SUPPLEMENTARY ECONOMIC APPENDIX

A.   APPROACH AND METHODOLOGY

1.   Economic analysis was only conducted for Batch 1/Stage 1 subprojects (water supply, sanitation, drainage, solid waste, roads, bridges, cyclone shelters). Economic analysis for Batch 1/Stage 2 and Batch 2/Stage 1 and 2 will be undertaken once the relevant subproject scopes have been defined. The subprojects in Batch 2 towns are likely to generate similar returns as Batch 1 towns as the towns face similar challenges and have similar needs.

2.   Linked document 8: *Economic Analysis* explains the overall methodology and approach – and presents the economic analysis findings per town. Linked document 7: *Financial Analysis* explains the overall methodology and approach for the financial analysis, including considerations such as cost recovery for revenue-generating subprojects. Further information on valuation of benefits is provided in this supplementary appendix due to page limitations in linked document 8.

B.   SUMMARY OF ECONOMIC COSTS AND BENEFITS

3.   Table 1 below provides a summary of the economic costs and benefits of all Batch 1/Stage 1 subprojects (water supply, sanitation, drainage, cyclone shelters, roads and bridges). The overall project EIRR is 23% and the benefits-cost ratio is 1.88 with a positive NPV.

Table 1: Economic Costs and Benefits of CTEIP Sub-Projects ($'000)

	Benefits							Costs			Net benefits
	Drainage	Roads	Bridges	Water	Sanitation	Cyclone Shelters	Total benefits	Capex	Opex	Total costs	
2014	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14044.7	0.0	14044.7	-14044.7
2015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14668.9	0.0	14668.9	-14668.9
2016	3430.1	2115.8	138.4	0.0	458.4	820.4	6963.2	3143.4	261.3	3404.7	3558.5
2017	3465.1	2160.9	141.2	1238.0	467.6	836.8	8309.6	0.0	436.3	436.3	7873.3
2018	3500.4	2204.0	144.0	1165.9	476.9	853.6	8344.9	0.0	436.3	436.3	7908.6
2019	3536.1	2248.0	146.9	1275.1	486.4	870.7	8563.2	0.0	436.3	436.3	8126.9
2020	3572.2	2292.8	149.9	1386.9	496.2	888.1	8786.0	0.0	436.3	436.3	8349.7
2021	3608.7	2211.6	152.9	1440.2	506.1	905.8	8825.2	0.0	436.3	436.3	8388.9
2022	3645.5	2255.6	155.9	1500.0	516.2	923.9	8997.1	0.0	436.3	436.3	8560.8
2023	3682.6	2300.4	159.0	1522.6	526.5	942.4	9133.6	0.0	436.3	436.3	8697.3
2024	3720.2	2346.1	162.2	1553.7	537.1	961.3	9280.6	0.0	486.1	486.1	8794.6
2025	3758.2	2392.7	165.5	1592.5	547.8	980.5	9437.1	0.0	486.1	486.1	8951.1
2026	3796.5	2300.4	168.8	1629.9	558.8	1000.1	9454.4	0.0	486.1	486.1	8968.4
2027	3835.2	2346.1	172.1	1667.1	570.0	1020.1	9610.6	0.0	486.1	486.1	9124.6
2028	3874.3	2392.6	175.6	1704.3	581.4	1040.5	9768.8	0.0	486.1	486.1	9282.7
2029	3913.8	2440.1	179.1	1741.5	593.0	1061.3	9928.9	0.0	486.1	486.1	9442.8
2030	3953.8	2488.4	182.7	1778.7	604.8	1082.6	10090.9	0.0	486.1	486.1	9604.9
2031	3994.1	2384.2	186.3	1888.7	616.9	1104.2	10174.5	0.0	486.1	486.1	9688.4
2032	4034.8	2431.5	190.1	1924.4	629.3	1126.3	10336.4	0.0	486.1	486.1	9850.4
2033	4076.0	2479.8	193.9	1971.7	641.9	1148.8	10512.1	0.0	486.1	486.1	10026.0
2034	4117.6	2529.0	197.7	2019.0	654.7	1171.8	10689.8	0.0	486.1	486.1	10203.8
2035	4159.6	2579.1	201.7	2066.3	667.8	1195.2	10869.7	0.0	486.1	486.1	10383.6
PV	21741.4	13543.3	933.7	7790.1	3091.4	5533.0	52632.8	26471.3	2572.7	29044.0	23588.8
NPV											23,588.8
IRR											23.0%
B/C											1.81

