ECONOMIC AND FINANCIAL ANALYSIS

A. Introduction

1. Under the multitranche financing facility (MFF) modality, flood and erosion management measures will be implemented at priority erosion reaches or sites over successive tranches. The MFF modality allows flexible and adaptive phased interventions that are technically appropriate for coping with the dynamic river morphology in Bangladesh. The first tranche will provide urgently needed structural and non-structural measures in three high priority subproject areas along the main rivers. Subsequent tranches will extend the protection structures and associated non-structural measures to adjacent stretches, and the design will be adjusted to the latest riverbank erosion conditions. The three subproject areas are Jamuna Right Bank 1 (JRB 1), Jamuna Left Bank 2 (JLB 2), and Padma Left Bank 1 (PLB 1). Emergency riverbank protection works may be provided at critically eroded sites along the main rivers within or outside the three subproject areas. The investment program will be implemented in three tranches over 9 years, and each tranche will be implemented in 4–5 years with overlapping.

2. The economic and financial analyses examined the economic viability of these three subprojects, and financial returns to farmers—the major beneficiaries of the investment. The Bangladesh Water Development Board does not generate revenue from its flood and riverbank erosion risk management services because of the public goods nature of riverbank protection revetments and flood embankments. Therefore, the financial internal rates of return are not relevant indicators of the investment program and were not assessed. Only the financial sustainability of the investment program was discussed.

3. The analyses are based on the engineering, social, and environmental design of the subprojects; and socioeconomic data collected from relevant government agencies and field surveys, and investigations conducted during the project preparatory technical assistance (TA).[1] Results of numerical inundation analyses under the TA were also used for background data. The analyses provide the economic internal rate of return (EIRR) and net present value (NPV) of each subproject, and estimates of financial returns to typical farmers. EIRRs are subjected to sensitivity analysis to assess the impact of adverse changes in key project variables. Switching values are calculated to estimate the percentage by which a variable would need to change before the EIRRs fall to the assumed cut-off rate for economic viability, and the NPVs fall to zero. Economic Analysis Supporting Documents shows detailed data of the analyses.[2]

B. Methodology

4. The analysis uses the domestic price numeraire approach, in which (i) domestic financial prices of local currency cost and benefit items are assumed to reflect their economic values, and (ii) financial prices of foreign currency costs and benefit items are converted to economic values by the application of the shadow exchange rate factor (SERF). Where appropriate, the prices of the main internationally traded commodities, notably agricultural inputs (fertilizers) and outputs (rice), have been estimated according to import and export parity prices based on border equivalent values.

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[1] Including Bangladesh Bureau of Statistics, Bangladesh Water Development Board, the Department of Agriculture, the Department of Disaster Management, and the Local Government Engineering Department, and ADB. 2014. *Technical Assistance to the People's Republic of Bangladesh for Preparing the Main River Flood and Bank Erosion Risk Management Program*. Manila.

[2] Economic Analysis Supporting Documents (accessible from the list of linked documents in Appendix 2).

5. Other key features of the methodology include the following: (i) EIRRs and NPVs have been estimated on the basis of a 30-year net cash flow, and no residual value at the end of the cash flow period has been assumed; (ii) constant 2013 prices have been used for project costs and benefits; (iii) where price escalation over the life of a subproject is expected to vary from the general level of price escalation, a specific escalation factor for such an item is applied; (iv) the long-term trend in the prices of key agricultural commodities, as indicated in World Bank commodity price forecasts, has been taken into account as part of the sensitivity analysis;[3] (v) 0.90 was applied as a standard conversion factor (SCF), as used by the Government of Bangladesh in the project appraisal; this equates to an SERF of 1.11; (vi) the financial price of unskilled labor engaged in subproject construction and in farming activities has been converted to an economic value by the application of a shadow wage rate factor (SWRF) of 0.75, as used by the Government of Bangladesh in the project appraisal; (vii) subproject investment and maintenance costs have been converted to economic values by the application of specific conversion factors, and on the basis of the proportions of foreign currency costs, labor, materials, and transport in financial prices and the application of conversion factors as appropriate (that is the SERF, SWRF, or SCF); (viii) the tax and duty component of financial prices has been netted out in obtaining economic values; (ix) a discount rate of 12%, used by the Government of Bangladesh, has been used to estimate NPVs and has been assumed to be the opportunity cost of capital—the cut-off rate against which economic viability is assessed.

