ADB | Japan Fund for Poverty Reduction

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# TA-8128 BAN (PPTA): Preparing Coastal Towns Infrastructure Improvement Project

## DRAFT FINAL REPORT
## VOLUME 4: ANNEX - CLIMATE CHANGE ASSESSMENT AND ADAPTATION STRATEGY

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## Cover Photographs

| | |
|---|---|
| Latrine, Amtali Pourashava | Damaged outfall flapgate, Galachipa Pourashava |
| Possible site for boat landing station, Pirojpur Pourashava | Water supply pond, and pond sand filter unit, Mathbaria Pourashava |

## This report consists of six volumes:

| | |
|---|---|
| Volume 1 | Main Report |
| Volume 2 | Additional Appendices |
| Volume 3 | Project Administration Manual |
| **Volume 4** | **Annex: Climate Change Assessment and Adaptation Strategy** |
| Volume 5 | Annex: Infrastructure, Water Resources |
| Volume 6 | Annex: Financial and Economic Analyses |

# PREPARING COASTAL TOWNS INFRASTRUCTURE IMPROVEMENT PROJECT PPTA - TA-8128 BAN

## DRAFT FINAL REPORT

## VOLUME 4: CLIMATE CHANGE ASSESSMENT AND ADAPTATION STRATEGY

## List of Contents


| | | | Page |
|---|---|---|---|
| | Glossary of Bangladeshi Terms | | iii |
| | Acronyms | | iii |
| | Location Map | | viii |
| | **Executive Summary** | | **I** |
| **I.** | **Strategy for Climate Change Adaptation in Bangladesh Coastal Towns** | | **1** |
| | I.1 | Approach for Climate Risk Screening in CTIIP | 1 |
| | I.2 | Incorporating Findings into Project Design | 4 |
| | I.3 | Methodology | 4 |
| **II.** | **Climate Change Scenarios** | | **11** |
| | II.1 | Current Climate of Bangladesh | 11 |
| | II.2 | Tropical Depressions and Cyclones | 14 |
| | II.3 | Storm Surges | 16 |
| | II.4 | Current Climate Change | 17 |
| | II.5 | Climate Change Projections and their Utility for CTIIP | 21 |
| **III.** | **Climate Change Vulnerabilities and Impacts** | | **30** |
| | III.1 | Introduction | 30 |
| | III.2 | Climate Risks to Coastal Towns | 30 |
| | III.3 | Flooding: Inundation Surveys and Maps | 31 |
| | III.4 | Possible Inundation based on Model Design Storms for 2012 and 2050 and Drainage Congestion | 40 |
| | III.5 | Analysis of Cyclone Impacts | 46 |
| | III.6 | Saline Intrusion | 50 |
| | III.7 | Climate Change Adaptation for Coastal Towns | 52 |
| **IV.** | **Climate Resilience Cost and Benefit Assessment** | | **55** |
| | IV.1 | Scenarios for Cost:Benefit Assessment of the Climate Resilience Measures for Infrastructure | 55 |
| | IV.2 | What Impacts can be Quantitatively and Economically Assessed | 57 |
| | IV.3 | Social Costs and Benefits | 62 |
| | IV.4 | Environment Costs and Benefits | 78 |
| | IV.5 | Economic Costs and Benefits | 86 |
| | IV.6 | Vulnerability Reduction Credit Analysis | 96 |

**V. Community Perceptions of Climate Change and Disaster Risk in Study Pourashavas** **102**
V.1 Introduction 102
V.2 Methodology 102
V.3 Mathbaria 104
V.4 Amtali 110
V.5 Pirojpur 118
V.6 Galachipa 120

**VI. Guidelines for Mainstreaming Climate Change into Infrastructure Designs** **122**
VI.1 Introduction 122
VI.2 Climate Impact Assumptions 122
VI.3 Adaptation 127

**VII. Guidelines for Mainstreaming Climate Change into Urban Planning** **140**
VII.1 The Urban Planning Approach to Climate Change Resilience 140
VII.2 Urban Master/ Land Use Plans 141
VII.3 Planning and Building Control 145
VII.4 Prioritizing and Programming Climate Resilient Infrastructure Investments 149

**Appendix 1: Economic Analysis Spreadsheets** **152**

**Appendix 2: Developing Climate Change Resilient Master Plans** **293**

**Appendix 3: Indicative Framework for Development of a Municipal Investment Plan** **297**

## GLOSSARY OF BANGLADESHI TERMS

| | |
|---|---|
| *crore* | 10 million (= 100 lakh) |
| *ghat* | boat landing station |
| *hartal* | nationwide strike/demonstration called by opposition parties |
| *khal* | drainage ditch/canal |
| *khas, khash* | belongs to government (e.g. land) |
| *katcha* | poor quality, poorly built |
| *lakh, lac* | 100,000 |
| *madrasha* | Islamic college |
| *mahalla* | community area |
| *mouza* | government-recogized land area |
| *parashad* | authority (pourashava) |
| *pourashava* | municipality |
| *pucca* | good quality, well built, solid |
| *thana* | police station |
| *upazila* | subdistrict |

## ACRONYMS

| | |
|---|---|
| ABD | Asian Development Bank |
| ADP | annual development plan |
| ADSL | Associates for Development Services |
| AIFC | average incremental financial cost |
| AP | affected person (resettlement) |
| | |
| BBS | Bangladesh Bureau of Statistics |
| BC | bitumous carpeting |
| BCCRF | Bangladesh Climate Change Resilience Fund |
| BDT | Bangladesh Taka |
| bgl | below ground level |
| BLS | boat landing station |
| BMD | Bangladesh Meteorological Department |
| BMDF | Bangladesh Municipal Development Fund |
| BMGF | Bill and Melinda Gates Foundation |
| BRAC | Bangladesh Rural Advancement Committee |
| BRM | Bangladesh Resident Mission (ADB) |
| BT | bitumen topped (road) |
| BUET | Bangladesh University of Engineering and Technology |
| BWDB | Bangladesh Water Development Board |
| | |
| CAG | Comptroller and Auditor General |
| CAGR | compounded annual growth rate |
| CARE | An NGO |
| CBO | community-based organization |
| CC | city corporation; cement concrete; climate change |
| CCA | climate change adaptation |
| CCF | Climate Change Fund |
| CCR | climate change resilience |
| CCRIP | Climate Change Resilient Infrastructure Project |
| CDIA | Cities Development Initiative for Asia |
| CDMP | Comprehensive Disaster Management Programme |
| CDTA | capacity development technical assistance |
| CEIP | Coastal Embankment Improvement Program |
| CEP | Coastal Embankment Project |
| CLTS | Community-Led Total Sanitation |
| CQS | Consultants' Qualification Selection |
| CTIIP | Coastal Towns Infrastructure Improvement Project |

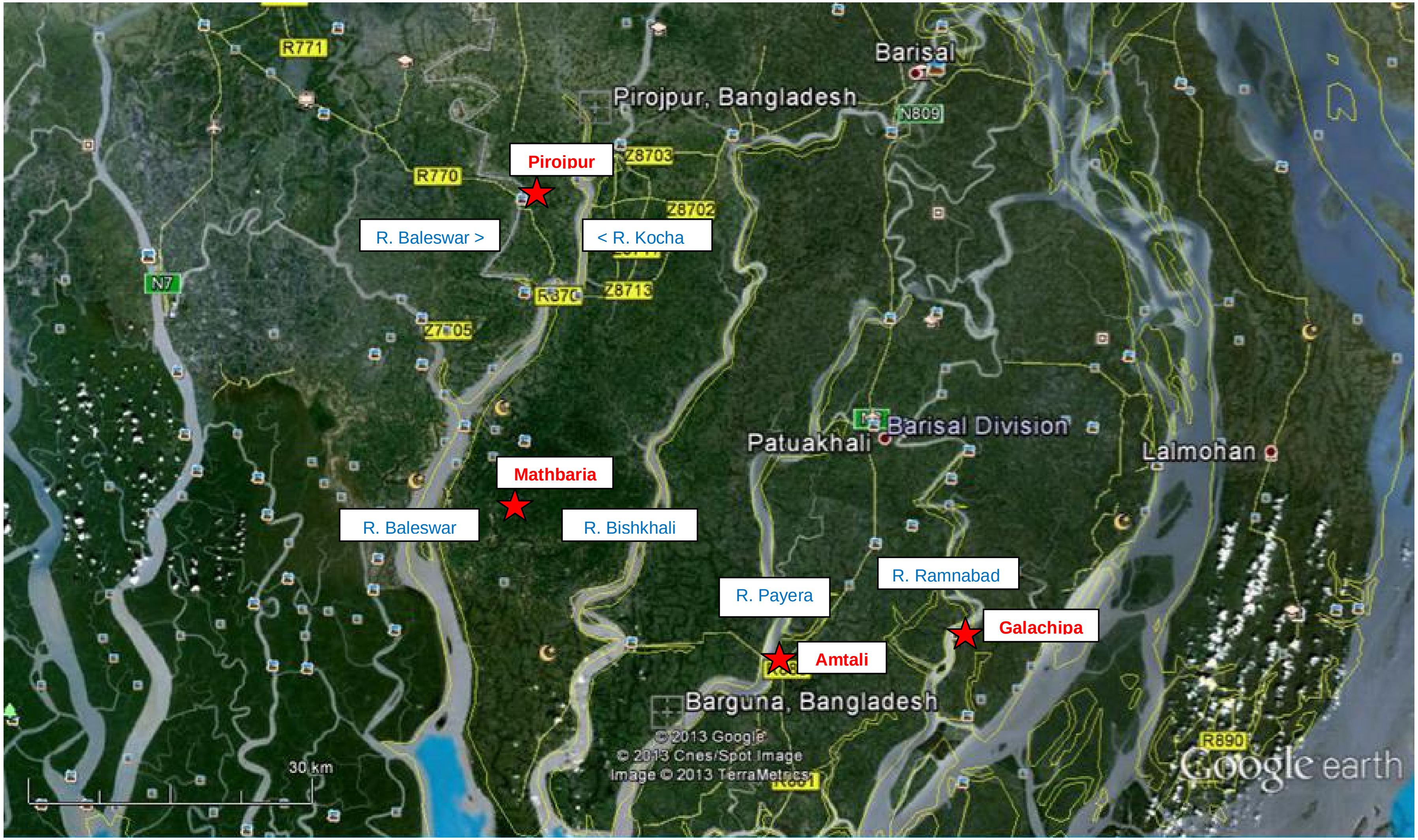
| | |
|---|---|
| CUIDG | |
| DANIDA | Danish International Development Agency |
| DED | detailed engineering design |
| DEM | digital elevation models |
| DEWATS | decentralized wastewater treatment system |
| DFID | Department for International Development (UK) |
| DFR | draft final report |
| DM | disaster management |
| DMC | developing member country |
| DMF | design and monitoring framework |
| DP | development partner |
| DPHE | Department of Public Health Engineering |
| DPP | development project proforma |
| DRM | disaster risk management |
| DRR | disaster risk reduction |
| DSCR | debt service coverage ratio |
| DSK | Dushthya Shasthya Kendra (an NGO) |
| DSP | deep set pump (in tubewell) |
| DTIDP | District Towns Infrastructure Development Project |
| DWASA | Dhaka Water Supply and Sanitation Authority |
| EA | executing agency |
| EARF | environmental assessment review framework |
| EIA | environmental impact analysis |
| EIRR | economic internal rate of return |
| EMP | environmental management plan |
| EOCC | economic opportunity cost of capital |
| EU | European Union |
| FAPAD | Foreign Aided Project Audit Directorate |
| FGD | focus group discussion |
| FMAQ | financial management assessment questionnaire |
| forex | foreign exchange |
| FS | feasibility study |
| FY | fiscal year (1 July – 30 June) |
| GBM | Ganges-Brahmaputra-Meghna river basin |
| GCM | General Circulation Model |
| GHG | greenhouse gas |
| GHK | GHK Consulting Limited (ICF GHK) |
| GIS | geographic information system |
| GIZ | German Society for International Cooperation |
| GOB | Government of Bangladesh |
| HBB | herring bone bond (road) |
| HH | household |
| IA | implementing agency |
| ICB | international competitive bidding |
| IEC | information-education-communication |
| IEE | initial environmental examination |
| IIED | International Institute of Economic Development |
| IOL | inventory of losses |
| IPCC | International Panel on Climate Change |
| IPPF | indigenous peoples planning framework |
| IT | information technology |
| IUCN | International Union for Conservation of Nature |
| IWA | International Water Association |

| | |
|---|---|
| JFPR | Japan Fund for Poverty Reduction |
| JICA | Japan International Cooperation Agency |
| KfW | German development funding agency |
| KPI | key performance indicators |
| LARP | land acquisition and resettlement plan |
| LBDT | lakh Bangladesh taka (BDT100,000) |
| LDRRF | local disaster risk reduction fund |
| LGD | Local Government Division |
| LGED | Local Government Engineering Department |
| LGI | local government institution |
| LOI | letter of intent |
| LS | lump sum |
| l/s, lps | liters per second |
| MAR | managed aquifer recharge |
| MBDT | million Bangldesh taka |
| MCA | multi-criteria analysis |
| MDG | Millennium Development Goals |
| M&E | monitoring and evaluation |
| MFF | Multitranche Financing Facility (ADB) |
| MHRW | Ministry of Housing and Public Works |
| MIDP | municipal infrastructure development plan |
| MIS | management information system |
| MLD | million liters per day |
| MLGRDC | Ministry of Local Government, Rural Development, and Cooperatives |
| MODMR | Ministry of Disaster Management and Relief |
| MOE | Ministry of Education |
| MOF | Ministry of Finance |
| MOU | memorandum of understanding |
| MSP | Municipal Services Project |
| MTBF | Medium Term Budget Framework |
| NAPA | National Adaptation Program of Action |
| NCB | national competitive bidding |
| NGO | non-government organization |
| NIRAPAD | Network for Information, Response and Preparedness Activities on Disaster |
| NPDM | National Plan for Disaster Management |
| NPV | net present value |
| NRW | non-revenue water |
| OCR | Ordinary Capital Resources (ADB) |
| ODA | official development assistance |
| OHT | overhead tank |
| OJT | on-the-job training |
| O&M | operation and maintenance |
| PAM | project administration manual (ADB) |
| PD | project director |
| PDA | project design advance |
| PDP | pourashava development plan |
| PIU | project implementation unit |
| PMO | project management office |
| PMU | project management unit |
| PPCR | Pilot Program for Climate Resilience |
| PPMS | project performance management system |
| PPP | public-private partnership |
| PPTA | project preparatory technical assistance |

| | |
|---|---|
| PRA | participatory rural appraisal |
| PSF | pond sand filter |
| PSU | pourashava sanitation unit |
| PWD | Public Works Department (datum) |
| | |
| QC | quality control |
| QCBS | Quality- and Cost-Based Selection |
| QM | quality management |
| | |
| RAJUK | Rajdhani Unnayan Katripakkha |
| RCC | reinforced cement concrete |
| RF | resettlement framework |
| ROW | right of way |
| R&R | resettlement and rehabilitation |
| RRP | report and recommendation of the president (ADB) |
| RSC | rural sanitation center |
| | |
| SCF | Strategic Climate Fund (ADB) |
| SDP | sector development plan |
| SEWTPS | socioeconomic and willingness-to-pay survey |
| SFYP | (Bangladesh) Sixth Five-Year Plan |
| SIDA | Swedish International Development Agency |
| SLR | sea level rise |
| SPA | social poverty assessment |
| SPCR | Strategic Program for Climate Resilience (GOB, 2010) |
| SPEC | Special Project Evaluation Committee |
| SPS | Safeguard Policy Statement (ADB) |
| SST | sea surface temperature |
| STWSSSP | Secondary Towns Water Supply and Sanitation Sector Project |
| SWM | solid waste management |
| SWOT | strength-weakness-opportunities-threat (analysis) |
| SWTP | surface water treatment plant |
| | |
| TA | technical assistance |
| TNA | training needs assessment |
| TOR | terms of reference |
| TOT | training-of-trainers |
| TRM | tidal river management |
| | |
| UDD | Urban Development Directorate, Ministry of Housing and Public Works |
| UFW | unaccounted-for water |
| UGIAP | urban governance improvement action plan |
| UGIIP | Urban Governance Infrastructure Improvement Project |
| ULB | urban local body |
| UNDP | United Nations Development Programme |
| UNFRA | United Nations Food Relief Agency |
| UN-HABITAT | United Nations agency for human settlements |
| UNICEF | United Nations Children's Fund |
| UP | union parashad |
| UPPRP | Urban Partnerships for Poverty Reduction Project |
| USAID | United States Agency for International Development |
| UTIDP | Upazila Towns Infrastructure Development Project |
| | |
| V | variation (contract) |
| VRC | vulnerability reduction credit (climate change adaptation) |
| | |
| WACC | weighted average cost of capital |
| WAPDA | Water and Power Development Authority |
| WARPO | Water Resources Planning Organization |
| WASH | water, sanitation and hygiene |

| | |
|---|---|
| watsan | water and sanitation |
| WB | World Bank |
| WFPF | Water Financing Partnership Facility (Netherlands Trust Fund) |
| WHO | World Health Organization |
| WQ | water quality |
| WRM | water resources management |
| WS | water supply |
| WSP | water service provider |
| WSP-EAP | Water and Sanitation Program – East Asia Pacific |
| WSS | water supply and sanitation |
| WSUP | Water and Sanitation for Urban Poor |
| WTP | willingness-to-pay |
| WWTP | wastewater treatment plant |

## LOCATION MAP




★ **Study town**

# CLIMATE CHANGE ASSESSMENT AND ADAPTATION STRATEGY

# EXECUTIVE SUMMARY

1. The Coastal Towns Infrastructure Improvement Project (CTIIP) is a mainstream urban sector investment project, and the project's climate adaptation assessment and strategy is to "mainstream" climate change. CTIIP will attempt to, in addition to "climate proofing" infrastructure investments, take a vulnerability-based view, where, in addition to climate-proofing, development is deliberately aimed at reducing vulnerability, including "creating an enabling environment by removing existing financial, legal, institutional, and knowledge barriers to adaptation and strengthening the capacity of people and organizations to adapt."[1]

2. CTIIP seeks funding from the Pilot Program for Climate Resilience (PPCR) to support the "additional costs and risks associated with integrating climate risk and resilience in core development activities, which adversely affect the viability of investments."[2] The CTIIP climate assessment will enable PPCR funding by justifying these incremental costs, and also integrate PPCR's results framework and indicators into the CTIIP investment and monitoring and evaluation plan.

3. Based on the CDTA report and several other projects and studies, the PPTA undertook a comprehensive review of the current and projected climate, the impacts this will have on coastal towns and infrastructure, identified options to reduce these impacts through the CTIIP investment, assessed the costs and benefits of these measures, and came up with a comprehensive set of climate resilient measures to be implemented by the project. The sections below summarize this work.

4. **Current and projected climate change.** Bangladesh annually receives on average 2286 mm of rainfall, with a standard deviation of 286 mm. The seasonal distribution shows that most of the rainfall occurs in the monsoon season amounting to 1616 mm /year which is 70.7% of the annual rainfall.

5. Tropical cyclones form in the Bay of Bengal mostly in the months of April-May and October-December. Bangladesh's coastal zone is vulnerable to these tropical cyclones and associated storm surges which cause irreparable damages to people, and the economy and ecology of the affected areas.

6. The country average minimum and maximum temperature shows that the minimum temperature has been increasing at the rate of 0.0094$^{o}$C/year and the maximum temperature increasing at the rate of 0.007$^{o}$C/year [Singhvi et al., 2010].[3] Rainfall exhibits increasing trends in all the seasons. The temperature over the study towns is also increasing by around 0.07-0.15 C/decade for minimum temperatures and 0.07-0.38 C for maximum temperatures. Monsoon rainfall has a trend of increasing by around 4.5-13.5%, which appears to be very high. The observation shows that the coastal zone has current sea level rise (SLR) of 4.0 mm in the western coast, 6.0 mm in the Meghna estuary and 7.8 mm/year in the western coast at Cox's Bazar, which is the net SLR comprising SLR due to global warming and local factors

[1] Klein, R.T.J., 2010. Mainstreaming Climate Adaptation into Development: A Policy Dilemma. In Ansohn, A., and Pleskovic, B. *Climate Governance and Development.* The World Bank.

[2] Climate Investment Funds, 2010, "Pilot Program on Climate Resilience (PPCR): Financing Modalities," June 15, 2010.

[3] Singhvi, A. K., Rupakumar, K., Thamban, M., Gupta, A. K., Kale, V.S., Yadav, R. R., Bhattacharyya, A., Phadtare, N. R., Roy, P. D., Chauhan, M. S., Chauhan, O. S., Chakravo rty, S., Sheikh, M.M., Manzoor, N., Adnan, M., Ashraf, J., Arshad, A. M. K., Quadir, D. A., Devkota, L. P., and Shrestha, A. B., 2010, Instrumental, terrestrial and marine records of South Asia during the Holocene. In: Global Environmental Changes in South Asia: A regional Perspective ( A. P. Mitra and C. Sharma ed.),54-124.

of land subsidence and sedimentation.

7. Projections of temperature and rainfall were reconstructed from the results obtained by Tanner et al. (2007),[4] showing the following changes for A2 and B1 emission scenarios:

- *Annual temperature for 2030*: 0.7-1.6 $^{0}$C and for 2050:0.9-2.4$^{0}$C
- *Monsoon rainfall for 2030*: 13-19 % and for 2050:19-25 %
- *Net SLR relative to coastal lands within the polder for 2030*: 11-29cm and 2050:17.5-39 cm.

