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IMPACT ASSESSMENT OF SLUICE GATE ON FISHING ACTIVITY, FISHERIES DIVERSITY, RIVERINE HABITABILITY AND LIVELIHOOD STABILITY OF THE FISHERMEN IN THE NORTHWESTERN BANGLADESH

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ABSTRACT

The present study was conducted at the Baral river adjacent area of both Charghat sluice gate of Charghat upazila and Baraigram sluice gate of Baraigram upazila under Rajshahi and Natore district of Bangladesh respectively during the period of May 2006 to April 2007 aiming to assess the sluice gate impact on fishing activity, fisheries diversity, riverine habitability and livelihood stability of the fishermen implying the gear, catch and environmental assessment survey, in-depth interview and participatory rural appraisal through *in situ* observation. The sluice gate impacted the fishing activity of the fishermen reducing or modifying the type, structure and number of gear, emphasizing to use minute meshed gear, restricting species and gear selectivity, increasing fishing effort and intensity and decreasing catch composition under limited operating periods. The sluice gate pessimistically affected the fisheries diversity reducing the type and number of fish species including prawn, decreasing their overall and local status and thrown them miserably in extinct, endangered, vulnerable and threatened position where abundance, availability and breeding of most species dominantly hampered, changed or reduced. The sluice gate created seasonal fluctuations of watered, inundated, ditched and arid condition among aquatic habitat where substituted household, degraded cropland, broken down riverbank and sedimentation built Chars among the terrestrial habitat in the Baral. The sluice gate drastically affected the livelihood stability throw inadequate, insufficient and lower category of all the assets where incapable to full scale use of individual and group fishing and other activities by the fishermen in the Baral river.

KEYWORDS: Baral River, Sluice Gate, Impact, Fishermen, Bangladesh

INTRODUCTION

The water management of the Flood Control and Drainage (FCD) systems in Bangladesh which are affected by many problems due to growing demand for better performance, conflicting water uses and inadequate organization and management. The primary objective of the FCD systems is to increase agricultural production, which has been accomplished to a large extent. However, the agricultural needs and hydrological conditions have undergone radical changes. For example, irrigated rice demands careful water management to maximize output. There is a need for integrated water management – this call for the involvement of the community as a prerequisite (Choudhury 2000). Careful water management is required in Bangladesh to get optimal results from the flood control, drainage and irrigation (FCDI) systems, in terms of developing sluice gate and enabling fishermen to achieve a reasonable living. Riverbanks around the reclaimed areas (sluice gate) provide protection against river, or its floods, or against riverbank breakdown. Many inland schemes have field depressions, called Beel (Ali & Schultz 2001).

According to the Government of Bangladesh, the primary objective of water management schemes is to increase agricultural production through the provision of one or a combination of FCDI system. The FCDI system's elements,

design criteria, types and characteristics of the FCDI scheme, performance analysis of the FCDI activities and their impacts on agriculture, riverine areas, fisheries production and water management are mentionable in this regards (Ali 2002). The FCDI scheme heavily depend upon dredging, Riverbank, polder and gravity drainage to manage floods, together with the effects of sluice gate, highways and railroads which obstruct the flow of water and in some cases aggravates the flood situation. To reduce the losses from floods as well as to use the surplus water for irrigation purpose, the Bangladesh Water Development Board constructed a number of Riverbanks and sluice gates and dug canals under some major projects like – Ganges Kobadak Irrigation Project, Karnafuli Multipurpose Project, Brahmaputra Right Riverbank Project, Manu River Project, Pabna Irrigation Project, Tista barrage project etc (Chowdhury & Hossain 2006).

