MORPHOLOGICAL CHANGE OF A RIVER

Brahmaputra River, Lower Reach

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Introduction

This report analyzes the morphological changes of the lower reach of the Brahmaputra River over a 10-year period from 2016 to 2026. In Bangladesh, this reach extends from the Bangladesh-India border at Nunkhowa (Kurigram) down to just upstream of the Teesta-Brahmaputra River confluence. The Kurigram district was used as study area which covers the intended reach.

The USGS EarthExplorer's reflectance images from Landsat 8-9 dataset of month February were used to measure total bank erosion and accretion across the reach and track surface area changes in five individual bars.

Methodology

Landsat Imagery Collection

1. On USGS EarthExplorer website (earthexplorer.usgs.gov), the following polygon was entered which covers the target river reach:

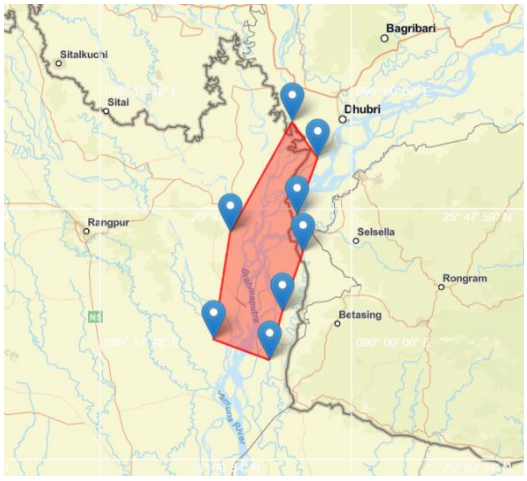


Figure 1 Query extend of the study area in USGS EE

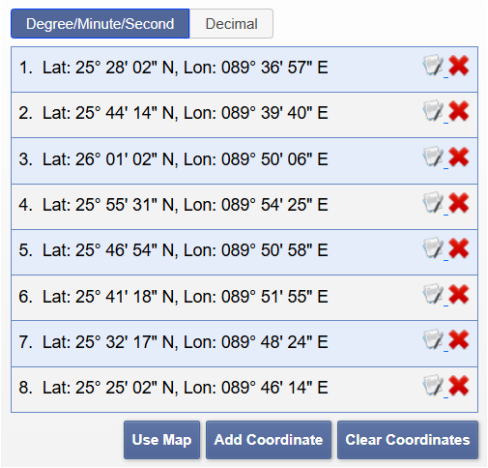


Figure 2 Coordinates of query area

2. Query criteria included date range of 01/11/2025 to 02/28/2026 (MM/dd/YYY), and cloud cover range of 0% - 10%.
3. Dataset was selected as "Landsat 8-9 OLI/TIRS C2 L2".
4. An acceptable item (no cloud over the region of interest) from the results was selected and downloaded. Additionally, the item's path and row were noted.
5. Another query was performed using the path and row from earlier step, and date range of 01/11/2015 to 02/28/2016.
6. Again, an acceptable item from the results was downloaded.

Erosion/Accretion

Isolate waterbody and land:

1. The downloaded reflectance bands 3 and 5 (year 2026) were added into ArcMap.
2. The Normalized Difference Water Index was computed using the "Raster Calculator" tool:

$$\text{NDWI} = \frac{B3 - B5}{B3 + B5}$$

3. Shape file of Bangladesh (*BGD_adm3.shp*) was imported.
4. The district "Kurigram" was selected, exported, and then added back into ArcMap.
5. Using the "Extract by Mask" tool with exported "Kurigram" layer, NDWI output of the study area was extracted.
6. Using the "Reclassify" tool, the study area was reclassified as either water or land.
    a. The number of classes was selected as 2.
    b. Break value was calibrated against Esri Landsat Explorer until the produced water body was acceptably similar to what was in real life at a similar timestamp.
    c. Break value of -0.055847 was found acceptable.
7. The produced raster was converted to polygon using "Raster to Polygon" tool.
8. These steps were performed for both 2016 and 2026 images.

Computation of erosion/accretion:

1. The river reach was selected and exported from the produced polygon of last step.
2. Using the "Geoprocessing > Intersect" function, unchanged area of river was produced.
3. Using the "Erase" tool, erosion and accretion were computed:
    a. Erosion = Area in 2026 – Unchanged Area
    b. Accretion = Area in 2016 – Unchanged Area
4. Geometric calculation of area (in hectare) for unchanged, erosion, and accretion were computed within their attribute tables.

Computation of bar:

1. Five distinct bars were selected and exported from the produced polygon of earlier step.
2. Using the "Geoprocessing > Intersect" function, unchanged area of bar was produced.
3. Using the "Erase" tool, erosion and accretion were computed:
    a. Accretion = Area in 2026 – Unchanged Area
    b. Erosion = Area in 2016 – Unchanged Area
4. Geometric calculation of area (in hectare) for unchanged, erosion, and accretion were computed within their attribute tables.