8. The PPTA findings show that the intensity of tropical cyclones will increase with the rise of sea surface temperature (SST). As a result, the probability of higher category cyclones is expected to increase significantly for the south-central coastal region by 2040-2050 **(Table ES.1)**.

**Table ES.1: Projection of Probability of Tropical Cyclones for the Future for Different Intensity Levels for the South-Central Coast Region covering the Study Pourashavas**

| Projection of probability of tropical cyclone incidence for future | | | | |
|---|---|---|---|---|
| **Categories** | **2011-2020** | **2021-2030** | **2030-2040** | **2040-2050** |
| Tropical Cyclonic storms Cat-0 ( 62-117 km/hr) | 0.2 | 0.2 | 0.1 | 0.05 |
| Cat-1 (118-153 km/hr) | 0.1 | 0.05 | 0.1 | 0.1 |
| Cat-2 (154-177 km/hr) | 0.1 | 0.05 | 0.05 | 0.1 |
| Cat-3 (178-207 km/hr) | 0.1 | 0.05 | 0.1 | 0.1 |
| Cat-4 (208-251 km/hr) | 0.1 | 0.2 | 0.2 | 0.15 |
| Cat-5 km/hr (speed>250 km/hr) | 0.05 | 0.1 | 0.1 | 0.15 |

Source: PPTA Consultant.

9. **Climate vulnerabilities assessment.** CTIIP Batch 1 towns—Amtoli, Galachipa, MAthbaria and Pirojpur—are situated in the most vulnerable zone of the coast, exposed to tropical cyclones, storm surges, sea level rise and high astronomical tides. The towns experienced severe damages in past cyclones that hit the south central coast and its neighborhood coastal zone. Besides, these towns are subjected to severe risks of flooding due to heavy monsoon rainfall from tropical storms, monsoon depressions and convective activities associated with monsoon troughs. The anticipated high sea levels will pose problems for drainage of the flood water in the future as the tidal level may go so high due to sea level rise that there is chance that the lowest tide in the monsoon season may remain at higher level compared to the bed of the drainage system, resulting in long-term inundation of large areas of the towns.

10. Current and future climate will impact the infrastructure, environment, ecology, agriculture, water supply, sanitation and livelihood of the people of the areas covering the selected coastal towns. The increase in temperature has the potential to cause material expansion resulting in damages to concrete structures such as buildings, bridges, and culverts and bitumen seals to roads, which are susceptible to softening unless higher temperature resistant construction materials are used. The expansion and contraction due to high fluctuation of temperature may affect life of the structures. Floods resulting from increased rainfall, cyclones and storm surges have the potential to damage roads,

[4] Tanner T.M., Hassan A, Islam KMN, Conway, D, Mechler R, Ahmed AU, and Alam, M, 2007. ORCHID: Piloting Climate Risk Screening in DFID Bangladesh. Detail Research Report. Institute of Development Studies, University of Sussex, UK.

embankments, water supply, sanitation, markets, housing and drainage structures. SLR will increase the potential risks.

11. Based on field surveys and flood modelling, **Table ES.2** indicates that anticipated flooded areas will increase in each pourashava. Also, what is most noticeable is the increase in the area flooded more than 25 cm deep (6.5-7.6%). The cause of this increase in the flooded area is attributed to the increase of monsoon rainfall. Of course the increase of flood area is a function of the topography, but as 25 cm is the depth at which the flooding causes significant physical and economic impacts, any action that can minimise these impacts will be helpful.

12. PPTA analysis of historical cyclone damage and correlations with intensity indicate that, based on future estimates of future cyclones of different intensities, total damage from cyclone winds, rainfall and storm surges (in a business as usual scenario) could nearly double by the 2050s, as shown in **Table ES.3**.

**Table ES.2: Inundation Areas and Depths, 2012 and 2050 – Batch 1 Towns**

| Town | Flooding | 2012 | | 2050 | | Change in area (%) |
|---|---|---|---|---|---|---|
| | | Area flooded (ha) | % total area | Area flooded (ha) | % total area | |
| Amtali | not flooded | 236 | 36% | 201.4 | 31% | -5.3% |
| | flooded | 414.4 | 64% | 449.3 | 69% | 5.4% |
| | flooded 0-25 cm | 367.2 | 56% | 352.9 | 54% | -2.2% |
| | flooded >25 cm | 47.2 | 7% | 96.4 | 15% | 7.6% |
| Galachipa | not flooded | 142 | 46% | 124.3 | 40% | -5.7% |
| | flooded | 167.1 | 54% | 184.8 | 60% | 5.7% |
| | flooded 0-25 cm | 113.7 | 37% | 111.4 | 36% | -0.7% |
| | flooded >25 cm | 53.4 | 17% | 73.4 | 24% | 6.5% |
| Pirojpur (urban core catchments) | not flooded | 455.7 | 61% | 405 | 54% | -6.8% |
| | flooded | 292.4 | 39% | 343.1 | 46% | 6.8% |
| | flooded 0-25 cm | 236.7 | 32% | 238.1 | 32% | 0.2% |
| | flooded >25 cm | 55.7 | 7% | 105 | 14% | 6.6% |

**Table ES.3: Future Projection of Damages Caused by Tropical Cyclones**

(Million US$)

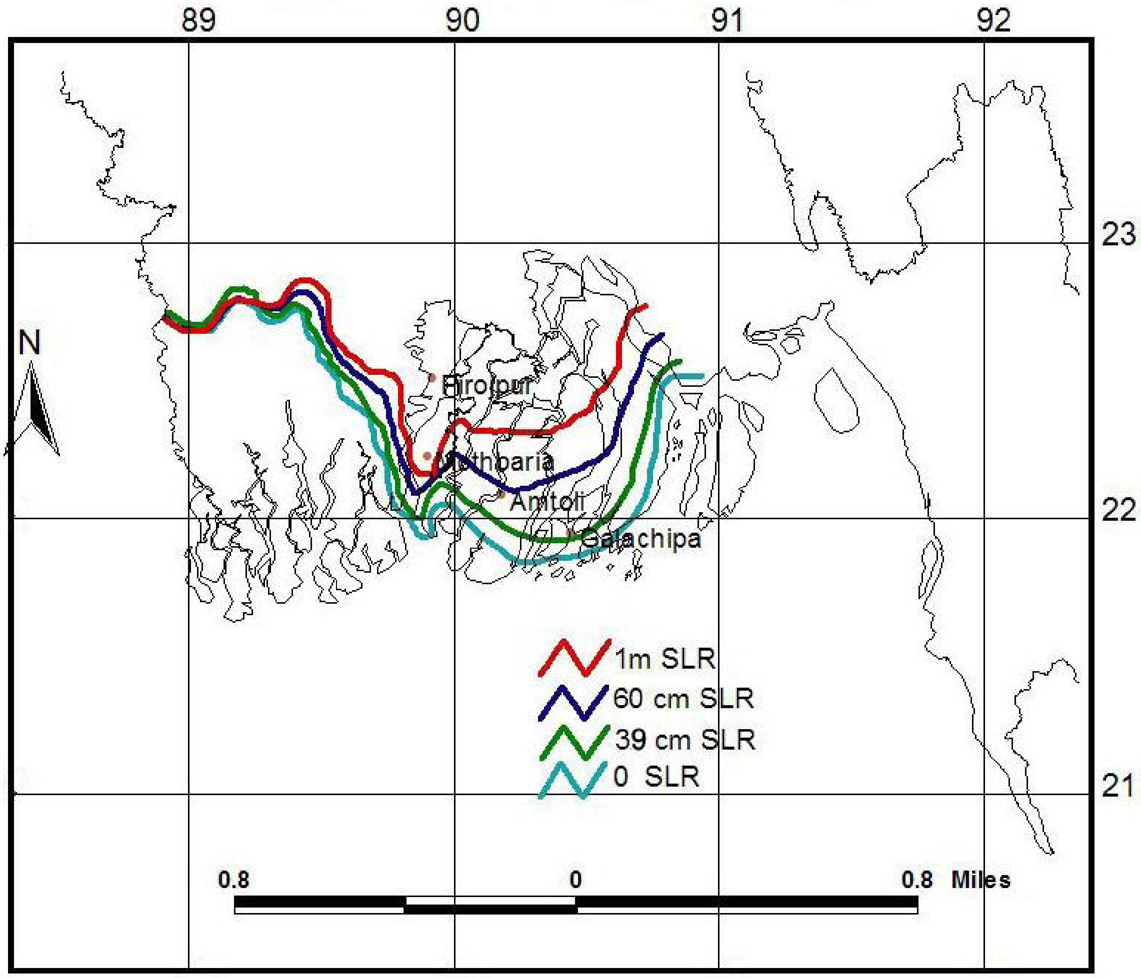
| Town | 2010 | 2020 | 2030 | 2040 | 2050 |
|---|---|---|---|---|---|
| Galachipa | 2.51 | 2.85 | 3.07 | 3.62 | 4.43 |
| Amtoli | 3.48 | 3.87 | 4.12 | 4.40 | 5.53 |
| Mothbaria | 2.65 | 3.07 | 3.34 | 3.65 | 4.95 |
| Pirojpur | 2.58 | 3.00 | 3.31 | 4.20 | 5.81 |
| Total | 12.79 | 13.83 | 15.87 | 20.71 | 21.84 |

Source: PPTA Consultant.

13. As noted in the CDTA report, saline intrusion is another threat to the coastal towns that is expected to worsen with future climate changes. Along with numerous health impacts induced by drinking saline water are hypertension, and for pregnant women pre-eclampsia, early delivery and swelling of legs (Khan et al., 2011).[5] The salinity impact on health appears to be a serious problem for the coastal zone (Khatoon and Salehin, 2012).[6]

14. The landward progression of salinity lines at 5ppt at different sea level rise scenarios from SLR of 0 cm (present), 39 cm for 2050, 60 cm for 2065 and 100 cm for 2100 is shown on **Figure ES.1**. The figure shows strong salinity intrusion by 2065 and 2100 over the central coastal zone. By 2050 Galachipa may reach 5 ppt salinity, in 2065 Amtali, Galachipa and Mothbaria will be engulfed by the 5 ppt line. Pirojpur is found to be out of danger even by 2100.

**Figure ES.1: Landward Movement of Equal Salinity Line (5 ppt) for Different Sea Level Rise Scenarios**




*(Source: Modified and redrawn from DoE, 2005 based on IWM data )*

5 Khan et al. 2011: Drinking water, salinity and maternal health in coastal Bangladesh: Implication of Climate Change. Environmental Health Perspectives 119(9):1328-1332.

6 Sayma Khatoon and Mashfique Salehin, 2012: Salinity constraints to different water uses. Bangladesh J. Sci. Res. 25 (1),33-42.

15. **Climate resilience measures.** Several design enhancements to improve infrastructure climate resilience in water supply, sanitation, drainage and flood control, and other municipal infrastructure have been prepared. In addition, TORs have been prepared for Institutional Strengthening and Awareness Building Consultants to enhance capacity in climate resilient urban planning and community preparedness for climate change **(Table ES.4)**.

**Table ES.4: Main Tasks for Strengthening Pourashava and Community Level Preparedness for Climate Change**

**Objective: Strengthen pourashava and community level preparedness for climate change, in all CTIIP towns**

| Component A | Component B | Component C | Component D |
|---|---|---|---|
| **Climate and disaster technical tools to inform adaptation and DRM decision making** | **Community-level awareness raising and warning systems for climate hazards and resilience options,** especially for the poor and marginalized | **Disaster preparedness** through support for pourashava level Disaster Risk Management Committees | Resource pro-poor, community level adaptation through **locally managed climate resilience funds** |
| **Outputs**<br>Downscaled climate model outputs<br>Improved tropical cyclone projections<br>Flood inundation monitoring and mapping<br>Cyclone and flood loss and damage assessments/tools | **Outputs**<br>Community awareness raising events<br>Fishing community early warning system<br>Community DRM hazard mapping and planning | **Outputs**<br>Orientation system for new civil servants/officials<br>Technical support for DRM Committees | **Outputs**<br>Funds Design/Management Plans<br>Locally managed funds for each subject pourashava |

16. Preliminary designs integrate a number of measures, both structural and non-structural, to mainstream climate resilience into the project investment, including:

*For water supply investments:*

- Increased water demand due to temperature rise predicted 1.2-2.4$^0$ C by 2050 has been taken into account in the water demand projection. 15% of average daily demand (ADD) has been assumed as increased water demand due to temperature rise.
- The cyclonic strong wind is taken into account for designing superstructure such as overhead tanks in order to make them strong enough to withstand.
- The upper well casing of production tube wells will be vertically extended for protection from flooding and storm surges.

- Provision for power backup (generator) to keep the water supply operational if the normal power supply gets interrupted/stopped from National Grid due to cyclones/storms.
- Protection measures (embankment with block pitching) around the water treatment plant have been kept in provision to protect from cyclone, storm, sea level rise etc.

*For sanitation investments:*

- Septic tanks and superstructures of public toilets, school toilets and community latrines will be constructed above flood level to keep protected from inundation during monsoon flooding.
- The pit of the latrine will be placed above the flood level;
- Elevated pit of about 1 m high with an impermeable lining extended down at least 0.6 m below ground level is expected;
- Cover slab with the provision of gas outlet will be placed at the top of the pit;
- Latrine platform and the pit will be separetly located;
- Latrine platform with squatting pan and water seal U-pipe will be directly connected to the pit by a junction pipe.

*For drainage and flood control:*

- Existing drains rehabilitated and capacities enhanced to 2050 projections – dredging, re-profiling, lining, etc., as appropriate.
- New drains constructed to same capacity, including reinstating and enhancing natural drainage channels, etc., wherever feasible.
- Runoff detention capacity introduced wherever feasible.
- Materials selected and construction quality monitored for increased durability, because of longer inundation periods, wastewater risks, etc.

*For roads:*

- Crest level raised 200mm above A1B[7] scenario sea levels in 234.
- Surface material all concrete with minimum thickness of 150 mm with adequate reinforcement.
- Pavements to be thickened sand aggregate. Sub-base to be 0.25 meters wider than overlying layer.
- Embankments additionally strengthened on roads in flood areas with either concrete or brick work.
- Cross drainage structures increased as necessary with full width drainage layer in sub-base. (minimum 2 per km).
- Need for larger culverts assessed.
- Strengthened abutments and approaches to bridges and culverts.

*For Cyclone Shelters:*

- Base level of first floor raised by 200mm to avoid higher storm surges.

*For Boat Landings:*

- Overall construction strengthened with allowances for greater tolerance in water level fluctuations.

[7] A1B represents a mid-range emission scenario for the future global emission of Greenhouse gases. A1B makes assumptions about future growth and development of human activities during the next century. It was used for the IPCC climate change assessments in 2007.

*For Solid Waste Management:*

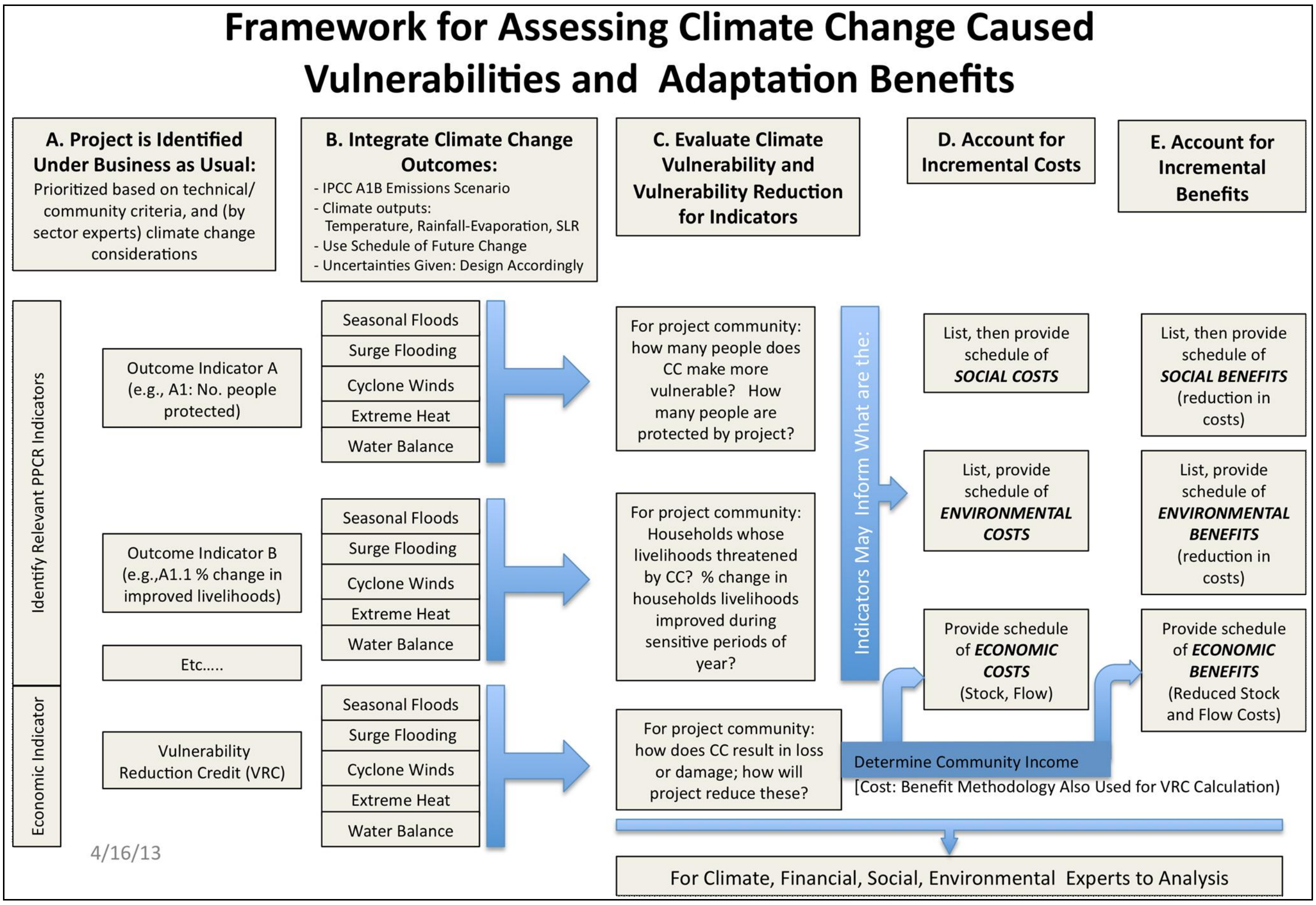
- Drainage improved to accommodate more frequent and intense rainfalls.
- Need to pump more water over landfill to avoid any heat stress.

17. **Climate damages and loss, resilience costs and benefits.** The PPTA has identified the losses and damages from climate change, and formulated a series of structural and non-structural measures to reduce these losses specifically related to climate change. The incremental costs of these measures were calculated, and then it was possible to assess both the economic, social and environmental costs and benefits of undertaking these measures. **Figure ES.2** outlines the process.

18. The PPTA evaluated the economic costs and benefits looking at both direct (stock) damage and loss, and indirect (flow) loss owing to lost productivity, health care costs, and reduced economic activity. Economic analyses were possible and performed for the water supply, sanitation, drainage and flood control, solid waster, cyclone shelter, bus terminals, markets, boat landings and road subprojects for each pourashava.

19. Social and environmental impacts of climate resilience were another priority addressed by the PPTA. While data was unavailable to quantify impacts, the consultant social safeguards and environmental specialists examined all climate resilient measures for the subprojects and articulated the potential impacts, positive and negative, from these measures.

**Figure ES.2: CTIIP Climate Assessment Framework**




Source: PPTA Consultant.

20. The analysis includes an alternative metric, based on the cost: benefit analysis but that also normalizes loss and damage for income levels. This measure, the vulnerability reduction credit (VRC), may be useful in comparing the relative scale of alternative climate resilience measures.

21. The conclusion to the environmental assessment was that climate resilience measures will benefit the general public by contributing to the long-term improvement of infrastructure and community livability in the project towns. The potential adverse environmental impacts are mainly related to the construction period, which can be minimized by mitigating measures and environmentally sound engineering and construction practices.

22. Economic costs:benefits were overall very favorable for climate resilience measures, as shown in **Table ES.5**. Proposed CTIIP infrastructure investments have uniformly attractive EIRRs. Water investments cost BDT293 million but resulted in EIRRs varying between 14 and 121%. One urban planning intervention, introducing climate resilient building codes, was assessed in aggregate for the four towns and resulted in the most significant levels of loss and damage reduction, but had a modest EIRR of 17%.

23. The vulnerability reduction credit analysis likewise showed significant VRC generation projected in each of the Batch 1 pourashavas. It is estimated that the projects in the four towns (including successful implementation of climate resilient building codes) have the potential to generate 12.5 million VRCs. The analysis assumes that VRCs are generated from the “climate resilient” measures. There is further reduction in loss or damage from the basic infrastructure investments without consideration of climate change. To be conservative in this analysis, these reductions in loss or damage are not counted as climate vulnerability reduction.[8]

24. **Figure ES.3** shows that Pirojpur generates the majority of VRCs. The largest source of VRCs generated by measure was from changes in the building codes to make buildings more climate resilient, followed by drainage and flood control **(Figure ES.4)**.

