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PHYSICAL MODELLING OF THE EFFECTS OF STRUCTURAL INTERVENTIONS AND DREDGING AT OFF-TAKE: A CASE SUDY

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Abstract

The Buriganga is the one of most important river flowing beside Dhaka, capital city of Bangladesh of which water quality has been severely deteriorated due to insufficient river flow, dumping of solid waste, disposal of contaminant effluent from different types of industries, especially effluent of tanneries. Feasibility Study of the Buriganga River Restoration Project reveals that augmentation of dry season flow in the Buriganga River is possible by diverting Jamuna river flow through the New Dhaleshwari River. To this end, structural interventions at the New Dhaleshwari will be needed together with capital and maintenance dredging. In order to augment flow in the Buriganga River during the dry season, a physical model study has been undertaken to determine the efficacy of the sedimentation basin, off-take structure and proposed dredging. To fulfil the objectives, a distorted model having a scale of 1:50 for vertical and 1:200 for horizontal is constructed. The model consists of 4km stretch of the (part width) Jamuna River and 10km stretch of the New Dhaleshwari river (full width). The model bed is prepared according to field survey data of Jamuna and Dhaleshwari rivers. The study shows that due to introduction of the guide bunds, intake canal and sedimentation basin, the discharge of the New Dhaleshwari river was increased from 0.85% to 1.71% ($725m^3s^{-1}$) of corresponding dominant discharge of the Jamuna River. However, after lowering (through dredging and as per design) of the river bed downstream of the intervention location New Dhaleshwari discharge became 3.60% ($1510\ m^3s^{-1}$) of the dominant discharge of the Jamuna. It is also found that targeted dry season flow ($141\ m^3s^{-1}$) augmentation in the Buriganga river is not possible without dredging beyond the intervention location as flood discharge increased by proposed intervention alone is not enough to cause expected lowering of the river bed downstream of the same. Moreover, it is found that the intake canal, sedimentation basin and exit canal would get silted up gradually with time. Annual volume of sediment deposition within the intervention location is $557235m^3$ and of this volume of sediment, 33% will be deposited within the intake canal, 59% within the sediment basin and 8% within the exit canal.

Keywords: *Sedimentation Basin, Dredging, Guide Bund, off-take structure, tailgate, launching apron*

Introduction

The Buriganga is the main river flowing beside Dhaka, capital city of Bangladesh. Over the last several decades the flow of Buriganga, Turag, Shitalakkha and Baluriver has been reduced drastically. As a consequence, the water quality of the river Buriganga has been severely deteriorated due to insufficient river flow, dumping of solid waste, disposal of contaminant effluent from different types of industries, especially effluent of tanneries. In addition, continual growth of population, illegal possession of riverbank and changes of the socio-economic conditions have severely encroached the once famous inland navigation route of Dhaka and Narayanganj. This has created a great nuisance and social problem of Dhaka City. The location of the study area is shown in **Fig 1**.

To ensure sufficient flow in the river Buriganga by diverting flow from the Jamuna through the New Dhaleswari River, Institute of Water Modelling (IWM) to carry out a full scale feasibility and mathematical model study (2008). The study revealed that in order to augment 141cumec dry season flow in the Buriganga river, 245cumec of the Jamuna flow has to be diverted through the New Dhaleshwari river.

It is understood that without sustainable management of the New Dhaleshwari off-take it would not be possible to augment flow in the Buriganga river during dry the season due to large scale sedimentation at the off-take and in the distributary river bed.

In order to ensure diversion of 245cumec of Jamuna flow structural interventions at the off-take in the form of guide bunds, sedimentation basin and dredging will be needed. Through this model investigation, the performance of the proposed sedimentation basin and associated works in inducing siltation within the sedimentation basin and thereby, allowing silt-free water to enter into the New Dhaleswari river has been assessed to determine the efficacy of the proposed plan and design of the same and also to find out the appropriate and cost effective layout of the intake canal, sedimentation basin and exit canal and proper dimension and alignment of the guide bunds at the intake canal.