The Baral river is one of the important offshoots of Padma river at the north-western part of Bangladesh that originated on the left bank of the Padma at Charghat upazila proper, almost 2 km south from the Sardah police circle at Rajshahi district and flows in a winding eastwardly course through the southern portion of this district till to passes after joining with the Atrai-Gumani river through Natore and Pabna district and finally mingles with the Hurasagar river after joining with the Koratoya river at the south of the Shahjadpur of Sirajgonj district. The Baral river has a total average length of 147 km, width of 125 m, depth of 6 m and drainage area about 230 sq km (Baby 2006). The Baral River receives water about 7 to 8 months (May to December) from the Padma only in the monsoon as watery season and other times (January to April) passed on as dry or off season. But it maintains flow throughout the year with local runoff water, water from Chalan Beel (flood plain) and other canals those are linking with its. Some important places located on the banks of the Baral River are - Charghat, Bagatipara, Baraigram, Gurudaspur, Chatmohor and Bera. The Baral River is also renowned by its fishermen who are living here as ethnic group of fishing community followed by traditional fishing since time immemorial. In most cases fishing is a seasonal and part-time occupation for them. They usually consumed the exploited fishes for their household need and rare in sometime, they sold either to the middlemen of the fish traders on the riverbank after just caught or sold by themselves as a retailer in nearby fish markets or as a mobile seller in rural villages through bicycle or head/shoulder bearing pot. But, when this two sluice gate built over the Baral river, then the large scope of fishing activity decreases day by day and also adversely affect on fisheries diversity, riverine habitability and livelihoods stability in the adjacent sluice gate area. However, there is no such specific literature notably on fishing activity, fisheries diversity, riverine habitability and livelihood stability, but it has potentiality to develop the future plan and progressive way for its fishermen. Therefore, the present study was carried out aiming to assess the sluice gate impact on fishing activity, fisheries diversity, riverine habitability and livelihood stability of fishermen of the Baral River in Bangladesh.

MATERIALS AND METHODS

The Baral river has two sluice gates situated at two different places of which - one at Charghat upazila proper of Rajshahi district known as ‘Charghat sluice gate’ and another is at Atghoria village of Baraigram upazila of Natore district known as ‘Baraigram sluice gate’ under the construction of Bangladesh water development board (BWDB) aimed to control flood water from inundation and also hold its excess water for irrigation purposes. The geo-code for the Baral river has latitude 24.3 and longitude 89.1 of which Charghat sluice gate has latitude 24.17 and longitude 88.45 and Baraigram sluice gate has latitude 24.16 and longitude 89.13 respectively (Figure 1). The present study was carried out for a total period of twelve months during May 2006 to April 2007 at the Baral river adjacent area of the mentioned two sluice gates. A total of 50 fishermen (25 from each sluice gate area) were randomly interviewed to collect various types of data for this study purpose. The study was conducted on the basis of both quantitative and qualitative data, comprehensive literature review and extracts of the local knowledge and information supplied by the on spot fishermen of the Baral River during the periods of investigation.

The quantitative data were collected from different secondary sources including fisheries, agriculture, statistics, education, BWDB, youth development, etc official authority in government sectors and BRAC, ASA, TMSS, Proshika, Caritas etc official authority in non-government sectors who were available or existed in both Charghat and Baraigram upazila during the study periods. From these sectors, different field surveyed reports, publications, project works and booklets of recent five years were quantitatively collected to choke out its data related with the present study objectives. On the other hand, it was precisely attempted to collect the qualitative data from the recommendation domain, potential key informant, fishers field school (FFS), household participant or respondent of the fishermen and womenfolk who were the exploiters or catchers in the Baral river around the sluice gate areas. The qualitative data were collected with the visiting schedule through using of different methods and techniques which are includes - gear assessment survey (GAS), catch assessment survey (CAS), environmental assessment survey (EAS), in-depth interview (IDI) and participatory rural appraisal (PRA). All types of data were collected fortnightly from the direct spot through *in situ* observation in the Baral River. All of the collected data were accumulated and binded according to the sequence of collection. The processed data were transferred to a master sheet from which classified into different tables were prepared revealing the findings of the study. These data were manipulated or verified to eliminate all possible errors and inconsistencies.

