11 Investments for Polder Safety and Water Management

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This chapter describes the evolution of investment fund allocations for infrastructure made through

the Blue Gold Program as demonstrated by the revisions made to the original BWDB Development Project Proforma (DPP) in June 2018 and September 2020, then to itemise the actual investments made to each of the 22 polders, and to comment on lessons learnt in designing future projects. The final section of the chapter emphasises the importance of budgeting for emergency repairs to coastal infrastructure.

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Briefing Materials

The following materials illustrate concepts, interventions, outcomes and lessons learnt, including through stories from community members.

Thematic brochures

• Improved water distribution and drainage through rehabilitation of water management infrastructure

Under the Blue Gold Program, investments have been made to the physical infrastructure. Table 11.1 below summarises the 16 different budget headings of the interventions and repairs that have been carried out. Of these, four investments account for 80% of the budget: Item 1 re-sectioning of 330km of embankment, Item 3 re-excavation of 545km of drainage channels or khals, Item 4 repair of 186 regulators/sluices, and Item 6 construction of 31 new regulators or sluices.

Table 11.1 Budget Allocations by Work Item (extracted from re-adjusted DPP)

		Re-Adjustment (September 2020)			
	Work Items	**Quantity**	**Total Cost Allocation**		
			BDT lakh	**Euro**	
1	**Re-sectioning of Embankment (km)**	330	4,233	4,203,247	13%

2	**Retired Embankment (km)**	21	1,252	1,243,307	4%
3	**Re-excavation of khals (km)**	545	8,676	8,615,650	28%
4	**Repair of Regulator/Sluice with gate (nos.)**	186	5,025	4,990,308	16%
5	**Repair of Inlets/Outlets (nos.)**	235	276	274,111	1%
6	**Construction of Drainage Regulator/ Sluice (nos.)**	31	7,220	7,170,278	23%
7	**Construction of Drainage Outlet (nos.)**	8	192	190,665	1%
8	**Construction Irrigation inlet (nos.)**	17	1,480	1,469,712	5%
9	**Construction of culvert (nos.)**	32	302	299,901	1%
10	**Pump shed (nos.)**	6	48	48,093	0%
11	**Low cost Bank Protection work (km)**	LS	620	615,690	2%
12	**Rehabilitation of Interior Dike (km)**	21	419	416,445	1%
13	**Closure/ Cross-bundh (km)**	LS	20	19,861	0%
14	**Supply of Drain pipe (m)**	9,000	256	254,220	1%
15	**Flood damage repair / Breach Closing**	LS	800	794,439	3%
16	**GoB O&M**	LS	600	595,829	2%
	Total		**31,420**	**31,201,758**	**100%**

Exchange rate as of 25 November 2020 @100.7 BDT : 1 Euro

Revisions to Polder Infrastructure Investments[Notes 1][edit | edit source]

In this sub-chapter, we review and comment on changes made to the original BWDB Development Project Proforma (in May 2013) through revisions approved in June 2018 and September 2020, which are set out below in Table 11.2.

Table 11.2 Investment Allocations by Budget Heads for DPPs and RDPPs (Costs in BDT lakh ie BDT 100,000)

SI. No	Work Items	DPP (May 2013)		RDPP (June 2018)		Cost Adjustment RDPP (September 2020)	
		Qty	Cost	Qty	Cost	Qty	Cost
1	**Re-sectioning of Embankment (km)**	551	6,627	330	5,327	330	4,233
2	**Retired Embankment (km)**	2	86	21	2,303	21	1,252
3	**Re-excavation of khals (km)**	1514	5,229	545	6,945	545	8,676
4	**Repair of Regulator/Sluice with gate (nos.)**	239	3,322	186	4,876	186	5,025
5	**Repair of Inlets/Outlets (nos.)**	664	2,887	235	674	235	276
6	**Construction of Drainage Regulator/ Sluice (nos.)**	11	1,428	31	6,847	31	7,220
7	**Construction Irrigation inlets (nos.)**	11	65	8	192	8	192
8	**Construction of Drainage Outlet (nos.)**	11	267	17	1,300	17	1,480
9	**Construction of culvert (nos.)**			32	704	32	302
10	**Pump shed (nos.)**			6	60	6	48
11	**Low cost Bank Protection work (km)**	1.1	66	LS	620	LS	620
12	**Rehabilitation of Interior Dike (km)**	38	785	21	96	21	419

13	**Closure/ Cross-bundh (km)**	1	20	LS	20	LS	20
14	**Supply of drainage pipe (m)**			9,000	256	9,000	256
15	**Flood damage repair / Breach Closing**			LS	600	LS	800
16	**GoB O&M**	LS	600	LS	600	LS	600
	Re-excavation of ponds	2	8				
	Total		**21,390**		**31,420**		**31,420**

Original DPP[edit | edit source]

The DPP was split into two categories 'Rehabilitation Polders' (anticipating 5 to 6[Notes 2] polders with an area of 25,000 ha) and 'Fine-Tuning Polders' (anticipating 20 to 22 polders with an area of 135,000 ha). The 'Rehabilitation Polders' had a heavier investment allocation (of circa Euro 300 per ha) as compared to the 'Fine-Tuning Polders' (of Euro 100 per ha). In addition, the scope for investments in 'Rehabilitation Polders' covered 11 of 12 DPP budget heads, whilst the scope for 'Fine-Tuning Polders' were restricted to 5 of 12 budget heads (refer Table 11.3): re-sectioning of embankments, re-excavation of khals, repairs to regulators/sluices, repairs to inlets/outlets, and O&M.

