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Morphological assessment of Muhuri accreted area in the Feni estuary

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Abstract

This study has been conducted to investigate the morphological development of the Muhuri Accreted Area (MAA) below Feni closure of the Muhuri Irrigation Project (MIP) in the Feni estuary. The study area consists of the accreted land south of the Feni closure dam and stretches from the Chittagong coast in the east, up to the Ichakhali regulator in the south and the Feni river in the west. From the study it has been found that below a water control structure when flow is obstructed in a tidal channel for a long time, heavy siltation results if the tidal water contains sediment load. This study covers the main dominating features (a) Land formation through accretion and (b) Migration of Feni river in the morphological development of Feni river estuary leading to the creation of MAA. Utilizing the bathymetric survey data, regression analysis has been done to correlate the rate of accretion with the depth and distance of the channel from the closure and the correlation coefficient is found satisfactory. The analysis shows that immediately after the construction of closure of MIP a rapid siltation have occurred and the level of the area rises about 4m in the first year and 0.6m in the second year. This study is also aimed to investigate the significance of net accretion in respect of time. So a series of land elevation, land subsidence and topographic survey data has also been analyzed. It has been observed that the accretion process becomes slow in respect of time and the accretion rate is approximately 0.04 m/year for the last 14 years. Another aspects such as features of the morphological development of the MAA regarding changed system of Feni channel, course of river and tendency of migration of Feni river has also been studied. A completely changed system of channel and river course of the Feni river is observed within the five years immediately after the obstruction of tidal flow in the Feni river. During the period the west and east bank of Feni river migrated approximately 300 m/year and 100 m/year respectively towards the westward direction, but after that the migration also becomes slow. The study reveals that the MAA is now suitable for empoldering. The level of empolderment is also assessed.

Keywords: Feni closure, bathymetric survey data, accretion height, empoldering level and migration of Feni river

1. Introduction

The continuing accretion of land occurring in the sea necessarily implies the complicated interplay between driving forces, transportation of sediment and subsequent sedimentation process in the estuary. In the Feni estuary the sea tides, waves, surges and Feni river discharges are the driving forces and mainly responsible for the morphological changes in the estuary of Feni river leading to the formation of MAA. The new land has been accreted from the sea downstream to the Feni closure of MIP is considered as an additional benefit of MIP. MIP actually is a reservoir project created by the three flushy rivers (1) Feni river (2) Muhuri river and (3) Kalidas-Pahalia river. The creation of this artificial reservoir body, linked with a network of 245 irrigation canals along with 3.411 km closure dam and 40 vent (each vent is 3.65mx3.65m) regulator stops the intrusion of sea water into the MIP area and in consequence land is accreted from sea downstream to the closure due to siltation. This accreted area situated in the Feni estuary is greatly influenced by the tidal flow. The tides moving up to the area twice a day carry huge quantity of sediment from the sea and play an important role in to and fro transport of sediment in the area. The morphological development of the Feni river is dominated by two main features: Land formation through accretion and Migration of Feni river. In the process of complex pattern of sediment displacement, a large part of Bangladesh is formed by alluvial deposits of the Ganges, Brahmaputra and Meghna with their tributaries and distributaries. These rivers supply a large quantity of sediment to the delta. Investigators have estimated the annual volume of sediment in the range of 1.2-2.5 billion tons. Coleman (1969) estimated it to be 2.5 billion tons; Peerbolte(1986), Nishat and Alam (1986) estimated it to be between 1.2-1.4 billion tons. The total amount of sediment supply is estimated to be 1.0-2.2 billion tons a year (Eysink, 1983).

For the development of water resources in the country closure, dams and regulators will have to be constructed across tidal channels. Similar phenomenon of siltation in a tidal estuary due to stoppage of tidal motion is observed in front of the closures, dams and sluices constructed in the coastal areas to prevent saline water inundation. In the coastal areas, under BWDB, there are thousands of sluices and regulators, which are closed after the monsoon period and are operated on the onset of next monsoon period. Thus virtually, the tidal channel remains closed for several months resulting into heavy siltation in front of the gates, which in turn make the sluices inoperable. Every year to make the sluices operative, silts have to be removed manually. Often excessive siltation renders the sluices totally inoperative. So it is important to understand the process and rate of siltation as well as the extent of siltation in a year at the drainage channel of regulator for proper planning of operation of these structures. Such an understanding would also assist in undertaking proper measures to solve these recurring phenomena after installing a regulating sluice at the mouth of an estuarine river. The main objective of this paper is to assess the morphological development of MAA through the studies of land formation in the estuary and planform of Feni river.

