Impact of Farakka Barrage at Farakka and its Surroundings Area

Indrajit Mandal, M.Sc. 2nd semester, University of Gour Banga, Malda, West Bengal, India

Abstract
The main objective of this paper is to examine the impact of Farakka barrage on upstream and downstream hydro-geomorphologic conditions based on some primary and secondary information. 38 km. Long feeder canal carrying water about 40000 cusecs. was constructed for supplying water to the Calcutta port. This project is taken up for rejuvenation of the navigational status of the Calcutta Port. After constructions and regulation of natural flow, some noticeable impacts have identified both in up and downstream of River Ganga like - bed level of downstream river segment has been raised, total flow volume as well as river energy in the downstream has reduced, sedimentation rate of both up and downstream has excessively increased, bank erosion is increase mainly upstream, channel width has widened, flood intensity has multiplied etc.

Keywords: Canal, Discharge, sedimentation, Cusecs, Channel etc.

1. Objectives
The broad objective of the study is to see the immediate impact of Farakka Barrage and water diversion through Feeder Canal (Upstream And Downstream Area of the Farakka Barrage) on the River Ganga.

2. Materials & Methodology
Showing the Data and its sources & Use purposes.

<table>
<thead>
<tr>
<th>Data types</th>
<th>Source</th>
<th>Purposes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water volume and Discharge</td>
<td>Ministry of Water Resource, New Delhi, Govt. of India</td>
<td>Discuss on Discharge of Ganga and Feeder Canal.</td>
</tr>
<tr>
<td>Bank Erosion data</td>
<td>1. Irrigation &amp; Waterways Department, Malda, West Bengal.</td>
<td>Discuss on Bank Erosion Of Ganga River in Malda and Murshidabad District (Upstream and Downstream of Farakka Barrage)</td>
</tr>
<tr>
<td>Channel Shifting Data</td>
<td>Laha Chalantika &amp; Bandyapadhyay, Dr. Sunando</td>
<td>Discuss on change of the river channel of upstream and downstream of Farakka Barrage For diverted the water.</td>
</tr>
<tr>
<td>Feeder Canal and Farakka Bar-</td>
<td>Farakka Barrage Project, P.O-Farakka Barrage, Dist-Murshidabad.</td>
<td>Discuss the different impact of water diversion through Feeder Canal.</td>
</tr>
<tr>
<td>rage related information/data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maps &amp;Images</td>
<td>Website of Ministry of Water Resources, Google Earth.</td>
<td>To Clarify my objectives.</td>
</tr>
</tbody>
</table>

For preparation in this term paper there are so many statistical techniques are used. For Preparation the bar graphs and Hydrograph Microsoft Office Excel 2007 are used.

Literature Review
Some literature or Articles are study by me for preparation in this term paper. There are many articles, Case study or documentary available in different Internet sources. Many governmental and non-governmental organisations are work in Impact of Farakka Barrage and water diversion through Feeder Canal on its upstream and downstream areas. They indicate the different impacts-like hydrological, geomorphological, social and economical. A report by Banerjee M., on “the impact of Farakka Barrage on the human fabric” emphasis the problem of the rural impoverishment and marginalization and response to the situation faced by the human beings. Bhattacharya Kapil, an eminent engineer (a former engineer in chief of West Bengal). Mr. Bhattacharya categorically affirmed that the barrage would definitely fail in its promise of navigability (Banerjee 1999.9-
According to the official report by Irrigation and Waterways Dept. Govt. of West Bengal there could be number of reason for the culmination of left swing and initiation of the right swing of main channel. One of the possible reasons could be the progressive diversion of flow from the main channel. A particular channel might have dominated over the other in course of time due to its more favourable orientation and ultimately became the carrier of main flow. A paper by Goswami, Sharma and Patgiri (1999) present 1) Alteration of the direction of the flow due to neck cut off. 2) Widening of a channel in response to bar development, 3) anabranches development 4) progressive shifting of meander bends. The official records regarding land erosion are available in Malda since 1931, which also took note of the fact that the river Ganga is slowly shifting its course in Malda district (Rudra2006 b:27).Laha Chalan tika and Bandypadhyya Sunando indicate-How to Ganga Channel is shifted with the time in upstream and downstream of Farakka Barrage. Parua P.K says how the river bank is erosion for construction of Farakka Barrage in Malda and Murshidabad district. He describe the causes of bank erosion and role of Farakka Barrage. We saw the report of Irrigation Department of Malda loss of land by bank erosion.