B/C = benefits/costs, CTEIP = Coastal towns environmental infrastructure project, IRR = internal rate of return, NPV = net present value.
Source: ADB Estimates.

a. Valuation of benefits – water supply

4.   **Amtali.** The subproject will increase water availability and fill the current demand gap up to 100 lpcd and allow for 3,836 additional household connections. The accounted economic benefits are from resource cost savings on the non-incremental water consumption by switching from alternative sources to piped water. The resource cost savings include labor costs to fetch water from public stand posts,[1] cost of installing storage tank,[2] cost to boil water for drinking purposes[3] and cost of water purchased from private vendors.[4]

5.   **Galachipa.** The subproject will increase the water available for distribution sufficient to fill the current demand gap up to 100 lpcd and allow for 2,672 additional household connections. The quantified economic benefits are from resource cost savings on the non-incremental water consumption by switching from alternative sources to piped water. The resource cost savings include labor costs to fetch water from public stand posts,[5] cost to install storage tank[6], cost to boil water for drinking purpose[7] and cost of water purchased from private vendors.[8]

6.   **Mathbaria.** The subproject will increase the water available for distribution sufficient to fill the current demand gap up to 100 lpcd and allow for 4,000 additional household connections. The quantified economic benefits are from resource cost savings on the non-incremental water consumption by switching from alternative sources to piped water. The resource cost savings include labor costs to fetch water from public stand posts,[9] cost to install storage tank,[10] cost to boil water for drinking purpose[11] and cost of water purchased from private vendor.[12]

b. Valuation of benefits – drainage

7.   **Amtali.** Property damage benefits have been assessed based on the construction cost,[13] repair cost[14] and clean up costs[15] of the properties[16] likely to be affected in floods in the without

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[1] Assuming a household spends 18 minutes per day fetching water as per PPTA socioeconomic survey report. The time spent is valuated at wage rate of BDT 375 ($4.81) per day for unskilled labor.

[2] The cost of storage tank, including operation and maintenance is assumed at BDT 1,042 ($13.36). Source: PPTA socioeconomic survey (2013).

[3] Assuming 5 minutes work of unskilled labor per day. Other monthly costs for purification per HH are BDT 129. Source: PPTA socioeconomic survey (2013).

[4] Cost of water from private vendors is assumed at BDT 100/m^3 ($1.28/m^3). Source: PPTA study (2013).

[5] Assumes a household spends 14 minutes per day fetching water (Source: PPTA socioeconomic survey). The time spent is valuated at wage rate for unskilled labor of BDT 375 ($4.81) per day.

[6] The cost of storage tank, including operation and maintenance, is assumed at BDT 2,320 ($29.74). Source: PPTA socioeconomic survey.

[7] Assuming nil minute work of unskilled labor per day because socio economic survey did not indicate time spent. Other monthly costs for purification per HH are BDT nil. Source: PPTA socioeconomic survey (2013).

[8] Cost of water from private vendors is assumed at BDT 100/m^3. Source: PPTA socioeconomic survey (2013).

[9] Assumes a household spends 25.6 minutes per day fetching water. The time spent is valuated at the wage rate for unskilled labor of BDT 375 ($4.81) per day.

[10] The cost of storage tank, including operation and maintenance is assumed at BDT 3,463 ($44.40). Source: PPTA socioeconomic survey.

[11] Assuming nil minutes work of unskilled labor per day among other costs. Other monthly costs for purification per HH are BDT nil. Source: PPTA socioeconomic survey.

[12] The cost of water purchased from private vendors is assumed at BDT 237/m^3 ($3.04/m^3). Source: PPTA socioeconomic survey.

[13] BDT 1,200/ sq. foot, BDT 1,600/sq. foot and BDT 2,000/ per sq. foot for *katcha, semi-pakka* and *pakka* house. Source: CDTA Draft Final Report (DFR).

[14] Repair cost is 6% of construction cost. Source: CDTA DFR.