RESULTS AND DISCUSSIONS

Cenarios of the Sluice Gate

The two sluice gates have been built over the Baral River in the present study area, of which distance between each other is about 30 km. The founder of the both sluice gate is Bangladesh Water Development Board (BWDB). The present scenarios of the two sluice gates are given in Table 1. The sluice gate is a structure built across a stream, river or estuary to store or control water that is usually of two basic types – masonry (concrete made) and riverbank (earth-fill or rock-fill made). A sluice-gate is used to supply water for human consumption, irrigation purpose and industrial use, to reduce peak discharge of floodwater, to increase the volume of water stored for generating hydroelectric power or to increase the depth of water so as to improve navigation that provide professional and recreation activity. Therefore a sluice gate is the central structure in a multi-purpose scheme aiming at the conservation of water resources maintaining water level to controlling by opening and closing gates and acts as the safety valve (Bari 2006; Lin et al. 2002 and Fu et al. 2001). The rapid opening of the sluice gate caused a sudden and significant fall in the upstream water level with the water surface downstream of the gate. The vertical pressure distribution became a hydrostatic pressure at a distance equal to twice the initial upstream water depth. Partial opening of the sluice gate allowed post-turbulent equilibrium water levels of discharge (Yamada 1992). Discharge characteristics for a sluice gate, ranging between the two extreme cases of a side sluice gate and a normal sluice gate have been explored. The behavior of the elementary discharge for large ranges of the upstream water depth to gate opening ratio, tail-water depth to gate opening ratio and skew angle were found (Swamee et al. 2000). The hydraulic characteristics of a side sluice gate were remains constant along with related to the main channel and the ratio of upstream depth of flow to sluice gate opened for free flow (Masoud 2003).

Table 1: Comparative Scenarios between Sluice Gate 1 and Sluice Gate 2

Scenarios	Sluice Gate 1	Sluice Gate 2
Official name	Water regulator	Water regulator
Local name	Charghat sluice gate	Baraigram sluice gate
Position	Charghat Bazar	Atghoria village
Location	About 400 m at northern side of Charghat upazila headquarter and one km at southern side of Sardah police academy, Rajshahi district, Bangladesh.	About 10 km at southern side of Baraigram upazila headquarter and about 15 km at northern side of Dayarampur police cantonment, Natore district, Bangladesh.
Founder	BWDB, Rajshahi.	BWDB, Natore.

Table 1: Contd.,

Project name	Baral river basin project	Baral river basin project
Aim/Objectives	- To control flood from inundation - To supply water for irrigation	- To control flood from inundation - To supply water for irrigation
Established (yr)	1984-1985	1995-1996
Regulatory gate (no)	3.0	5.0
Length (m/gate)	1.3	1.5
Height (m/gate)	4.3	3.5
Width (m/gate)	0.6	0.9
Weight (ton/gate)	3.0	4.2
Bridge length (m)	4.0	7.5
Expenditure (Tk)	32.5 millions	42.5 millions
Construction (type)	Reinforced concrete casting	Reinforced concrete casting
Gate opened (date)	10 May	10 July
Gate closed (date)	20 August	20 September
Gate operation (period)	3 Months +/- 10 Days	2 Months +/- 10 Days
Gate operator (MLSS)	2 persons (alternative)	1 person (consolidate)
Gate repairing (type)	Gate fitting, concrete block fitting	Gate fitting, concrete block fitting
Gate repairing (no)	4-5 times from establish	2-3 times from establish
Last repairing (yr)	2001	2000
Riverbank foment (yr)	2004	2003
Riverbank foment (type)	100 millions concrete block fitting (proposed but not found)	100 millions concrete block fitting (proposed but not found)
Riverbank foment (Tk)	7.5 millions	7.5 millions
Inside outlook	Baral river	Baral river
Outside outlook	Padma river	Baral river
River direction between two sluice gate (place)	Charghat Upazila)→Rustompur→Momenpur→Arani→Lukmanpur→ Galimpur→Malanchi→Dayarampur→Atghoria→Baraigram (Upazila).	

Assessment of Sluice Gate Impact on Fishing Activity

The sluice gate negatively or pessimistically affected on the type, structure, construction, operation, number variation, catch per unit effort (CPUE), species or gear selectivity, catch composition etc of the fishing gear operated by the fishermen in the Baral river. Seldom adversely affected to the mesh size, accessibility, fishing intensity and fishing duration or spend time. The major or adverse pessimistic impacts of the sluice gate are mentioned in Table 2. It was found that the relative use and efficiency of fishing gears in the Chandpur irrigation project area during the period from 1977 to 1979. The use of gill nets and cast nets remained relatively constant throughout the entire period of study. The relative efficiency of the different fishing gears for catching fishes showed (Khaleque & Islam 1985) markedly similar to the present study in the Baral River.