25. All of these assessments—social, environmental, economic and VRC—are just a starting point in understanding the potential impact these projects shall have in reducing climate vulnerabilities. Improved monitoring and evaluation of climate changes and impacts will result in significantly improved data to assess impact. Nonetheless, the PPTA study demonstrates the considerable benefits CTIIP project may bring.

[8] See the discussion in Chapter I on the strategy and how these base level investments may be reducing the “adaptation deficit,” a necessary, but not sufficient, precursor to reducing climate vulnerabilities.

## Table ES.5: Economic Costs:Benefits for Study Towns

| | Cumulative Project Life Loss/Damage (million BDT, no discount rate) | | | | | Cumulative Project Costs (million BDT, no discount rate) | | | Economic Returns of Project (million BDT, million USD) | | | Vulnerability Reduction Credits (VRCs) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sector | Baseline Loss/ Damage With Climate Change | Project (no climate resilience) Loss/ Damage With Climate Change | Project (with climate resilience) Loss/ Damage With Climate Change | Net Reduction in Loss/ Damage from Project (with climate resilience) | Net Reduction in Loss/ Damage from Climate Resilience Measures | Cumulative Project Costs (no climate resilience) | Cumulative Project Costs (with climate resilience) | Cumulative Incremental Costs of climate resilience | NPV of climate resilience measures | EIRR of climate resilience measures | NPV (3%, USD of climate resilience measures | Cumulative VRCs | USD/VRC |
| Water Supply | 3202562.1 | 3196492.5 | 3195237.7 | 7324.4 | 1254.8 | 1340.4 | 1565.1 | 293.8 | 746.9 | 104% | $9.60 | 1270209.3 | $2.97 |
| Sanitation | 436.7 | 53.9 | 32.3 | 404.3 | 21.6 | 89.6 | 94.7 | 4.7 | 28.9 | 172% | $0.37 | 49184.9 | $1.23 |
| Drainage/ Flood Control | 12497.4 | 4520.4 | 924.8 | 11572.6 | 3595.7 | 1276.0 | 1546.6 | 270.6 | 2250.4 | 180% | $28.92 | 3827262.9 | $0.91 |
| Solid Waste | 268.3 | 79.3 | 19.9 | 248.5 | 59.5 | 57.1 | 72.6 | 15.4 | 22.3 | 158% | $0.29 | 37980.6 | $5.22 |
| Roads | 10847.1 | 1802.1 | 768.3 | 10078.8 | 1033.8 | 1318.6 | 1530.0 | 211.4 | 389.3 | 111% | $5.00 | 662084.5 | $4.10 |
| Bridges | 2395.5 | 1590.2 | 159.1 | 2236.4 | 1431.2 | 322.8 | 355.3 | 32.5 | 923.7 | 354% | $11.87 | 1571008.5 | $0.27 |
| Cyclone Shelters | 3471.9 | 520.8 | 256.9 | 3215.0 | 263.9 | 668.8 | 746.7 | 77.5 | 253.3 | 103% | $3.26 | 430837.9 | $2.31 |
| Boat Landing Stations | 186.5 | 45.4 | 13.8 | 172.7 | 31.6 | 23.6 | 28.5 | 4.8 | 23.2 | 201% | $0.30 | 39468.9 | $1.55 |
| Markets | 530.2 | 108.8 | 39.2 | 491.0 | 69.5 | 58.6 | 67.6 | 8.9 | 59.3 | 220% | $0.76 | 100785.3 | $1.13 |
| Bus Terminal | 211.8 | 42.4 | 15.7 | 196.1 | 26.7 | 45.2 | 49.6 | 4.2 | 0.2 | 137% | $0.00 | 29559.3 | $1.82 |
| Building Codes | | | | | | | | | 2999.4 | | | 5101021.2 | $0.00 |
| Town Total: | 3233407.5 | 3205255.9 | 3197467.6 | 35939.9 | 7788.2 | 5200.7 | 6056.7 | 923.7 | 7697.0 | | $60.36 | 13119403.4 | |

**Figure ES.3:**

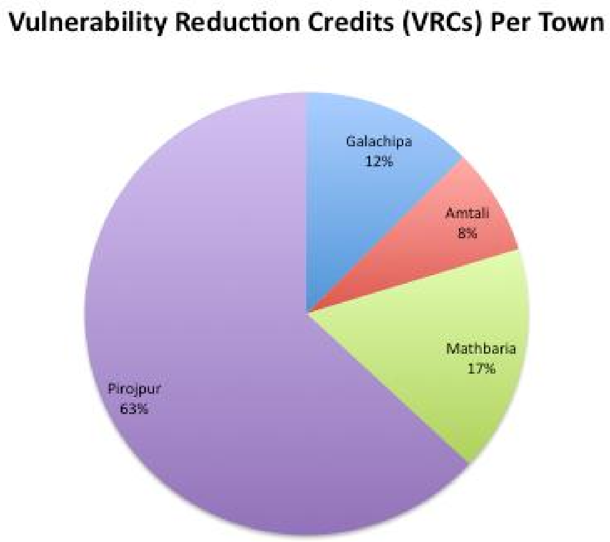
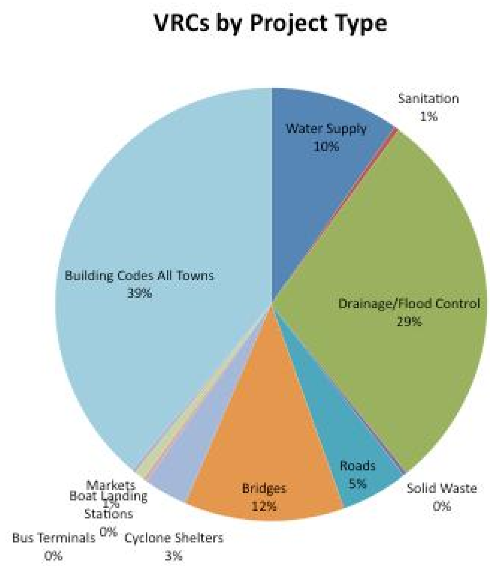



**Figure ES.4:**



# I. STRATEGY FOR CLIMATE CHANGE ADAPTATION IN BANLADESH COASTAL TOWNS

## I.1 Approach for Climate Risk Screening in CTIIP

1. CTIIP assessed the vulnerability of subject communities to future change and how the subprojects can reduce these vulnerabilities. This serves as the basis for the incremental cost: benefit analysis, and for determining the nature of the vulnerabilities and approaches to reduce these.

2. The Coastal Towns Infrastructure Improvement Project (CTIIP) is a mainstream urban sector investment project. Effectively mainstreaming climate change into this project is the challenge of the climate change assessment and adaptation strategy. Ayers et al (2013) provide this definition:

> Mainstreaming of climate change into development and/or development cooperation is the process by which development policies, programmes and projects are (re)designed and (re)organized, and evaluated from the perspective of climate change mitigation and adaptation. It means assessing how they impact on the vulnerability of people (especially the poorest) and the sustainability of development pathways—and taking responsibility to readdress them if necessary. Mainstreaming implies involving all social actors—governments, civil society, industry, and local communities—into the process. Mainstreaming calls for changes in policy as far upstream as possible.[9]

3. "Mainstreaming" climate "is seen as making more sustainable, effective and efficient use of resources than designing and managing policies separately from ongoing activities. In theory, mainstreaming should create 'no regrets' opportunities for achieving development that is resilient to current and future climate impacts for the most vulnerable groups, and avoid potential tradeoffs between adaptation and development strategies that could result in mal-adaptation in the future."[10] There are two approaches to mainstreaming:

- A technological approach ("climate proofing, or "mainstreaming minimum", ensuring that projections of climate change impacts are considered in decisions about climate investments); and,
- A vulnerability-based view, where, in addition to climate-proofing, development is deliberately aimed at reducing vulnerability, including "creating an enabling environment by removing existing financial, legal, institutional, and knowledge barriers to adaptation and strengthening the capacity of people and organizations to adapt."[11]

4. Ayers, et al argue for the second approach as superior because it addresses the "adaptation deficit" that needs to be overcome before people can adapt to future climate changes.

5. CTIIP strategy is a hybrid of the technological and the vulnerability-based approach to mainstreaming climate change into development activities. While CTIIP acknowledges that vulnerability-based mainstreaming is more robust, it also accepts that this is an aspiration

[9] Ayers, J.M, et al, 2013. "Mainstreaming climate change adaptation into development: A Case study of Bangladesh," Wiley Interdisciplinary Reviews - Climate Change.
[10] Ibid.
[11] Klein, R.T.J., 2010. Mainstreaming Climate Adaptation into Development: A Policy Dilemma. In Ansohn, A., and Pleskovic, B. *Climate Governance and Development.* The World Bank.

that, owing to institutional constraints, limitations on potential to eliminate all existing financial, legal, and institutional barriers, will only be partially met.

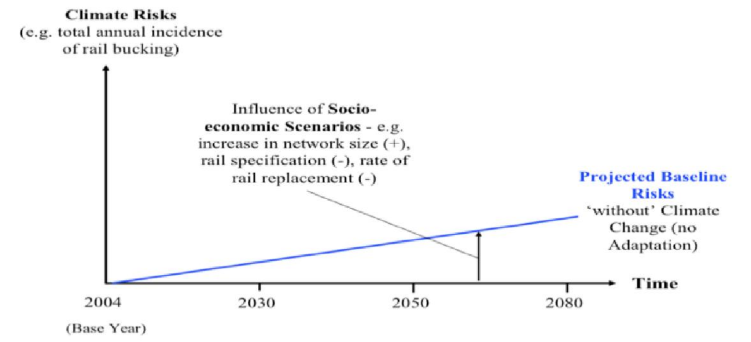
6. However, CTIIP's strategy is ambitious considering these constraints, and will, in addition to "climate proofing" the infrastructure investments, address these systemic barriers whenever possible, and take as the primary metric "human climate vulnerability", rather than simply assessing investments against climate impact avoidance.

7. The basic approach follows the principals from **Figure I.1** taken from Boyd and Hunt.[12] A baseline—first pretending that climate change will not take place—is established showing how vulnerabilities change through factors such as population increase, economic activity, etc. The assessment secondly incorporates a baseline with climate change, identifying additional community vulnerabilities (expressed in terms of anticipated loss and damage). The project then looks at how the CTIIP project - without climate resilience measures - results in changes (up or down) in climate vulnerability. Finally, the analysis looks at the CTIIP project with climate resilience to understand what climate vulnerabilities may be reduced at what incremental cost.

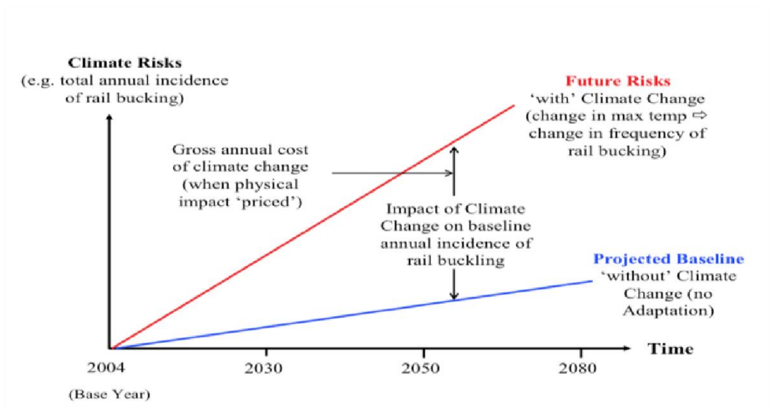
[12] Richard Boyd and Alistair Hunt, (2006) "Costing the local and regional impacts of climate change using the UKCIP Costing Methodology," paper submitted to Stern Review, Metroeconomica Limited, July 2006.

**Figure I.1**: **Steps in Estimating the Impact of Climate Change and Adaptation Measures**

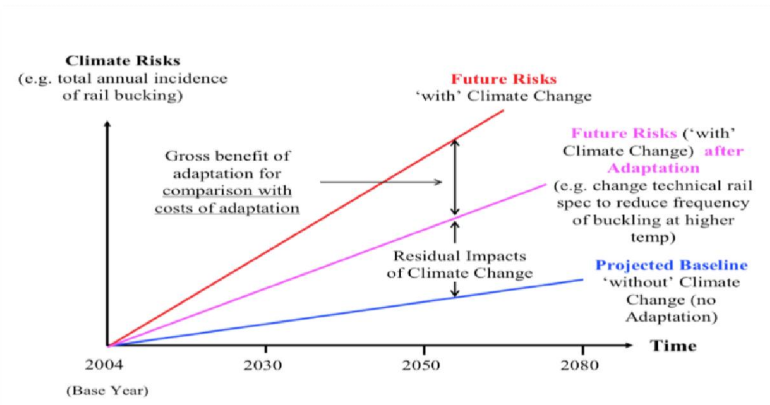
**(a) Step One: Establish the projected baseline with no planned adaptation (Future Society – Climate Today)**




**(b) Step Two: Estimate the impact of climate change with no planned adaptation (Future Society – Future Climate)**




**(c) Step Three: Estimate the change in climate risks from implementing planned adaptation policies and measures**




Source: Boyd and Hunt, 2006.

## I.2 Incorporating Findings into Project Design

8. A starting point for understanding the climate changes and their impacts on the coastal town communities was meeting with pourashava officials and experts, local non-governmental organizations, and performing survey interviews of local people, asking them how they perceive climate, its impact on their lives, and how past disasters (flooding and cyclones, most prominently) have effected them. A sample community hazard mapping exercise was undertaken with people from a vulnerable ward in each pilot town, to see how storm and other climate hazards play out geographically and how the local people interpret their vulnerabilities and needs. Further details on these activities is in Volume 5.V: Community perceptions of climate change and disaster risk in study pourashavas.

9. A critical foundation for climate resilient project design was for CTIIP to assess the current climate, climate trends, and providing a robust -enough view of the possible future climate in the coastal towns. CTIIP assessed the existing climate work (World Bank[13], CCRIP[14], and CDTA[15], among others), and performed additional work assessing:

- Inundation levels for the four pilot coastal towns, including surveying and performing GIS mapping of current and future levels with climate change,
- Cyclone intensity levels for the towns, including a statistical analysis of future intensity of cyclones based on sea surface temperatures, and creation of functions for storm intensity and damage and loss for each pilot town.
- Analysis of potential for saline intrusion in the coastal towns.

10. These climate change and climate change impacts were then provided to the subproject engineers and urban planners for use in assessing future climate vulnerabilities and to design climate resilient infrastructure. Further details of the climate analyses is in Volume 5.II, Climate Change Scenarios. Details of the climate impacts (cyclones, inundation, saline intrusion) work is in Volume 5:III: Climate Change Vulnerability Assessments).

## I.3 Methodology

11. CTIIP PPTA took a comprehensive look at existing literature on recent infrastructure and community based climate adaptation activities undertaken in Bangladesh. CTIIP also studied the literature on assessing future vulnerabilities and strategies (such as ADB's Coastal Climate Resilient Infrastructure Project - CCRIP) that outlined a strategy and outline of options for reducing climate vulnerability in its infrastructure interventions. The literature on non-structural measures, including critically, locally managed funds for climate adaptation, such as initiatives led by the Asian Coalition for Community Action Program (ACCA). A guiding document for climate scenarios, vulnerability assessments, and project design for climate resilience was the ADB CDTA Coastal Infrastructure Improvement Project.[16]

12. Based on the projected climate changes and impacts on flood levels, saline, cyclone intensity, CTIIP to a comprehensive view of subprojects and addressed climate change vulnerabilities through a combination of structural and non-structural measures. Social, environmental, and economic costs were evaluated with the support of PPTA experts in these areas. The assessment identified the appropriate Pilot Program for Climate Resilience's (PPCR) outcome indicators to articulate PPCR requirements for incremental

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[13] World Bank, 2011: The Cost of Adapting to Extreme Weather Events in a Changing Climate, BANGLADESH Development Series, Paper 28.
[14] ADB PPTA 7902-Ban, 2012: Coastal Climate Resilient Infrastructure Project (CCRIP).
[15] ADB CDTA 7890, 2013: Final Report of Coastal Infrastructure Improvement Project (CIIP).
[16] See ADB CDTA 7890, 2013: Final Report of Coastal Infrastructure Improvement Project (CIIP).

funding of the climate resilience measures.

13. CTIIP has evaluated the economic costs and benefits looking at both direct (stock) damage and loss, and indirect (flow) loss owing to lost productivity, health care costs, and reduced economic activity **(Figure I.2)**. Economic analyses were possible and performed for the water supply, sanitation, drainage and flood control, solid waster and road subprojects for each pourashava. Further detail on the assumptions and methodology is in Volume 5.IV Costs and Benefits of Climate Resilience Measures, including the cash flow EIRR analyses and the social and environmental analyses of the climate resilience measures.

14. The analysis includes an alternative metric, based on the cost: benefit metrics but that also normalizes loss and damage for income levels, the vulnerability reduction credit (VRC) that may be useful in comparing the relative scale of alternative climate resilience measures.

15. There are a number of challenges in this exercise, and not all vulnerabilities and impacts can be readily monetized or even quantified. In addition, assessing the damage and loss in economic terms is further challenging. The CDTA work was able to provide basic guidance for loss and damage owing to flooding, and some non-monetary views on damages impacting health. CTIIP employs these metrics and further quantifies and monetizes a number of impacts owing to health related costs and economic activity, vehicular operating costs and time saving, and opportunity costs of fetching water, for instance.

16. Owing to limited resources and limits to what can be quantified at this time, much vulnerability will neither be monetized nor even quantified. Cyclone shelters, for instance, do not have readily apparent economic flow streams. Of course, cyclone shelters are essential at protecting human health and life, but can the full set of benefits be monetized?

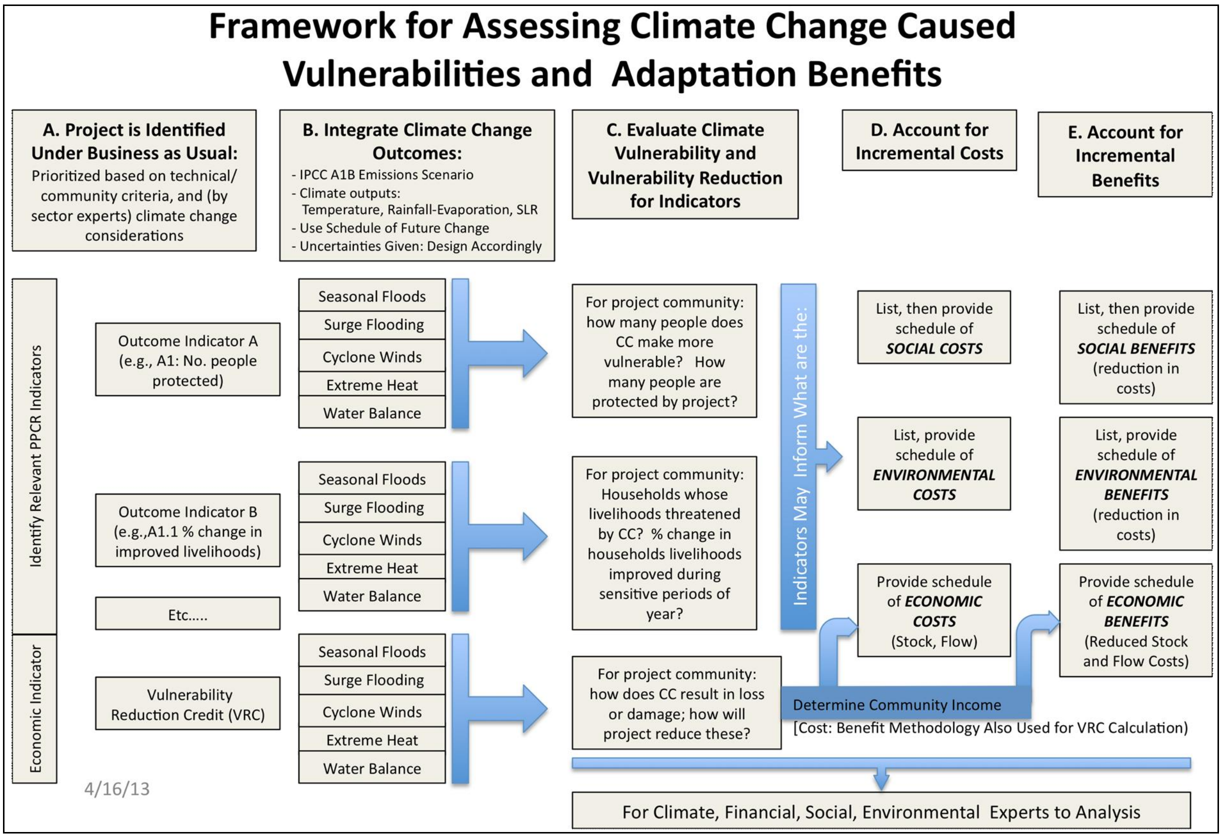
17. However, it was possible for the PPTA to perform an economic analysis on the benefits of introducing cyclone shelters, and discovered that shelters have a good economic internal rate of return (EIRR) if we account for the reduced medical costs and reduced income owing to health impacts. A number of other very real impacts are highlighted in the **Table I.1**.

