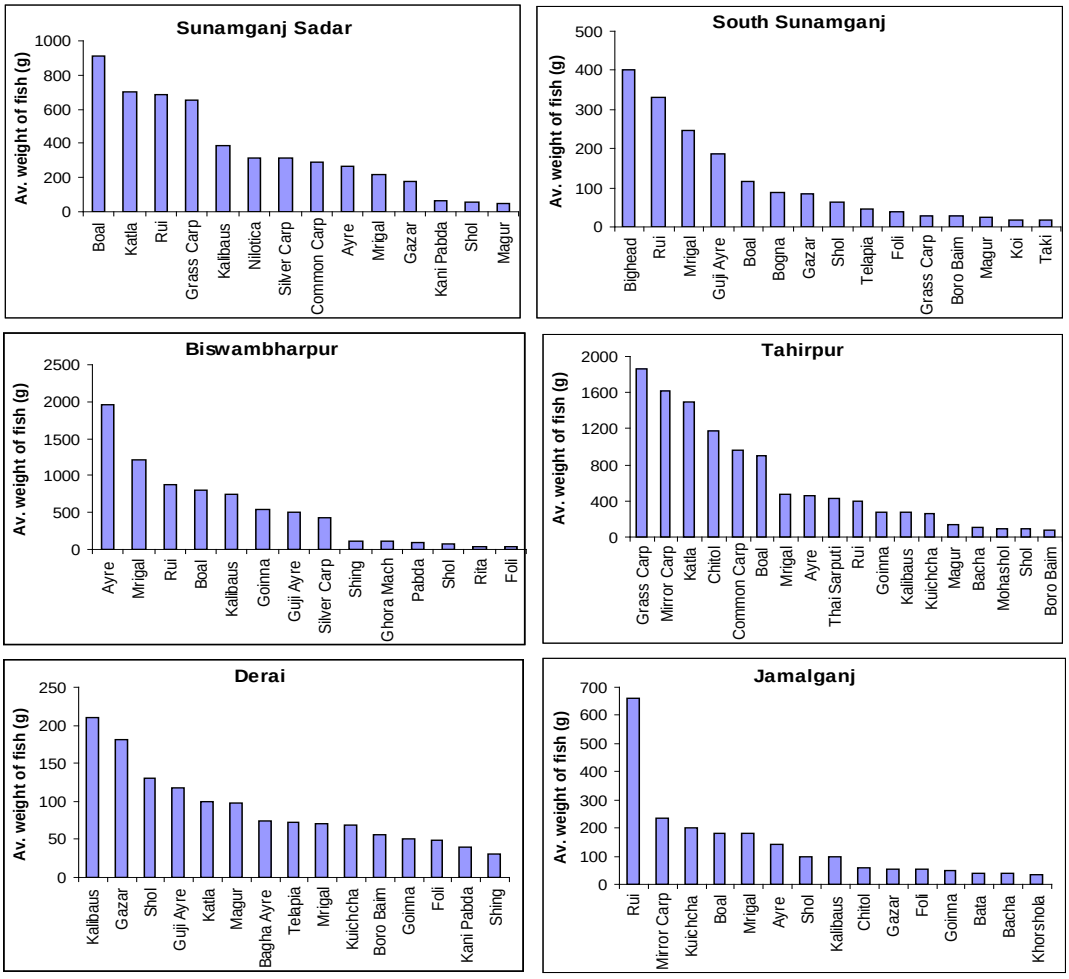


Figure 15. Average weight (gm) of large size fishes from catch monitoring in different upazilas of the study sites.

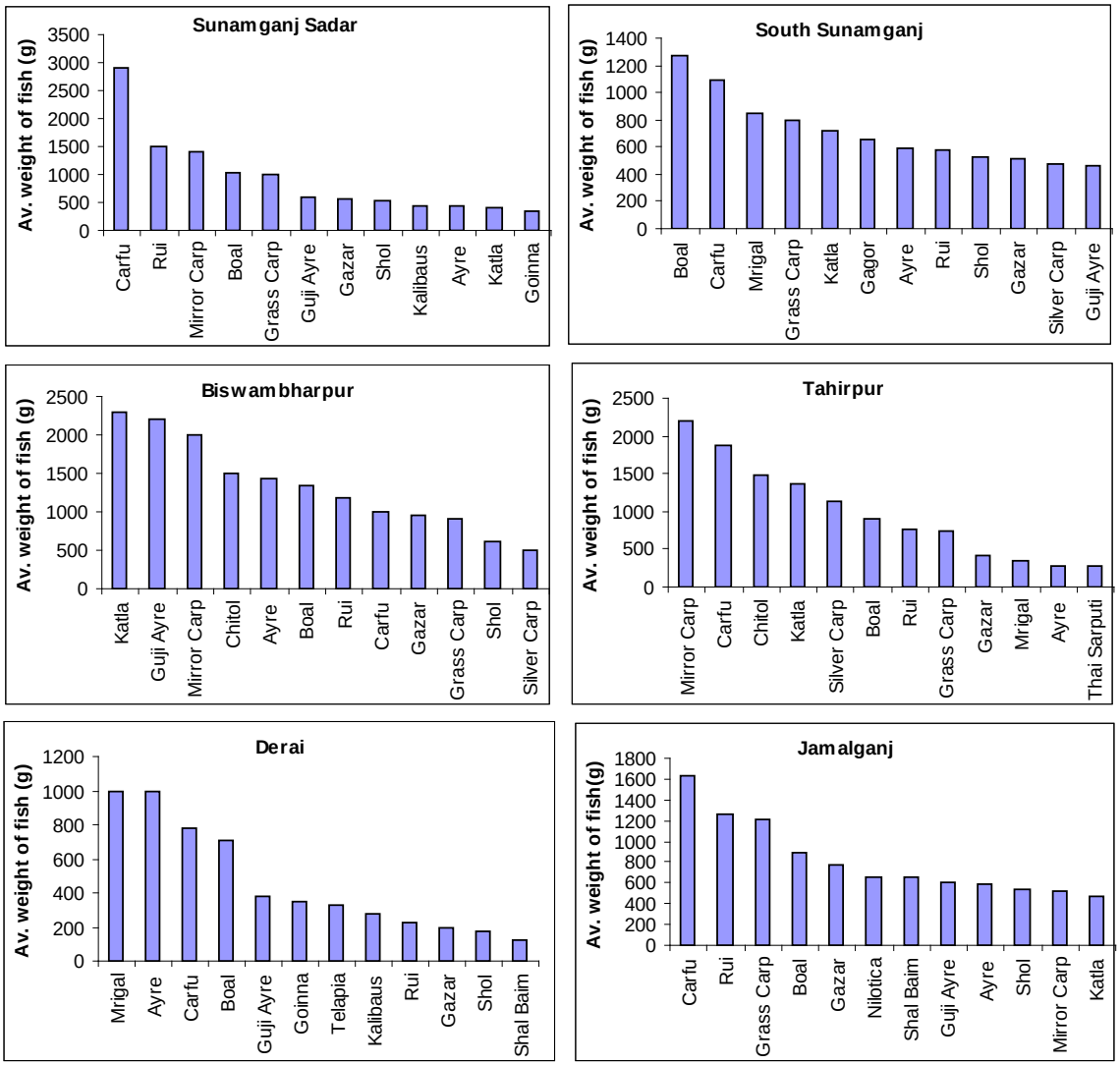


Figure 16. Average weight (gm) of large size fishes from organized catch in different upazilas of the study sites.

There was substantial variation in production (kg/ha) through organized catch at most sampling sites with average production of 357, 313 and 398 kg/ha in 2007-08, 2008-09 and 2009-10 respectively (Figure 17). Variation in production was lower among twelve water bodies (Boiragimara, Aung Gung, Aislauni, Babonpai, Chatol Udaitara, Nitai Goan, Moinpur, Kochua, Monikamarer kuri, Ghotghatia, Abua, and Thapna). Two water bodies (Pachgachiya and Terajani) stand away from this general production value, and Terajani has the highest production from organized catch (1,177, 1,480 and 1,619 kg per hectare in 2007-08, 2008-09 and 2009-10 respectively). An Analysis of Variance (ANOVA) was performed for 27 water bodies through incorporating

production in 2007-08, 2008-09 and 2009-10 respectively. The analysis reveals that there was an average production increase of 9% between 2007-8 and 2009, and a 26% increase in production between 2008-09 and 2009 values.However, an ANOVA test did not find significance in the differences (p = 0.546).

