**International Journal of Excellence Innovation and Development**
||Volume 2, Issue 1, Jan. 2019||Page No. 041-055||

# Impact of Stocking Common Carp (*Cyprinus Carpio*) on Production in Some Selected Beels in Gazipur District, Bangladesh

Arafat Hossain Apon[1,2], Amir Hossain[2,3], Saiful Islam[1], Hafzur Rahman[1,2], Abdulla-Al-Asif[4,5], Jabed Ali Mirza[1], Md Masum Billah[6]

[1]Department of Fisheries Management, Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh, 2202, Bangladesh
[2]Department of Fisheries and Marine Science, Noakhali Science and Technology University, Noakhali-3814, Bangladesh
[3]Department of Fisheries Biology & Genetics, Bangladesh Agricultural University, Mymensingh, 2202, Bangladesh
[4]Department of Aquaculture, Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh, 2202, Bangladesh
[5]Department of Fisheries and Marine Bioscience, Jashore University of Science and Technology, Jashore-7408, Bangladesh
[6]Department of Land Management, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM, Serdang, Malaysia

***Abstract*—**The present study was conducted in three seasonal beels in Gacha union under Gazipur sadar upazila in Gazipur district during the period from June 2015 to January 2016. The objectives of the study were to evaluate the impact of stocking common carp on the abundance and biodiversity of native fish species in seasonal beels. Three seasonal beels such as Baroholai, Makhna and Buridha which were connected with Turag River through different canals were selected to implement the study. Baroholai and Makhna beel were stocked with common carp fingerlings at 2500 per hectare. Buridha beel served as control. Necessary data were collected from the fishermen and lease holders of the concern beel through using structured questionnaire by survey method. A total of 42-43 species of fishes were recorded from stocked beel as against of 43 species in control beel. Shanon- Weiner diversity index averaged 2.58 in stocked beel as opposed to 2.68 for control beel. The studied beel had medium richness in terms of biodiversity and faunal abundances. Per hectare fish production was 522-577kg in stocked beels as compared to 365kg in control beel. Cyprinidae was the most abundant group contributing to the bulk of fishery yield. Surface feeder took a lead over other groups of fishes in stocked beel as opposed to bottom feeder in case of control beel. Bottom dwelling small catfishes seems to be affected in presence of common carp in the stocked beels. Control beel harboured increased number and quantity of catfishes. Fish productions in the seasonal beels were profitable. Per hectare total cost of fish production averaged tk 34976.67 as against of total gross return of tk 92683.67. Benefit cost ratio (BCR) was found to be 2.57-3.42 in stocked beel and 2.01 in control beel. Further researches are needed to precisely determine the possible consequences of stocking common carp in seasonal beels.

***Keywords*—***Taxonomy, diversity, abundance, fish species assemblage, cost-benefit analysis*

## INTRODUCTION

Bangladesh is uniquely rich in water bodies. It is endowed by the three major river systems namely the Ganges-Padma, the Meghna and the Jamuna-Brahmaputra. A large number river with innumerable tributaries and distributaries are criss-cross the country. Their combined flow is nearly 6 million cusecs, all of which drain into the Bay of Bengal. Three types of water resources are available in Bangladesh such as, freshwater, brackish water and marine water. There are two types of inland water bodies such as open water bodies and closed water bodies. The country contains 4700795 ha of inland water area, of which 3906343 ha comprises the open water and the rest 794361 ha occupy the closed water (DoF, 2016). The fisheries sector contributes about 3.69% of the country's GDP in 2014-15 and 23.12% to the agricultural income. About 1.92% of total export earnings (DoF, 2016) were derived from exporting fish and fishery products. Beels are saucer like deeper portion in floodplain which may retain water throughout the year (permanent *beels*) or dry up during winter (seasonal *beels*). Beels are well known for their rich biological diversity including fish fauna. Fisheries remain as an important activity in such water bodies, since time immemorial, but such waters have still larger spectrum of utilities such as (I) recharge of ground water, (II) accumulation of flood waters, (III) shore-line stabilization, (IV) trapping of toxic substances, (V) trapping of nutrients, (VI) repository of biodiversity as abode for large variety of plant and animal species, (VII) sources- for entertainments, (VIII) protection and development of aquatic food chains, (IX) breeding, grazing and nursery grounds for riverine fish stock, and (X) regulator of local climate and so on (Jha, 1989; Islam *et al.*, 2017). The beels are considered as biologically sensitive habitats as they play a vital role in the recruitment of fish population in the riverine ecosystems and provide nursery grounds for commercially important fishes (Devnath *et al.*, 2004). But due to the progressive decline in protein intake, we arrived at a situation of protein deficiency. Common carp (*Cyprinus carpio*) has been brought to Bangladesh from Nepal in 1979 for culture purpose. The common carp originated from temperate climatic region with preference to warm temperatures. It naturally inhabits lakes, ponds or slow moving waters, preferably with a muddy bottom. It has high tolerance to wider range of temperature between 0°c and 41°c. The Common carp is omnivorous and can feed on a variety of food materials with preference to feed from the bottom (Horvath, 1992;

  

Yeasmin *et al.*, 2016; Islam *et al.*, 2016; Yeasmin *et al.*, 2018; Hossain *et al.*, 2016). Continued decline in fish production from capture fishery is an alarming situation for the country. Now the open water fisheries resources of the country are being treated as highly endangered. Out of 266 reported freshwater fin fishes in Bangladesh (Rahman, 2000), 54 species are already threatened to varying level of threat. Among the threatened fish species, 12 are critically endangered, 28 endangered and 14 are vulnerable (IUCN, 2000). The present research work has been undertaken to determine the yield performance of Common carp in this selected beels; to determine the effect of Common carp on Biodiversity of native species in the beels; and to assess the economic contribution of Common carp stocked in the beels.

# METHODOLOGY

**Study period**

The present study was conducted during the period from May 2015 to January 2016. But data was collected from October to January in the studied beels.

**Study area**

The present study was conducted in three beels in Gacha union under Gazipur upazila in Gazipur district. Barohalai with coordinate, 23°56'08.5"N 90°21'57.8"E; Makhna with coordinate 23°56'30.7"N 90°21'56.8"E and Buridha with coordinate 23°56'15.9"N 90°22'11.6"E.

**Sampling procedure**

Data were collected twice in a month in order to determination of catch composition, amount of fish harvested and species assemblage in three beels.

**Grouping of indigenous species**

Indigenous fish species recorded during the period of investigation were arranged according to arbitrarily family guild, niche based tropho-tropic guild and tropho-spatial guild for the sake of result interpretation (Table 1).

***Family based fish guilds***

***Table 1:*** *Outlines of family based common fish guild in the studied beels.*

| Group | Including family |
|---|---|
| Carps | Cyprinidae |
| Barbs | Cyprinidae, Cypriodontidae |
| Minnows | Cyprinidae, Aplochelidae, Cyprinodontidae |
| Catfishes | Clariidae, Siluridae, Heteropneustidae, Chacidae, Schilbeidae, Bagridae, Sisoridae, Pangasiidae |
| Perches | Anabantidae, Nandidae, Pristolepitidae, Ambassidae, Cichlidae |
| Minnows | Cyprinodotidae, Cyprinidae |
| Eels | Mastacembelidae, Anguillidae, Synbranchidae |
| Prawns | Palaemonidae |
| Gars | Belonidae, Hemirhamphidae |
| Gobies | Gobiidae |
| Gouramies | Belontiidae |
| Loaches | Cobitidae |
| Featherbacks | Notopteridae |
| Snakeheads | Channidae |

***Niche-based tropho-trophic fish guilds***

Niche-based tropho-trophic fish were grouped as, Planktivore, Detritivore, Omnivores, Predators, Larvivore, and Ovolarvivores.

***Niche based tropho-spatial fish guilds***

Niche based tropho-spatial fish guilds were grouped as, Surface feeder, column feeder and Bottom feeder.

**Species assemblage impact assessment**

***Estimation of Shanon-Weiner Diversity Index***

The Shannon's diversity index (H′) was used to measure the extent of diversity by combining aspects of species richness (S) and evenness (E). The formula for Shannon diversity index is:

$$H' = - \Sigma p_i \, Ln \, P_i$$

$P_i$ = proportional abundance of the *I* th species = ni /N
$n_i$ = number of individual recorded in *I* th species
N = total no. of individuals in the sample
Ln = natural log.
Species evenness (E) = $H/H_{max}$ Hmax = Log(S)
S = Species richness

Inferences can be drawn on the basis of the H′ values calculated. The lesser values will be the lower diversity and vice-versa.

***Fish catch estimation***

Total catch of fish during sampling was calculated as follows:

Total catch for a specific type of gear = N × f × CPUE
N = No. of fishing days per year
f = Mean number of individual fishing unit per day
CPUE = Mean catch per unit effort
Total catch for gears = Sum of catch by different gears
Total catch from the ditches = average catch from a ditch × total no. of ditch.
Total catch = total catch from all gears + total catch from all ditches.

**Data analysis**

The data were scrutinized and checked for possible inconsistencies. After thorough verification, the data were compiled in tabular form and entered into MS Excel sheet for performing necessary analysis. Statistical functions such as, range, mean, standard deviation and percentage were used to explain the data. Student's t-test at 5% level of significance was employed to compare the treatment (common carp stocking) means with that of the control.

# RESULTS

**Taxonomic account of the fishes**

During the period of investigation 43 indigenous fish species including 2 species of prawns and one exotic species of Common carp (*Cyprinus carpio*) were recorded from Baroholai, which were in Makhna beel and 42 in Buridha beel. These species were distributed over 8 orders, 18 families, 31 genera and 43 species. Among the 17 families Cyprinidae, Clupidae, Siluridae, Mastacembelidae, Gobiidae, Ambassidae & Palaemonidae were the predominating forms having

  

represented by 10 species, 2 species, 2 species, 2 species, 1 species, 2 species and 2 species, respectively (Table 2).

