

Studies on geo-morphology, ecology and fish production of the 92 rivers of Rajshahi Division, Bangladesh

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Abstract

Geo-morphology, ecology and fish production of the 92 rivers of Rajshahi division have been presented in this paper. Fifteen rivers are dead and 11 rivers have severe erosion problem. Siltation has increased in 66 rivers and depth has decreased in 11 rivers. Sixty nine rivers are suffering from low flow conditions. Fish diversity has decreased in 20 rivers while fish production has declined in 75 rivers. A total of 31 fish species have extinct, 25 species are under threat of extinction and 43 species have low production. Siltation and pollution are the major causes of fish habitat loss. Recommendations are made to protect and conserve fish habitat and riverine fisheries of Rajshahi division.

Key words: River, Geo-morphology, Ecological change

Introduction

Rajshahi division is in the northwestern part of Bangladesh, which is bounded by the River Padma in the South and the River Jamuna in the East. In Bangladesh there are 1 000 main rivers, including three principal rivers (*viz.* Borak-Meghna, Brahmaputra-Jamuna and Ganga-Padma) and 300 major rivers, having a total length of 24,140 km and total catchment area of river systems is about 1.61 million km² (Rashid 1991). The River Ganga (Padma) originated from the Gongothree glacial of the Himalayas, flows 2 400 km before entering Rajshahi, Bangladesh. From Rajshahi, it is called Padma, again flows 112 km to meet the River Meghna at Chandpur (Bangla Academy Science Encyclopedia, BASE 2002). The River Ganga was dammed at Farakka diverting flow to facilitate navigation in the rivers Hugli and Bhagiroti in Kolkata, India. The Farakka Barrage has severe adverse impacts on the geo-morphology, ecology, and fish and fisheries of the River Padma and its branches and surrounding areas.

The River Brahmaputra is originated from the Manosh Shorobar (glacial) of the Koilash mountain, flows through the Tibet and Assam, and enters into Kurigram, Bangladesh. From Dewanganj, Jamalpur, the Brahmaputra divided into two branches, the River Jamuna and River Brahmaputra. The Brahmaputra flows through Mymensingh, Kishoreganj and Norshingdi to meet the River Meghna at Bhairabazar (BASE 2002) while River Jamuna flows through Tangail, Serajganj, Pabna and

Manikganj to meet the River Padma at Goalonda. The River Teesta, originating in India, was dammed at Gajaldoba, India; water was withdrawn for the last 20 years with consequent of siltation in down stream in Bangladesh, causing destruction of fish habitats, extinction of some species, and desertification of adjacent areas (Ghosh 2001). During rainy season, all the 44 sluice gates of the Teesta barrage are kept open causing flood in Bangladesh. The aim of this study is to generate data on geo-morphology, ecology and fisheries of the river systems of Rajshahi division, which will help researchers, policy makers, planners, development partners and administrators to formulate guidelines to manage and conserve riverine ecosystem, fish and fisheries of this division.

Materials and methods

Information on loss of habitat, fish biodiversity, production and other relevant aspects of study rivers were collected from different sources, especially from different National dailies of the country. Different reports, journals (Ghosh 2001, Mortuza *et al.* 1995, Sarker 1997, Khatun 1994, Hossain & Afroze 1991, Nabi & Hossain 1983, Jayaram & Singh 1977, Das Gupta 1947, Shaw & Shebbeare 1937) and books (Mazid 2002, Ali 1997, Tsai & Ali 1997, Rashid 1991, Rahman 1989, Menon 1974, Jhingran 1975, Hamilton 1822) were also explored to get information on fish species diversity, density, siltation, flow condition and other aspects of eco-morphological changes of rivers. This study was conducted between January'98 and July'03.

