Tech. J. River Res. Inst. 15(1): 1-7, 2020 (August), ISSN: 1606-9277

ASSESSING RIVERBANK EROSION AT UPSTREAM AND DOWNSTREAM SIDE OF PADMA BRIDGE BY USING SATELLITE IMAGES

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Abstract

Riverbank erosion is one of the critical and unpredictable natural calamities in Bangladesh that took place in almost every year. This phenomenon takes into account the quantity of rainfall, soil properties, structural stability, river morphology, topography of river floodplain and monsoon floods. In this study an attempt was made to assess the riverbank erosion at upstream and downstream side (Naria Upazila) of Padma Bridge and tried to identify the possible remedial measures. With the aid of satellite images and GIS software, the bank line over the past four decades (1980 - 2019) were delineated and analysis were made to identify probable impact on life and livelihood at Naria Upazila, Shariatpur, Bangladesh due to river bank erosion. Analysis shows, erosion at downstream is more prominent rather than the upstream of the selected reach. During this period total erosion was occurred at downstream side (Naria Upazila) 2823 meter by length (4456 ha by area) where the maximum erosion was happened 2159 meter in between the year 1988 – 1990. On the other hand, total 1995 meter (2823 ha by area) erosion was measured at the upstream side of the Padma bridge in that time (1980 – 2019) where the maximum erosion was happened in between the year 1990 – 1995. Present trend of river bank shifting will disappear the Naria region within a very short period. In this regards, management should take initiative immediately to adopt techniques that work with the natural processes. To sustain the life and livelihood and reducing the riverbank erosion, structural and non-structural measures should be adopted.

Key words: *Riverbank erosion, satellite images, GIS software, remedial measures*

Introduction

Bangladesh is one of the most disaster prone countries around the world with severe cyclone, destructive flood and associated river bank erosion. River bank erosion is one of the natural disasters that cause displacement of inhabitants who previously lived near river banks. (Das, 2010). Impacts of river bank erosion are multifarious: social, economic, health, education and sometimes political. The first and foremost impact is social, i.e., homelessness due to land erosion which compels people to migrate (Iqbal, 2010). More than 700 rivers, with their tributaries and distributaries have criss-crossed the country forming a network of river system (Islam and Rashid, 2011). Shariatpur District (Dhaka division) located in between 23°01' and 23°27' north latitudes and in between 90°13' and 90°36' east longitudes. Naria Upazila is situated in the district of Shariatpur whose total area of 203.58 square kilometres. It borders Zajira Upazila to the west and north, Munshiganj District to the north, Bhedarganj Upazila to the east and south, and Shariatpur Sadar Upazila to the west. The Padma River flows through the northern part of this upazila.

Bangladesh is a disaster prone country (Hossain and Ferdousi, 2004). The Population is 160 million with growing rate of 1.33 per annum (UNDP, 2009) and more than 75 percent of the population lives in the rural areas (Agarwal and Bina, 1990). In recent years, river bank erosion has become a common natural disaster in Bangladesh. More than 310 rivers and tributaries have made this country a land of rivers (Siddique et al., 2014; RIC,2008). A large number of people become homeless due to river bank erosion (Das, 2011). Padma riverbank erosion at Naria upazila, Shariatpur is not a recent phenomenon, from the last few decade people of the Naria upazila has been experiencing high riverbank erosion. Riverbank erosion undoubtedly poses a significant threat to inhabitants of Naria and consequently the economy of surrounding regions. The main focus of this study is to assess the erosion trend and changes of shoreline of Padma River in Naria upazila and identify the probable impact on the local structures and livelihood due to the river

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bank erosion. Also it will be tried to find out the remedial measures to counter the morphological changes at the study area.

Objectives

The specific objectives of this study is given below.

i) To assess the erosion trend and changes of shoreline of Padma River in Naria upazila, Bangladesh.

ii) To identify the probable impact on the local structures and livelihood due to the river bank erosion in the study area.

