SANCTUARY STATUS ON DIVERSITY AND PRODUCTION OF FISH AND SHELLFISH IN SUNAMGANJ DEKAR *HAOR* OF BANGLADESH

M. S. ISLAM[1*] AND AFZAL HOSSAIN[2]

[1]*Department of Coastal and Marine Fisheries, Sylhet Agricultural University, Sylhet, Bangladesh*
[2]*Research Associate, Fisheries Component, KGF Project, Sylhet Agricultural University, Sylhet, Bangladesh*

Abstract

To ascertain the sanctuary status on diversity and production of fishes data were collected through primary and secondary sources. A total of 64 species belonged to 48 genera including fish (57), freshwater prawns (2), crabs (1) and mollusks (4) were recorded. Of 57 fish species, 52 were indigenous and rest 5 exotic, which belonged to 9 orders and 24 families. Cypriniformes was the most dominant order with 33.33% of total fishes followed by Perciformes (24.56%), Siluriformes (22.81%), Channiformes (7.03%) and both Osteoglossiformes and Clupeiformes (3.51%). Rest orders showed comparatively less percentage. Cyprinidae occupied the highest position (29.82%) in fish population among recorded families. By percent contribution small indigenous species showed the highest contribution (38.86%) with the highest amount (1936.50 kg/ha) in total fish production than other groups. Average fish production in sanctuaries obtained as 4983.60 kg/ha, which is manifolds higher than *haor* fish production (408 kg/ha) in Bangladesh. Fifteen (15) fish species were found as threatened and categorized them into critically endangered (1), endangered (8) and vulnerable (6). Results of the study reveal that sanctuary has positive impact on diversity and production of fishes in the *haor*. Therefore, it may be concluded that restoration of threatened species, diversity of flora and fauna, and overall fish production may be increased in wetlands by establishing sanctuary.

Key words: Sanctuary, *haor*, diversity, fish production

Introduction

Bangladesh is blessed with vast water resources scattered all over the country in form of *haor, baor, beels,* canals, lakes, small and large rivers, and estuaries. Diverse environment is the basis for diversity of lives both animals and plants. Inland open and closed waterbodies are the major sources of fish production in Bangladesh from time immemorial. But due to different environmental and manmade destructive activities, natural fish stocks are declining day by day (Azher *et al*. 2006). A good number of fishes are highly regarded for their taste and nutritive value but these are now critically endangered, endangered and vulnerable (Hasan *et al*. 2012). Water is harmed profusely all over the country by insane interruption of human beings. For these reasons, diversity of flora and fauna has been decreasing all over the world.

---

*Author for correspondence: <islamms2011@yahoo.com>.

Fish sanctuary is an adaptive approach for conservation of fish for natural propagation in open waterbodies. It is a demarcated protected area, where fishes are not disturbed or captured. So establishment of sanctuary is a way that carries such facilities and creates opportunities for protection, conservation and breeding of open water fishes in natural way. Fishes assemble in sanctuaries for shelter, lead peaceful life without any disturbance and can move freely towards feeding and breeding grounds. Fish sanctuaries have positive impact in all cases on fish production, biodiversity and socioeconomic condition of fishers (Azher *et al.* 2006, Hasan *et al.* 2012, DoF 2016, Hossain *et al.* 2017). Moreover, as a part and form of fisheries management, sanctuaries are relatively easy for user communities to implement and enforce.

Many government and non-government organizations have made attempt to fish stock development by establishing sanctuaries in beels and rivers of Bangladesh. Department of Fisheries (DoF) has established many sanctuaries in open waterbodies (rivers, *haors*, *baors* and *beels*) of the country to protect the native species. Other different organizations under their development projects attempted to establish fish sanctuaries in open waterbodies in different areas of the country to protect the indigenous fishes (Parvez *et al.* 2017).