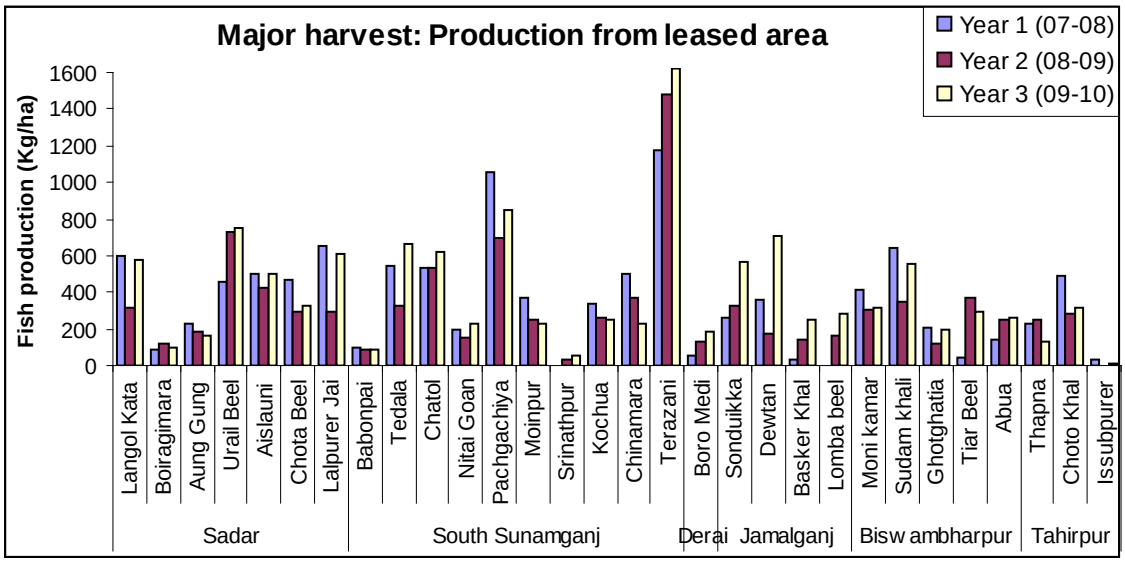


Figure 17. Estimated production (kg/ha) based on organized catch records in all studied sites.

Catch monitoring data shows a high variation in production with an average production of 220 kg/ha (Figure 18). The lowest production (<100 kg/ha) was found in Boiragimara, Urail *beel*, Tedala, Choto *beel*, Medi *beel*, Sudamkhali, Ghotghotia, Thapna and Issubpurer khal. Lower fish production (between 100 and 200 kg/ha) was found in five water bodies (Aislauni, Lalpurer Jai, Dewtan, Lomba *beel* and Tiar *beel*). Simultaneously better production (200-300 Kg/ha) was found in seven waterbodies (Babonpai, Moinpur, Srinathpurer dola, Kochua, Sonduikka, Basker and Abua). Concurrently, the highest production (>300 Kg/ha) was found in eight water bodies (Langol Kata, Aung Gung, Chota beel, Netai Gang, Pachgachia, Chinamara, Terajani and Choto Khal).

In 2009 fish production in individual catches (monitoring) revealed that 52% waterbodies contributed to <200 Kg/ha and 48% waterbodies contributed to >200 Kg/ha. However, in 2008 fish production in individual catches showed that 45% waterbodies contributed to <200 Kg/ha and 55% waterbodies contributed to >200 Kg/ha. Analysis showed that production from catch monitoring decreased in 2009 when compared to 2008. The main effective factors that categorically lowererd fish production in catch monitoring (individual catches) in 2009 was fishing restriction like those enforced by BUGs on individual fishing (open catch) in and around beels that only permits a small number of fishermen to fish. Besides, a lower fisher density, low

water stability and restricted fishing with seine net and high abundance of aquatic vegetation (at few sites) were also factors of depletion of open catches. In 2008 a total of 29,482 fisher's days were estimated from monitoring waterbodies and in 2009 this number reduced to 27,331. Fisher's days significantly decreased by 43% for seine nets and traps in 2009 followed by cast net (29%), Hook and Line (27%), Long line (18%), Spear (9%), small lift nets (8%) and push nets (7%). In contrast fisher's days significantly increased by 170% for large lift nets. These fisher days variations by gear types in 2008 and 2009 are given in figure 19.

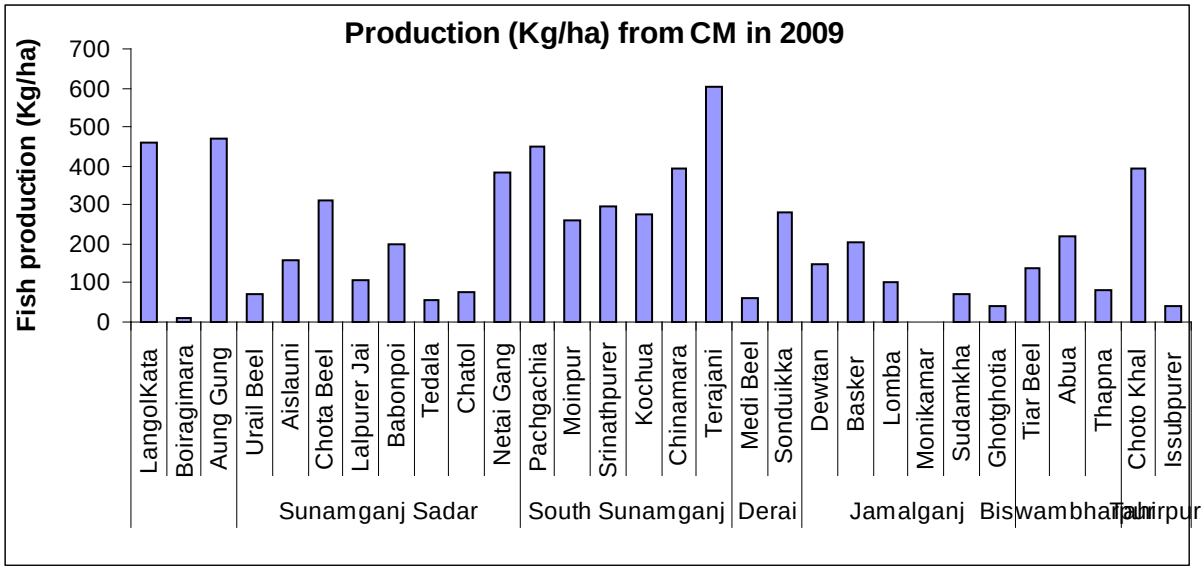


Figure 18. Estimated production (kg/ha) based on catch monitoring data in all studied sites.

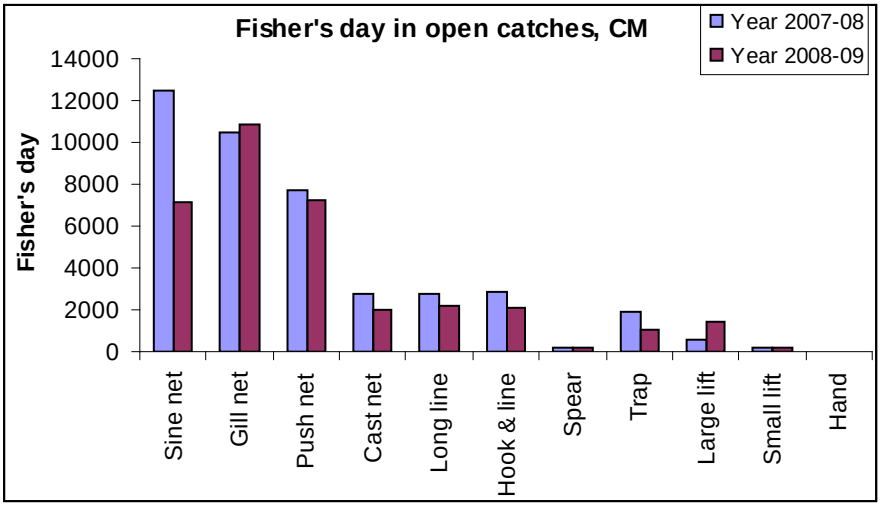


Figure 19. Status of fisher's day during 1st and 2nd year of CM survey.

## 3.2. Seasonal Variations of Fish Production

The seasonal variation of fish production is common in the *haor* habitat and is mainly affected by flooding, flood duration 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 April and June, and Novermber to December of the same year (Figure 20).

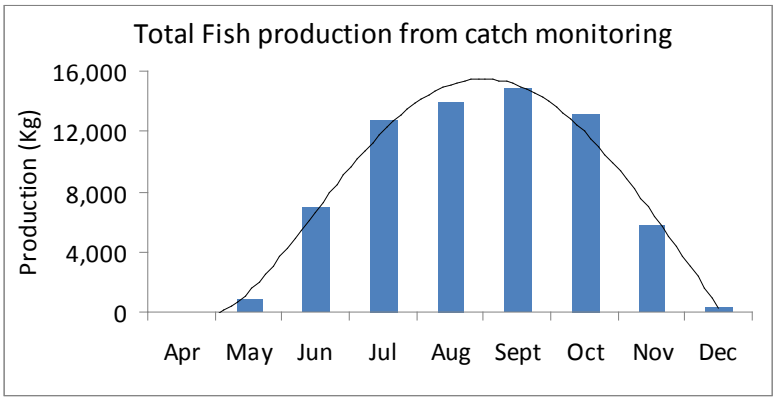


Figure 20: Monthly variation of estimated fish production (kg) from catch monitoring in all survey sites in 2009.

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

The value of annual lease across the project water bodies varied enormously from Tk.394 to Tk. 21,883 per hectare with an average value of Tk.4,010 per hectare 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. 1,319 to Tk. 159,727 per hectare with an average sale value of Tk. 35,764 per acre at 95% confidence limits. Regression analysis between leased value (Tk. per hectare) and fish sale value (Tk. per hectare) shows significance at 95%CL (P-value was found 0.0008 and F-statistic was 14.49) (Figure 21). This reveals that lease value could be simply achievable through fish sale value. Simultaneously the fish sale value also shows positive correlation with leased area which reveals that large area is more beneficial (Figure 22). However, some small waterbodies with a high lease value had few opportunities of obtaining the money required for such lease value. The BUGs should focus on income generation or fish value chain to assure the payment and these watarbodies could be used for seasonal stocking with native fish species.