6. The costs of the investment program include an estimate for about 12 kilometers (km) of erosion protection and other works in an additional subproject area that may be undertaken under the third tranche. These works are not related to the three priority subprojects identified, and no specific interventions have been designed in the additional subproject area because of likely changes to riverbank alignments caused by the dynamic river morphology. Hence, no economic analysis has been undertaken for the additional subproject area.

7. **Cost estimates**. The investment and maintenance costs of physical works—and the land acquisition, resettlement, and associated costs of each subproject—have been estimated on the basis of physical quantities of civil works, structures, etc. Standard unit rates used by the Bangladesh Water Development Board (BWDB) were applied. Annual maintenance costs have been conservatively assumed at 5% for embankment works, 2% for riverbank protection works, and 1% for hydraulic structures.[4] Maintenance costs are assumed to commence in the year following completion of the construction of relevant structures.

8. In addition to the specific costs related to each subproject, a variety of program costs (program management, community-based disaster risk management, consulting services, capacity building, etc.) will be incurred to ensure the effective implementation and sustainability of program investments. These program overhead costs, as well as costs for emergency riverbank protections, cannot be assigned to a specific subproject. They have been allocated on a pro-rata basis across the three subprojects for the economic analysis.

C. Benefits

9. Benefits are expected to be derived from multiple sources related to the type and scale of work undertaken in each subproject area. Benefits are both direct and indirect, though not all

[3] World Bank. 2013. *Commodity Price Forecast Update*. http://siteresources.worldbank.org/INTPROSPECTS/Resources/334934-1304428586133/Price_Forecast.pdf

[4] The economic analysis used conservative estimates. Actual requirements of maintenance costs are estimated at about 1% of the construction costs for riverbank protections and hydraulic structures, and 1%–2% for embankments.

have been quantified. Each subproject involves two major investment activities: (i) construction of riverbank protection revetments, and (ii) rehabilitation or construction of flood embankments. Riverbank protection revetments prevent land erosion, including loss and breaches of flood embankments. Riverbank protection works themselves, however, yield little economic benefits as revetments protect only narrow slips of land along rivers. The flood protection benefit is triggered by rehabilitation or construction of flood embankments that protect vast flat lands from flood inundation. Flood embankments need to be constructed after stabilization of the riverbanks, through the construction of bank protection works. Tranche 1 includes embankment works only in the JRB 1 subproject area, where 11 km of reliable riverbank protections had been constructed under the Asian Development Bank (ADB)-funded predecessor project.[5] Embankment works in other subproject areas can be started from the second tranche, after the tranche 1 riverbank protection works. Full realization of economic benefits from investments in riverbank protection is delayed until completion of the flood embankment construction and rehabilitation.

10. **Riverbank erosion protection**. Benefits from erosion protection are based on the estimated area of land that would be lost annually if protection were not implemented. The area concerned is estimated on the basis of the length of riverbank protection revetments constructed in km, and the width in meters (m) of land that would be eroded without protection. Erosion rates were estimated based on findings of the river morphology analysis conducted under the TA. The width of bank that would be eroded without protection is likely to vary considerably, depending on the site. Different erosion rates were applied for different sites—assumed at in the order of 100 m annually—depending on location. Erosion is not generally a regular annual occurrence. To reflect this irregularity in the economic cash flow, it has been assumed that erosion would occur intermittently in 5-year cycles, with a period of 5 years of erosion followed by 5 years without erosion and so on throughout the 30-year period of the economic analysis. The erosion pattern in PLB 1 at Harirampur was assumed to be different, with continuous erosion of 300 m each year, but an erosion length that reduces by 1 km each year. This pattern mimics the reoccupation of the meander bend that exists here. The erosion protection benefits were computed, applying a standard financial value of land of Tk3.7 million per hectare (ha), converted to an economic value of Tk3.3 million.[6] The standard financial values of lands were used because of the absence of detailed surveys of the areas that would be affected by erosion to determine affected assets (if any), their value, and affected economic activity (if any).