The most important *haors* in respect of biodiversity and natural fish production are Shaneer, Hail, Hakaluki, Dekar, Tanguar and Kawadigi in greater Sylhet. Dekar *haor* is one of the most important and the largest *haor* among these. There are 8 fish sanctuaries in this *haor*. These sanctuaries are established by the assistance of NGOs and DoF, and these are managed by local fishermen. These are established for the greater interest of the nation in order to increase fish production, protection of threatened indigenous fish, employment opportunity and poverty eradication of fishermen. A few works have been done regarding status of sanctuary on fish production and diversity in the *haor*. Considering these backdrop, an extensive survey was conducted to assess the status of sanctuary on fish production, conservation of fishes and diversity in Dekar *haor* of Sunamganj.

Materials and Methods

Dekar *haor* lies between latitude 24°46ʹN and 24°57ʹN and longitude 91°20ʹE and 91°31ʹE. The *haor* is bounded by four Upazilas (Dakshin Sunamganj, Sunamganj sadar, Dowarabazar and Chhatak) of Sunamganj district. Six fish sanctuaries in different *beels* (Chilamara, Ashamara, Gujani, Gujaria, Bordoi and Magura hat kapania) of the Haor were selected for the study. Average size/area of the *haor* is 25,200 ha (MPHA 2012). Following activities were done to fulfull the objectives of the study.

Primary data collection: Data were collected during October, 2018 to March, 2019 from the *haor* of Bangladesh through a questionnaire. Several questions were asked to collect the primary data. Some of the open-ended questions were asked to know their strengths, drawbacks, assistance from government and non-governments, marketing facilities and policy barriers.

Fish sample collection: To determine existing fish diversity of the *haor*, fish samples were collected from fishermen. Monthly non selective gear was used in study area to collect species composition. Samples in each habitat were randomly collected and primarily sorted out in the collection area with the help of fishermen. Then samples were preserved in 5% formalin solution and brought to the laboratory for subsequent studies. In Water Quality and Biological Laboratory of Coastal and Marine Fisheries Department under Faculty of Fisheries of Sylhet Agricultural University in Sylhet, fishes were counted and identified upto genus/species level with the help of books and manuals (Ahmed *et al*. 2008, DoF 2014, Siddiqui *et al*. 2007a, Siddiqui *et al*. 2007b). During dry period water level gradually receded in *beels*, fishes were caught by ber jal and cast net everyday until final harvest. Sanctuaries were drained out for final harvest. Number of fish species, weight, and other data were recorded during fishing period in each study spot. Production, species composition and abundance of every sanctuary were calculated. Total catches of sanctuaries were estimated based on summing of total harvests in the study period of each sanctuary using recorded data. Catch/production (kg/ha) was estimated using the following equation:

$$\text{Catch/ha/study period (months)} = \frac{\text{Total sanctuary catches by group-wise (kg)}}{\text{Total area covered by sanctuary (ha)}}$$

Personal interviews and meetings: Interviewed 20 pre-selected respondents in government, NGOs, stakeholders of sanctuary, fisheries community, local buyers, member of sanctuary management committee, *haor* side settlers and knowledgeable local people.

Focus group discussion: There were four FGDs conducted to validate the data. Interviews were conducted with the sanctuary owners, fish farmers, fish retailer, fish traders, fishermen community and regulatory authorities.

Secondary data collection: Secondary data were collected from some published reports, scientific papers, some official documents and web-based information.

Data were entered into MS Excel spreadsheet and analyzed using MS Excel Data Analysis Tool Kit. At each stage of the survey, data were checked, edited and coded in the field.

Results and Discussion

Total number of finfishes and shellfishes (crustaceans and molluscs), revival of threatened fish species, catch composition and species-wise fish production during study period were observed to assess the status of sanctuary on diversity and production of fishes in Dekar *haor* of Sunamganj district.