Methodology

A methodology is the systematic, theoretical analysis of the methods applied to a field of study, or the theoretical analysis of the methods and principles associated with a branch of knowledge. Methodology cannot provide solutions but offers the theoretical underpinning which method can be applied to a specific case. The methodological flow chart of this study is given in the fig. 1

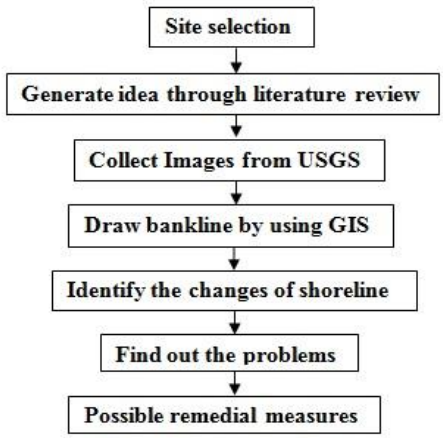

Fig.1: Flowchart of key steps of the study

Study setting and sample collection

For this study upstream and downstream side of Padma Bridge in the Shariatpur district was considered. The special focus was given for finding the trend of riverbank erosion at Naria upazila which is situated in the downstream side of Padma Bridge. Total 9 (nine) figures were collected after 5 (five) years interval from the United States Geological Survey (USGS) in between the year 1980 - 2019. After collecting the images, ArcGIS 10.4 software was used to analyze that figures. The properties of the collected images are given in the table 1.

Table 1. Details of the collected images of Padma River from USGS

Year	Month	Resolution	Satellite
1980	February	60m × 60m	LANDSAT 1
1988	January	60m × 60m	LANDSAT 3
1990	January	30m × 30m	LANDSAT 4
1995	January	30m × 30m	LANDSAT 4
2000	January	30m × 30m	LANDSAT 4
2005	January	30m × 30m	LANDSAT 4
2010	January	30m × 30m	LANDSAT 5
2015	January	30m × 30m	LANDSAT 7
2019	January	30m × 30m	LANDSAT 7

The overview of ArcGIS working process for completing this study was like this

Data Adding ⇨ Creating Shape file ⇨ Bankline Delineation ⇨ Erosion or ⇨ Deposition Measurement ⇨ Area ⇨ Calculation ⇨ Mapping

Results and Discussions

Erosion or Deposition at Naria Region

Padma River flows through the northern part of Naria Upazila, Shariatpur. From the analysis of USGS images of Padma riverbank at Naria Upazila, maximum erosion was found 2823 meter and deposition 1787 meter in the time 1980 – 2019. For observing the erosion or deposition at the study area ArcGIS 10.4 software was used. Total scenario of erosion/deposition (in the fixed time interval) at downstream side of Padma Bridge is tabulated in table 2.

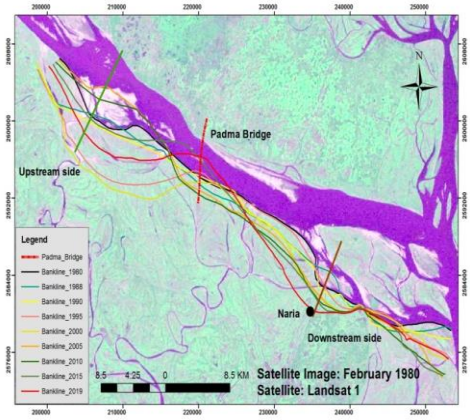

Fig. 2. Changes of Coast line at the study area from 1980 – 2019

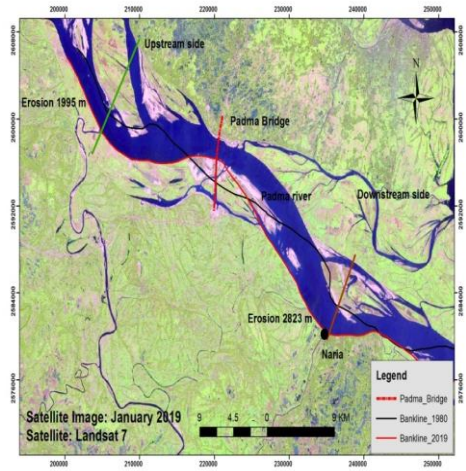

Fig. 3. Erosion at Upstream and Downstream Side of Padma Bridge (1980 – 2019)