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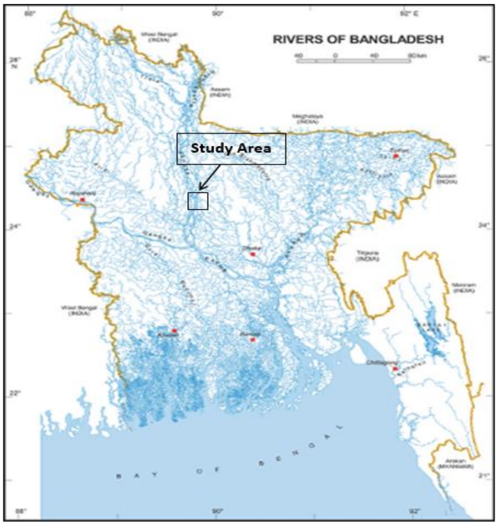

Fig 1. Location of the study area

Objectives of the Study

The objectives of the distorted overall model:

- To verify 141 cumec dry season flow of the Buriganga river by diverting 245 cumec waterfrom the Jamuna river;
- Qualitative assessment of sedimentation and flow distribution at the intake;
- Optimization of location and alignment of sediment basin;
- Performance of sediment basin;
- Morphological assessment at and aroumd the intake qualitatively and
- To get overall idea and sustainability about the system.

Methodology

Study area selection

Keeping the objective of the study in view the study area has been selected. The study area is situated just downstream of the Bangabandhu Bridge and consists of 5km reach (part width) of the Jamuna river and 10km reach (full width) of the New Dhaleshwari river including the off-take.

Data collection and model development

In order to construct the physical model, the primary data include bathymetry and bank line covering the whole study reach, D_{50} of bed and bank materials, water level gradient, point velocities, sediment load and discharges at selected cross-sections both in the Jamuna river as well as in the Dhaleshwari river. Bathymetric survey has been constructed in the selected reach of the Jamuna and the New Dhaleshwari. Discharge has been measured at 3(three) cross-sections (1 in the New Dhaleshwari and 2 in the Jamuna). These measurements have mainly been used for calibration of the model. Therefore, an attempt has been made to measure discharge of the Jamuna River when it is more or less at dominant flow stage. Bathymetric data was collected according to the requirement of the physical model investigation. In the Jamuna river, cross-sections have been measured at an interval of 300m to 400m whereas the same in the New Dhaleshwari river is measured at an interval of 200 m. Some densely spaced cross-sections were measured at the off-take location and wherever necessary for accurate reproduction of prototype bed configuration in the model. GPS survey has been conducted to record the boundary position of the intake canal. The collected secondary data include historical discharges and water levels of the Jamuna recorded at different gauge stations of BWDB. Design drawings of guide bunds, intake canal and sedimentation basin have been supplied by BWDB. Positions of the guide bunds, intake canal and sedimentation basin have also been supplied by BWDB in map form and as numerical data.

An extent of about 5km of Jamuna River extending from 3km upstream to 2km downstream of the New Dhaleshwari off-take has been reproduced in the overall distorted morphological model. The model also includes about 10km reach of the New Dhaleshwari River from the off-take. Partial width of Jamuna River and whole width of Dhaleshwari River have been reproduced in the model. The preliminary layout of the off-take structures has been introduced in the model based on the supplied data. A preliminary layout of the model was given with the reference grid points in the model. Channel planform has been reproduced using these grid points and the bed and bank levels have been fixed up by levelling instrument as per bathymetry using rise and fall method. It has required some cutting and filling of sand from the model. The model was investigated on a mobile bed and hydraulic similarity was established in the model with a distorted scale. The scale ratio was selected as 1:50 for vertical scale and 1:200 for horizontal scale for model construction.

The model is a sand bed morphological model. The model study aims at investigation of the effectiveness of the proposed structural interventions at the off-take to ensure diversion of at least 245cumec of Jamuna river flow into the New Dhaleshwari during dry season. The model has been designed to fulfil both the flow and sediment transport criteria simultaneously. In this physical model, various types of instrument and facilities are needed such as, a sharp-crested weir for measuring flow, point gauge for measuring water level, 3-D current meter for measuring velocity, high resolution camera for taking video and photographic view of model, stopwatch for taking instant time and floats for identifying flow path of flowing water.

The required discharge in the model has been ensured using sharp-crested weir. Flow over the weir has been estimated using Rebock's formula. Model velocity was measured by a 3D velocity meter. Water slope was calculated by analysing the water level measured at different position using point gauges installed in the model. During the model run, flow lines have been identified by dropping floats at the inflow section upstream and by recording their positions from the bank line in the successive downstream sections throughout the entire length of the model and finally catching them at the downstream end of the model. A stopwatch is used to calculate the surface velocity of the flow. Finally, model data have been collected, analyzed and each test results are interpreted.