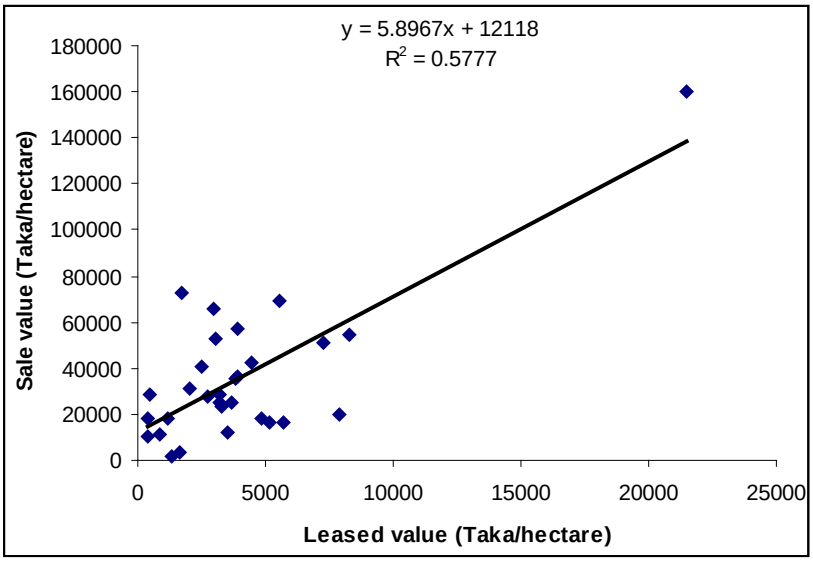


Figure 21. Regression analysis between leased value (Tk/hectare) and Sale value (Tk/hectare).

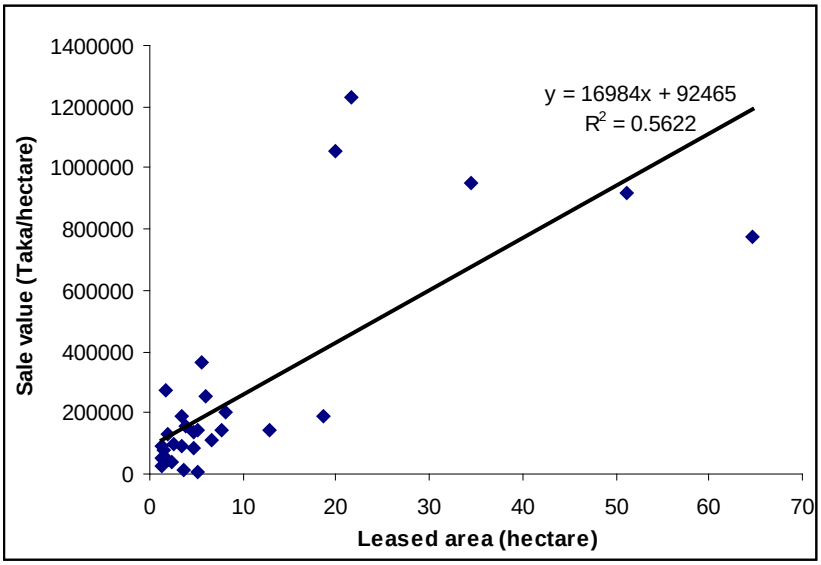


Figure 22. Sale value (Tk/acre) plotted as a function of leased area at all studied sites.

Biodiversity of self-recruiting indigenous species using the Shannon-Weiner index (H') in the study sites ranged from 1.079 to 3.149 in 2009. The biodiversity monitoring 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 depends on what is happening in other adjacent water bodies. A comparision of biodiversity index (H') for 28 sites, based on natural species proportions is shown in Figure 23.

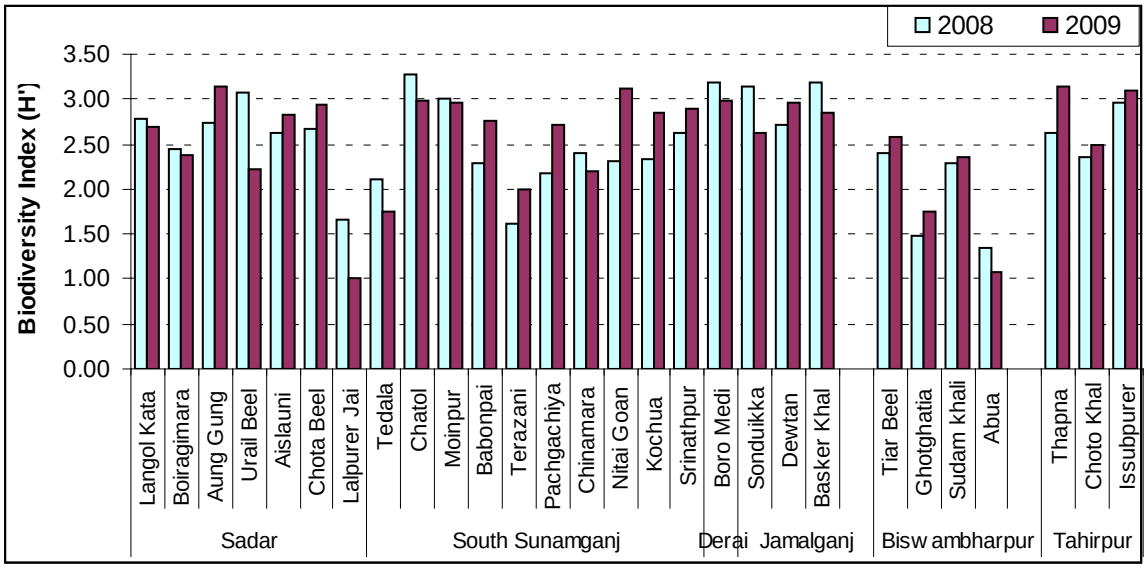


Figure 23. Estimate of mean H' has been plotted for each water body through catch monitoring in 2008 and 2009.

## 3.7. Length-Frequency Distribution

*Measuring of fish length by CE*

Four waterbodies were selected for Length frequency data collection among the 30 assigned waterbodies. These are Abua prokashito nainda nodmax in Bishwambharpur Upazila; Thapna group jalmahal in Tahirpur Upazila; Tedala huglia chatol in South Sunamganj Upazila; and Baro medi *beel* in Derai Upazila.The main objective of this analysis is to estimate growth parameters, mortality rate, recruitment patterns and exploitation rates of important 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 Center. Table (9) gives the present status of length-frequency data collection.

Table 9. Length-frequency data collection status during reporting period

| Upazila | Water body | Starting Month | No. of sheet collected | Main species |
|---|---|---|---|---|
| South Sunamganj | Tedala Huglia Chatol | January | 2534 | Jat puti (*P.sophore*), Gol Chanda *(Chanda lala)*, Baila (*G. giuris*), Meni (*N. nandus*), Taki (*C. punctatus)* |
| Bishwambharpur | Abua prokasito Nainda Nodi | January | 3947 | Kachki(*Corica soborna*), Chapia (*G. chapra*), Ful Dhela*(salmostoma phumin)*, Gol Chanda*(Chanda lala),* Golsha tengra*(Mystus seenghala)* |
| Tahirpur | Thapna Group Jalmahal | January | 2341 | Kakila (*X. cancila*), Chapia (*G. chapra*), Gol Chanda *(Chanda lala), Meni (Nandus nundus*), Jat puti (*P.sophore*) |
| Derai | Medi Beel | January | 3309 | Taki(*C. punctatus),*Jat puti (*P.sophore*) Koi *(Anabus testudineus),*Meni(*N.nandus*), Smaxng(*Heteropneustes fossilis),*Gol Chanda *(Chanda lala)* |

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. Length-frequency data was analyzed to estimate mean length and annual growth parameters for the 8 important species: two species from the Abua Prokasito Nainda Nodi, two species from the Thapna Group Jalmahal, two species from the Tedala Huglia Chatol and two species from the Boro Medi beels.

Parameters for *Gudusia chapra*:

*Gudusia chapra*

Normally distributed length frequency (combined) and computed mean length of *Gudusia chapra* in the river Abua are shown in figure 24a. The growth parameters, $L\infty$ (asymptotic length) and K (growth co-efficient) of the *G. chapra* were found to be 13.65 cm and 1.13 per year. Estimated growth performance index ($\phi$') for *G. chapra* was found to be 2.323. The growth curves of those parameters are shown over its normal length distribution in figure 24b.

Parameters for *Chanda nama* (Lomba chanda):

*Chanda nama*

Normally distributed length frequency (combined) and computed mean length of *Chanda nama* in the river Abua are shown in figure 24c. The growth parameters, L∝ and K of the *Chanda nama* were found to be 12.6 cm and 1.2 per year. Estimated growth performance index (ϕ') for *Chanda nama* was found to be 2.28. The growth curves of those parameters are shown over its normal length distribution in figure 24d.