18. It is interesting to note that relatively few impacts could not be quantified, and even if not monetized for CTIIP's cost: benefit analyses, an economic value could be assigned to the vulnerabilities, by going beyond market prices and employing a variety of approaches including revealed preference, stated preference, and benefit transfer approaches.[17] Some of the few non-quantified vulnerabilities include impacts of climate change on river/canal transport. It is important, however, to indicate that just because there is a way to quantify (and monetize) vulnerability of most assets, including, for instance, religious and recreational assets like playing fields and mosques by considering loss of activity (number using playing fields or attending religious ceremonies), this does not necessarily reflect the full value of the asset.

19. As far as the PPTA is aware, many questions have not been addressed in practice for projects funded by PPCR. The baseline setting is one; while climate change has been underway for some time, most approaches to look at climate vulnerabilities start with the present. Hence, the "incremental costs and benefits" of climate adaptation are not fully accounted for, and thus the importance of PPCR funding is underestimated.

[17] See Vardakoulias, O., (2013), New Economics Foundation, "Valuing the environment in economics," *Economics in policy-making briefing* for a summary of alternative approaches to placing economic value on environmental assets, that may apply to the broad set of coastal town assets.

**Figure I.2: CTIIP Climate Assessment Framework**




Source: PPTA Consultant.

20. The anticipated results of this exercise, however, give a view towards how the adaptation measures will reduce vulnerabilities, and the extent to which this is the case. It will also result in a clearer adaptation strategy by giving additional tools to consider the relative costs and benefits of alternative measures, and, in conjunction with the community surveys of hazards and climate hazard mapping point out potential vulnerabilities that CTIIP interventions can address.

**Table I.1 Coastal Town Assets, Their Vulnerabilities to Climate Change, and How We Can Assess Them**

| Coastal Town Assets | | Vulnerabilities | Can we Quantify Impacts? | Residual we cannot quantify | Rough Estimate of Asset Value of Residual | Can we Monetize? | Issues |
|---|---|---|---|---|---|---|---|
| Income, population and health | People's lives | Storm accidents/ disease/heat | Yes | NA | nil | No | |
| | People's health | Storm accidents/ disease/disability | Yes | If not clear cyclone event difficult to quantify | Very minor | Yes, possibly lost income and health costs | |
| | Wages | Lost to storms, flooding and sickness | Yes (most especially of the urban poor / slum dwellers) | Minor so will not quantify | Very minor | Yes, lost income | Need average incomes. Based on average loses through flooding (Khulna), SIDR PDNA |
| | Housing | Siting of assets. Loss and damage from cyclone winds and all flooding | Yes, especially katcha housing | Minor so will not quantify | Very minor | Yes, cost of damage to physical assets | Need asset values. Based on average loses through flooding (Khulna), SIDR PDNA. Need baseline data on wind damage |
| | Recreational assets | Siting of assets. Damage and loss of assets and activity | Yes, damage to physical assets | Minor so will not quantify | Very minor | No | Requires inventory/stock data, asset valuation for different classes of use/building, and damage (or proxy) estimates |
| | Religious assets | Siting of assets. Damage and loss of assets and activity | Yes, damage to physical assets | Loss of activity | Minor | Yes | Requires inventory/stock data, asset valuation and damage (or proxy) estimates |
| Infrastructure & services<br><br>Energy, water and sanitation, drainage | Water supply | Loss of power/ electricity supply<br>Flooding of facilities<br>Contamination of water supply by salinity and dirty water | Yes | NA | Nil | Yes (cost of lost or damaged assets) | Requires asset inventory, valuation for facilities, and damage (or proxy) estimates |

| Coastal Town Assets | | Vulnerabilities | Can we Quantify Impacts? | Residual we cannot quantify | Rough Estimate of Asset Value of Residual | Can we Monetize? | Issues |
|---|---|---|---|---|---|---|---|
| | Storm and waste water services | Flooded drains and submerged drains and associated infrastructure, e.g. pumping stations<br>Backlogging of stagnant water<br>Damage to properties and sanitation facilities.<br>Economic, financial, social, governance, health, education, etc., losses owing to lack of access (to schools, markets, etc.) during flood periods.<br>More complex and financially demanding infrastructure to operate and maintain.<br>Human resources at risk during flooding events | Yes, some, e.g. extent of flooded areas and frequency of flooding; losses to infrastructure, properties, assets, businesses, etc., can be measured, and damage to sanitation facilities<br><br>Possible to quantify lack of access to schools or markets. | Cannot easily quantify – social, governance, health, education impacts, etc. | ?<br>Major – because of nr of & breadth of affected sectors, especially long-term, but very difficult to quantify | Yes<br>Some | During certain times of the year the low tide river levels will be higher than drain inverts, and it will be impossible for the towns to be drained by gravity<br>Situation will become more severe with time.<br>Data have to be collected and recorded, be reliable and easily accessible |
| | Solid waste | Siting and managing dumps and transfer systems | Yes (damage to physical assets – secondary transfer, (sanitary) landfill) | NA | Nil | Not yet | Coastal towns do not have operational SWM systems |
| | Electricity | Siting of critical assets.<br>Storm induced disruption to supply, heat induced increase in demand and load shedding | Yes, damage to physical assets (sub-stations, pylons and poles) | Impact of loss of energy supply on other activities | Relatively minor? | Yes (cost of lost or damaged assets) | Requires inventory/stock data, asset value, and damage (or proxy) estimates. |
| | Fuels | Siting of storage assets.<br>Disruption of supply, environmental impacts if released | Yes, could change demand and access | Loss of productivity | Relatively minor? | Yes (cost of lost or damaged assets) | Requires inventory/stock data, asset value, and damage (or proxy) estimates |

| Coastal Town Assets | | Vulnerabilities | Can we Quantify Impacts? | Residual we cannot quantify | Rough Estimate of Asset Value of Residual | Can we Monetize? | Issues |
|---|---|---|---|---|---|---|---|
| Transport | Roads and footpaths | Damage/loss of asset and loss of activity | As per roads sub-project | Can quantify all | NA | Yes | Requires asset value, and damage (or proxy) estimates and transport activity value. As per roads use road damage approach in CDTA report |
| | Rivers/canals | Loss of transport activity | Probably not | N/a | N/a | N/a | |
| | Boat Landings | Damage/loss of asset and loss of activity | Yes | NA | Nil | No | Requires asset value, and damage (or proxy) estimates and river transport activity value |
| | Bus deports | Damage/loss of asset and loss of activity | Yes | | | Yes | Requires asset value, and damage (or proxy) estimates and bus activity value |
| | Vehicles | Damage and loss of activity | Yes, but tangential link to spatial land use planning | N/a | N/a | N/a | |
| Land, agriculture and ecosystems | Farms | Loss of agricultural land for urban development. Siting of critical assets (storage) | Yes. Damage to physical assets (storage). Loss of livelihoods and income from conversion of agriculture land to other uses.<br><br>Indirect in that farm land in ‘safe’ areas may be required for new development | Reduction of food security | Minor | Yes, where storage facilities exist. | Requires asset value, and damage (or proxy) estimates. |
| | Fisheries | Damage and loss of productivity storms, flooding, droughts | Not applicable | NA | Nil | NA | |
| | Forests | Damage to forests, indirect ecosystem losses owing to storms, drought, floods, salinity | Maybe, loss of natural embankment protection and increased vulnerability arising there from | NA | Nil | Probably not | |
| | Indigenous Species | Loss of wildlife from storms, floods, salinity | Not applicable | NA | Nil | NA | |

| Coastal Town Assets | | Vulnerabilities | Can we Quantify Impacts? | Residual we cannot quantify | Rough Estimate of Asset Value of Residual | Can we Monetize? | Issues |
|---|---|---|---|---|---|---|---|
| Industry and Commerce | Buildings | Loss and damage from cyclone winds and all flooding | Yes | N/a | Nil | NA | Requires inventory/stock data, asset valuation for different classes of buildings, and damage (or proxy) estimates |
| | Other commercial assets/inventories | Loss and damage from cyclone winds and all flooding | Yes | NA | Nil | Yes, for damage to assets | Composite of critical facilities/assets above? |
| | Commercial income | Loss of income from lost access to business | Yes | NA | NA | Yes, but complex to calculate? | Economic activity lost for period when critical assets (WS, electricity, roads etc) are down |

Source: PPTA Consultant.

# II. CLIMATE CHANGE SCENARIOS

## II.1 General Climate of Bangladesh

21. Bangladesh is situated in the heart of the South Asian monsoon region. With the Bay of Bengal and vast Indian Ocean to the south of Bangladesh and huge mountain ranges—Himalayan Mountains and Arakan ranges to the north and east respectively—the country receives very high annual rainfall, about 70-75% of which is concentrated during the monsoon season (June-September). There are four climatic seasons in Bangladesh:

| | |
|---|---|
| Winter | December-January |
| Pre-monsoon | March-May |
| Monsoon | June-September |
| Post-monsoon | October-November |

22. The climatology of annual distribution of country-average monthly minimum and maximum temperature is shown on **Figure II.1**. The figure shows high values of maximum temperature from March-October with peak in April (33.5 $^0$C) and a secondary peak in September (31.6 $^0$C). The lowest minimum temperature is obtained in January (12.5 $^0$C). **Figure II.2** shows the annual pattern of monthly rainfall. This shows that very high rainfall occurs in the monsoon season, 46 times greater than in the winter season.

**Figure II.1: The Climatology of Annual Distribution of Country Average Minimum and Maximum Temperature**

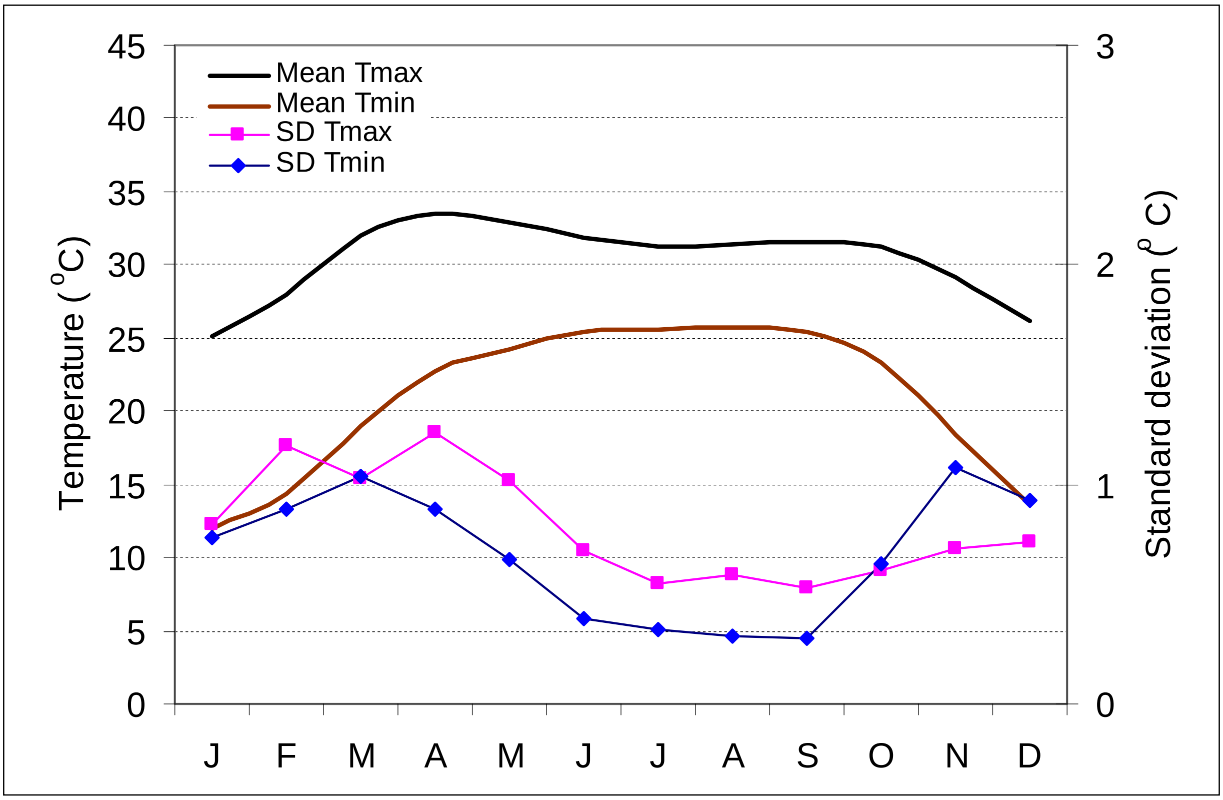
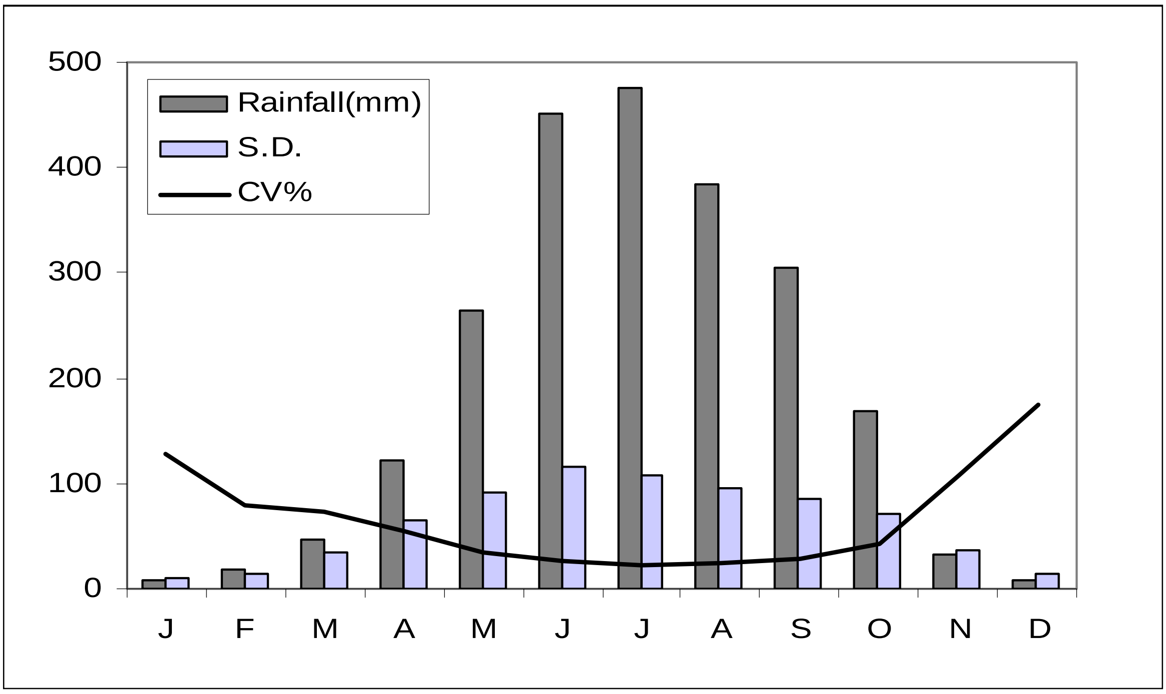


**Figure II.2: Annual Distribution of the Climatology of Country Mean Rainfall Based on 1948-2004 Data**

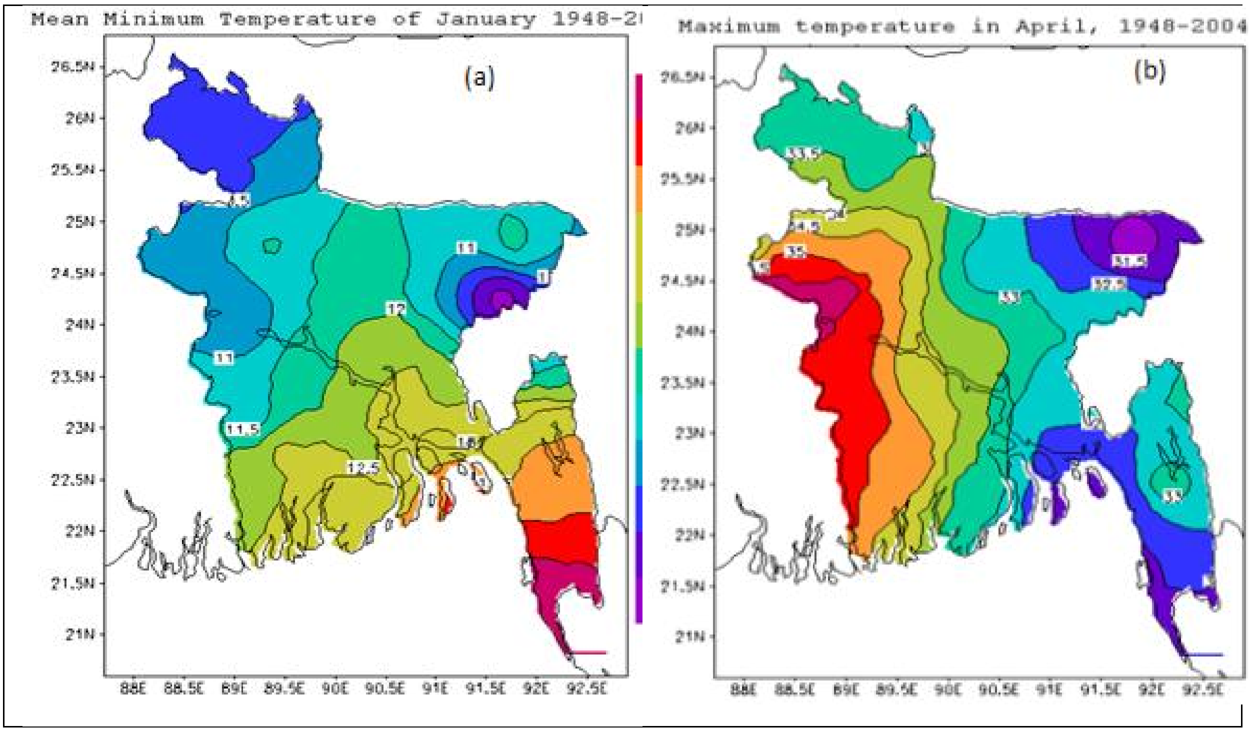



23. The spatial distribution of temperature shows that the coastal zone is relatively warmer in the winter **[Figure II.3(a)]**. The high summer temperature is obtained in the central western part of the country which includes the western coastal zone, whereas the central and eastern coastal zone has slightly milder temperature **[Figure II.3(b)]**. The spatial distribution shows that the maximum temperature of April is relatively low in the coastal zone, but the temperature increases from east to west.

24. Bangladesh annually receives on an average 2286 mm of rainfall, with standard deviation of 286 mm. The seasonal distribution shows that most of the rainfall occurs in the monsoon season amounting to 1616 mm /year which is 70.7% of the annual rainfall. The pre-monsoon season get about 19% of the annual rainfall. The post-monsoon season occupies 9% of the annual rainfall. The winter is relatively dry and receives about 1.5% of the annual rainfall.

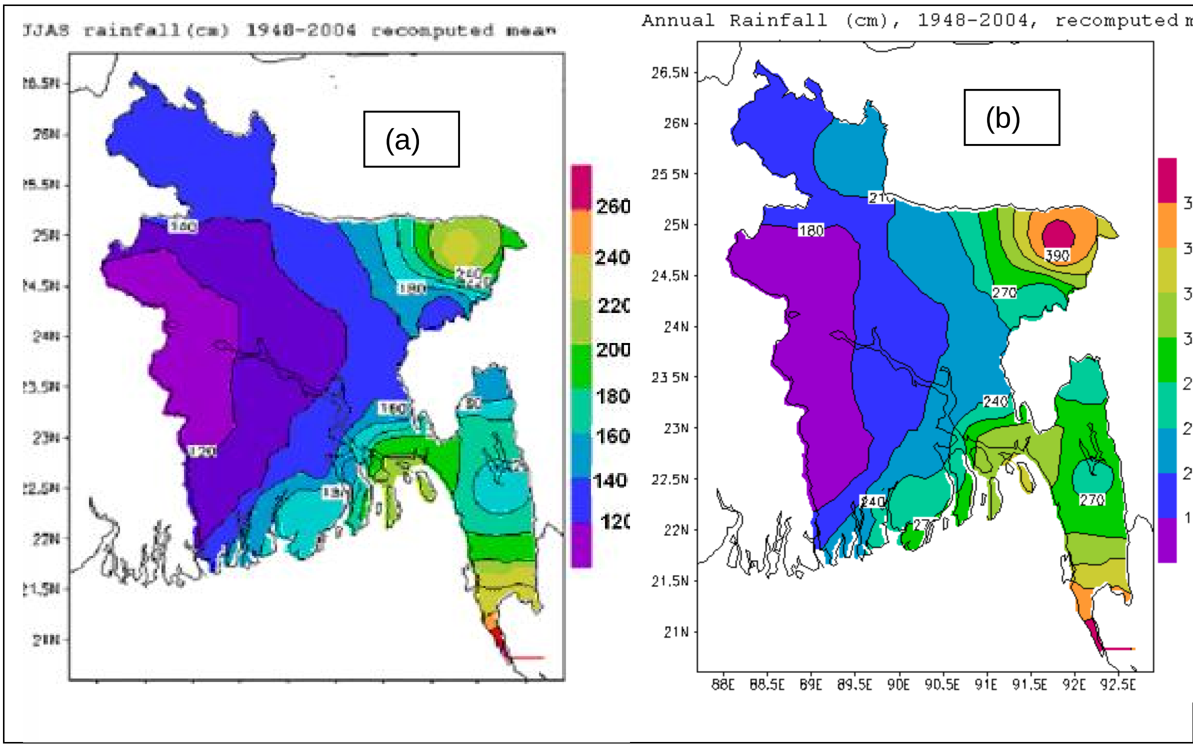
25. The geographical variation of annual rainfall is shown on **Figure II.4 (a,b)** for the monsoon season and annual respectively. It reveals from the figures that the highest amount of rainfall is obtained in the north-eastern and south-eastern part of Bangladesh amounting to around 2000-2800 in the monsoon season and 3000-4000 mm for the annual. Relatively low rainfall is obtained in central-western Bangladesh which is oriented in the north–south direction. The low rainfall area bulges towards central Bangladesh. The distribution pattern is more or less similar for both annual and monsoon. The geographic distribution of annual rainfall shows that the coastal zone experiences around 2000-3500 mm of rainfall, but it is relatively higher over the southeastern coastal zone and gradually decreases towards the west. Over the areas containing the study towns the annual rainfall is around 2400-3000 mm. The deficit and excess rainfall from normal becomes critical causing droughts and floods.