Introduction

The Farakka Barrage & Feeder Canal is designed to serve the need of preservation and maintenance of the Calcutta Port by improving the regime and navigability of the Bhagirathi-Hooghly River system. The Farakka Barrage Project organisation has been assigned the work of execution of the following principal components of the project-2245 metre long barrage a Ministry of across the river ganga with rail- cum- road bridge, necessary river training works and a head regulator on the right side-213 meter long barrage across the river Bhagirathi at Jangipur (near Ahiran).Feeder Canal of 1133 cusec (40,000) carrying capacity and 38.38 K.M long,(Ministry of Water Resources)taken of the head regulator on right of Farakka Barrage. Navigation works such as locks, lock channel, Shelter Basins, navigation lights and other infrastructure.

Water Diversion through Feeder Canal:

| Discharge in Cummec |
|---------------------|----------------|----------------|
| 0                  | 2000           | 4000           |
| 4000               | 6000           | 8000           |
| 8000               | 10000          |                |

<table>
<thead>
<tr>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Showing the water diversion through Feeder Canal according to Indo-Bangladesh Agreement 1977

Water Sharing Formula (1996 Treaty) of Indo-Bangladesh:

<table>
<thead>
<tr>
<th>Availability at Farakka</th>
<th>Share of India</th>
<th>Share of Bangladesh</th>
</tr>
</thead>
<tbody>
<tr>
<td>70000 Cusecs or less</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>70000-75000 cusecs</td>
<td>Balance of flow</td>
<td>35000 cusecs</td>
</tr>
<tr>
<td>75000 cusecs or more</td>
<td>40000 cusecs</td>
<td>Balance of Flow</td>
</tr>
</tbody>
</table>

Source: Ministry of Water Resources. New Delhi
Impact of Farakka Barrage and Water Diversion Through Feeder Canal:

There have so many impact of water diversion. Some impact are positive (base on area) and some impact are negative. Thee are:-

a) Impact on stream energy,
b) Impact on River Channel or Interception of the flow channel/ changed from straight to sinuosity.
c) Impact on River Discharge
e) Widening of the river and increasing length
f) Impact on bank erosion and displacement
g) Impact on ground water table
h) Tendency to bypass the Farakka barrage along Kalindri -Mahananda

Impact On Stream Energy

Stream energy is the natural power of the river. By this energy river can erosion and transportation. But stream energy is change different types of Natural and anthropogenic causes, barrage one of them. When the water flow reach the barrage and then the stream energy is decrease, the velocity of stream is decrease suddenly. This is the major cause of sedimentation at Farakka barrage. Stream energy is unexpected loss by the water diversion. So sediment transportation power is decrease. When water flow reach near the barrage and river velocity is decrease and sediment deposition starts rapidly. Day after day same process are generate and create many island & sand bars. This process are most rapidly growth on downstream of farakka barrage. So we saw many sand bars and island in upstream and downstream of farakka barrage. The water diversion at Farakka is bound to have an impact as it was an attempt to introduce a new ecological system against the usual course of nature.

Impact On River Channel:

The cause of water diversion through Feeder Canal, main channel of Ganga River highly affected. Because the water discharge volume is decreasing both dry and monsoon season. The pre monsoon and post monsoon season is very bad, the river channel almost dry. The river have lost her Energy, so the carrying capacity is fall and it’s result sedimentation & formation of sand bars and island. The channel is divided many little channel and it coarse is flow meandering. The river depth is decrease. And the monsoon season ganga flow it natural course. But this flow is totally control by the Farakka Barrage Authority. If So there create in imbalance. If the water not diverted by the Feeder Canal the fact is totally different because the total water is pass by the main channel of Ganga. The Barrage has caused serious inter-ception in the dynamic equilibrium of the river hindering.
the natural oscillation of the river within its meandering belt.

As this historical record shows, the shifting of the Ganga has been a longterm phenomenon that has constantly shaped and reshaped the territorial history of Malda district. Hence the present river-shifts in the district have to be situated and understood in the longterm context. Shortly after the Ganga traverses around the Rajmahal hill in Jharkhand, the river enters its estuarine stage in Bengal, gradually splitting into several major and minor distributaries that flow over lower West Bengal (Laha & Bandyapadhyay).