**Species assemblage**

Presence of a good number of species in the stocked and control beel is indicative of the relative richness of selected beels in term of fish biodiversity. Species occurrences with arbitrary Impact Index in the stocked and non-stocked beels are presented in Table 3. Species occurrence (S) and Species index (SI) and Shanon diversity index (H) in different beels are shown in Table 4.

**Species diversity by total number and unit abundance**

Mean annual species diversity by total number of individual and unit abundances are shown in Table 6. Species diversity suffered a loss 3% in Baroholai beel. The mean value of Shanon diversity indiex was found to be 2.687 in control beel and 2.582 in the stocked beels. Individual value of Shanon index was 2.579 in Baroholai beel and 2.584 in Makhna beel. There was no significant difference ($p>0.05$) in the value of Shanon dversity index between the stocked and control beel (Table 5).

***Table 2:*** *List of fish species including prawns "Recorded from the studied beels".*

| **Order** | **Family** | **Genus** | **Species** |
|---|---|---|---|
| 1. Cypriniformes | 1. Cyprinidae | *1 Catla* | *1 C. catla* |
| | | *2. Labeo* | *1 L. rohita 2. L. bata 3. L. calbasu.* |
| | | *3. Cirrhinus* | *1. C. cirrhosus 2. C.reba* |
| | | *4. Cyprinus* | *1.C. carpio* |
| | | *5. Puntius* | *1. P. sarana 2. P. chola 3. P. ticto 4. P. sophore* |
| | | *6.Amblypharyngodon* | *1 A. mola* |
| | 2.Clupeidae | *7. Aspidopariar* | *1 A. jaya* |
| | | *8 Esomus* | *1 E. danricus* |
| | | *9. Botia* | *1 B. dario* |
| | | *10. Gadusia. 11. Corica* | *1. G. chapra 2. C. soborna* |
| | 3. Aplocheilidae | *12. Aplocheilus* | *1 A. panchax* |
| 2. Perciformes | 1. Ambassidae | *1. Chanda* | *1 C. nama* |
| | | *2. Pseudambassis* | *1. P. ranga* |
| | 2. Anabantidae | *1. Anabas* | *1. A. testudineus* |
| | 3. Mastacembelidae | *1. Mastacembelus* | *1. M. pancalus* |
| | | *2. Macrognathus* | *1. M. aculeatus* |
| | 4. Nandidae | *1. Nandus* | *1. N. nandus* |
| | 5. Ospronemidae | *1. Colisa* | *1. C. fasciata 2. C. lalia* |
| | 6. Gobidae | *1. Glossogobius* | *1. G. giuris* |
| 3. Siluriformes | 1. Clariidae | *1. Clarias* | *1. C. batrachus* |
| | 2. Bagridae | *1. Sperata* | *1. S. aor* |
| | | *2. Mystus* | *1. M. tengara 2. M. vittatus 3. M. cavasius* |
| | 3. Heteropneustidae | *1. Heteropneustes* | *1 H. fossilis* |
| | 4. Schilbeidae | *1. Clupisoma* | *1. C. garua* |
| | | *2. Ailia* | *1.A. coila* |
| | 5. Siluridae | *1. Wallago* | *1.W. attu* |
| | | *2. Ompok* | *1.O. pabda* |
| 4. Beloniformes | 1. Belonidae | *1. Xenetodon* | *1.X. cancila* |
| 5. Channiformes | 1. Channidae | *1. Channa* | *1.C. punctatus 2.C. striatus* |
| 6. Clupeiformes | 2. Engraulidae | *1. Gudusia* | *1.G. chapra* |
| 7. Osteoglossiformes | 1. Notopteridae | *1. Notopterus* | *1.N. notopterus* |
| 8. Decapoda | 1. Palaemonidae | *1. Macrobrachium* | *1. M. rogenbarggi 2. M. malcom* |

***Table 3:*** *Species occurrence and impact index in the studied beels.*

| **SPC** | **Fish species** | **Stocked Beel** | | **Control Beel** | **Impact Index** |
|---|---|---|---|---|---|
| | | **Baroholai** | **Makhna** | **Buridha** | |
| *1* | *Catla catla* | + | + | + | No impact |
| *2* | *Labeo rohita* | + | + | + | No impact |
| *3* | *Labeo calbasu* | - | - | + | **Negative** |
| *4* | *Labeo bata* | + | + | + | No impact |
| *5* | *Cirrhinus cirrhosus* | + | + | + | No impact |

  

| SPC | Fish species | Stocked Beel | | Control Beel | Impact Index |
|---|---|---|---|---|---|
| | | Baroholai | Makhna | Buridha | |
| *6* | *Cyprinus carpio* | + | + | **0** | **Stocked** |
| *7* | *Puntius chola* | + | + | + | No impact |
| *8* | *Puntius sophore* | + | + | + | No impact |
| *9* | *Puntious ticto* | + | + | + | No impact |
| *10* | *Puntious sorona* | + | + | + | No impact |
| *11* | *Amblypharyn mola* | + | + | + | No impact |
| *12* | *Aspidopariar jaya* | + | + | + | No impact |
| *13* | *Esomus danricus* | + | + | + | No impact |
| *14* | *Aplocheilus panchax* | + | + | + | No impact |
| *15* | *Botia Dario* | + | + | + | No impact |
| *16* | *Wallago attu* | + | + | + | No impact |
| *17* | *Sperata aor* | + | **(-)** | + | Ambiguous |
| *18* | *Mystus vittatus* | + | + | + | No impact |
| *19* | *Mystus cavasius* | + | + | + | No impact |
| *20* | *Mystus tengara* | + | + | + | No impact |
| *21* | *Clarius batrachus* | + | + | + | No impact |
| *22* | *H. fossilis* | + | + | + | No impact |
| *23* | *Ailia coila* | + | + | + | No impact |
| *24* | *Clupisoma garua* | **(-)** | **(-)** | + | **(Negative)** |
| *25* | *Ompok pabda* | **(-)** | **(-)** | + | (Negative) |
| *26* | *Corica soborna* | + | + | + | No impact |
| *27* | *Gudusia chapra* | + | + | + | No impact |
| *28* | *Chanda nama* | + | + | + | No impact |
| *29* | *Pseudambassis ranga* | + | + | + | No impact |
| *30* | *A.testudineus* | + | + | + | No impact |
| *31* | *Nandus nandus* | + | + | + | No impact |
| *32* | *M. rosenbergii* | + | + | + | No impact |
| *33* | *M. malcomsoni* | + | + | + | No impact |
| *34* | *M. aculeatus* | + | + | + | No impact |
| *35* | *M. pancalus* | + | + | + | No impact |
| *36* | *Xenentodon cancila* | + | + | + | No impact |
| *37* | *Colisa fasciatus* | + | + | + | No impact |
| *38* | *Colisa chunu* | + | + | + | No impact |
| *39* | *Glosssogobius giuris* | + | + | + | No impact |
| *40* | *L. guntea* | **(-)** | + | + | Ambigous |
| *41* | *Chana punctatus* | + | + | + | No impact |
| *42* | *Chana striatus* | + | + | + | No impact |
| *43* | *N. notopterus* | + | + | + | No impact |

** += positive impact, 0 = No impact, (-) = negative impact, ± = Ambigous

***Table 4:*** *Species occurrence, Species index and Shanon diversity index of indigenous fish in the studied beels.*

| Parameters | Baroholai Beel | Makhna | Average | Buridha Beel |
|---|---|---|---|---|
| Total area(ha) | 12 | 7 | 9.5 | 5 |
| Species occurrence (S) | 42 | 40 | 41 | 44 |
| Species index(SI) | 0.95 | 0.90 | 0.92 | 1.0 |
| Shanon Index (H) | 2.579 | 2.584 | 2.582 | 2.685 |

***Table 5:*** *Mean Yield (kg/ha) and unit abundance (No. ha$^{-1}$) in the studied beels*

| SL no. | Species | Baroholai | | Makhna | | Buridha | |
|---|---|---|---|---|---|---|---|
| | | Yield (kg/ha) | No/ha | Yield (kg/ha) | No/ha | Yield (kg/ha) | No/ha |
| 1 | *Catla catla* | 17.668 | 25 | 27.737 | 35 | 13.149 | 18 |
| 2 | *L. rohita* | 9.368 | 22 | 14.412 | 30 | 8.012 | 16 |
| 3 | *C. cirrhosa* | 2.615 | 7 | 2.937 | 5 | 4.001 | 10 |
| 4 | *C. carpio* | 60.834 | 55 | 84.223 | 73 | 0 | 0 |
| 5 | *P. chola* | 72.626 | 6545 | 61.413 | 5672 | 27.299 | 2145 |
| 6 | *P. sophore* | 63.459 | 4532 | 79.364 | 6572 | 21.738 | 1987 |