[15] BDT 2,000, BDT 5,000 and BDT 9,000 cleanup cost for low, medium and high income groups respectively. Source: CDTA DFR.

project situation. Projected inundation levels affecting different types of properties, commercial, public, residential (*katcha* (permanent), *pakka* (precarious/temporary) and *semi pakka* (semi-permanent materials)), are considered in the technical design of the project. Average area[17] of different types of properties estimated is based on the available data in two *pourashavas*. Damage and repair benefits (i.e. costs avoided) have been estimated on 5% of the properties projected to be inundated more than 0.25 m. Clean up cost benefits (i.e. costs avoided) have been estimated on all properties expected to be inundated. Income increase[18] benefit has been estimated on the number of households likely to be affected due to number of days of flooding. Reduced medical cost benefits have been estimated based on the average expenditure on treatment[19] for waterborne diseases per household and the number of households likely to be affected due to flooding. Agricultural crop losses caused by flooding was estimated based on area of land,[20] average yield[21] and market price of crops.[22] Reduced road damage benefits have been assessed on the kilometers[23] of road likely to be affected due to floods and related repair costs.[24] Benefits are adjusted for real GDP growth rate of 2% per annum over the analysis period.[25]

8.   **Galachipa.** Property damage benefits have been assessed based on the construction cost,[26] repair cost[27] and clean up costs[28] of the properties[29] likely to be affected in floods in the without project situation. Projected inundation levels affecting different types of properties, commercial, public, *katcha, pakka* and *semi pakka*, are considered in the technical design of the project. Average area[30] of different types of properties estimated is based on available data in two *pourashavas*. Damage and repair benefits have been estimated on 5% of properties projected to be inundated by more than 0.25 m. Clean up cost benefits have been estimated on

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[16] The number of properties likely to be affected as per projected inundation levels is provided in the Table below.

Depth	Commercial	Public	Katcha	Pacca	Semi Pacca
< 0.25m inundation	42	22	170	16	63
> 0.25m inundation	48	26	199	19	75

[17] Commercial buildings– 93 square meters; Public buildings – 46 square meters; Katcha houses – 9 square meters; Pacca houses – 70 square meters and Semi pacca houses – 28 square meters.
[18] Average household income for Amtali is BDT 13,841; average number of days of flooding – 11.4 days; affected households 239; Source: PPTA socioeconomic survey report.
[19] BDT 1,097 monthly expenditure on treatment.
[20] 0.3 square kilometre of agricultural land is likely to be affected due to flooding. Source: PPTA technical estimate.
[21] Average yield assumed to be 1.5 tonne per acre. Source: PPTA technical estimate.
[22] Average support price assumed to be BDT 17,500 per tonne. Source: PPTA interviews.
[23] 2.0 kilometers are likely to be affected as per PPTA technical estimate.
[24] Repair costs are 4 lakh BDT as per PPTA technical estimate.
[25] Average GDP growth rate of GoB is 6% per annum.
[26] BDT 1200 per square foot, BDT 1600 per square foot and BDT 2000 per square foot for katcha, semi-pakka and pakka house. Source: CDTA DFR.
[27] Repair costs are 6% of construction cost. Source: CDTA DFR.
[28] BDT 2,000, BDT 5,000 and BDT 9,000 cleanup cost for low, medium and high income groups respectively. Source: CDTA DFR.
[29] The number of properties likely to be affected as per projected inundation levels is provided in the Table below.

Depth	Commercial	Public	Katcha	Pacca	Semi Pucca
< 0.25m inundation	173	63	798	109	292
> 0.25m inundation	39	28	335	38	120
>0.75m inundation	2	2	13	2	4

[30] Commercial buildings– 93 square meters; Public buildings – 46 square meters; Katcha houses – 9 square meters; Pacca houses – 70 square meters and Semi pacca houses – 28 square meters.

all properties expected to be inundated. Income increase[31] benefit has been estimated on the number of households likely to be affected due to number of days of flooding. Reduced medical cost benefits have been estimated based on the average expenditure on treatment[32] for waterborne diseases per household and the number of households likely to be affected due to flooding. Agricultural crop loss due to flooding has been estimated on the area of land,[33] average yield[34] and market price of crops.[35] Reduced road damage benefits have been assessed on the kilometers[36] of road likely to be affected due to floods and related repair costs.[37] Benefits are adjusted for real GDP growth rate of 2% per annum over the analysis period.[38]