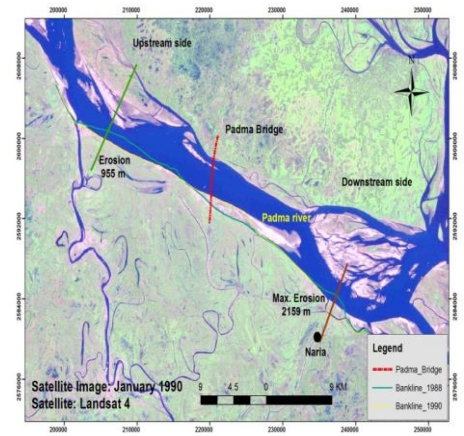

Fig. 4. Maximum Erosion at Downstream Side of Padma Bridge (1988 – 1990)

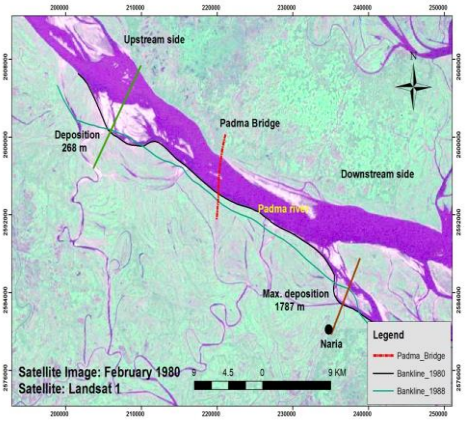

Fig. 5. Maximum Deposition at Downstream Side of Padma Bridge (1980 – 1988)

Table 2. Erosion or Deposition at the downstream side of Padma Bridge (Naria Region)

Erosion/Deposition from 1980 – 2019			Erosion/Deposition with fixed time Interval		
Year	Erosion (m)	Deposition (m)	Year	Erosion (m)	Deposition (m)
1980-1988	…..	1787	1980 – 1988	…..	1787
1990	385	…..	1988 – 1990	2159	…..
1995	…..	158	1990 – 1995	…..	541
2000	1039	…..	1995 – 2000	1198	…..
2005	1117	…..	2000 - 2005	75	…..
2010	1525	…..	2005 - 2010	406	…..
2015	1712	…..	2010 - 2015	180	…..
2019	2823	…..	2015 - 2019	1118	…..

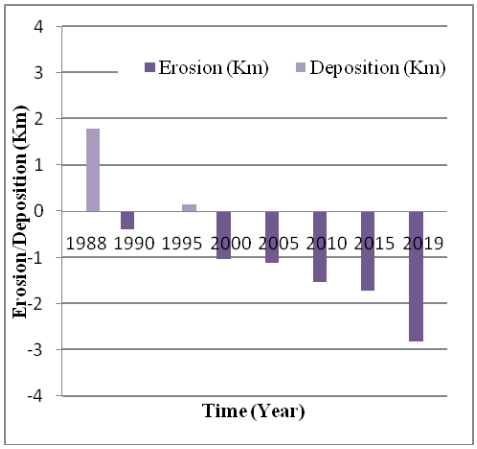

Fig. 6 (a). Riverbank Erosion or Deposition at Naria Upazila from 1980 – 2019.

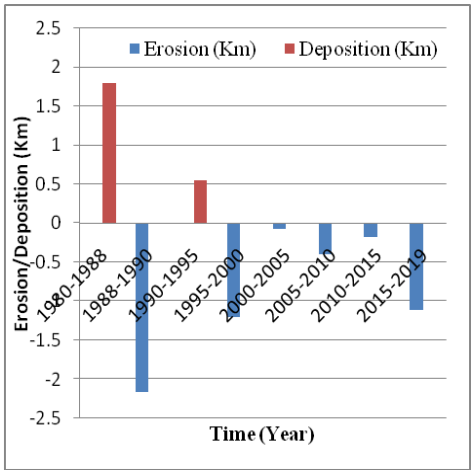

Fig. 6 (b). Riverbank Erosion or Deposition at Naria Upazila from 1980 – 2019.