2. Literature

After implementation of MIP to stop the sea water intrusion into the area in the year 1977-78 to 1985-86 (BWDB, 1986) by BWDB about 3000ha of new land has been accreted from the sea downstream to the Feni closure of MIP due to siltation Known as MAA. The area for the morphological study spreads over Sonagazi thana of Feni district and Mirsarai thana of Chittagong district. This selection of the study area has been guided to some extent by the availability of data and other sources of documents, reports and information. The LRP (presently Survey and Study division), BWDB an organization responsible for morphological study in the lower Meghna estuary had carried out a continuous survey work at the downstream of the Feni closure dam. Data on bathymetric, topographic and hydrological measurements before and immediately after the construction of Feni closure dam was monitored by this organization. Feasibility study of Muhuri accreted area (main report, appendix A/B/C/D/E/F) below the Feni closure in the year 1998 to 1999 was carried out by the Development Design Consultants Ltd. (DDC, 1999) and is used for the collection of necessary information of the area. Besides, various reports (IECO, 1964,1983; MPO, 1984; MES-I, 1997; MES-II, 2001; SSSU-07, 2002), feasibility studies (LRP, 1987) and research papers Eysink, 1983; Koch and Barua, 1985, 1986; Pramanik, 1978; Goodbred and Khuel, 1999 also provides useful data for this study. The feasibility report and design report of Muhuri closure dam, inventory of MIP have also been used for the collection of necessary information of the project area.

3. Data collection and analysis

Tidal Movement: The sea surface rises and falls regularly twice a day along the coast of Bangladesh. So tide along the coast of Bangladesh is semi-diurnal, which means it has a time period of about 12 hours 25 minutes.

Sediment Data: The Muhuri and Feni river of MIP carry heavy concentration of silt loads in order of 2 million tons per year (IECO, 1983), but due to construction of closure dam and Feni regulator a major portion of these sediments are now trapped in the reservoir side. Only a small quantity of these sediments is carried by the discharge through the Feni regulator. Therefore the contribution of upland sediment discharge in the down stream of closure dam is very small. The major source of sediment in the Feni estuary is silt carried by the sea water (Eysink,1983). It is found that the concentration towards the regulator site i.e., MAA is gradually reduced and average sediment concentration near the regulator site during high water flow condition is about 400 mg/l. At the outfall of the estuary, higher value of sediment concentration is observed.

Grain size distribution of suspended and bed material: The analysis of the grain size distribution of suspended sediment of Feni estuary indicates that the mean grain size of suspended and bed sediment of Feni river varies from 0.012mm to 0.05mm and from 0.03mm to 0.14mm respectively (LRP TR-7,1982).

Bathymetry: The LRP of BWDB have completed the topographic and bathymetric survey work of the area presently known as MAA located at the downstream of Feni closure dam. The survey of the area was undertaken by LRP for the years 1982, 1986 and 1987 (the dam was completed on 28th February of 1985). They had prepared two contour maps based on the survey. It should be mentioned here that the level of the area was observed more or less at the same height for the years 1982 to 1985 (before construction of closure). So the survey data of 1982 hereafter referred as 1985. For the analysis of these maps, about 9 (nine) km^2 survey area are considered. The area is divided into 9 (nine) cross-sectional grids. Each grid is about 2 km long and 170 m wide. These cross-sections give a good coverage of the entire Muhuri Accreted Area. The distances of the cross-sections from the Feni closure are 375m, 545m, 720m, 880m, 1040m, 1210m, 1380m, 1540m and 1700m respectively. Subsequent years land elevation data has been used to study the significance of cross-sectional developments and changes in sediment depth in respect of time.

Remote sensing: In addition to land formation another dominated feature of the morphological development of Feni river is the channel shifting processes through migration. The channel shifting processes in the Muhuri Accreted Area are characterized by migration rate of the East/West bank of Feni river. Satellite images are used to assess the channel shifting processes in the study area. In the present study 4 (four) landsat frames in the period between 1984 and 1997 have been used. Migration rate obtained from satellite data have been verified against field data.

Water Level: During monsoon for the period 2000-2004, the mean and maximum ranges of tide in the Feni estuary have been found as 3.50m and 5.50m respectively. The tides have also been studied on the basis of annual maximum High Water Level data collected over the periods 1985 to 2004 at the gauge downstream of Feni regulator in the Feni river. The maximum high water level and mean of annual maximum high water level of Feni river near Feni regulator is found about 6.0m and 5.276m (SOB) respectively over the 20 years period. The seasonal mean high water level of Feni river near Feni regulator for the period 2000-2004 are also shown in Table 1. From this table it has been found that the average of mean high water level during pre-monsoon, monsoon, post-monsoon and dry period are 3.47m, 4.14m, 3.61m and 2.69m (PWD) respectively. Analysis of daily mean high water level of Feni river downstream to the Feni regulator from 2000-2004 shows that the monsoon high water level exceeds 4.50m (PWD) elevation few times a year (PWD= SOB + 0.46).