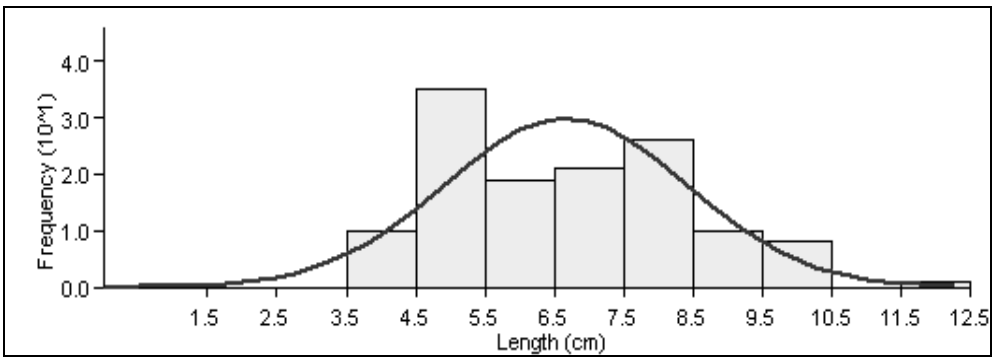


Figure 24a. Normally distributed length and computed mean length (6.66 ±1.746 cm) of *G. chapra* caught in the river Abua Prokasito Nainda Nodi.

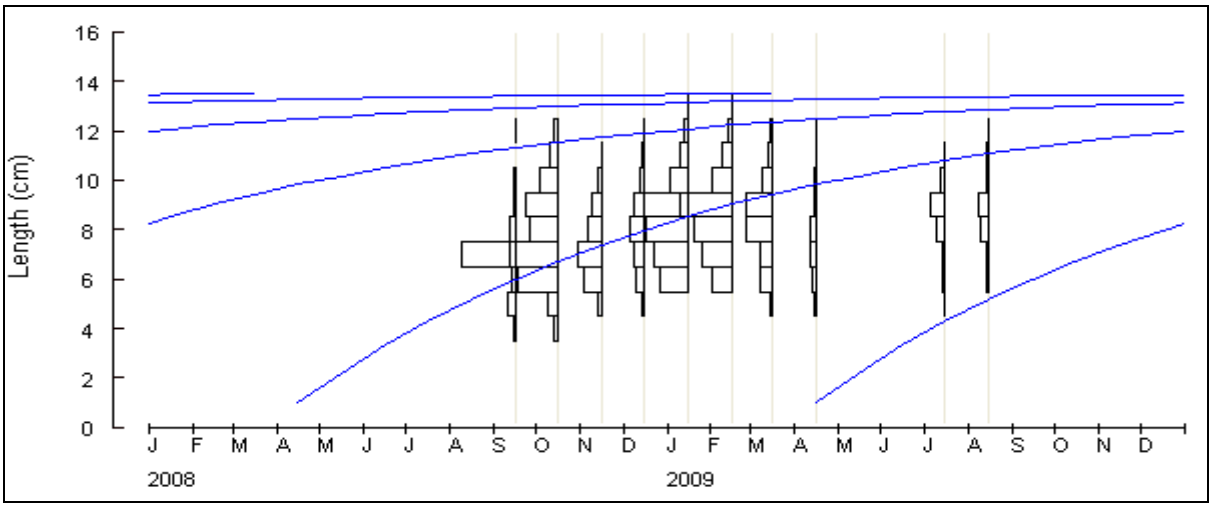


Figure 24b. Growth curve superimposed over the normal length frequency data of *G. chapra* caught in the river Abua Prokasito Nainda Nodi (L∝ = 13.65 ,K=1.13, Rn = 0.208, SS-1, SL = 6).

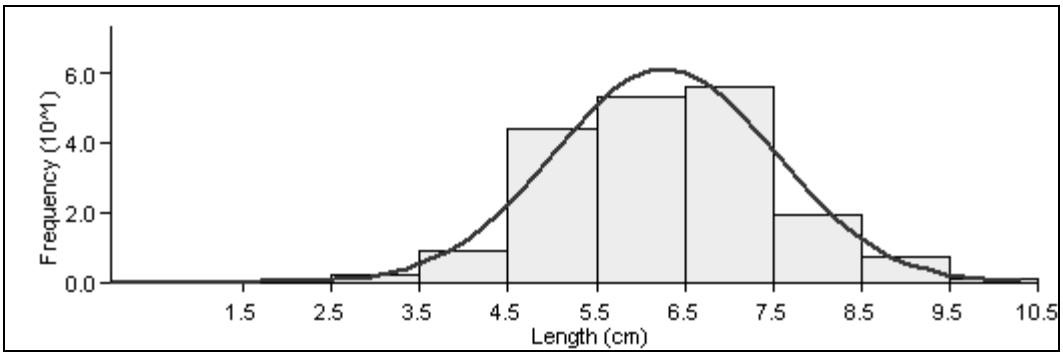


Figure 24c. Normally distributed length and computed mean length (6.27±1.24 cm) of Lomba chanda (*Chanda nama*).

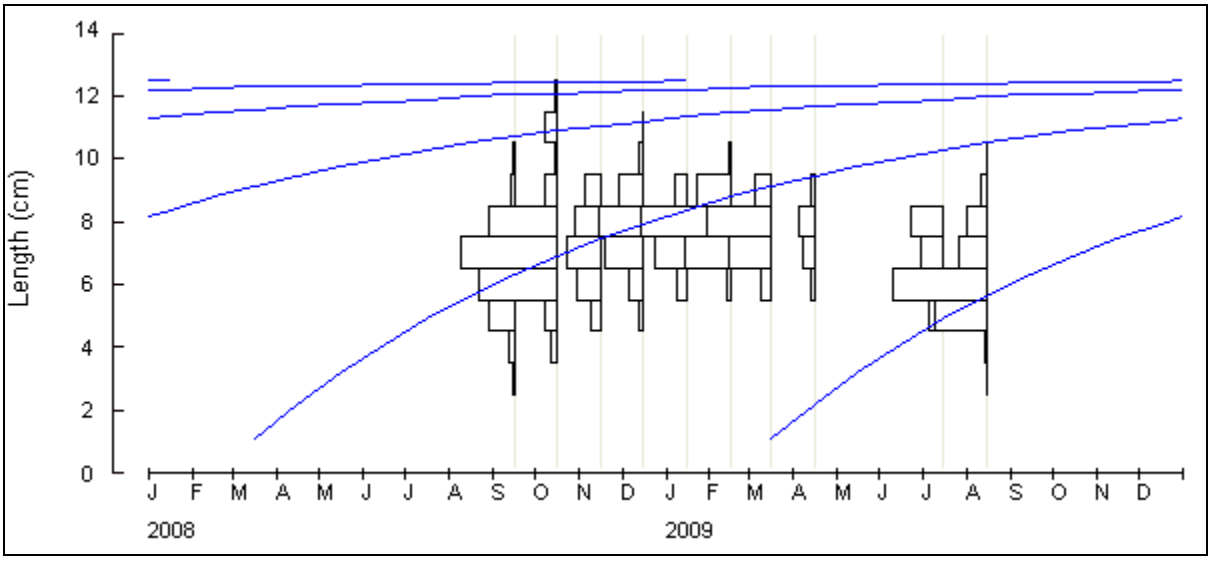


Figure 24d. Length frequency distribution of Lomba chanda (*Chanda nama*) caught in the Abua Prokasito Nainda Nodi (L∝ = 12.6, K=1.2, SS=6, SL=10.5, Rn=0.398).

Parameters for *Puntius sophore* (Jat puti):

*Puntius sophore*

Normally distributed length frequency (combined) and computed mean length of (Puti) *Puntius sophore* in the Tedala Hoglia Chatol Beel are shown in figure 25a. The growth parameters, L∝ and K of the *P. sophore* were found to be 13.6 cm and 0.85 per year. Estimated growth performance index (ϕ') for *P. sophore* was found to be 2.196. The growth curves of those parameters are shown over its normal length distribution in figure 25b.

Parameters for *Nandus nandus* (Meni):

*Nandus nandus*

Normally distributed length frequency (combined) and computed mean length of Meni (*Nandus nandus*) in the Tedala Hoglia Chatol Beel is shown in figure 25c. The growth parameters, L∝ and K of the *Nandus nandus* were found to be16.5 cm and 0.75 per year. Estimated growth performance index (ϕ') for *Nandus nandus* was found to be 2.310. The growth curves of those parameters are shown over its normal length distribution in figure 25d.

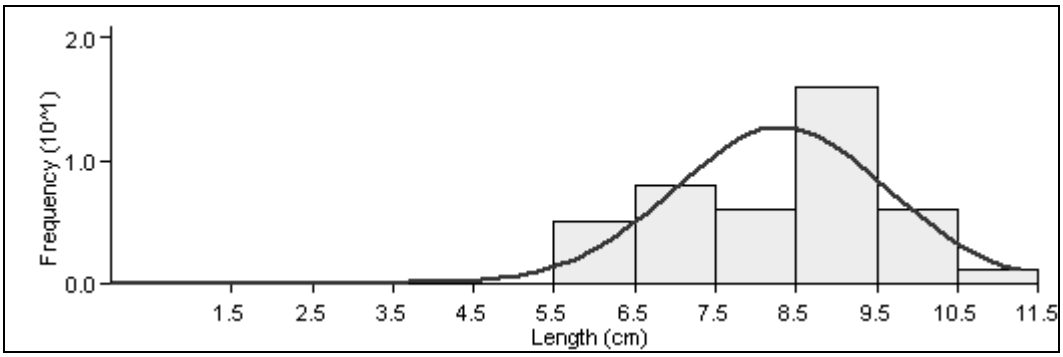


Figure 25a. Normally distributed length and computed mean length (8.31±1.318 cm) of Jatputi (*Puntius sophore*) caught in the Tedala Hoglia Chatol Beel.