**Impact On River Discharge**

The 40000 Cusecs water (average) diverted through Feeder Canal on the downstream of Farakka Barrage. So it influences the river discharge of Ganga. Farakka Barrage Authority controls the water discharge of Ganga. So it is the main cause of Indo-Bangladesh water sharing dispute. The many debate are here to India and Bangladesh Government. In 1977 sign an Agreement was signed for water sharing and this treaty was affected the water discharge of Ganga.
We saw in this bar graph the river discharge is decrease year after year after construction of Farakka Barrage project and diversion of water by the Feeder Canal. The water diversion directly affected on the river discharge of Ganga. Day after day discharge of Ganga is decrease. We saw the difference of pre Farakka flow and post Farakka flow in this bargraph.

In this discharge hydrograph we saw that the impact of water diversion through Feeder Canal create a inter-relationship between discharge of Ganga and Discharge of Feeder Canal. In the dry season discharge of Ganga is maximum in January month and the minimum discharge of Ganga in March month. In the March month the water diverted through Feeder Canal is maximum then the discharge of Ganga. So the river discharge is changed by the water diversion.

This bar graph is shows that the discharge of Ganga in dry season. The green colour bars are shows the discharge after the diversion if the water not diverted the discharge may occur the red colour bars. So we clearly saw that the what are the impact on Ganga river discharge of water diversion through Feeder Canal.
Impact On Sedimentation
Due to the obstruction caused by the Barrage each year nearly 64 crore tonnes of silt is accumulated in the riverbed. In the last three decades this has resulted in the accumulation of nearly 1856 crore tonnes of silt. In Malda the river looks like a closed marshland with aquatic plants flowing in it. Each year in Malda the riverbed is rising at the rate of 50 cm resulting in declining slope in the opposite direction between Farakka and Rajmahal. In the lean seasons the depth of Ganga near Manikchak ghat is barely 10 metres. Data Source: Rudra, Kalyan). According to Abbas & Subraman the yearly average sediment deposition is 801 million tons (Source: Adhunik Bhu-Jol Vidya & Somudra Vidya-Dutiman Bhattacharyya & Maitreye Chakrabarty, 2010). The water flow was stop on the wall of the barrage and siltation process was increase. Each year in Malda the riverbed is rising at the rate of 50 cm resulting in declining slope in the opposite direction between Farakka and Rajmahal. In the lean seasons the depth of Ganga near Manikchak ghat is barely 10 metres. (Banerjee. M -1999).

Sedimentation on the River Bed on upstream of the Farakka Barrage.

There are so many island create on the river bed upstream and downstream of Ganga. Some island is permanent and some are moves with the time. We saw this bar graph the islands are mainly create the surrounding of the barrage. Here the red colour bars are situated on the upstream of Farakka Barrage and blue colour bars are situated on downstream of farakka barrage. Below Rajmahal the river is divided in two with Bhutni Diara in between. Now the river is flowing through the western channel as the eastern channel has dried up due to siltation.

Increase of Island Area In Ganga River channel Data Source: Laha Chalantica & Bandyapadhyay sunando.
Impact On The River Bank Erosion
In Malda, the upstream areas of Farakka, on the left bank of Ganga, for a long time five community development blocks are being more or less affected by erosion. They are Manikchak, Kaliachak I, Kaliachak II, Kaliachak III and Ratua. The entire 174 kms stretch along the Ganga, from Bhutni in Malda to Jalangi in Murshidabad has been facing erosion.

Showing the Loss of Land by River Bank Erosion in upstream of Farakka Barrage. Data Source: Parua P. K, Superintending Engineer. Farakka Barrage Project cited in Banerjee M

Showing the Loss of Land by River Bank Erosion in downstream of Farakka Barrage. (Data Source: Parua P. K, Superintending Engineer. Farakka Barrage Project cited in Banerjee M)

Images: River Bank Erosion

River Channel Widening
The river channel of ganga is widening for river bank erosion. River channel widening is a perpetual process in the upstream and downstream of farakka barrage. It is mainly due to lateral erosion. It is noted that the Groves of the flood plains in the Malda (upstream of farakka barrage) and Murshidabad (downstream of farakka barrage) which were developed on the river banks now their locations are existing within the channel beds. Sometimes 30m-100m from the present bank which have
submerged. The process of River channel widening repeats in the up and downstream of farakka barrage and responsible for more destruction in the existing flood-plains.