Assessment of Sluice Gate Impact on Fisheries Diversity

The sluice gate optimistically as well as pessimistically affected on the fisheries diversity existed in the Baral River. In most cases, these impacts occurred especially on the species types, species status, seasonal abundance, and breeding period of the fish and fisheries related species caught by the fishermen in the Baral. In the species types, a total number of 260 species of freshwater fishes with 40 species of fisheries related items including prawn should have existed in the river. But in the present evidence, a good number of these species has been extinct or declined. In the species status, the species those existed in the river but now to be had in threatened, vulnerable or in endangered conditions in most cases. Among the total species all were not available in the whole season but only abundant in distinct season and some of them strictly changed their naturally breeding periods. This entire phenomenon occurred due to sluice gate obstacle, riverbed up rise and water crisis in the Baral River. The pessimistic impacts of the sluice gate on the fisheries diversity are attempted to identified and mentioned very briefly in Table 3.

The capture fisheries were also seriously affected by the impact of the Pabna Irrigation and Rural Development Project (PIRDP) Riverbank in Pabna. This has obstructed fish migration and reduced areas of open water habitats for fishes, such as beel, canals and floodplain. It is estimated that the floodplain area has been reduced by 47% (from 11707 to 6208 hectares) and fish production of 75% (from 11082 to 2811 tons) over the period 1984 to 1990. It is also stated that there are 138 villages of fishing communities in the project area. Because of the decline in open water capture fisheries, the number of full time fishermen has fallen while the number of part-times has increased (Anon, 1991). It is reported that the annual catch per unit area (CPUA) from regulated rivers (191 kg/ha) inside the PIRDP were generally found lower than that of unregulated river in the north-west (485 kg/ha) and north-central (321 kg/ha) regions of Bangladesh. Within the PIRDP, values of CPUA varied between sites with the highest value observed at Gangbhanga (177 kg/ha) and the lowest at Alnar (155 kg/ha) beel/flood plain. A total annual number of fish species recorded from low elevation floodplains inside (64 species) scheme was 41% lower than outside (91 species) scheme of the project (FAP-17 1994). A mark-recapture programme at the PIRDP site in north-west Bangladesh showed that *Catla catla*, *Channa striata* and *Wallago attu* migrated through the sluice gates, both with and against prevailing currents in different seasons, while the smaller *Anabas testudineus*, *Glossogobius giuris* and *Puntius sophore* did not. Species assemblages were significantly different inside and outside the FCDI schemes, with up to 25 species absent or less abundant inside compared to outside. The majority of these species were large predators or conspicuous members of the highly prized migratory 'whitefish' category, including Silurid catfish, Indian major carps, Mullets and Clupeids. In their absence, species inside FCDI schemes were dominated by much smaller resident 'blackfish' species. Assemblages inside FCDI schemes thus had both reduced species richness and the unit value reduced by up to 25%. It was concluded that FCDI schemes such as the PIRDP negatively affect fish species assemblages and stock values, by reducing the accessibility of impounded floodplains to migrant fish. Though some fish are capable of penetrating existing sluice gates, management measures are required to encourage the passage of more species (Halls et al.1998).

The Ganges flood plains contain various types of water bodies (ponds, beel, baor, flooded lands, rivers etc) which total area under water is relatively constant but the areas under flooded lands are gradually declining because of various interventions by humans like Farakka barrage, coastal Riverbank project and FCDI are probable reasons behind fall in capture fishery by 30%, beel fishery by 40%, flood plain fishery by 26% and the combined river and estuarine catch by 31% (Islam et al. 1998). The fisheries resources of the Barnai (FCD) project area found during July 1992 to June 1994 identifying fish and fisheries species, total production of fish catch/ha, annual growth rate, estimated water areas etc before and after the FCD project. About 126 fish and 13 fisheries species have been identified. A good number of fishes such as – *Hilsa ilisha*, *Pangasius pangasius*, *Setipinna phasa*, *Nandus nandus*, *Silonia silondia*, *Bagarius bagarius*, *Eutropiichthys vocha*, *Channa gachua* and *Trygon* sp. are now threatened after the implementation of the FCD project. Exotic carp, *Oreochromis* sp., *Puntius gonionotus*, *Clarias gariepinus* etc have been widely cultured in the Barnai project area. The total fish production of the Barnai project area has increased nearly 125 metric tons within 10 years after the commissioning of the FCD project. The production of rivers and canals, beels, flood lands and ponds are 66 kg, 350 kg, 60 kg and 1050 kg/hectare respectively. The annual growth rate of rivers and canals, beels, flood lands and ponds were obtained as 3.5%, 3.2%, 5.1% and 5% respectively. The total annual growth rate of fish of the Barnai (FCD) project area was calculated as 0.5%. However, the annual population growth rate of that area is more than 2%. The total water area of the Barnai (FCD) project area (10900 ha) was estimated as rivers and canals 525 ha, beels 1325 ha, flood lands 7500 ha and ponds 1550 ha (Mortuza et al. 2001).