**Figure II.3 (a.b): The Geographical Distribution of Minimum Temperature of January (a) and of Maximum Temperature of April (b)**




Note: The climatology is based on data for the period 1948-2004.

**Figure II.4 (a,b): Distribution of Monsoon Rainfall (a), and Annual Rainfall (b) in cm**



26. The monsoon rainfall mechanism of Bangladesh is associated mainly with the convective activities associated with the semi-permanent monsoon trough and the monsoon depressions being formed in the head Bay and moving inland to Bangladesh, India and Myanmar. About 92% of the catchments of the great rivers of Ganges, Brahmaputra and Meghna (GBM) originating in the Himalayan mountain system lies outside Bangladesh and rainfall produced over these areas ultimately drains through Bangladesh constituting the remaining 8% of catchments.

27. The pre-monsoon rainfall over Bangladesh is mainly caused by the thunderstorm activities associated with the passage of subtropical westerly troughs in the middle and upper troposphere. In the lower troposphere, the warm moisture laden air flows inland steering the process of thunder storms formation with occasional tornado occurrence. In this season, the tropical depressions are also found to occur in the Bay of Bengal. They make their way to inland causing heavy rainfall over Bangladesh and the adjacent territories of India and Myanmar.

28. The winter rainfall occurs from the activities of subtropical disturbances. These disturbances usually have northerly positions well above Bangladesh's latitude. Sometimes, they happen to extend southward over Bangladesh, when the country gets some rainfall. Because of a lack of moisture in the atmosphere, rainfall is scanty during this season.

## II.2 Tropical Depressions and Cyclones

29. The monsoon depressions, tropical cyclones, and meso-scale heavy rainfall associated with thunderstorms and tornadoes are common disaster events in Bangladesh. The local high intensity rainfall causes flash floods, water-logging, and landslides impacting health, livelihood, resources and environment. The depressions and tropical cyclones form over the Bay of Bengal, move to inland and produce high rainfall. Tropical cyclones are the cause of death for hundreds of thousands of people and animals, and damage to infrastructure, the environment, resources, and livelihoods. The months April-May and October-December are considered the tropical cyclone seasons.

30. The low-lying coastal zone of Bangladesh is highly vulnerable both to the floods at extreme tides during strong monsoon activities, and from tropical cyclones.A total of 57 tropical cyclones have impacted Bangladesh during the period 1961-2010 based on analysis in Quadir and Iqbal (2008) and updated data obtained from the JTWC site. The distribution of land-falling cyclones over different regions of Bangladesh coast is shown in **Table II.1**. The tropical cyclones have a horizontal dimension of about 1,000-1,500 km. As a result the selected study area experiences impacts from the tropical cyclones that hit the west Bengal coast adjacent to Bangladesh border up to Chittagong and its nearby areas depending on the strength of the cyclones. From the above data analysis, around 49% of the tropical cyclones that hit the Bangladesh coast during the period 1961-2010 affected the study towns.

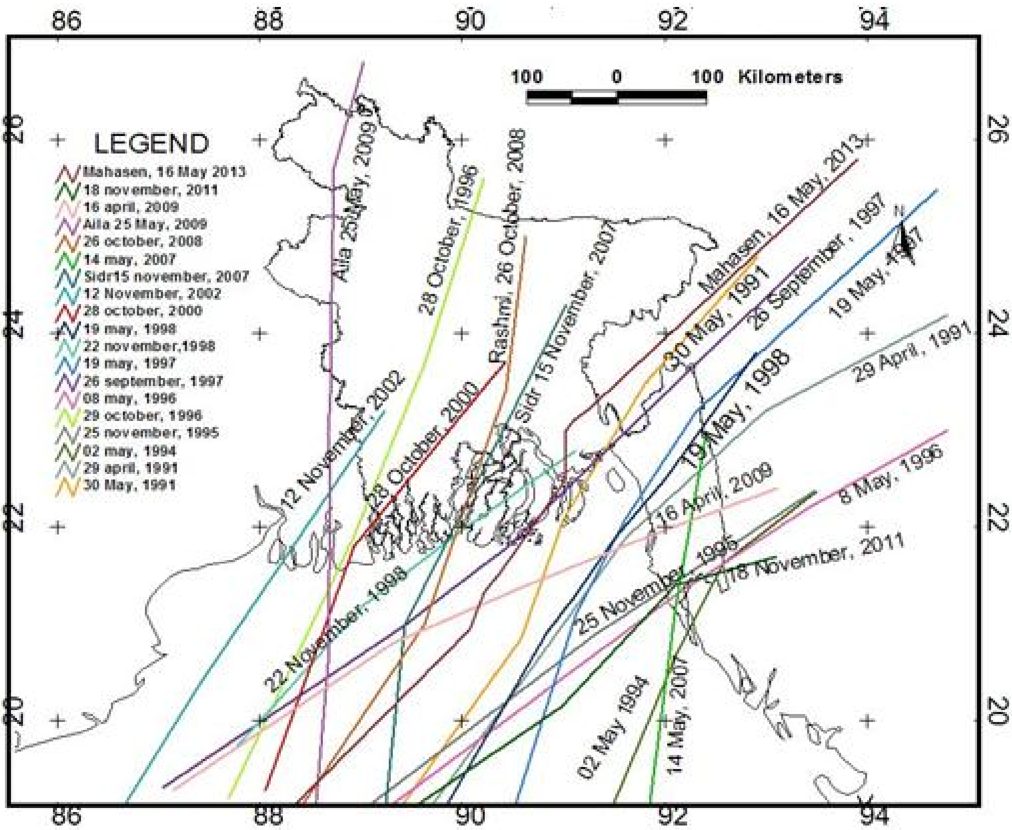
**Table II.1: Distribution of Land-falling Cyclones to the Different Regions of the Coast of Bangladesh and Neighborhood Areas (1961-2010)**

| Ser. No. | Coastal Region | Number of tropical cyclones hit the coast | % of the total number of tropical cyclones |
|---|---|---|---|
| 1 | Sundarban coast (Satkhira, Khulna and Bagerhat) | 15 | 26 |
| 2 | Central coast (Borguna, Potuakhali, Pirozpur, Barisal and Bola and Meghna estuary) | 13 | 23 |
| 3 | East central coast (Noakhali and Chittagong) | 15 | 26 |
| 4 | Southeastern coast (Southern Chittagong, Cox's Bazar and Teknaf | 14 | 25 |
| | **Total** | **57** | **100** |

31. The tracks of the tropical cyclones hitting Bangladesh coast during the period 2091-2010 have been shown in **Figure II.5**. All together 20 tropical cyclones hit Bangladesh during this period. Among them the cyclone of April 29 1991 that hit the coast of Noakhali-Chittagong belongs to category 4. About 134,000 people lost their lives due strong wind (250 km/hr) and high storm surges (8 meters) from this cyclone. Cyclone Sidr which hit the Potuakhali-Borguna coast achieved category-5 intensity with maximum wind speeds of 254 km / hr and is the most intensive tropical cyclone of this century. In spite of its very high intensity, the storm surge was recorded to be between "only" 6-8 m. The cyclone landfall time coincided with low tidal phase, as a result the storm surge height was relatively low. The death toll was 2,388 during this devastating cyclone. Damage and loss from Cyclone Sidr was concentrated on the southwest coast of Bangladesh. Four of Bangladesh's thirty districts were classified as "severely affected" and a further eight were classified as "moderately affected". Of the 2.3 million households affected to affected to some degree, about one million were seriously affected. The total damage and loss was estimated as US $ 1.7 Billion (World Bank, 2008).

32. **Table II.2** shows that the frequency of cyclone categories 1 and 2 has decreased from 1991 to 2010, while the frequency of categories 4 and 5 has increased. Before 1991 there was no category-5 cyclone in Bangladesh. Thus the tropical cyclone and storm surge hazard has grown in Bangladesh. **Table II.3** indicates that Bangladesh on average gets 1.14 tropical cyclones per year.

**Figure II.5: Tracks of Tropical Cyclones for the Period 1991-2013**




[Source: PPTA consultants].

**Table II.2: Category-wise Distribution of Tropical Cyclones Affecting Bangladesh According to Saffir-Simpson Classification (1961-2010)**

| Tropical Cyclone Class | 1961-1970 | 1971-1980 | 1981-1990 | 1991-2000 | 2001-2010 | Total |
|---|---|---|---|---|---|---|
| Cyclonic Storms Category-0 62-118 km/hr | 3 | 10 | 4 | 6 | 3 | 26 |
| Category-1 118-153 km/hr | 5 | 1 | 4 | 2 | 1 | 13 |
| Category-2 154-177 km/hr | 3 | 1 | 2 | 0 | 1 | 7 |
| Category-3 178-208 km/hr | 3 | 0 | 0 | 3 | 0 | 6 |
| Category-4 209-251 km/hr | 1 | 0 | 0 | 2 | 1 | 4 |
| Category-5 Above 252 km/hr | 0 | 0 | 0 | 0 | 1 | 1 |
| Total | 15 | 12 | 10 | 13 | 7 | 57 |

*Note: The classification of Atlantic Hurricanes is found more convenient and useful in describing the intensity levels; as such, this classification has been adopted for this study.*

**Table II.3: Probability of Different Categories of Cyclones affecting Bangladesh (1961-2010)**

| Intensity Level | Probability/decade | Probability/year |
|---|---|---|
| Category-0 (62-117 km/hr) | 5.2 | 0.52 |
| Category-1 (118-153 km/hr) | 2.5 | 0.26 |
| Category-2 (154-177 km/hr) | 1.4 | 0.14 |
| Category-3 (178-251 km/hr) | 1.2 | 0.12 |
| Category-4(209-51km/hr) | 0.8 | 0.08 |
| Category-5 (v>251 km/hr) | 0.2 | 0.02 |
| Total | 11.4 | 1.14 |

33. The category-0 (cyclonic storms of low intensity) occurs once in 2 years. From the above table it is seen that the tropical cyclones of Cat-1, 2 and 3 has the probability of 0.52, which implies that Bangladesh is hit on an average by 1 cyclone of belonging to categories 1, 2 and 3 every2 years. The category 4 cyclone is a 12.5 year event, while the category 5 cyclone is 50 year event.

## II.3 Storm Surges

34. The strong winds of tropical cyclones at the surface level frictionally interact with the ocean water and generate high water waves called storm surges. The strong pressure drop inside the tropical cyclones enhances the height of these surges. Most of the damages due to storm surges are caused by storm surge flooding over the coastal zone. The storm surge height is influenced by the coastline configuration, bathymetry of the coastal sea and direction of the cyclone track relative to the coastline. The funnel shape of the Meghna

estuary is responsible for high storm surges over and around that area. The tidal height above and below the mean sea level further modifies the absolute surge height as $S_h = S \pm h_t$, where $S_h$ is total surge and S is the surge due to tropical cyclone and $h_t$ is the tidal height above or below the tidal level. Thus if the cyclone passes through the coast at high tide the surge will be higher. The extreme shallowness of the topography makes the western and central coasts highly vulnerable to storm surge inundations. **Table II.4** shows the distribution of storm surge heights as a function of wind speed for the Bangladesh coast (World Bank 2011).[18]

35. Available literature indicates a range of 1.5 to 10.0 m high storm surges for severe cyclones during 1960-2012. Heights in excess of 10m also may also occur. Surges can be even more devastating if the cyclones make landfall during high tide. In general, it has been observed that the frequency of a wave (surge plus tide) along the Bangladesh coast with a height of about 10m is approximately once in 20 years, and the frequency of a wave with a height of about 7m is approximately once in 5 years (MCSP, 1993).[19]

**Table II.4: Tropical Storm Surges and the Limit to Coastal Inundation Maximum Wind Speed with some adjustment**

| Maximum Wind Speed (Km/hour) | Storm Surge Height (m) | Limit to Coastal Inundation (km) |
|---|---|---|
| 85 | 1.5 | 1.0 |
| 115 | 2.5 | 1.2 |
| 135 | 3.0 | 1.5 |
| 165 | 3.5 | 2.0 |
| 195 | 4.8 | 4.0 |
| 235 | 6.5 | 5.0 |
| 260 | 7.8 | 5.5 |

Source: World Bank, 2011.

## II.4 Current Climate Change

36. **Trends of temperature and rainfall.** The country average minimum and maximum temperature shows that the minimum temperature increases at the rate of 0.0094$^{o}$C/year and the maximum temperature increases at the rate of 0.007$^{o}$C/year [Singhvi et al., 2011]. However, the investigations for individual seasons show that the changes vary over the seasons. The trend for the winter temperature is higher for the minimum temperature. The trend of maximum temperature is positive for monsoon and post-monsoon seasons and negative for winter. The rainfall trends exhibits an increase for all seasons. The percentage trend is higher for winter, pre-monsoon and post-monsoon seasons than for the monsoon season.

[18] World Bank, 2011: The Cost of Adapting to Extreme Weather Events in a Changing Climate, BANGLADESH Development Series, Paper 28.

[19] MCSP, 2003. Multipurpose Cyclone Shelter Program, Final Report, Vol. IV, Planning and Development Issues, UNDP/World Bank/GoB Project BGD/91/025, Government of Bangladesh.

37. The trends of temperature and rainfall for seven stations covering the study towns of the coastal zone have been reported by Quadir and Iqbal (2008)[20], ADB Report (2012)[21] and ADB CDTA-7890 (2013)[22] report **[Tables II.5 and II.6]**. The results over the project area show that the temperature exhibits a generally increasing trend, with variations from station to station and season to season (Table II.6). This table shows that the rising trends are dominant in Bhola, Khepupara, Potuakhali, Khulna and Satkhira (trends most frequently range 0.15-0.4$^0$C/decade). The study of Quadir and Iqbal [2008] indicates that sea surface temperature (SST) of the Bay of Bengal has increased by 0.47$^o$C during the past 50 years which affects the ecology of the coastal sea and coastal zone. The trend of annual mean SST has been found to be 0.094 $^0$C /decade which is comparable with the increasing trends of the country average air temperature of Bangladesh [Quadir, Iqbal, 2008].

38. **Table 11.7** indicates that rainfall substantially increases in most of the stations for all seasons, except Bhola where the rainfall is found to decrease. In Barisal, rainfall is found to decrease in the monsoon and post-monsoon seasons, but strong increasing trends are exhibited in the winter and pre-monsoon seasons. The general trend of monsoon rainfall per decade is around 5-10 % for stations in and around the study areas.

**Table II.5: Trend of Country Average Minimum and Maximum Temperature and Rainfall (1961-2007)**

| Parameter | Winter | Pre-monsoon | Monsoon | Post-monsoon | Annual |
|---|---|---|---|---|---|
| Tmin (0C/decade) | 0.13 | 0.07 | 0.07 | 0.10 | 0.09 |
| Tmax (0C/decade) | -0.03 | -0.10 | 0.18 | 0.23 | 0.07 |
| Rainfall (%/decade) | 7.65 | 7.02 | 0.73 | 3.41 | 2.26 |

Source: Report of ADB TA7902-BAN CCIIP, 2012.

**Table II.6: Current Trends of Minimum and Maximum Temperature($^0$C/decade) [Source: Quadir and Iqbal (2008) and ADB Report (2013) of CDTA 7980]**

| Stations | Winter | | Pre-monsoon | | Monsoon | | Post-monsoon | | Annual | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Tmin | Tmax | Tmin | Tmax | Tmin | Tmax | Tmin | Tmax | Tmin | Tmax |
| Barisal | *-0.26* | 0.03 | *-0.12* | *-0.07* | *-0.08* | 0.11 | *-0.09* | 0.26 | *-0.13* | 0.07 |
| Bola | 0.32 | 0.15 | 0.27 | 0.07 | 0.23 | 0.28 | 0.08 | 0.27 | 0.24 | 0.19 |
| Khepupara | 0.22 | 0.15 | 0.20 | -0.16 | 0.23 | 0.16 | 0.17 | 0.19 | 0.15 | 0.09 |
| Khulna | *-0.18* | *-0.17* | *-0.07* | *-0.08* | *-0.07* | 0.17 | 0.10 | 0.21 | -0.03 | 0.03 |
| Mongla | -0.1 | 0.29 | 0.18 | 0.62 | 0.09 | 0.26 | 0.05 | 0.47 | 0.07 | 0.38 |
| Shatkhira | 0.10 | -0.03 | 0.04 | -0.01 | 0.10 | 0.16 | 0.08 | 0.19 | 0.08 | 0.07 |
| Patuakhali | 0.03 | 0.18 | 0.18 | 0.41 | 0.34 | 0.40 | *-0.15* | 0.14 | 0.11 | 0.30 |

[20] Quadir D. A. and Iqbal A. 2008: Tropical Cyclones: Impacts on Coastal Livelihoods-Investigation of the coastal inhabitants of Bangladesh. International Union of Conservation of Nature and Natural Resources (IUNCN)-Bangladesh Office.

[21] ADB PPTA 7902-Ban, 2012: Coastal Climate Resilient Infrastructure Project (CCRIP)

[22] ADB CDTA 7890, 2013: Final Report of Coastal Infrastructure Improvement Project (CTIIP).

**Table II.7: Trends of Seasonal Rainfall in the Coastal Zone (1951-2007)**

| Station | Winter | | Pre-monsoon | | Monsoon | | Post-monsoon | |
|---|---|---|---|---|---|---|---|---|
| | mm/10yr | % | mm/10yr | % | mm/10yr | % | mm/10yr | % |
| Khepupara | 4.8 | 9.8 | 290 | 8.9 | 153.0 | 8.6 | 23.4 | 9.0 |
| Pirojpur** | -7.0 | -13.6 | -26.0 | -7.5 | 111.0 | 6.6 | 64.0 | 28.5 |
| Patuakhali | 3.6 | 8.6 | 16.0 | 4.4 | 112.4 | 6.0 | 21.6 | 7.6 |
| Khulna | 8.5 | 22.6 | 13.7 | 4.9 | 21.7 | 1.6 | 6.0 | 2.6 |
| Jhalokathi** | 1.0 | 2.6 | 0.0 | 0.0 | 156.0 | 10.8 | 69.0 | 33.9 |
| Bhola | -4.1 | -7.9 | -9.4 | -2.7 | -52.2 | -3.1 | -1.0 | -0.4 |
| Barisal | 4.4 | 8.5 | 20.3 | 5.8 | -10.5 | -0.6 | -5.1 | -2.2 |
| Barguna** | -24.0 | -59.0 | 9.0 | 2.4 | 276.0 | 13.5 | 59.0 | 21.1 |
| Mothbaria** | -3.0 | -7.3 | 60.0 | 14.5 | 94.0 | 4.5 | 79.0 | 37.6 |
| Satkhira | 8.2 | 15.9 | 16.2 | 4.1 | 38.0 | 1.7 | 4.6 | 1.6 |

Note: ** indicate that data are obtained from BWDB rain gauge stations.
Sources: Quadir and Iqbal (2008), ADB TA 7902-BAN (2012) and ADB CDTA 7890-BAN (2013).

39. **Extreme climatic events.** The analysis of the observed daily minimum temperature at the 10$^{th}$ percentile show that the number of cold nights has decreased and the 90$^{th}$ percentile shows that the number of warm nights has increased (UK Met Office, 2011)[23]. The observed rainfall analysis indicates that the frequency of extreme rainfall days with daily rainfall more than 10 mm, 20 mm and 50 mm are all increasing. It also shows that rainfall above 95$^{th}$ and 99$^{th}$ percentile exhibits increasing trends (SMRC, 2009).[24]

40. **Sea level rise.** Sea level rise (SLR) is a secondary effect of global warming caused by the volumetric expansion of sea water and the addition of liquid water to the sea due to the melting of the polar and mountain glaciers. For low-lying countries like Bangladesh the coastal zones are highly vulnerable to sea level rise. Studies by Khan et al (1999)[25] and SMRC (2001)[26] have reported increasing trends in SLR using tidal observation data of 1978-1998 **(Table II.8)**.

**Table II.8: Observed Sea Level Rise during the Period 1978-1998**

| Stations | Latitude | Longitude | Sea Level Rise (mm/year) |
|---|---|---|---|
| Hiron Point | 21°48' N | 89°28'E | 4 |
| Char Changa | 22°08' N | 91°06'E | 6 |
| Cox's Bazar | 21°26' N | 91°59'E | 7.8 |

[23] UK Met Office, 2011, Climate: Observations, projections and impacts: Bangladesh, UK Met Office, 2011.