Table 1
Mean High Water Level of Feni river d/s of Feni regulator for the period 2000-2004

YEAR	MEAN WATER LEVEL IN METER (PWD)			
	Pre-Monsoon (Mar-May)	Monsoon (Jun-Sep)	Post-Monsoon (Oct-Nov)	Dry Period (Dec-Feb)
2000	3.46	4.30	3.62	2.79
2001	3.36	4.05	3.49	2.67
2002	3.38	4.04	3.55	2.56
2003	3.42	4.11	3.76	2.73
2004	3.73	4.23	-	-
Mean	3.47	4.14	3.61	2.69

4. Results and discussions

4.1 Accretion height computation through utilizing the field data by regression analysis

To find out the accretion height, use is made of the data obtained from the contour maps of the bathymetric area. The levels of each cross-section are used to compare the situation between 1985 to 1986 and 1986 to 1987. Here it is mentioned that the information and data for 1985 represents situation before closing of the channel and that of 1986 and 1987 represents situation after the closing of the channel. The comparison is made by using the following form of regression equations correlating accretion with previous year’s channel bed level using the data of different years for each of the nine cross- sections, that can be expressed as:

$$\Delta h = a \pm bh$$

where, Δh is the accretion height in a year after the construction of closure, a and b are the intercept value and regression coefficient respectively and h is the previous year channel bed level.

From this comparison, it is evident that more or less all the 9 (nine) equations show a definite trend and there exists a good correlation among them. Average coefficient of correlation for the sections considered are found to be 0.976 and 0.634 in the years 1986 and 1987, respectively. Based on which a general equation for the particular year has been developed (Equation 1 and 2). The value ***a*** and ***b*** of this equation are obtained respectively by correlating the intercept values and regression coefficients of the developed sectional equations with the distance of cross-sections from the closure.

Thus the accretion heights have been estimated with respect to the distance of cross-sections from the closure dam and depth of the channel as shown in Tables 2 and 3. This accreted area in respect of time is acquainted as Muhuri Accreted Area.

The analysis of field data for the year 1986 (one year after the construction of the closure dam) gives the following equation to calculate the accretion height during this period.

$$\Delta h_1 = a_1 - b_1 h \quad (1)$$

where, $a_1 = -7.2899 \times 10^{-4} d + 3.98435673$ which is obtained from intercept values versus distance relationship (Fig. 1), $b_1 = +2.545 \times 10^{-5} d + 0.85825081$ which is obtained from coefficient of regression versus distance relationship (Fig. 2), d is the distance from the closure dam in meter, h is the initial bed level of the channel before closure and Δh_1 is the accretion height one year after the construction of closure dam.

Table 2
Computed accretion rate from field data in the year 1986 (one year after construction of closure)

Cross-section	Value of a_1 and b_1 respectively	Average river bed level (m,PWD)	Avg. accretion height (Eq. 1) (meter)
1-1	3.711, 0.868	0.342	3.414
2-2	3.587, 0.872	-0.66	4.163
3-3	3.459, 0.877	-0.0751	3.525
4-4	3.343, 0.881	-0.0753	3.409
5-5	3.226, 0.885	0.5758	2.716
6-6	3.102, 0.889	0.9504	2.257
7-7	2.978, 0.893	1.6758	1.482
8-8	2.862, 0.897	1.825	1.225
9-9	2.745, 0.902	1.75	1.167

Similarly from the analysis of field data the following equation is obtained to calculate the accretion height for the year 1987 (over the year 1986).

$$\Delta h_2 = a_2 + b_2 h_1 \quad (2)$$

where, $a_2 = + 8.6 \times 10^{-4} d + 1.31069$ which is obtained from intercept values versus distance relationship, $b_2 = - 1.872 \times 10^{-4} d - 0.3551846$ which is obtained from coefficient of regression versus distance relationship, d is the distance from the closure dam in meter, h_1 is the bed level of the channel in 1986 (one year after the construction of closure dam) and Δh_2 is the accretion height in the year 1987.

The calculated values of accretion height for the different cross-sections in the year 1986 and 1987 using Equations (1) and (2) are shown in Table 2 and 3 respectively.