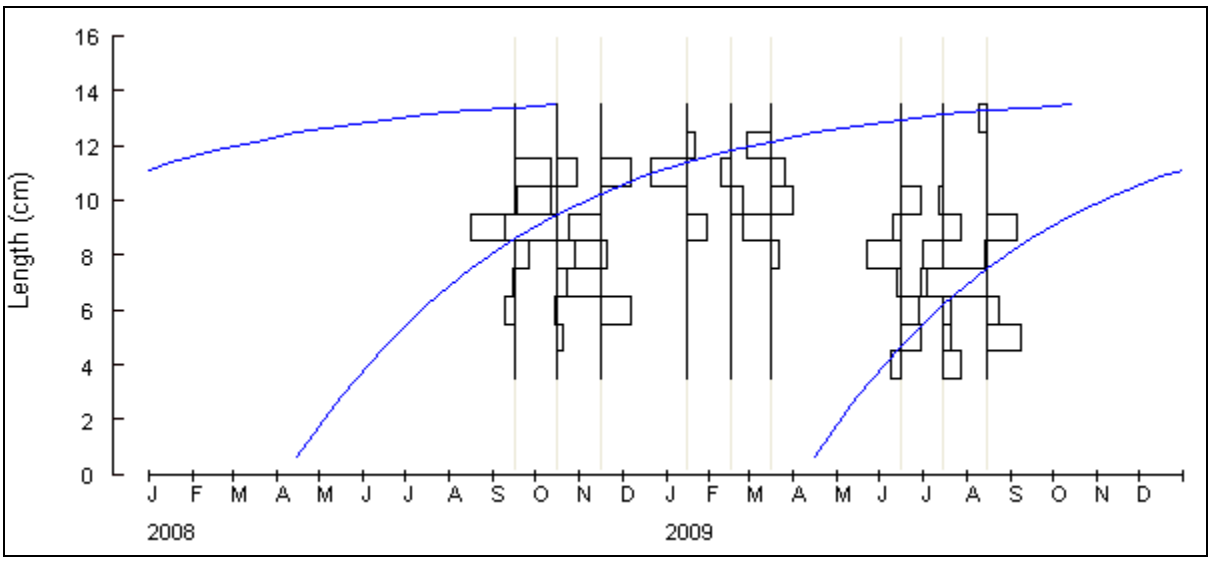


Figure 25b. Length frequency distribution of Jatputi (*P. sophore*) caught in Tedala Huglia Chatol Beel (L∝ = 13.6, K=0.85, SS=9, SL=8, Rn = 0.25).

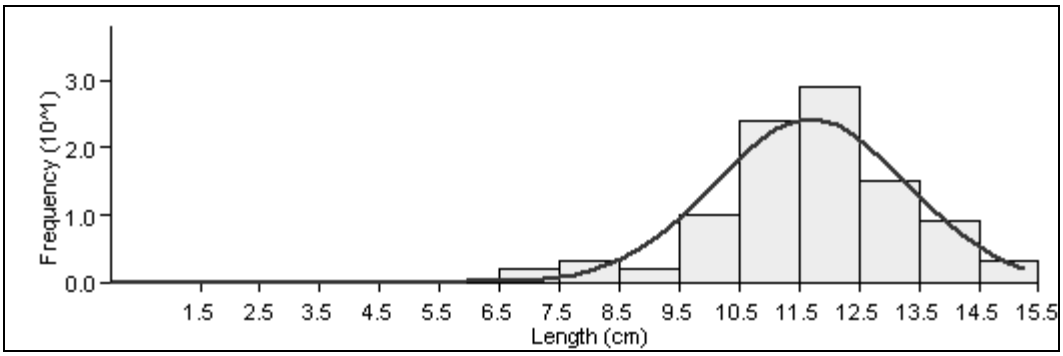


Figure 25c. Normally distributed length and computed mean length (11.69±1.6 cm) of Meni (*Nandus nandus*) caught in the Tedala Huglia Chatol Beel.

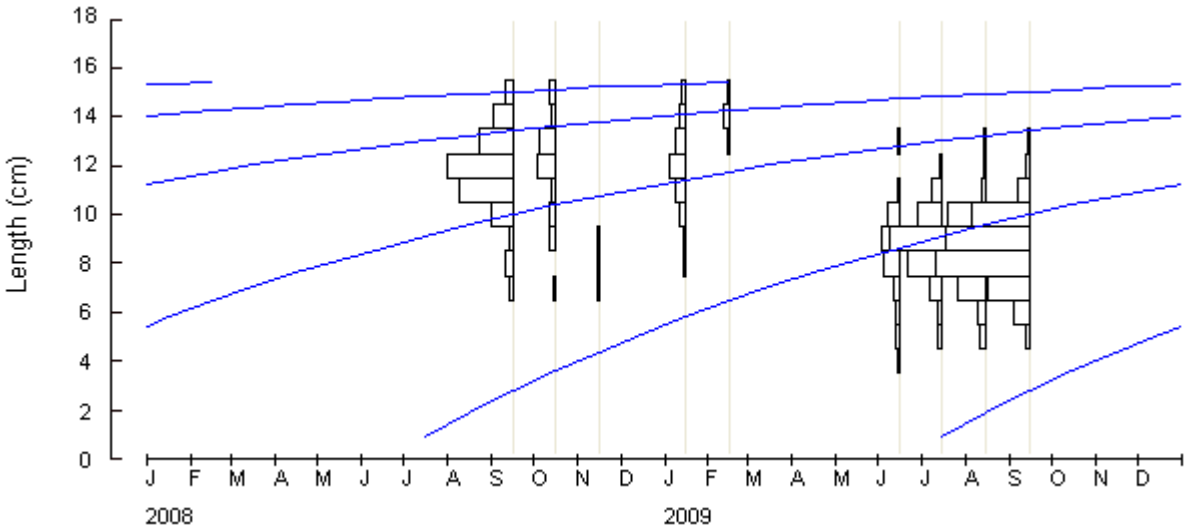


Figure 25d. Length frequency distribution of Meni (*Nandus nandus*) caught in Tedala Huglia Chatol Beel (L∝ 16.5, K = 0.75, SS = 9, SL = 10.0, Rn = 0.16 ).

<u>Parameters for *Salmostola phulo* (Ful chela):</u>

*Salmostola phulo*

Normally distributed length frequency (combined) and computed mean length of *Salmostoma phulo* in the Thapna Group Jalmahal is shown in figure 26a. The growth parameters, L∝ and K of the *S. phulo* were found to be 16.25 cm and 1.1 per year. Estimated growth performance index (ϕ') for *S. phulo* was found to be 2.463. The growth curves of those parameters are shown over its normal length distribution in figure 26b.

Parameters for *Xenentodon cancila* (Kakila):

*Xenentodon cancila*

Normally distributed length frequency (combined) and computed mean length of *Xenentodon cancila* in the Thapna Group Jalmahal are shown in figure 26c. The growth parameters, L∝ and K of the *Xenentodon cancila* were found to be 30.5 cm and 1.15 per year. Estimated growth performance index (ϕ') for *Xenentodon cancila* was found to be 3.029. The growth curves of those parameters are shown over its normal length distribution in figure 26d.

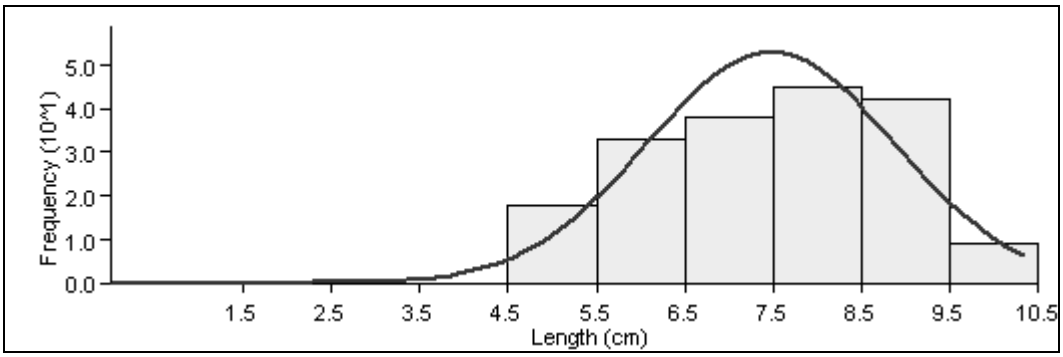


Figure 26a. Normally distributed length and computed mean length (7.47±1.391 cm) of Ful chela (*S. phulo*) caught in the Thapna Group Jalmahal.