Table 11.3 DPP Allocations for Rehabilitation and Fine-Tuning Polders **(costs in BDT lakh)**

Sl. No	**Work Items**	**DPP (approved 30 July 2013)**		**Rehab Works**		**Fine Tuning**	
		Qty	**Cost**	**Qty**	**Cost**	**Qty**	**Cost**
1	**Re-sectioning of Embankment (km)**	551	6,627	112	2,617	439	4,010
2	**Retired Embankment (km)**	2	86	2	86		
3	**Re-excavation of khals (km)**	1516	5,237	194	1,220	1320	4,009
4	**Repair of Regulator/Sluice with gate (nos.)**	239	3,322	25	649	214	2,673
5	**Repair of Inlets/Outlets (nos.)**	664	2,887	40	214	624	2,673
6	**Construction of Drainage Regulator/ Sluice (nos.)**	11	1,428	11	1,428		
7	**Construction of Drainage Outlet (nos.)**	11	267	11	267		
8	**Construction Irrigation inlet (nos.)**	11	65	11	65		
9	**Construction of culvert (nos.)**	-					
10	**Pump shed (nos.)**	-					
11	**Low cost Bank Protection work (km)**	1.1	66	1.1	66		
12	**Rehabilitation of Interior Dike (km)**	38	785	38	785		
13	**Closure/ Cross-budh (km)**	1	20	1	20		
14	**Supply of Drain pipe (m)**	-					
15	**Flood damage repair / Breach Closing**	-					
16	**GoB O&M**	LS	600				600
	Re-excavation of ponds	2	8	2	8		
	Total		**21,398**		**7,425**		**13,965**

The initial priority for infrastructure activities was on four 'Fine-Tuning' polders, thus allowing time for survey data to be collected and designs to be prepared for the 'Rehabilitation' polders.

Early surveys showed that a number of new regulators were required in the 'Fine-Tuning Polders' for which no allocation had been made. For example, the new 3-Vent Kherjurtala Sluice on the east

side of P30 and draining to the active Kazibacha River was proposed to be located close to the existing 1-V Kherjurtala Sluice but with larger drainage capacity to take waters which had otherwise been expected to drain via the 2-V Kalatola Sluice on the west side of P30. However, the Jhapjhapia River which previously carried the drainage water from Kalatola Sluice had become blocked by sediment and so the sluice had become non-functional.

The absence of a DPP budget allocation for land acquisition and for the construction of new regulators in Fine-Tuning Polders meant that important investments were unable to be processed in the first five years of the project – from its start in March 2013 to June 2018, before the RDPP (first revision, June 2018) was approved. Although designs for some new structures and retired embankments had been prepared, tenders for these contracts could only be advertised when budgets were available in the Annual Development Plan (ADP) – and this required their inclusion in the revised DPP.

First Revision (June 2018)[edit | edit source]

To allow for the completion of investments, it was agreed that an additional fund would be made available which resulted in an increase to Blue Gold infrastructure investments from BDT 21,390 lakh to BDT 31,420 lakh, and that the duration of the project would be extended from end-December 2018 to end-December 2020.

The major increases in budget allocations in the June 2018 revision were for: retired embankments (from BDT 86 lakh to BDT 2,303 lakh), the construction of drainage regulators/sluices (from BDT 1,428 lakh to BDT 6,847 lakh), construction of drainage outlets (from BDT 267 lakh to BDT 1,300 lakh) and to add in culverts, pump-sheds, supply of drainage pipe, and flood damage repair.

The distinction between the two categories of 'Rehabilitation Polders' and 'Fine Tuning Polders' was abandoned in the June 2018 RDPP to allow greater flexibility in meeting the investment needs, and to thus allow the construction of new regulators and retired embankments in the earlier category of Fine-Tuning Polders. The 2018 revision also included a new item for land acquisition of BDT 3,300 lakh (equivalent to €3.3 million) by GoB alone, sufficient for the acquisition of an estimated 34.5 ha. This aimed to encourage landowners in Blue Gold to release land for retired embankments, since they had objected to releasing land when land acquisition payments were being made to landowners in nearby polders subject to rehabilitation under CEIP-1.

Second Revision (September 2020)[edit | edit source]

By December 2019, it was recognised that an additional season (ie FY 2020/21) would be required to complete project investments. A zero-cost extension to end-December 2021 was therefore agreed, along with adjustments between budget heads to maximise the use of available funds. It was also agreed that the functionality of infrastructure (ie operability of all gates, and removal of obstructions in primary khals) was an important objective of the extension.