Similarity condition of the model

The model is designed based on the scale laws and conditions for scale model of the river. In the design of overall distorted morphological model scale conditions related to the three governing processes have to be fulfilled in order to obtain complete similitude between the model and prototype. These processes are (1) flow (2) sediment transport and (3) bed topography. For scaling and design of the model following scale conditions have been taken into account.

i) Roughness Condition

In the model the following roughness condition should be satisfied properly:

$C_r^2 = L_r / h_r$

Where,

C_r = roughness scale

L_r = horizontal scale

h_r = vertical scale

ii) Froude Condition

The scale condition that has to be satisfied reads as:

$F_m < 0.5$ where F_m= Froude number in the model

iii) Minimum Water Depth

Minimum water depth in the model should be maintained for correct measurement of flow velocity.

iv) Sediment Transport Condition:

a) Minimum Sediment transport

The following scale condition should be satisfied to ensure minimum sediment transport in the model.

$V_m > V_{cr}$

where,

V_m= velocity in the model

V_{cr}= critical velocity for sand movement for a particular size

b) Transport Intensity

The following scale condition has to be satisfied for reproduction of the transport intensity when most of the sediment in the prototype is transported as suspended load:

$V_r = C_r D_r^2 \Delta_r$

where,

V_r= velocity scale
C_r= roughness scale
D_r = diameter scale
Δ_r = relative density scale

c) Sediment Transport Direction

The scale condition for transport direction is:

$V^2_r = C_r^2 D_r \Delta_r$

d) Rouse Condition

The Rouse number dictates the mode of sediment transport. It is the ratio of particle settling velocity to the shear velocity (rate of fall versus strength of turbulence acting to suspend particles).

$$P = \frac{w_s}{\kappa u_*}$$

Here, the Rouse number is given by P. The term in the numerator is the (downwards) sediment, the sediment setting velocity w_s. The upwards velocity on the grain is given as a product of the Von Karman's constant, $\kappa = 0.4$, and the shear velocity, u_*. The following table (**Table 1**) gives the approximate required Rouse Numbers for transport as bed load, suspended load, and wash load.

Table1. Approximate required Rouse Numbers for transport

Sl. No.	Mode of Transport	Rouse Number
1	Bed load	$\frac{w_s}{\kappa u_*}$>2.5
2	Suspended load: 50% Suspended	1.2<$\frac{w_s}{\kappa u_*}$<2.5
3	Suspended load: 100% Suspended	0.8<$\frac{w_s}{\kappa u_*}$<1.2
4	Wash load	$\frac{w_s}{\kappa u_*}$< 0.8

In order to reproduce the concentration vertical in the model the following scale condition should be satisfied:

$(V_*/\omega)_r = 1$

where,
V_* = shear velocity
ω = fall velocity

It is evident that different scale conditions will arise in order to satisfy flow and sediment transport conditions discussed above. A compromise should, therefore, be sought that may lead to scale effects to some extent. It is also evident that the model and the prototype roughness play a vital role in selecting the different scale factors. The roughness values may be obtained from previous model studies on the Jamuna river. The design of the model has been made after analyzing the field data. A constant discharge has been considered for the design. Since dominant discharge of a river is responsible for determining its slope and size, the dominant discharge of the Jamuna river is considered for design of the model. Therefore, the same discharge has been considered for model calibration and application tests. Based on the available literature the dominant discharge of the Jamuna river is considered to be 40,000m^3s^{-1}.

e) Shields Condition

The Shields parameters, also called the Shields criterion or Shields number, is a non-dimensional number used to calculate the initiation of motion of sediment in a fluid flow. It is non-dimensionalization of shear stress.

$$\theta = \frac{hi}{\Delta d50}$$

h = Average depth in meter
i = Slope of the channel/ water surface
d_{50}= Median diameter of the particle in meter
$(s\text{-}1) = \Delta = 1.65$
$g = 9.81\ ms^{-2}$

Model Set-up

Outdoor modelling facilities of RRI are used for setting up the planned model. The overall model is constructed in an open-air bed of 100m × 60m. The model setup includes model scale, model discharge, model grid, bathymetry and bank line, re-circulation system, gauging points, tailgates and existing and proposed structures (**Fig 2**).

The sediment has been fed manually at the upstream limit of the model. The design of the existing and proposed structures have been collected from the client and reproduced in the model.