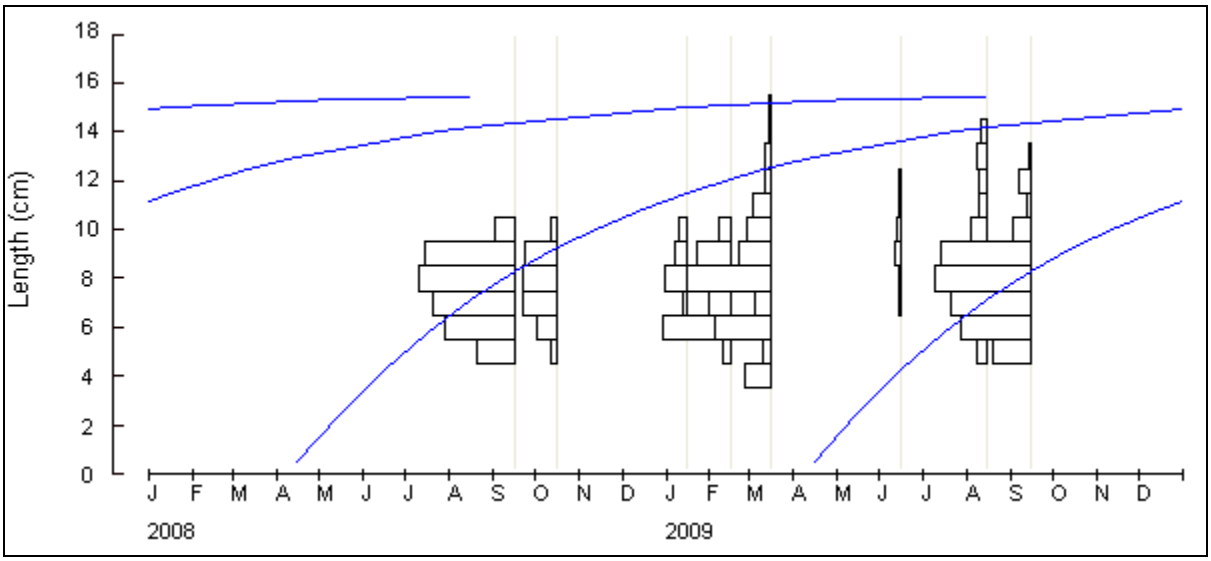


Figure 26b. Length frequency distribution and growth curve of Ful chela (*Salmostoma phulo*) caught in the Thapna Group Jalmahal(L∝ = 16.25, K=1.1, SS=8, SL=8, Rn=0.181).

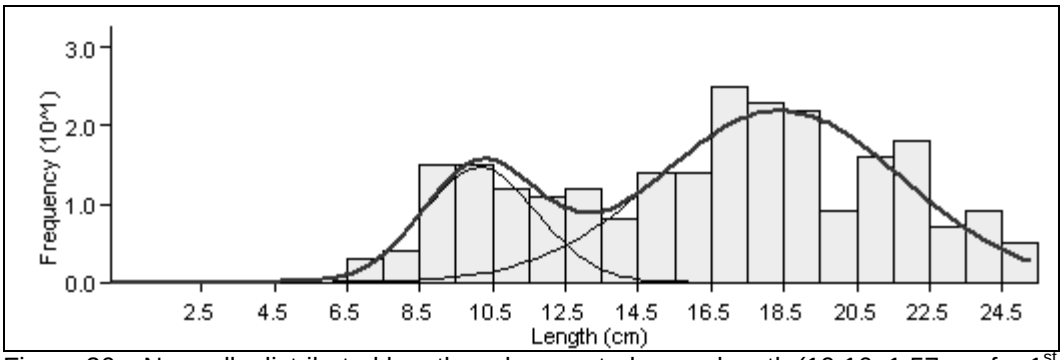


Figure 26c. Normally distributed length and computed mean length (10.16±1.57 cm for 1st and 18.39± 3.35 cm for 2nd) of Kaikla (*Xenentodon cancila*) caught in the Thapna Group Jalmahal.

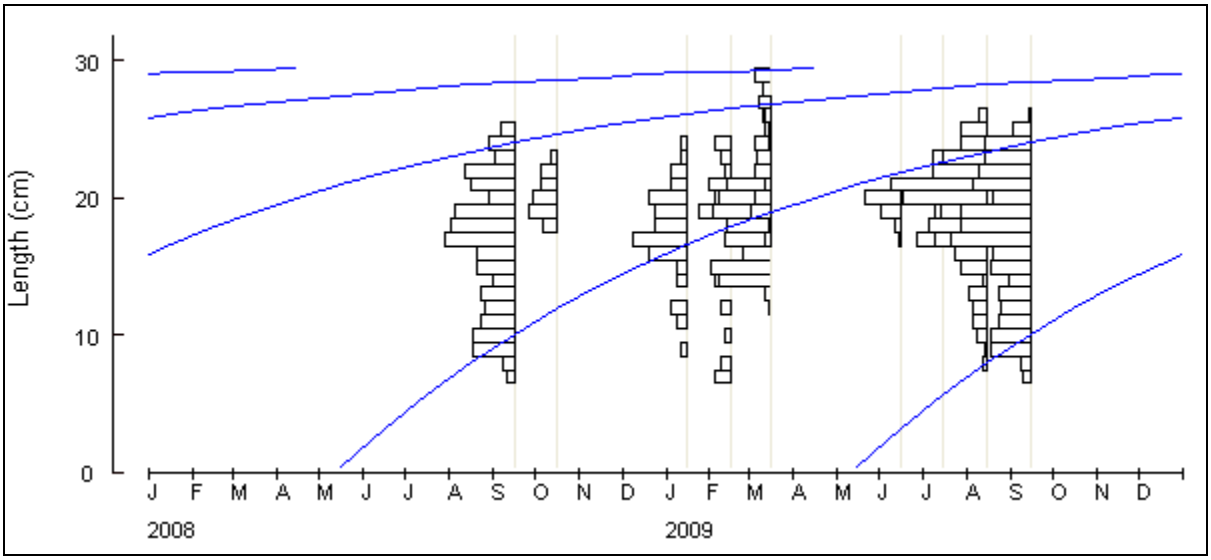


Figure 26d. Estimated growth curve of Kakila (Xenentodon cancila) caught in the Thapna Group Jalmahal(L∝ = 30.5, K=1.15, SS=9, SL=8, Rn=0.185).

Parameters for *Glossogobius giuris* (Baila):

Normally distributed length frequency (combined) and computed mean length of *Glossogobius giuris* in the Boro Medi are shown in figure 27a. The growth parameters, L∝ and K of the *Glossogobius giuris* were found to be 16.8 cm and 1.0 per year. Estimated growth performance index (ϕ') for *Glossogobius giuris* was found to be 2.451. The growth curves of those parameters are shown over its normal length distribution in figure 27b.

*Glossogobius giuris*

Parameters for *Channa punctatus* (Taki):

*Channa punctatus*

Normally distributed length frequency (combined) and computed mean length of *Channa punctatus* in the Boro Medi are shown in figure 27c. The growth parameters, L∝ (asymptotic length) and K (Growth co-efficient) of the *Channa punctatus* were found to be 26.25 cm and 1.1 per year. Estimated growth performance index (ϕ') for *Channa punctatus* was found to be 2.880. The growth curves of those parameters are shown over its normal length distribution in figure 27d.

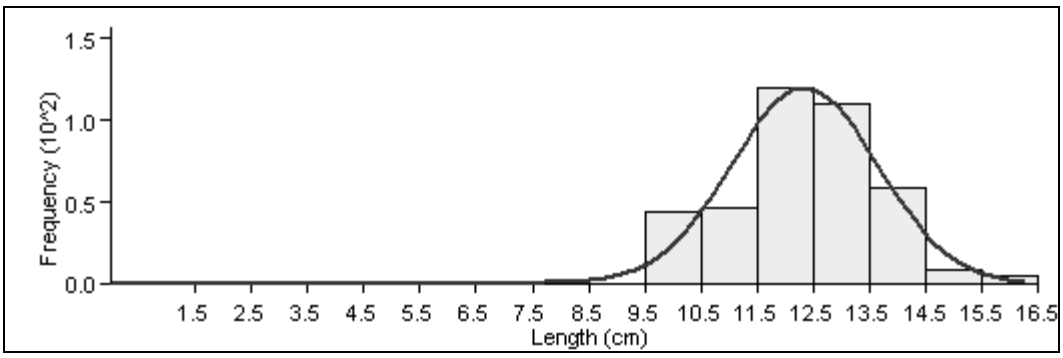


Figure 27a. Normally distributed length and computed mean length (12.34±1.29 cm) of Baila (*Glossogobius giuris*) caught in the Boro Medi beel.