Diversity status of fishes from catch assessment survey: As shown in Table 1, a total of 64 (finfish-57 and shellfish-7) species belonged to 48 genera including finfish (57), freshwater prawn (2), crab (1) and molluscs (4) recorded during survey period in the *haor*. It was observed that fish species was the highest number (57 spp.) of which 52 indigenous and rest 5 exotic. The recorded fishes belonged to 42 genera followed by mollusk (4 spp.), freshwater prawns (1 sp.) and crabs (1 sp.), respectively. In the present study, identified fishes were categorized into 11 major groups like as featherbacks, barb and minnows, snakehead, carps, loach, catfish, eel, perch, mudskipper, gars and puffer fish (Table 1). By per cent contribution small indigenous species (SIS) showed the highest contribution (38.86%) to the total production. SIS species were closely followed by catfishes (20.95%), prawn (17.87), eel (7.56%), carps (7.52%) and snakehead (4.02%). Rest groups showed comparatively less per cent contribution to the total production (Table 2). Iqbal *et al.* (2015) reported catfish appeared as the most dominant group contributing 33% of total production followed by minnows and barbs 16%, carps 11%, loach 8%, snakeheads 6% and others contributed the rest. Haroon *et al.* (2002) recorded 92 species of fish and prawn in Sylhet-Mymensingh basin and reported barbs were the most dominant group comprising 19% and catfishes contributed to about 18% of total catch. Contribution of carps, minnows and snakeheads were 16, 13 and 11%, respectively. Contribution of perches, gouramies, prawns, spiny eel, shads, featherbacks and miscellaneous mixed species were 6, 5, 3, 3, 2 and 4%, respectively to total catch.

Apart from the indigenous fishes, 5 exotic fishes were *Hypophthalmicthys molitrix, Ctenopharyngodon idella, Oreochromis niloticus, Cyprinus carpio* var. *specularis, Cyprinus carpio* var. *communis.* These species are widely cultured in Bangladesh. These are also found in open waters probably due to escape from adjacent ponds and seasonal waterbodies during flash flood. Suravi *et al.* (2017) recorded 4 exotic fishes in Dekar *haor* over the period of September, 2015-August, 2016. Sayeed *et al.* (2015) reported 7

Table 1. List of fish and shellfish (prawns, crabs and molluscs) in sanctuaries of the Dekar *haor*.

Order (species No.)	Family (species No.)	Scientific name	Local name	Group name
Finfish species				
Osteoglossiformes (2)	Notopteridae (2)	*Chitala chitala*	Chitol	Featherbacks
		Notopterus notopterus	Foli	
Clupeiformes (2)	Clupeidae (1)	*Corica soborna*	Kachki	Minnows
	Engraulidae (1)	*Gudusia chapra*	Chapila	
Channiformes (4)	Channidae (4)	*Channa marulius*	Gojar	Snakehead
		Channa orientalis	Cheng	
		Channa punctatus	Taki	
		Channa striatus	Shol	
Cypriniformes (19)	Cyprinidae (17)	*Amblypharyngodon mola*	Mola	Carps, Barb & Minnows
		Bengala elanga	Elong	
		Gibelion catla	Catla	
		Chela laubuca	Chela	
		Cirrhinus cirrhosus	Mrigal	
		Ctenopharyngodon idela	Grass Carp	
		Cyprinus carpio var. communis	Carpio	
		Cyprinus carpio var. specularis	Lal Carpu	
		Esomus danricus	Darkina	
		Hypophthalmicthys molotrics	Silver Carp	
		Labeo bata	Laso/Bata	
		Labeo calbasu	Kalibaush	
		Labeo gonius	Gonia	
		Labeo rohita	Rui	
		Osteobrama cotio	Dhela	
		Puntius sophore	Jat Punti	
		Puntius ticto	Tit Punti	
	Cobitidae (2)	*Botia dario*	Rani	Loach
		Lepidocephalichthys guntea	Gutum	
Siluriformes (13)	Bagridae (4)	*Mystus gulio*	Gulsha	Catfish
		Mystus tengra	Bujuri	
		Mystus vittatus	Tengra	
		Sperata aor	Ayre	
	Siluridae (2)	*Ompok pabda*	Modu Pabda	
		Wallago attu	Boal	
	Schilbeidae (3)	*Ailia coila*	Bashpata	
		Eutropiichthys vacha	Bacha	
		Pseudeutropius atherinoides	Batashi	
	Sisoridae (1)	*Bagarius bagarius*	Bagh Machh	
	Clariidae (1)	*Clarias batracus*	Magur	
	Heteropneustidae (1)	*Heteropneustes fossilis*	Shing	
	Chacidae (1)	*Chaka chaka*	Cheka	
Synbrachiformes (1)	Synbranchidae (1)	*Monopterus cuchia*	Kuchia	Eel

