OCCASIONAL PAPER

28

NO VOICE, NO CHOICE: RIVERINE CHANGES AND HUMAN VULNERABILITY IN THE 'CHARS' OF MALDA AND MURSHIDABAD

Jenia Mukherjee

July 2011

INSTITUTE OF DEVELOPMENT STUDIES KOLKATA

DD-27/D Salt Lake City, Sector - 1
Kolkata - 700 064
Phone : +91 (33) 23213120/21 Fax : +91 (33) 23213119
e-mail : idsk1@vsnl.net, Website : www.idsk.edu.in

No voice, no choice: Riverine changes and human vulnerability in the 'chars' of Malda and Murshidabad

Jenia Mukherjee*

Abstract

The paper attempts to study the ecological history of 'chars' (bars or sandy shoals) in the two districts of West Bengal – Malda and Murshidabad, which are a part of the Lower Gangetic Basin (LGB). 'Chars' are sandy shoals that emerge as an aftermath of river-bank erosion that engulfs one part of the land and gives rise to another patch on its other side. The shifting of the Ganges as a long-term phenomenon, constantly shaping and reshaping the territory of LGB is evident from historical records. Erosion and land re-allocation are age-old problems along the bank of the Ganges. The erosion of vast stretches of land and subsequent emergence of 'chars' have been in progress for the last 200 years or so. But with the construction of the Farakka Barrage in 1975, the entire process of erosion/sedimentation has augmented leading to the rise of 'existing' or 'running chars' in the study-area. Several large 'chars' have come up in the last few decades along with the opening up of deep channels which has in turn affected the linear path of the river. The construction of the Farakka Barrage has caused huge sedimentation, increasing flood intensity and aggravating tendency of bank failures in both Malda (upstream) and Murshidabad (downstream).

These geological patches ('chars') are the emblem of uncertainty, poverty, vulnerability, border disputes between states and countries and lack of governance leading to the exercise of different forms of crime and criminality. Due to the continuous emergence, submergence, re-emergence and re-submergence of the 'chars', we find that the people living in the 'chars' (the erosion victims) suffer from the 'SDRR' (settlement> displacement>re-settlement>re-displacement) syndrome where hazard (mainly in the form of river-bank erosion and inundation) easily gets transformed into disaster as, Disaster = Hazard x Vulnerability. People have moved between four to 16 times in the last 15 years in some of these newly developed running/existing 'chars'. But what binds them here? Why do they return again to these fragile landscapes as soon as water recedes? How do they cope?

The paper has reflected on some of these crucial issues.

* Assistant Professor, History of Ecology and Environment, Institute of Development Studies Kolkata

Bar Formation: A General Understanding

William M. Davis pointed out long ago (1899) "…a river is seen to be a moving mixture of water and waste."[1] If we minutely observe the flow of a river, we find that the smallest fragments among the detritus make a rapid journey from the point where the river receives them to their final resting place in the sea. But many of the detrital pieces step and stop for a long period of time. The continuous blanket of detritus that forms the bed of an alluvial stream has an even-gradient usually. However, it may have numerous subaqueous undulations caused by distribution of some of the bed material in disjunct concentrations known as bars. The bars migrate gradually downstream as a result of their being filled out on their downstream sides by material washed from their upstream slopes; they may be completely destroyed by a great flood which, however, leaves new ones when it subsides.

The common types of bars which occur in alluvium streams include: alternate bars, middle bars and point bars. To study bar formation we need to have a thorough understanding of the mechanics of flow and sediment transport of a river controlling bed morphology in river bends. A bar formation depends on a number of factors such as: w/d (width/depth) ratio in the bend, sinuosity (ratio of channel length to valley length), human activities and most importantly, the very interaction between 'system' and 'environmental' variables (Table 1).

TABLE: 1

System variables	Environmental Variables
Weathering process	Climatic characteristics
Transport process	Geology
Sediment discharge	Topography and slope
Solute concentration	Vegetation
Sediment quality	Tectonic activity

(Source: Ian Statham, Earth Surface Sediment Transport, Oxford : Clarendon Press, 1977)

The Lower Gangetic Basin: Past and Present

To understand 'char' formation in Malda and Murshidabad districts of West Bengal, first we need to trace the course of the River Ganges in its lower section.

Many changes have occurred in the hydrography of the LGB during the past centuries of which we have information from fragmented sources such as: old scriptures, records of administrative and revenue divisions, travellers' accounts, etc. Ptolemy's account is a powerful source of our knowledge as we find here a depiction of all the major streams of the Ganges Delta. He had provided more or less correct latitudinal and longitudinal locations of their mouths. His account is important because though he made "a mistake of about four minutes to a degree in the calculation of longitude, but it is quite easy to locate the rivers he mentioned."[2] From the early maps we get to know the geographical details of the basin, mainly the lower part. Mention may be made of the early Portuguese explorers and cartographers of 16th century like: De Barro and Gastaldi who had provided the oldest of modern maps of the Ganges Delta,[3] and the Dutch explorer Matheus Van den Brouche of 17th century. These maps can be regarded as predecessors of the first correct map of the rivers of Bengal by Major James Rennell after his long survey of the Bengal Province between 1764 and 1779. However, these have certain cartographic lacunae and hence need to be studied cautiously.[4]

By a comparison of Matheus Van den Brouche and Major James Rennell's maps we can trace the route of the Ganges in Bengal and find out that 17th and 18th centuries were periods of great changes.[5]

From Van den Brouche's map we find:

- The Bhagirathi, through which the waters of the Ganges used to pass from the 12th – 16th centuries, is no longer the main stream of the river. The Padma channel, which is shown as a broad, braiding stream, entwining numerous large islands, now carries the bulk of the Ganges waters.
- The Bhagirathi, however, is still connected with the Ganges, north of Murshidabad, and serves as its western distributary. The only island shown in the Bhagirathi is the one near its off-lake from the Ganges. South of this island it meanders freely.

- Besides the Bhagirathi, the Jalangi and Chandna are the only major distributaries of the Ganges. Both these streams have a south-western course, and the Jalangi joins the Bhagirathi from the east near its Damodar confluence.

The salient features of Rennell's map were:

- The Padma is the main channel of the Ganges which flows independently to the sea without uniting with either the Brahmaputra or the Meghna. The meanders of the Ganges between Rajsahi and Goalundo are more pronounced on this map than that of Van den Brouche's.
- The Bhagirathi has been further reduced, its connection with the Ganges functioning only during the rains. Among the active distributaries of the Ganges are the Chandna and Jalangi.

The evolution of the present drainage system is the result of changes that had occurred since the last two hundred years.

In the second decade of the 20th century, the course of the Ganges between Rajmahal and Farakka was straight and aligned in a south-easterly direction. This course is described in the topographical sheet bearing No.72 P/13 (1:63360), surveyed in the year 1922-23. This is a changed course of the river as previously Ganges flowed along an altogether different course dashing Gour, the medieval capital town of Bengal, as reflected in the writings of R.K. Mukherjee[6] and Sir J.N.Sarkar.[7] Major Hirst (1915) attributed the subsequent changes of the course of river to tectonic causes and apprehended that there was a severe earthquake in 1505 A.D. shortly after which the Ganges left its old course past Gour and retreated southwards. There were two other distributaries of the Ganges namely Choto Bhagirathi and Pagla which joined each other near Mehdipur and flowed southeast to join Mahananda. The latter subsequently discharged into the Padma near Godagarhi Ghat of Rajshahi (Bangladesh). In the process of this migration, Kalindri, Choto Bhagirathi and Pagla were left moribund. The capital town of Gour, which flourished in the 15th and 16th centuries, was located on the interfluve between Kalindri and Bhagirathi. The decay of these two distributaries might have been a slow process covering several centuries. There are historical references of medieval riverine route between Chittagong and Gour. The medieval navigation route must have been through Padma-

Mahananda-Kalindri or Choto Bhagirathi. The bulk of the Ganges water must have flown through this course; otherwise it could hardly facilitate navigation. The lower Mahananda below old Malda must have been a part of the Ganges. The decline of Gour after 1575 A.D. may be attributed to the changing course of the Ganges system. These changes must have taken place much before Rennell pursued the survey during 1764-1779 as his map depicts the course of Ganges flowing far south of Gour.