Assessment of Sluice Gate Impact on Riverine Habitability

Through the environmental assessment survey and eye witness *in situ* observation, the present conditions of the riverine habitability of the Baral River were appraised. The result found major two categories of the riverine habitability such as aquatic habitats (*e.g.* watered, inundated, ditched, arid, etc) and terrestrial habitats (*e.g.* household, cropland, Riverbank, chars, etc) of the Baral river. Most of these habitats have been the positive or negative results after built of two sluice gates over the Baral River. Among aquatic habitats, the watered condition of the Baral river found from early monsoon to early winter (May to November) seasons receiving water from the Padma River, Chalan beel/flood plain, etc and water from local runoff that directly pertained with the fishing activity and hold fisheries diversity for the fishermen. The inundated condition of the Baral often found at the middle of the watered condition from early autumn to late autumn (July to September) seasons when flooded its adjacent household, cropland and locality that strictly hampered the fishing activity very much due to its overflow water. The ditched condition of the Baral found from early winter to late winter (November to January) seasons when the water level fall down so as to be divided the river into several ditch like water bodies which can be new dimensions to perform cage, pen and community based fisheries management here. Finally, arid condition of the Baral found from early summer to late summer (February to April) seasons when it was totally dysfunctional non-fishing dried habitat that left the fishermen to another off-fishing or subsistence works to lead their livelihood stability (Figure 2).

Among terrestrial habitats, the household of the fishermen situated on the bank or near adjacent to the Baral where they living. But when drought (cyclonic storm broken down the household) and flood (promoted to be migrated to other household) occurred due to sluice gate largely influenced their household leading livelihoods and made them vulnerable as so they had to changed their fishing profession to another subsistence works. Cropland of the fishermen found at the both side of the Baral River was used as small scale and seasonal crop farming land. But the soil was not so good to handful production because of silt deposition and routinely seasonal fluctuation of river water that overturn the soil layer throughout the year. Mostly one or rarely two crops found to be harvested around the year and production was in susceptible range even decreased day by day due to water crisis very much in dry season here. Riverbank could be helped to high-quality fishing activity for the fishermen, but now it was broken down very roughly by the much current water flow in monsoon or flood time due to narrow space of the sluice gate. Chars or sandbars were formed (as too large size and too high that not submerged during the flood time) at the mouth of Charghat sluice gate of the Baral river by the deposition and sedimentation of the huge amount of silt carried out from the near Padma river. It was greatly hindered to freely inflow of river water due to upraise its riverbed and as a result inundated often the nearest household, cropland and locality. It also disconnected the Baral River and aversely increased water pressure during monsoon due to built of sluice gate and no necessary steps were taken to be removed or dragged the Chars by the government. All of these phenomenons perceived due to sluice gate adverse affects, mentioned briefly in Table 4.

The sedimentation, riverbank erosion, riverbed uplifting, sandbar or Char formation are some of endemic and recurrent natural hazards for the declining aquatic habitat of the Baral river, especially during the mature stage due to heavy down pour or flood when it become sluggish and meander or braid by massive oscillations of wave and currents of water flow. Every year, thousands of people are affected by these hazards which destroy farm and homestead land, housing structure, standing crop, poultry and livestock, vegetation, household utensil and communication system. Losses of theses asset, force the peoples to move at new places without any option and put them in disastrous situation to obliged drawn savings and often fall into further debt (Alam & Chowdhury 2006; Islam 2006). A local reporter (Charghat upazila) stated that about one lakh hectares agriculture land decrease fertility due to construction of sluice gate on Baral River. The sluice

gate over the Baral river now becomes a death-trap for peoples living here. Its river bed raises gradually by the reason of sedimentation much. The production of Rabi crops reduce for water crisis in dry season. Also the income-way of thousands of fishermen comes to an end here (Nayadiganta 2006). Farakka dam, Riverbanks and sedimentation are the three major factors causing the decreases in the natural habitats available for major carps. Over fishing is the most important factor linked to decline of major carps in the inland open waters of the river system (Tsai & Ali 1985).

