

Journal of Fisheries and Aquatic Science

ISSN 1816-4927



www.academicjournals.com

Journal of Fisheries and Aquatic Science

ISSN 1816-4927 DOI: 10.3923/jfas.2016.174.184



Research Article Fish Diversity in Three Selected Areas of Mid-Coastal Region, Bangladesh

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Abstract

The study was conducted in three selected coastal areas of Noakhali and Laxmipur region of Bangladesh to know the diversity status of wild and farmed fishes. Fish samples were collected from the selected site based on the spot inspection of fish landing center, physical market place, taking photographs of fishes, interviewing of the fisherman and Arotdars and sample collection. However, during the study period, only 63 species of fish mostly commercial in nature were found. Among the documented species, 47 were from fresh water sources and the rest (16 species) from salt and or brackish water. The highest number of species (13) belonged to the family Cyprinidae. Maximum (39%) species were recorded from Laxmipur and minimum (24%) from Chairmanghat. Among the total number of species recorded, 29 species were considered as not threatened (NO) in Bangladesh, 9 were vulnerable (VU), 5 were considered as critically endangered (CR), 8 were endangered (EN) and 12 were Data Deficient (DD). The marine fish and freshwater fish composition in the study area were 26.4 and 74.6%, respectively. The non-availability and less availability of some species indicate the decline of the diversity of fishes in the study area in general and perhaps in the country as a whole.

Key words: Wild fish, natural abundance, distribution of fish, river, endangered data deficient

Received: August 05, 2015

Accepted: November 28, 2015

Published: February 15, 2016

Citation: Md. Akram Ullah, Muhammad Nasir Uddin, Md. Solaiman Hossain, M. Belal Hossain and Md. Abul Hossain, 2016. Fish diversity in three selected areas of mid-coastal region, Bangladesh. J. Fish. Aquat. Sci., 11: 174-184.

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Fish and fisheries play a significant role in the economy of Bangladesh in terms of animal protein supply, employment and foreign currency earning and poverty alleviation. The people of Bangladesh depend on fish for 60% of their animal protein requirement and the rest 37% protein comes from livestock and poultry. Fish contributes about 4.37% to GDP and 23.37% to the agricultural sector (DoF., 2014). About 11% of the total population (16 million) of the country are directly involved in fisheries sector for their livelihood, 1.316 million (approximately) involved in seasonal fishing and other fisheries related activities (DoF., 2014).

In terms of overall production, Bangladesh ranks fourth in Inland fish productions among the countries of the world (FAO., 2014). Bangladesh is a country of rivers, beels, haors, baors and wetlands. The country has vast and diversified water resources of 4.7 million ha (DoF., 2012). It has a globally important wetland ecosystem and associated aquatic biodiversity ranked third in Asia, with approximately 260 indigenous fresh water species (Rahman, 2005). The Inland fishery of Bangladesh is one of the most productive resources in the world. A large number of big rivers with their tributaries and branches crisscross the country. The floodplains act as nutrient-rich nurseries for a large number of larval and juvenile fish species.

A large reservoir, Kaptai Lake, with an area of about 68,800 ha of water surface is the largest man-made freshwater body in Bangladesh. Owing to such natural and man-made changes, a good number of valuable fish species dwelling in freshwater ecosystems have become threatened or endangered and some already started facing the threat of extinction (Afroz, 2007). In addition, marine water bodies cover an extensive area of 16.6 million ha which includes territorial waters, coastlines, continental shelves, coastal polders and a vast area of Exclusive Economic Zone (DoF., 2014). All these water bodies have a high potential for fish production both from capture- and culture-oriented management. The total fish production in Bangladesh was estimated to near about 3.41 Mt in 2012-13 and it would be 3.56 million Mt in 2013-14 fiscal, according to Ministry of Fisheries and Department of Fisheries (DoF., 2014). Of which near about 2.07 (82.73%) and 0.5 (17.27%) million tons came from Inland and marine waters, respectively (DoF., 2014). Bangladesh prides itself on being very rich in fish diversity. Its numerous and diverse inland water bodies-beels (flood plain depressions and lakes), ponds, rivers, canals, ditches- and vast paddy fields are home to over 260 freshwater fish species (DoF., 2014). Inland water resources of Bangladesh are