**Tendency To Bypass The Farakka Barrage Along Kalindri-Mahananda:**
Ganga is trying to bypass this obstruction and may be in one devastating flood it will merge with Kalindri in the eastern side and the combined flow will merge with Mahananda at Nimasarai Ghat of Malda and afterwards the collective flow will merge with Ganga/Padma in Godagari Ghat of Bangladesh. In the expert committee report set up by the Planning Commission in 1996 it is stated that once the Ganga is allowed to avulse into one of its abandoned channels on the left bank, Farakka Barrage will be outflanked. According to the design of Farakka Barrage, in the 109 bays of the barrage the highest capacity of water flow is 500 cusecs per ft. But now the flow is passing through the right 54 gates only and so during monsoon the water accumulated here is 700 cusecs/ft. Feeder canal can bear only 40,000 cusecs. And the rest looks for a way out and flows through Kalindri, Pagla and others. In 1998 the flow was 26.80 lakh cusecs which couldn’t go through the barrage. The flow got obstructed between Rajmahal hills whose stony rocks it couldn’t cut through and made its way through these rivers causing the century’s biggest flood in Malda.

**Impact On The Flood**
Flood is the natural disaster in upstream and downstream area of farakka barrage. After the construction of farakka barrage and Feeder Canal the flood frequency is increase. When the water reach at farakka then the water flow is stop and when the water level become high then the water create flood on the upstream of Ganga basically the south-western part of the Malda district. The Feeder canal bearing only 40000 cusec water but the rainy season 700000 cusec water reach the farakka and create a difficult situation.

**Impact On Ground Water**
Any diversion of water from the main channel would obviously cause reduction of water level in the downstream section. This phenomenon becomes acute during lean months (pre-monsoon). Deltaic rivers receive substantial supply of water from the ground water table when the river level goes down a critical limit. This situation results in more and more seepage of ground water towards the river. In the case of Ganga/Padma this flow of ground water towards the river removes the underlying unconsolidated sands composing the lower strata of the bank and thereby the overlying strata find no support to stand in its original position. The ultimate result is vertical collapse of the bank threatening the human habitation thereon. On the other hand of upstream portion of the Farakka Barrage ground water level is increase. Because the water reserve capacity of the barrage are play important role. South-western part of the Malda district’s ground water level is increase after construction of Farakka Barrage. The water level (A Report on the Impact of Farakka Barrage on the Human Fabric South Asia Network on Dams, Rivers &People November 1999) of the Ganga rose about 8 mtr. Upstream of the Farakka barrage and the ground water level experienced corresponding upheaval in the district of Malda.

**Conclusion:**
After discussion this term paper we can say that there are so many impact of water diversion through Feeder Canal some are positive but some are negative impact. But the frequency of negative impact is high. We can tell bank erosion, flood, landless etc. The Farakka Barrage and its activity is disaster to the local area (upstream and downstream area) of Malda and Murshidabad. The implementation of the Farakka Barrage has also retarded the natural flow of the Ganga. This has definitely forced the Ganga to deposit sediment load at all points upstream of the Farakka Barrage.

**References**
[5] Jha Vibhas Chandra, Professor and Ex-Head,Department of Geography,Visva-Bharati University & Bairagya Haraprasad, Researcher, Dept. of Geography, Visva-Bharati University, Environmental impact of flood and there sustainable management in deltaic region of West Bengal, India.
Caminhos de Geografia Uberlândia v. 12, n. 39 set/2011


[9] Comprehensive district agriculture plan(c-dap) for Malda-Final report. XIth Plan Period. Nabard Consultancy Services Pvt Ltd. Nabard West Bengal Regional Office, 6 Road Street, Kolkata 700 016 -2013


[12] Muhammad Adel Miah, Interdisciplinary Sciences Research Center, Department of Chemistry and Physics, University of Arkansas at Pine Bluff, Farakka Barrage- the greatest ever riparian bluff for upstream water piracy, Academia Journal of Environmental Sciences 1-3, March 2013