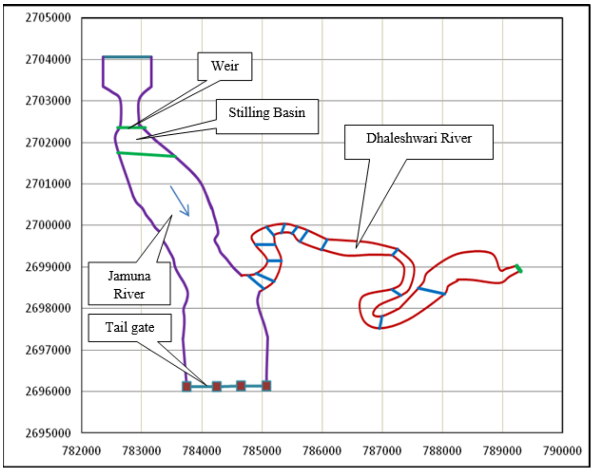

Fig 2. Layout of the model

Calibration of the model and calibration result

Calibration of this model has been conducted in existing condition of the river to ensure that the model is able to reproduce the flow condition, morphological behaviour and sediment transport in the field. The main focus of model calibration has been concentrated on three governing processes namely flow, sediment transport and changes in bed topography.

At the end of the calibration test the discharge through the New Dhaleshwari is found to be as about 0.8% of the Jamuna River. The variation in the New Dhaleshwari discharge with time during the calibration test has been occurred with the developments in the Jamuna bed in response to the imposed conditions for sediment transport similar to that in the prototype.
Calibration of sediment transport depends on the reliable field data of the same. During calibration test sediment has been fed manually at the inflow section of the model. Initially, the rate of sediment feeding has been determined using Engelund and Hansen model. However, at the end of the test the calculated rate has been verified and it is found that equilibrium sediment transport rate in the model is 0.00014 m^3/s for dominant discharge

The necessary measurements taken during the calibration test have been processed and analyzed. The scales of the different basic and derived parameters have been determined based on the calibration test results. **Table 2** presents the characteristics parameters of the dominating processes for the morphological model after calibration. The scale factors for both basic and derived parameters have also been shown in this table. It is noticeable from the table that although the model has been constructed considering a depth scale factor of 50, the actual depth scale ratio after calibration test is found to be 54.64.

Table 2. Characteristics parameters and scale factors obtained after calibration of the model

Parameters	Unit	Prototype	Model	Scale factor
Basic Parameters				
Discharge (Q)	m^3s^{-1}	21172.14	0.39886	53082
Width (W)	m	814	4.07	200
Cross-sectional area (A)	m^2	12454.2	1.1396	10929
Depth (D)	m	15.3	0.28	54.64
Velocity (V)	ms^{-1}	1.7	0.35	4.86
Slope (i)	-	0.00007	0.001	0.07
D_{50}	m	0.00018	0.0001	1.8
Sediment transport (s)	m^2s^{-1}	0.00330	0.000034	97
Sediment transport (S)	m^3s^{-1}	2.686	0.00014	19185
Sediment density	(kgm^{-3})	2650.0	2650.0	1
Relative density	-	1.65	1.65	1
Derived Parameters				
Chezy (C)	$m^{1/2}s^{-1}$	52	21	2.48
Froude Number (F_r)	-	0.14	0.21	0.67
Shear velocity (u*)	ms^{-1}	0.102	0.052	1.96
Critical Shear velocity (u*c)	ms^{-1}	0.0124	0.0124	1.00
Fall Velocity (w)	ms^{-1}	0.022	0.009	2.44
Sheilds parameter (Θ)	-	3.61	1.70	2.12
Critical Shields parameter for motion (Θcrm)	-	0.053	0.095	1.8
Critical Shields parameter for suspension (Θcrs)	-	0.074	0.097	0.76
Rouse parameter (w/kU_*)	-	0.536	0.429	1.25
Rouse (suspension) number (U_*/w)	-	4.66	5.82	0.80
Reynolds particle parameter (Re_*)	-	18.45	5.24	3.52
Reynolds critical particle parameter (Re_*c)	-	2.24	1.24	1.81
Non-dimensional particle paramete (D_*)	-	4.55	2.53	1.8
Critical velocity for motion (Vcrm)	ms^{-1}	0.37	0.28	1.32
Critical velocity for suspension (Vcrs)	ms^{-1}	0.44	0.27	1.63
Critical depth (hcr)	m	0.316	0.0156	20.25
Weigh function of influence of bed slope (fΘ)	-	0.5674	1.0837	0.52
Mode of oscillation	-	1.0000	1.0000	1.00
Flow adaptation length (λ_w)	m	2104	6.24	337.0
Adaptation length for sediment transport (λ_s)	m	2493	6.50	384
Interaction parameter (lP)	-	1.18	1.04	1.14
ID bed celerity (C_{bw})	ms^{-1}	0.00108	0.00091	1.18
ID morphological time scale	days	42.93	0.2542	168.90
2D Morphological time scale	days	376	3.33	113
Aspect ratio	-	53.203	14.536	3.66