[24] SMRC, 1998, The impact of tropical cyclones on the coastal regions of SAARC countries and their influence in the region. SMRC No - 1, SAARC Meteorological Research Centre (SMRC), E-4/C Agargaon, Dhaka 1207, Bangladesh, September 2008, pp 319.

[25] Khan, T.M.A, Quadir, D.A., Akter, F., and Sarker, M. A., 1999. Sea Level Changes and Coastal Erosion Problems along Bangladesh Coast. Journal of Remote Sensing and Environment, v-3; 87-103.

[26] SMRC, 2003. The vulnerability assessment of the SAARC coastal region due to sea level rise: Bangladesh Case, SMRC-No 3, SMRC publication, Dhaka, Bangladesh.

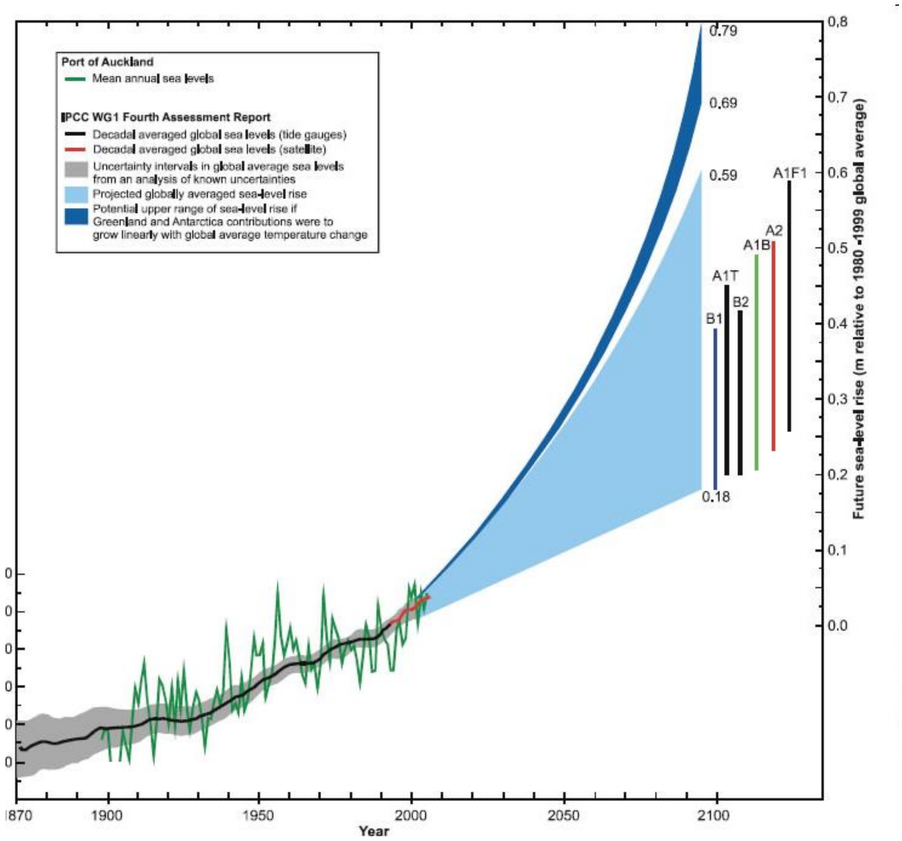
41. IPCC presented the graph of observation in **Figure II.6** that depicts an increase of current global sea level rise of around 3mm/year. The local factors are to be added with the observed SLR shows that the trends increase from west to east (Table II.8). The observed sea level rise is the composite of sea level rise due to global warming, geological subsidence of the delta and geological subsidence of the lands as shown below:

$$RSLR = SLR + GS - SP;$$

Where,

RSLR= Relative Sea Level Rise
SLR= Sea Level Rise due to Global Warming
GS= Geological Subsidence rate
SP = Sedimentation process.

**Figure II.6: Mean Global Sea Level Projection with Uncertainties (IPCC, 2007)**



42. ADB TA 7902-BAN study (2012), following Khan and Islam (2008)[27] and Goodbred and Kuehl [1999],[28] made an assessment that the geological subsidence (GS) rate over the south-central coastal zone is around 2 mm in the western coastal zone and 4-5 mm in the eastern coasts. Thus GS rate of the south-central coastal zone covering the study towns may be considered to be 3 mm/year. Since most of the areas of the coastal zone are protected by closed embankments (polders), the sedimentation process (SP) is not very active within the polders; as a result there is very little rise of land elevation due to sedimentation over these areas. However, instead of neglecting this factor, we consider a modest value of sedimentation rate of 1 mm/year over the poldered areas. Outside polder area thesedimentation rate is close to subsidence rate (Khan and Islam, 2008). From this consideration the subsidence over the areas covering the study towns is 3 mm/day.

## II.5 Climate Change Projections and their Utility for CTIIP

43. It is impossible to “predict” future climate change, as this change is dependent on global greenhouse gas emissions trends that cannot be known with certainty. Additionally, even if there was certainty in the emissions trends, the science of climate change is limited in the certainty it can provide for different climate variables like temperature and rainfall. As such, it is important to perform project level risk assessments based on uncertainties for the climate outcomes, and determine what is the likely range of possible outcomes for climate, and what this means for project investments.

44. Prior to the projection of climate change, the baseline scenarios of rainfall relative to 1990, 2000 and 2010 are shown in **Table II.9**. The baseline climatology indicates that the rainfall has increased during the past decades. As because there is no meteorological stations in the study pourashava, the monthly rainfall was produced through spatial interpolation of the observed data in neighboring stations.

45. A number of attempts were made to develop climate change scenarios for Bangladesh using General Circulation Models (GCM) in the early 1990s which provided more or less similar results [Ahmed et al., 1998,[29] World Bank, 2000;[30] Agarwala et al., 2003[31]]. More recent climate change scenarios have been generated based on a subset of climate models made available through IPCC, 2007, that best simulated the average rainfall during the main monsoon rainy season in Bangladesh (Tanner et al., 2007).[32] Changes were analyzed based on two established scenarios of future greenhouse gas emissions: A2 (high emissions scenario) and B1 (low emissions scenario).

27 Khan, S. R. and Islam, M. B. 2008: Holocene stratigraphy of the lower Ganges-Brahmaputra river delta in Bangladesh. Front. Earth Sc. China, 2(4): 393-399.

28 Goodbred, S.L.Jr.,Kuehl, S.A., 1999, Late quaternary evolution of the Ganges-Brahmaputra River delta: Significance of high sediment discharge and tectonic processes on margin sequence development. Sedimentary Geology. Vol 27: 559-562.

29 Ahmed A. U., Alam M., 1998: Development of Climate Change Scenarios with General Circulation Models. In “ Huq S., Z. Karim, M. Assaduzzaman, M. Mahtab eds. Vulnerability and Adaptation to Climate Change for Bangladesh. Dordecht.

30 WB, 2000: Bangladesh Climate Change and Sustainable Development, Report No. 21104-BD, The World Bank, Dhaka, pp. 95.

31 Agarwala,S., T., Ahmed, A.U., Smith, J., Aalst, M.V., 2003: Development and climate change in Bangladesh: Focus on Coastal Flooding and the Sunderbans. Organization for Economic Co-operation and Development (OECD).

32 Tanner T.M., Hassan A, Islam KMN, Conway, D, Mechler R, Ahmed AU, and Alam, M, 2007. ORCHID: Piloting Climate Risk Screening in DFID Bangladesh. Detail Research Report. Institute of Development Studies, University of Sussex, UK.

**Table II.9: The baseline scenarios of rainfall for 1990, 2000 and 2010 for the study pourashavas estimated by interpolation of the meteorological observations of surrounding stations**

| Baseline of Rainfall (mm) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Amtoli | 1990 | 7 | 23.6 | 44.6 | 89.7 | 244.3 | 502.7 | 598.1 | 353.76 | 370.5 | 239.1 | 57.3 | 8.7 |
| | 2000 | 8.8 | 22.4 | 41.1 | 82.5 | 249.4 | 504.1 | 631 | 416.4 | 410.12 | 276.4 | 48.7 | 6.6 |
| | 2010 | 10.7 | 21.2 | 37.6 | 68.2 | 254.5 | 505.3 | 664.3 | 462.41 | 446.93 | 313.8 | 40 | 4.5 |
| Galachipa | 1990 | 5.8 | 20 | 44.5 | 98 | 260.3 | 547 | 372.7 | 410.7 | 395.6 | 253.4 | 59.7 | 10.7 |
| | 2000 | 8 | 21.1 | 42.1 | 89.9 | 275.4 | 554 | 584.6 | 432.3 | 398.9 | 295.2 | 50.9 | 8 |
| | 2010 | 10.2 | 22.2 | 39.6 | 81.7 | 290.5 | 559.3 | 743.7 | 454.77 | 404.92 | 336.9 | 42.1 | 5.4 |
| Mothbaria | 1990 | 8.8 | 33 | 52.5 | 86 | 207.8 | 431.7 | 460.9 | 344 | 329.74 | 194.5 | 51.9 | 5.5 |
| | 2000 | 8.95 | 24.6 | 42.8 | 75.8 | 206.9 | 431.2 | 490.1 | 375.5 | 354.4 | 219.4 | 43.6 | 5 |
| | 2010 | 9.1 | 16.2 | 33.4 | 65.7 | 206 | 430.8 | 524.8 | 407.36 | 376.3 | 250.3 | 35.2 | 4.5 |
| Pirojpur | 1990 | 9 | 30 | 51.1 | 88.8 | 196.5 | 399.9 | 406.6 | 350 | 308.7 | 177.9 | 45.1 | 6.15 |
| | 2000 | 8.85 | 24.8 | 45.5 | 78.7 | 192.5 | 395.3 | 425.4 | 365.1 | 328.6 | 191.4 | 40 | 6 |
| | 2010 | 8.7 | 19.4 | 39.8 | 69.1 | 188.4 | 390.7 | 441.9 | 387.54 | 354.05 | 206.9 | 34.5 | 5.8 |

**Table II.10: Baseline monsoon rainfall for monsoon months June, July and August**

| **Baseline of Monsoon Rainfall (mm) for June-August** | | | |
|---|---|---|---|
| **Station Name** | **1990** | **2000** | **2010** |
| Amtoli | 1454.56 | 1551.5 | 1632.01 |
| Galachipa | 1330.4 | 1570.9 | 1757.77 |
| Mothbaria | 1236.6 | 1296.8 | 1362.96 |
| Pirojpur | 1156.5 | 1185.8 | 1220.14 |

46. **Table II.11** shows the climate change scenarios of Bangladesh for the future at 10 years interval reference to the year 2000 for temperature and rainfall based on Tanner et al. (2007) reference to A2 and B1 scenarios of the future GHG emission. The climate projections are derived from the GCM model results used for IPCC AR4 studies.

**Table II.11-A: New scenarios of temperature ($^{0}$C) of Bangladesh for future at 10 years interval with 2000 as the base year (reconstructed after Tanner, et al. 2007 using expert judgment)**

| GHG Scenario | YEAR | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | 2065 |
|---|---|---|---|---|---|---|---|---|
| A2 | Annual | 0.49 | 0.95 | 1.42 | 1.89 | 2.35 | 2.82 | 3.05 |
| | DJF | 0.73 | 1.40 | 2.07 | 2.74 | 3.41 | 4.08 | 4.42 |
| | JJA | 0.58 | 1.08 | 1.50 | 1.84 | 2.10 | 2.28 | 2.34 |
| B1 | Annual | 0.51 | 0.98 | 1.38 | 1.71 | 1.98 | 2.18 | 2.26 |
| | DJF | 0.92 | 1.66 | 2.23 | 2.64 | 2.89 | 2.98 | 3.00 |
| | JJA | 0.59 | 1.05 | 1.41 | 1.67 | 1.81 | 1.85 | 1.83 |

**Table II.11-B: Scenarios of future rainfall (%) over the study area at 10 years interval with 2000 as the base year (reconstructed after Tanner et al. 2007 using expert judgment following the current climate change)**

| GHG Scenario | | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | 2065 |
|---|---|---|---|---|---|---|---|---|
| A2 | Annual | 3.54 | 6.87 | 9.87 | 12.53 | 14.86 | 16.86 | 17.74 |
| | Winter | 19.34 | 34.91 | 47.16 | 56.09 | 61.70 | 63.99 | 63.89 |
| | JJA | 4.63 | 9.05 | 13.47 | 17.89 | 22.32 | 26.74 | 28.95 |
| B1 | Annual | 1.5 | 4.2 | 8.0 | 12.9 | 19.0 | 26.2 | 30.2 |
| | Winter | 29.2 | 47.2 | 52.0 | 43.6 | 22.0 | -12.8 | -35.2 |
| | JJA | 7.4 | 13.7 | 18.7 | 22.4 | 24.7 | 25.7 | 25.7 |

47. A large uncertainties were depicted in the projections of Tanner et al., but when the results are compared with the current scenarios from 2000 to 2010, it is seen that the upper range of the projections represent the realistic situations (Table II.6 and II.7). From this consideration the upper ranges of the scenarios produced by Tannar et al. are considered as the scenarios for this ADB PPTA study. The projections have been interpolated and extrapolated where applicable to derive scenarios on annual basis; but have been presented at 10 year interval up to 2065 in the table. The PPTA results of temperature and rainfall scenarios for 2050 are consistent with those obtained in earlier studies including those of CDTA.

48. **Projection of sea level rise.** For the Bangladesh delta it is necessary to take account local geological factors such as land subsidence and deposition while assessing the net sea level rise. For the coastal area covering the study towns, the subsidence is around 3 mm/year. The study of Khan and Islam (2008) depicted that the subsidence rate is close to the sedimentation rate, which is around 3 mm/year in central coastal zone. However, the sedimentation rate has drastically reduced due to the construction of embankments or polders along the channels. The authors (Khan and Islam.) expressed concern about poor sedimentation within the polders, leading to transgression. Though there is no clear mention of the deposition rate inside the polder in any study, we consider a deposition rate of 1 mm/year over the polderized areas. The sedimentation in the land areas outside polders are considered to be adjusted with subsidence.

49. The IPCC AR4 results of sea level rise with different GHG scenarios are shown in Figure II.6. The uncertainties are clearly shown in the figure. Based on the information provided by IPCC, the net sea level rise has been generated for 2010, 2030, 2040, 2050, 2060 and 2065 based on the methodology as discussed above. From the figure it reveals that the sea level rise during 2000-2007 more or less follows the upper range of the sea level rise. Based on this fact and also to ensure higher level of safety we consider the upper range of the IPCC projection.

50. From **Table II.12** it is seen that the net sea level rise for the Bangladesh coast is 21 cm for 2030 and 39 cm in 2050 relative to the lands inside the polders. The sea level rise would reach up to 0.52 m in 2060.

**Table II.12: Bangladesh Sea Level Rise in 2010, 2030 and 2050, with 1990 as the Reference Year Considering IPCC Prediction with Uncertainties**

| Projection year | Sea level rise (cm) due to warming | Land Subsidence (cm) | Sediment Deposition (cm) in side polders | Sediment Deposition (cm) outside polders | Net sea level rise (cm) relative to lands inside polder | Net sea level rise (cm) relative to lands outside polder |
|---|---|---|---|---|---|---|
| | A | B | C | D | **A+B-C** | A+B-D |
| 2010 | 3.5 | 3 | 1 | 3 | **5.5** | 3.5 |
| 2020 | 8.5 | 6 | 2 | 6 | **12.5** | 8.5 |
| 2030 | 15 | 9 | 3 | 9 | **21** | 15 |
| 2040 | 21.5 | 12 | 4 | 12 | **27.5** | 21.5 |
| 2050 | 29.4 | 15 | 5 | 15 | **39.4** | 29.4 |
| 2060 | 39.6 | 18 | 6 | 18 | **51.6** | 39.6 |
| 2065 | 44.4 | 19.5 | 6.5 | 19.5 | **57.9** | 53. |

*Note: Local factors of land subsidence and deposition are considered.*

51. **Increase of Storm Surge height due to Sea Level Rise.** Because of the sea level rise the height of the storm surge as well as the tidal level will increase. Here, the future sea level rise for different time levels has been added to the storm surge height related to the intensity is displayed in **Table II.13**. The table shows that the storm surge may reach up to 9.4 m in the year 2050, however, if this event occurs at high tide the storm surge height may rise by another 2 meter or more depending on the track of the cyclone. Figure 4.14 shows the risk areas for inundation storms surges by 2050 (Susmita Dasgupta, 2011).[33]

**Figure II.13: The projection of storm surges for future sea level rise at different storm intensity**

| Vmax (km/year) | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | 2065 |
|---|---|---|---|---|---|---|---|---|
| 85 | 1.5 | 1.6 | 1.6 | 1.7 | 1.8 | 1.9 | 2.0 | 2.1 |
| 115 | 2.5 | 2.6 | 2.6 | 2.7 | 2.8 | 2.9 | 3.0 | 3.1 |
| 135 | 3 | 3.1 | 3.1 | 3.2 | 3.3 | 3.4 | 3.5 | 3.6 |
| 165 | 3.5 | 3.6 | 3.6 | 3.7 | 3.8 | 3.9 | 4.0 | 4.1 |
| 195 | 4.8 | 4.9 | 4.9 | 5.0 | 5.1 | 5.2 | 5.3 | 5.4 |
| 235 | 6.5 | 6.6 | 6.6 | 6.7 | 6.8 | 6.9 | 7.0 | 7.1 |
| 260 | 7.8 | 7.9 | 7.9 | 8.0 | 8.1 | 8.2 | 8.3 | 8.4 |
| 280 | 9.0 | 9.1 | 9.1 | 9.2 | 9.3 | 9.4 | 9.5 | 9.6 |

52. Gupta et al. (2011) have produced probable inundation maps showing the future projections of 2050 based on storm surge modeling **[Figure II.7]**. Currently, 8.06 million people in coastal Bangladesh are vulnerable to inundation depths greater than 1 m resulting from cyclonic storm surges. With population growth, that number is projected to increase 68 percent by 2050 under the baseline scenario. Without further adaptation measures, the figure would rise to 110 percent by 2050 under the climate change scenario, and the population exposed to inundation depths greater than 3 m would rise by 67 percent.

[33] Dasgupta S. et al. 2011: Cyclones in a Changing Climate: The Case of Bangladesh

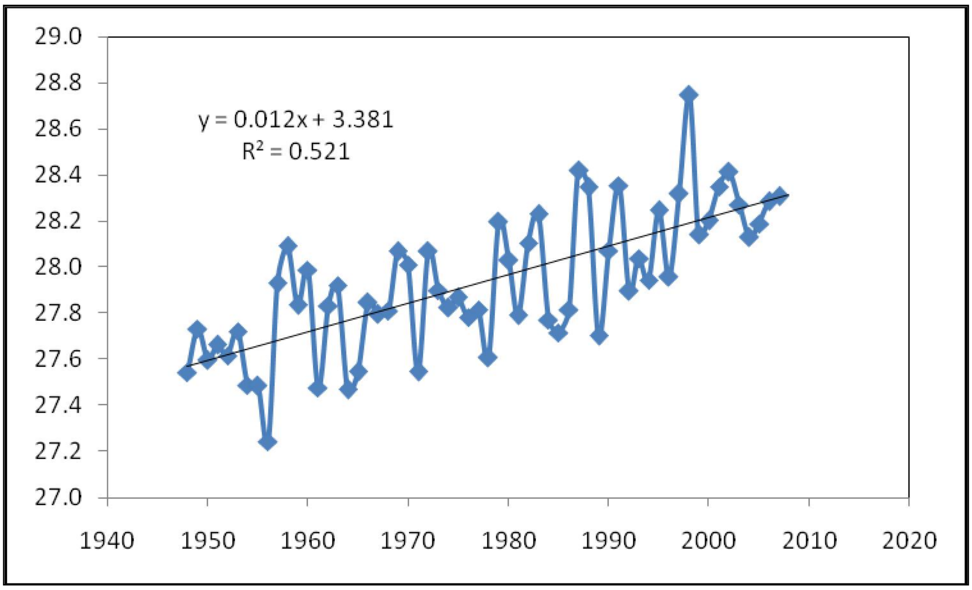
**Figure II.7: High risk area by 2050 in a changing climate (Dagupta et al. 2011)**

| Inundation depth (m) | Baseline scenario ($km^2$) | Climate change scenario ($km^2$) | Change (%) |
|---|---|---|---|
| > 1 | 20,876 | 23,764 | +14 |
| > 3 | 10,163 | 17,193 | +69 |

53. **Projection of tropical cyclones.** There is no GCM-based prediction yet on the future scenario of tropical cyclones for the Bay of Bengal. It is pertinent to consider the observational results which depict that the frequency of cyclonic storms with speeds between 62-87 km/hour forming over the Bay of Bengal are decreasing, while that of severe cyclonic storms with a wind speed higher than 87 km/hr are increasing (Singhvi et al., 2010).

54. Quadir and Iqbal (2008) have shown that the return period of very severe cyclones with intensity of super cyclonic storms has increased over the Bay of Bengal. The frequency of severe cyclonic storms with hurricane intensity is on the rise, though the frequency of weak cyclonic storms has been found to decrease during the recent decades. Emanuel (2005) has suggested that 1 $^{0}$C rise of sea surface temperature (SST) will cause the increase of wind speed of a cyclone by 4%, 2 $^{0}$C by 10% and 4 $^{0}$C by 22%. The rising trend of SST of the Bay of Bengal thus depicts that in the future a larger number of tropical cyclones will attain higher wind speeds. The CTIIP consultancy team has attempted to develop a relationship between the tropical cyclone intensity with SST anomaly of the Bengal for the cyclones that had landfall in Bangladesh and the adjacent coasts of India and Myanmar. An analysis of annual mean SST of the Bay of Bengal shows that the SST has an increasing trend of 0.012$^{0}$C / year **(Figure II.8)**.