Perciformes (14)	Ambassidae (3)	*Chanda nama*	Nama Chanda	Perch
		Pseudambassis baculis	Kata Chanda	
		Pseudambassis ranga	Lal Chanda	
	Nandidae (1)	*Nandus nandus*	Meni/Bheda	
	Pristolepidae (1)	*Badis badis*	Napit	
	Cichlidae (1)	*Oreochromis niloticus*	Tilapia	
	Gobiitidae (1)	*Glossogobius guiris*	Bailla/Bele	Mudskipper
	Anabantidae (1)	*Anabas testudineus*	Koi	
	Osphronemidae (3)	*Colisa chuna*	Chuna Khalisha	
		Colisa fasciata	Khalisha	
		Colisa lalia	Lal Kholisha	
	Mastacembelidae (3)	*Macrognathus aculeatus*	Tara Baim	Eel
		Macrognathus pancalus	Chirka	
		Mastacembelus armatus	Boro Baim	
Beloniformes (1)	Belonidae (1)	*Xenentodon cancila*	Kakila	Gar
Tetraodontiformes (1)	Tetraodontidae (1)	*Tetraodon cutcutia*	Potka	Puffer fish

Shellfish
Prawn

Decapoda (2)	Palaemonidae (2)	*Macrobrachium malcolmsonii*	Chatka Chingri
		Macrobrachium rosenbergii	Golda

Crab

Decapoda (1)	Potamidae (1)	*Labothelphusa wood masoni*	Kakra

Molluscs

Mesogastropoda (3)	Viviparidae (1)	*Bellamya bengalensis*	Guli Shamuk
	Pilidae (1)	*Pila globosa*	Apple Shamuk
	Thiaridae (1)	*Tarebia lineata*	Lomba Shamuk
Unionoida (1)	Unionidae (1)	*Lamellidens marginalis*	Jhinuk/Chinai

Table 2. Production and per cent contribution of fish groups and prawn recorded from sanctuaries catch only.

Groups of fishes	Production (kg/ha)	Per cent
Featherbacks	64.00	1.28
Snakehead	200.15	4.02
Major and minor carps	374.90	7.52
Exotic carp	30.80	0.62
SIS species	1936.50	38.86
Catfish	1043.80	20.95
Spiny eel	377.00	7.56
Puffer fish	66.00	1.32
Prawn	890.45	17.87
Total production	4,983.60	100.00