11. **Flood protection**. Flood protection benefits are estimated on the basis of the number and value of the main assets located within the area to be protected from future flood inundation, and the probability of damages under various flood scenarios. Floods with a probability of 0.01 (with a return period of 100 years), 0.02 (50 years), and 0.50 (2 years) were considered. These are identical with the 1988, 2007, and 2003 floods respectively. The design flood of embankments under the investment program is a 100-year flood. Agricultural assets (standing crops), buildings, and roads represent the major types of assets in potential inundation areas. Bangladesh Bureau of Statistics (BBS) *upazila* (district)-level data are the principal source of asset data. *Upazila*-level flood damage data were collected from *upazila* offices of the former Department of Relief and Rehabilitation (DRR), which has been

[5] ADB. 2002. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the People's Republic of Bangladesh for the Jamuna-Meghna River Erosion Mitigation Project*. Manila (Loan 1941-BAN (SF), approved on 25 November 2002 for $42.2 million equivalent, and closed on 30 June 2011).

[6] This value is considered conservative. Field investigations indicated an average financial value of Tk15,000 per decimal of char (river island) land, which is among the least valuable land in project areas. One decimal is equal to 0.01 acres and 0.004 ha.

reorganized into the Department of Disaster Management (DDM). The collected field data were examined, verified, and corrected based on flood inundation simulation results.

12. Estimates for specific assets are based on the following:

(i) The 2013 area of crops cultivated is estimated from subproject area field investigations and the gross margin per ha estimated for the aman rice crop, which is the crop predominantly grown in the flood (kharif) season.

(ii) In the absence of estimates for 2013, the number of buildings within a subproject area is based on the numbers reported in BBS surveys in 1991 and 2001, from which estimates for 2013 have been derived by applying the average annual growth rate for each type of building over 1991–2001. BBS estimates are provided for three building types: municipal, urban, and rural.

(iii) The construction cost for each type of building assumes an average area of 400 square feet (ft^2) for municipal and urban buildings, and 300 ft^2 for rural buildings. Based on field investigations, construction costs are estimated at Tk500 for municipal (pucca), Tk400 for urban (semi-pucca), and Tk150 per ft^2 for rural (kutcha) buildings.[7]

(iv) For roads, the approach used for estimating benefits of protecting buildings has also been applied. The lengths of roads in a subproject area in each flood year and in 2013 are derived from BBS data, and the damage to roads in each flood year is derived from DRR *upazila* data.

(v) Annualized loss probability data for roads have also been estimated.

(vi) Construction costs have been based on unit rates of the Local Government Engineering Department, at Tk8,762,500 per km for paved roads and Tk2,500,000 per km for earthen roads.

13. In addition to buildings and roads, the subproject areas contain various strategic assets (hospitals, schools, etc.) that have values significantly higher than the general buildings referred to the items (ii) and (iii) in para. 12. These have not been included in the analysis, except where field investigations have identified appropriate values for those assets.

14. **Improved accessibility by embankment roads**. The vehicle operating costs approach was employed to estimate the economic benefits of improved accessibility caused by paved roads on embankments. The reduction of motorized and nonmotorized vehicle operating costs was quantified as a benefit. The without-project annual average daily traffic was determined for the nearest road, using baseline information from the Local Government Engineering Department. Traffic of the following categories of vehicles was counted: motorized vehicles (auto-rickshaw, taxi, car, motorcycle, pick-up, microbus, bus, minibus, truck, tractor); nonmotorized vehicles (bicycle, bullock cart, rickshaw, rickshaw van); and pedestrians. The total benefit is derived from existing traffic on the nearby roads, which will most likely be diverted, and newly generated traffic.

15. **Estimated benefits**. The overall investment program would protect 7,248 ha of land against erosion; and benefit 122,388 ha of land (including farmlands, rural homesteads, and urban areas) from flood inundation (Table 1).

[7] One square feet is equal to 0.0929 square meters.

Table 1: Land and Population Protected Against Erosion and Flooding

Sub-project	Area (ha)	Popu-lation ('000)	Erosion Protection (ha)[a] T1	T2	T3	Total	Flood Protection (ha) T1	T2	T3	Total
JRB 1	41,417	1,053	188	1,925		2,113	23,447	6,121		29,568
JLB 2	82,927	1,105	1,050	700	770	2,520	0	20,764	39,773	60,537
PLB 1	52,070	737	2,340	0	275	2,615	0	32,283		32,283
Total	**176,414**	**2,895**	**3,578**	**2,625**	**1,045**	**7,248**	**23,447**	**59,168**	**39,773**	**122,388**

ha = hectare, JLB = Jamuna Left Bank, JRB = Jamuna Right Bank, PLB = Padma Left Bank, T = tranche.
[a] The area protected from erosions was calculated for the assumed 30-year lifetime of the physical works, as used in the economic analysis.
Note: Numbers may not sum precisely because of rounding.
Source: Project Preparatory Technical Assistance 8054-IND Final Report (December 2013).