Results

Loss of habitat

In Rajshahi division, principal and major rivers, Padma, Jamuna, Atrai, Mahananda, Dharla, Teesta, Karatoa, Bangali, Dudkumar, Barnai, Chickli, Phulkumar, Talma and Tangon have silted up in many areas (Ghosh 2001, Sarker 1997, Khatun 1994, Hossain and Afroze 1991, Nabi and Hossain 1983), causing obstruction of fish migration routes and destruction of breeding and nursery grounds (Table 1). Available information revealed that 15 rivers comprising 16% of total study rivers became dead due to siltation in Rjshahi division (Table 2). In an average, yearly 870 million acre feet (maf) of water flow into the country from India and another 203 maf accumulate within the country through rainfall (Ali 1997). The combined flow of the Rivers Padma and Brahmaputra vary between 5 000 m³s⁻¹ in the driest period (March-April) and 80 000-140 000 m³s⁻¹ in the late August to early September (WARPO 2000). Water flow of most rivers decreases to a critical level especially in dry season (November to May) (Nazem and Kabir 1986). These rivers flow only in rainy season (June to October) with surface run-off and flash flood due to heavy shower (Nazem and Kabir 1986). Siltation rate has increased in 66 rivers and 69 rivers are suffering from low flow conditions (Table 2). There are 57 trans-boundary rivers, 54 with India and 3 with Myanmar flow through Bangladesh to the Bay of Bengal (Nazem and Kabir 1986). Out of 300 major rivers, 100 are dead due to siltation

(Hossain 1992). The Ganga-Padma, the Brahmaputra-Jamuna and the Borak-Meghna river systems transport annual sediment loads of between 1.7 and 2.4 billion tons (United Nations 1995). Silt deposition rate in the rivers Padma, Jamuna, Brahmaputra, Teesta and Dharla is 35 million t yr⁻¹ (United Nations 1995), if this rate is continued and rivers are not dredged, then all rivers of the country will be silted up within next 25 years (United Nations 1995). Fish diversity has decreased in 20 rivers, while fish production has declined in 75 rivers (Table 2). Pollution from industrial waste is a serious problem encountered by the rivers of Rajshahi division (WARPO 2000). There are 4 403 establishments discharge their un-treated effluents/wastes directly into many rivers of this division (Table 3). The rivers Atrai, Boral, Gumani, Nandakuya and Narod Nad have been polluted due to discharge of untreated effluent from Natore Sugar Mill and Jamuna Distilleries (Mortuza *et al.* 1995). Damping of domestic and industrial wastes decreased depth of the above mentioned rivers (Mortuza *et al.* 1995). During winter, silted river bed is used for crop production.

Table 1. Geo-morphology, ecology and fish production of the rivers (n = 92) of Rajshahi division, Bangladesh

Name of rivers	Numbers	Conditions
Borat, Barnai, Barnoi gun, Bhaddra boti, Bhollai, Borail, Chandra, Chickli, Dhaijan, Fakirni, Karatoa, Mora Boral, Nageshwari, Pakhira, Zinziram	15	Silted, dead, only flow in rainy season
Boral, Burhikhora, Burhiteesta, Charalkata, Chicknai, Deonai, Dharala, Dhum, Gumani, Rani, Teesta	11	Erosion
Akhira, Atrai, Bangali, Boral, Bhersha, Burhiteesta, Charalkata, Chicknai, Chaoyai, Chota Jamuna, Dhalia, Dahwk, Daphne, Deonai, Dharla, Dharoni, Dhum, Doibhanga, Dudkul, Dudkumar, Gangadhar, Ghagot, Goor, Guhala, Ghoraghat, Ghoramara, Gumani, Gurnoi, Haldibari, Halhalia, Haraboti, Hurasagar, Ichhamoti, Jabonchhera, Jagot, Jalchhera, Jamuneshwari, Kakra, Kalamdar, Kharkharia, Kulik, Kumlai, Mahananda, Manosh, Manushkhayoa, Mora Dhajjan, Nageshwari, Nagor, Nandakuya, Nurasagar, Padma, Pagla, Panga, Punarbhaba, Ratnai, Rani, Sati, Shook, Shri nadi, Sonaburi, Songkosh, Shuyoardubi, Tanggon, Tapa, Tirnai, Tulshiganga, Zinziram	66	Increased siltation
Akhira, Atrai, Boral, Burhikhora, Chicknai, Chaoyai, Dhalia, Dudkumar, Kumlai, Pagla, Phulzor	11	Decreased depth
Akhira, Atrai, Bangali, Boral, Bhadreshshor shao, Bhersha, Burhikhora, Chaoyai, Dhalia, Dahwk, Daphne, Dharla, Dharoni, Dhum, Doibhanga, Dudkul, Gangadhar, Ghagot, Goor, Guhala, Ghoraghat, Ghoramara, Gumani, Gurnoi, Haldibari, Halhalia, Haraboti, Hurasagar, Ichhamoti, Jabonchhera, Jagot, Jalchhera, Jamuneshwari, Kakra, Kalamdar, Karatoa, Karum, Kharkharia, Kulik, Kumlai, Mahananda, Manosh, Manushkhayoa, Mora Dhajjan, Nageshwari, Nagor, Nandakuya, Nurasagar, Padma, Panga, Pangkhaj, Punarbhaba, Phulzor, Ratnai, Rani, Sati, Setnai, Shingimari, Saniajan, Shook, Shri nadi, Sonaburi, Songkosh, Shuyoardubi, Talma, Tanggon, Tapa, Tirnai, Tulshiganga	69	Low water flow
Akhira, Atrai, Bangali, Boral, Bhadreshshor shao, Burhiteesta, Chaoyai, Dhalia, Dharla, Dudkumar, Ghagot, Ichhamoti, Karum,	20	Decreased fish diversity