The equilibrium water level slope is found to be 0.001. Calibration of morphology has been concentrated on achieving an equilibrium condition in the model bed configuration similar to the initial bathymetry of the model. The observed (initial) *bathymetry* (monsoon 2017) and calibrated bathymetry is shown in **Fig 3** and the observed (initial) velocity (monsoon 2017) and calibrated velocity distribution at prefixed cross-section is shown in **Fig 4.**

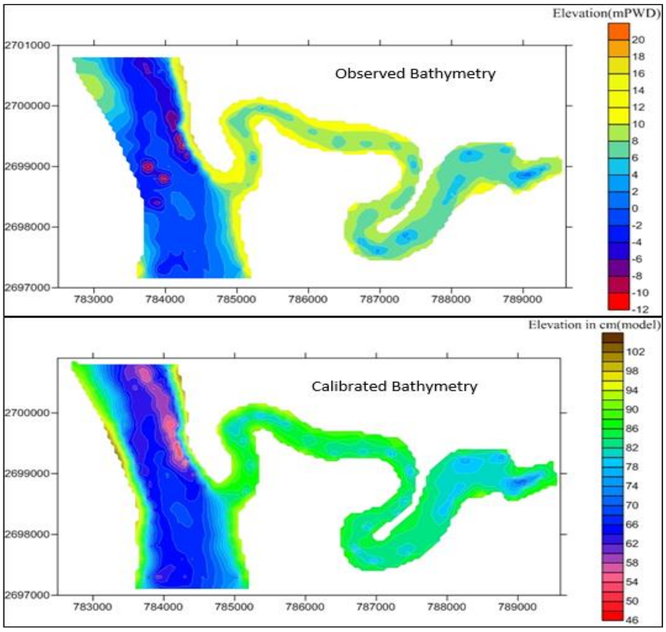

Fig 3. Initial and final bed topography in the model during the calibration test

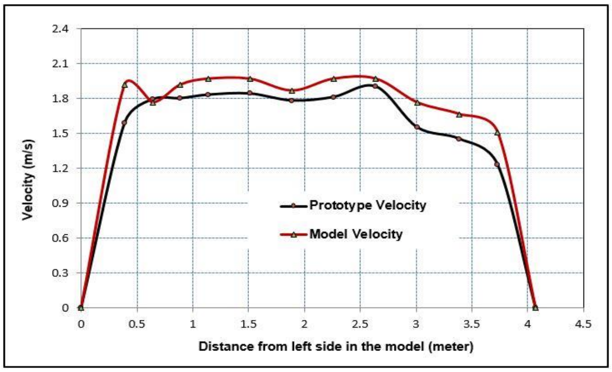

Fig 4. Comparison between prototype and model velocity distribution at prefixed cross-section

Test scenarios

The conducted tests comprise of base run (T0) and application tests (T1-T7). The base run has been conducted without any proposed structural interventions in place for a constant discharge (dominant discharge). The application tests have been conducted with proposed structural interventions in place and for the same discharge as in base run as well as for Jamuna discharge corresponding to its low water level of 6.08mPWD and 5.80mPWD at the New Dhaleshwari off-take. Test conditions of the subsequent tests have been decided based on understanding gained from the prior test results. It has done through interactive communication between RRI and BWDB i.e. taking feedback from the BWDB engineers concerned

Test T1 is the first application test. In this test, the model bathymetry is formed based on the equilibrium bathymetry obtained from T0. This test has been done with dominant discharge of 21,172 m^3s^{-1} (for part width of the Jamuna) with respect to +10.9mPWD water level of the Jamuna river at off-take location.

Test T2 is the second application test. In this test, the same bathymetry as obtained from the calibration test has been used as initial bathymetry. Moreover, the guide bunds, intake canal and sedimentation basin (**Fig 5)** have been introduced in the model as per latest layout and design supplied by the BWDB. New Dhaleshwari river channel downstream of the interventions is kept as it is i.e. no dredging is considered there. The model is run for the same discharge (dominant) as in Test T1.