16. The contribution to total benefits from each of the benefit streams varies by subproject, as indicated in Table 2.

Table 2: Subproject Contributions to Benefit Streams by Subproject (%)
(with entire multitranche financing facility case)

Subprojects Benefit Stream	JRB 1	JLB 2	PLB 1	All Subprojects
Reduced erosion	30.0	18.9	49.8	31.5
Reduced flood damage	64.9	78.3	32.3	62.3
Improved accessibility	5.1	2.9	11.9	6.3
Total	**100.0**	**100.0**	**100.0**	**100.0**

JLB = Jamuna Left Bank, JRB = Jamuna Right Bank, PLB = Padma Left Bank.
Note: Numbers may not sum precisely because of rounding.
Source: Asian Development Bank estimates.

D. Economic and Sensitivity Assessments

17. The economic analysis reveals that all subprojects are viable and robust with respect to potential negative changes in key project variables, as summarized in Tables 3–6. The analysis indicates that each tranche is feasible, albeit with wide variations in the EIRRs of individual subprojects (Table 3). Such variations are due to different timing of embankment installation. The most notable case is JLB 2, which is expected to have an EIRR of only 3.0% by the end of the first tranche. Tranche 1 activity at JLB 2 is limited to the construction of 7 km of riverbank protection works that prevent erosion on slips of riverine lands and yield few economic benefits. The subproject EIRR improves substantially with the construction of flood embankments under tranches 2 and 3. On the contrary, the first tranche of JRB 1 can expect a high EIRR, as flood embankments can be constructed during the first tranche in the areas with riverbank protection structures that had been constructed under the past ADB-funded project (footnote 5). All subprojects attain EIRRs of 20.2%–24.9% by the end of the investment program.

Table 3: Economic Investment Cost and Internal Rate of Return

Subproject	With T1 Investment Cost ($ million)	With T1 EIRR (%)	With T1 and 2 Investment Cost ($ million)	With T1 and 2 EIRR (%)	With T1, 2, and 3 (Entire MFF) Investment Cost ($ million)	With T1, 2, and 3 (Entire MFF) EIRR (%)
JRB 1	29.2	**16.6**	84.3	**21.5**	84.7	**21.5**
JLB 2	32.0	**3.0**	63.3	**14.0**	126.7	**20.2**
PLB 1	25.2	**25.6**	56.3	**28.7**	84.7	**24.9**
All subprojects	**86.5**	**15.0**	**204.0**	**21.2**	**296.1**	**21.9**

EIRR = economic internal rate of return, JLB = Jamuna Left Bank, JRB = Jamuna Right Bank, MFF = multitranche financing facility, PLB = Padma Left Bank, T = tranche.
Source: Asian Development Bank estimates.

Table 4: Net Present Value ($ million)

Subproject	With Tranche 1	With Tranches 1 and 2	With Tranches 1, 2 and 3 (Entire MFF)
JRB 1	6.9	29.3	29.3
JLB 2	(12.0)	5.7	35.6
PLB 1	16.9	42.1	33.2
All Subprojects	**11.8**	**77.2**	**98.2**

( ) = negative, JLB = Jamuna Left Bank, JRB = Jamuna Right Bank, MFF = multitranche financing facility, PLB = Padma Left Bank.
Source: Asian Development Bank estimates.

Table 5: Switching Values (%)

Subproject	With Tranche 1			With Tranches 1 and 2			With Tranches 1, 2, and 3		
	B	IC	O&M	B	IC	O&M	B	IC	O&M
JRB 1	23.1	44.6	214.2	34.1	74.8	409.9	34.1	74.8	409.9
JLB 2	(100.7)	(69.5)	(735.8)	12.4	19.3	165.4	35.2	80.4	627.5
PLB 1	47.6	123.3	1948.1	54.2	162.4	1258.0	41.8	102.3	850.5
All Subprojects	15.3	76.3	206.4	36.7	196.8	552.4	36.8	84.6	586.5

( ) = negative, B = benefit, IC = investment cost, JLB = Jamuna Left Bank, JRB = Jamuna Right Bank, O&M = operation and maintenance, PLB = Padma Left Bank.
Source: Asian Development Bank estimates.