considered one of the richest resources in the world in both area and potential for fisheries development (Islam, 1989; Rahman, 2005). Among 260 species of freshwater fishes, 143 may be considered as Small Indigenous Species (SIS). Among the 260 freshwater fish species, many species are threatened in Bangladesh. The diversity of these fishes is categorized under different levels of threat, such as, vulnerable (VU), endangered (EN) and critically endangered (CR) and so on. Such categories of threat levels provide an assessment of the likelihood of extinction under the current circumstances (Rahman, 1989). It revealed 54 threatened freshwater fish species in Bangladesh, of which 12 are critically endangered, 28 are endangered and 14 are vulnerable. Therefore, appropriate attempts should be taken to prevent the loss of fish biodiversity and thus to meet the protein demand of the people of Bangladesh (Khan et al., 2000). The principal objective of the present study is to know the diversity of natural and farmed fish in three selected areas/spots of the study areas of Noakhali and Laxmipur district.

MATERIALS AND METHODS

Study area: The study was conducted from July, 2014 to April, 2015 in three designated coastal areas including Chairmanghat, Ramgoti and Laxmipur fish landing center (Fig. 1). The area is falls under Hatiya, Ramgoti and Laxmipur sadar Upazilla of Noakhali and Laxmipur district in the Mid-Southern region of Bangladesh. It is boarded by Chandpu*r*district to the north, Bhola district to the South, Feni district to the East and Barisal and Bhola districts to the west. To know wild and farmed fish diversity and marketing system of defined areas various activities were carried out using different survey tools and specific methodology.

Primary data collection: Primary data on the concerned fishes were collected from the local people. Relevant data such as local name, distribution and availability of the species were collected from the study sites.

Design and test of questionnaire: For the present study, questionnaires were prepared in consistent with the objectives for collecting relevant information. The questionnaire was composed of both closed and open form of questions. Thus final survey questionnaire was developed in logical sequence so that farmers could answer systematically and confidently without hesitation. However, the questionnaires were prepared in english but the fish retailers were asked the questions through face to face interviews in Bengali during the interview.



Fig. 1(a-b): Geographical location of the designated studied areas

Cross check interviews with key informants: After collecting the data through questionnaire interviews, it was necessary to check the information for justification of the collected data. Crosscheck interviews were conducted with key informants such as Upazila Fisheries Officer (UFO), District Fisheries Officers (DFO) and relevant NGO workers where, information was contradictory or requested for further assessment.

Data processing and analysis: The collected data was scrutinized and summarized carefully before the actual tabulation. Some of the collected data was in local units due to respondent's familiarity with those units. These data of local units were converted into international units before transferring to the computer. Preliminary data sheets (in computer) were compared with the original questionnaire

and result sheets to ensure the accuracy of the data entry. After data entry, data was processed and finally analyzed with Microsoft Excel version 2013.

RESULTS

Fish diversity: A total of 63 fish species were found in the study areas. The list of fishes available during survey period in the selected areas is shown in Table 1. As there were fishes from diverse ecosystem, the available fishes were categorized under freshwater and salt-water (marine and estuarine) basis. In Table 2, distribution and conservation status of collected fresh water species in the study areas are presented. Similarly in Table 3, distribution and conservation status of collected marine water species are shown. Among total number of species found during the study, 5 species were critically endangered (CR), 8 species were endangered (EN), 9 species were vulnerable (VU), 12 species were Data Deficient (DD) and

Table 1: List of fish species in the study area

29 species were not threatened (NO) based on Khan *et al.* (2000) list of threatened fishes of Bangladesh. Besides, family based number of fish species in study area are shown in Fig. 2 and 3 in conservation status of the fish species found in the studied area are shown.

Comparative market shares of fresh water and marine fish:

In the present study, it was found that marine fish comprises in average 26.4% of fish available in the market observed. On the other hand, fresh water fish were 74.6% as shown in Fig. 4. It may be mentioned that the studied market place is far from sea and estuary and that may be the reason behind the less availability of fishes from marine origin. Besdies, road communication to stuided fish markets from nearest sea landing center is not adequate and there is no waterway linkages that make transportation of marine fishes difficult.