The construction of the Farakka Barrage has brought a major change in the topography and hydrography of the study-area. Below Rajmahal the river is divided in two with Bhutni Diara (the large mid-stream island existing for more than hundred years) in between. As the eastern channel has dried up due to siltation, the river now flows through the western channel. On the eastern side of Bhutni, a branch of Koshi River (Mara Koshi) and Fulhar (a tributary of Mahananda) have joined Ganges. From the meeting point of Fulhar and Ganges, Kalindri has emerged. It has later merged with Mahananda at Nimasarai Ghat of Malda city. Bhagirathi (not to be confused with the main Bhagirathi) and Pagla after emerging from Mathurapur and Khasmahal have flown in the east, later merging with each other near Malda-Bangladesh border had merged with Mahananda. The delta of Ganges can be said to start from Farakka in West Bengal. The river divides into two arms about 40 km south-east below Farakka at Khejurtala village in Murshidabad district. The right arm of the river (which was the original course of Ganges) continues to flow south in West Bengal in the name of the Bhagirathi (called Hooghly in its downstream stretch) and crosses 500 km. to the sea. The left arm of the main Ganges flows into Bangladesh after flowing along the border of Murshidabad for 60 km. in the name of Padma, joined by the Brahmaputra and the Meghna Rivers, and all these rivers form this huge delta before ultimately falling into the Bay of Bengal.

The Construction of the Farakka Barrage: Cause and Impact

As we have already seen from the two maps (Van Den Brouche and Rennell), that since the 17th century the Bhagirathi became a much narrow outlet of the Ganges and the Padma became voluminous. The Farakka Barrage was constructed to serve the need of preservation and maintenance of the Calcutta Port by

improving the regime and navigability of the Bhagirathi-Hoogly River system. As the Calcutta Port was located 120 km north of the delta, it was never an ideal port for the movement of big vessels. Before the construction of the Calcutta Port, the Bhagirathi lost its connection from the main channel of the Ganges. From 17th century account of Jean-Baptiste Travernier we find that at Suti the main source of the Ganges was filled up with sand and sediment.[8] Between 1768 and 1777 the Bhagirathi almost remained dry in the winter months.[9] Jalangi and Mathabhanga were the alternative channel-routes for the movement of steamers. But these two channels also lost their importance in the last decade of the 19th century.[10]

From the middle of 19th century the British became anxious about the future of the Calcutta Port and started thinking about the feasibility of an alternative port construction. In a report to the British Government, the Secretary of the Bengal Chamber of Commerce wrote, “I am directed by the Committee of the Bengal Chamber of Commerce, to solicit the favour of your bringing to the notice of the most noble Governor of Bengal, the difficult and dangerous state of the navigation of the river Hooghly, which threatens, at no distant period, to render access to the port of Calcutta altogether impracticable for any vessel but those of the smallest tonnage.”[11] Port Canning was constructed between 1865 and 1866. But due to the problem of sediment accumulation, this port also had a limited lifeline till 1871 only.

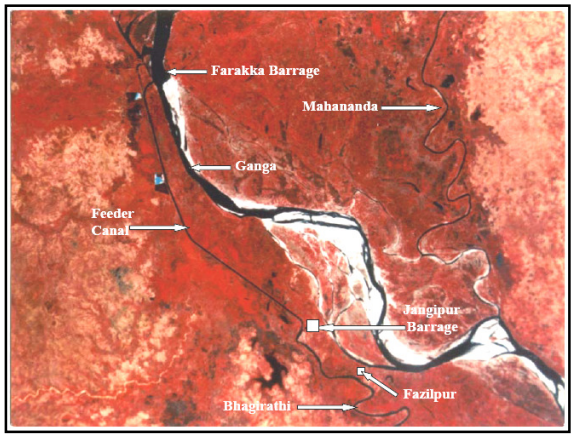
Several methods to bring more water into the Bhagirathi River failed. In June, 1931, only 19 cusec water flowed into the river at Jangipur.[12] The distributaries that feed the river like Mayurakshi, Ajay, Damodar, Rupnarayan and Haldi and smaller outlets like Pagla, Banslai, etc. in the western side and Jalangi and Mathabhanga-Churni in the eastern side carry huge amount of silt and the construction of a number of dams over the western-side distributaries has reduced the capacity of the channels to drain the silt in the sea even in the rainy seasons.[13]

In spite of these difficulties the survival of the Calcutta Port was extremely important. The plan for the construction of a barrage on Ganges near Rajmahal and the creation of a feeder canal to bring the surplus water from the Ganges to the Bhagirathi River first surfaced in the opinion of Sir Atherton in 1853.[14] In the post-

independence period, the question of revival of Calcutta Port seemed to be a vital issue. In 1957, the internationally renowned river expert Dr. Walter Henson was invited in India to provide technical solution to the problem. After thorough investigation, Henson reflected, "The best and only technical solution of the problem is the construction of a barrage across the Ganges at Farakka with which the upland discharge into the Bhagirathi-Hooghly can be regulated as planned and with which the long-term deterioration in the Hooghly can be stopped and possibly converted into a gradual improvement...The tidal reach will be improved and the frequency and intensity of bores will be decreased."[15]

The Farakka Barrage project was started in 1962 and was completed in 1971. The excavation of the 38km.long feeder canal took about four years and the project was commissioned on 21st May, 1975. In its 196th report, the Public Accounts Committee reflected, "The Committee are greatly perturbed to find that while in 1961 and again in 1965, it was decided that in view of the character of the project, its essentiality and the benefits which were likely to be derived from the various works, it should be completed by 1970-71, in actual fact only the barrage was completed in 1971, but the essential canal work for taking the headwaters from the Ganga to feed the Bhagirathi-Hooghly system and save the deterioration in the Calcutta Port was completed only four years later in 1975."[16]

Fig. 1: Layout of the Farakka Barrage Project



(Source: Kalyan Rudra, The Encroaching Ganga and Social Conflicts: The Case of West Bengal, India, p. 7.)

Table: 2: Salient features of the Farakka Barrage Project

A. Farakka Barrage	
Length :	2.62 Km
Number of Bays :	109
Span of Each Bay :	18.30 m
Lowest Bed Level :	10.30 m above m.s.l.
Pond Level :	21.90 m above m.s.l.
Crest Level of Spillway :	15.80 m above m.s.l.
Crest Level of Under Sluices and River Sluices :	14.30 m above m.s.l.
B. Head Regulator	
Pond Level :	21.90 m above m.s.l.
Full Supply Level at Land :	1133 cumec
Clear Water Way :	11 bays of 12.20 m each
Crest Level :	18.10 m above m.s.l.
C. Feeder Canal :	
Length :	38.30 km
Design Discharge :	1133 cumec
Bed Width :	150.80 m
Full Supply Depth :	6.10 m
D. Jangipur Barrage :	
Length :	212.70 m
Number of Bays :	15
Span of Each Bay :	12.2 m
Crest Level :	14.30 m above m.s.l.