exotic in Hakaluki *haor* of Moulvibazar. Exotic species may cause major problems for native species. So more emphasis should be given to nonindigenous species to avoid the potential negative impact on natural stocks.
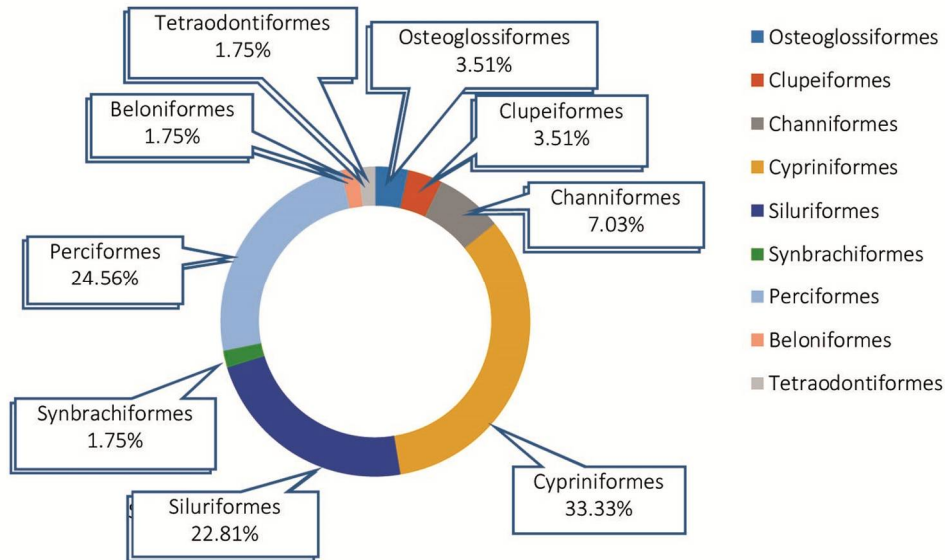

Fig. 1. Per cent contribution of different orders of fishes in catch composition of the Dekar *haor*.

Cypriniformes occupied the highest percentage (33.33) in order-wise catch composition by number of fish species followed by Perciformes (24.56), Siluriformes (22.81) and Channiformes (7.03). Other orders showed comparatively lower per cent contribution to the total number of fish species (Fig. 1). Mia *et al.* (2017) reported Cypriniformes was the highest abundant order (33%) followed by Perciformes (25%), Siluriformes (22%), Synbranchiformes (8%), Beloniformes (4%), Osteoglossiformes (4%), Tetraodontiformes (2%) and Decapoda (2%), respectively. Pramanik and Hasan (2017) recorded Siluriformes as the most diversified order in the river Dhonagoda. These findings revealed that Cypriniformes, Perciformes and Siluriformes were most dominant and important fish orders than other orders in *haors* and rivers, which are in agreement with the findings of the present study.

There were 24 families under 9 orders of 57 finfish species of which Cyprinidae was the most abundant family (29.82%) with 17 species. Channidae and Bagridae were the second dominant families (7.02%) each with 4 species followed by Schilbeidae (5.26%) with 3, Ambassidae (5.26%) with 3, Osphronemidae (5.26%) with 3, Mastacembelidae (5.26%) with 3, Notopteridae, Cobitidae and Siluridae (3.51%) each having 2 and the rest families (1.75%) each with 1 species (Table 1). Mia *et al.* (2017), Parvez *et al.*

(2017) and Pramanik and Hasan (2017) reported Cyprinidae was the dominant family among recorded families. These are coincided with the findings of the present survey.

Small sized crab and prawn (*Macrobrachium lamarrei*) are available in the *haor*. Two commercially important freshwater prawn species and one species of crab were recorded in family Palaemonidae and Potamidae respectively. Single species of univalves under each Viviparidae, Pilidae and Thiaridae, and one pearl produced species of bivalves under Unionidae of molluscs were found in the *haor* during the survey period. Suravi *et al.* (2017) and Pandit *et al.* (2015) recorded respectively 2 and 3 prawn species under one family in Dekar *haor* and Soma Nadi *Jalmohal* of Sunamganj.