A main aim of the September 2020 re-adjustment was to make transfers (of from 20% to 60% of the 2018 budget) between budget heads, taking account of implementation experience and the projected pipeline of new investments. The one major change made in the September 2020 revision was to increase the allocation to the rehabilitation of interior dykes (from BDT 96 lakh to BDT 419 lakh).

Lessons Learnt[edit | edit source]

A number of lessons learnt from the practical challenges which emerged from the planning process:

Build in allowance for climate change effects[Notes 3] – The budget allocation was insufficient for the significantly higher budgets (ca 10+ times multiplier of funds available to Blue Gold) required to address the effects of climate change. This resulted in inconsistencies with design policies adopted for adjacent polders (eg where World Bank's CEIP-1 designs allowed for incorporation of the full effects of climate change).

Go for greater flexibility – Don't categorise polders as Fine-Tuning or Rehabilitation, since the dynamic situation in the coastal zone requires adaptation to changing events (eg previously active tidal rivers becoming silted up).

Include funds for land acquisition - No funds for land acquisition were envisaged in the DPP so no budget allocation was allowed for the land acquisition for retired embankments or for new structures. The June 2018 revision included a new item for land acquisition to which BDT 3,300 lakh (€ 330,000) was allocated for GoB funding, sufficient for the acquisition of an estimated 34.5 ha.

O&M Budget: In the coastal zone, water infrastructure serving polder communities is expected to provide protection and facilitate water management in a particularly aggressive environment - where floods, cyclones, river erosion and accretion, salinity, tidal flows etc can cause devastating damage to embankments with the associated adverse economic consequences of large-scale flooding, or result in structures falling into disuse and unable to regulate the flow of water in and out of the polder. The resultant heavy repair and maintenance costs required to ensure the continued serviceability of the infrastructure are currently not met in full - because O&M budgets with government organisations such as BWDB are – inevitably – heavily and never sufficient, local government is not mandated for this role, and community contributions fall far short of the huge sums required. This conundrum is well understood but remains unresolved, and because of these gaps, the coastal zone remains locked in a project-driven cycle where infrastructure deterioration both precedes and follows rehabilitation.

Given this unsatisfactory arrangement, the GoB O&M fund in the RDPP provides for the inevitable repairs to breached or vulnerable embankments in Blue Gold. In processing the RDPP (approved in June 2018), the O&M budget was set at BDT 18 crore by MoWR but was eliminated by the Planning Commission in the first round of discussions and then included after protests from MoWR but at the reduced amount of BDT 6 crore – an amount which was known by MoWR to be insufficient for the remaining three years of the project. In compensation, BDT 2 crore was added in the September 2020 re-adjustment to the allocation of BDT 6 crore provided for Flood Damage and Repair (Item 15) in the June 2018 RDPP. For future projects in the coastal zone, the importance of this budget is worth emphasising. A consideration of the implications for emergency repairs is presented below, with particular reference to the repair of a breach in Polder 29 along the Lower Bhadra River at the village of Chandghar.

Participatory Planning: Pre-DPP planning visits to rural communities are often exploratory and result in a long list of required interventions, some of which are later excluded from the DPP because of budgetary constraints. Because of the pressure to finalise a DPP, the choice of which investments to exclude from the DPP is often not referred back to the community. The high level of detail required in the DPP in order to obtain approval of the Project Evaluation Committee (PEC) means that there is limited opportunity for community participation after the DPP formulation has been approved, and only when the DPP is subject to revision. It is only during early contact with representatives from rural communities, and union and upazila parishads after DPP approval – when there is heightened interest by local parties in influencing how funds will be spent – that communities become aware that some of their priority investments are not included in the project. This breach of trust results in understandable reluctance from the local communities to start the process of formation of water management groups – which underpins participatory water

management.

Investments by Polder and by BWDB Division[edit | edit source]

For each of the six BWDB divisions responsible for polders in the Blue Gold Program, Table 11.4 summarises the amount invested in infrastructure for each polder. It shows the investments vary from BDT 166 lakh (equivalent to Euro 166,000) for P43/2E in Patuakhali O&M to BDT 3,318 lakh (equivalent to Euro 3.3 million) for P47/4 in Kalapara – with an average investment of BDT 1,304 lakh (equivalent to Euro 1.3 million).

Separate links to a series of tables provide the quantity and amount of infrastructure works contracted for each polder by each of the six BWDB Division against the RDPP budget heads: Satkhira O&M-2, Khulna O&M-1, Khulna O&M-2, Patuakhali O&M, Barguna and Kalapara. A series of infrastructure maps covering each of the 22 Blue Gold polders is available here showing the location of Blue Gold investments, with a summary table on each map of the quantity and cost for the RDPP budget heads.