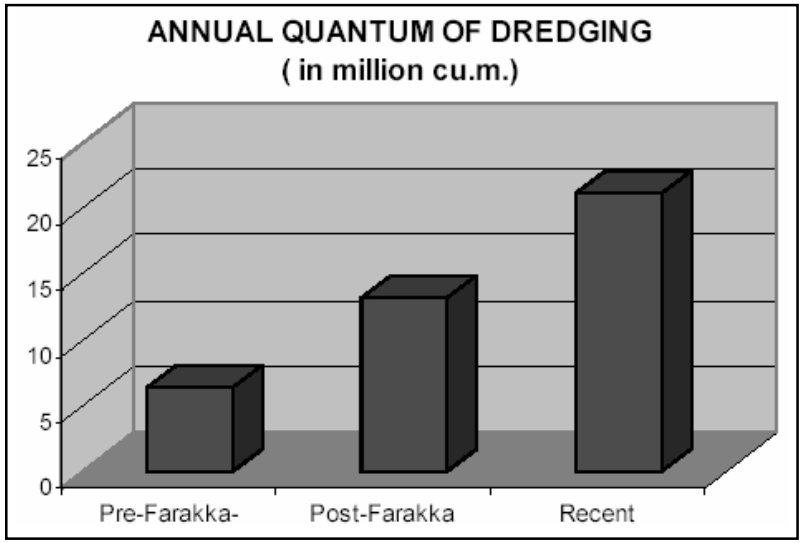
(Source: S.K. Basu, A Geotechnical Assessment of the Farakka Barrage Project, Murshidabad and Malda Districts, West Bengal, Geological Survey of India, Bull.No.4, pp.2-3.)

The barrage was built with the pious intention of inducing water into the Hooghly River with a view to flush the sediment load into the deeper part of estuary to retain the navigational status of the Calcutta Port. The 2.64 km long Farakka Barrage was designed to divert 40,000 cusecs (1133 cumec) of Ganges water to Bhagirathi. However, there is a huge gap between the real purpose and the actual outcome.

The induced water through Ganges-Bhagirathi feeder canal was supposed to flush the sediment load from the estuary and keep the navigation channel free from siltation. But sedimentation in the

estuary continues unabated. It is admitted in the published document of the Calcutta Port Trust that induced discharge from Farakka Barrage had not been able to negate the estuarine sedimentation.[17] The annual quantum of dredging has increased from 6.40m.m3 during pre-Farakka days to 13.24m.m3 during post-Farakka days,[18] which has further been increased to 21.18m.m3 per annum during 1999-2003.[19]

Fig. 2: Pre-Farakka (till 1975); Post-Farakka (1976-1994); Recent (1999-2003)



(Source: Kalyan Rudra, ibid, p. 9.)

There is an obvious relationship between Farakka Barrage construction and river-bank erosion in Malda and Murshidabad. The direction of the river flow has been altered and it is no longer co-axial to the barrage due to the reduction of the cross-sectional area and gradual meander formation between Rajmahal hills and Farakka. Being oblique, the flow concentrates more towards the right side of the barrage causing swelling of water during the peak of the monsoon.[20]

In Malda the total eroded land between 1979 and 2004 had been 4247 hectares. More than 200 sq. km. of fertile land had been swept away till 2004.[21] The dimension of loss of livelihoods can be seen in the loss of 61.10 sq. km agricultural lands, 25 sq. km

orchards, 85 sq. km settled land, 7 sq. km wetlands and 13 sq. km other lands totalling 191.10 sq. km in the last one decade. In 2001 itself, 2, 500 (approx) families in Malda were displaced.[22] Since the last three to four decades five community development blocks are being more or less affected by erosion: Manikchak, Kaliachak 1, Kaliachak 2, Kaliachak 3 and Ratua. According to the report of the Committee set up by Planning Commission (1996) nearly 4.5 lakhs of people have lost their homes due to left bank erosion and 22 mouzas have gone in the river of Manickchak, Kaliachak 1 and Kaliachak 2.[23] Over the last three decades 500 sq. km of land and about 2 million people, from about 40 village panchayats in Manickchak, Kaliachak 1 and Kaliachak 2 and English bazaar block have been affected by flood and erosion.

Fig. 3: The five most vulnerable community development blocks

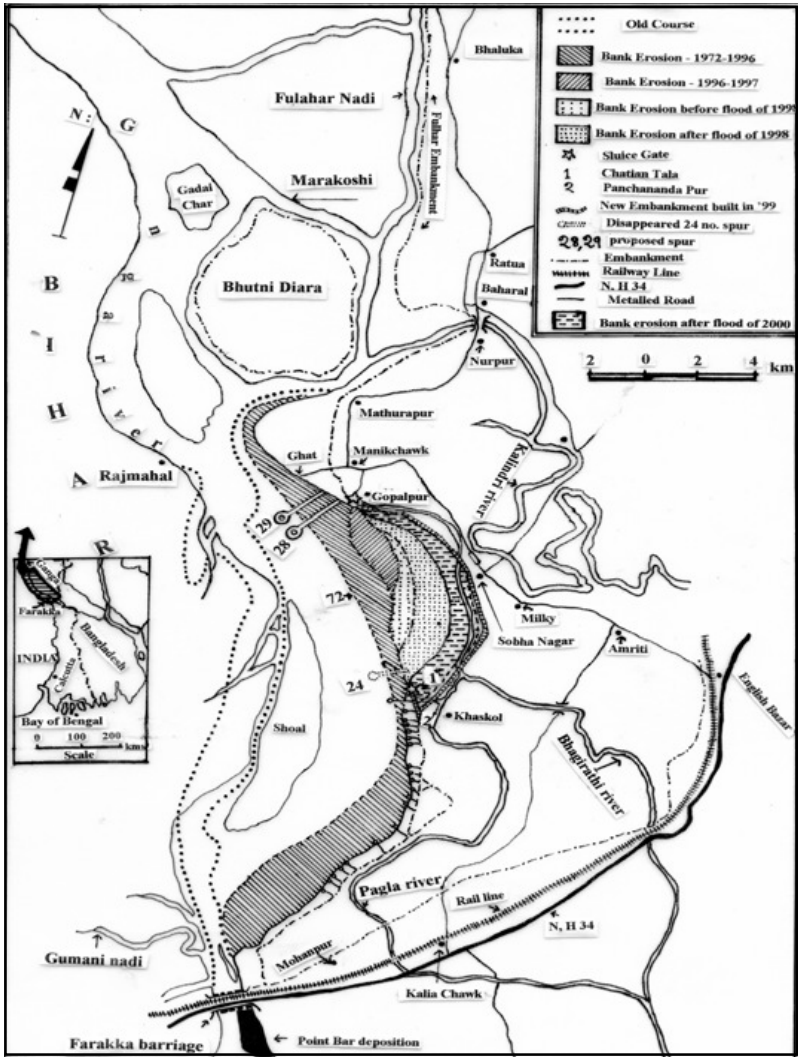
(Source: *Regional & Institutional Profile of Malda District,* http://wbplan.gov.in/docs/DHDR/Draft_DHDR_Malda/DHDR_Chapter1.doc., date of access: June 23, 2010)

Table 3: Left bank erosion by the Ganges in the Malda district (Upsteam from the Farakka Barrage)