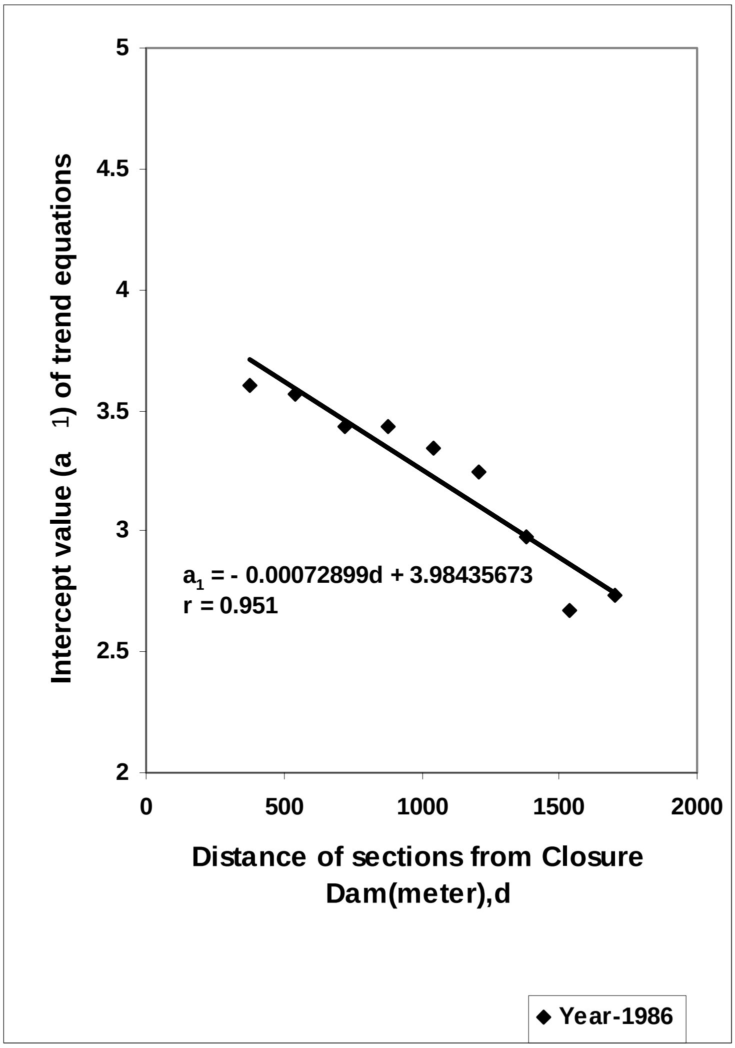


Fig. 1. Relation between intercept values of accretion height equations and the closure distance

4.2 Accretion with the distance of cross-sections from the closure in the MAA

The rate and pattern of the accretion in the MAA have been discussed here. It appears from the bathymetric survey data that before the construction of closure dam, the possible amount of the incoming sediment in the tidal mouth of the Feni river is the same, i.e., the level of the channel in the all cross-sections is approximately the same (flat tidal area). In Table 2 it has been found that in 1986, the rate of accretion gradually decreased as the distance from the closure increased. This is because of the greater contribution of settling the suspended sediment in the area nearer to the closure. These have occurred due to longer period of inundation and lower effect of turbulence of water nearer to the closure. During this period, the accretion rate is also maximum because of the longer period of inundation of low-level in each tide.

Table 3
Computed accretion rate from field data in the year 1987 over the silted up channel of 1986

Cross-section	Value of a_1 and b_1 respectively	Average river bed level (m,PWD)	Avg. accretion height (Eq.2) (meter)
1-1	1.958, -0.425	3.725	0.375
2-2	2.094, -0.457	3.7	0.403
3-3	2.234, -0.49	3.425	0.556
4-4	2.362, -0.52	3.4	0.594
5-5	2.490, -0.55	3.325	0.661
6-6	2.626, -0.582	3.175	0.778
7-7	2.762, -0.614	3.325	0.720
8-8	2.890, -0.643	3.025	0.945
9-9	3.018, -0.673	3.0	0.999