  

| SL no. | Species | Baroholai | | Makhna | | Buridha | |
|---|---|---|---|---|---|---|---|
| | | Yield (kg/ha) | No/ha | Yield (kg/ha) | No/ha | Yield (kg/ha) | No/ha |
| 7 | *P. ticto* | 11.272 | 1172 | 12.120 | 1376 | 10.162 | 1187 |
| 8 | *P. stigma* | 2.247 | 214 | 3.614 | 286 | 4.534 | 328 |
| 9 | *A. mola* | 4.263 | 457 | 5.419 | 507 | 1.799 | 189 |
| 10 | *E. danricus* | 1.295 | 1124 | 1.725 | 1438 | 0.439 | 851 |
| 11 | *O. cotio* | 1.844 | 876 | 2.314 | 1085 | 0.707 | 729 |
| 12 | *A. panchax* | 1.429 | 977 | 1.106 | 780 | 0.020 | 82 |
| 13 | *B. Dario* | 0.012 | 3 | 0.005 | 1 | 0.032 | 8 |
| 14 | *Wallago attu* | 47.445 | 51 | 38.915 | 48 | 42.204 | 58 |
| 15 | *Sperata aor* | 11.540 | 16 | 0 | 0 | 0.722 | 9 |
| 16 | *M. vittatus* | 4.061 | 547 | 3.563 | 483 | 4.748 | 510 |
| 17 | *M. cavius* | 12.172 | 876 | 10.042 | 763 | 15.109 | 1063 |
| 18 | *M. tengra* | 1.524 | 1134 | 1.721 | 1092 | 4.009 | 2907 |
| 19 | *C. batrachus* | 0.184 | 2 | 0.289 | 2 | 0.188 | 2 |
| 20 | *H. fossilis* | 3.381 | 76 | 2.350 | 64 | 10.135 | 357 |
| 21 | *Ailia coilia* | 0.679 | 86 | 1.891 | 93 | 0.387 | 62 |
| 22 | *P. anthero* | 1.050 | 107 | 0 | 0 | 1.982 | 205 |
| 23 | *C. garua* | 2.534 | 45 | 2.313 | 53 | 2.956 | 72 |
| 24 | *O. pabda* | 0.183 | 5 | 0 | 0 | 0.885 | 8 |
| 26 | *Corica soborna* | 2.407 | 6745 | 4.041 | 1276 | 0.920 | 2078 |
| 27 | *G. chapra* | 81.657 | 6877 | 92.041 | 7524 | 24.791 | 1982 |
| 28 | *Chanda nama* | 12.689 | 5437 | 11.702 | 4792 | 4.072 | 1792 |
| 29 | *P. ranga* | 4.964 | 1098 | 4.799 | 1201 | 2.351 | 7291 |
| 30 | *A. testudineus* | 8.654 | 154 | 5.435 | 128 | 15.064 | 327 |
| 31 | *N. nandus* | 0.722 | 12 | 1.114 | 16 | 1.567 | 24 |
| 32 | *M. rosenbarggi* | 0.139 | 5 | 0.165 | 8 | 0.707 | 17 |
| 33 | *M. Malcom* | 0.108 | 7 | 0.110 | 12 | 0.150 | 15 |
| 34 | *M. aceulatus* | 9.896 | 132 | 13.091 | 169 | 17.792 | 301 |
| 35 | *M. pancalus* | 11.341 | 327 | 7.831 | 218 | 25.499 | 783 |
| 36 | *X. cancila* | 2.644 | 143 | 1.730 | 108 | 0.843 | 67 |
| 37 | *C. fasciata* | 0.529 | 64 | 0.519 | 54 | 0.634 | 82 |
| 38 | *C. chunu* | 1.340 | 1232 | 1.76 | 1403 | 2.311 | 1628 |
| 39 | *G.giuris* | 37.11 | 2976 | 52.15 | 4398 | 66.7493 | 6434 |
| 40 | *C.punctatus* | 13.34 | 279 | 22.458 | 563 | 26.738 | 479 |
| 41 | *C. striatus* | 0.492 | 2 | 0 | 0 | 0.787 | 3 |
| 42 | *N. notopterus* | 0.581 | 3 | 1.851 | 7 | 2.178 | 9 |
| Total | | 5T22.323 | | 577.013 | | 364.096 | |

**Species assemblage and fish yield in common groups**

Mean contribution of common groups to the total fish yields in the studied beels were shown in table 6.

***Table 6:*** *Mean contribution of common groups to the total fish yields in the studied beels.*

| Common Groups | Baroholai Beel | | Makhna | | Buridha | |
|---|---|---|---|---|---|---|
| | Yield (Kg/ha) | %Yield | Yield (Kg/ha) | %Yield | Yield (Kg/ha) | %Yield |
| Barb | 149.60 | 31.10 | 156.51 | 30.68 | 63.73 | 21.50 |
| Carp | 90.48 | 18.81 | 129.30 | 25.35 | 25.16 | 8.48 |
| Catfish | 84.75 | 17.62 | 61.56 | 12.07 | 81.34 | 27.44 |
| Clupeid | 84.0 | 17.47 | 96.08 | 18.83 | 25.71 | 8.67 |
| Perch | 27.03 | 5.62 | 11.34 | 2.22 | 23.05 | 7.77 |
| Minnow | 4.56 | 0.94 | 5.14 | 1.00 | 1.16 | 0.39 |
| Eels | 21.23 | 4.41 | 20.9 | 4.10 | 43.29 | 14.60 |
| Snakehead | 13.83 | 2.87 | 23.22 | 4.55 | 27.52 | 9.28 |
| Prawn | 0.24 | 0.051 | 0.27 | 0.05 | 0.85 | 0.28 |
| Gar | 2.64 | 0.54 | 1.73 | 0.33 | 0.84 | 0.28 |
| Gouramy | 1.86 | 0.38 | 2.07 | 0.40 | 1.51 | 0.50 |
| Loach | 0.01 | 0.003 | 0.005 | 0.01 | 0.03 | 0.01 |
| Featherback | 0.58 | 0.12 | 1.85 | 0.36 | 2.17 | 0.73 |
| Total | 480.94 | 100 | 510.05 | 100 | 296.42 | 100 |

  

Species wise representaion of the individual members of" the Barbs" to the total yield are shown in Table 7.

***Table 7:*** *Fish production in different beels under the group Barb.*

| Fish | Baroholai Beel | | Makhna | | Buridha | |
|---|---|---|---|---|---|---|
| | Yield(Kg/ha) | %Yield | Yield(Kg/ha) | %Yield | Yield(Kg/ha) | %Yield |
| *P. chola* | 72.62 | 48.54 | 61.41 | 39.23 | 27.29 | 42.83 |
| *P. sophore* | 63.45 | 42.41 | 79.36 | 50.70 | 21.73 | 34.10 |
| *P. ticto* | 11.27 | 7.53 | 12.12 | 7.74 | 10.16277 | 15.94 |
| *P. stigma* | 2.24 | 1.50 | 3.614 | 2.30 | 4.53 | 7.11 |
| Total | 149.60 | 100 | 156.51 | 100 | 63.73 | 100 |

The group "Carps" was represented by *Catla catla, Labeo rohita, Cirrhinus cirrhusa* and *Cyprinus carpio* (Table 8).

***Table 8:*** *Fish production in different beels under the group "Carp".*

| Fish | Baroholai Beel | | Makhna | | Buridha | |
|---|---|---|---|---|---|---|
| | Yield (Kg/ha) | %Yield | Yield (Kg/ha) | %Yield | Yield (Kg/ha) | %Yield |
| *Catla catla* | 17.66 | 19.52 | 27.73 | 21.45 | 13.14 | 52.25 |
| *L. rohita* | 9.36 | 10.35 | 14.41 | 11.14 | 8.01 | 31.84 |
| *C. cirrhosa* | 2.61 | 2.89 | 2.93 | 2.27 | 4.001 | 15.90 |
| *C. carpio* | 60.83 | 67.22 | 84.22 | 65.13 | 0 | 0 |
| Total | 90.48 | 100 | 129.30 | 100 | 25.16 | 100 |

Species- wise mean yields of catfishes are furnished in Table 9.

***Table 9:*** *Fish production in different beels under the group "Catfishes".*

| Fish | Baroholai Beel | | Makhna | | Buridha | |
|---|---|---|---|---|---|---|
| | Yield (Kg/ha) | %Yield | Yield (Kg/ha) | %Yield | Yield (Kg/ha) | %Yield |
| *Wallago attu* | 47.4452 | 55.97818 | 38.91525 | 63.20653 | 42.20454 | 51.88176 |
| *Sperata aor* | 11.54 | 13.61546 | 0 | 0 | 0.72216 | 0.887746 |
| *M. vittatus* | 4.0612 | 4.791603 | 3.563084 | 5.787196 | 4.74861 | 5.837435 |
| *M. cavius* | 12.17205 | 14.36118 | 10.04297 | 16.31189 | 15.10977 | 18.57434 |
| *M. tengra* | 1.52405 | 1.798149 | 1.72197 | 2.796841 | 4.00962 | 4.928999 |
| *C. batrachus* | 0.1848 | 0.218036 | 0.28938 | 0.470014 | 0.18819 | 0.231341 |
| *H. fossilis* | 3.3814 | 3.989542 | 2.35055 | 3.817786 | 10.13523 | 12.45917 |
| *Ailia coilia* | 0.6798 | 0.802061 | 1.89104 | 3.071446 | 0.3876 | 0.476474 |
| *P. anthero* | 1.05 | 1.238842 | 0 | 0 | 0 | 0 |
| *C. garua* | 2.5344 | 2.99021 | 2.31345 | 3.757528 | 2.95647 | 3.634369 |
| *O. pabda* | 0.1837 | 0.216738 | 0.48071 | 0.780774 | 0.88536 | 1.088367 |
| Total | 84.7566 | 100 | 61.5684 | 100 | 81.34755 | 100 |

The minnows were represented by 4 species such as *Amblypharyngodon mola, Aspidopariar jaya, Esomus dandricus, Osteobrama cotio* and *Aplocheilus panchax* (Table 10).

***Table 10:*** *Fish production in different beels under the group Minnows.*

| Fish | Baroholai Beel | | Makhna | | Buridha | |
|---|---|---|---|---|---|---|
| | Yield (Kg/ha) | %Yield | Yield (Kg/ha) | %Yield | Yield (Kg/ha) | %Yield |
| *A. mola* | 4.26 | 48.27 | 5.41 | 51.29 | 1.79 | 60.63 |
| *E. danricus* | 1.29 | 14.66 | 1.72568 | 16.33 | 0.43 | 14.81 |
| *O. cotio* | 1.84 | 20.87 | 2.31 | 21.90 | 0.71 | 23.83 |
| *A. panchax* | 1.42 | 16.18 | 1.11 | 10.47 | 0.02 | 0.71 |
| Total | 8.83 | 100 | 10.56 | 100 | 2.96 | 100 |

The group "Clupeids" was comprised of *Gudusia chapra* and *Corica soborna* ( Table 11).

***Table 11:*** *Fish production in different beels under the group Clupeid.*

| Fish | Baroholai Beel | | Makhna | | Buridha | |
|---|---|---|---|---|---|---|
| | Yield (Kg/ha) | %Yield | Yield (Kg/ha) | %Yield | Yield (Kg/ha) | %Yield |
| *G. chapra* | 81.65 | 97.13 | 92.04 | 95.79 | 24.79 | 96.42 |
| *Corica soborna* | 2.41 | 2.86 | 4.04 | 4.21 | 0.92 | 3.57 |
| Total | 84.06 | 100 | 96.08 | 100 | 25.71 | 100 |

  

Perches were represented by 4 species such as, *Anabus testudienus*, *Chanda nama*, *Pseudambassis ranga* and *Nandus nandus* .Contribution of these species to the total yields is shown in Table 12.