Years	Maximum approximate bank-length affecte (kilometers	Approximate erosiom width (m) (metres)	Land loss (hectares)	Approximate maximum discharge ('000 cusecs)	Maximum water-level (metres)
1931-1978	—	—	14335	—	—
1979	5.0	200	60	42.80	22.90
1980	7.0	150	105	73.00	24.80
1981	11.0	400	260	57.00	23.70
1982	5.0	150	65	68.00	24.80
1983	5.0	200	90	60.50	24.90
1984	7.0	100	70	61.40	24.80
1985	6.0	150	90	57.30	24.30
1986	6.0	200	105	49.80	24.20
1987	8.0	300	240	73.90	25.40
1988	7.0	100	70	68.00	25.10
1989	10.0	150	150	36.80	22.90
1990	8.0	200	160	55.50	24.20
1991	11.0	150	170	69.70	25.30
1992	9.0	150	130	46.40	23.90
1993	7.0	200	145	54.20	—
1994	7.0	1250	160	67.90	24.90
1995	8.0	200	145	49.80	24.00
1996	15.0	250	310	71.00	25.10
1997	6.0	100	60	47.70	24.10
1998	10.0	900	330	75.90	25.40

(Source: Superintending Engineer, Farakka Barrage Project, reproduced from Showkat Iqbal, 'Flood and Erosion Induced Population Displacements: A Socio-economic Case Study in the Gangetic Riverine Tract at Malda District, West Bengal, India', Journal of Human Ecology, vol. 30, no. 3, p. 204)

Fig. 4: River Bank erosion along the Ganges, upstream of the Barrage



(Source: Sutapa Mukhopadhyay and Malay Mukhopadhyay, *Bank Erosion of River Ganga, Eastern India – A Threat to Environmental Systems Management*, http://www.quebec2007.ca/pdf/salle204a/seance21/articles/s_mukhopadhyay.pdf, date of access: June 22, 2011)

So far as the district of Murshidabad is concerned the rotational bank failures between the Farakka Barrage and Jalangi, a stretch

of about 100 km, has been severe. The human impact of this has been massive. While about one million people are displaced every year by flood and erosion in Bangladesh; it is no less than 10,000 people who are evicted every year from their homelands by erosion in Murshidabad district alone.[24] In mid-1970s, in Dhulian and its adjoining areas about 50,000 people became homeless. The encroaching river wiped out 50 mouzas and engulfed about 10,000 hectares of fertile land. A large part of the interfluve, lying between the Bhagirathi and Padma with an area of about 77 sq. km. between Nayansukh and Giria, disappeared forever between 1925 and 1974.[25] Thus the map of this area has been changed beyond recognition. This is evident when we compare the older topo-sheet published by the Survey of India in 1925 and the recent satellite images.[26] Farakka, Samserganj, Suti I, Suti II, Raghunathganj II, Lalgola, Bhagwangola I, Bhagwangola II, Raninagar I, Raninagar II and Jalangi face the problem of bank erosion massively year after year.

The following table provides a comprehensive picture of land loss and population displacement during 1988-1994 in Murshidabad District:

Table 4: Land Loss and Population Displacement during 1988-1994

Year	Eroded in sq. km.	Families Affected	Population Displaced (Projected)
1988	4.35	872	4,360
1989	107.00	8,875	44,475
1990	7.50	612	3,060
1991	8.90	763	3,815
1992	34.00	1,197	5,985
1993	19.00	1,099	5,495
1994	25.85	818	12,000
Total	**206.60**	**14,236**	**79,190**

(Source: Kalyan Rudra, ibid, p. 32)

The 'Chars' in Malda and Murshidabad: Addressing the issue of human vulnerability

The human impact of continuous bank-erosion[27] and sedimentation in Malda and Murshidabad has been tremendous leading to

displacement, eviction, loss of land and property, making the areas vulnerability prone. Vulnerabilities to natural hazards are not equally distributed[28] and exposure to risk and vulnerability depends on certain factors such as: unstable global patterns of settlement, resource management, social organization, political economy, etc. It is important to mention Terry Cannon's concept of 'political economy of vulnerability' (i.e. ranking the people from more to less vulnerable along a continuum from total resilience at one end to total susceptibility, at the other taking into account the various political, economic and geographical components of vulnerability) in this context.[29] Human vulnerability is a constant reality for the rural poor in any developing region where livelihood insecurity forms a key component of human poverty. Any coincident ecological or economic shock thus directly affects livelihood opportunities among vulnerable sections of the rural population whose livelihoods become even more insecure. But the problem does not end here, and the erosion victims in the 'chars' face all these problems (vulnerabilities) along with additional ones getting entangled with the problem of 'special/ added vulnerability' which regresses human development to its absolute maximum.

The construction of the Farakka Barrage has disturbed the apparent equilibrium condition and the river started to adjust this huge human interference by aggradations and degradation of its bed and channel pattern by erosion and siltation. In the post-barrage condition, the normal sediment transport system has been intercepted due to controlled operation of the barrage gates and the river bed on upstream started aggrading with the change of erosion/deposition pattern of river bed and banks. The new sand islands ('chars') have come up gradually with the general rise in river bed level and formation of deep narrow thalweg on left side. The normal flood level has increased with reduction in channel capacity. This has increased the flood intensity on upstream at lesser discharge in post barrage situation which could be noticed in Malda district in during last two decades.[30] The river has dumped so much sand behind the barrage that the river-bed has risen over 70 meters.

From historical record we find the shifting of the Ganges is a long-term phenomenon that has constantly shaped and reshaped the territorial history of the Malda district. In 1595, Man Singh decided to build a new capital for the Mughal Subah of Bengal at the new

upriver site of Rajmahal (now in Jharkhand) on the west bank of the Ganges. Eventually in 1826, the place named Tandah was swallowed by the river and its site remerged much later as a Diara char. Initially, the location of the new capital at Rajmahal or Akbarnagar was favourable, because of its accessibility by river and its impregnability in view of the natural protection afforded to it by the Rajmahal hills. The temporary shift of the Subah headquarters from Rajmahal to Jahangirnagar or Dhaka thus took place for strategic rather than ecological reasons and in 1639, Shah Shuja shifted the capital of the Subah back to Rajmahal and also extended the city further. However, the Ganges appears to have oscillated in the opposite direction at this point of time, gradually yielding new 'chars' and 'diaras' along its right-bank which reduced the impregnability of the city. When Mir Jumla transferred the headquarters of the Subah back to Dhaka in 1660, the river had shifted more than 4 km away from the city, leaving Rajmahal as yet another medieval relic city along the shifting trajectories of the Ganges.

Erosion and land reallocation is an age-old problem along the bank of the Ganges. The erosion of vast stretches of land and subsequent emergence of 'chars' have been in progress for last 200 years or so. Major Henry Thomas Colebrooke, in his paper 'On the courses of the Ganges through Bangal', described the devastation caused by the river in the Murshidabad district. He noted: "The quantity of land, which has been destroyed by the river in course of a few years, will amount, upon most moderate calculation, to 40 square miles, or 25,600 acres: but this is counter-balanced, in a great measure, by alluviation which has taken place on the opposite shore."[31] In the late 19th century, W. W. Hunter (1876) observed that an acre of land was engulfed by the gnawing Padma within half an hour.[32] Captain W. Sherwill accounted on the emergence and submergence of 'chars' and wrote, "Islands become inhabited, cleared and cultivated; population increases, large village start up, land revenue is collected for ten or twelve years; then fabric will disappear within one rainy season."[33]

But the riverine change in the post-Farakka situation has played a massive role in the rise of the new running or existing 'chars' in Malda and Murshidabad and brought vagaries to the life of the erosion-victims living in these fragile land patches. A scientific