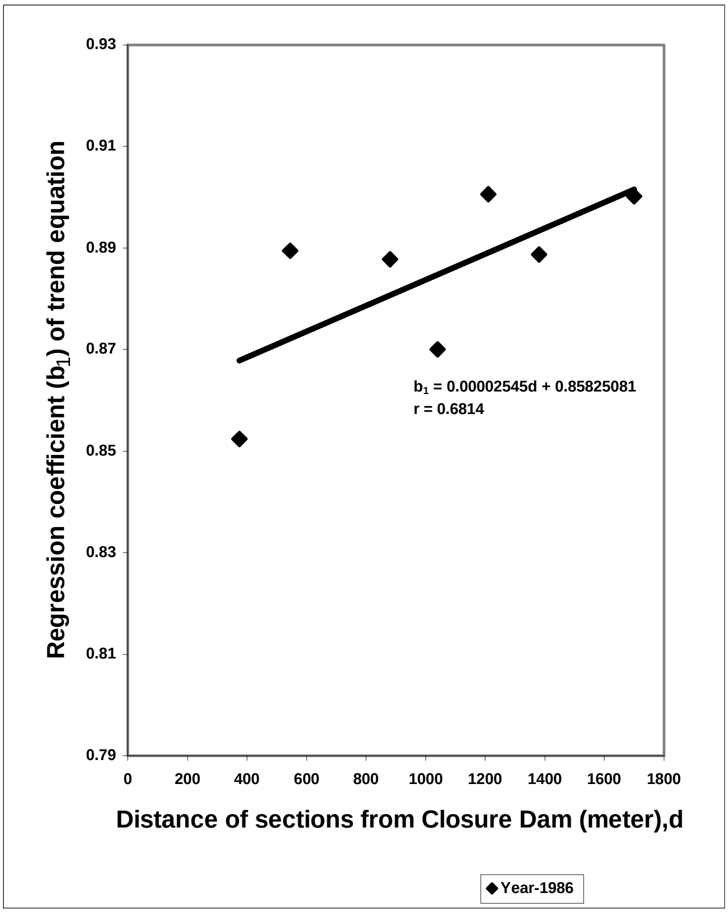


Fig. 2. Relation between regression coefficients of accretion height equations and the closure distance

Again in the year 1987, it is evident that the rate of accretion increases as the distance of the section increases from the closure (Table 3). This is because, already huge amount of sediment have been deposited in the area nearer to the closure within one year and the level of this area increased nearly to the mean water level (Table 1). Therefore, the possibilities of deposition of higher amount of sediment are reduced. But on the other hand, due to longer period of inundation of far sections, the deposition of sediment in those sections is higher. The accreted area below the Muhuri closure dam has very shallow depth. About 4 (four) meter of accretion of land had occurred near to closure within one year after the construction of the closure dam. During this period, the level of maximum land of this accreted area increased about nearly to the mean water level. As a result the amount of accretion in the year 1987 is reduced.

4.3 Land formation and significance of accretion in respect of time

The estuarine area of the Feni river is known as an area of a net deposition of sediments supplied either by the river or by the sea. The major part of deposition due to construction of Feni river closure consists of fine marine sediments. The accretion of land in this estuary is a continuous and generally a very gradual process interfered by the dynamics of the ever-changing course of the channel.

From the very inception of the implementation process of MIP, herewith a statistics regarding morphological development of MAA is summarized accordingly. The analysis of data for the period 1973-1977 at the Feni river mouth indicates that most of the accreted land consists of marine sediments. Due to accretion of this land the open water area in the mouth of the Feni river decreased about 40% over the period (Pramanik, 1978). After implementation of MIP, analysis of LRP, BWDB survey work data covering 9 (nine) km^2 area downstream of Feni closure dam in the 9 (nine) cross-sectional grids shows that the level of the area was more or less at the same height for the year 1982 to 1985 (before construction of closure). Immediate after the construction of closure dam (Dam was completed on 28^{th} February of 1985), a rapid siltation of the area had occurred and due to this siltation, the level of the bathymetric survey area rises from –0.66 mRL to 3.7 mRL PWD in the first year and 3.4 mRL to 4.0 mRL PWD in the second year (Tables 2 and 3). These accreted area have been gradually risen up in course of time. Thus after the construction of the Feni closure dam the newly accreted land is formed during the period 1985-1990 with an elevation of 3.80 mRL to 4.20 mRL SOB, which is named as Muhuri Accreted Area (Figure 3).

From the recent topographical survey carried out by the DDC consultants it is observed that most of the accreted areas have ground elevation 4.2 mRL to 4.8 mRL SOB, indicating that the accreted area is more or less matured. The area-elevation relation of the matured MAA is presented in Table 4.

It should be mentioned here that the land of the MAA is almost flat having mild slope mainly from north to south and also has a gentle cross slope in the east-west direction. In order to estimate the net accretion, spot levels at ten stations covering the accreted area from north to south also have been taken by the DDC consultants to have the land-subsidence (if any) of the MAA. It has been observed that there is no land subsidence as shown in the Table 5.

Again in order to determine the trend of accretion process in the MAA after construction of the closure dam, the land elevation measurement data over the years 1985-1990, 1997 and recent 2002/2004 have been analyzed. The five locations (Fig. 3) have been selected for measuring land formation in the MAA close to the dam and the land elevation data collected from those five locations are shown in Table 6.