***Table 12:*** *FisEh production in different beels under the group "perches".*

| Fish | Baroholai Beel | | Makhna | | Buridha | |
|---|---|---|---|---|---|---|
| | Yield (Kg/ha) | %Yield | Yield (Kg/ha) | %Yield | Yield (Kg/ha) | %Yield |
| *Chanda nama* | 12.68 | 46.94 | 6.65 | 36.97 | 4.07 | 17.66 |
| *P. ranga* | 4.96 | 18.36 | 4.80 | 26.65 | 2.35 | 10.19 |
| *A. testudineus* | 8.65 | 32.01 | 5.43 | 30.18 | 15.06 | 65.33 |
| *N. nandus* | 0.72 | 2.67 | 1.11 | 6.18 | 1.56 | 6.79 |
| Total | 27.03 | 100 | 18.01 | 100 | 23.05 | 100 |

The group "Prawn" was represented by 2 species which included *Macrobrachum rosenbergii* and *Macrobrachium malcomsonii* (Table 13).

***Table 13:*** *Fish production in different beels under the group Prawn.*

| Fish | Baroholai Beel | | Makhna | | Buridha | |
|---|---|---|---|---|---|---|
| | Yield (Kg/ha) | %Yield | Yield (Kg/ha) | %Yield | Yield (Kg/ha) | %Yield |
| *M. rosenbarggi* | 0.13915 | 56.09 | 0.16536 | 60 | 0.70788 | 82.51 |
| *M. malcom* | 0.1089 | 43.90 | 0.11024 | 40 | 0.150042 | 17.48 |
| Total | 0.24805 | 100 | 0.2756 | 100 | 0.857922 | 100 |

List of the the species included in the group "Eels" is presented in Table 14.

***Table 14:*** *Fish production in different beels under the group eels.*

| Fish | Baroholai Beel | | Makhna | | Buridha | |
|---|---|---|---|---|---|---|
| | Yield (Kg/ha) | %Yield | Yield (Kg/ha) | %Yield | Yield (Kg/ha) | %Yield |
| *M. aceulatus* | 9.89 | 46.59 | 13.09 | 62.56 | 17.79 | 41.09 |
| *M. pancalus* | 11.34 | 53.40 | 7.83 | 37.43 | 25.49 | 58.90 |
| Total | 21.23 | 100 | 20.92 | 100 | 43.29 | 100 |

The group "Gars" represented by X. *cancila* to the total fish yield in Baroholai beel, Makhna beel and Buridha beel, respectively (Table 15).

***Table 15:*** *Fish production in different beels under the group "Gars".*

| Fish | Baroholai Beel | | Makhna | | Buridha | |
|---|---|---|---|---|---|---|
| | Yield (Kg/ha) | %Yield | Yield (Kg/ha) | %Yield | Yield (Kg/ha) | %Yield |
| *X. cancila* | 2.644 | 100 | 1.730 | 100 | 0.843 | 100 |

The group "Gouramies" was comprised of *Colisa fasciata* and *C. chunu* (Table 16).

***Table 16:*** *Fish production in different beels under the group "Gouramies".*

| Fish | Baroholai Beel | | Makhna | | Buridha | |
|---|---|---|---|---|---|---|
| | Yield (Kg/ha) | %Yield | Yield (Kg/ha) | %Yield | Yield (Kg/ha) | %Yield |
| *C. fasciata* | 0.52 | 28.32 | 0.51 | 24.27 | 0.634 | 38.36 |
| *C. chunu* | 1.34 | 71.67 | 1.62 | 75.72 | 1.021 | 61.63 |
| Total | 1.86 | 100 | 2.13 | 100 | 1.65 | 100 |

The Loaches were represented by two species such as, *B. dario* (Table 17).

***Table 17:*** *Fish production in different beels under the group Loach.*

| Fish | Baroholai Beel | | Makhna | | Buridha | |
|---|---|---|---|---|---|---|
| | Yield (Kg/ha) | %Yield | Yield (Kg/ha) | %Yield | Yield (Kg/ha) | %Yield |
| *B. dario* | 0.012 | 100 | 0.005 | 100 | 0.032 | 100 |

The snakeheads were comprised of species viz., *Chana punctatus* and *Chana* (Table 18).

***Table 18:*** *Fish production in different beels under the group "Snakeheads".*

| Fish | Baroholai Beel | | Makhna | | Buridha | |
|---|---|---|---|---|---|---|
| | Yield (Kg/ha) | %Yield | Yield (Kg/ha) | %Yield | Yield (Kg/ha) | %Yield |
| *C. punctatus* | 13.346 | 96.43 | 22.45 | 100 | 26.73 | 97.13 |
| *C. striatus* | 0.492 | 3.56 | 0 | 0 | 0.78 | 2.86 |
| Total | 13.83 | 100 | 22.45 | 100 | 27.52 | 100 |

  

Featherbacks was supported by 1 species *Notopterus notopterus* (Table 19).

***Table 19:*** *Fish production in different beels under the group Feather back.*

| Fish | Baroholai Beel | | Makhna | | Buridha | |
|---|---|---|---|---|---|---|
| | Yield (Kg/ha) | %Yield | Yield (Kg/ha) | %Yield | Yield (Kg/ha) | %Yield |
| *N. notopterus* | 0.58135 | 100 | 1.851 | 100 | 2.178 | 100 |

**Niche-based tropo spatial fish production**

Quantitative contribution of individual species to the total yield in relation to specific feeding zone is summarized in Table 20, 21, 22 and 23.

***Table 20:*** *Yield of tropho-spatial guilds in the studied beels.*

| Tropho-spatial guilds | Baroholai Beel | | Makhan beel | | Buridha beel | |
|---|---|---|---|---|---|---|
| | Yield (Kg/ha) | % yield | Yied (Kg/ha) | % yield | Yield (Kg/ha) | % yield |
| Surface feeders | 284.08 | 54.38 | 301.40 | 53.09 | 114.76 | 16.55 |
| Column feeders | 9.95 | 1.904 | 16.26 | 2.86 | 10.19 | 1.46 |
| Bottom feeders | 228.291 | 43.71 | 249.97 | 44.04 | 568.39 | 81.98 |
| Total: | 522.32 | 100 | 567.64 | 100 | 693.35 | 100 |

***Table 21:*** *Species assemblage of surface feeders in tropho-spatial fish guilds.*

| Surface feeders: | | Baroholai beel | | Makhna beel | | Buridha beel | |
|---|---|---|---|---|---|---|---|
| | | Yield (kg/ha) | percent | Yield (kg/ha) | percent | Yield (kg/ha) | percent |
| 1 | *Catla catla* | 17.66 | 6.219 | 27.74 | 8.83 | 13.15 | 11.32 |
| 2 | *P. chola* | 72.62 | 25.56 | 61.41 | 19.55 | 27.29 | 23.49 |
| 3 | *P. sophore* | 63.45 | 22.34 | 79.36 | 25.26 | 21.74 | 18.71 |
| 4 | *P. ticto* | 11.27 | 3.97 | 12.12 | 3.86 | 10.16 | 8.74 |
| 5 | *P. stigma* | 2.25 | 0.79 | 3.61 | 1.15 | 4.53 | 3.90 |
| 6 | *G. chapra* | 81.65 | 28.74 | 92.04 | 29.29 | 24.79 | 21.33 |
| 7 | *Corica soborna* | 2.41 | 0.85 | 4.04 | 1.28 | 0.92 | 0.79 |
| 8 | *A. mola* | 4.26 | 1.50 | 5.41 | 1.73 | 1.80 | 1.55 |
| 9 | *E. danricus* | 1.29 | 0.45 | 1.73 | 0.55 | 0.44 | 0.38 |
| 10 | *O. cotio* | 1.84 | 0.65 | 2.31 | 0.74 | 0.71 | 0.61 |
| 11 | *A. panchax* | 1.43 | 0.50 | 1.11 | 0.35 | 0.02 | 0.02 |
| 12 | *B. Dario* | 0.01 | 0.004 | 0.005 | 0.002 | 0.03 | 0.03 |
| 13 | *Ailia coilia* | 0.68 | 0.24 | 1.89 | 0.62 | 0.38 | 0.33 |
| 14 | *P. anthero* | 1.05 | 0.37 | 2.12 | 0.67 | 1.45 | 1.24 |
| 15 | *Chanda nama* | 12.68 | 4.46 | 10.65 | 3.39 | 4.07 | 3.50 |
| 16 | *P. ranga* | 4.96 | 1.74 | 4.79 | 1.52 | 2.35 | 2.02 |
| 17 | *X. cancila* | 2.64 | 0.931 | 1.73 | 0.55 | 0.84 | 0.72 |
| 18 | *C. fasciata* | 0.52 | 0.18 | 0.51 | 0.16 | 0.63 | 0.54 |
| 19 | *C. chunu* | 1.34 | 0.47 | 1.56 | 0.49 | 0.87 | 0.75 |
| Total | | 284.08 | 100 | 314.17 | 100 | 116.21 | 100 |

***Table 22:*** *Species assemblage of Column feeders in tropho-spatial fish guilds.*

| Column feeders | | Baroholai | | Makhna | | Buridha | |
|---|---|---|---|---|---|---|---|
| | | Yield (kg/ha) | Percent | Yield (kg/ha) | Percent | Yield (kg/ha) | Percent |
| 1 | *L. rohita* | 9.36 | 94.15 | 14.41 | 88.61 | 8.01 | 78.62 |
| 2 | *N. notopterus* | 0.58 | 5.84 | 1.85 | 11.38 | 2.17 | 21.37 |
| Total | | 9.95 | 100 | 16.26 | 100 | 10.19 | 100 |