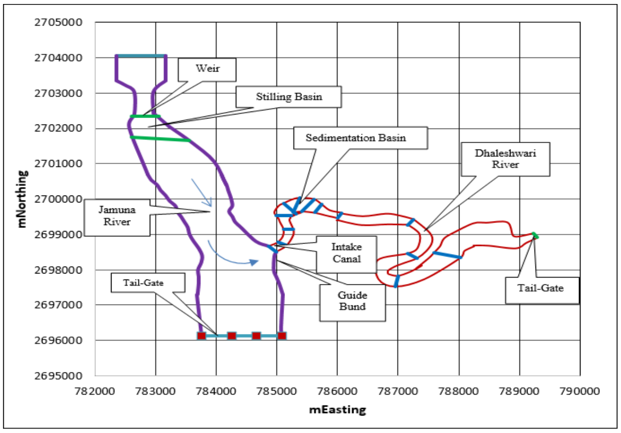

Fig 5. Model layout with proposed interventions at the New Dhaleshwari river off-take area

T3 is the third application test. In this test, the same bathymetry as obtained from the calibration test has been used as initial bathymetry. Moreover, the guide bunds, intake canal and sedimentation basin have been introduced in the model as per Test T2. However, in this test launching apron is placed all along the interventions where scour occurred in the test T2. New Dhaleshwari river channel downstream of the interventions is kept as it is i.e. no dredging is considered there. The model is run for the same discharge (dominant) as in Test T1 and Test T2.

Test T4 is the fourth application test. This test has been done keeping the water level at the New Dhaleshwari off-take at 5.8mPWD and 6.08mPWD. 5.80mPWD is the minimum recorded water level corresponding to the Jamuna flow of 2850 m^3s^{-1} whereas 6,08mPWD is the design water level. During this test potential for dry season flow through the New Dhaleshwari river for Jamuna river channel discharge of 2000 m^3s^{-1}, 3000 m^3s^{-1} and 4000 $m^3s^{-1}$and water level at the New Dhalesjwari off-take at 5.8mPWD and 6.08mpWD has been investigated. The dredged channel at the intervention locations has been considered and bathymetry of the New Dhaleshwari river in the downstream of the interventions is kept as it is in Test T3.

Test T5 is the fifth application test. In this test, in addition to the all arrangements as in Test T4, the bed level of the New Dhaleshwari river channel downstream of the structural interventions has been lowered and provided with the section as shown in **Fig 6** The considered dry season flows of the Jamuna river and corresponding water levels are the same as in Test T4.

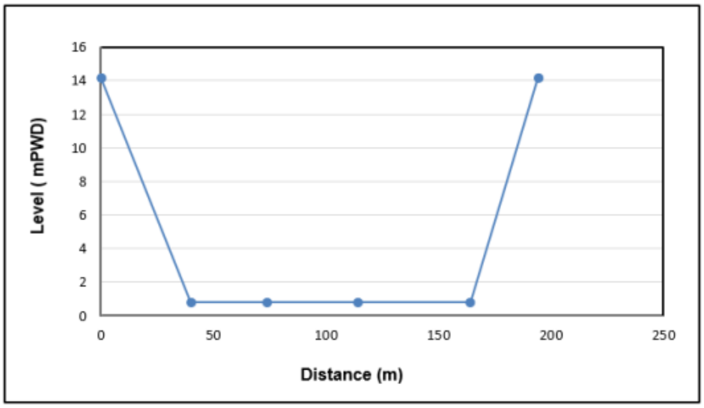

Fig 6. Typical channel section downstream of the intervention in Test T5

In Test T6, the same bathymetry as is in Test T5 has been used as initial bathymetry. Moreover, the guide bunds, intake canal and sedimentation basin have been introduced in the model as Test T2. However, no launching apron is placed along the interventions. The model is run with dominant discharge. The main difference between Test T6 and Test T2 is that the New Dhaleshwari river channel downstream of the interventions has not been dredged for the latter case.

In Test T7, the same bathymetry as is in Test T6 has been used as initial bathymetry. The structural interventions at the off-take are also the same as they are in Test T6. The only difference in test conditions between Test T6 and Test T7 is that launching apron has been provided along the interventions particularly at the scour prone locations as shown in **Fig 7**

Fig 7. Launching apron at the off-take mouth along the right bank

Results and Discussion

Discharge Distribution

Based on the measured discharges in the model it can be concluded that for dominant discharge of the Jamuna river the percentage of discharge through the New Dhaleshwari river is about 0.85% of the Jamuna river which is close to 0.8% as measured in the field. Whereas for T2 the percentage of discharge through the New Dhaleshwari river is about 1.71% (725 m^3s^{-1}) of the Jamuna river which is twice higher than that obtained in Test T1. It is to be noted here that this increase in the discharge through the New Dhaleshwari river may be attributed to the interventions at the off-take. For T3 the percentage of discharge through the New

Dhaleshwari river is about 1.73% of the Jamunariver which is remains almost the same (slightly higher) as is measured in Test T2.