Table 6: Sensitivity Analysis of Economic Internal Rate of Return for With-Tranche 1 Case (%)

Subproject	Base Case	Cost increased by 15%	Benefit decreased by 15%
JRB 1	16.6	14.1	13.7
JLB 2	3.0	1.6	1.4
PLB 1	25.6	22.4	21.9
All subprojects	**15.0**	**12.5**	**12.1**

JLB = Jamuna Left Bank, JRB = Jamuna Right Bank, PLB = Padma Left Bank.
Source: Asian Development Bank estimates.

E. Non-Quantified Benefits

18. A number of potential benefits have not been considered because of difficulties in quantifying them. These include (i) prevention of loss of life; (ii) savings in the social cost of displacement and flood distress; (iii) savings to the government's budget for compensation payments to people affected by bank erosion and floods; (iv) protection of public service facilities, such as the Enayetpur hospital or prominent government buildings, from erosion; and sustained access to provided services; (v) reduced costs for flood disaster relief and reconstruction; (vi) avoided sand-casting or carpeting of agricultural lands, which reduces fertility, as a consequence of flood inundation; (vii) improvements in river navigation through a stabilized river channel; (viii) increased commercial agribusiness resulting from increased demand for input supplies and output markets on more stable farmlands; and (ix) increase in economic activities as a result of more stable riverbanks. The potential increase in land value has not been considered in the economic evaluation.

F. Estimated Financial Returns to Farmers and Impacts on Poverty

19. **Incremental agricultural activity**. To estimate financial returns to farmers, agriculture benefits deriving from reduced erosion or flooding of cultivated land, and incremental production on reclaimed land, are estimated using with- and without-project cropping patterns, and crop budgets. The construction or rehabilitation of flood embankments with gated structures will reduce and regulate flood inundation depths, and will change land types categorized by

inundation depths as in Table 7.[8] Cropping patterns are estimated for the five land categories, and the area under key crops within the cropping pattern. Crop yields on existing potential erosion and inundation lands are assumed to be improved close to the existing levels in 2013 in flood-free lands under the with-project condition. Unit area (ha) crop budgets for the with- and without-project situations are estimated for each crop in the cropping pattern to derive gross margins (net returns) per ha. This approach is applied to existing land, to land subject to erosion, and to land expected to be recovered under a project to estimate total net incremental returns for agriculture activity as a whole.

Table 7: Estimated Changes of the Area per Land Classification per Subproject (ha)

Land Classification	JRB 1	JLB 2	PLB 1	Total
F0 (<30 cm)	5,607	27,711	11,151	44,469
F1 (30–90 cm)	2,052	6,813	3,240	12,105
F2 (90–120 cm)	1,674	(441)	(891)	342
F3 (120–360 cm)	(5,184)	(32,031)	(11,781)	(48,996)
F4 (>360 cm)	(3,969)	(5,184)	(2,052)	(11,205)

( ) = negative, cm = centimeter, ha = hectare, JLB = Jamuna Left Bank, JRB = Padma Right Bank, PLB = Padma Left Bank.
Note: The land classification is based on inundation depth.
Source: Project Preparatory Technical Assistance 8054-IND Final Report (December 2013).

20. Average annual rice production would increase by 312,244 tons valued at Tk5,464million in 2013 prices. Average annual farm income of an owner-farmer in the program area would increase by 100% to Tk34,457 per ha. Average farm income of a tenant farmer would increase by 40% to Tk47,051 per ha (Table 8).