From the land elevation data it has been observed that just after construction of the Feni closure the accretion rate was very high for the first year and ground elevation raised from –1.85 to 3.75 m (SOB) i.e., rate of accretion was approximately 3 to 4 m/year and for the second year it was about 0.5 m/year which has a close agreement with the cross-sectional data of the LRP (Table 2 and 3). After that, the accretion process becomes slow down in this area over the time and the accretion rate is approximately 0.04 m/year for the last 14 years, which is not very much significant in respect of time. So, it is evident that the MAA is now more or less matured and suitable for empoldering.

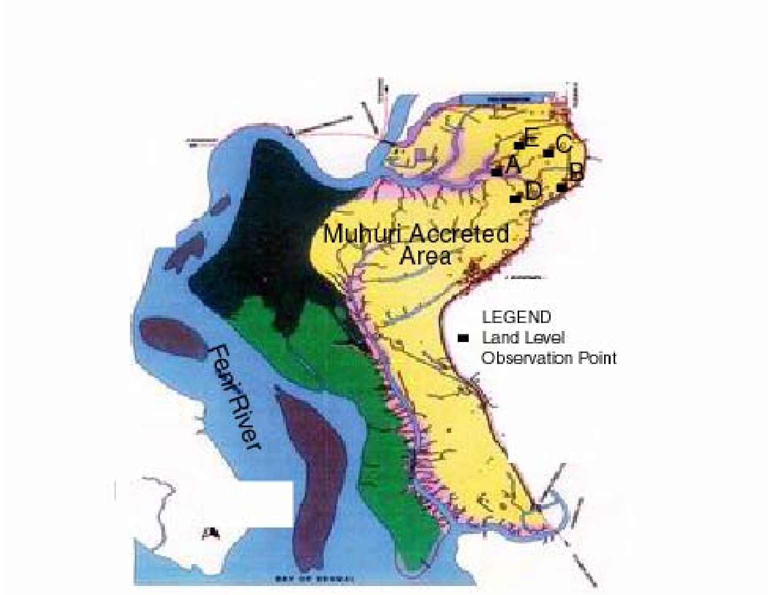


Fig. 3. Muhuri Accreted Area

Table 4
The area-elevation relation of the matured MAA (DDC,1999)

Elevation m (SOB)	Area (ha)
<= 3.00	143.0
3.00-3.30	44.0
3.30-3.60	32.0
3.60-3.90	114.0
3.90-4.20	112.0
4.20-4.50	670.0
4.50-4.80	735.0
=>4.80	122.0

Total = 1972.00 ha

Table 5
Land subsidence data of the Muhuri Accreted Area (DDC,1999)

Date of observation	Land Levels (m SOB) on observation stations									
	No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	No.9	No.10
7-2-98	4.936	4.632	4.616	4.988	5.091	5.072	4.793	5.181	4.889	4.370
26-7-98	4.932	4.637	4.612	4.991	5.089	5.077	4.795	5.177	4.885	4.378

Table 6
Trend of land formation (Elevation in m SOB) at 5 selected points in Muhuri Accreted Area

Year	Location A	Location B	Location C	Location D	Location E
1985	-1.85	-1.5	-1.2	1.85	3.75
1986	3	3.25	3.75	3	3.75
1987	3.5	3.96	4.17	3.5	3.8
1988	3.62	4.2	4.34	3.6	3.85
1990	4.05	4.25	4.24	4.15	4.15
1997	4.45	4.62	4.4	4.6	4.6
2002/2004	4.61	4.78	4.56	4.76	4.77

The rate of accretion at the selected points of the MAA over the years after the completion of closure indicates that the rate follows exponential trend with good correlation. The exponential equation obtain as follows:

$$Y=a\,e^{-bT}$$

where, a is the coefficient, b is the exponent, Y is the rate of accretion in m/year and T is the year after the completion of closure, i.e., 1985. The average of the accretion rate (m/year) for the selected points in Fig. 3 over the time segments 1985 to 1988 and 1988 to 2002 with good correlation are shown in Fig. 4.

4.4 Empoldering Level of the MAA

Once the siltation has reached to a level that accreted land will be inundated only during high tides, people will consider starting cultivating the land. To ensure safe habitation, the land should be empoldered. Empoldering of the land is executed by dykes and regulating structures. It is assumed that the maximum elevation of a char is related to monsoon mean high water (MHW) level and the local flow and wave conditions. As stated earlier (Table 1), time- series of high-tide water levels over the last 5 years indicate that average of the monsoon MHW level downstream of the Feni regulator is about 4.14 m PWD. Present topographic data of the land elevation show that the char has an elevation between 4.50 to 5.25 m PWD. The inundation of the higher parts of the char is limited to less than a few times a year.