	Markets and landing centers				
Families and species	 Chairmanghat	Ramgoti	Laxmipur		
Cyprinidae					
Punctius ticto	-	\checkmark	\checkmark		
Gibelion catla	\checkmark	\checkmark			
Labeo rohita	\checkmark	\checkmark			
Puntius sophore	-	\checkmark	\checkmark		
Amblypharyngodon mola	\checkmark	\checkmark	\checkmark		
Labeo gonia	-	\checkmark	\checkmark		
Chirrhinus cirrhosus	\checkmark	\checkmark	\checkmark		
Labeo calbasu	\checkmark	\checkmark	\checkmark		
Puntius sarana	-	\checkmark	\checkmark		
Cyprinus carpio	\checkmark	\checkmark	\checkmark		
Ctenopharyngodon idella	-	\checkmark	\checkmark		
Hypophthalmicthys molitrix	\checkmark	\checkmark	\checkmark		
Aristichthys nobilis	\checkmark	\checkmark	\checkmark		
Schilibeidae					
Silonia silondia	\checkmark	-	\checkmark		
Clupisoma garua	\checkmark	-	-		
Eutropiichthhys vacha	-	-	\checkmark		
Eutropiichthys murius	-	\checkmark	\checkmark		
Ailia coila	\checkmark	\checkmark	-		
Engraulidae					
Gudusia chapra	\checkmark	\checkmark	\checkmark		
Setipinna taty	\checkmark	\checkmark	-		
Coilia dussumieri	\checkmark	\checkmark	-		
Setipinna phasa	\checkmark	\checkmark	\checkmark		
Clupeidae					
Tenualosa ilisha	\checkmark	\checkmark	\checkmark		
Corica suborna	-	-	\checkmark		
Anabantidae					
Anabus testudineus	-	\checkmark	\checkmark		
Bagridae					
Mystus tengara	-	\checkmark	\checkmark		
Hemibagrus menoda	\checkmark	\checkmark	-		

Table 1: Continue

	Markets and landing centers					
Families and species	 Chairmanghat	Ramgoti	Laxmipur			
Sperata aor	-	\checkmark	\checkmark			
Rita rita	\checkmark	\checkmark	\checkmark			
Batasio batasio	\checkmark	-	-			
Siluridae						
Wallago attu	-	\checkmark	\checkmark			
Ompok pabda	-	-	\checkmark			
Pangasiidae						
Pangasius pangasius	\checkmark	-	\checkmark			
Pangasius hypophthalmus	\checkmark	\checkmark	\checkmark			
Heteropneustidae						
Heteropneustes fossilis	-	\checkmark	\checkmark			
Centropomidae						
Lates calcarifer	\checkmark	\checkmark	\checkmark			
Sillaginidae						
Sillaginopsis panijus	\checkmark	-	-			
Sciaenidae						
Jhonius coiter	\checkmark		\checkmark			
Channidae						
Channa striatus	-	\checkmark	\checkmark			
Channa marulius	-	-	\checkmark			
Channa orientalis	-	-	\checkmark			
Channa punctatus		\checkmark	\checkmark			
Mugilidae						
Rhinomugil corsula	\checkmark		\checkmark			
Liza parsia	\checkmark	\checkmark	\checkmark			
Gobiidae						
Glossogobius giuris	-	\checkmark	\checkmark			
Parapocryptes batoides	\checkmark	-	-			
Polynemidae						
Polynemus paradiseus	\checkmark	-	-			
Harpodontidae						
Harpodon nehereus	\checkmark	\checkmark	\checkmark			
Notopteridae						
Notopterus notopterus	-	\checkmark	\checkmark			
Notopterus chitala	-	\checkmark	\checkmark			
Nandiade						
Nandus nandus	-	\checkmark	\checkmark			
Carangidae						
Decapterus russelli	\checkmark	-	-			
Osphronemidae						
. Colisa fasciata	-	\checkmark	\checkmark			
Mastacembelidae						
Macrognathus aculeatus	-	\checkmark	\checkmark			
Mastacembelus armatus	-	\checkmark	\checkmark			
Claridae						
Clarius batrachus	-	\checkmark	\checkmark			
Clarias gariepinus	-	\checkmark	\checkmark			
Plotosidae						
Plotosus canius	\checkmark	_	\checkmark			
Characidae						
Pvgocentrus nattereri	_	\checkmark	\checkmark			
Belonidae		·	v			
Xenentodon cancila	_	~/	./			
Cichlidae		v	v			
Oreachromic maccambicus	./	./	./			
Oreachromis Nilaticus	v	v	V			
Ambasidae	v	v	V			
Annuasiude Chanda nama		,				
Changa hama	-	V	-			