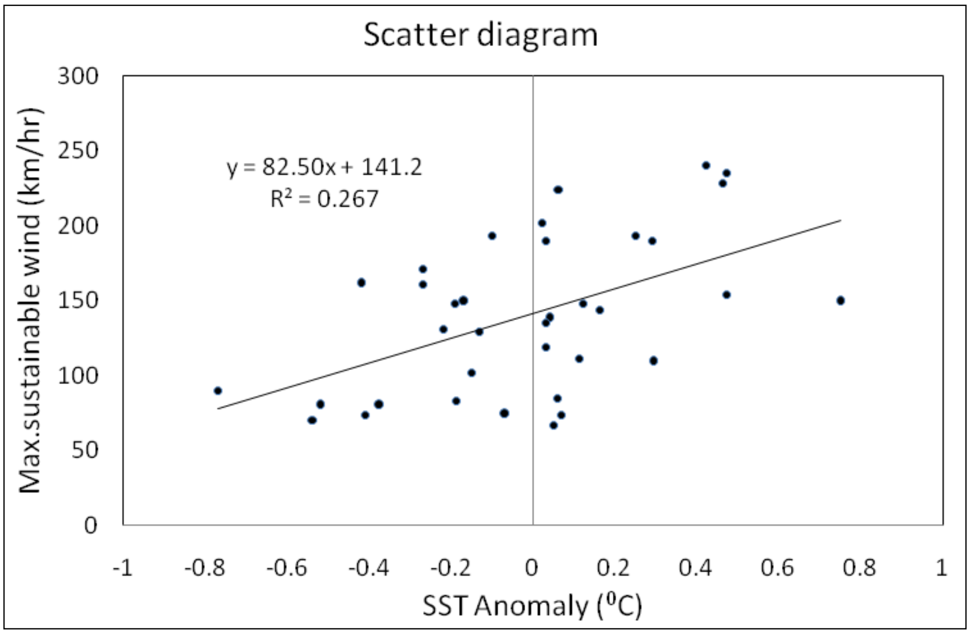
**Figure II.8: Trends and Variability of Surface Sea Temperature over Bay of Bengal from 1942-2008**




Kaplan SST, Source: NOAA NESDIS website). The SST has increased by 0.78 C in the past 60 years [Quadir and Iqbal, 2008.

55. The CTIIP climate change adaptation consultants [Quadir and Schultz, 2013] investigated the impacts of the SST variation on the wind speed of the tropical cyclones of the Bay of Bengal **(Figure II.9)**. The figure indicates the high sensitivity of tropical cyclones on the SST variability for the Bay of Bengal. It shows that the intensity of tropical cyclones increases by around 82.5 km/hr for $1^0$C rise of monthly SST.

**Figure II.9: Response of SS on the Tropical Cyclone Intensity over the Bay of Bengal that hit the Bangladesh Coast and Adjacent Territories of India and Myanmar**




Source: PPTA Consultant.

56. As noted, the SST trend is 0.012$^0$C/year for the Bay of Bengal. Considering this SST increasing trend the increase of SST has been estimated and the corresponding increase of maximum wind speed of tropical cyclones of the Bay of Bengal hitting Bangladesh and nearby coasts of India and Myanmar have been assessed based on the regression equation relating these variables. The results are given in **Table II.14**. According to this assessment the intensity will increase by about 14% by the year 2030 and 28% by 2050.

**Table II.14: Increase of the Intensity of Tropical Cyclones Hitting Bangladesh Coast based on the Relation between SST and Maximum Wind of Tropical Cyclones**

| Climate parameters | 2020 | 2030 | 2040 | 2050 | 2050 |
|---|---|---|---|---|---|
| Increase of SST ($^0$C) | 0.12 | 0.24 | 0.36 | 0.48 | 0.48 |
| Increase of Vmax (km/hr) | 9.8 | 19.8 | 29.4 | 39.6 | 39.6 |

*Note: RMS value of the regression equation is 41.3 and $R^2$-value is 0.267 reference to 2010.*

57. **The future probabilities of tropical cyclones.** The probability/year of different categories of tropical cyclones was extrapolated using the future scenarios of tropical cyclone intensity of different categories relative to the statistics of the decade 1991-2000, which was a relatively normal year in terms of the distribution of tropical cyclone intensity (Table II.2). The results of the future cyclone probability estimate are given in **Table II.15**.The results show that the transition occurs from low intensity cyclones to high intensity once. The probability of category- 4 and 5 cyclones are seen to be high in 2050 when the probability of category-0 cyclone are seen to come down to zero.

58. Based on the above discussion on the climate change and future projections the summery tables have been produced **(Table II.16)**.

**Table II.15: Projection of probability of tropical cyclone probability for the future for different intensity levels**

| Projection of probability of tropical cyclone incidence for future | | | | |
|---|---|---|---|---|
| **Categories** | **2011-2020** | **2021-2030** | **2030-2040** | **2040-2050** |
| Tropical Cyclonic storms Cat-0 ( 62-117 km/hr) | 0.4 | 0.4 | 0.2 | 0.1 |
| Cat-1 (118-153 km/hr) | 0.2 | 0.1 | 0.2 | 0.2 |
| cat-2 (154-177 km/hr) | 0.2 | 0.1 | 0.1 | 0.2 |
| Cat-3 (178-207 km/hr) | 0.2 | 0.1 | 0.2 | 0.2 |
| Cat-4 (208-251 km/hr) | 0.2 | 0.4 | 0.4 | 0.3 |
| Cat-5 km/hr (speed>250 km/hr) | 0.1 | 0.2 | 0.2 | 0.3 |

**Table II.16: Summary of Climate Change and Future Scenarios**

| Climate parameter | Observed climate change | Future climate change scenarios | Confidence of prediction |
|---|---|---|---|
| Temperature | Increase of temperature with □Tmax=0.35 $^0$C<br>And □Tmin=0.45 $^0$C during last 50 years | Temperature is expected to increase. Annual temperature<br>Scenarios:<br>In 2030 in the range 0.7-1.6 $^0$C<br>In 2050 in the range 1.2-2.4 $^0$C | High confidence and good agreement between climate models. |

| Climate parameter | Observed climate change | Future climate change scenarios | Confidence of prediction |
|---|---|---|---|
| Rainfall | An increase of rainfall intensity.<br>Increasing trends in all seasons. | Models indicate wetter monsoon rainfall with future scenarios:<br>2030 with increase of 10-13%<br>2050 with increase of 22-24% | Low confidence with high level of uncertainties |
| Droughts | Droughts are associated with low rainfall and high evaporation in some years. The El Nino Southern Oscillation plays role in drought events. | Reduction of dry season rainfall and increase of temperature will cause dry spells with increased severity.<br>The surface water availability will decrease. | Drought is a direct function of temperature and an inverse function of rainfall. Thus the confidence level is moderate. |
| Floods | High intensity rainfall causes floods. Floods have increased in the recent decades. The return period also decreased. | The flood intensity will further increase | Moderate confidence |
| Cyclones and storm surges | Observation supports the increasing frequency and intensity of tropical cyclones of bay of Bengal | Cyclone intensity will increase<br>Storm surges will also increase | Medium confidence.<br>The results are based on SST variation and its relation with tropical cyclone maximum wind speed. |
| Sea level rise (include sedimentation and subsidence effects) | The sea level rise (SLR)<br>has been confirmed by observation. | SLR in 2030:<br>21 cm reference surface to land inside polder<br>SLR in 2050:<br>39 cm relative to land surface inside polder | Wide range of uncertainties. |
| Tidal fluctuation | The tidal amplitude is high in rivers of the selected coastal towns | SLR will cause the tides and storm surge heights to have higher levels. | Wide range of uncertainties |
| Salinity | Salinity in tolerant level for surface water and ground water for Amtoli and Galachipa | Galachipa will be engulfed by the 5 ppt salinity line due to 39 cm sea level rise by 2050 and Galachipa, Amtoli and Mothbarioa by 2060. | Obtained through modeling by IWM and adjusted by consultancy team for 39 cm and 60 cm sea level rise. |

59. The higher wind speed would naturally produce higher storm surges and more so in the state of higher sea level in the future. The study of World Bank (Dasgupta et al., 2011)[34] has also expressed similar view. Larger storm surges threaten greater future destruction, because they will increase the depth of inundation and will move further inland, threatening larger areas than in the past. The vulnerability of the Bangladesh coastal zone may increase even more as current scientific evidence points towards a probable increase in the frequency

[34] Dasgupta S, Haque, M, Khan,Z. H., Masood M. S., Murshed M., Ahmed Z., Mukharjee N., Pande K., 2010: Climate Proofing Infrastructure: Incremental cost of limiting future inland monsoon flood damage.The World Bank, Development Research Group, Environment and Energy Team.

of intense tropical cyclones in the Bay of Bengal (Singh et al. 2007)[35] in a warmer environment.

60. The above projections of climate change, sea level rise and tropical cyclone intensity serve as guidelines to the scientists to analyze the impacts and assess the vulnerability of coastal infrastructure and formulate the structural and non-structural climate resilience and adopt suitable design options for achieving the anticipated resilience.

[35] Singh, O.P. (2007). Long-term trends in the frequency of severe cyclones of Bay of Bengal: observations and simulations. *Mausam, 58*(1), 59-66.

# III. CLIMATE CHANGE VULNERABILITIES AND IMPACTS

## III.1 Introduction

61. The climate change vulnerability study under the PPTA project makes projections of the future climate change, sea level rise, increased probability of tropical cyclones and inundation by extreme monsoon rainfall, high astronomical tide and storm surges associated by tropical cyclones, and changes in salinity levels in water supplies. This chapter provides a detailed analysis of the coastal zone vulnerabilities in order to formulate engineering and non-engineering adaptation solutions.

## III.2 Climate Risks to Project Towns

62. The climate change vulnerability study under the PPTA project makes projections of the future climate change, sea level rise (SLR), increased probability of tropical cyclones and inundation by extreme monsoon rainfall, high astronomical tide and storm surges associated by tropical cyclones, and changes in salinity levels in water supplies.

63. The study towns—Amtali, Galachipa, Mothbaria and Pirojpur—are situated in the most vulnerable zone of the coast, being exposed to tropical cyclones, storm surges, sea level rise and strong astronomical tides. The towns have experienced severe damages in past cyclones that hit the south central coast and its neighborhood coastal zone. Besides, these towns are subjected to severe risks of flooding due to heavy monsoon rainfall from tropical storms, monsoon depressions and convective activities associated with monsoon troughs. The anticipated high sea levels will pose problems for drainage of flood water in the future as the tidal level may go so high due to sea level rise that there is chance that the lowest tide in the monsoon season may remain at higher level compared to the bed of the drainage system, resulting in long-term inundation of large areas of the towns.

64. Current and future climate will impact the infrastructure, environment, ecology, agriculture, water supply, sanitation and livelihood of the people of the areas covering the selected coastal towns. The increase in temperature has the potential to cause material expansion, resulting in damages to concrete structures such as buildings, bridges, and culverts and bitumen seals to roads, which are susceptible to softening unless higher temperature resistant construction materials are used. The expansion and contraction due to high fluctuation of temperature may affect the life of structures. Floods resulting from increased rainfall, cyclones and storm surges have the potential to damage roads, embankments, water supply, sanitation, markets, housing and drainage structures. SLR will increase the potential risks.

65. Higher salinity is also hazardous to metal and concrete structures in addition to its impacts on fresh water supply, agriculture, environment and ecology. The heath impact of human intake of saline water with salinity contents above tolerance causes health hazards to people, especially for pregnant women. Thus, the increase of salinity in the coastal zone is a serious problem in broader perspectives.

66. The increase of future severity of storms will increase the potential storm surge related damage as well as causing additional erosion damage from the over-topping of roads and embankments. High winds associated with storm events have the potential to damage lives, plants, buildings, agriculture, and fisheries as well as causing secondary damage from trees and other debris. Wind-driven wave action can have a significant erosive effect on exposed road embankments, bridges and sanitation systems.

67. PPTA findings show that the intensity of tropical cyclones will increase with the rise of

Sea Surface Temperature (SST). As a result the probability of the higher category cyclones would increase in 2040-2050.

68. The probability/year of different categories of tropical cyclones was extrapolated using the future scenarios of tropical cyclone intensity of different categories relative to the statistics of the decade 1991-2000, which was a relatively normal year in terms of the distribution of tropical cyclone intensities. The results of the future cyclone probability estimate are given in **Table III.1.** The results show that the transition occurs from low intensity cyclones to high intensity once. The probability of category- 5 cyclones is seen to be high in 2040-2050, while the probability of category-0 cyclone is seen to come down to 0.1.

**Table III.1: Projection of Probability of Tropical Cyclone Probability for the Future for Different Intensity Levels**

| **Projection of probability of tropical cyclone incidence for future** | | | | |
|---|---|---|---|---|
| **Categories** | **2011-2020** | **2021-2030** | **2030-2040** | **2040-2050** |
| Tropical Cyclonic storms Cat-0 (62-117 km/hr) | 0.4 | 0.4 | 0.2 | 0.1 |
| Cat-1 (118-153 km/hr) | 0.2 | 0.1 | 0.2 | 0.2 |
| Cat-2 (154-177 km/hr) | 0.2 | 0.1 | 0.1 | 0.2 |
| Cat-3 (178-207 km/hr) | 0.2 | 0.1 | 0.2 | 0.2 |
| Cat-4 (208-251 km/hr) | 0.2 | 0.4 | 0.4 | 0.3 |
| Cat-5 km/hr (speed>250 km/hr) | 0.1 | 0.2 | 0.2 | 0.3 |

Source: PPTA Consultant.

## III.3 Flooding: Inundation Surveys and Maps

69. The PPTA team collected field data for 30 or more uniformly distributed sites over the pourashavas on the inundation depth and duration of inundation. The information was collected from people residing in the locality and recorded in data sheets with the location being noted on respective base maps. Since there is a big time lag from the events, there may be some error originating from memory loss of the respondents. The data were analyzed by GIS for visualization of the spatial distribution of the inundation and to identify the severely affected areas.

70. The study pourashavas of Pirojpur, Mathbaria, Amtali and Galachipa show that parts of each pourashava are highly vulnerable to inundations from extreme tides and flooding caused by high intensity monsoon rainfall, and that most of these areas are rural. Each year the loss and damage from floods and water logging inside the pourashavas cause significant damage to properties, human suffering and loss of economic activity and livelihoods. And in several years, inundation caused by storm surge flooding during tropical cyclones caused very severe damage and loss.

### III.3.1 Flood Inundation in Pirojpur

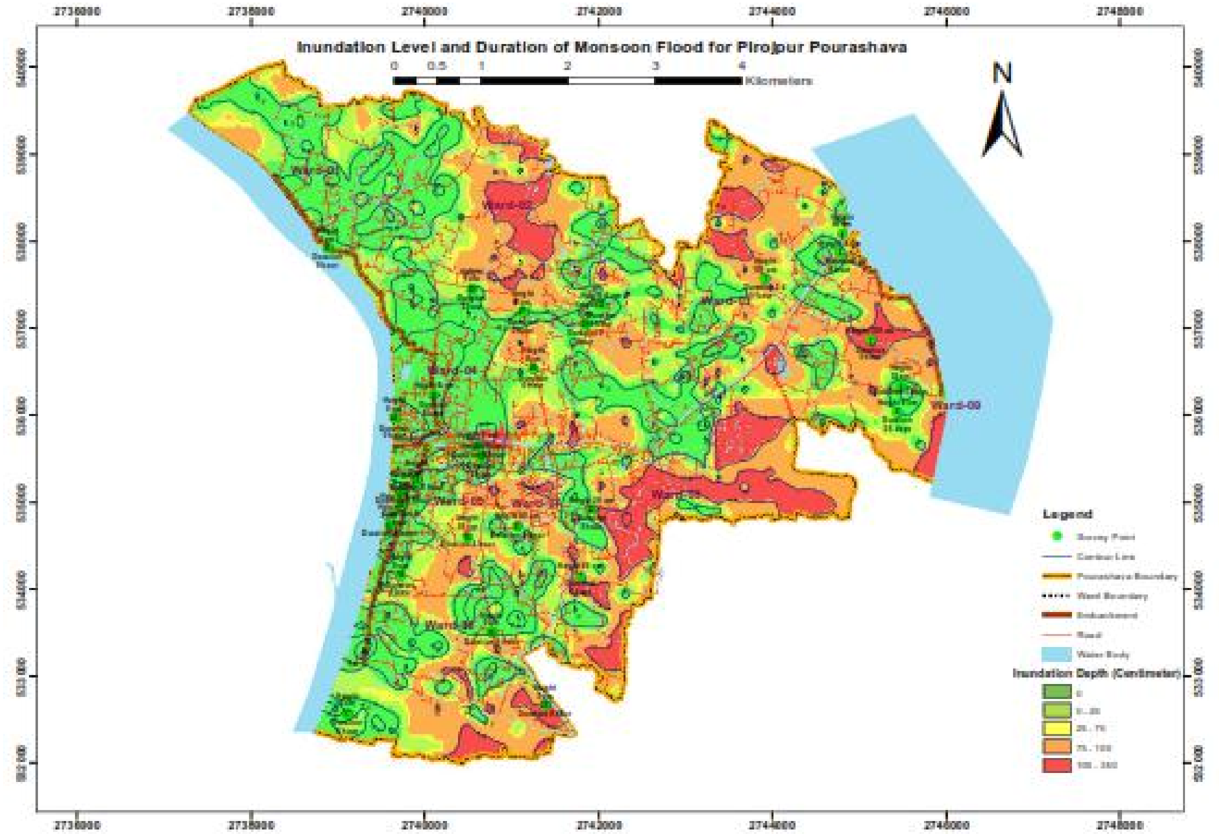
71. Inundation maps of Pirojpur for monsoon and tidal flooding for 2012 and storm surge due to cyclone Sidr were produced**.** For the preparation of the flood maps for monsoon, the 30 observational points were related with digital elevations and it was found that the flood depths follow a distinct inverse relation. This allowed the investigation to generate distinct classes of inundation against the elevation of the respective points that is shown in **Table III.2**. This relation was then used to map the inundation areas. The monsoon inundation map is shown on **Figure III.1(a)**.

**Table III.2: Relating the Elevation with Five Inundation Classes**

| Ser. No. | Inundation Classes (Depth in cm) | Range of elevation (m) |
|---|---|---|
| 1 | No flood | 1.9 m and above |
| 2 | 0-40 | 1.75-1.9 |
| 3 | 40-50 | 1.7-1.75 |
| 4 | 50-100 | 1.5-1.7 |
| 5 | Above 100 cm | -.75-1.5 |

Source: PPTA Consultant.

**Figure III.1(a): Monsoon Inundation Map for Pirojpur Pourashava**

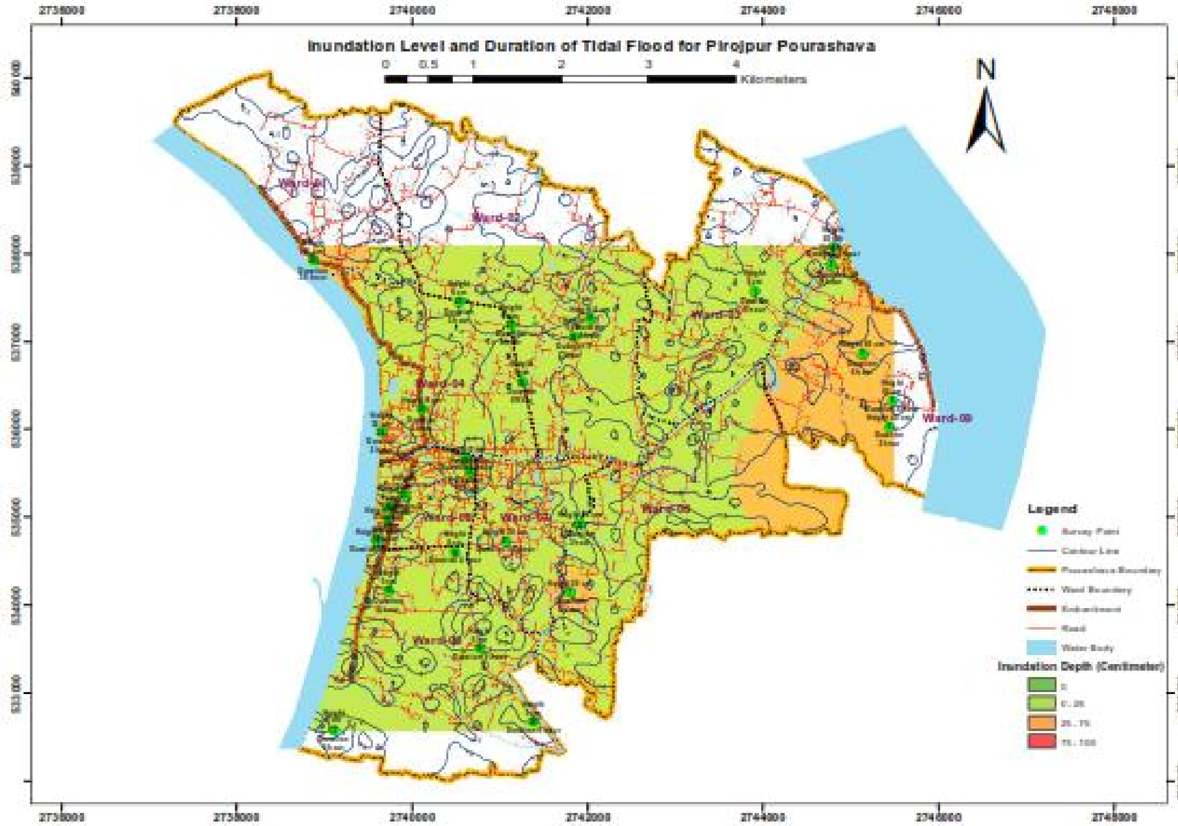



Source: PPTA Consultant.