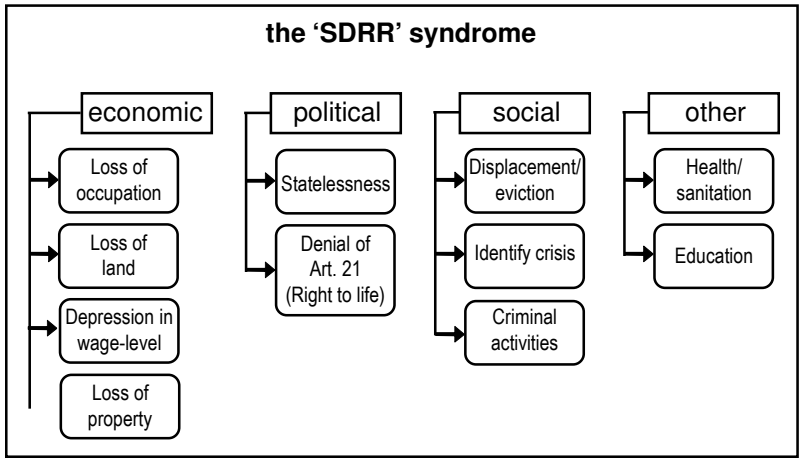
explanation of the emergence and submergence of running 'chars' has been provided by Supriya Sengupta. He argues that accumulated silt leads to the rise of a sand-bed ('char') in the interfluves; being obstructed by this bed the river then divides into two channels with the 'char' in between. This makes the flow oblique. The flow gets obstructed with the river-bank eventually causing river-bank erosion. The eroded silt and sediment is carried by the river which again accumulates to form a 'char', and the cycle continues.[34]

It is important to understand the different types of 'chars' in this context. Broadly 'chars' in our study-area can be classified into the dead, mature and running or existing chars as per their duration of existence. The dead 'chars' is the one which has not faced any significant change due to fluvial action for the last few decades. The 'chars' which has not faced any significant change due to fluvial action for the last 10-15 years is known as the mature char. The existing or running 'chars' are those land patches which face regular changes due to the action of the river and continuously emerge and submerge, the process being known as 'Sikasti' (land that gets eroded) and 'Payasti' (newly formed or emerged land) in the local dialect. The duration of existence largely determines the intensity of vulnerability in the 'chars'.

Several large 'chars' in Malda have come up since the last few decades such as the Gadai Char and the Dakatia Char along with the opening up of deep channels which has in turn affected the linear path of the river. The Hamidpur Char have come up in this district. The appearance, disappearance and re-appearance of charlands in Panchanandapore in Malda district have become a regular phenomenon. In Murshidabad also the same process has been active leading to the Nirmal Char and the Jalangi charlands.

The erosion victims in these uncertain patches are affected with the 'SDRR' (settlement, displacement, resettlement and re-displacement) syndrome due to the continuous emergence, submergence, re-emergence and re-submergence of the chars. People have moved between four to 16 times in the last 15 years! Thus, human vulnerability takes an added dimension in the existing charlands and the erosion victims get afflicted with a special and added form of erosion and flood-induced actuality.

Illustration 1: The problems faced by the erosion victims in the existing charlands



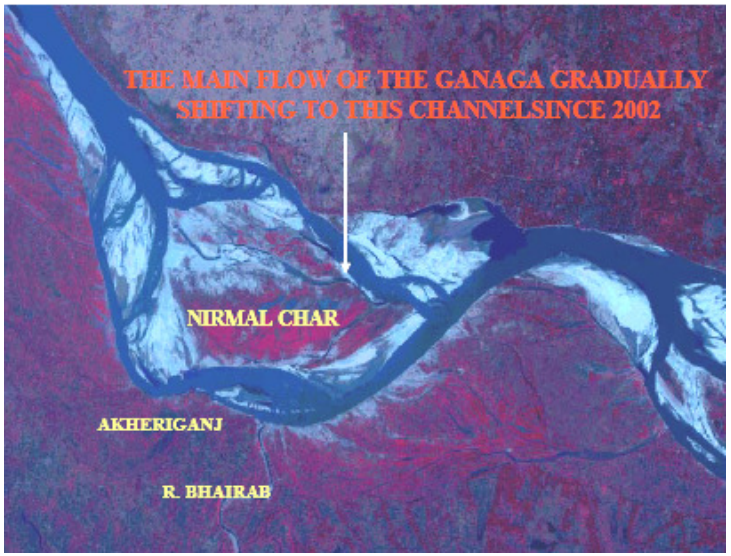
The people who migrate and settle in the newly emerged char lands lead a life under the shadow of poverty and insecurity. The erosion and resultant homelessness cause an oversupply of agricultural labour in the fertile 'chars' engaging the labourers at a wage lower than the minimum fixed by the government. In the Malda 'chars', the average daily wage of adults working in the chars is even less than Rs. 60.

There are no hospitals in the 'chars'. An expecting woman has to be taken 10 kms away by boat to the mainland. Thirteen expecting women died due to lack of timely medical attention in the past one year from the Malda chars. Most children suffer from malnutrition. Even schemes like pulse polio are a far cry in most chars. Fifteen to twenty children die on an average, of malnutrition every year in the 'chars' of the Malda district.

The problem is not confined to that of erosion and displacement; there also exists the border problem as the Murshidabad 'chars' have developed towards Bangladesh. As per official estimate, till 1992-94 more than 10,000 hectares of 'chars' have come up at places which have become inaccessible from the Indian side but can be reached easily from Bangladesh. The erosion wiped away boundary posts at many places creating border dispute. Akheriganj, which literally means the last settlement, virtually disappeared from the map when the 1989-1900 erosion struck it. The disastrous

erosion engulfed 2,766 houses and left 23,394 persons homeless.[35] Many erosion-victims migrated to the newly emerged Nirmal Char along the opposite bank. A population of 20,000 lives in an area of 50 sq. km. in Nirmal Char. From here Rajshahi town of Bangladesh can be reached within 45 minutes on road, whereas to come to the mainland of India one has to cross the mighty Padma which will take more than three hours. Moreover the basic infrastructure provided here is far too poor and the people's plight is further heightened by negligence of the mainland administration. Since there is no primary health centre, people go to Rajshahi for treatment. The concept of international border is very much flexible due to basic problems of living.

Fig. 5: Nirmal Char



(Source: Kalyan Rudra, ibid, p. 31.)

Instances of fighting for harvesting with Bangladeshi cultivators have been reported again and again apart from the usual problem of allotting created land to the rightful owners. Once again the question of Bangladeshi infiltrators, the recent fiasco over ISI agents has increased in this district due to these 'chars' areas.[36] The Jalangi Char has been cultivated by the Bangladeshi nationals in spite of strong protest by the Indian Government. In April 1993, a joint survey was conducted to ascertain the boundary on the 'chars', but

Bangladesh subsequently declined to accept this newly identified boundary. Certainly, Bangladesh has a better access to the 'chars' and it is also often difficult for the district authorities of Murshidabad to provide proper security to the new settlers there.[37]

This cross-border conflict not only has an inter dimension, but it also has intra-level of complexities. In Malda, 'chars' have created problem with the adjoining state of Bihar. Mouzas on the charlands like Piarpore, Paranpur, Palashghacha, Kanchi Jadupur, Srighar, Begamganj, Dogachchi, Daskathia, Nityanandapur, Mangatppur, Hosenabad, Hakimabad, Jituagar inhabited by one and half lakh people, can be accessed from Paglar Ghat in two hours by boat, it does not have a single health centre or primary school and the administration there is of Bihar. Yet for registration of land one has to come to Malda since the land belongs to Malda officially. In the census handbook these places are shown to be part of Malda. A strange kind of dual stateship prevails here. Those displaced have ration cards and voter ID cards issued to them by the West Bengal government. In the words of the victims of the Malda coastal erosion, "If we know which administration we belong to, we could figure out our rights and make necessary demands." The newly emerged clusters of settlement 'chars' are not acknowledged as revenue villages. The people suffer from the irony of dual citizenship. Even the village headman of Hamidpur char, Pullesh has received a voter card from Jharkhand and ration card from West Bengal. Again, though the Jharkhand government has issued voter's ID card, job applications made to Jharkhand state are rejected as they are considered outsiders.