9.　　**Mathbaria.** Property damage benefits have been assessed based on the construction cost,[39] repair cost[40] and clean up costs[41] of the properties[42] likely to be affected in floods in the without project situation. Projected inundation levels affecting different types of properties, commercial, public, residential (*katcha, pakka and semi pakka*) are considered in the technical design of the project. The average area[43] of different types of properties estimated is based on the available data in two *pourashavas*. Damage and repair benefits have been estimated on 5% of properties projected to be inundated more than 0.25 m. Clean up cost benefits have been estimated on all properties expected to be inundated. Income increase[44] benefits have been estimated on the number of households likely to be affected due to number of days of flooding. Reduced medical cost benefits have been estimated based on the average expenditure on treatment[45] for waterborne diseases per household and the number of households likely to be affected due to flooding. Agricultural crop losses due to flooding have been estimated on area of land,[46] average yield[47] and market price of crops.[48] Reduced road damage benefits have been assessed on the kilometers[49] of road likely to be affected due to floods and related repair

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[31] Average household income for Galachipa is BDT 13,167; average number of days of flooding – 27.4 days; affected households 2287. Source: PPTA socioeconomic survey report.

[32] BDT 1,126 monthly expenditure on treatment.

[33] 0.65 square kilometre of agricultural land is likely to be affected due to flooding. Source: PPTA technical estimate.

[34] Average yield assumed to be 1.5 tonne per acre. Source: PPTA technical estimate.

[35] Average support price assumed to be BDT 17,500 per tonne. Source: PPTA interviews.

[36] 2 kilometers are likely to be affected as per PPTA technical estimate.

[37] Repair cost is 4 lakh BDT as per PPTA technical estimate.

[38] Average GDP growth rate of GoB is 6% per annum.

[39] BDT 1,200 per square foot, BDT 1,600 per square foot and BDT 2,000 per square foot for *katcha, semi-pakka and pakka* house. Source: CDTA DFR.

[40] Repair cost is 6% of construction cost. Source: CDTA DFR.

[41] BDT 2,000, BDT 5,000 and BDT 9,000 cleanup cost for low, medium and high income groups respectively. Source: PPTA socioeconomic survey.

[42] The number of properties likely to be affected as per projected inundation levels is provided in the Table below.

Depth	Commercial	Public	Katcha	Pacca	Semi Pucca
< 0.25m inundation	90	43	424	46	154
> 0.25m inundation	129	61	605	66	220

[43] Commercial buildings– 93 square meters; Public buildings – 46 square meters; Katcha houses – 9 square meters; Pakka houses – 70 square meters and semi pakka houses – 28 square meters.

[44] Average household income for Mathbaria is BDT 21,744; average number of days of flooding – 36.2 days; affected households 861; Source: PPTA socioeconomic survey report.

[45] BDT 1,061 monthly expenditure on treatment.

[46] 0.5 square kilometre of agricultural land is likely to be affected due to flooding. Source: PPTA technical estimate.

[47] Average yield assumed to be 1.5 tonne per acre. Source: PPTA technical estimate.

[48] Average support price assumed to be BDT 17,500 per tonne. Source: PPTA interviews.

[49] 6 kilometers are likely to be affected as per PPTA technical estimate.

costs.[50] Benefits are adjusted for real GDP growth rate of 2% per annum over the analysis period.[51]

10.   **Pirojpur.** Property damage benefits have been assessed based on the construction cost,[52] repair cost[53] and clean up costs[54] of the properties[55] likely to be affected in floods in the without project situation. Projected inundation levels affecting different types of properties, commercial, public, residential (katcha, pakka and semi pakka) are considered in the technical design of the project. Average area[56] of different types of properties estimated is based on the available data in two *pourashavas*. Damage and repair benefits have been estimated on 5% of properties projected to bet inundated by more than 0.25 m. Clean-up cost benefits have been estimated on all properties expected to be inundated. Income increase[57] benefit has been estimated on the number of households likely to be affected due to number of days of flooding. Reduced medical cost benefit has been estimated based on the average expenditure on treatment[58] for waterborne diseases per household on the number of households likely to be affected due to flooding. Agricultural crop loss due to flooding has been estimated on area of land[59], average yield[60] and market price of crops.[61] Reduced road damage benefits have been assessed on the kilometers[62] of road likely to be affected due to floods and related repair costs.[63] Benefits are adjusted for real GDP growth rate of 2% per annum over the analysis period.[64]

c. Valuation of benefits – sanitation

11.   **Amtali.** Two benefits are envisaged under this subproject: (i) income increase[65] and (ii) reduced medical costs[66] based on number of sick days[67] due to improper or inadequate sanitation. Benefits are adjusted for real GDP growth rate of 2% per annum over the analysis

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[50] Repair cost is 4 lakh BDT as per PPTA technical estimate.