Result Analysis

Riverbank changes:

Feature	Transition	Area (ha)	% of Total Area	Rate (ha/yr)
Stable Water	Water -> Water	6,379.23	22.70	–
Erosion	Land -> Water	9,358.33	33.30	935.8
Accretion	Water -> Land	12,363.44	44.00	1236.3
Total Area	Active Corridor	28,101.00	100.00	–
Net	Net Accretion	+3,005.11	–	+300.51

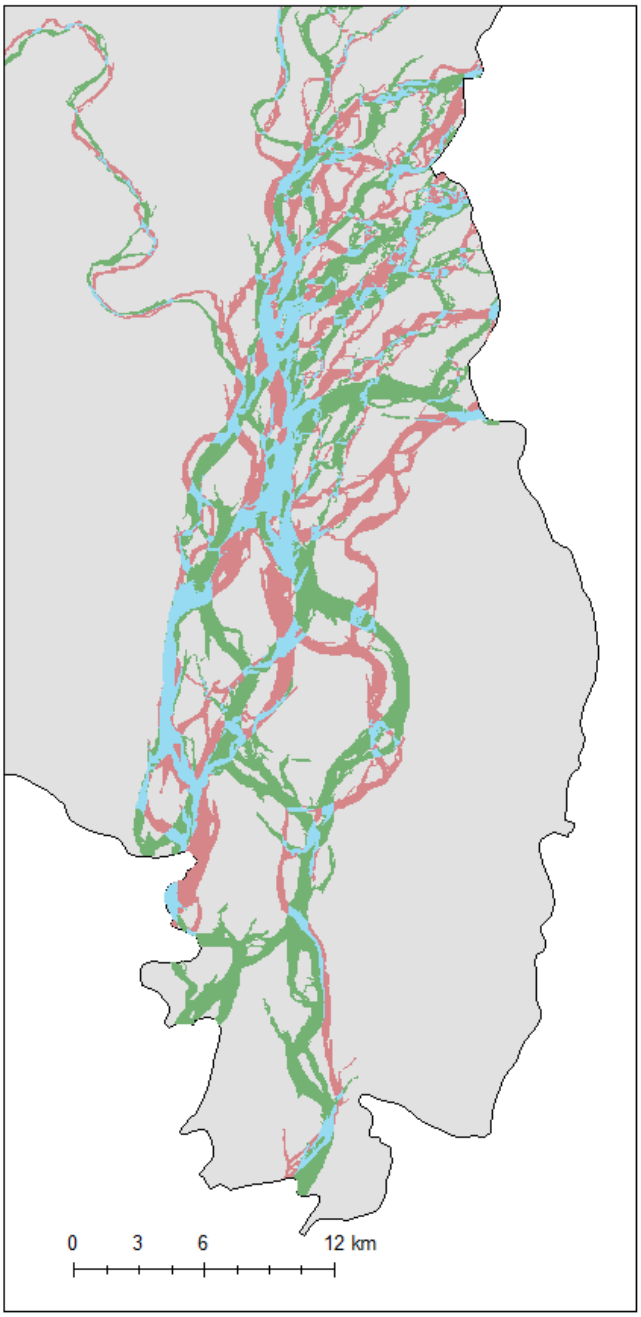
Comments:

Between 2016 and 2026, the reach experienced $12{,}363$ ha of accretion compared to $9{,}358$ ha of erosion, resulting in a net land gain of $3{,}005$ ha (net accretion rate of ≈ 300 ha/year). This reflects the aggrading nature of the Brahmaputra.

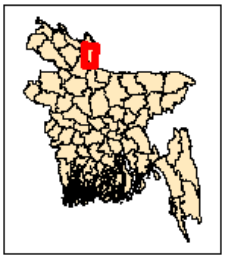
Only $6{,}379$ ha (22.7%) of the active water area remained stable over the 10-year span. More than 77% of the active channel underwent either erosion or deposition.

Morphological Change Over 10 Years

Lower Reach of Brahmaputra River



Study Area Location



N

Legend

- River Accretion
- River Erosion
- Stable Water
- Land

Metadata

Source: USGS EarthExplorer
Dataset: Landsat 8 & 9 (OLI / TIRS)
Projection: WGS 1984 UTM Zone 45N
Author: Azraf Taohid Akib
202330044
Affiliation: Dept. of EWCE, MIST
Date: September 09, 2026

Bar changes:

Bar No.	Area 2016 (ha)	Area 2026 (ha)	Stable Area (ha)	Accretion (ha)	Erosion (ha)	Net Change (ha)	% Change
01	1225.35	1551.27	818.26	733.01	407.10	+325.91	+26.60
02	436.88	226.98	120.43	106.54	316.45	-209.91	-48.05
03	718.04	829.30	427.17	402.12	290.86	+111.26	+15.50
04	1483.71	1931.88	721.78	1210.10	761.93	+448.17	+30.21
05	461.19	401.67	262.54	139.14	198.66	-59.52	-12.91
Total	**4,325.18**	**4,941.09**	**2,350.18**	**2,590.91**	**1,974.99**	**+615.91**	**+14.24**