Fig. 6: Pullesh, the village headman of Hamidpur char

(Source: A Photo Essay on '"Ganga Bhangan" and the Child Campaign by NSHM CRY Volunteers, http://www.slideshare.net/guest3c47bab1/ganga-bhangan-and-the-child, date of access: July 20, 2010.)

Human life on 'chars' lacks facilities of sanitation, education, medical treatment, market, and even drinking water. People have no access to government service. People have regressed in human development terms. Article 21 of the Indian Constitution has ensured right to life for every citizen. The Supreme Court of the country has stated in a landmark judgment that "The right to life under article 21 means something more than survival or human existence. It would include the right to live with human dignity. It would include all those aspects of life which go to make a man's life meaningful, complete and worth living…any act which offends against or impairs human dignity would constitute deprivation pro tanto of right to live" (Supreme Court, 1981). But erosion-victims of Malda and Murshidabad 'chars' are denied of this right. They are compelled to live in a subhuman condition.

Women are the worst sufferers in these fragile landscapes. Landlessness has forced women to take up the additional burden of providing financial support to the family apart from adjusting with extreme domestic hardships. In entering the market, the major options before them are to be a laborer in the thriving bidi industry both in Malda and Murshidabad or to be couriers in the smuggling nexus. The first occupation has engaged girls from their pre-adolescence stage, took them away from schools and forced them to unhealthy conditions. The latter is even more degrading in terms of sexual harassment and lack of security. Brian O'Neil in 'Women and Displacement: A Case Study of Women displaced by Ganga erosion in Malda district of West Bengal in India' has also reflected on the issue of gender inequality among the erosion-victims in Malda. He mentions, "Class, caste, ethnicity, gender, disability and age are the other factors that have affected people's vulnerability to this kind of disaster situation. It was also found out that even though this kind of disaster and the subsequent displacement of human population affect both men and women, it is women who have suffered more."[38] From field surveys conducted, O'Neil's study revealed the fact that women are not a homogenous category and the degree of their vulnerability and sufferings in times of displacement depended on their socially significant personal attributes like age, religion, education and household aspects like asset owning (mainly land), presence of male members, number of times of being displaced, place of relocation, and so on. For example,

belonging to a particular religious category determines the degree of women's vulnerability in times of displacement. As found during the fieldwork, the deserted and widows among the Muslims get a lot of help from certain practices like Fetura, Zakat and Asul, prevalent among the Muslims, which define the imperative of helping the poor. Recently, Priyanka Dutta's paper on 'Migration as source of risk-aversion among the environmental refugees: The case of women displaced by erosion of the river Ganga in the Malda district of West Bengal, India' has also highlighted the same issue.[39] She has added that through these charities Muslim widows sustain themselves and hence they have a lesser tendency to migrate.[40]

Remedial Strategies to Mitigate the Crisis

A large number of flood mitigation measures were implemented by the government since the enunciation of the National Policy on Flood (management) in 1954. All the remedial measures that have been implemented to mitigate crisis such as the construction of 30 km embankment, 27 spurs and revetments, etc. proved to be ineffective owing to the gradual shifting of the Ganges towards the left bank upstream of the Farakka Barrage. Major portions of the seven retired embankments and spurs have been washed out. The spurs have created additional problems rather than mitigating them. In addition to the trapped sediment load, tons of boulders which are used for anti-erosion works along the banks, are too often dislodged and deposited into the river. The construction of a 100-m long spur requires 14357 tons of boulders. Out of 27 spurs constructed so far upstream of the Farakka Barrage, 20 spurs have been fully or partially swept away. Spur Nos. 18, 20 and 24 which were recently re-constructed have also been out-flanked. The flow of the river gets obstructed by accumulated sediments, boulders and ruins of the eroded villages. The current is thus deflected causing severe bank-erosion.[41]

Fig. 7: Local residents on a stretch of the broken embankment

(Source: S.S. Chattopadhyay, 'Ravaged by a river', Frontline, vol. 20, issue 20, September 27 - October 10, 2003)

"The construction of embankments does not offer any guarantee against flood yet the engineer- contractor-politician nexus operates in the same fashion every year. And then come the announcement of State Irrigation Minister Debabrata Bandopadhyay on August 19, that the state government has launched a Rs. 1200 crores project to combat floods and repair embankments in the state," observes Manisha Banerjee.[42]

People living on 'chars' cannot avail themselves of government schemes that are meant to benefit the poor, like the National Rural Employment Guarantee Act (NREGA) which provides 100 days of guaranteed work to all rural households. [43] While river-bank erosion has been continuing year after year, causing displacement of numerous people in the region, the only organized rehabilitation initiative for these displaced families can be found at the Bangitola Field, on the way to Pagla Ghat in Panchanandapur. Lack of proper coordination between block offices and panchayats adds to the sufferings of the displaced people. The government did initiate rehabilitation and compensation programmes, but they have been mostly ad-hoc and haphazard, with little long term planning. Women are systematically ignored in the resettlement process in terms of both faulty as well as lack of gender–sensitive rehabilitation policies.

The government fails to recognize that a considerable proportion of the displaced are women and hence there is a need for gender-sensitive rehabilitation policies. Lyla Mehta's argument is relevant in this context. She mentions that women, suffering from environmental hazards are entrapped with a 'double bind'; on one hand gender inequality is perpetuated in terms of unequal resource allocation and distribution by male biases, on the other hand, this is exacerbated by biases within the state policies dealing with displacement-rehabilitation-resettlement.[44]

While the role of government depicts a pessimistic picture, rays of hope peep in from the initiatives launched by few action groups and NGOs operating in this vulnerable zone. A local group *Ganga Bhangan Protirodh Action Nagorik Committee* (GBPANC), duly supported by *Child Rights and You* (CRY) has initiated a number of measures to meet the problems of the erosion-victims in the 'chars' and protect their rights. They are bold enough to declare that they are carrying the fight for 'equality' and not 'charity'. In spite of silence from the part of the government, the local community organized by Nagorik Committee has surveyed the land at their own and even attempted to submit the same to the local village panchayats as a step to institutionalize their existence. The Committee has also undertaken a scheme to reach out to the pregnant women and malnourished children, living on the 'chars' and develop a networking system with the state authorities and other organizations including the political parties and civil societies to get across the true pictures of sufferings and sorrows, trials and disasters that the people of the 'chars' are relentlessly subjected to.

No voice, no choice: coping-up as a compulsory exercise

The erosion victims in the 'chars' of Malda and Murshidabad districts live a life beyond redemption. But why do they still prefer to stay in these uncertain land patches? As we have already seen, people have moved between four to 16 times in the last 15 years in some of these 'chars'. Still what binds them here? Why do they return again as soon as water recedes, even being aware of the fragile condition of the 'chars'?

To understand this, socio-economic marginality of the people has to be taken into consideration.

Like vulnerability, adaptation or coping with crisis situations also

depend on institutional and structural factors. Again, people in the 'chars' facing added/special vulnerability adapt less or lack the means to cope with crisis than their less vulnerable counterparts living in the mainland. Vulnerability is indirectly proportional to resilience (i.e. vulnerability = 1/resilience) and vulnerability is directly proportional to susceptibility (vulnerability = susceptibility). So it is imperative to have an understanding of social differentiation in adaptation.

Moreover, 'chars' are extremely fertile lands with high productivity. Barren sand-fields are steadily converted into croplands through bio-manuring and labour. Thanks to their traditional attitudes and feelings, they know more or less accurately the level to which the river water will rise for different volumes of water released from upstream reservoirs. They remain alert during the monsoons. Small boats are kept ready to carry them away from the rising waters.