[51] Average GDP growth rate of GoB is 6% per annum.

[52] BDT 1,200 per square foot, BDT 1,600 per square foot and BDT 2,000 per square foot for *katcha, semi-pakka and pakka* house. Source: CDTA DFR.

[53] Repair cost is 6% of construction cost. Source: CDTA DFR.

[54] BDT 2,000, BDT 5,000 and BDT 9,000 cleanup cost for low, medium and high income groups respectively. Source: CDTA DFR.

[55] The number of properties likely to be affected as per projected inundation levels is provided in the Table below.

Depth	Commercial	Public	Katcha	Pakka	Semi Pakka
< 0.25m inundation	532	951	4231	524	795
> 0.25m inundation	158	250	1102	143	220
>0.75m inundation	0	0	0	0	0

[56] Commercial buildings– 93 square meters; Public buildings – 46 square meters; Katcha houses – 9 square meters; Pakka houses – 70 square meters and Semi pakka houses – 28 square meters.

[57] Average household income for Pirojpur is BDT 14,620; average number of days of flooding – 4.6 days; affected households 10670; Source: PPTA socioeconomic survey report.

[58] BDT 1,533 monthly expenditure on treatment.

[59] 7.37 square kilometres of agricultural land are likely to be affected by flooding. Source: PPTA technical estimate.

[60] Average yield assumed to be 1.5 tonne per acre. Source: PPTA technical estimate.

[61] Average support price assumed to be BDT 17,500 per tonne. Source: PPTA interviews.

[62] 15 kilometers are likely to be affected as per PPTA technical estimate.

[63] Repair cost is 4 lakh BDT as per PPTA technical estimate.

[64] Average GDP growth rate of GoB is 6% per annum.

[65] Monthly household income is BDT 13,841. Source: PPTA socioeconomic survey.

[66] Monthly household expenditure on health is BDT 1,097; 30% of this attributed to sanitation. Source: PPTA socioeconomic survey.

[67] 2.5 days per year for each household. Source: PPTA socioeconomic survey.

period.[68]

12.　**Galachipa.** Two benefits are envisaged under this subproject: (i) income increase[69] and (ii) reduced medical costs[70] based on number of sick days[71] caused by improper or inadequate sanitation. Benefits are adjusted for real GDP growth rate of 2% per annum over the analysis period.[72]

13.　**Mathbaria.** Two benefits are envisaged under this subproject: (i) income increase[73] and (ii) reduced medical costs[74] based on number of sick days[75] caused by improper or inadequate sanitation. Benefits are adjusted for real GDP growth rate of 2% per annum over the analysis period.[76]

14.　**Pirojpur.** Two benefits are envisaged under this subproject: (i) income increase[77] and (ii) reduced medical costs[78] based on sick days[79] caused by improper or inadequate sanitation. Benefits are adjusted for real GDP growth rate of 2% per annum over the analysis period.[80]

d. Valuation of benefits – roads

15.　**Amtali.** In the absence of traffic count/surveys, the number of vehicles in the *pourashava* was based on the estimated number of vehicles[81] in the subproject area. Two main benefits are envisaged under this subproject: (i) vehicle operating cost (VOC) savings[82] and (ii) income increase[83] based on less time spent commuting on improved project roads. In addition to this, climate resilience measures will ensure that road damages[84] due to floods is prevented. Benefits are adjusted for real GDP growth rate of 2% per annum over the analysis period.[85]

16.　**Galachipa.** In the absence of traffic count/surveys, the number of vehicles in the