Erosion or Deposition at the upstream side of Padma Bridge

After collecting the Riverbank images from USGS, ArcGIS 10.4 software was used to calculate the amount of erosion or deposition at the upstream side of Padma Bridge during 1980 – 2019. From the analysis, maximum erosion and deposition was found 3814 meter and 3526 meter respectively. It was also observed the total scenario of erosion/deposition at the fixed time interval which is tabulated in the table 3.

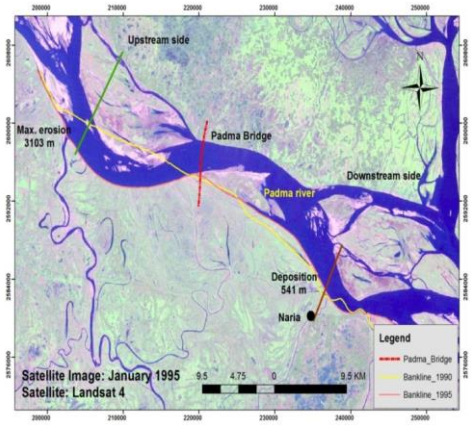

Fig.7. Maximum Erosion at Upstream Side of Padma Bridge (1990 – 1995)

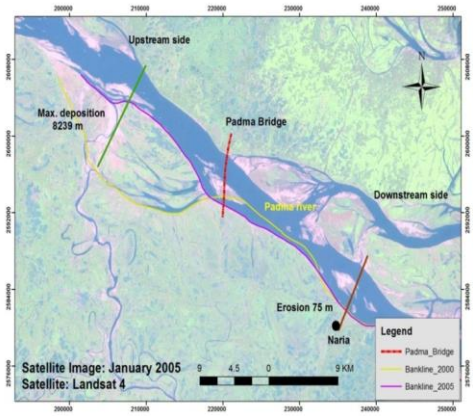

Fig. 8. Maximum Deposition at Upstream Side of Padma Bridge (2000 – 2005)

Table 3. Erosion or Deposition at the upstream side of Padma Bridge

Erosion/Deposition from 1980 – 2019			Erosion/Deposition with fixed time Interval		
Year	Erosion (m)	Deposition (m)	Year	Erosion (m)	Deposition (m)
1980-1988	…..	268	1980 - 1988	…..	268
1990	688	…..	1988 - 1990	955	…..
1995	3814	…..	1990 - 1995	3103	…..
2000	4730	…..	1995 - 2000	910	…..
2005	…..	3526	2000 - 2005	…..	8239

Erosion/Deposition from 1980 – 2019			Erosion/Deposition with fixed time Interval		
Year	Erosion (m)	Deposition (m)	Year	Erosion (m)	Deposition (m)
2010	…..	2030	2005 - 2010	1500	…..
2015	311	…..	2010 - 2015	2325	…..
2019	1995	…..	2015 - 2019	1688	…..

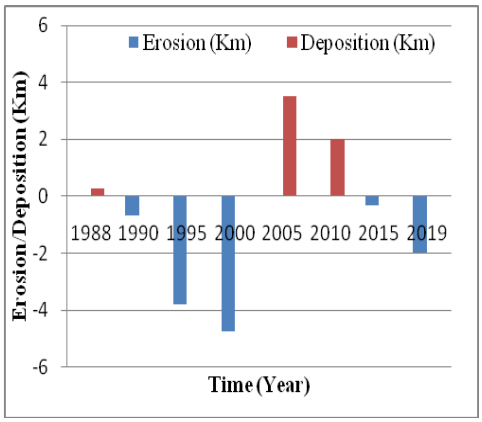

Fig. 9(a). Riverbank Erosion/Deposition at Upstream side of Padma Bridge from 1980 – 2019.