Pagla, Pangkhaj, Setnai, Shingimari, Talma, Teesta, Zinziram Akhira, Atrai, Bangali, Boral, Bhadreshshor shao, Bhersha, Burhikhora, Burhiteesta, Charalkata, Chaoyai, Choto Jamuna, Dhalia, Dahwk, Daphne, Deonai, Dharla, Dharoni, Dhum, Doibhanga, Dudkul, Dudkumar, Gangadhar, Ghagot, Goor, Guhala, Ghoraghat, Ghoramara, Gumani, Gurnoi, Haldibari, Halhalia, Haraboti, Hurasagar, Ichhamoti, Jabonchhera, Jagot, Jalchhera, Jamuneshwari, Kakra, Kalamdar, Karum, Kharkharia, Kulik, Kumlai, Mahananda, Manosh, Manushkhayoa, Mora Dhaijan, Nageshwari, Nagor, Nandakuya, Nurasagar, Padma, Pagla, Panga, Pangkhaj, Punarbhaba, Phulzor, Ratnai, Rani, Saniajan, Sati, Setnai, Shingimari, Shook, Shri nadi, Sonaburi, Songkosh, Shuyoardubi, Talma, Tanggon, Tapa, Tirnai, Tulshiganga, Zinziram	75	Decreased density and low fish production
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Table 2. Statistics of present conditions of the rivers (n = 92) of Rajshahi division

Conditions	No. of rivers	% of study rivers	Problems occurred
Dead rivers	15	16	Navigation, scarcity of fish, unemployment, malnutrition due to protein shortage, low agricultural production due to shortage of water
Erosion	11	12	Increased siltation rate, decreased depth
Increased siltation	66	71	Decreased depth, destroyed breeding and feeding grounds
Decreased depth	11	12	Navigation, transport of essential commodities, decreased income, increased unemployment rate
Low flow	69	75	Increased siltation, decreased productivity of the river
Decreased fish diversity	20	21	Loss of biodiversity
Low fish production	75	81	Scarcity of fish, decreased income of fishers, increased unemployment rate and malnutrition

Table 3. Number of industrial establishments and polluting industries in Rajshahi division

No. of establishments	Textiles, apparels & tanneries	Paper, paper products & printing	Chemicals, plastics & petroleum	Non-metallic Minerals manufactures
4 403	545	113	181	360

(Source: WARPO 2000)

Loss of fish diversity

In Rajshahi division, 135 fish species were available in the rivers and beels, which have reduced to 104 species (Hossain *et al.* 2002). Thirty one fish species have extinct from the rivers of Rajshahi division (Table 4) and 25 fish species are under threat of extinction (Table 5). Yield and distribution of 43 fish species have decreased (Table 6). The River Padma is the most affected river among the rivers of Rajshahi division. In many places, the Padma has silted up and, fish yield and diversity have decreased alarmingly (Nabi and Hossain 1983). Similar conditions are also observed in the rivers Atrai, Barnai, Chickli, Dharla, Dudkumar, Jamuna, Karatoa, Mahananda, Phulkumar,

Talma, Tanggon and Teesta (Ghosh 2001, Mortuza *et al.* 1995, Sarker 1997, Khatun 1994, Hossain & Afroze 1991). The River Bangali, once was a major breeding ground for major carps, has silted up and the breeding ground has destroyed. Once *Tenulosa ilisha* was available in the Rivers Padma, Jamuna, Teesta, Karatoa, Bangali and other northwestern and northeastern rivers. Currently, *T. ilisha* is found only in the lower Meghna river (Islam 2001). *Pangasius pangasius* was available in the most rivers of Bangladesh and now its distribution is limited to southern rivers of the country (Rahman *et al.* 1995). Distribution and yield of *Eutropiichthys vacha*, *Bagarius bagarius*, *Ompok pabda*, *O. bimaculatus* and *Ailia coila* have declined in the rivers of Rajshahi division (FRSS 2002).