Table 11.4 Summary of Works Contracted by Polder by BWDB Division

BWDB Division	Polder	Amount to Polder		Amount to Divn	
		BDT lakh	%	BDT lakh	%
Satkhira O&M-2	**2**	2,634	9%	2,634	9%
	25	1,387	5%		
	26	1,222	4%		
	29	1,794	6%		
Khulna O&M1	**27/1**	483	2%		
	27/2	170	1%		
	28/1	387	1%		
	28/2	1,130	4%	6,573	23%
Khulna O&M-2	**22**	448	2%		
	30	1,199	4%		
	31-part	1,404	5%		
	34/2-part	1,560	5%	4,611	16%
Patuakhali O&M	**43/2A**	2,045	7%		
	43/2B	2,100	7%		
	43/2D	1,528	5%		
	43/2E	166	1%		
	55/2A	1,588	6%		
	55/2C	1,236	4%	8,663	30%
Barguna O&M	**43/1A**	504	2%		
	43/2F	1,423	5%	1,927	7%
Kalapara	**47/3**	961	3%		
	47/4	3,318	12%	4,279	15%
Total		**28,686**			

Emergency Repairs[edit | edit source]

The importance of access to a budget for repairs and maintenance to water infrastructure in the coastal zone has been mentioned above under 'O&M Budget' in 'Lessons Learnt'.

To give an idea of the scale of the threat of breaches to polder embankments, records from March 2017 for the 22 Blue Gold polders showed an active threat to 13 polders at 29 different locations in Patuakhali, Khulna and Satkhira. Since BWDB is responsible for 139 polders, the potential emergency arrangements to be addressed by the Board is considerable.

At polder level, when a BWDB Executive Engineer is confronted by a threatened breach to a polder embankment, he needs to make a series of decisions. One of his/her options is for embankment retirement, for which agreement will be required from the community: (a) that land will be provided for the retired embankment and/or to check whether funds are available for land acquisition; and (b) that the alignment of the retired embankment is accepted, and that it is sufficiently distant from the face of a bank which is being actively eroded to ensure embankment integrity for a period of (say) ten years – and this can be a distance of around 100m. Other options include provision of revetment to the affected length of embankment (plus a transition length both upstream and downstream) with a design that addresses the cause – which might be wind- or wave-induced erosion, or sub-surface riverbank scour resulting in geotechnical instability.

The ADB-funded Flood and Riverbank Erosion Risk Management Investment Program (FRERMIP) has significant experience with sand-filled geo-textile bags providing low-cost flexible revetment below low-water level in combination with concrete block revetment from low-water level to the upper limit of flood flows including a freeboard allowance. Although this form of revetment is being increasingly used in the tidal regions, it is generally restricted to sand-filled geo-textile bags alone. Because the geo-textile bags are degraded through exposure to ultraviolet (UV) when energy from *sunlight* breaks the bonds within the polymer structure, they do not provide a long-term solution for the inter-tidal zone. Whilst geo-textile bags are effective in stabilising riverbanks below low-flow level, other treatment is required for sections of riverbank which are exposed to sunlight. For tidal rivers, the diurnal variation in river levels means that the reaches exposed at low-tide level should be treated with materials that are resistant to UV exposure, potentially the reinforced concrete jute mattresses which are being tested and developed under FRERMIP. The jute mattress is filled with a dry sand-cement mix, laid across the shaped ground from the low-tide level to the flood-level with an allowance for freeboard (to cater for the wind-induced waves caused by a storm during high tide conditions) and overlapping the geo-textile bags. By soaking the mattress, the sand-cement mixture reacts to form a concrete blanket shaped to the ground profile. In due course, the jute material breaks down and is washed or blown away.

Case Study: Polder 29 at Chadghar in the Lower Bhadra River, Khulna District[edit | edit source]

All of those who live and work in the coastal zone face the consequences of erosion damage to polder embankments. But those who are resident in the polders, and whose families and livelihoods are dependent on the exclusion of flood waters from the polder bear the brunt of the consequences when polder embankments fail.

As a case study[Notes 4], this section recounts the history leading to a breach in a polder embankment, the immediate aftermath and the consequences for the community. The section which follows it summarises the studies and research which was conducted in parallel to determine a longer-term intervention strategy.

Chadghar village is located in Sharafpur union of Dumuria upazila in Khulna district, close to the eastern perimeter bund of Polder 29 and adjacent to the Lower Bhadra river. Since the creation of the polder in 1968, the embankment has been prone to river erosion and has reportedly been eroded eleven times in this reach. During IPSWAM (2004-2011), the embankment was eroded twice.

To provide context, the image below in Figure 11.1 presents the eroding riverbank as well as alignments of the old and new embankments – and the extent of flooding.