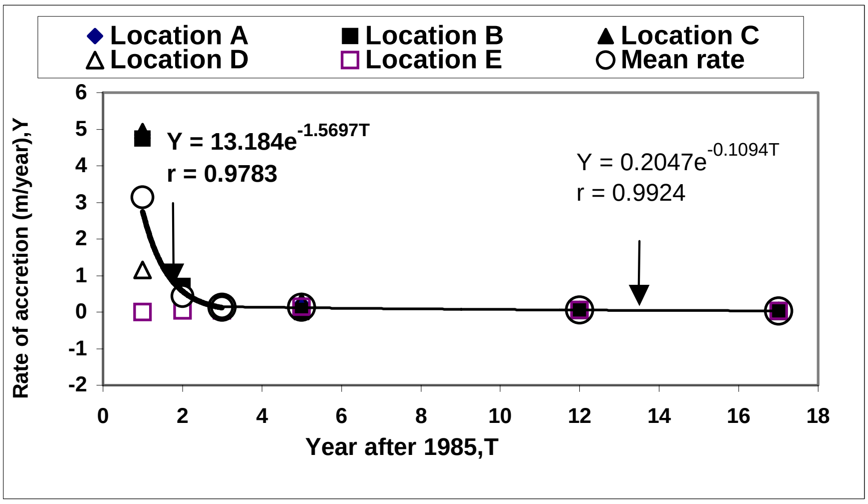


Fig. 4. Average rate of accretion (m/year) over the time at the selected points of MAA

Daily mean high water level of Feni river at downstream of Feni regulator from 2000-2004 indicates that the monsoon high water level exceeds 4.50m (PWD) elevation few times a year. For this study the minimum level for empoldering therefore is taken as 4.50 m PWD. This level is also supported by the present land use and old land inside the existing embankment. The frequency analysis of annual maximum high water level of Feni river (MES, 1997) at down-stream of Feni regulator indicates that the maximum empoldering level for 100 years return period may be taken as 7.50 m PWD. The present crest level of the sea dyke completed in the year 2003-2004 also supports this level.

4.5 Lateral progression of Feni river estuary

Besides, land formation through accretion another main dominated feature of the morphological development of MAA is the migration of Feni river (Fig. 3). Migration of Feni river contributes to the lateral progression of Feni river estuary. So it is also worthwhile to analyze the migration behavior of Feni river in the study of morphological development of MAA.

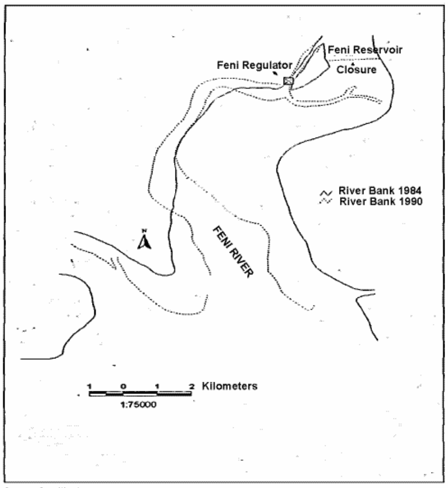
In order to find out the migration behavior of the Feni river a plan form study has been performed using satellite imagery. A comparison of the bank position in 1984 and 1990 (Fig. 5) shows a completely changed system of channel and river course of the Feni river. The study of the bank positions indicates that there is a general tendency of the movement of the Feni river mouth (both bank) in westward direction. The process has been accelerated just after construction of the Feni river closure dam and subsequently the rate of bank migration is reduced but not stopped. During the period 1984-1990 the left bank of Feni river migrated approximately 300 m/year and right bank migrated approximately 100 m/year towards westward direction, but after that the migration becomes slow. An erosion was evident after 1990 at the left bank of the Feni river just down-stream of the Feni regulator and average rate of erosion of the bank was approximately 25 m/year during the period 1990-1997.

After the severe flood of September 1998, a field survey was carried out from the Feni regulator to 2.0 km downward to assess the erosion rate of the east bank of Feni river.

From the field survey data, it is found that average erosion rate of the east bank of Feni river at above mentioned river reach is approximately 25 m indicating that prediction of erosion rate per year from planform study is more or less consistence. Recent field survey data by using temporarily pickets and measuring the perpendicular distance from the left bank of the Feni river to the picket in the period Nov'03- Sep'04 shows that erosion rate of the east bank of Feni river at the above mentioned river reach is approximately zero. Although within 2.0 km downstream of Feni regulator there is a tendency of migration of the west bank of Feni regulator but due to different river training works it is again almost zero, but afterwards still the river is migrating towards westward direction for the last 20 years. Thus during the following five years immediately after the construction of Feni closure dam the migration of Feni river yields maximum contribution to the lateral progression of Muhuri Accreted Area.