* \checkmark = Present, - = Absent

Table 2: Distribution and	conservation status	s of collected	species	(Fresh water)
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Scientific Name	Distribution	Conservation status
Punctius ticto	Rivers and tanks	VU
Anabustes tudineus	Swamps, lakes, canals and ponds	NO
Labeo rohita	Beels, ponds, rivers and streams	VU
Mystus tengara	Pools, streams, rivers and canal	NO
Wallago attu	Large rivers, beels, lakes and tanks	NO
Amblypharyngodon mola	Rivers, streams, canals and ditches	NO
Pangasius pangasius	Large rivers and estuaries	CR
Heteropneustes fossilis	Ponds, ditches, beels and swamps	NO
Labeo gonius	Rivers, streams and ponds	EN
Channa striatus	Rivers, streams and ponds	NO
Channa punctatus	Ponds, beels and ditches	NO
Cirrhinus cirrhosus	Rivers, lakes and ponds	DD
Glossogobius giuris	Rivers, canals and estuaries	NO
Notopterus notopterus	Rivers, canals and flood plains	VU
Sperate aor	Rivers, canals, khal and beels	VU
Corica suborna	Rivers, lakes and estuaries	NO
Nandus nandus	Ditches, tanks, beels and bheries	VU
Rita rita	Rivers and estuaries	CR
Colisa fasciata	Ponds, ditches, canals and rivers	NO
Labeo calbasu	Rivers, lakes and ponds	EN
Macrognathus aculeatus	Ponds, ditches, canals and rivers	VU
Puntius sarana	Ponds, ditches, canals and rivers	CR
Clarius batrachus	Rivers, canals, flood plains and beels	NO
Channa marulius	Rivers, canals, lakes and swamps	EN
Pvaocentrus nattereri	Rivers, ponds, canals and stream	DD
Mastacembelus armatus	Rivers, ponds, canals and beels	EN
Chitala chitala	Rivers, lakes, beels and reservoirs	EN
Xenentodon cancila	Rivers, ponds, canals and beels	NO
Ailia coilia	Rivers, ponds and streams	NO
Aristichthys nobilis	Ponds and lakes	DD
Ctenopharvngodon idella	Lakes, ponds, pools and rivers	DD
Cyprinus carpio	Ponds and beels	DD
Hypophthalmicthys molitrix	Rivers, ponds and lakes	DD
Oreochromis niloticus	Streams, canals, lakes and rivers	DD
Oreochromis mossambicus	Streams, canals, lakes and rivers	DD
Pangasius hypophthalmus	Rivers, streams and ponds	DD
Clarius gariepinus	Pools, lakes and rivers	DD
Liza parsia	Rivers, estuaries and lagoons	NO
Ompok pabda	Streams, rivers, canals and beels	EN
Plotosus canius	Estuaries and rivers	VU
Channa orientalis	Ponds, ditches, beels and swamps	VU
Chanda nama	Streams, canals, beels and ponds	VU
Puntius sophore	Rivers, stream, ponds and paddy field	NO
Eutropiichthys vacha	Rivers and lakes	CR
Silonia silonda	Estuaries and rivers	EN
Gibelion catla	Rivers, lakes and ponds	NO
Batasio batasio	Estuaries and rivers	EN

CR: Critically endangered, EN: Endangered, VU: Vulnerable, NO: Not threatened, DD: Data deficient, Source: Red Book (Khan et al., 2000)

Fish diversity status in the studied area: The experimental areas are highly diversified with fish fauna including both marine and fresh water species. The main reason of fish faunal diversification in three selected studied areas is their location in mainstream channel of GBM (Ganga-Bhramhaputra-Meghna) river system. In monsoon time huge amount of water are carried by GBM river system towards the Bay of Bengal. During that time, the water itself carries a huge amount of

nutrient which are deposited in the coastal belt and circulated with tidal fluctuation and nutrient upwelling process takes place. The nutrients are used by primary producers, the phytoplankton are the prime cause of enormous growth size of zoo-plankton. Finally, both herbivores and carnivores fish species growth follows phyto-zooplankton production rate. During survey period 63 species of fish fauna was identified in which 47 species were fresh water sources and rest 16 species