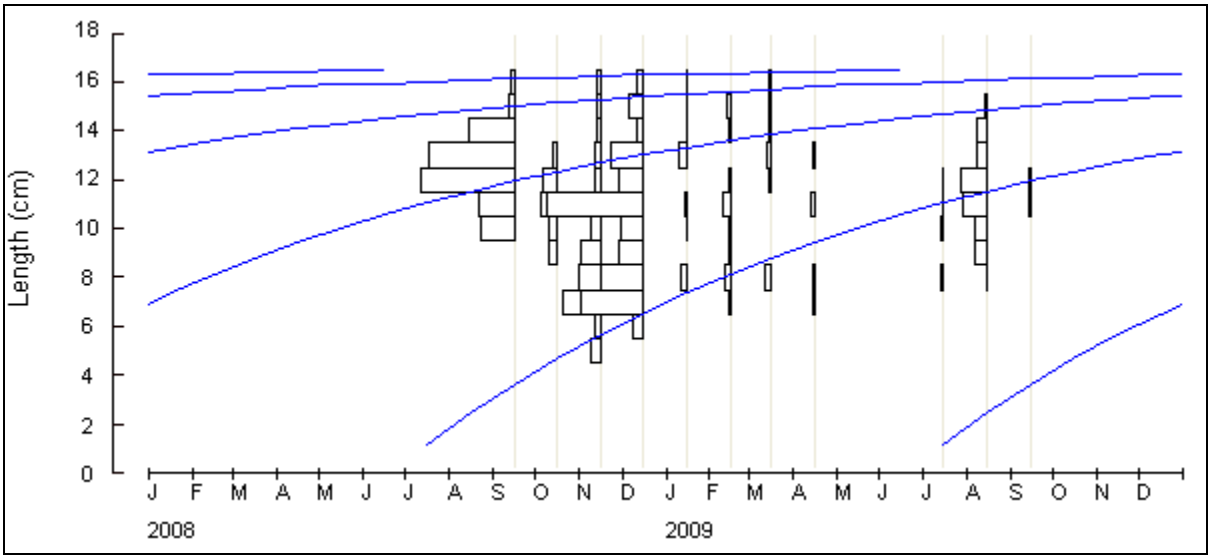


Figure 27b. Length frequency distribution and growth curve of Baila (*Glossogobius giuria*) caught in the Boro Medi beel (L∝=16.8 cm, K=1.0, SS=4, SL=6.5, Rn = 0.164).

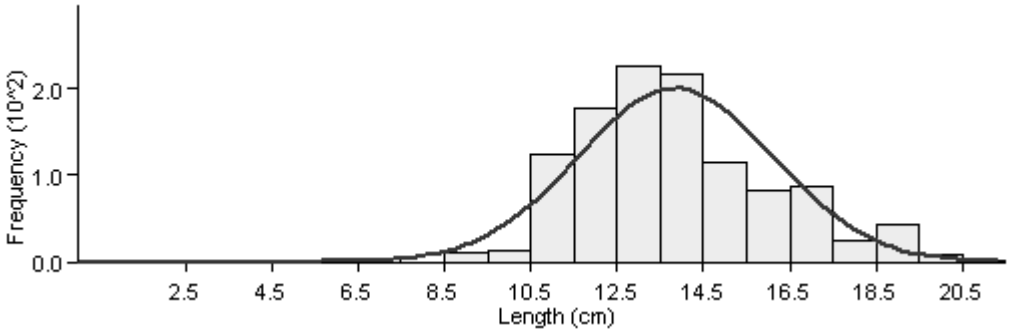


Figure 27c. Normally distributed length and computed mean length (13.85±2.26 cm) of Taki (*Channa punctatus*) caught in the Boro Medi beel.

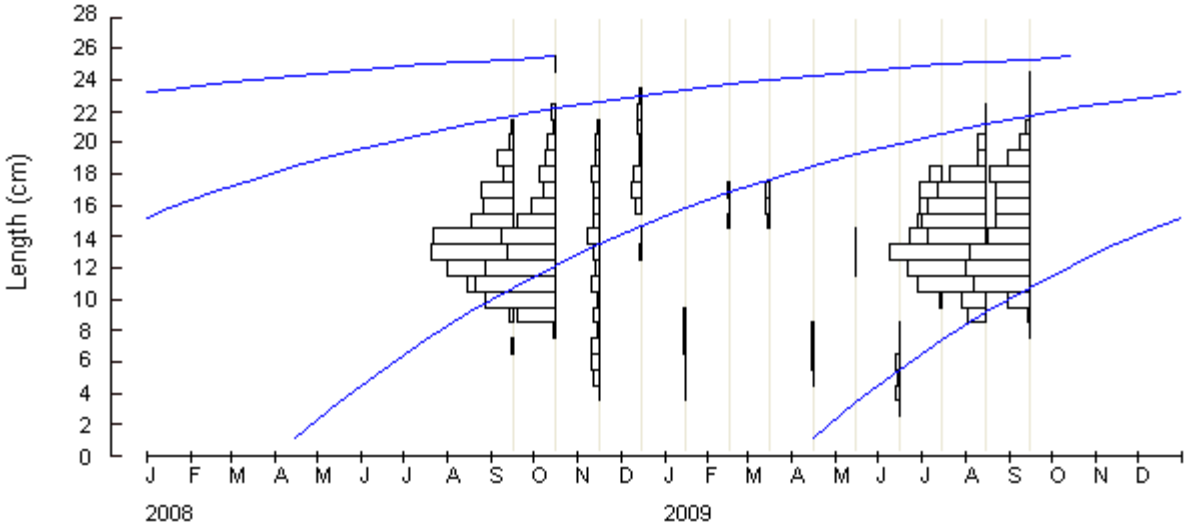


Figure 27d. Length frequency distribution and growth parameters of Taki (*Channa punctatus*) caught in Boro Medi beel (L∝ = 26.25 cm, K = 1.1, SS=12, SL=9.5, Rn=0.164).

The estimated growth parameters for the eight major species in Tedala, Abua nodi, Thapna Group Jalmahal and Medi beel are given in table 10. The estimates of growth performance index (ϕ') varied between 2.19 (*Puntius sophore*) and 3.029 (*Xenentodon cancila*).

Table 10. Growth parameters (L∝, K and Phi (ϕ') estimated for 8 key species in four SCBRMP sites.

| **Name of waterbodies** | **Species** | **L∝ (cm)** | **K** | **Phi (ϕ')** |
|---|---|---|---|---|
| Tedala Huglia Chatol | *Puntius sophore* | 13.6 | 0.85 | 2.196 |
| | *Nandus nandus* | 16.5 | 0.75 | 2.31 |
| Abua prokasito Nainda Nodi | *Gudusia chapra* | 13.65 | 1.13 | 2.323 |
| | *Chanda nama* | 12.6 | 1.2 | 2.28 |
| Thapna Group Jalmahal | *Salmostoma phulo* | 16.25 | 1.1 | 2.463 |
| | *Xenentodon cancila* | 30.5 | 1.15 | 3.029 |
| Boro Medi Beel | *Glossogobius giuris* | 16.8 | 1 | 2.451 |
| | *Channa punctatus* | 26.25 | 1.1 | 2.88 |

## 3.8. Water Quality Parameters Record Collection

Water quality parameters are also important for assigned waterbodies. The main object of the data collection is to calculate fluctuation of year around water temperature, water transparency, and water level (gauge reading). This data will reflect the waterbody environments for species acclimatization and its direct relation with the productivity of the waterbody. In order to measure the productivity, the Community Enumerators record fortnightly data on temperature, transparency and water depth (gauge reading). The following table 6 shows the Fluctuation status of water quality parameters of assigned waterbodies (January-December '09).

Table 11. Fluctuation status of water quality parameters in 30 assigned waterbodies.

| Sl. No | Name of Waterbidy | Water temperature (°C) | | Water transparency (cm) | | Water level (m) | |
|---|---|---|---|---|---|---|---|
| **Upazila: Sadar** | | **Maximum** | **Minimum** | **Maximum** | **Minimum** | **Maximum** | **Minimum** |
| | Chota *beel* | 32 | 19 | 90 | 35 | 3.35 | 0.90 |
| | Langolkata o jur *beel* | 32 | 20 | 145 | 35 | 5.2 | 0.60 |
| | Lalpurer jai & Gozariar dair | 32 | 20 | 145 | 35 | 3.65 | 0.90 |
| | Bairagimara *beel* | 31 | 22 | 75 | 40 | 3.97 | 0.92 |
| | Urail *Beel* | 30 | 21 | 72 | 35 | 2.48 | 0.80 |
| | Aislauni Prokasmaxto Mitar dubi | 32 | 20 | 90 | 35 | 3.75 | 0.90 |
| | Aung Gung | 31 | 21 | 120 | 35 | 3.50 | 0.40 |
| **Upazila: Sadar** | | | | | | | |
| | Baskar Khal | 31 | 20 | 140 | 40 | 3.20 | 0.70 |
| | Dewtan *Beel* | 31 | 20 | 140 | 35 | 2.90 | 0.50 |
| | Sonduikka group Jalmahal | 31 | 20 | 140 | 40 | 4.00 | 0.80 |
| | Minmba *beel* Gol *beel* | 31 | 20 | 180 | 70 | 5.00 | 1.00 |
| **Upazila: South Sunamganj** | | | | | | | |
| | Netai Gang | 32 | 20 | 145 | 40 | 4.60 | 0.82 |
| | Patchgacmaxa *Beel* | 31 | 19 | 145 | 40 | 5.40 | 0.60 |
| | Srinathpurer Dola | 31 | 20 | 140 | 35 | 3.70 | 0.50 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Kochua Gang | 32 | 20 | 70 | 35 | 4.10 | 1.20 |
| | Cmaxnamara *Beel* | 31 | 19 | 130 | 40 | 5.00 | 1.50 |
| | Terazani balir dubi | 31 | 20 | 50 | 130 | 3.78 | 0.50 |
| | Babonpai *Beel* | 31 | 19 | 100 | 35 | 4.60 | 0.40 |
| | Tedala Huglia Chatol | 31 | 19 | 130 | 40 | 5.00 | 0.75 |
| | Moin pur *Beel* group | 31 | 20 | 135 | 45 | 5.00 | 1.00 |
| | Chatol Udai Tara *Beel* | 31 | 20 | 140 | 50 | 6.20 | 1.00 |
| **Upazila: Derai** | | | | | | | |
| | Medi *Beel* | 31 | 20 | 140 | 50 | 4.50 | 0.80 |
| **Upazila: Biswambharpur** | | | | | | | |
| | Moni Kamarer Kuri | 32 | 21 | 170 | 50 | 4.00 | 0.80 |
| | Tiar *Beel* Minmba *Beel* Gool *Beel* | 31 | 20 | 165 | 60 | 4.50 | 1.00 |
| | Sudam khali River | 32 | 19 | 90 | 55 | 3.50 | 1.00 |
| | Ghotghatia Nodmax | 31 | 19 | 170 | 45 | 4.50 | 0.45 |
| | Abua Prokasmaxto Nainda Nodmax | 31 | 19 | 105 | 30 | 20.70 | 15.20 |
| **Upazila: Tahirpur** | | | | | | | |
| | Thapna Group Jalmahal | 32 | 20 | 150 | 80 | 8.4 | 1.00 |
| | Issbpurer Khal | 32 | 19 | 130 | 35 | 6.00 | 1.60 |
| | Choto Khal-Boro Khal | 31 | 19 | 120 | 55 | 6.00 | 1.50 |