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[68] Average GDP growth rate of GoB is 6% per annum.
[69] Monthly household income is BDT 13,167 in Galachipa. Source: PPTA socioeconomic survey.
[70] Monthly household expenditure on health is BDT 1,126; 30% of this attributed to sanitation. Source: PPTA socioeconomic survey.
[71] 2.1 days per year for each household. Source: PPTA socioeconomic survey.
[72] Average GDP growth rate of GoB is 6% per annum.
[73] Monthly household income is BDT 21,744 in Mathbaria. Source: PPTA socioeconomic survey.
[74] Monthly household expenditure on health is BDT 1,061; 30% of this attributed to sanitation. Source: PPTA socioeconomic survey.
[75] 2 days per year for each household in Mathbaria. Source: PPTA socioeconomic survey.
[76] Average GDP growth rate of GoB is 6% per annum.
[77] Monthly household income is BDT 13,167 in Galachipa. Source: PPTA socioeconomic survey.
[78] Monthly household expenditure on health is BDT 1,533; 30% of this attributed to sanitation in Pirojpur. Source: PPTA socioeconomic survey.
[79] 1.8 days per year for each household. Source: PPTA socioeconomic survey.
[80] Average GDP growth rate of GoB is 6% per annum.
[81] Number of vehicles per day on project roads has been assumed to be 83 four wheeler, 150 motorized rickshaw, 900 two wheeler, 113 bus and 75 trucks in Amtali.
[82] Savings in VOC has been assumed at BDT 10 per vehicle for car, BDT 4 per vehicle for motorized rickshaw, BDT 1.5 per vehicle for two wheelers, BDT 13 per vehicle for buses and BDT 16 per vehicle for trucks.
[83] Savings in time assumed to be 5 minutes and earnings per kilometre assumed to be BDT 14 based on an average monthly HH income of BDT 13,841 in Amtali as per PPTA socioeconomic survey.
[84] In the initial five years 5% per year, followed by 4% per year for next five years, then 3% per year for the next five years and 2% per year thereafter of project roads are expected to be affected. Damage benefits based on the 2013 estimated construction cost duly increased by 2% real increase every year.
[85] Average GDP growth rate of GoB is 6% per annum.

pourashava was based on the estimated number of vehicles [86] in the subproject area. Two main benefits are envisaged under this subproject: (i) vehicle operating cost (VOC) savings[87] and (ii) income increase[88] based on less time spent commuting on improved project roads. In addition, the climate resilience measures will ensure that road damages[89] due to floods is prevented. Benefits are adjusted for real GDP growth rate of 2% per annum over the analysis period.[90]

17.   **Mathbaria.** In the absence of traffic count/surveys, the number of vehicles in the *pourashava* was based on the estimated number of vehicles[91] in the subproject area. Two benefits are envisaged under this subproject: (i) vehicle operating cost savings (VOC)[92] and (ii) income increase[93] based on less time commuting on improved project roads. In addition, climate resilience measures will ensure that road damages[94] due to flooding is prevented. Benefits are adjusted for real GDP growth rate of 2% per annum over the analysis period.[95]

18.   **Pirojpur.** In the absence of traffic count/surveys, the number of vehicles in the *pourashava* was based on the estimated number of vehicles[96] in the subproject areas. Two benefits are envisaged under this subproject: (1) vehicle operating cost savings (VOC)[97] and (ii) income increase[98] based on less time spent commuting on improved project roads. In addition, climate resilience measures will ensure that road damages[99] due to flooding is prevented. Benefits are adjusted for real GDP growth rate of 2% per annum over the analysis period.[100]

e. Valuation of benefits – bridges

19.   **Mathbaria.** The number and category of vehicles[101] to use these bridges has been

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[86] Number of vehicles per day on project roads has been assumed to be 45 four wheeler, 64 motorized rickshaw, 300 two wheeler, 2 bus and 20 trucks in Galachipa.

[87] Savings in VOC has been assumed at BDT 10 per vehicle for car, BDT 4 per vehicle for motorized rickshaw, BDT 1.5 per vehicle for two wheelers, BDT 13 per vehicle for buses and BDT 16 per vehicle for trucks.

[88] Savings in time assumed to be 5 minutes and earnings per kilometre assumed to be BDT 13 based on an average monthly HH income of BDT 13,167 in Galachipa as per PPTA socioeconomic survey.