Fig. 2: Family wise species diversity in the experimental area during survey period

Table 3: Distribution and conservation status of collected species (Marine Wate	Table	3: Di	stribution	and	conservation	status of	fcollected	species	(Marine wate
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Scientific name	Distribution	Conservation
status		
Gudusia chapra	Rivers and streams	NO
Tenualosa ilisha	Rivers, estuaries and marine water	NO
Setipinna phasa	Rivers and Estuaries	NO
Lates calcarifer	Estuaries and the Bay of Bengal	NO
Sillaginopsis panijus	Rivers and estuaries	NO
Jhonius coiter	Rivers and estuaries	NO
Rhinomugil corsula	River	NO
Parapocryptes batoides	Streams, estuaries and lagoons	NO
Polynemus paradiseus	Seas, bays, gulfs and rivers	NO
Harpodon nehereus	Bay of Bengal and estuaries	DD
Decapterus russelli	Seas and estuaries	NO
Clupisoma garua	Bay of Bengal and estuaries	CR
Hemibagrus menoda	Bay of Bengal and estuaries	NO
Coilia dussumieri	Streams, estuaries and lagoons	NO
Setipinna taty	Seas and estuaries	NO
Eutropiichthys murius	Seas and estuaries	DD

CR: Critically endangered, NO: Not threatened, DD: Data deficient, Source: Red Book (Khan et al., 2000)

are marine habitat. Their percentage variations are showed in Fig. 5. Most of the fresh water species are derived from culture fisheries and all the marine species from capture fisheries. The study was conducted for 10 months (July, 2014 to April, 2015) and on basis of market survey and on spot interviewing of retailer and wholesaler. From interview data a statement has comes that when the supply of marine water fishes are abundant it declines the supply of culture fishes. Banning period of hilsa also play a vital role in the supply of culture fishes.



Fig. 3: Conservation status of the fish species found in the studied area (Khan et al., 2000)



Fig. 4: Comparative market shares of fresh water and marine fish in the study areas (based on primary data)



Fig. 5: Percentage variation of species in the study areas (based on primary data)

Fish diversity status in Chairmanghat: Comparing to three designated region, Chairmanghat was less diversified region for fish fauna. Only 33 fish fauna out of total 63 species had identified from Chairmanghat fish landing center and fish market. But from the analysis of collected data, it showed that maximum marine and estuarine species (16 species) were from this region.

Fish diversity status in Ramgoti: Ramgoti showed moderate diversification of fish species compared to Chairmanghat and Laxmipur region. A number of 47 species had been identified from this region. Among the shared species, contribution of fresh water and marine water species were almost fifty-fifty. Abundant capture of marine species declines

supply of cultured species in Ramgoti due to increasing demand of marine species (low price).

Fish diversity status in Laxmipur: Maximum number of fish fauna had identified from Laxmipur fish markets. The number of fish species were identified are 51. Among the shared species, most of them are fresh water sources in compared to other two designated areas.

Fish marketing systems: In fish marketing systems, there were a number of middlemen involved in four markets of Lakshmipur district. The market chain from farmers or fishermen to consumers passes through a number of intermediaries: local fish traders, agents, wholesalers and retailers (Fig. 6).



Fig. 6: Fish distribution chain from fisherman to consumers in three markets and landing centers of studied area (based on survey)

It was found that the fishes in the studied market places and landing centers usually come from Mymensingh, Khulna, Sitakunda, Chittagong, Cox's bazaar, Chandpur, Comilla, Sonagazi, Sebarhat, Chatkhil, Hatiya, Chairman Ghat, Boiar Char, Char Langanya, Char Jabbar, Ziar Char, Sandwip, Chandpur, Barisal and reportedly even from India, Myanmar. Here, it may be mentioned that whole ale market in Feni areas are not exclusively for natural fishes. The wholesalers also trade farmed fish coming from fishery project, or other places.

DISCUSSIONS

There is much information on nationwide fish diversity in Bangladesh. Findings of the some previous reports are presented in Table 4 to compare with present study. A comprehensive study by Rahman (2005) identified 265 fresh water fish species from entire Bangladesh. The present regional survey recorded only 63 species from Noakhali Coastal area.