* Water Temperature (°C): Max-32, Min-19 * Water Transparency (cm): Max-180, Min-30 * Water Level (m): Max-20.70, Min-0.40

## 4. Work Plan for 2010

| 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 | Baharul Alam | Chota *beel* |
| 8 | Md. Nasir Ahmed | Kaima beel Koiya beel |
| 9 | Animesh Chandra Dev | Noldegha Bandor Kona* |
| **Jamalganj** | | |
| 10 | Golam Sarjious | Gool *beel* Lomba *beel* |
| 11 | Md. Enamul Haque | Basker *Khal* |
| 12 | Md. Shahid Mia | Dewtan *Beel* |
| 13 | Md. Sahjahan Alam | Sonduikka group Jolmohal |
| 14 | Md.Habibur Rahman | Basker Beel o Jolsuker Beel |
| 15 | Md. Badsah Miah | Dhola Pakna Jolmohal |
| 16 | Sobnom Akter | Kaldohor* |
| **South Sunamganj** | | |
| 17 | Md. Ataur Rahman | Netai Goan |
| 18 | Shuvash Ranjan Das | Patchgachia *Beel* |
| 19 | Gopal Chandra Das | Moin pur *Beel* group |
| 20 | Abdur Rashid | Srinathpurer Dola |
| 21 | Md. Monwar Hussain | Kochua Goan |
| 22 | Samor Chakraborti | Chinamara *Beel* |
| 23 | Md. Numan Miah | Terazani balir dubi |
| 24 | Md. Iqbal Hossen | Babonpai *Beel* |
| 25 | Md. Ramjan Ali | Tedala Hugliya Chatol |
| 26 | Shoiful Alom | Tedala Hugliya Chatol |
| 27 | Md Johur Islam | Chatol Udai Tara *Beel* |
| 28 | Suvash Ranjan Das | 84/8, Surma Nodi* |
| **Derai** | | |
| 29 | Rantu Ranjan Das | Medi *Beel* |
| 30 | Md. Humayun Kabir | Medi *Beel* |
| 31 | Rajat Kanti Talukdar | Juripanjuri |
| 32 | Md.Sazzad Hossain | Najar Dighi |
| 33 | Nazir Hossain | Medha Prokashito Kachma beel |
| 34 | Shefa Akter | Goza beel |

| | | |
|---|---|---|
| **Biswambharpur** | | |
| 35 | Mst. Roksana Akter | Moni Kamarer Kuri |
| 36 | Mst. Kamrunahar | Tiar *Beel* Lomba *Beel* Gool *Beel* |
| 37 | Mst. Mashoda Khatun | Sudam khali River |
| 38 | Subal Chandra Barman | Ghotghatia Nodhi |
| 39 | Sunil Barman | Abua Prokashito Nainda Nodhi |
| 40 | Pradip Chandra Talukder | Abua Prokashito Nainda Nodhi |
| 41 | Suranjan Sarkar | Tinbila Beel |
| 42 | Subal Chandra Bormon | Pondua beel* |
| **Tahirpur** | | |
| 43 | Chhoyful Alam. | Thapna Group Jolmohal |
| 44 | Nayan Manik Talukdar | Thapna Group Jolmohal |
| 45 | Rafiq Ahmed | Issbpurer *Khal* |
| 46 | Ali Akbar | Choto *Khal*-Boro *Khal* |
| 47 | Md. Golam Kibria | Matian Hour Jolmohal |
| 48 | Mukter Hossain | Digha Kochma beel |
| 49 | Shihab Uddin | Horuar beel o lomba beel |

*control waterbody

**Appendix 2.** List of catch monitoring sites by habitat types and assigned Research Assistant in 2010

| **Upazila: Sunamganj Sadar** | | | | |
|---|---|---|---|---|
| **Sl. No.** | **Name of *beel*** | **BUG Member** | **Water body types** | **Assigned WorldFish Research Assistant** |
| 1 | Chota *beel* | 30 | SB | Md. Mahedi Hasan |
| 2 | Lalpurer jai & Gozariar dair | 15 | SB | |
| 3 | Bairagimara *beel* | 51 | LB | |
| 4 | Urail *Beel* | 19 | SB | |
| 5 | Aislauni Prokashito Mitar dubi *Beel* | 24 | SB | |
| 6 | Kaima *beel* Koiya *beel* | 32 | LB | |
| 7 | Aung Gung | 30 | SB | Md. Kamrul Islam |
| 8 | Noldegha Bandor Kona* | - | SB | |
| 9 | Langolkata o jur *beel* | 29 | SB | Md. Mizanur Rahman |
| **Upazila: Jamalganj** | | | | |
| 10 | Basker *Khal* | 30 | K | Md. Kamrul Islam |
| 11 | Dewtan *Beel* | 30 | SB | |
| 12 | Sonduikka group Jolmohal | 19 | SB | |
| 13 | Basker *Beel* o Jolsuker *Beel* | 43 | LB | |
| 14 | Lomba *Beel* gol *Beel* | 30 | SB | |
| 15 | Dhola Pakna Jolmohal | 40 | LB | |
| 16 | Kaldohor* | - | SB | |

| | | | | |
|---|---|---|---|---|
| **Upazila: South Sunamganj** | | | | |
| 17 | Netai Goan | 23 | SB | Md. Mizanur Rahman |
| 18 | Patchgachia *Beel* | 27 | SB | |
| 19 | Srinathpurer Dola | 37 | SB | |
| 20 | 84/8, Surma Nodi* | - | R | |
| 21 | Kochua Goan | 28 | SB | Md. Mehedi Hasan |
| 22 | Chinamara *Beel* | 28 | SB | |
| 23 | Terazani balir dubi | 26 | SB | |
| 24 | Babonpai *Beel* | 36 | LB | |
| 25 | Tedala Hugliya Chatol | 48 | LB | |
| 26 | Moinpur *Beel* group | 25 | SB | Md. Kamrul Islam |
| 27 | Chatol Udai Tara *Beel* | 60 | LB | |
| **Upazila: Derai** | | | | |
| 28 | Medi *Beel* | 117 | LB | Md. Kamrul Islam |
| 29 | Juripanjuri | 42 | LB | Md. Mizanur Rahman |
| 30 | Najar Dighi | 27 | LB | |
| 31 | Medha Prokashito Kachma *Beel* | 116 | LB | |
| 32 | Goza *Beel* | 23 | SB | |
| **Upazila: Biswambharpur** | | | | |
| 33 | Moni Kamarer Kuri | 30 | P | Balaram Mahalder |
| 34 | Tiar *Beel* Lomba *Beel* Gool *Beel* | 27 | SB | |
| 35 | Sudam khali River | 18 | R | |
| 36 | Ghotghatia *Nodhi* | 21 | R | |
| 37 | Pondua *Beel** | - | SB | |
| 38 | Abua Prokashito Nainda Nodhi | 80 | R | Md. Mizanur Rahman |
| 39 | Tinbila *Beel* | 38 | SB | |
| **Upazila: Tahirpur** | | | | |
| 40 | Thapna Group Jalmahal | 50 | LB | Balaram Mahalder |
| 41 | Issbpurer *Khal* | 41 | K | |
| 42 | Choto *Khal*-Boro *Khal* | 28 | K | |
| 43 | Matian Hour Jolmohal | 231 | LB | |
| 44 | Digha Kochma *Beel* | 27 | SB | |
| 45 | Horuar *Beel* o Lomba *Beel* | - | LB | |

Note: SB - Small *Beel*; LB-Large *Beel*; R- River; K -*Khal*; P- Pond,
*Control site