***Table 23:*** *Species assemblage of Bottom feeders in tropho-spatial fish guilds.*

| Bottom feeders | | Barokhali | | Makhna | | Buridha | |
|---|---|---|---|---|---|---|---|
| | | Yield (kg/ha) | Percent | Yield (kg/ha) | Percent | Yield (kg/ha) | Percent |
| 1 | *C. cirrhosa* | 2.61 | 1.14 | 2.93 | 1.17 | 4.14 | 1.67 |
| 2 | *C. carpio* | 60.83 | 26.64 | 84.22 | 33.69 | 0 | 0 |
| 3 | *Wallago attu* | 47.44 | 20.78 | 38.91 | 15.56 | 42.20 | 17.58 |
| 4 | *Sperata aor* | 11.54 | 5.05 | 0 | 0 | 0.72 | 0.31 |
| 5 | *M. vittatus* | 4.06 | 1.77 | 3.56 | 1.42 | 4.74 | 1.97 |
| 6 | *M. cavius* | 12.17 | 5.33 | 10.04 | 4.01 | 15.11 | 6.29 |
| 7 | *M. tengra* | 1.52 | 0.66 | 1.72 | 0.68 | 4.11 | 1.67 |

  

| Bottom feeders | | Barokhali | | Makhna | | Buridha | |
|---|---|---|---|---|---|---|---|
| | | Yield (kg/ha) | Percent | Yield (kg/ha) | Percent | Yield (kg/ha) | Percent |
| 8 | *C. batrachus* | 0.18 | 0.08 | 0.28 | 0.11 | 0.18 | 0.07 |
| 9 | *H. fossilis* | 3.38 | 1.48 | 2.35 | 0.94 | 10.13 | 4.22 |
| 10 | *C. garua* | 2.53 | 1.11 | 2.31 | 0.92 | 2.95 | 1.23 |
| 11 | *O. pabda* | 0.18 | 0.08 | 0.48 | 0.19 | 0.88 | 0.36 |
| 12 | *A. testudineus* | 8.65 | 3.79 | 5.43 | 2.17 | 15.06 | 6.27 |
| 13 | *N. nandus* | 0.72 | 0.31 | 1.11 | 0.44 | 1.56 | 0.65 |
| 14 | *M. roserng* | 0.14 | 0.06 | 0.16 | 0.06 | 0.71 | 0.29 |
| 15 | *M. malcom* | 0.10 | 0.04 | 0.11 | 0.04 | 0.15 | 0.06 |
| 16 | *M. aceulatus* | 9.89 | 4.33 | 13.09 | 5.23 | 17.79 | 7.41 |
| 17 | *M. pancalus* | 11.34 | 4.96 | 7.83 | 3.13 | 25.49 | 10.62 |
| 18 | *G. giuris* | 37.11 | 16.25 | 52.15 | 20.86 | 66.74 | 27.81 |
| 19 | *C. punctatus* | 13.34 | 5.84 | 22.45 | 8.98 | 26.73 | 11.14 |
| 20 | *C. striatus* | 0.49 | 0.21 | 0.76 | 0.30 | 0.78 | 0.326 |
| Total | | 228.29 | 100 | 249.96 | 100 | 240.01 | 100 |

**Tropo-trophic based fish production**

Quantitative representation of individual species under each tropo-trophic domain is depicted in Figure 1.

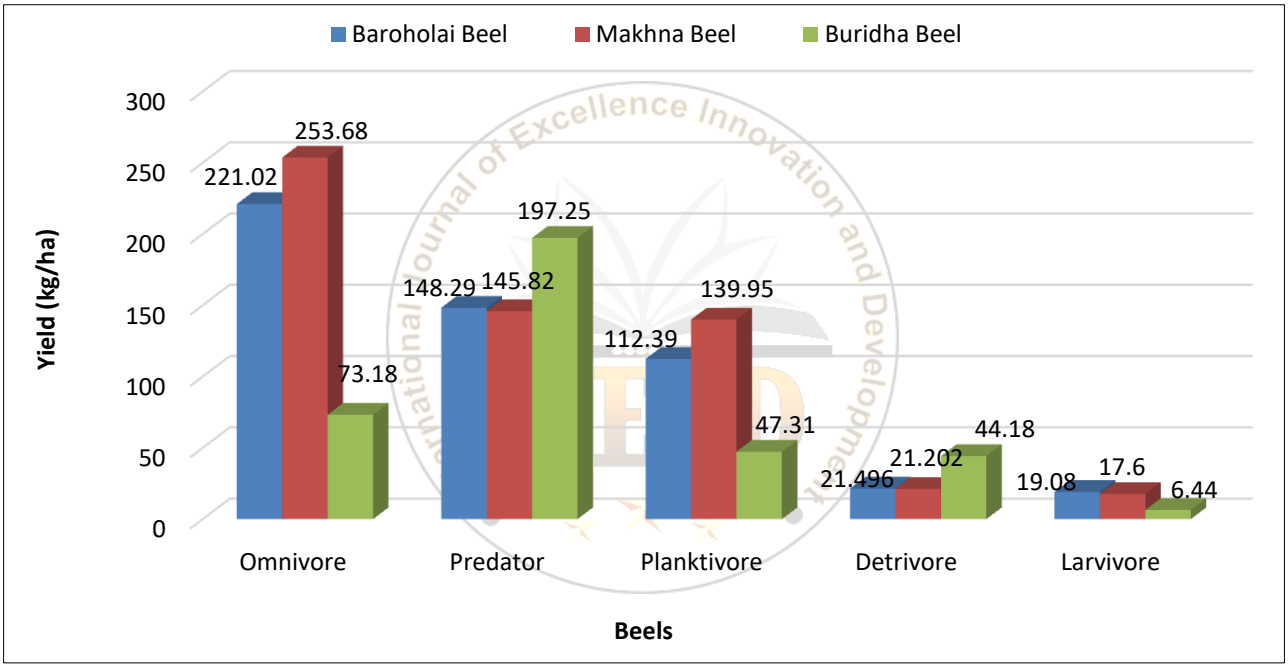


***Fig. 1:*** *Contribution of fishes to tropho-trophic guild in the studied Beel.*

**Most abundant and rare species:**

List of 10 most abundant and 10 least available species of fish as recorded from the studied beels are furnished in Table 24 and 25.

***Table 24:*** *List of ten most abundant species of fish in the studied beels.*

| Sl.No. | Baroholai Beel | | Makhna | | Buridha | |
|---|---|---|---|---|---|---|
| | Species | Yield (kg/ha) | Species | Yield (kg/ha) | Species | Yield (kg/ha) |
| 1 | *G. chapra* | 81.65 | G. chapra | 92.04 | G.giuris | 66.74 |
| 2 | *P. chola* | 72.62 | C. carpio | 84.22 | Wallago attu | 42.20 |
| 3 | *P. sophore* | 63.45 | P. sophore | 79.36 | P. chola | 27.29 |
| 4 | *C. carpio* | 60.83 | P. chola | 61.41 | C.punctatus | 26.73 |
| 5 | *Wallago attu* | 47.44 | G.giuris | 52.15 | M. pancalus | 25.49 |
| 6 | *G.giuris* | 37.11 | Wallago attu | 38.91 | G. chapra | 24.79 |
| 7 | *Catla catla* | 17.66 | Catla catla | 27.73 | P. sophore | 21.73 |
| 8 | *C.punctatus* | 13.34 | C.punctatus | 22.45 | M. aceulatus | 17.79 |
| 9 | *Chanda nama* | 12.68 | L. rohita | 14.41 | M. cavius | 15.11 |
| 10 | *M. cavius* | 12.17 | M. aceulatus | 13.09 | A. testudineus | 15.06 |
| Total yield(kg/ha) | | 419.01 | | 485.81 | | 282.98 |

  

***Table 25:*** *List of ten least available species of fish in the studied beels.*

| Baroholai | | | Makhna | | | Buridha | | |
|---|---|---|---|---|---|---|---|---|
| **SL.** | **Species** | **Yield** | **SL.** | **Species** | **Yield** | **SL.** | **Species** | **Yield** |
| 1 | *B. dario* | 0.01 | 1 | Sperata aor | 0 | 1 | C. carpio | 0 |
| 2 | *M. malcomsonii* | 0.11 | 2 | P. anthero | 0 | 2 | P. anthero | 0 |
| 3 | *M. rosenbergi* | 0.14 | 3 | B. dario | 0.005 | 3 | A. panchax | 0.02 |
| 4 | *O. pabda* | 0.18 | 4 | M. malcom | 0.11 | 4 | B. Dario | 0.03 |
| 5 | *C. batrachus* | 0.18 | 5 | M. roserng | 0.17 | 5 | M. Malcom | 0.15 |
| 6 | *C. striatus* | 0.49 | 6 | C. batrachus | 0.29 | 6 | C. batrachus | 0.19 |
| 7 | *C. fasciata* | 0.52 | 7 | O. pabda | 0.48 | 7 | Ailia coilia | 0.38 |
| 8 | *N. notopterus* | 0.58 | 8 | C. fasciata | 0.52 | 8 | E. danricus | 0.43 |
| 9 | *Ailia coilia* | 0.68 | 9 | C. striatus | 0.76 | 9 | C. fasciata | 0.63 |
| 10 | *N. nandus* | 0.72 | 10 | A. panchax | 1.11 | 10 | O. cotio | 0.71 |
| Total | | 3.63 | | | 3.44 | | | 2.56 |

**Monthly variation in fish catch**

Monthly variation in the mean yield of fish in different beels have been presented in Table 33 and displayed in Figure 2.