[89] In the initial five years 5% per year, followed by 4% per year for next five years, then 3% per year for the next five years and 2% per year thereafter, of project roads are expected to be affected. Damage benefits based on the 2013 estimated construction cost duly increased by 2% real increase every year.

[90] Average GDP growth rate of GoB is 6% per annum.

[91] Number of vehicles per day on project roads has been assumed to be 10 four wheelers, 88 motorized rickshaws, 2,000 two wheelers, 100 buses and 60 trucks in Mathbaria.

[92] Savings in VOC has been assumed at BDT 10 per vehicle for cars, BDT 4 per vehicle for motorized rickshaws, BDT 1.5 per vehicle for two wheelers, BDT 13 per vehicle for buses and BDT 16 per vehicle for trucks.

[93] Savings in time assumed to be 5 minutes and earnings per kilometre assumed to be BDT 22 based on an average monthly HH income of BDT 21,744 in Mathbaria as per PPTA socioeconomic survey.

[94] In the initial five years 5% per year, followed by 4% per year for next five years, then 3% per year for the next five years and 2% per year thereafter, of project roads are expected to be affected. Damage benefits based on the 2013 estimated construction cost duly increased by 2% real increase every year.

[95] Average GDP growth rate of GoB is 6% per annum.

[96] Number of vehicles per day on project roads has been assumed to be 70 four wheelers, 28 motorized rickshaws, 665 two wheelers, 88 buses and 70 trucks in Pirojpur.

[97] Savings in VOC has been assumed at BDT 10 per vehicle for cars, BDT 4 per vehicle for motorized rickshaws, BDT 1.5 per vehicle for two wheelers, BDT 13 per vehicle for buses and BDT 16 per vehicle for trucks.

[98] Savings in time assumed to be 5 minutes and earnings per kilometre assumed to be BDT 15 based on an average monthly HH income of BDT 14,620 in Pirojpur as per PPTA socioeconomic survey.

[99] In the initial five years 5% per year, followed by 4% per year for next five years, then 3% per year for the next five years and 2% per year thereafter, of project roads are expected to be affected. Damage benefits based on the 2013 estimated construction cost duly increased by 2% real increase every year.

[100] Average GDP growth rate of GoB is 6% per annum.

[101] Number of vehicles per day on Mathbaria project bridges has been assumed to be 20 four wheelers, 200 motorized rickshaws and 250 two wheelers.

estimated. Two benefits are envisaged under this subproject: (i) vehicle operating cost savings (VOC)[102] and (ii) income increase[103] based on less time spent commuting on the new bridges. At present automated vehicles are not able to use bridges because the load capacity is insufficient. Benefits are adjusted for real GDP growth rate of 2% per annum over the analysis period.[104]

20.   **Pirojpur.** The number and category of vehicles[105] to use these bridges has been estimated. Two benefits are envisaged under this subproject: (i) vehicle operating cost savings (VOC)[106] and (ii) income increase[107] based on less time spent commuting due to use of bridges. At present automated vehicles are not able to use bridges because the load capacity is insufficient. Benefits are adjusted for real GDP growth rate of 2% per annum over the analysis period.[108]

f. Cyclone shelters

21.   **Amtali.** Two benefits are envisaged under this subproject: increased income[109] and (ii) reduced medical costs[110] based on reduced number of sick days[111] caused by improper or inadequate sanitation. Technical models used by the PPTA consultants show that climate change impacts will result in an estimated two cyclones per year in the project area. Benefits are adjusted for real GDP growth rate of 2% per annum over the analysis period.[112]

22.   **Galachipa.** Two benefits are envisaged under this subproject: income increase[113] and (ii) reduced medical costs[114] based on reduced number of sick days [115] caused by improper or inadequate sanitation. Technical models used by the PPTA consultants show that climate change impacts will result in an estimated two cyclones per year in the project area. Benefits are adjusted for real GDP growth rate of 2% per annum over the analysis period.[116]

23.   **Mathbaria.** Two benefits are envisaged under this subproject: (i) income increase[117] and (ii) reduced medical costs[118] based on reduced number of sick days [119] caused by improper or inadequate sanitation. Technical models used by the PPTA consultants show that climate

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[102] Savings in VOC has been assumed at BDT 10 per vehicle for cars, BDT 4 per vehicle for motorized rickshaws and BDT 1.5 per vehicle for 2-wheelers.