For T4 and T5 the discharge through the New Dhaleshwari river for three probable dry season Jamuna river discharges and two corresponding probable water levels (5.8mPWD and 6.08mPWD) has been measured and the results are shown in **Table 3** and **Table 4** respectively. It is to be noted here that entry of dry season flow of the Jamuna river much depends on the existence of a channel near the off-take as the parent river (Jamuna) follows a braided pattern.

Table 3. Dry season discharge through the New Dhaleshwari river (without dredging in the downstream of the interventions)

Q_{Jamuna}(m^3s^{-1})	$Q_{Dhaleshwari}$ (m^3s^{-1})	
	WL = 5.80 mPWD	WL= 6.08 mPWD
2000	Insignificant	16
3000	25	31
4000	33	41

Table 4. Dry season discharge through the New Dhaleshwari river (with channel bed lowering in the downstream of the interventions)

Q_{Jamuna}(m^3s^{-1})	$Q_{Dhaleshwari}$(m^3s^{-1})	
	WL = 5.80mPWD	WL = 6.08mPWD
2000	348	410
3000	402	460
4000	455	605

It means together with the proposed interventions the river channel downstream of the same has also to be dredged to augment the dry season flow of the New Dhaleshwari river.

For T6 and T7, the percentage of discharge through the New Dhaleshwari river is about 3.62% (1520 m^3s^{-1}) and 3.60% (1510 m^3s^{-1}) of the corresponding Jamuna river discharge respectively. In both cases, the increase in discharge is due to lowering of the river bed in the downstream of the interventions.

Evolution of Bed Configuration

In equilibrium condition of T2, a sand bar is formed along the left bank of the New Dhaleshwari mouth (**Fig 8**) as in pre-dredge condition and the deep channel is along the right bank throughout the intake channel up to the sedimentation basin. In the sedimentation basin the dredged channel got silted up gradually with time. The same happened to the dredged channel downstream of the sedimentation basin. Initially more sediment is deposited in the intake canal rather than the sedimentation basin.

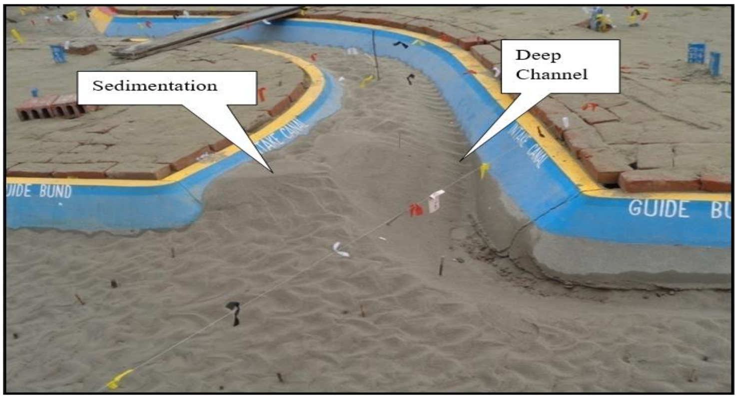

Fig 8. Final bed configuration at the off-take after sedimentation in the dredged channel in Test T2

Similar trend in deposition pattern is observed in Test T3. On the other hand, both in Test T2 and Test T3 somewhat overall lowering of bed level in the downstream of the intervention location is noticeable. Similar developments in bed level in the intake and exit canals have been noticed during Test T6 and Test T7 except the fact that the equilibrium bed level within the intervention location is somewhat lower in later two tests compared to that in former two tests. The morphological developments within the sedimentation basin with time are, however, relatively intricate for later two tests. Sedimentation pattern within the sedimentation basin in Test T6 (**Fig 9**) is noticeably different from that found in Test T6.

Fig 9. Extent of initially formed local scour at the entrance

In test T7, initially, a channel is formed along the right side of the sedimentation basin without endangering the launching apron provided at the sedimentation basin. After passage of time this channel is shifted towards the left side and has started to get filled up with sediment. A large sand bar is formed along the mid part of the sedimentation basin forming a distinct channel along the right side causing partial launching of the provided apron after dynamic equilibrium condition is reached. Scour tendency is observed at the outlet of the sedimentation basin along the left side where launching apron has been provided. The general morphological developments within the sedimentation basin are sedimentation along the left side and consequent formation of a large sand bar. The 2D plot of the initial and final bed level in the model appears in **Fig 10**. It shows sedimentation both within and beyond interventions.