Table 4. List of fish species (n= 31) extinct from the rivers of Rajshahi division

Group	Family	Species	Local name
Carp & barbs	Cyprinidae	1. <i>Tor putitora</i> (Hamilton)	Golden mahseer
		2. <i>T. khudree</i> (Sykes)	Mohashol
		3. <i>T. mosal</i> (Hamilton)	Mohashol
		4. <i>T. tor</i> (Hamilton)	Mahashol
		5. <i>Cirrhina reba</i> (Hamilton)	Raik / Reba
		6. <i>Labeo nandina</i> (Hamilton)	Nandil
		7. <i>L. gonius</i> (Hamilton)	Ghainna / Kurchi
		8. <i>L. pangusia</i> (Hamilton)	Ghainna
		9. <i>L. boga</i> (Hamilton)	Baghna / Boga
		10. <i>L. bata</i> (Hamilton)	Baghna / Bata
		11. <i>L. boggut</i> (Sykes)	Boga / Bata
		12. <i>L. fimbriatus</i> (Bloch)	Chotto rui
		13. <i>Rasbora elonga</i> (Hamilton)	Elong
		14. <i>R. rasbora</i> (Hamilton)	Rasbora
		15. <i>Puntius sarana</i> (Hamilton)	Sarputi
		16. <i>Chela laubuca</i> (Hamilton)	Kash Khaira
		17. <i>Barilius bola</i> (Hamilton)	Bhol
		18. <i>Barilius vagra</i> (Hamilton)	Koksa
		19. <i>Rohitee cotio</i> (Hamilton)	Dhela / Dhipali
		20. <i>Crossocheilus latius</i> (Hamilton)	Ghora Muikha
		Murrel	Channidae
22. <i>Channa barca</i> (Hamilton)	Piplashol		
23. <i>C. orientalis</i> (Hamilton)	Cheng		
24. <i>Channa marulius</i> (Hamilton)	Gajar		
Sisor	Sisoridae	25. <i>Sisor rhabdophorus</i> (Hamilton)	Chenua sisor
Pipe-fishes	Syngnathidae	26. <i>Microphis deocata</i> (Hamilton)	Kumirer khil
Butter catfish	Siluridae	27. <i>Ompok pabo</i> (Hamilton)	Pabda
Square-head catfish	Chacidae	28. <i>Chaca chaca</i> (Hamilton)	Cheka
Catfish	Schilbeidae	29. <i>Silonia silondia</i> (Hamilton)	Shilong
Catfish	Bagridae	30. <i>Rita rita</i> (Hamilton)	Rita / Rida
Glass perch	Centropomidae	31. <i>Chanda ranga</i> (Hamilton)	Lal Chanda

(Source : Hossain *et al.* 2002, IUCN 2000)

Table 6. List of fish species (n= 43) with low yield and reduced distribution in the rivers of Rajshahi division