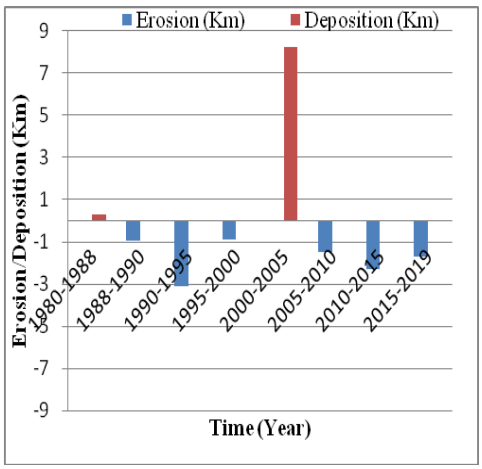

Fig. 9(b). Riverbank Erosion/Deposition at Upstream side of Padma Bridge from 1980 – 2019.

Comparative situation of riverbank erosion or deposition at the study area

Form the bar chart (Fig.10), the trend of erosion or deposition at the study area can be easily understandable. The erosion at the downstream side (Naria) is more than the upstream side of Padma Bridge. In 2005 and 2010 the picture was totally different. In that time deposition happened at upstream side but at the same time erosion was happened at the downstream side (Naria). From 2015 - 2019 erosion happened on both side (upstream and downstream side of Padma Bridge) and the rate of erosion was increasing with time. This trend of erosion is a concerning issue for the inhabitants of that region. If it continues the location of Naria may disappear from his actual position in near future.

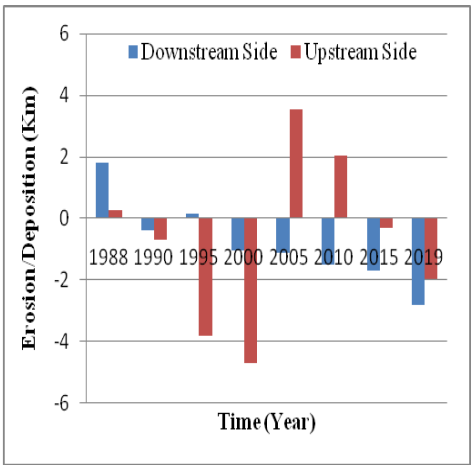

Fig. 10. Erosion or Deposition at the Study Area from 1980 – 2019.

Identification of Vulnerable Location

From the delineated coastlines one vulnerable location was identified in the vicinity of Shariatpur district. The downstream side (Naria upazila) is more vulnerable than upstream side of Padma Bridge which is shown in Fig.11.Over the course of last 39 years total 4456 ha erosion have taken place at the downstream side which is around double from the upstream side of Padma Bridge.

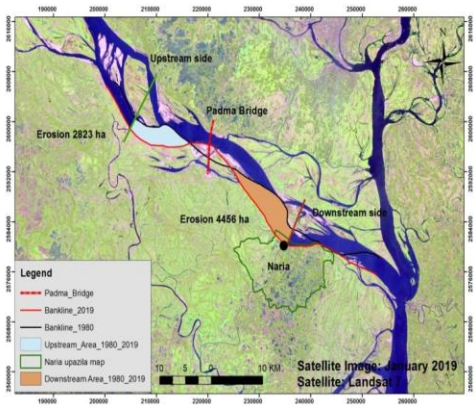

Fig. 11. Eroded area at upstream and downstream side of the study area.

Conclusions

Riverbank erosion of Padma River is not a recent phenomenon. From the last few decade people of the Naria Upazila, Shariatpur has been experiencing high river bank erosion. This type of natural calamities undoubtedly poses a significant threat to inhabitants of Naria and consequently the economy of surrounding regions. Maximum bankline was changed during 2000 – 2019 (near Naria upazila) and situation is continuing. Presently, rate of bank erosion at downstream of Padma bridge is more prominent rather than upstream. Results shows, trend of shifting is rapid and Naria Upazile will disappear in near future. Many families of that area who were totally dependent on agriculture had lost homesteads and agricultural productions which made them socio-economically vulnerable. To sustain the life and livelihood and reducing the riverbank erosion, structural and non-structural measures should be adopted.

Recommendations

The following recommendations can be drawn from this study:

I. Riverbank erosion is a regular phenomenon in the country. Comprehensive river management plan should be made nationally and immediately.

II. Management will need to adopt simply implement techniques to reduce river bank erosion rather than traditional hard engineering.

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