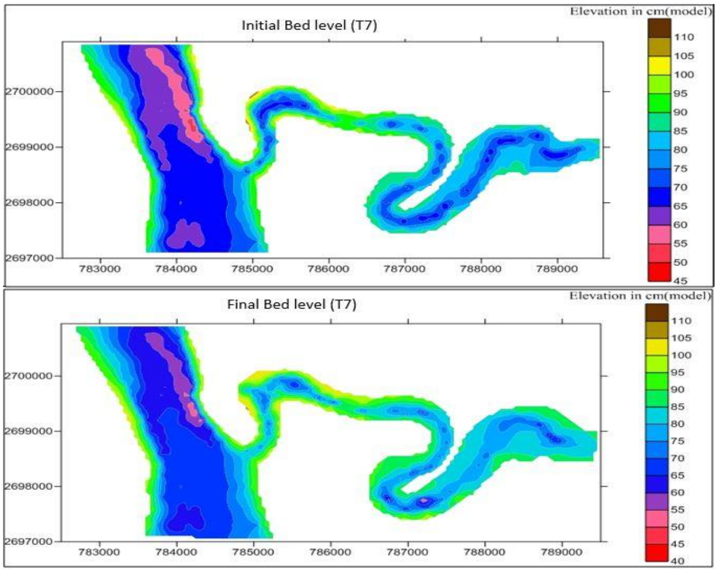

Fig.10. Comparison of bed level in Test T7

It is found from the Test T2 results that for reaching a dynamic equilibrium condition, a total volume of 2228941m^3 of sediment (prototype) is deposited within the intervention location. An analysis shows that 33% of this sediment volume will be deposited within the intake canal, 59% within the sediment basin and 8% within the exit canal. The average annual volume of sediment deposition within the intervention location is 557235m^3. The investigation also shows that due to increased flood discharge in the New Dhaleshwari river, bank erosion potential of the same will be increased particularly at bend locations.

Conclusion and Recommendations

There exists, sedimentation problem at the New Dhaleshwari off-take. The mean bed level as well as the minimum bed level at the mouth of the river is much higher than the dry season water level of the parent river (Jamuna). As a result, no flow situation occurs during dry season in the New Dhaleshwari River. In order to restore the polluted Buriganga River, a flow of 141 m^3s^{-1} has to be added to bring up the dissolved oxygen level to a tolerable limit. It could be done by augmenting 245m^3s^{-1} of flow from the Jamuna river through new Dhaleshwari River.

In order to augment the targeted flow from the Jamuna river a sustainable solution of the sedimentation problem at the off-take and in the river channel downstream of the same is essential. The proposed interventions at the off-take in the form of guide bunds, intake channel, sedimentation basin and exit channel could be a solution of the existing problem if properly planned and implemented with provision for long-term monitoring and maintenance dredging. Model results suggest that targeted flow augmentation of the New Dhaleshwari river is possible with the proposed interventions at the off-take and dredging as per design. However, river channel downstream of the interventions has also to be dredged to a level of 0mPWD with sufficient width for smooth passage of dry season flow. The extent of such dredging should be determined based on monitoring survey field data analysis. A technically sound dredging strategy and phase wise implementation plan may be devised.

Implementation of the proposed structural interventions with dredging only within the interventions as per design will increase the flood discharge through the New Dhaleshwari River. Discharge of the New Dhaleshwari River corresponding to the dominant discharge of the Jamuna river will be more than two times higher compared to that in base condition. However, this increased discharge is not sufficient enough to lower the bed level of the downstream channel to a level that allows for the smooth conveyance of targeted dry season flow. The dredged channel will tend to get filled up gradually. Several sand waves will move from upstream to downstream during the filling up process. It may take about 4 to 5 years for the river to reach its dynamic equilibrium state by filling the dredged channel if no maintenance dredging is carried out.

There is potential for forming deep scour hole at the off-take mouth on the right side, at the starting point of the sedimentation basin on the right side and at the end point of the sedimentation basin on the left side. These locations should be protected well against local scour and developments there should be monitored closely. Due to increased flood discharge and consequent increased flow velocity bank erosion potential may increase in the entire river system particularly at the bend locations. In order to cope with this situation outer bank of the eroding bends may be stabilized by undertaking appropriate bank protection measures.

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