Assessment of Sluice Gate Impact on Livelihood Stability

Basically the fishermen livelihoods were comprised with three principal elements – Firstly the assets (human, physical, social, natural and financial capital); Secondly the capabilities (individual fishing, group fishing, net weaving, fish trading etc) and thirdly the activities (fishing, fishery-related, non-fishing, and off-fishing etc). The sluice gate optimistically as well as pessimistically influenced on all these elements of the livelihood stabilities by the fishermen is given in Table 5.

CONCLUSIONS

The both sluice gate of the Baral River impacted optimistically as well as pessimistically on the fishing activity, fisheries diversity, riverine habitability and livelihood stability but the environmental negative affects are dominant in the present situation. All government and non-government sector related with this environmental development should come forward to take appropriate operation or alternative measures to minimize or reduce the adverse affects of the sluice gate on both environment and fishers who are trying to stable their livelihoods.

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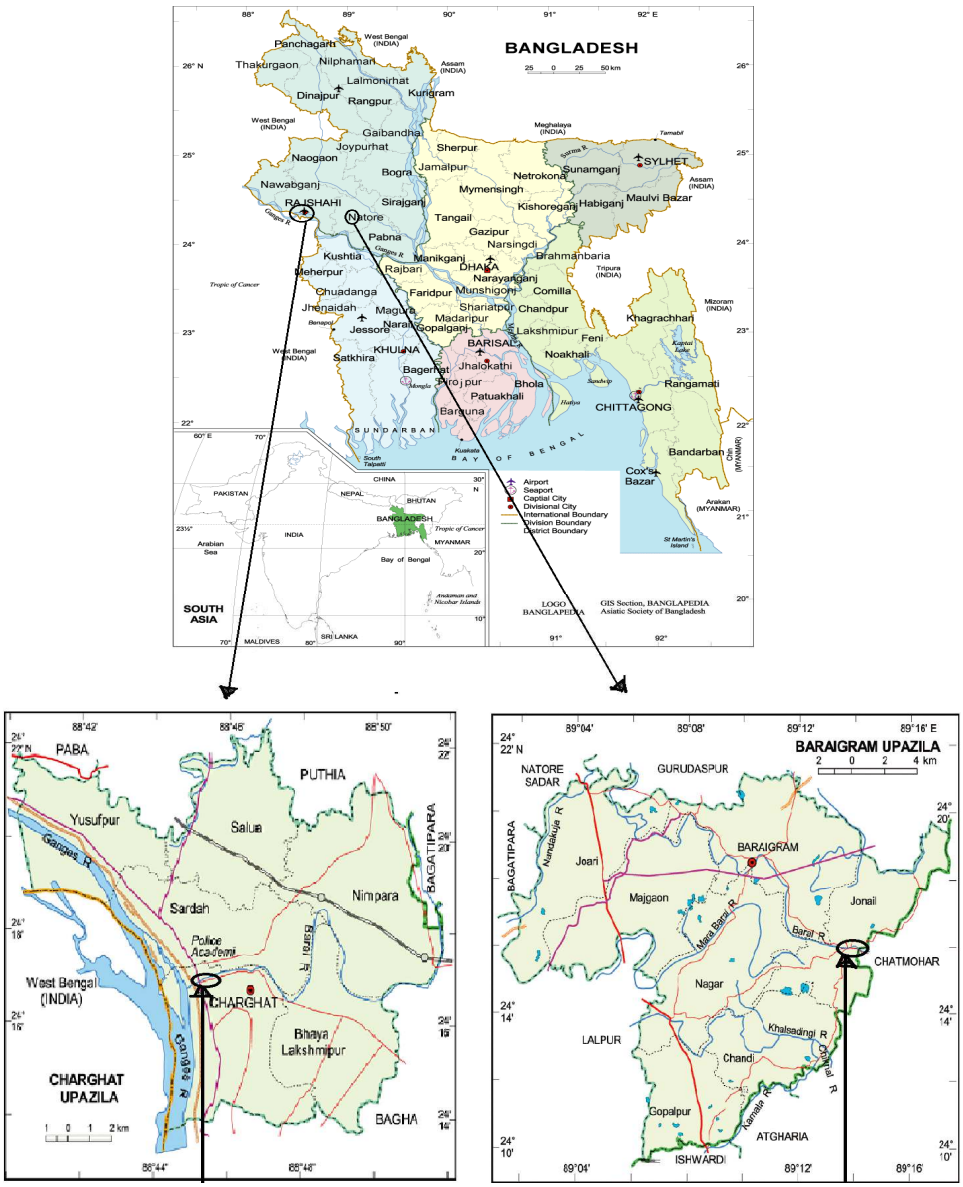
APPENDICES