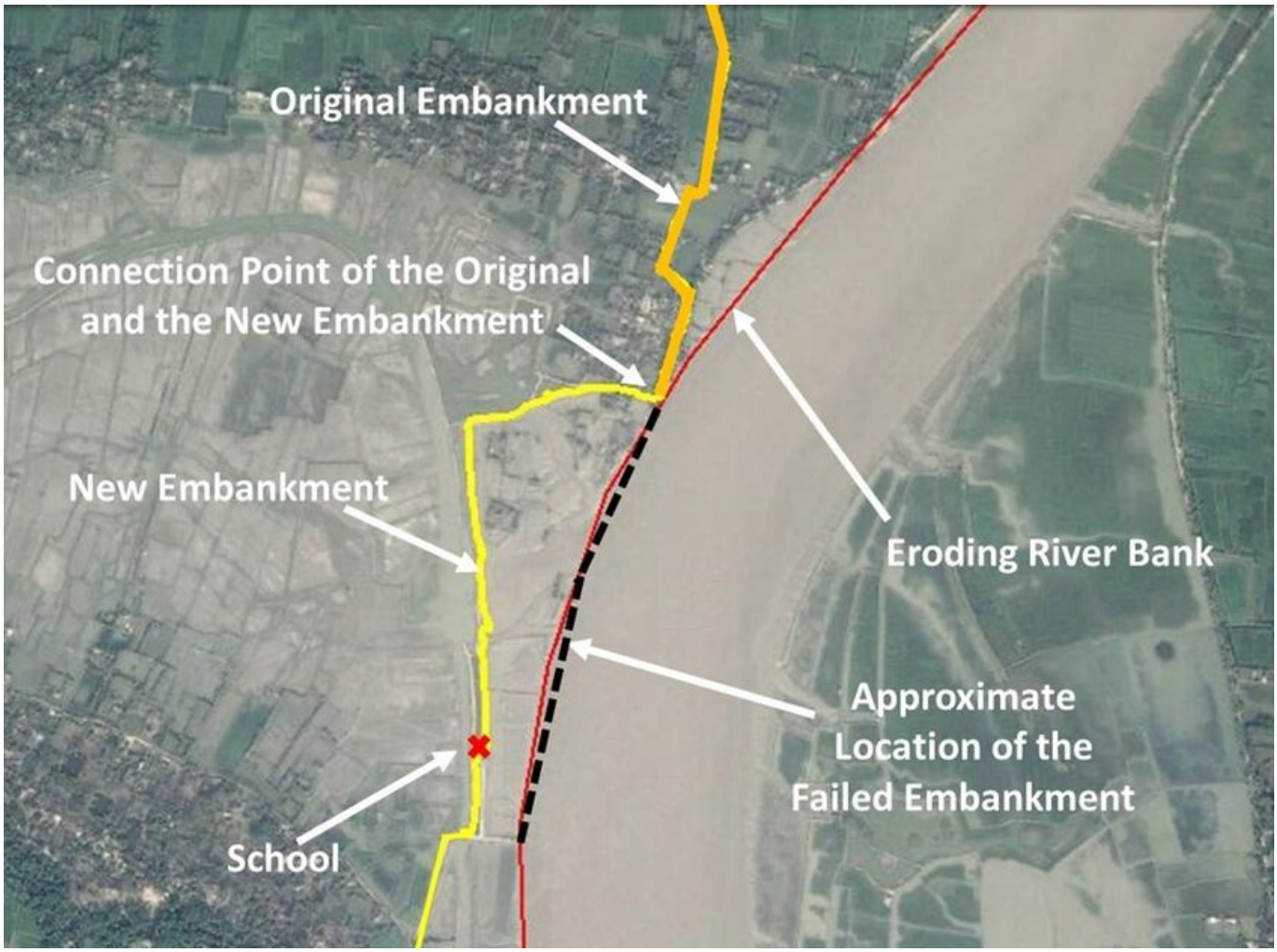

Figure 11.1 Aerial photograph of breach in Lower Bhadra River near Chadghar village

For the sake of this discussion, the timeline starts from dry season 2014:

2014 Dry Season: Several meetings about a retired (realigned) embankment with a setback distance of around a 100m were held with WMGs, WMA and UPs. The community, however, was unwilling to accept a retirement of the embankment as a considerable area of land had been lost through erosion and retirement during over the last decade.

2014 Monsoon: Further erosion of the riverbank occurred and lengths of the polder embankment close to Chadghar were in a critical state and close to being breached by river-waters. WMA, WMGs, UP and the BWDB Divisional Executive Engineer held meetings at the erosion site to persuade landowners to donate land for a retired embankment.

2015 Dry Season: Despite the imminence of a breach, the local community (Chatchatia Sluice WMA - known as "CS WMA" in 2015) objected to the alignment of the proposed retired embankment because funds for land acquisition or compensation were not offered[Notes 5], and because many houses and land would be outside the proposed embankment and remain at risk. Eventually, BWDB

reluctantly accepted a compromise alignment acceptable to CS WMA but which was too close to the actively eroding riverbank.

April 2015: A construction contract for the retired embankment was awarded. In the meantime, apprehending a probable breach, the UP provided 'backing'[Notes 6] to the embankment in several reaches, as well as 'porcupines'[Notes 7]. Other local techniques were also used, but nothing worked well. At one location, because the embankment was weakened to such an extent that a breach was expected imminently, the BWDB Executive Engineer constructed a 'ring dike' on the country-side to provide a line of defence in the event of a breach.