Group	Family	Species	Local name	
Carps & barbs	Cyprinidae	1. <i>Catla catla</i> (Hamilton)	Katla	
		2. <i>Labeo rohita</i> (Hamilton)	Ruhu / Rui	
		3. <i>L. calbasu</i> (Hamilton)	Kaliboush	
		4. <i>Cirrhina mrigala</i> (Hamilton)	Mrigal	
		5. <i>Puntius pulchellus</i> (Day)	Phulputi	
		6. <i>P. gelius</i> (Hamilton)	Gili puti	
		7. <i>P. chola</i> (Hamilton)	Chala puti	
		8. <i>P. conchoni</i> (Hamilton)	Kanchan puti	
		9. <i>P. stigma</i> (Day)	Puti	
		10. <i>P. ticto</i> (Hamilton)	Tit puti	
		11. <i>P. sophore</i> (Hamilton)	Jat puti	
		12. <i>P. phutunio</i> (Hamilton)	Phutani puti	
		13. <i>Rasbora daniconius</i> (Hamilton)	Darkina	
River shad	Clupeidae	14. <i>Tenuulosa ilisha</i> (Hamilton)	Ilish	
		15. <i>Gudusia chapra</i> (Hamilton)	Chapila	
		16. <i>Corica soborna</i> (Hamilton)	Kachki	
Catfish	Sisoridae	17. <i>Bagarius bagarius</i> (Hamilton)	Baghair	
		18. <i>Gagata gagata</i> (Hamilton)	Gang tengra	
Catfish	Siluridae	19. <i>Wallago attu</i> (Bloch & Schneider)	Boal	
Butter catfish		20. <i>Ompok pabda</i> (Hamilton)	Madhu pabda	
		21. <i>O. bimaculatus</i> (Bloch)	Kani pabda	
Catfish	Pangasiidae	22. <i>Pangasius pangasius</i> (Hamilton)	Pangas	
	Schilbeidae	23. <i>Eutropiichthys vacha</i> (Hamilton)	Bacha	
24. <i>Clupisoma garua</i> (Hamilton)		Ghaura		
25. <i>Ailia coila</i> (Hamilton)		Kajuli		
Catfish		Bagridae	26. <i>Mystus seenghala</i> (Sykes)	Guizza air
			27. <i>M. aor</i> (Hamilton)	Ayre
			28. <i>M. gulis</i> (Hamilton)	Nuna tengra
	29. <i>M. vittatus</i> (Bloch)		Tengra	
30. <i>M. cavasius</i> (Hamilton)	Kabashi tengra			
31. <i>Ailichthys punctata</i> (Day)	Kajuli			
Featherback	Notopteridae	32. <i>Notopterus notopterus</i> (Pallas)	Foli	
		33. <i>N. chitala</i> (Hamilton)	Chital	
Mud perch	Nandidae	34. <i>Nandus nandus</i> (L.)	Meni / Bheda	
Murrel	Channidae	35. <i>Channa striatus</i> (Bloch)	Shol	
		36. <i>C. punctatus</i> (Bloch)	Taki / Lati	
		37. <i>C. gachua</i> (Hamilton)	Cheng	
Perch	Anabantidae	38. <i>Anabas testudineus</i> (Bloch)	Koi	
Spiny eel	Mastacembelidae	39. <i>Mastacembelus armatus</i> (Lacepede)	Baim / Salbaim	
		40. <i>M. pancalus</i> (Hamilton)	Guchi/Chirka	
		41. <i>Macroglyptus aculeatus</i> (Bloch)	Tara baim	
Gar fish	Belontiidae	42. <i>Xenentodon cancila</i> (Hamilton)	Kakila	
Gobies	Gobiidae	43. <i>Glossogobius giuris</i> (Hamilton)	Bele / Bailla	

(Source : Ghosh 2001, Mortuza *et al.* 1995, Sarker 1997, Khatun 1994, Hossain and Afroze 1991, Rahman 1989)

Discussion

Water flow in most study rivers decreases alarmingly especially in winter season due to water withdrawal and flow diversion by damming the principal and major rivers of this division. Due to low flow in winter, many rivers have silted up (Rahman 2000, Hossain 1992), consequently breeding and nursery grounds of most riverine fish species have decreased drastically. During rainy season, sluice gates of all dams in India kept open to pass huge surface run-off and Bangladesh gets flood every year. In addition to flush flood, huge and strong water flow creates erosion in many rivers especially in the rivers Bangali, Brahmaputra, Dharla, Jamuna, Karatoa and Teesta. Siltation and pollution are the major natural and anthropogenic factors for the loss of fish habitats.

Due to loss of breeding and nursery habitats, many fish species are not able to reproduce in the wild, consequently fish diversity and density have decreased in many study rivers. Extinction of fish species is an ultimate result of habitat loss and over-fishing.

Conclusions

Most rivers of Rajshahi division are going to be dead day by day due to siltation and low flow. This study suggests that these rivers should be dredged to protect and conserve fish habitats and, riverine fish and fisheries. However, in reality, dredging of river systems is a costly operation, which needs International aid and cooperation. Considering the cost of dredging, it is recommended to dredge a stretch of 5 to 10 km of each river, which will act as a fish sanctuary of that particular river. Moreover, the dredged stretch of the river may be used as a source of domestic water supply for the nearest city/town. To prevent from drying up of most rivers it is necessary to maintain natural water flow. Therefore, it is recommended to implement International Water Policy/Law (EU, 2000) to get natural flow from shared or common rivers originating in India. It is also recommended to undertake detail studies on geo-morphology, ecology and fish production of the rivers of Rajshahi division in order to formulate guidelines for the management, protection and conservation of fish habitats and fish and fisheries.

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