Sluice Gate 1: Charghat Slucie Gate **Sluice Gate 2: Baraigram Slucie Gate**

Figure 1: Showing Position of Sluice Gate 1 and Sluice Gate 2 in the Baral River, Northwestern Bangladesh (Source: Google Map)

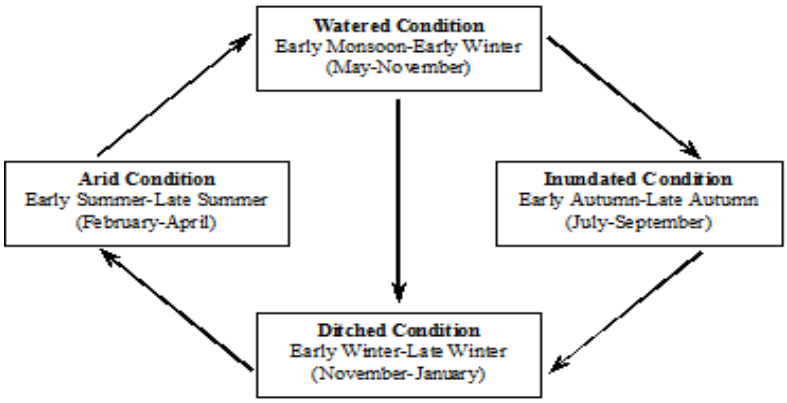


Figure 2: Cyclic View of Seasonal Fluctuations of the Aquatic Habitats of the Baral River, Northwestern Bangladesh

Table 2: Pessimistic Impacts on Fishing Activities of the Fishermen in the Baral River, Northwestern Bangladesh

S. No	Fishing Activities	Pessimistic Impacts
1	Gear type	Comparing with the parent river Padma and on all around rivers of Baral only 12 types of fishing gear found to be operated here due to seasonal watery condition of the sluice gate areas.
2	Structure	Fishermen have to be structurally modified some fishing gears to increase their fishing effort and intensity due to built of sluice gate.
3	Construction	Minute meshed even some locally moderated shape and size fishing gear constructed to catch all types of fishes that alarming us to be decreased fisheries diversity in the Baral river.
4	Operation	Very limited of gear operating period, harvesting duration and encircling area for the engaged fishermen due to shortage water depth after built of sluice gate on the Baral.
5	Number variation	Number of fishing gear varied diurnally as well as fortnightly in respect of time consumed for fishing activity and performed to other subsistence works for its fishermen due to sluice gate.
6	Catch per unit effort (CPUE)	To contribution of species by the number or weight the CPUE in every gear decreased day after day due to insufficient water of sluice gate concern area.
7	Species or gear selectivity	Species selection towards gear and gear selection by fishermen were restricted and limited to diminished fishing activity in sluice gate water crisis area.
8	Catch composition	Catch composition of every species per gear also controlled for limitation of fisheries diversity due to built of sluice gate.
9	Fishing intensity and duration	Fishermen increased their number of fishing gear and fishing haul and spent time or duration behind exploitation to be obtained a handful catch, but never had they been caught due to construction of sluice gate.

Table 3: Pessimistic Impacts on Fisheries Diversities in the Baral River, Northwestern Bangladesh