July 2015: Early in the month, BWDB and TA visited the site and estimated physical progress to be around 20%, noting poor-quality uncompacted earthwork in an embankment which was aligned only 20m from the riverbank. There was fierce community hostility towards BWDB/TA. On 30 July 2015, a depression developed in the Bay of Bengal becoming 'Cyclone Komen' which crossed the shoreline on 31 July 2015. The original embankment breached at the end point Baintala khal during high tide compounded by effects of cyclone Komen accompanied with heavy rainfall, resulting in flooding and damage to houses and crops. The breach also developed three deep channels across the alignment of the partially-constructed retired embankment, making continuation of the work very difficult.

Impact of Breach: According to preliminary reports, the flood affected about 9 to 11 villages under Dumuria Upazila and 2 villages under Shurkhali Union of Batiaghata Upazila of Khulna District. About 1286 households were affected, 404 houses were destroyed and 325 houses were partially damaged. Some 684 ghers were destroyed. T Aman seedlings were damaged in about 30 ha of land and vegetables were damaged in about 20 ha of land. A vast area of land was covered by silt and saline water.

Emergency Measures: The Union Parishad (UP) and WMA, with technical advice from BWDB, mobilised the local community to construct a ring dike around the country-side of the existing embankment. Although all efforts were made to close the breach, they were prevented by high velocity flows. Photo 11.1 shows one of the three breaches through the realigned embankment at Chadghar, showing: (a) the high velocity flows leading to high tide; (b) the failed attempts – bamboo bandals and narrow earthen embankment - by the local community to close the breach; and (c) a child from one of the families whose home was on the original embankment.

Photo 11.1 The third breach in the realigned embankment (August 2015)

Photo 11.2 provides more detail of the failed attempts by the local community to close the breach, with bamboo bandals and narrow earthen embankment formed from sandbags.

Photo 11.2 Emergency embankment (August 2015)

2016 Dry Season: To close the three breaches (deep channels/creeks) formed during monsoon 2015 and to protect Chadghar, BWDB's Design Circle designed a new embankment with three closures provided with a minimum set-back distance of 100m. A contract for the works was awarded in February 2016. Two of the three breaches were closed by the contractor. For the closure of the third creek "breach 3", an immense amount of work was required to drive bullah piles which would provide the framework for the sand-filled geobags which would close the breach. In late-May and early-June, repeated attempts to close the channel of the third creek failed as the inter-tidal velocities were too high. It was finally closed on 28 June 2016. The main embankment was still very weak but intact. The embankment withstood the 2016 floods.

Photo 11.3 Driving bullah piles in Breach 3 to provide a framework for sand-filled geobags

2017 Dry Season: The embankment withstood the 2016 floods. By April 2017, repair works carried over from 2015/16 were still only 50% complete. By June 2017, the contract was completed – in time for the flood season.

Research Leading to Intervention[edit | edit source]

In parallel, with the activities to complete the polder embankment at Chadghar, various studies and investigations were initiated to address the cause of the long-term erosion and to invest in mitigation measures.

IWM was contracted by Blue Gold on 19th February 2015 to carry out investigations for "Riverbank Erosion Management in polder 29, Khulna" to identify the causes of erosion and develop a comprehensive adaptive approach to mitigation. The final report, submitted in May 2016, recommended a series of top blocked semi-permeable spars with sand filled geo-bag in the scour holes as erosion protection measure. in October 2016, BWDB's Design Circle-5 supplied a design in line with IWM's recommendation. A review by Deltares (May 2017) of the design documents expressed serious reservations about the current design and recommended against proceeding with

the design in its present form:

'If the purpose of the structure merely consists of testing a new type of groyne battery, it remains worth noting that bank erosion upstream and downstream of the battery will change the direction of attack at the upstream and downstream terminations. The structure has not been conceived for this and might fail as a result, putting an untimely end to the corresponding monitoring programme.'

Furthermore, the results of a report in July 2017 on the numerical modelling of top blocked spurs, recommending that a more suitable location (than the Lower Bhadra River) should be selected for pilot testing where environmental conditions are milder and where there would be no interaction with any other bank protection or river training structures.

In March 2017, a reconnaissance visit was made to the site of the breach by a specialist river engineer, the team leader of the Flood and Riverbank Erosion Risk Management Investment Program (FRERMIP). During the field trip, the thalweg of the incoming high velocity spring tide flows were close to the riverbank in the area of the breached embankment. The report on the visit recommended emergency riverbank protection, to control the riverbank erosion, using sand-filled geotextile bags along the bank. These bags, once undercut from erosion slide down the underwater slope and protect the slope against further erosion, as the sand-fill acts as filter against the fine clayey and silty subsoils. Further investigation was recommended to: (a) study the underwater slopes of the eroding banks, to assure that the launching process can take place; and (b) fix the scour depth to correctly calculate the required number of bags.

A series of studies were undertaken to provide design information:

- Float tracking survey results – Abdul Ghani (April 2017)
- IWM River surveys (12/13 and 27/28 May 2017)
- IWM Borehole investigation (11 to 15 June 2017)

and after the installation of the emergency protection works:

- IWM Post-monsoon river survey (11 and 17 November 2017)

Procurement arrangements were put in place for the award of a contract to carry out the emergency protection works. Tenders from a number of pre-alerted shortlisted contractors were evaluated and a contract was awarded on 15th May 2017 to LA-TTSL Joint Venture, a firm with experience in implementing similar works in the Jamuna River under FRERMIP. The works were completed by early July 2017, involving the placement of nearly 17,250 geobags.