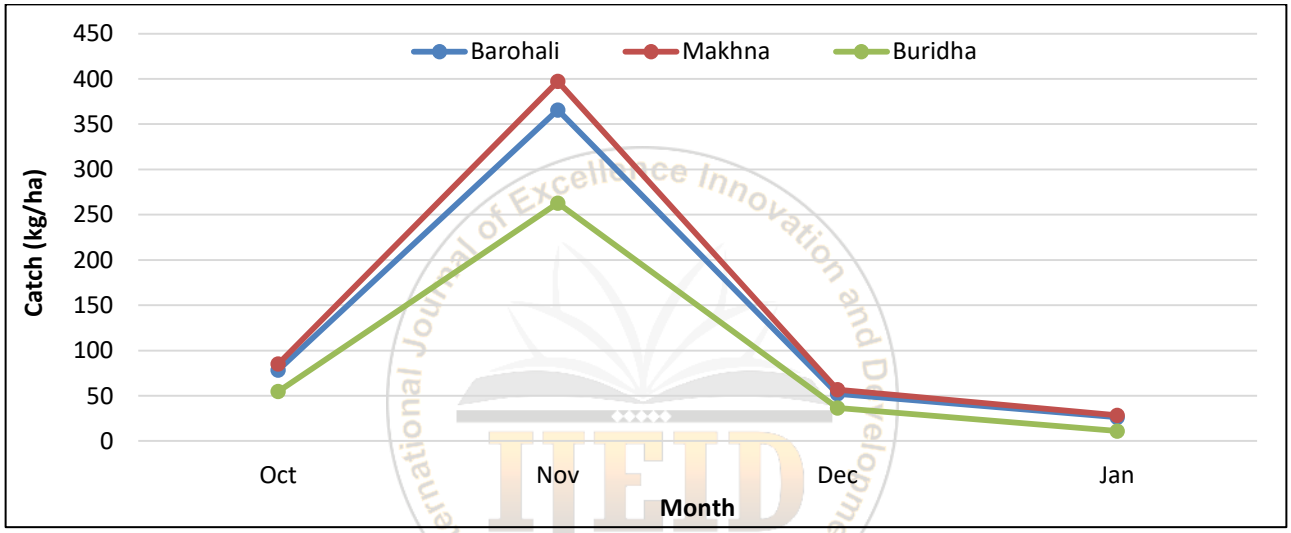


***Fig. 2:*** *Variation in monthly fish catch in the studied beels.*

**Yield and inference of indigeneous fish**

Results of comparison of the individual yields of fishes in stocked and non-stocked beel are presented in Table 26.

***Table 26:*** *Comparison of mean yield (kg/ha) of the indigenous fish species in the studied beels*

| SL.No. | Fish species | Mean Yield in stocked beel (kg/ha) | Mean Yield in control beel (kg/ha) | Mean yield difference (kg/ha) | Remarks |
|---|---|---|---|---|---|
| 1 | *Catla catla* | 22.70 | 13.14 | 9.55 | Significant (+) |
| 2 | *L. rohita* | 11.89 | 8.01 | 3.88 | Significant(+) |
| 3 | *C. cirrhosa* | 2.77 | 4.01 | -1.22 | Significant (-) |
| 4 | *C. carpio* | 72.53 | 0 | 72.53 | Significant (+) |
| 5 | *P. chola* | 67.02 | 27.29 | 39.72 | Significant (+) |
| 6 | *P. sophore* | 71.41 | 21.73 | 49.67 | Significant (+) |
| 7 | *P. ticto* | 11.69 | 10.16 | 1.53 | Significant (+) |
| 8 | *P. stigma* | 2.93 | 4.53 | -1.60 | Significant (-) |
| 9 | *G. chapra* | 86.84 | 24.79 | 62.05 | Significant (+) |
| 10 | *Corica soborna* | 3.22 | 0.92 | 2.30 | Significant (+) |
| 11 | *A. mola* | 4.84 | 1.79 | 3.05 | Significant (+) |
| 12 | *E. danricus* | 1.51 | 0.44 | 1.07 | Significant (+) |
| 13 | *O. cotio* | 2.07 | 0.70 | 1.37 | Significant (+) |
| 14 | *A. panchax* | 1.26 | 0.02 | 1.24 | Significan(+) |
| 15 | *B. dario* | 0.008 | 0.032 | -0.024 | Significant (-) |
| 16 | *Wallago attu* | 43.18 | 42.20 | 0.98 | Significant (+) |

  

| | | | | | |
|---|---|---|---|---|---|
| 17 | *Sperata aor* | 5.77 | 0.72 | 5.05 | Significant (+) |
| 18 | *M. vittatus* | 3.81 | 4.74 | -0.93 | Significant (-) |
| 19 | *M. cavius* | 11.10 | 15.10 | -4.00 | Significant (-) |
| 20 | *M. tengra* | 1.62 | 4.00 | -2.38 | Significant (-) |
| 21 | *C. batrachus* | 0.23 | 0.18 | 0.05 | Significant (+) |
| 22 | *H. fossilis* | 2.86 | 10.13 | -7.26 | Significant (-) |
| 23 | *Ailia coilia* | 1.28 | 0.38 | 0.90 | Significant (+) |
| 24 | *P. anthero* | 0.52 | 0 | 0.52 | Significant (+) |
| 25 | *C. garua* | 2.42 | 2.95 | -0.53 | Significant (-) |
| 26 | *O. pabda* | 0.33 | 0.88 | -0.55 | Significant (-) |
| 27 | *Chanda nama* | 6.34 | 4.07 | 2.27 | Significant (+) |
| 28 | *P. ranga* | 4.88 | 2.35 | 2.53 | Significant (+) |
| 29 | *A. testudineus* | 7.04 | 15.06 | -8.01 | Significant (-) |
| 30 | *N. nandus* | 0.91 | 1.56 | -0.65 | Significant (-) |
| 31 | *M. roserbargii* | 0.15 | 0.70 | -0.55 | Significant (-) |
| 32 | *M. malcomsoni* | 0.10 | 0.15 | -0.05 | Significant (-) |
| 33 | *M. aceulatus* | 11.49 | 17.79 | -6.30 | Significant (-) |
| 34 | *M. pancalus* | 9.58 | 25.49 | -15.91 | Significant (-) |
| 35 | *X. cancila* | 2.18 | 0.84 | 1.34 | Significant (+) |
| 36 | *C. fasciata* | 0.52 | 0.63 | -0.11 | Significant (-) |
| 37 | *C. chunu* | 1.45 | 0.87 | 0.58 | Significant (+) |
| 38 | *G. giuris* | 44.63 | 66.74 | -22.11 | Significant (-) |
| 39 | *C. punctatus* | 17.90 | 26.73 | -8.83 | Significant (-) |
| 40 | *C. striatus* | 0.62 | 0.78 | -0.15 | Significant (-) |
| 41 | *N. notopterus* | 1.21 | 2.17 | -0.96 | Significant (-) |
| Total Yield (kg/ha): | | 544.97 | 364.97 | 180.01 | Significant (+) |

**Status of threatened species**

Status and yield of threatened species of fish are presented in Table 27.

***Table 27:*** *Mean yield (kg/ha) and inference of IUCN threatened species in the studied beels.*

| Sl.No. | Fish species | IUCN status | Yield (kg/ha) | | Remarks |
|---|---|---|---|---|---|
| | | | Stocked Beels | Control Beel | |
| 1 | *Ompok pabda* | EN | 0.33 | 0.88 | Non-significant |
| 2 | *Botia Dario* | EN | 0.01 | 0.03 | Non-significant |
| 3 | *Chanda nama* | VU | 6.34 | 4.07 | (+) significant |
| 4 | *Puntious ticto* | VU | 11.69 | 10.16 | Non-significant |
| 5 | *M. aculeatus* | VU | 11.49 | 17.79 | (-) significant |
| 6 | *Mystus cavasius* | VU | 11.10 | 15.10 | (-) significant |
| 7 | *P. ranga* | VU | 4.88 | 2.35 | (+) significant |
| 8 | *N. notopterus* | VU | 1.21 | 2.17 | Non-significant |
| 9 | *Nandus nandus* | VU | 0.91 | 1.56 | (-) significant |
| 10 | *Sperata aor* | VU | 5.77 | 0.72 | Not comparable |

** EN= Endangered, VU = Vulnerable

**Total fish yield**

Data on the total yield of fish in stocked beels and control beel are furnished in Table 28. Total mean fish yield stood at 522.323kgha-$^{1}$ and 577.013 kgha$^{-1}$ in Baroholai and Makhna beel respectively.

***Table 28:*** *Comparison of total mean fish yield in stocked and control beel.*

| Treatment | Mean fish yields (kg/ha) | | Remarks |
|---|---|---|---|
| | Stocked Beel | Control Beel | |
| Including common carp | 544.97 | 364.97 | Significant ($p<0.05$) |
| Excluding common arp | 472.44 | 364.97 | Significant ($p<0.05$) |
| Common carp alone | 72.53 | - | |

**Cost and return of fish production in the studied beels**

Cost of fish production and economic return from stocked and non-stocked beels under the present investigation are presented in (Table 29).

  

***Table 29:*** *Cost-return of fish production in different beels.*

| Sl No | Items | Cost(Tk/ha) | | |
|---|---|---|---|---|
| | | **Baroholai (8 ha)** | **Makhna (6ha)** | **Buridha (4.5ha)** |
| **Variable cost:** | | | | |
| 01 | Clearing aquatic vegetation | 2000.00 | 1600.00 | 1200.00 |
| 03 | Salary of guards | 30000.00 | 30000.00 | 30000.00 |
| 04 | Bamboo pool | 5000.00 | 4500.00 | 3000.00 |
| 05 | Labor cost for fixing bamboo ploes | 800.00 | 800.00 | 800.00 |
| 07 | Cost of Fingerling(1,16,000) | 19500.00 | 15000.00 | 0.000 |
| 09 | Marketing cost (20% of harvested fish) | 158786.00 | 131558.00 | 62260.00 |
| 10 | Miscellaneous cost | 2000.00 | 2000.00 | 2000.00 |
| | **A.Sub-total of variable cost :** | **218086.00** | **185458.00** | **99260.00** |
| **Fixed Cost:** | | | | |
| 11 | Lease money | 80000.00 | 60000.00 | 45000.00 |
| 12 | Country Boat | 5000.00 | 5000.00 | 5000.00 |
| 13 | Guard shed/Gola | 5000.00 | 5000.00 | 5000.00 |
| 14 | Bana (with net) | 1000.00 | 1000.00 | 1000.00 |
| B. **Sub-total of fixed cost:** | | **91000** | **71000** | **56000** |
| **Total cost (A+B):** | | **309086.00** | **192558.00** | **155260.00** |
| 15 | Total fish production(kg) | 4178.58 | 3462.07 | 1638.43 |
| 16 | Average fish price(Tk/kg) | 190 | 190 | 190 |
| 17 | Total Gross income (Tk) | 793930.20 | 657793.30 | 311301.70 |
| 18 | Net income (Tk) | 484844.00 | 465235.00 | 156041.00 |
| 19 | BCR | 2.57 | 3.42 | 2.01 |
| Per ha VC (Tk) | | 27260.00 | 30909.00 | 22057.00 |
| Per ha FC (Tk) | | 11375 | 11833 | 12444 |
| Per ha TC (Tk) | | 38335 | 32093 | 34502 |
| Per ha fish yield (kg) | | 522.25 | 577.00 | 364.00 |
| Per ha total Gross income(Tk) | | 99241.00 | 109632.00 | 69178.00 |
| Per ha net income(Tk) | | 60906.00 | 77539.00 | 34676.00 |
| Average per ha net income (Tk) | | 69222.50 | | 34676.00 |