Table 8: Estimated Annual Farm Household Income (per ha) in Subprojects

Description	Situation	JRB 1		JLB 2		PLB 1	
		Owner Farm	Tenant Farm	Owner Farm	Tenant Farm	Owner Farm	Tenant Farm
Gross value of production (Tk)	Without	106,689	53,344	101,631	50,815	102,664	51,332
	With	135,968	67,984	144,297	72,149	144,379	72,190
Inputs costs (Tk)	Without	34,668	17,334	33,706	16,853	33,902	16,951
	With	37,877	18,939	41,946	20,973	42,444	21,222
Labor costs (Tk)	Without	55,797	0	50,117	3,447	51,260	0
	With	63,539	0	67,425	10,034	68,042	0
Total production costs (Tk)	Without	90,465	17,334	83,823	20,300	85,162	16,951
	With	101,416	18,939	109,371	31,007	110,486	21,222
Net benefit (Tk)	Without	16,223	36,010	17,807	30,515	17,502	34,381
	With	34,552	49,045	34,927	41,142	33,893	50,968
Incremental benefit (Tk)	With	18,328	13,035	17,120	10,626	16,391	16,587

JLB = Jamuna Left Bank, JRB = Jamuna Right Bank, PLB = Padma Left Bank.
Note: Numbers may not sum precisely because of rounding.
Source: Asian Development Bank estimates.

21. **Impacts on poverty**. Poverty remains the major socioeconomic concern in Bangladesh, with 31.5% of the population living in poverty.[9] Rural areas have a higher poverty incidence (35.2%) than urban areas (21.3%), and most of the rural poor are landless and marginal farmers. Landless farmers work as sharecroppers (tenants) on terrain owned by landlords.

[8] F0: 0–30 cm (high land); F1: 30–90 cm (medium high land); F2: 90–180 cm (medium low land); F3: 180–360 cm (low land); and F4: above 360 cm (very low land).

[9] Poverty headcount rate at the upper poverty line by the cost of basic needs method, a minimum food requirement of 2,122 kilocalories per person per day. Bangladesh Bureau of Statistics. 2011. *Statistical Year Book of Bangladesh –2010*. Dhaka.

Marginal farmers eke out crops on a fraction of a hectare, but not enough to feed a family for the year; most of them also work as sharecroppers. Riverine districts in the program area, which are prone to riverbank erosion and flood disaster, have a higher concentration of landless poor and marginal farmers as a consequence of years of riverbank erosion. Riverbank erosion annually affects about 100,000 people, and forces yet more displacements and/or loss of livelihoods.

22. Engineering interventions under the investment program will directly protect these poor residents along the rivers from bank erosion and flood inundation. They will also benefit from increased farming and farm productivity. The farm income of tenant farmers will increase by 36% in JRB 1, 35% in JLB 2, and 48% in JRB 1 (Table 8). Increased farm activity will raise the overall demand for farm labor by 30%—all of which is expected to be provided by landless and marginal farmers (Table 9). Thus, the combined effect of program benefits (i.e., increased farm income and increased employment) on landless and marginal farmers will significantly help reduce poverty in the program area.

Table 9: Farm Agriculture Labor Demand and Supply in Subproject Areas

Description	Situation	JRB 1		JLB 2		PLB 1	
		Owner Farm	Tenant Farm	Owner Farm	Tenant Farm	Owner Farm	Tenant Farm
Total family labor	Without	0	563	0	314	0	488
available (person-day)	With	0	563	0	314	0	488
Total labor requirements	Without	279	279	251	251	256	256
(person -day)	With	318	318	337	337	340	340
Incremental (person -day)	With	39	39	87	87	84	84
Total family labor use	Without	0	279	0	233	0	256
(person -day)	With	0	318	0	287	0	340
Total hired labor	Without	279	0	251	17	256	0
(person -day)	With	318	0	337	50	340	0
Total unused family labor	Without	0	284	0	81	0	232
(person -day)	With	0	245	0	27	0	148

JLB = Jamuna Left Bank, JRB = Jamuna Right Bank, PLB = Padma Left Bank.
Note: Numbers may not sum precisely because of rounding.
Source: Asian Development Bank estimates.

G. Financial Sustainability

23. The project is financially sustainable. Enhancement of the operation and maintenance (O&M) capacity of BWDB was built into the project design, to minimize O&M costs. Examples are asset inventories and the establishment of a management information system that will enable early maintenance with minimal costs before serious deterioration, and a community awareness campaign to avoid damages resulting from vandalism. O&M costs are allocated from BWDB's revenue budget. The estimated O&M costs after completion of the investment program will be less than 5% of the current annual O&M budget of BWDB, and could be considered easily affordable.[10]

[10] A realistic estimate was applied: 1% of the total construction costs for riverbank protection works and 2% of embankment works.