S. No	Fisheries Diversities	Pessimistic Impacts
1	Species type	A total number of 260 species of freshwater fishes with 40 species of fisheries related items including prawn not found in spite of transitional sluice gate area between two rivers. Amongst the total fish and fisheries related species, about 37 species are available in the fishing.
2	Species overall status	The present overall status of species despondently decreasing their number and thrown them ultimately in the threatened position. Overall status was examined as small indigenous fish species (19.8%), large indigenous fish species (5.8%), self recruit fish species (21.5%), exotic fish species (9.9%), threatened fish species (32.2%) and fisheries related species (10.8%).
3	Species local status	Most of the species are miserably in extinct, endangered, vulnerable and threatened in locally as well as in IUCN status in the Baral river which warning us red alert for the next other species. Local status was examined as extinct (2.5%), extinct in wild (3.3%), critically endangered (3.3%), endangered (4.1%), vulnerable (6.6%), near threatened (8.3%), least concern (11.6%), rare (9.9%), very few (13.2%), few (14.9%), common (16.5%) and very common (5.8%).
4	Species abundance	Mostly abundant in monsoon but not found in whole season due to water crisis in the Baral.
5	Seasonal availability	Most of the fish species only abundant in Monsoon and Winter, while Summer season left to dry due to sluice gate construction.
6	Breeding period	Breeding period of most fish species is hampered, changed or reduced due to construction of sluice-gate.

Table 4: Optimistic and Pessimistic Impacts on Riverine Habitabilities of the Baral River, Northwestern Bangladesh

S.No	Riverine Habitabilities	Optimistic Impacts	Pessimistic Impacts
	Aquatic Habitats		
1	Watered	Increased more fishing activity for professional and subsistence fishermen from month of May to December in the Baral river.	Baral hold water only 7 to 8 months and thrown the fishermen to off fishing or non fishing activities.
2	Inundated	Influenced most of fishes and fisheries items to breed in time intervals and exposed them to develop their fry & fingerlings.	Waterlogged at mouth side & adjacent locality of the Baral for the long duration of flood or inundation.
3	Ditched	Scope to perform cage, pen and community based fisheries management stocking fries and fingerlings from sources.	Ditch like water bodies left to dry and not picked up such management yet.
4	Arid	Scope to culture fish species by stocked fingerlings in newly formed its small, narrow ditches or swamp after water dropped.	During Summer, the Baral river left to dry or arid condition and water crisis very much here for its sluice gate impact.
	Terrestrial Habitats		
5	Household	After substitution household land would be used in cropping for rice and pulse cultivation when water dropped or fall.	Most households were substituted during flood in every year and opposed to migrated others places.
6	Cropland	Caused crop rotation, turned up soil plane and deposited silt to improved soil fertility for cultivation of crops.	Degraded crop land type, changed crops persistency, and decreased production, texture and quality of soils.
7	Riverbank	No positive impact found.	Water pressures, currents and wave actions of sluice gates areas enforced to broken down Riverbank.
8	Sedimentation	No positive impact found.	Raised riverbed, dropped water depth, blocked river mouth and built sandbar or Char due to sluice gate.

Table 5: Optimistic and Pessimistic Impacts on Livelihood Stabilities of the Fishermen

Livelihood Stabilities	Optimistic Impacts	Pessimistic Impacts
Fishermen Assets/Capitals		
• Human asset	No positive impact found.	Inadequate even lack of labour to the fishing activity during off season.
• Physical asset	Can be used full scale of labour beyond fishing.	Insufficient of boat, gear, market facility, river-side household, ice plant etc.
• Social asset	Able to community based fisheries management.	Treated throughout socio-contextual issues, lower status than other caste, etc.
• Natural asset	No positive impact found.	Water scarcity, bank erosion, sedimentation, chars forming, fisheries diversity declined.
• Financial asset	Fishing might subsistence but not full time jobs.	Poor income through less caught fishes, low price of fishing efforts, labour, etc.
Fishermen Capabilities		
• Individual fishing	Able to carry out total fishing catch and income.	Decreased due to cost of gear, raising gear intensity and shortage of water.
• Group fishing	Benefited by non-cashed labored.	Low priced labour, intermediaries involving, much time consuming, etc.
• Net weaving	No positive impact found.	No used in off-season, high price of net twine but lower labor cost to make.
• Fish trading	No positive impact found.	Poor fishery and marketing facility with high cost and intermediaries involving.

Table 5: Contd.,

Fishermen Activities		
• Fishing	May to December in watery season.	Insufficient catch due to less water, more number of fishermen engaged at a time.
• Fishery-related	No positive impact found.	Difficult to initiate fishery related activity in sluice gate area of the Baral.
• Off-fishing	No positive impact found.	Net weaving, net preserving, boat making etc limited in 3 to 4 months in Baral and mentioned lower standard in other rivers.
• Non-fishing	No positive impact found.	Actually nobody gave non-fishing activity to so called lower status fishermen.