## DISCUSSIONS

During the period of investigation a moderate level of fish biodiversity were noted in the selected beels such as, Baroholai, Makhna and Buridha situated in Gacha union under Gazipur district. A total of 43 indigenous fish species including 2 species of prawns and one species of exotic Common carp (*Cyprinus carpio*) were recorded from Boroholai beel, as against of 42 species in case of Makhna beel. Control Buridha beel also harbored 42 species. The recorded species were distributed over 8 orders, 18 families and 31 genera. A few species of rare occurrence viz., *Ompok pabda, Notopterus notopterus, Botia dario, Puntius ticto, Chanda nama, Nandus nandus* and *Sperata aor* were also found. A very much similar level of species occurrence (75 species) was also reported from Jharkand, India by Paik *et al* (2003). Haque *et al.* (1999a) recorded a maximum of 60 fish species from oxbow lake project. On the other hand, much lower fish diversity with 26-33 species was reported from Rajdhala beel in Netrokona district (Rahman, 2000). Chanda beel and Saldu beel each contained 40 species of fish (Ehsan *et al*., 2000). A total of 42 indigenous fish including 2 prawn species was recorded from the Buridha beel, as opposed to 41-43 species from stocked beels. A slightly higher number of species (49) was recorded by Rahman and Hasan (1992) from Kaptai Lake. Haque *et al.* (1999b); Mondal *et al.* (2018) and Akter *et al.* (2016) found 43, 58 and 60 indigenous fish species fish species from three oxbow lakes. A total of 40 fish species including three exotic fish were recorded by Ehshan *et al* (2000) from Chanda *beel.* Shaha and Hossain (2002) documented 40 fish and 6 non-fish species from Salda beel in Tangail district. Saha (2007) identified 66 indigenous fish and prawn species in Boro beel in Pabna district. Presence of 42-43 indigenous fish species in Baroholai, Makhna and Buridha beels under the present study appeared to be due to open and mass migration of the indigenous species to the selected beels from the adjacent Turag River during the period of flooding.

The control beel displayed the highest Shanon-Wiener diversity index of 2.687. The stocked beels had a slightly lower Shanon diversity index (2.579- 2.584). The species index of indigenous species was 0.95 in Baroholai Beel, 0.90 in Makhna Beel and 1.0 in Buridha Beel. Hossain *et al.* (1999) estimated the Shannon-Weiner diversity indices of 3.55-4.054 in Chanda beel, 3.41-3.98 in Halti beel, and 2.49-3.30 in BSKB beel. Considering the magnitude of Shanon diversity index, all the beels under the present study were of medium richness in terms of species abundances.

In the context of fish biodiversity in Bangladesh, it could be concluded that during the study period Baroholai, Makhna and Buridha beel contained moderate level of

  

species diversity. Among the 29 families, Cyprinidae was found to be the most dominant and diverse group with 12 genera having 22 species. Next successive position were secured by Bagridae with 5 species; Palaemonidae with 2 species, Channidae, Ambassidae with 2 species each; Mastacembelidae with 2 species, Clupeidae and Osphronemidae contained two species each. With regard to quantitative representation, Cyprinidae formed the bulk of the total fish yield in all the studied beels, constituting 48.19% in Baroholai beel, 51.37% in Makhna Beel and 27.69% in Buridha beel. Clupeidae was next to Cyprinidae in term of numerical and quantitative representation. Among the clupeids, Chapila (*Gudusia chapra*), appeared in the stocked- and control beel in a massive number. The massive occurrence of *Gudusia chapra* in the stocked beels under the present study confirmed the findings of Saha (2007) who observed the similar scenario in Boro beel, Borobila beel and Gawha beel. Baila (*Gossogobius giuris)*, a voracious bottom feeder under the family Gobidae was present in an outstanding number in the control beel as compared to stocked beels (Baroholai and Makhna). Indian seasonal freshwater bodies were reported to be inhabited by 75 species under 23 families where dominance of Cyprinidae was clearly marked (Paik *et al*, 2003). Sugunan and Bhattachariya (2000) reported that Cyprinidae with 19 species was the major contributor of beel fishery yield in Assam followed by Ophiocephalidae with 4 species; Nandidae, Ambassidae, Mastacembeliae, Anabantidae and Cobitidae each with 2 species, and the rest of the families having one species each. Mohan and Singh (2004) noted the numerical dominance of Cyprinidae in the fishery yield of Kailana Lake, Jodhpur. The population structure and family composition of Baroholai, Makhna and Buridha beel as observed in the present study are in conformity with the findings of the above works.

Among the Cyprinids, Barbs were found to be the most abundant in all the beels constituting 29.04%, 24.97% and 16% of the total yield in Baroholai, Makhna and Buridha beel, respectively. A very much similar dominance of Puntius species in open water beels was also noted by Sugunan and Bhattachariya (2000) from West Bengal, India. Prolific breeding performance, availability of ample space for grazing and abundant food resources were the triggering factors for large scale occurrence of *Puntius* spp in the flood plains (Azher, 2009).

Catfishes (12.31- 23.45 %) were the third dominating group followed by Gobbies (6.05-11.46%) and Perches (6.41- 15.03%) in the overall composition of the beel fishery in the present study. Large catfishes particularly the members of Genus *Sperata* and *Wallago* were attributed for increased contribution of catfishes to the beel fishery. Yield of small catfishes (*Mystus sp*.) were found to be greatly reduced in the stocked beel (Baroholai and Makhna) beel as compared to control beel. Diminishing yield of catfishes in the stocked beels appeared to be due to the presence of common carp. Perches occupied the sixth dominant position (5.56-6.22%) in respect of their quantitative representation. *Chanda nama* popularly known as Golchanda took the lead in all the beels. There was no significant difference in the yield of perches in stocked and control beels. *Chanda nama* and *Pseudambassis ranga* were found to occur in the studied beels in huge number. The persistent occurrence of these spiny glass fish in the studied beels supported the findings of Saha (2007) who noted the regular occurrence of *Pseudambassis* spp in their field studies.

Prawns (*Macrobrachium spp*) were found to be represented by 2 species in each beels.

Minnows were represented by 11 species and this group as a whole constituted 4.57% of the total fish yield in Baroholai beel, 5.19% in Makhna Beel and 3.67-% in Buridha beel. Stocked beel contained increased quantity (48.15-58.64kg/ha) of minnows than the control bee (31.95kg/ha. Abundant occurrence of minnows in the stocked beels appeared to be due to availability of sufficient amount of natural fish food resources in the form of phyto-, zoo- and ichthyo-plankton and nutrient enriched suspended detritus arising from autochthonous organic materials i.e., decomposed rice and grass roots.This group constituted 3.71%, 3.59% and 10.16% of the total yield in Baroholai, Makhna and Buridha beel, respectively. The production of eels averaged 39.85kg/ha in stocked beels as opposed to 88.45 kg/ha in control beels. This level of eel production is comparable with those reported by Rahman (2010) from three seasonal beels in Mymensingh and Rangpur district.

As per list of IUCN (2000), 54 species of fish are under varying level of threat in Bangladesh. The results of the present study indicated that among the threatened fish species, 10 were present in both stocked beels as well as, control beel. Some of the species in Bangladesh already recognized as endangered such as, *Ompok pabda* and *Botia daio* were present in fairly good number in the stocked and non-stocked beel. These species are endangered in the national context of Bangladesh but they may not endanger in the context of Baroholai, Makhna and Buridha beel. The status of these species are much more bettter than presumed earlier.

Fish production in the stocked beels (Baroholai- and Makhna) was much higher than that in the control beel where no common carp was stocked. Mean yield of indigenous fish was estimated to be 461.489 kgha-$^{1}$ and for Common carp was 60.834 kgha-$^{1}$ in total 522.323 kgha-$^{1}$ in Baroholai beel where Makhna beel yielded 492.790 kgha$^{-1}$ by indigenous fish and 84.223 kgha-$^{1}$ by Common carp and in total 577.013 over the same period of time. The control beel yielded an average of 364.97 kgha-$^{1}$. Common carp alone contributed 11.64% of the total yield in Baroholai beel and 14.59% in Makhna beel. Carp was the most dominant group followed by Barb, Minnows, Clupeids and Perches in all the beels. The yield of indigenous fish including Common carp in the present studied beels is much less than the national average of 770 kg/ha (DoF, 2014). Similar level of fish yield (1948.72 kg/ha) was also reported by Ehshan *et al*. (2000) from Chanda Beel in Gopalpur district where carp contributed 27.51% and non-carps accounted for

  

72.49% of the total yield. Production of indigenous fish was 557 kg/ha in Bukabara beel, 593 kg/ha in Kannadah beel and 529 kg/ha in Rajganj beel (Haque *et al*., 1999); as against of stocked carps of 367 kg/ha in Bukabara and 678 kg/ha in Kannadah. The migratory chapila (*Gudusia chapra)* alone *comprised* about 50% of the catch, but it was relatively scarce in the non-stocked lakes. Azher (2009) Rahman *et al.* (2017) and Ahmed (1999) recorded the highest yield of 1239.88 kg /ha in Chotabora beel in Mithamoin, which is higher than the present yield of 871.26 kg/ha to 1091.80 kg/ha from non-stocked and stocked beels.