[103] Savings in time assumed to be 8.5 minutes and earnings per kilometre assumed to be BDT 22 based on an average monthly HH income of BDT 21,744 in Pirojpur as per PPTA socioeconomic survey.

[104] Average GDP growth rate of GoB is 6% per annum.

[105] Number of vehicles per day on Pirojpur project bridges has been assumed to be 5 four wheelers, 75 motorized rickshaws and 150 two wheelers.

[106] Savings in VOC has been assumed at BDT 10 per vehicle for cars, BDT 4 per vehicle for motorized rickshaws and BDT 1.5 per vehicle for two wheelers.

[107] Savings in time assumed to be 9 minutes and earnings per kilometre assumed to be BDT 15 based on an average monthly HH income of BDT 14,620 in Pirojpur as per PPTA socioeconomic survey.

[108] Average GDP growth rate of GoB is 6% per annum.

[109] Monthly household income is BDT 13,841 in Amtali. Source: PPTA socioeconomic survey.

[110] Saved expenditure on health is BDT 1,097 per household.

[111] 15 days loss of income is assumed to be saved by 1,800 households in Amtali.

[112] Average GDP growth rate of GoB is 6% per annum.

[113] Monthly household income of BDT 13,167 in Galachipa. Source: PPTA socioeconomic survey.

[114] Saved expenditure on health is BDT 1,126 per household.

[115] 15 days loss of income is assumed to be saved 1,900 household in Galachipa.

[116] Average GDP growth rate of GoB is 6% per annum.

[117] Monthly household income is BDT 21,744 in Mathbaria. Source: PPTA socioeconomic survey.

[118] Saved expenditure on health is BDT 1,061 per household.

[119] 15 days loss of income is assumed to be saved by 1,800 households in Mathbaria.

change impacts will result in an estimated two cyclones per year in the project area. Benefits are adjusted for real GDP growth rate of 2% per annum over the analysis period[120].

24. **Pirojpur.** Two benefits are envisaged under this subproject: (i) income increase[121] and (ii) reduced medical costs[122] based on reduced number of sick days[123] caused by improper or inadequate sanitation. Technical models used by the PPTA consultants show that climate change impacts will result in an estimated two cyclones per year in the project area. Benefits are adjusted for real GDP growth rate of 2% per annum over the analysis period.[124]

C.   SUMMARY OF SENSITIVITY ANALYSIS

25.   Table 2 below summarizes the sensitivity analysis by subproject. The analysis shows that all subprojects are robust even with a 20% increase in costs and a 20% decrease in benefits.

Table 2: Sensitivity Analysis

Project Component	NPV ($ million)	EIRR (%)	B/C
Drainage sub-project			
Base case	13.337	32.0	2.6
20% increase in costs	11.727	27.1	2.2
20% decrease in benefits	9.060	26.1	2.1
Roads sub-project			
Base case	5.670	21.7	1.7
20% increase in costs	4.214	18.3	1.5
20% decrease in benefits	2.962	17.4	1.3
Bridges sub-project			
Base case	0.418	21.8	1.8
20% increase in costs	0.315	18.4	1.5
20% decrease in benefits	0.231	17.7	1.4
Water sub-project			
Base case	2.347	15.6	1.4
20% increase in costs	0.718	12.9	1.2
20% decrease in benefits	0.758	13.2	1.1
Sanitation sub-project			
Base case	1.363	25.7	1.8
20% increase in costs	1.139	21.9	1.6
20% decrease in benefits	0.867	21.1	1.4
Cyclone Shelters sub-project			
Base case	2.075	19.6	1.6
20% increase in costs	1.402	16.4	1.4
20% decrease in benefits	0.968	15.7	1.3

B/C = benefits/costs, EIRR = economic internal rate of return, NPV = net present value.
Source: ADB Estimates.

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[120] Average GDP growth rate of GoB is 6% per annum.
[121] Monthly household income is BDT 14,620 in Pirojpur. Source: PPTA socioeconomic survey.
[122] Saved expenditures on health are BDT 1,533 per household.
[123] 15 days loss of income is assumed to be saved by 2200 household in Pirojpur.
[124] Average GDP growth rate of GoB is 6% per annum.