The emergency protection works implemented by Blue Gold comprised of: (i) a dumped 6m wide underwater apron consisting of 3 layers of 250kg geobags along 950m of bankline and (ii) an above low water level protection of 1.5 layers of placed 250kg geobags on the slope along 111m. While the purpose of the underwater protection is to prevent large scale, continuous erosion of the bankline, the slope protection above low water level is designed to minimize local erosion in places with settlements close to the bankline.

In June 2018, a report on the emergency works provided an overview of the studies, the results, the type of protection works, the works which were implemented and the performance of the works after the 2017 flood season. The report concluded that the implemented emergency works appeared to perform satisfactorily, and that the river was not expected to significantly change course over the next years. However, it also noted that the nature of the protection was not suitable for a long-term protection, and that adaptation works were required as well as erosion protection of the upper bank

above low water level. To ensure the sustainability of the implemented works and to avoid future problems with erosion in the vulnerable reach, the report advised that the implemented emergency works should be upgraded and extended in both upstream and downstream directions to minimize the risk of outflanking of the protection.

Through the Blue Gold Innovation Fund, EKN financed all the research studies and reports, as well as the contract for the emergency protection works by the LA-TTSL Joint Venture.

Lessons Learnt[edit | edit source]

Adequate funds for unforeseen emergencies should be made available.

Under BWDB rules, funds for "emergency works" are allocated only after a breach is imminent or has occurred. At this stage, costs for repair are much more expensive because land in the vicinity of a breach is flooded, so:

a. borrow pits with soils suitable for use in embankments are generally not available close to the site of a breach, so there is a cost of haulage – delivering materials to the site of the breach
b. It is difficult to get machinery, equipment and materials to the site of a breach, and required labour gangs and boats
c. Access by land to the site of a breach is restricted, along narrow embankments especially constructed to gain access to the breach site
d. Soil from borrow pits is often saturated, and achieving acceptable level of soil compaction at high moisture content is impossible
e. In tidal reaches of coastal rivers:
    i. the effective working time for a contractor is limited to 4 hours in two sessions either side of high or low tide (depending on the tidal regime during daylight hours); and
    ii. the velocities either side of high tide can be very considerable. In these conditions, the final closure of breaches often requires driving bandals to contain earth-filled geotextile bags – so that they are not swept away by the high velocity flows.

Pre-emptive action to strengthen vulnerable embankments before they fail is justified because:

1. Costs of repair of threatened infrastructure (embankments, sluices etc) are much reduced if work is done before embankment failure; and
2. Costs in terms of human lives, and damage to crops, livestock, businesses and households can be prevented.

Possible measures which could be considered:

1. Providing the field XEN with technical assistance from an experienced design team – supported, for example, by IWM - who would prepare recommended engineering interventions and obtain local community acceptance, assisted by representatives from WMG, WMA, UP, UZP and any local MP.
2. Providing flexible funding arrangements by pre-allocating budgets under the Annual Development Plan (ADP) so that pre-emptive actions can be included in the Revised Annual Development Plan (RADP) in February/March, thus leaving a four-month window for tendering and construction from March to June (when the onset of the monsoon prevents work from continuing).
3. Providing a 5-year on-call framework contract for pre-emptive emergency repair including stock-piling geotextile bags in *godowns* (storage sheds) of BWDB Divisions. Incentivising contractors through appropriate contractual arrangements to complete pre-emptive works on

time and to a good quality, and to be accountable for successful implementation and the integrity of the embankment, perhaps for the duration of the framework contract.

Emergency maintenance is a major role of BWDB in the O&M Agreement between BWDB and polder-level WMA, and should be extended to include investments for pre-emptive works – with BWDB and WMA together agreeing a prioritized list of actions.

Notes[edit | edit source]

1. ↑ See also Section G Chapter 28.3
2. ↑ *DPP Recast*. May 2013. p. 21.
3. ↑ See also Chapter 12.3 concerning design allowance for climate change effects.
4. ↑ A presentation at a seminar on bank protection in April 2017 adds to the summary given below.
5. ↑ The CS WMA was aware that the World Bank-funded Coastal Embankment Improvement Project Phase 1 was offering land acquisition and compensation in Polders 32, 33, 35/1 and 35/3. In a public meeting, they made clear their preference for financial compensation.
6. ↑ 'Backing' is the practice of using earth to build up the width of the embankment on its country-side.
7. ↑ To prevent riverbank erosion, 'porcupines' are installed to slow river velocities and thus encourage sediment deposition close to the riverbank.