Common carp performed well in Baroholai beel and Makhna beel where it was stocked at 2500 fry per hectare. The average survival rate varied from 4.5% to 5.4%. The harvested common carp was in the range of 1.00 kg to 2.0 kg with an average size of 1.2kg. Ansal *et al*. (2000) performed a study on ecological impact of exotic fishes on native fish fauna and observed the competition of common carp with *Cirrhina reba*. Zambrano *et al.* (1999) reported that stocking of common carp at a much higher densities have detrimental ecological impacts at several trophic levels. Sugunan and Bhattachariya (2000) observed that common carp competes with the native *Cirrhina mrigala.* Petr (1997) reviewing the widespread use of common carp throughout Indo-Pacific countries and Islands found no adverse impacts of common carp on native fauna.

Sugunan and Bhattacharjya (2000) reported that that common carp are not suitable for stocking in Indian reservoirs because of its high vulnerability to predators. But on the other hand, stock enhancement trials in Gralia beel (Jessore) and Hilna beel( Noagaon) under Third Fisheries project (TFP, 1990-1995) of the Department of Fisheries provided convincing results in favor of stocking Indian major carps and common carp (10 cm size fingerlings at the rate of 20 kg/ha) in seasonal floodplains. Common carp achieved the best result in terms of economic return, with net return of up to 30 times the biomass stocked. The size of common carp landed following the stocking by the TFP was between 1 and 3 kg, which was achieved in a 5-7 months period.

## CONCLUSIONS

Stoking of common carp in seasonal beels appeared to be economically profitable in the context of Bangladesh. Though common carp exerts a little bit negative effect on the bottom dwelling fishes but its addition to the seasonal beels seems to be beneficial in terms of increased fish production and profit. Further studies should be conducted to precisely determine the consequences of stocking common carp in open water system.

## REFERENCE

[1] M.N. Ahmed, Fingerling stocking in open waters. In: Middendorp, H.A.J., P.M. Thompson and R.S. Pomeroy (ed). Sustainable Inland Fisheries Mannagement in Bangladesh. ICLARM Conference, 1999, 58: 201-207.

[2] A.K.M. Haque, H.A.J. Middendorp, M.R. Hasan, Impact of carp stocking on the abundance and biodiversity of non-stocked indigenous fish species in culture-based fisheries in Bangladesh. pp. 393-395. In: Proc. 4th Indian Fisheries Forum. Asian Fisheries Society. Kochin, 1999, India.

[3] M.D. Ansal, A. Dhawan, K. Kaur, Ecological impact of exotic fishes on native fish fauna. Fishing Chimes. 2000, 20(6):13-15.

[4] S.A. Azher, Impacts of fish sanctuary on production and biodiversity on aquatic organisms in rivers and beels of haor area. A Ph. D Thesis, Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh. 2009, pp. 320.

[5] S. Devnath, M.Y. Sarkar, N.S. Chowdhury, M.N. Amin, M.A.R. Hossain, Bioavailabilty of benthos in Gawha Beel. Chapai Nawabganj. Bangladesh Journal of Fisheries, 2004, 28(1-2): 9-13.

[6] DoF (Department of Fisheries), Fish Fortnight Compendium, 2014. Department of Fisheries, Ministry of Fisheries and Livestock, Dhaka, Bangladesh, 2014, p. 95.

[7] DoF (Department of Fisheries), Fish Fortnight Compendium, Department of Fisheries, Ministry of Fisheries & Livestock, Bangladesh. 2016, pp. 125-130.

[8] M.A. Ehshan, M.S. Hossain, A. Razzaque, M.S. Alam, Kua-An unusual but important fishing of Chanda beel. Bangladesh Journal of Zoology, 2000, 28(1): 69-74.

[9] A.K.M.A. Haque, A. Islam, M.A.R. Mollah, M.R. Hasan, Impact of carp stocking on non-stocked indigenous fish in the oxbow lakes of southern Bangladesh. National Workshop on Community Based Fisheries Management and Future Strategies for Inland Fisheries in Bangladesh. Dhaka, Bangladesh. 1999a, pp. 51-57.

[10] A.K.M.A. Haque, H.A.J. Middendorp, M.R. Hasan, Impact of carp stocking on the abundance and,biodiversity of non-stocked indigenous fish species in culture-based fisheries: A case study from the oxbow lakes project. In: H.A.J. Middendorp, P. M. Thompson and, R.S. Pomeroy (eds.). Sustainable Inland Fisheries Management in Bangladesh, ICLARM Conf. Proc., 1999b, 58: 141-148.

[11] M.S. Hossain, M.A. Ehshan, M.A. Mazid, S. Rahman, A. Razzaque, Biodiversity in floodplains with special reference to artificial stocking. Bangladesh J. Fish. Res., 1999, 4 (1): 69-74.

[12] L. Horvath, 1992: A ponty (Cyprinus carpio) petefejlodesnek elwmzese es szabalyozasa. A. Halhusstermeles Fejlesztese. No.9 Haltenyesztesi Kutato Intezet, Szarvas, Hungary.

[13] IUCN (International Union for Conservation of Nature) Red List, Red Book of Threatened Fishes of Bangladesh. 2000, pp.17-24.

[14] B.C. Jha, Classification, Management and Status of Fish Production in Beels. Inland Fisheries Society of India, CIFRI, Barrackpore, India. 1989, pp. 52 -60.

  

[15] T.K. Paik, S.K. Chakraborty, Ichthyofauna of east Singhbhum district, Jharkhand, India, Journal of Aquatic Biology, 2003, 18(2): 55-60.

[16] T. Petr, The future fisheries in natural lakes under environmental stress in Tropical Asia. pp. 35-43 In: Sidik, B.J., F.M. Yousuf, Zaki, M.S.M. and Petr,T (erds). International conferencre on Fisheries and Environment: beyond 2000. University Putra Malaysia, Serdang, 1997, Malaysia.

[17] M.F. Rahman, Technical intervention in seasonal floodplains under community based fishculture and its impacts on livelihood of the beneficiaries in Bangladesh. Ph.D. dissertation, Department of Fisheries Management, BAU, Mymensingh. 2010, p. 167.

[18] M.M Rahman, Comparison of benthic fauna of two beels of Netrakona district under of different management condition. An M.S. dissertation submitted to the Department of Aquaculture, BAU, Mymensingh. 2000, p.75.

[19] M.M. Rahman, M.R. Hasan, A study on fish and fisherman of Kaptai Lake. BAU Res. Prog., 1992, 6: 495-503.

[20] J.K. Saha, Assessment of Aquatic Biodiversity in three beels of Bangladesh and relationship with environmental parameters. Ph.D. Dissertation, Dept. of Aquaculture, Bangladesh Agricultural University, Mymensingh. 2007, p. 324.

[21] V.V. Sugunan, B.K. Bhattacharjya, Ecology and fisheries of beels in Assam. Central Inland Capture Fisheries Research Institute. Bull No. 104. Barrackpore, India. 2000, p. 65.

[22] TFP (Third Fisheries Project), Implementation completion (floodplain stocking component). Third Fisheries Project. Department of Fisheries, Dhaka, 1996, Bangladesh.

[23] L. Zambrano, M.R. Perrow, V. Aguirre-Hildalg, Impact of introduced carp (Cyprinus carpio) in sub-tropical shallow ponds in central Mexico. Journal of Aquatic Ecosystem Stress and Recovery, 1999, 6(4): 281-288.

[24] S.M. Yeasmin, M.A. Rahman, M.M.M. Hossain, M.H. Rahman, A.A. Asif, Identification of causative agent for fungal infection and effect of disinfectants on hatching and survival rate of common carp (*C. carpio*) larvae. Asian Journal of Medical and Biological Research, 2016, 1(3):578-588.

[25] M.M. Islam, A.A. Asif, M.R. Amin, The Induced Breeding of Common Carps (*Cyprinus carpio*) in Bangladesh. Indian Journal of Science, 2016, 23(84): 619-632.

[26] M.Y. Yeasmin, M.H. Rahman, M.A. Rahman, A.A. Asif, M.A.M. Farid, M.M. Billah, Influence of Feeding Administration of Brood-Stock on Breeding Performance of Common Carp (*Cyprinus carpio* Linnaeus, 1758). Journal of Aquaculture Engineering and Fisheries Research, 2018, 4(3):127-137.

[27] S. Akter, M.F.U. Zaman, M.H.U. Jaman, I.N. Sithi, D. Yesmin, A.A. Asif, Morphometric study of banded gourami (*Colisa fasciata*) in Jessore, Bangladesh. Asian Journal of Medical and Biological Research, 2016, 2 (1): 113-120.

[28] M.T. Hossain, M.S. Alam, M.H. Rahman, A.A. Asif, S.M. Rahmatullah, Present status of Indian major carp broodstock management at the hatcheries in Jessore region of Bangladesh. Asian-Australasian Journal of Bioscience and Biotechnology, 2016, 1 (2), 362-370.

[29] M.A. Islam, A.A. Asif, M.A. Samad, B. Sarker, M. Ahmed, A. Satter, A. Hossain, A comparative study on fish biodiversity with conservation measures of the Bhairabriver, Jessore, Bangladesh. Asian Journal of Medical and Biological Research, 2017, 3 (3): 357-367.

[30] H. Rahman, J.A. Mirza, A. Hossain, A.A. Asif, E. Haq, P. Chwakravorty, M. Rahman, Economics of fish production in paddy fields in Bangladesh. Asian Journal of Medical and Biological Research, 2017, 3 (3): 379-390.

[31] M.A.I. Mondal, M.A. Kader, M.R.U. Nabi, A.A.M. Siddiqui, M.M. Billah, A.A. Asif, Bio-economic analysis of ESBN fishery of Kumira, the coastal area of Chittagong, Bangladesh. Asian Journal of Medical and Biological Research, 2018, 4 (3), 315-322.

  