Sixty four species (finfish-57 and shellfish-7) under 30 families recorded in the *haor* during the survey period. Suravi *et al.* (2017) reported 51 fish species (finfish-49 and shellfish-2) under 19 families in Dekar *haor* but crab and molluscs were not assessed under their study. But it was observed that numbers of indigenous fish species increased during the study period due to establishment of fish sanctuary in Dekar *haor* (Table 1). Azher *et al.* (2007) investigated the impacts of sanctuary on fish diversity over a period of three years and identified 50 (46 finfish and 4 prawn), 64 (60 fish and 4 prawn) and 64 (60 fish and 4 prawn) species respectively in 2003 (base line year), 2004 and 2005 in Mohi river sanctuary. They also recorded respectively 57 (53 fish and 4 prawn), 61 (57 fish and 4 prawn) and 62 (58 fish and 4 prawn) species during the same period in Dopi *beel* sanctuary. They did not consider crab and molluscs under their research. Parvez *et al.* (2017) demonstrated the number of fish species and total fish production were increased in Dhepa river of Dinajpur district over a period of 24 months from January 2014 to December 2015 owing to establishment of fish sanctuary. FFP (2005) reported after establishment of sanctuaries 23 fish species and some shrimp/prawn species including endangered species increased their population in the commanding area of the project. Fishes increased by 30% or more in different waterbodies including river in CMFM-2 project commanding area due to sanctuaries. It has been reported some threatened species as *Chitala chitala*, *Notopterus notopterus*, *Gudusia chapra*, *Puntius sarana*, *Ompok pabda*, *Nandus nandus*, etc and some endangered species like *Rita rita*, *Sperata seenghala*, *Pseudeutropius atherinoides*, *Mastacembelus armatus*, etc reappeared in the catch (DoF 2007). Several researchers (Parvez *et al.* 2017, Hossain *et al.* 2017, Hasan *et al.* 2012) stated the positive impacts of sanctuary on fish and shellfish diversity which support the findings of the present study.

Fish production
As shown in Table 2, the group-wise production (kg/ha) and percentage contributed by fish and prawn in the studied area during survey period. Total production of all groups obtained in sanctuaries was 4,983.60 kg/ha. With respect to per cent contribution small

indigenous species (SIS) was most dominant among all groups. SIS was closely followed by catfish, prawn, carps, spiny eel and snakehead. Rest groups showed comparatively less per cent contribution to the total production. On average the fish production in *haor* of Bangladesh was 408 kg/ha (DoF 2017). Azher *et al*. (2007) recorded average total yield of fishes and prawn from sanctuaries under T_1 and T_2 in Dopi *beel* as 5,613.72 and 8,307.64 kg/ha, respectively in 2005. But it was only 112.59 kg/ha in control treatment (T_3) of Chota-bora *beel*. They also recorded total yield of the same in treatment sanctuaries ranged from 3636.24 - 5256.74 kg/ha in Mohi river but in control treatment of Ghor river, it was only 204.15 kg/ha in 2005. Kadir *el al*. (1999) recorded fish catch from fish aggregating devices (brush parks/piles) in Ashura, Dikshi and Goakhola-Hatiara *beel*s as 2956, 5025 and 1750 kg/ha, respectively in 1997. But in 1998, the catch was 5650, 1720 and 1835 kg/ha from these three *beels*. In the present study production of fish obtained from sanctuaries are higher in most cases than the yield reported by above mentioned researchers**.**

Table 3. List of threatened species recorded from Dekar *haor* during study period.

Scientific name	IUCN (2015) status	Current status in studied area
Chitala chitala	EN	Rare
Notopterus notopterus	VU	Common
Gudusia chapra	VU	Abundant
Channa marulius	EN	Common
Labeo bata	VU	Rare
Rohtee cotio	EN	Common
Megarasbora elonga	EN	Rare
Botia dario	EN	Rare
Sperata aor	VU	Rare
Ompok pabda	EN	Common
Wallago attu	VU	Abundant
Bagarius bagarius	CR	Rare
Chaka chaka	EN	Rare
Monopterus cuchia	VU	Common
Mastacembelus armatus	EN	Common

CR - Critically endangered, EN - Endangered and VU - Vulnerable.