A recent trend has developed in romanticizing these survival efforts of the poorest and idealizing their initiatives as 'adaptation', 'coping up', etc. But though there is a need to recognize these skills and techniques as they are eco-friendly and cost-effective, and incorporate them in the mainstream knowledge of hydrological and agrarian practices, we should not forget that the suffering masses are obliged to take risks and compelled to sustain their livelihood in this hostile environment. It is not a simple matter of semantics to describe this ability as resilience, competency, or as capacity to adapt. We need to recognize and define this ability of adaptation — as day-to-day, continual but contingent, set of strategic/structural choices and decisions made by individuals and communities who are extremely poor and vulnerable.[45] They are bound to dance with the moods of the river[46] They are the poorest, the most toiling masses in the most uncertain eco-system, they are the people with no voice, hence no choice.

Notes

1. Quoted in C.H. Crickmay, *The Work of the River: A Critical Study of the Central Aspects of Geomorphology* (New York: American Elsevier Publishing Co. Inc., 1974), pp. 17-18.
2. N.K. Bhattasali, 'Antiquity of the Lower Ganges and its Courses', *Science and Culture*', VII, 1941.

3. Radhakamal Mukherjee, *The Changing Face of Bengal* (Calcutta: University of Calcutta, 1938), p. 141.
4. P.L. Madan, *River Ganga: A Cartographic Mystery* (New Delhi: Manohar, 2005).
5. S.A.I. Hamid Rizvi, *Comparative Physiography of the Lower Ganges and Lower Mississippi Valleys*, unpublished PhD dissertation (Baton Rouge: Lousiana State University, 1995), pp. 120-123.
6. R.K. Mukherjee writes, "Leaving the hills of Rajmahal, Ganges seemed to have passed northwards through the modern Kalindri and then southwards in the lower course of Mahananda, east of the ruins of ancient Gour" (*The Changing face of Bengal*, ibid, p. 141).
7. Jadunath Sarkar writes, "Time has levelled to the dust the glories of the Gauda under Hindu and Muslim rule and the ruins of their capital lies scatterred in heaps for miles along the eastern bank of Kalindri river through which flowed the main current of the Ganges down to the close of the Thirteenth Century" (*The History of Bengal: Muslim Period 1200-1757*, [Patna: Academia Asiatica, 1973], p. 24).
8. W.S. Sherwill, *Report on the rivers of Bengal*, (Calcutta : Calcutta Printing and Publishing Company, 1858), p. 17.
9. James Rennell writes, "The Cossimbazar river is almost dry from October to May" (*Memoir of a Map of Hindoostan* (London, 1788), p. 385.
10. Kalyan Rudra, *Ganga Bhangan Katha: Malda-Murshidabad,* (Kolkata: Mrittika), p. 27.
11. Papers relating to the formation of Port Canning on the Matla Bengal: Bengal Printing Co. Ltd, 1865), p. 1, quoted in Kalyan Rudra, ibid, p. 28.
12. *Annual Report on Major rivers, 1931-32*, Nadia River Division, p. 12, quoted in Kalyan Rudra, ibid.
13. Ibid, pp. 28-30.
14. Ibid, p. 30.
15. Begum Khursida, *Tension over the Farakka barrage* (Calcutta, 1987), p. 29, quoted in ibid, p. 31.
16. Serial No. 2, Appendix – VII, para 2.4, *196th Report of the Public Accounts Committee* (5th Lok Sabha), Public Accounts Committee (1977-78), 6th Lok Sabha, 37th Report, Farakka Barrage Project Report, Ministry of Agriculture and Irrigation', Lok Sabha Secretariat, New Delhi, Nov. 1977.
17. Kalyan Rudra, *The Encroaching Ganga and Social Conflicts: The Case of West Bengal, India*, (West Bengal: Dept. of Geography, Habra H.C. Mahavidyalaya, 2003), p. 9.

18. T. Sanyal and A.K. Chakraborty, 'Farakka Barrage Project: Promises and Achievements', S.C. Chakraborty edited *Commemorative Volume, 125 Years of Kolkata Port Trust* (1995) p. 57*,* quoted in Kalyan Rudra, ibid.
19. Kalyan Rudra, ibid.
20. Ibid, p. 12.
21. J. Maitra, *Boundary Dispute between West Bengal and Jharkhand: Correspondences and Documents*, (Malda, West Bengal : CPI(M) District Committee, 2004), pp.17-19.
22. Priyanka Dutta, *Migration as source of risk-aversion among the environmental refugees: The case of women displaced by erosion of the river Ganga in the Malda district of West Bengal, India*, COMCAD Arbeitspapiere – Working Papers, No. 98, 2011, p. 15.
23. Manisha Banerjee, *A Report on the Impact of Farakka Barrage on the Human Fabric* (submitted to World Commission on Dams: Thematic Review: Flood Control Options And many other thematic reviews) New Delhi, 1999, pp. 13-14.
24. K.M. Elahi and John Rogge, *Riberbank erosion, flood, and population displacement in Bangladesh: A report on the Riverbank Erosion Impact Study*, Jahangirnagar University, Dhaka, Bangladesh, 1990, cited in Kalyan Rudra, ibid, p. 29 and Showkat Iqbal, 'Flood and Erosion Induced Population Displacements: A Socio-economic Case Study in the Gangetic Riverine Tract at Malda District, West Bengal, India', *Journal of Human Ecology*, vol. 30, no. 3, p. 204.
25. Kalyan Rudra, 'Exploration to the Bhagirathi off-take' (in Bengali) (Biswa Biksha, 1992), vol.2, no.2, pp. 27-33.
26. Kalyan Rudra, *The Encroaching Ganga and Social Conflicts*, ibid, p. 32.
27. Known as 'bhangan' in the local dialect.
28. Cutter, Blaikie et. al., Downs et. al., Anderson and Woodrow, Oliver-Smith, Anderson, Maskrey, Varley, quoted in E. Enarson and B.H. Morrow (ed), *The Gendered Terrain of Disaster through Women's Eyes* (USA: Praeger Publishers, 1998), p. 2.
29. Terry Cannon, 'Vulnerability Analysis and Disasters', D.J. Parker, ed, *Floods,* London: Routledge, 2000.
30. P.K. Parua, 'Fluvial Geomorphology of the River Ganga around Farakka', *Journal of the Institution of Engineers*, 2002, vol.82, pp.193-196.
31. R. H. Colebrook, 'On the course of the Ganges through Bengal', *Asiatic Researches*, vol. 7, p. 14.

32. Quoted in Kalyan Rudra, *The Encroaching Ganga and Social Conflicts*, ibid, pp. 30.
33. W. Sherwill, *Report on the rivers of Bengal*, ibid, p. 18.
34. Supriya Sengupta, *Nadi*, Bichitra Bidya Granthamala, Jiggasha, 1982, p. 7, quoted in Kalyan Rudra, *Ganga Bhangan Katha: Malda-Murshidabad*, ibid, p. 57.
35. Kalyan Rudra, ibid.
36. Manisha Banerjee, ibid, p. 19.
37. Kalyan Rudra, ibid, p. 33.
38. Brian O'Neil, 'Women and Displacement: A Case Study of Women displaced by Ganga erosion in Malda district of West Bengal in India', *Development and Environment*, http://epc2010.princeton.edu/download.aspx?submissionId=100534, date of access: June 20, 2010.
39. Priyanka Dutta, *Migration as source of risk-aversion among the environmental refugees: The case of women displaced by erosion of the river Ganga in the Malda district of West Bengal, India*, COMCAD Arbeitspapiere – Working Papers, No. 98, 2011, p. 17.
40. Ibid.
41. Kalyan Rudra, ibid, p. 11.
42. Manisha Banerjee, ibid, p. 15-16.
43. The Mahatma Gandhi National Rural Employment Guarantee Act aims "at enhancing the livelihood security of people in rural areas by guaranteeing hundred days of wage-employment in a financial year to a rural household whose adult members volunteer to do unskilled manual work," http://nrega.nic.in/netnrega/home.aspx
44. M. Kumar, 'Incorporating Gender Issues in National Responses', paper presented at the *Regional Workshop on NHRIs and IDPS*, organized by Asia Pacific Forum, Colombo, October, 2005, p. 8.
45. Kuntala Lahiri Dutta and Gopa Samanta, 'Like the Drifting Grains of Sand: Vulnerability, Security and Adjustment by Communities in the Charlands of the Damodar River, India', *South Asia: Journal of South Asian Studies,* vol. 30, no. 2, 2007, p. 348.
46. Gilles Saussier, *Living in the Fringe*, (Paris: Figura Association, 1998).