5. Conclusions

Cross-sectional data collected has been used to correlate the accretion height with previous year's channel bed for each section and found increased with decreasing channel bed. The correlation coefficient of the relationship is satisfactory, e.g., the average coefficient of correlation is found to be 0.976 for the year 1986. These cross-sectional equations of the accretion height for the particular year have been utilized to correlate the rate of accretion with the depth and distance of the channel from the closure and found reasonable agreement. The calculation shows that in the year 1986 i.e., immediately after construction of Feni closure the accretion rate is the maximum. This is because of the greater contribution of settling the sediment due to longer period of inundation of low level in each tide. In the year 1987, the average accretion height is found to be small. The reason is that during this period, the level of deposition in this area is approaching to the mean high water. It has also been observed that the accretion process becomes slow in respect of time and for the last decade the accretion rate is approximately 0.04m/year. A comparison of bank line shows that presently Muhuri Accreted Area is bounded by a completely changed system of channel and `river course of the Feni river. From available information and plan-form study using satellite images, it is clear that the shifting of the Feni river is in the western direction which is reduced over the time.



Source: Satellite Image

Fig. 5. Planform studies of Feni river (1984-1990)

References

Bangladesh Water Development Board (1986). “Project completion report”, Muhuri Irrigation Project, December 1986.

Barua D.K. and Koch F.G. (1985). “Erosion hazards and accretion prospects in the Lower Meghna estuary”. Paper presented at the workshop on river bank erosion impact study in the Jahangir Nagar University, March.

Barua D.K. and Koch F.G. (1986). “Characteristic morphological relationship for tide dominated channels of the Meghna estuary”, LRP-TR/21 Nov. 29, Dhaka, Bangladesh.

Coleman J.M. (1969). “Brahmaputra River: Channel Processes and Sedimentation”. Sediment Geol.,3, pp. 129-239.

DDC (1999). “The Feasibility study of Muhuri Accreted Area”. Main report, appendix A/B/C/D/E/F, January.

Eysink, W.D. (1983). “Basic considerations of the morphology and land accretion potentials in the Estuary of the lower Meghna River”. LRP, TR-15, BWDB.

Goodbred, S.L. and Kuehl, S.A. (1999). Holocene and modern sediment budgets for Ganges-Brahmaputra river: evidence for high stand dispersal to floodplain, self and deep-sea depocenters, Geology 27(6), p.559-562.

IECO (1964). “Master plan for BWDB”.

IECO (1983). “Operation and Maintenance manual for project major works”, Muhuri Irrigation Project.

LRP TR-7 (1982). “Sediment Concentrations and Salinities between Bhola Island and Chittagong Coast”, BWDB, May.

LRP (1986). “ Project Summary of Land Reclamation Project”, Dhaka.

LRP (1987). “Feasibility study on construction of a cross dam between Sandwip Island and Noakhali main land, Bangladesh. Final report TR-21.

LRP (1987). “ Report on Feni accretion at the mouth of the Feni river downstream of the Feni regulator and erosion of the right bank of the outfall channel” (Unpublished).

MES (1997). “Frequency Analysis of Water Level in Feni Estuary”, Technical note, MES-012.

MES-II (2001). “Hydro-Morphological Dynamics of the Meghna Estuary”, June.

MES-II (2001). “Year 2000 Update of Trends and Processes”, Technical note, MES-029, June.

MPO (1984). 2nd Interim report of National Water Plan Project, Ministry of Irrigation, Government of Bangladesh.

Nishat A and S. M. Z. Alam (1986). “ Sediment transport characteristics of the Brahmaputra and the Ganges”. Paper presented at the regional workshop on erosion and sediment transport process, Dhaka, Bangladesh, December 20-23.

Peerbolte, E.B. (1986). “Mathematical modeling of Lower Meghna Estuary”. A review paper presented at the regional workshop on erosion and sediment transport process, Dhaka, Bangladesh, December.

Pramanik M.A.M. (1978). “ Sedimentation Pattern and Land Formation studies in the Feni and Little Feni river estuaries using landsat imageries”.

SSSU (2002). “Considerations on Morphological processes in the Meghna Estuary”, Report of the Survey and Study Support Unit (SSSU) Morphologist, SSSU-07, July.

Abbreviations

BWDB	Bangladesh Water Development Board.
DDC	Development Design Consultants limited.
LRP	Land Reclamation Project.
MAA	Muhuri Accreted Area.
MES	Meghna Estuary Study.
MHWL	Mean High Water Level.
MIP	Muhuri Irrigation Project.
PWD	Public Works Department.
SOB	Survey of Bangladesh.
SSSU	Survey and Study Support Unit.