Status of fish species in the *haor*

As shown in Table 3, the status of fishes collected from the sanctuary was identified based on the Red List of IUCN Bangladesh (2015). Out of 57 freshwater fishes 15 species considered as a threatened fish and categorized them as critically endangered (1), endangered (8) and vulnerable (6) (IUCN 2015). The scenario of threatened species

category has slightly been changed in recent years. Especially, *Wallago attu* was vulnerable but it is now abundant in study area and inters into least concern (LC) category (IUCN 2015). Similar scenario was seen for *Notopterus notopterus*, *Channa marulius*, *Rohtee cotio* and *Mastacembelus armatus* which were endangered species previously but currently these were in vulnerable based on IUCN Bangladesh (2015) and now common in the *haor*. Catch monitoring data revealed that 7 species *viz.*, *Chitala chitala*, *Labeo bata*, *Megarasbora elonga*, *Botia dario*, *Sperata aor*, *Bagarius bagarius* and *Chaka chaka* had been revived and are rarely caught in studied area. These species reappear might be due to installation of sanctuary in surveyed area.

Sanctuary ecosystem in open waterbodies acts as the eco-friendly habitat by providing facilities for shelter, suitable breeding and feeding place, and good water quality for fish and other fauna, and flora. Open water fishes get excellent protection in sanctuaries and they find favourable natural breeding and grazing grounds in the area of sanctuary. Findings of this study imply that fish sanctuary helps to increase the production of finfish and shellfishes. Some species are also reappeared in sanctuaries of Dekar *haor* including the threatened fish species. Therefore, sanctuaries should be established in suitable areas of *haor, baor* and other open waters for conservation, protection and restoration of the breeding and grazing fields, and habitats of fish and other species.

References

Ahmed, A. T. A., S. M. H. Kabir, M. Ahmad, A. K. A. Rahman, E. U. Haque, Z. U. Ahmed, Z. N. T. Begum, M. A. Hassan and M. Khondker (eds.). 2008. *Encyclopedia of Flora and Fauna of Bangladesh*, Vol. 18. Part II. *Arthropoda: Crustacea*. Asiatic Society of Bangladesh, Dhaka. 226 pp.

Azher, S. A., F. Khanom and S. Dewan. 2006. Impacts of fish sanctuaries on the production and diversity of plankton in *beels* of *haor* region in Bangladesh. *Bangladesh J. Fish. Res.* **10** (2): 139-150.

Azher, S. A., S. Dewan, M. A. Wahab, M. A. B. Habib and G. M. Mustafa. 2007. Impacts of fish sanctuaries on production and biodiversity of fish and prawn in Dopi *beel*, Joanshahi *haor*, Kishoregonj. *Bangladesh J. Fisheries* (Special Issue) **30**: 23-36.

DoF (Department of Fisheries). 2007. Annual Report 2005-06. Department of Fisheries, Ministry of Fisheries and Livestock, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh. 1-111 pp.

DoF (Department of Fisheries). 2014. Freshwater Fishes of Bangladesh. Department of Fisheries, Bangladesh. 213 p.

DoF (Department of Fisheries). 2016. National Fish Week Compendium. Ministry of Fisheries and Livestock, Bangladesh. 51-53 pp.

FFP (Fourth Fisheries Project). 2005. Final Report. Fourth Fisheries Project, Department of Fisheries, Ministry of Fisheries and Livestock, Government of the Peoples' Republic of Bangladesh, Dhaka, Bangladesh. 9 p.

Haroon, A. K. Y., G. C. Haldar, S. L. Rahman, M. A. Razzaque, M. Alam and S. M. Nurul Amin. 2002. Sylhet-Mymensingh basin fish stock assessment. Final Report. Bangladesh Fisheries Research Institute, Riverine Station, Chandpur, Bangladesh. pp. 81.

Hasan, M. A. N. G. M, N. S. Lucky and M. A. R. Hossain. 2012. Natural Food Abundance and SIS Biodiversity of Matshaya Rani Fish Sanctuary. *J. Environ. Sci. & Natural Resources* **5**(1): 319-328.

Hossain, M. M., T. M. Moon, M. H. Rahman and M. A. Islam. 2017. Establishment of sanctuary in Belua river for fish exploitation and its impacts on fisheries biodiversity in the coastal region of Bangladesh. *European Journal of Advanced Research in Biological and Life Science* **5**(2): 33-44.