However, regional diversity and availability of fish based on market, marketing is scarce and an attempt was made to document regional fish diversity based on landing, supply chain and market, though the study did not focused on marketing of fish. During the study period, a total of 63 fish species under 28 families were found. Among them 16 were from marine and brackish water source and the rest were from freshwater origin. Most of the fresh water species were available in rivers, streams, canals and ponds. However, secondary data indicated that not all the species are available all the seasons. This, coupled with increased fishing pressure is reducing fisheries diversity in the study areas. Major dominant species were observed in the present study area, similar to several studies that reported the dominance of the resident species (Rahman, 2005; Bhuiya, 2002). Fish habitat destruction by developmental works like roads, embankments, drainage and flood control related constructions and natural siltation along with over-fishing have been commonly cited as causes of the deterioration of the country's resources (Hughes *et al.*, 1994; Ali, 1997).

Data analysis showed that the sharing of fresh water species is approximately 75%, where marine and estuarine species contributed only 25%. Laxmipur fish market and landing center delivered maximum number of species, most of them are fresh water derivatives and Chairmanghat fish market and landing center shared minimum numbers of species but most of them are marine and estuarine sources. In comparison to Chairmanghat and Laxmipur, Ramgoti shared moderate numbers of species, in which sharing percentage of fresh water and marine water species is relatively same. Among the species found during the study period, 5 species belonged to critically endangered (CR) species, 8 endangered (EN) and 9 vulnerable (VU) species. Highest number of species (29) was found from the not threatened (NO) categories. Twelve species belonged to DD (lack available data or data deficit) group, based on IUCN Bangladesh National Categories. Natural fish diversity has been degrading due to many reasons such as overfishing, aquaculture practice and introduction of exotic species, habitat loss and degradation, sedimentation, pollutions, alterations to hydrology and dredging. Thus the availability of indigenous fresh water fish species have been declined largely over the years and many of them are either rare or at the verge of extinction. The availability and distribution of the fishes were recorded during the entire study period and information on seasonal distribution was collected from secondary data. Fishes were more or less available round the year. But all the species were not available in all seasons. It was observed that seasonal fluctuation in the fish species is a normal phenomenon (Ahmad, 1997). There were also some species, which were found throughout the year. Abundance of fish also varies from season to season depending on demand and production. Abundance of fish in winter was comparatively higher than the rest of the year as the water level in freshwater body decreases during other season. Not all the species were readily available in the market.

No. of species	No. of family	Study area	References
128	34	Noakhali	Hossain <i>et al.</i> (2014)
139	34	Mymensingh	Chandra (2009)
251	61	Bangladesh	Siddiqui <i>et al.</i> (2007)
265	55	Bangladesh	Rahman (2005)
106	34	Mymensingh and Tangail	Doha (1973)
71	25	Dhaka	Bhuiyan (1964)
63	22	Coastal areas of Noakhali and Laxmipur District	Present study (2014-2015)

Table 4: Some previous studies on freshwater fish species of Bangladesh

CONCLUSION AND RECOMMENDATIONS

During the study period, a total of 63 fish species under 28 families were found. Among them, 16 species were found in marine environment and others from fresh water or brackish water or both. Most of the species were available in rivers, streams and canals. However, not all species of fish were available in all the seasons. But the non-availability and less availability of some species indicate the alarming decline of the diversity of fishes in the surveyed area and perhaps in the country as a whole. Researchers have reported that the number of fresh water species has been gradually declining. The importance and demand, studies on diversity of natural and farmed fish status of fish through countrywide analysis of qualitative and quantitative availability of natural fish in Bangladesh are undeniable. Therefore, in depth long-term investigation of natural fish is urgently needed not only for the conservation and rehabilitation but also for creating the awareness among the policy makers of the government and non-government organizations, groups and general mass. This will not only pave the way for better-protected diversity of natural fish but also help the people who make their living on natural fish with a more sustainable livelihood approach in near future. Based on the findings of the present study specific suggestions for improving marketing systems and reducing gradual decline of fish diversity in three designated fish markets of Noakhali and Laxmipur district should incorporate:

- Declaration of fish sanctuary in the major depressions
- Any water management structure should have fish friendly provisions
- Inclusion of more wild fish in aquaculture systems
- Fishermen should be motivated for wild fish conservation
- No pesticides should be used in aquaculture systems
- Introduction of fish quality control measure
- Improvement of hygienic conditions of fish landing centers and markets
- Provision of governmental, institutional and banking assistances

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