Bibliography

1. Ahmed, I, 'Rivers and Environmental Refugees', *Indian Journal of Landscape Systems and Ecological Studies*, vol. 24, 2001.
2. Banerjee, Manisha, *A Report on the Impact of Farakka Barrage on the Human Fabric* (submitted to World Commission on Dams: Thematic Review: Flood Control Options And many other thematic reviews) New Delhi, 1999.

3. Basu, S.K., 'A Geotechnical Assessment of the Farakka Barrage Project, Murshidabad and Malda Districts, West Bengal', *Geological Survey of India*, Bull.No.47, 1982.
4. Bhattasali, 'Antiquity of the Lower Ganges and its Courses', *Science and Culture*', VII, 1941.
5. Cannon, Terry, 'Vulnerability Analysis and Disasters', D.J. Parker, ed, *Floods,* (London: Routledge, 2000).
6. Colebrook, R.H., 'On the course of the Ganges through Bengal', *Asiatic Researches*, vol. 7.
7. Crickmay, C.H., *The Work of the River: A Critical Study of the Central Aspects of Geomorphology* (New York: American Elsevier Publishing Co. Inc., 1974).
8. District Human Development Report: Malda, (HDRCC: Development and Planning Department, Government of West Bengal), April 2007.
9. Dutta, Priyanka, *Migration as source of risk-aversion among the environmental refugees: The case of women displaced by erosion of the river Ganga in the Malda district of West Bengal, India*, COMCAD Arbeitspapiere – Working Papers, No. 98, 2011.
10. Elahi, K.M. and John Rogge, *Riberbank erosion, flood, and population displacement in Bangladesh: A report on the Riverbank Erosion Impact Study*, (Dhaka: Jahangirnagar University, 1990).
11. Enarson, E and B.H. Morrow (ed), *The Gendered Terrain of Disaster through Women's Eyes* (USA: Praeger Publishers, 1998).
12. Hamid Rizvi, S.A.I., *Comparative Physiography of the Lower Ganges and Lower Mississippi Valleys*, unpublished PhD dissertation (Baton Rouge: Lousiana State University, 1995).
13. Hunter, W.W., *A Statistical Account of Bengal*, vol. 9 (Districts of Murshidabad and Pabna), (London: Trubner and Co., 1876).
14. Inglis, W.A., 'Some of the problems set us by the Rivers of Bengal', *Journal of the Asiatic Society of Bengal*, vol. 5, no.10, 1909.
15. Iqbal, Showkat, 'Flood and Erosion Induced Population Displacements: A Socio-economic Case Study in the Gangetic Riverine Tract at Malda District, West Bengal, India', *Journal of Human Ecology*, vol. 30, no. 3.
16. Kumar, M, 'Incorporating Gender Issues in National Responses', paper presented at the *Regional Workshop on NHRIs and IDPS*, organized by Asia Pacific Forum, Colombo, October, 2005.
17. Lahiri Dutta, Kuntala and Gopa Samanta, 'Like the Drifting Grains of Sand: Vulnerability, Security and Adjustment by Communities in the Charlands of the Damodar River, India', *South Asia: Journal of South Asian Studies,* vol. 30, no. 2, 2007.

18. Leopold, L.B., M. G. Wolman, J.P. Miller, *Fluvial Processes in Geomorphology* (San Francisco: W.H. Freeman and Co., 1964).
19. Madan, *River Ganga: A Cartographic Mystery* (New Delhi: Manohar, 2005).
20. Maitra, J, *Boundary Dispute between West Bengal and Jharkhand: Correspondences and Documents*, (CPI(M) District Committee: Malda, West Bengal, 2004).
21. Mukherjee, R.K., *The Changing Face of Bengal* (Calcutta: University of Calcutta, 1938).
22. Sutapa Mukhopadhyay and Malay Mukhopadhyay, *Bank Erosion of River Ganga, Eastern India – A Threat to Environmental Systems Management*, http://www.quebec2007.ca/pdf/salle204a/seance21/articles/s_mukhopadhyay.pdf, date of access: June 22, 2011.
23. O'Neil, Brian, Women and Displacement: A Case Study of Women displaced by Ganga erosion in Malda district of West Bengal in India, *Development and Environment*, http://epc2010.princeton.edu/download.aspx?submissionId=100534, date of access: June 20, 2010.
24. Parua, P.K., 'Erosion Problems of the River Ganga in the districts of Malda and Murshidabad in West Bengal', *Civil Engineering Today*, Journal of ASCE, vol. 13, no. 2, 1999.
25. Parua, P.K., 'Fluvial Geomorphology of the River Ganga around Farakka', *Journal of the Institution of Engineers*, 2002, vol.82.
26. Rennell, James, *Memoir of a Map of Hindoostan* (London, 1788).
27. Richards, Keith (ed), *River Channels: Environment and Process* (Oxford: Basil Blackwell, 1987).
28. Rudra, Kalyan, 'Exploration to the Bhagirathi off-take' (in Bengali) *Biswa Biksha*, vol.2, no.2, 1992.
29. Rudra Kalyan, *Ganga Bhangan Katha: Malda-Murshidabad,* (Kolkata: Mrittika, 2002).
30. Rudra, Kalyan, 'Problems of River Bank Erosion along the Ganga in Murshidabad district of West Bengal', *Indian Journal of Geography & Environment,* vol. 1.
31. Rudra, Kalyan, 'Living On the Edge: The Experience along The Bank of the Ganga in Malda District, West Bengal', *Indian Journal of Geography & Environment* vol. 5, 2000, pp. 57-67.
32. Rudra, Kalyan, 'Quaternary history of the lower Ganga distributaries', *Geographical Review of India*, vol. 48, no. 3, 1987.
33. Rudra, Kalyan, *The Encroaching Ganga and Social Conflicts: The Case of West Bengal, India*, (West Bengal: Dept. of Geography, Habra H.C. Mahavidyalaya, 2003).

34. Rudra, Kalyan, 'The Farakka Barrage Project – An interruption to fluvial regime', *Indian Journal of Landscape System and Ecological Studies*, vol 19, no. 2, 1996.
35. Rudra,Kalyan 'Will Ganga outflank the Farakka Barrage?' (in Bengali), *Desh,* 09.12.2000, pp.58-68.
36. Saussier, Gilles, *Living in the Fringe*, (Paris: Figura Association, 1998).
37. Sherwill, W, *Report on the rivers of Bengal*, (Calcutta: Calcutta Printing and Publishing Company, 1858).
38. Statham, Ian, *Earth Surface Sediment Transport*, (Oxford: Clarendon Press, 1977).
39. Tandon, S.K., Charu. C. Pant and S. M. Casshyap (ed), *Sedimentary Basins of India* (Nainital: Gyanodaya Prakashan, 1991).