Iqbal, M. M., M. A. Rahman, S. Uddin and S. K. Barman. 2015. Fish biodiversity of Kushiara river at Monumukh point prior to the implementation of Tipaimukh Hydroelectricity DAM. *SAU Res. Prog. Rep.* No. **2**, Sylhet Agricultural University, Sylhet, Bangladesh.

IUCN (International Union for Conservation of Nature) Bangladesh. 2015. *Red List of Bangladesh Vol. 5: Freshwater Fishes*, Bangladesh Country Office, Dhaka, Bangladesh. xvi+360 pp.

Kadir, M. M., M. M. Hossain and M. S. Kabir. 1999. Patterns of fish catches in rivers and open *beels*. Paper presented in the National Workshop on Community Based Fisheries Management and Future Strategies for Inland Fisheries in Bangladesh. 1999, Dhaka, Bangladesh. pp. 45-50.

Mia, M., M. S. Islam, N. Begum, I. N. Suravi and S. Ali. 2017. Fishing gears and their effect on fish diversity of Dekar *haor* in Sunamganj district. *J. Sylhet Agril. Univ.* **4** (1): 111-120.

MPHA (Master Plan of Haor Areas). 2012. Draft Final Report, Vol. II, Ministry of Water Resources, Bangladesh Haor and Wetland Development Board, Government of the People's Republic of Bangladesh, pp. 1-18.

Pandit, D., M. Kunda, M. J. Islam, M. A. Islam and P. P. Barman. 2015. Assessment of present status of fish biodiversity in Soma Nadi Jalmohal of Sunamganj in Bangladesh. *J. Sylhet Agril. Univ.* **2**(1): 127-135.

Parvez, I., H. S. HrisikeshSujan, M. A. Alam, M. N. Akter, K. Roy and M. R. Haque. 2017. Fish biodiversity and conservation status of the Dhepa river sanctuary in protection and restoration of threatened fishes of the northwest Bangladesh. *Journal of Biodiversity and Environmental Sciences* **10**(1): 183-190.

Pramanik, M. M. H and M. M. Hasan. 2017. Dhonagoda River: Threats investigation of river and biodiversity for policy implementation. *Fisheries and Aquaculture Journal*, **8**: 236. doi:10.4172/2150-3508.1000236.

Sayeed, M. A., R. C. Dev, D. Bhattarcharjee, M. H. Himuand and M. T. Alam. 2015. Fish biodiversity of Hakaluki *haor* in north-east region of bngladesh. *SAU Res. Prog. Rep.* No. **02**, Sylhet Agricultural University, Sylhet, Bangladesh, 71-78 pp.

Siddiqui, K. U., M. A. Islam, S. M. H. Kabir, M. Ahmad, A. T. A. Ahmed, A. K. A. Rahman, E. U. Haque, Z. U. Ahmed, Z. N. T. Begum, M. A. Hassan, M. Khondker and M. M. Rahman (eds.). 2007a. *Encyclopedia of Flora and Fauna of Bangladesh*, Vol. 17. *Molluscs*. Asiatic Society of Bangladesh, Dhaka. 415 pp.

Siddiqui, K. U., M. A. Islam, S. M. H. Kabir, M. Ahmad, A. T. A. Ahmed, A. K. A. Rahman, E. U. Haque, Z. U. Ahmed, Z. N. T. Begum, M. A. Hassan, M. Khondker and M. M. Rahman (eds.). 2007b. *Encyclopedia of Flora and Fauna of Bangladesh*, Vol. 23. *Freshwater Fishes*. Asiatic Society of Bangladesh, Dhaka. 300 pp.

Suravi, I. N., M. S. Islam, N. Begum and M. A. Kasem. 2017. Fish bio-diversity and livelihood of fishers of Dekar *haor* in Sunamganj of Bangladesh. *J. Asiat. Soc. Bangladesh, Sci*. **43**(2): 233-244.

(*Revised copy received on 16.07.2019*)