See more[edit | edit source]

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Chapter 10: Coastal Infrastructure

Blue Gold Lessons Learnt Wiki
Section C: Water Infrastructure

Next chapter:
Chapter 12: Survey, Design and Procurement

Section C: Water Infrastructure		
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Blue Gold Wiki

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Bangladesh Water Development Board, government agency which is responsible for surface water and groundwater management in Bangladesh, and lead implementing agency for the Blue Gold Program

Development Project Proforma: a formal document which sets out the intention of a GoB organisation to invest in a development project, seeking approval for the investment and, if successful, a budget allocation. The DPP follows a prescribed format, including the project's financial and physical scope, benefits, and proposals for monitoring and internal and external audits. The approval of a development project proposal follows a number of stages: formation with preliminary studies, formulation to develop greater detail and with additional information to make the economic case for the project, scrutiny by the executing agencies and concerned ministries, appraisal by the Planning Commission, recommendation for approval by Project Evaluation Committee (PEC), Minister/ECNEC approval, and inclusion of a budgetary allocation in the Annual Development Plan (ADP).

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A defined set of temporary activities through which facilitators seek to effect change

Earthen dyke or bundh raised above surrounding ground level, for example so that roads or railway lines are above highest flood levels, or so that an area is empoldered to protect it from external floods and saline waters.

Bangladesh Taka

Structure designed to only admit (fresh or saline) water across an embankment.

A culvert is a structure that allows water to flow beneath a road, railroad, trail, or similar obstruction from one side to the other.

small earthen embankment or dam

Government of Bangladesh; a donor to the Blue Gold Program

Operation and Maintenance

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Revised Development Project Proforma

hectare

A vertical gate to control the flow of water; also referred to as 'regulator'

Annual Development Plan

Coastal Embankment Improvement Project

Financial Year

river whose flow and level are influenced by tides

An area of low-lying land surrounded by an earthen embankment to prevent flooding by river or seawater, with associated structures which are provided to either drain excess rainwater within the polder or to admit freshwater to be stored in a khal for subsequent use for irrigation.

actions taken to prevent or repair the deterioration of water management infrastructure and to keep the physical components of a water management system in such a state that they can serve their intended function.

Ministry of Water Resources

A process through which stakeholders influence and share control over development initiatives and the decisions and resources which affect them.

A process by which the local stakeholders are directly and actively involved in identification, planning, design, implementation, operation & maintenance and evaluation of a water management project.

Flood and Riverbank Erosion Risk Management Investment Program - A program financed by ADB and EKN with consultancy services provided by Northwest Hydraulic Consutants and Mott MacDonald, which provided structural and non-structural flood and riverbank erosion risk management measures in three high priority subproject areas, with the aim in subsequent projects of extending the protected reaches using designs adjusted to current riverbank erosion conditions and considering the possibilities of reclaiming lost floodplain land.

A livelihood is a way of making a living. It comprises capabilities, skills, assets (including material and social resources), and activities that households put together to produce food, meet basic needs, earn income, or establish a means of living in any other way.

Integrated Planning for Sustainable Water Management

Water Management Group - The basic organizational unit in Blue Gold representing local stakeholders from a hydrological or social unit (para/village). Through Blue Gold, 511 WMGs have been formed and registered. The average WMG covers an area of around 230 ha has 365 households or a population of just over 1,500.

Water Management Association - In Blue Gold, the polder-level representative of WMGs, and signatory to an O&M Agreement with BWDB

Union Parishad - Union Council chaired by an elected Union Chairman

Technical Assistance

drainage channel or canal

An area enclosed by low embankments to store either freshwater or brackish water for the production of fish, shrimps or prawns.

transplanted aman; a rice crop, with nurseries for seedlings started in June/July, for transplanting in July/August in areas liable to a maximum flood depth of about 50cm. Harvested in November/December. Local varieties are sensitive to daylength whereas modern varieties are insensitive or only slightly sensitive.

Union Parishad - Union Council chaired by an elected Union Chairman

Institute of Water Modelling

the removal of materials in the river bank by water flowing in the river channel; also termed bank scour. In coastal polders, riverbank erosion - if unchecked - can result in breaches to polder embankments - where they are aligned close to rivers - and consequent loss of human and animal life as well as damage to farmland, crops, housing, and other infrastructure.

Embassy of the Kingdom of the Netherlands, the contractual representative of the Minister of Foreign Trade and Development Cooperation of the Netherlands and signatory to the agreement for the Blue Gold Program with the External Resources Division of the Ministry of Finance as the signatory for the Government of Bangladesh

Executive Engineer (BWDB)

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Upazila Parishad or Upazila Council: Middle tier of local government, between Union and District, chaired by an elected Upazila Chairman. The civil administration at this level is headed by the UNO

Namespaces

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- Discussion

Variants

Blue Gold Program Wiki

The wiki version of the Lessons Learnt Report of the Blue Gold program, documents the experiences of a technical assistance (TA) team working in a development project implemented by the Bangladesh Water Development Board (BWDB) and the Department of Agricultural Extension (DAE) over an eight+ year period from March 2013 to December 2021. The wiki lessons learnt report (LLR) is intended to complement the BWDB and DAE project completion reports (PCRs), with the aim of recording lessons learnt for use in the design and implementation of future interventions in the coastal zone.