Comments:

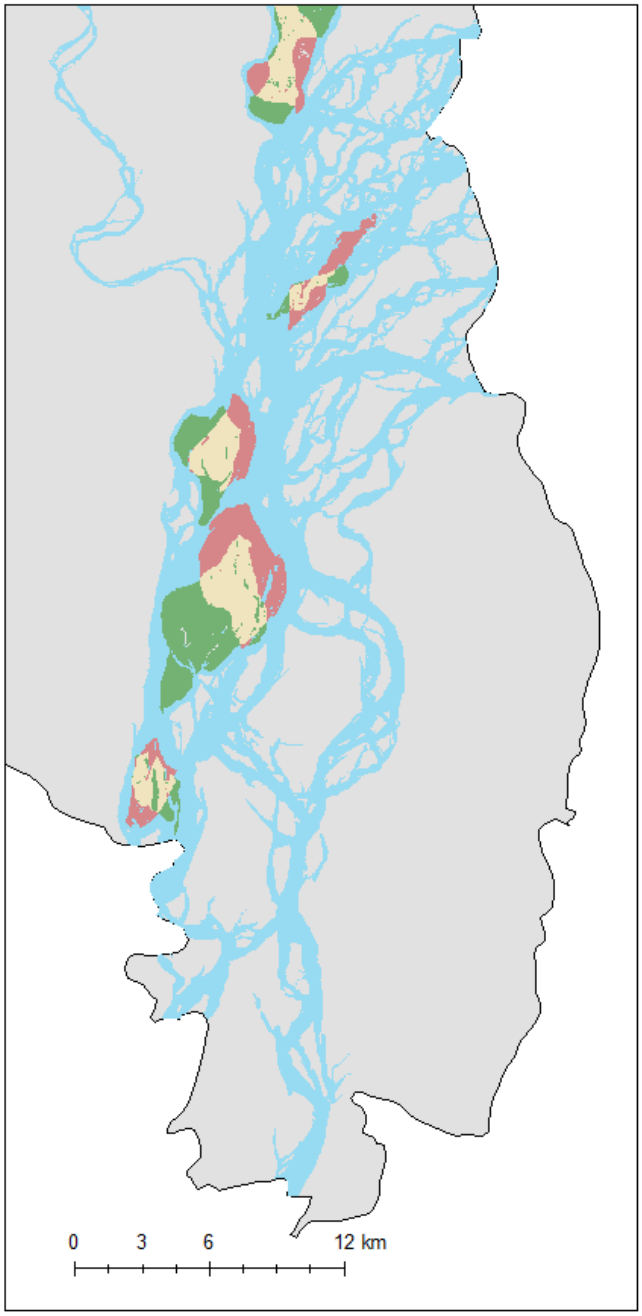
Across the five sampled bars, net surface area increased by 615.91 ha (+14.24%). This positive sediment mirrors the reach-scale analysis from earlier task, where deposition exceeded erosion across the active channel.

Individual bar responses show high spatial variance:

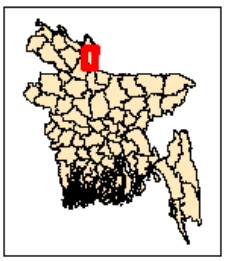
- Bars 1, 3, and 4 expanded significantly, with Bar 4 adding 1,210.10 ha of newly emerged sand surface.
- Bar 2 experienced severe degradation, losing nearly half its surface area (-48.05%), indicating a secondary channel activation cutting through the bar platform.

Morphological Change Over 10 Years

Lower Reach of Brahmaputra River



Study Area Location



N

Legend

- Bar Accretion
- Bar Erosion
- Bar Unchanged
- Land

Metadata

Source:	USGS EarthExplorer
Dataset:	Landsat 8 & 9 (OLI / TIRS)
Projection:	WGS 1984 UTM Zone 45N
Author:	Azraf Taohid Akib 202330044
Affiliation:	Dept. of EWCE, MIST
Date:	September 09, 2026

Conclusion

Between 2016 and 2026, the lower reach of the Brahmaputra functioned predominantly as a net depositional system. Deposition outpaced erosion across the channel, resulting in a net gain of roughly 3,005 ha of land.

Channel stability was very low. Only 22.7% of the active channel remained permanent water, meaning more than three-quarters of the channel shifted through either bank erosion or sediment deposition.

The sampled bars mirrored this reach-scale growth with an overall 14.2% area increase, but they also highlighted high local volatility. While dominant bars expanded substantially, most notably Bar 4 adding over 1,200 ha of new surface, others like Bar 2 were cut nearly in half as new secondary channels sliced through their platforms.

Overall, it captures an intensely dynamic braided river in constant reorganization, driven by high sediment supply, bar migration, and continuous channel shifting.