72. It is seen that the central, north-eastern, eastern, south-eastern and southern parts of Pirojpur Pourashava are sporadically flood prone, with different depths of flooding due to monsoon rainfall (Figure III.1(a)). The yellow tone shows potential flooding of 40-50 cm depth, orange depicts potential flooding 50-100 cm and red shows the potential inundation levels, above 100 cm. The duration varies from a few hours to 3.5 days.

73. The distribution of inundation due to extreme high astronomical tides is shown on **Figure III.1(b)**. The extreme tidal inundation dominates over the central-eastern part of Pirojpur near the Kocha River with inundation depths of around 50 cm and inundation durations of 1.5-6 hours.

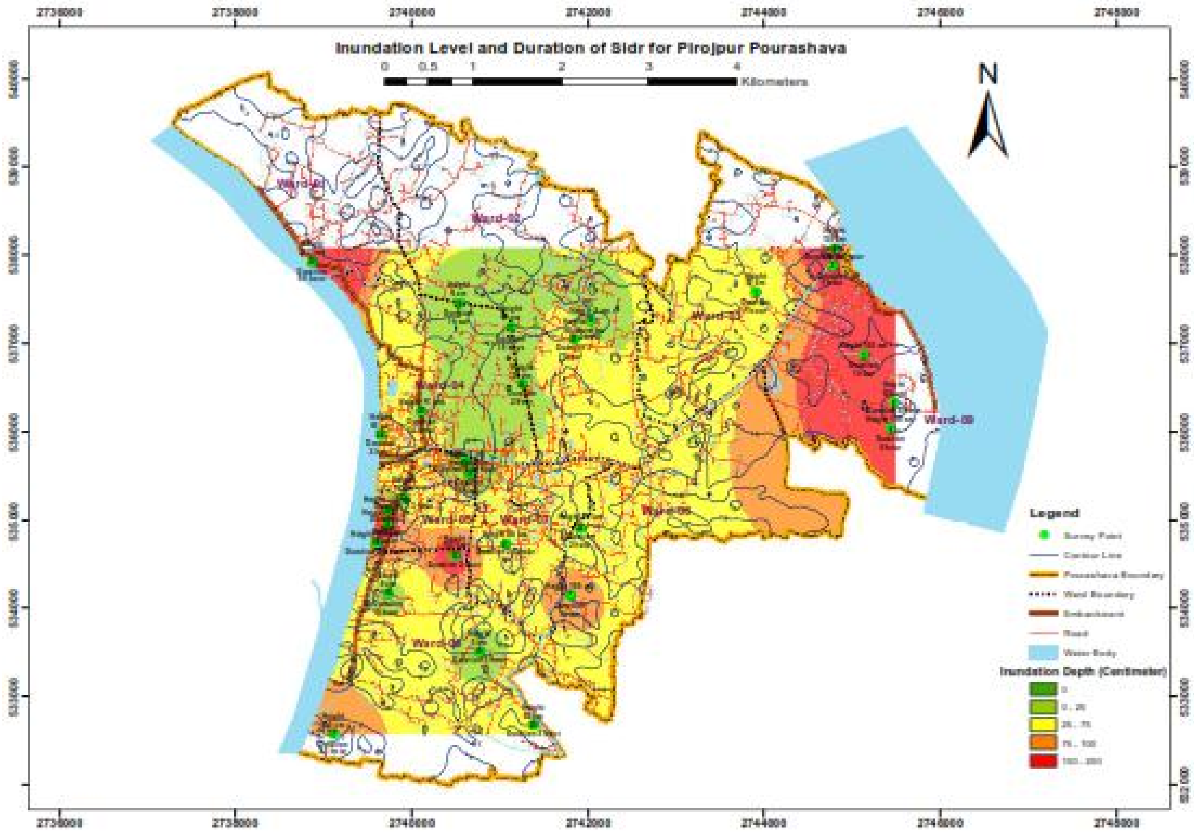
**Figure III.1 (b): Pirojpur Inundation Levels and Duration due to Extreme Astronomical Tides**




Source: PPTA Consultant.

74. **Figure III.1(c)** is the map of storm surges associated with cyclone Sidr. It can be seen from the figure that most of the pourashava was affected by a storm surge except for the core town areas. Maximum inundation of around 1 meter and durations of up to 4 hours have been reported. The central eastern part of the pourashava near the Kocha River has maximum inundation levels. It took around 4 hours to drain out the water from these areas.

**Figure III.1(c): Inundation in Pirojpur Pourashava due to Storm Surge associated with Sidr**



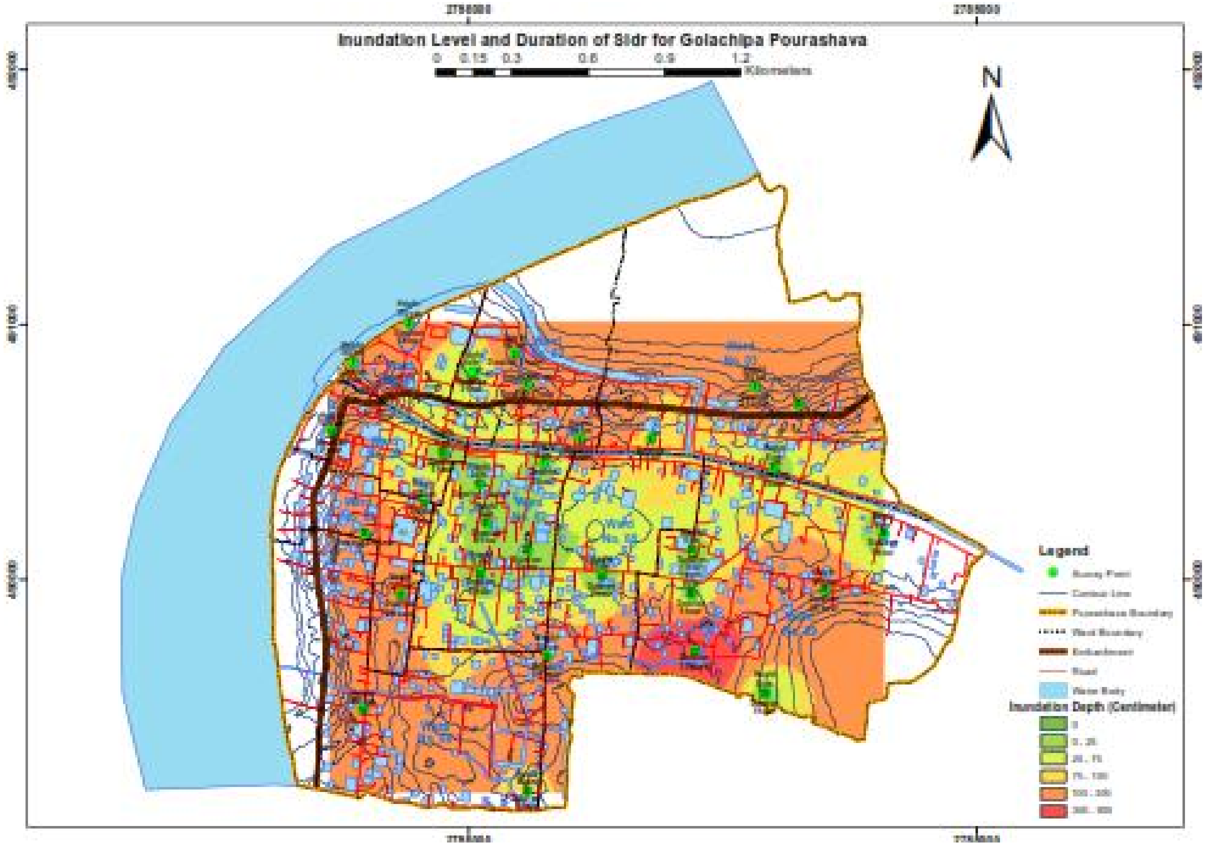

Source: PPTA Consultant.

### III.3.2 Flood Inundation in Galachipa

75. Because of some confusion in the data collected from the field, the monsoon and extreme tidal inundation maps could not be prepared. Collected data indicate that some areas in southeastern Galachipa Pourashava exhibit inundation ranging from 70-90 cm but duration may vary from one week to 1 month. These are the poorly drained areas where the long-lasting inundations cause damage to properties and sufferings to lives and livelihood.

76. The inundation map of Galachipa is presented in **Figure III.2** for storm surge due to Sidr**.** The map indicates that all areas of the pourashava, except a small area in the central part, were inundated. The depth of inundation varied from 100-200 cm. The range of duration was 1.5 - 4 hours at different locations, except in one point in the southeast where the duration was found to be 1.5 days.

**Figure III.2: Storm Surge Inundation Map due to Cyclone Sidr for Galachipa Pourashava**

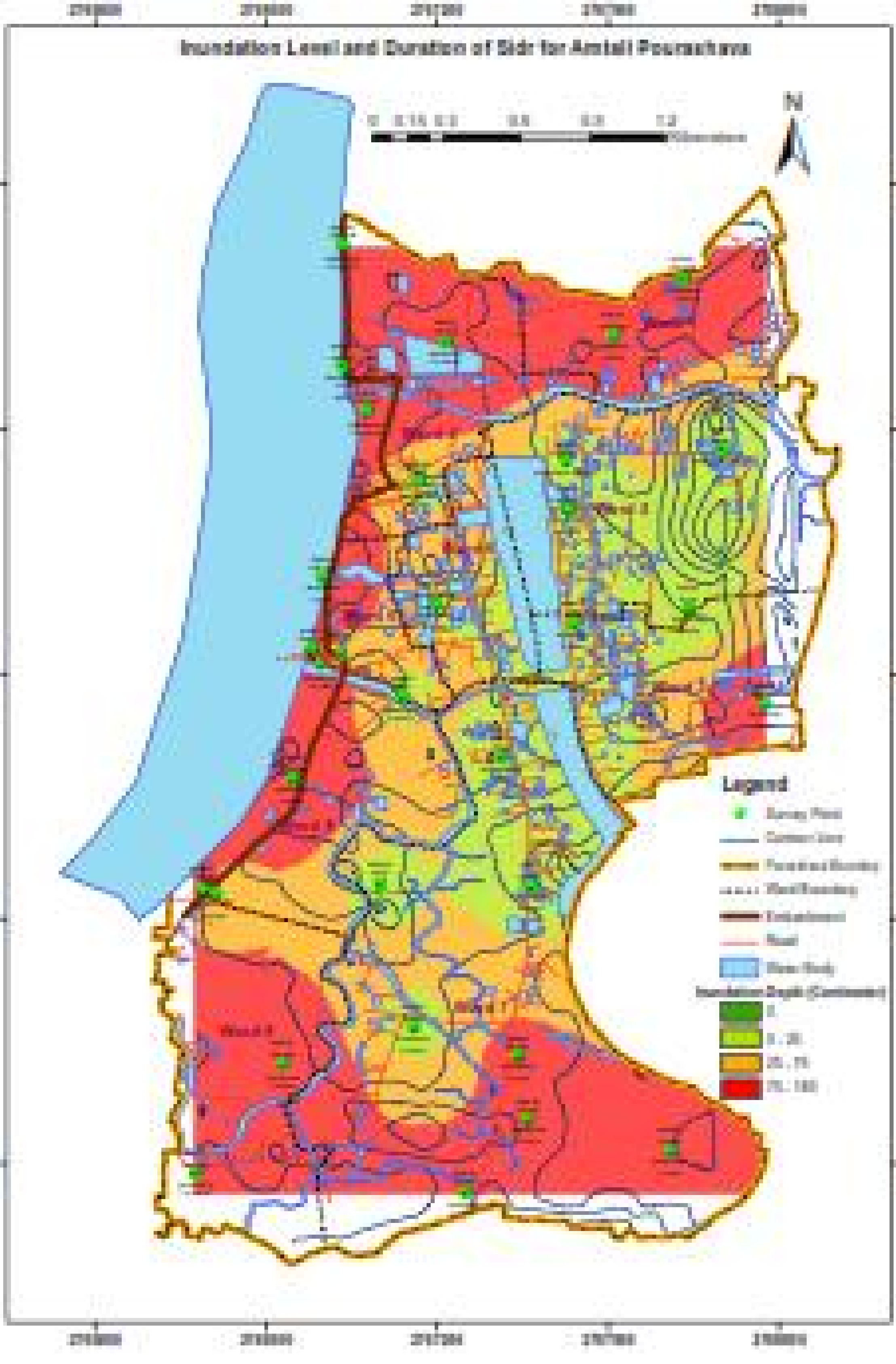



Source: PPTA Consultant.

### III.3.3 Flood Inundation in Amtali

77. Inundation maps of monsoon and extreme tidal events were not prepared, because the field data doesn't match with the distribution of contour lines. **Figure III.3** shows inundation by storm surges associated with the category-5 cyclone Sidr. Large parts of the pourashava were inundated except a portion in the core areas of the town. According to the information collected from the field, the storm surge overtopped and damaged the embankment in a number of places. The inundation level was from 50-200 cm and duration was around 1-2 hours. But this short duration storm surge damaged the *katcha* and semi *pucca* houses, trees, household properties and crops. It was reported that 11 people died in the pourashava due to the shattering impacts of storms and surges.

**Figure III.3: Inundation Map for Amtali from Storm Surge Associated with Cyclone Sidr**




Source: PPTA Consultant.

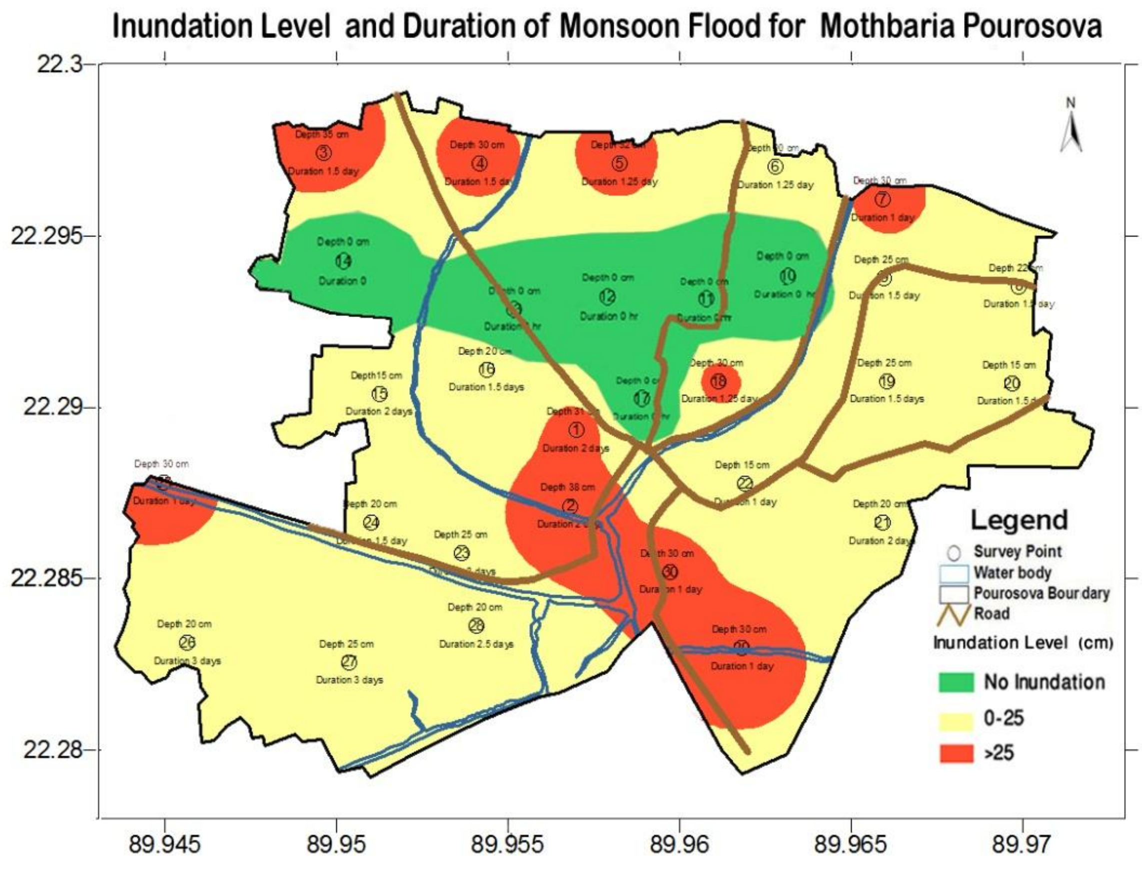
### III.3.4 Flood Inundation Maps for Mathbaria

78. Based on the GIS map prepared using the field data **[Figure III.4(a)]**, it is seen that monsoon flooding is widespread in Mathbaria, except an area to the north as shown in green. Some areas to the extreme north of the town experience floods of 25-35 cm depth. A zone with high inundation levels (25-40 cm) extends from the central part of the pourashava to the southeast. Patches of high inundation are located in the south. The relatively small area (denoted by green tone) in the south-central part is not affected by flood. The rest of the areas with yellow tone are inundated by depth up to 25 cm. The inundation lasts for 1-3 days causing suffering to people, their livelihood and damage to the infra structures.

79. **Figure III.4(b**) shows that tidal inundation is not dominant in the town except for isolated locations.

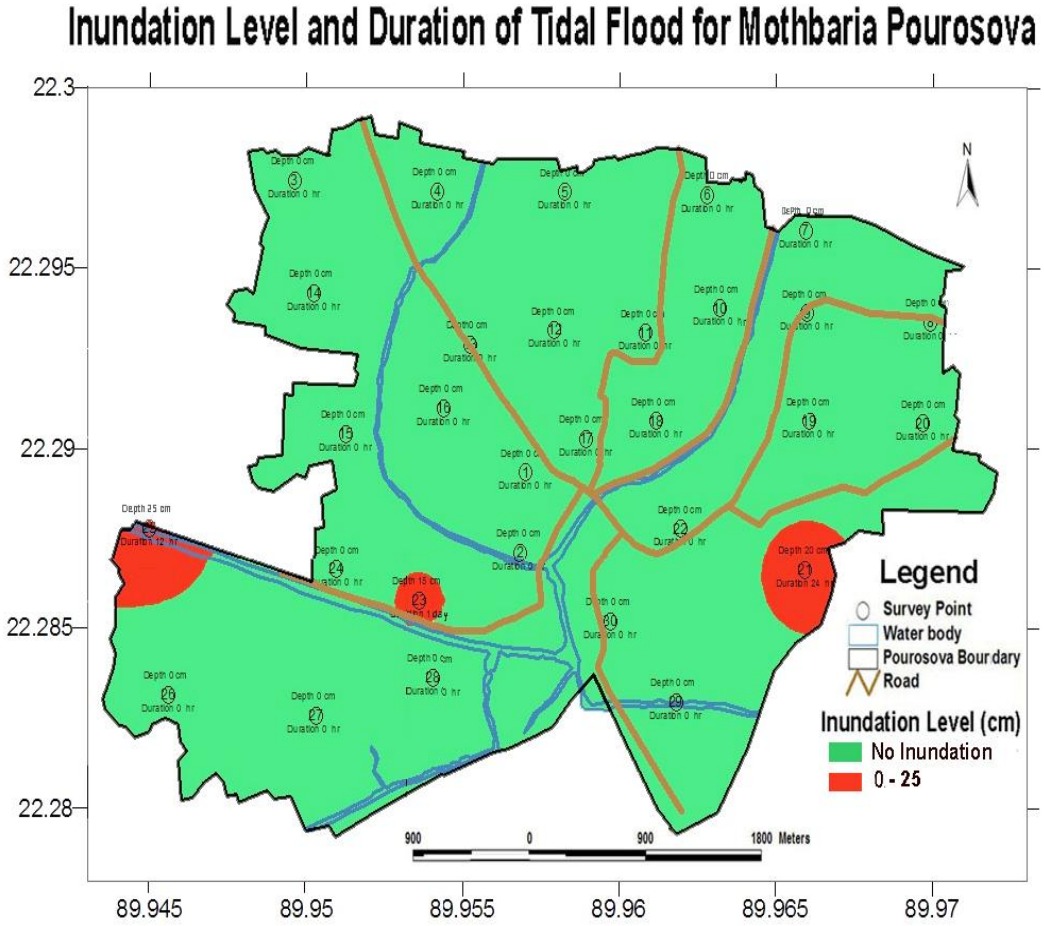
80. **Figure- III.4(c)** shows that the whole pourashava was severely affected by storm surge inundation during Sidr. Most of the area had a flooding depth of 75-125 cm and above. The duration was around 1.5-2.5 hours.

**Figure III.4(a): Inundation Level due to Extreme Monsoon Flooding in 2012 in Mathbaria**



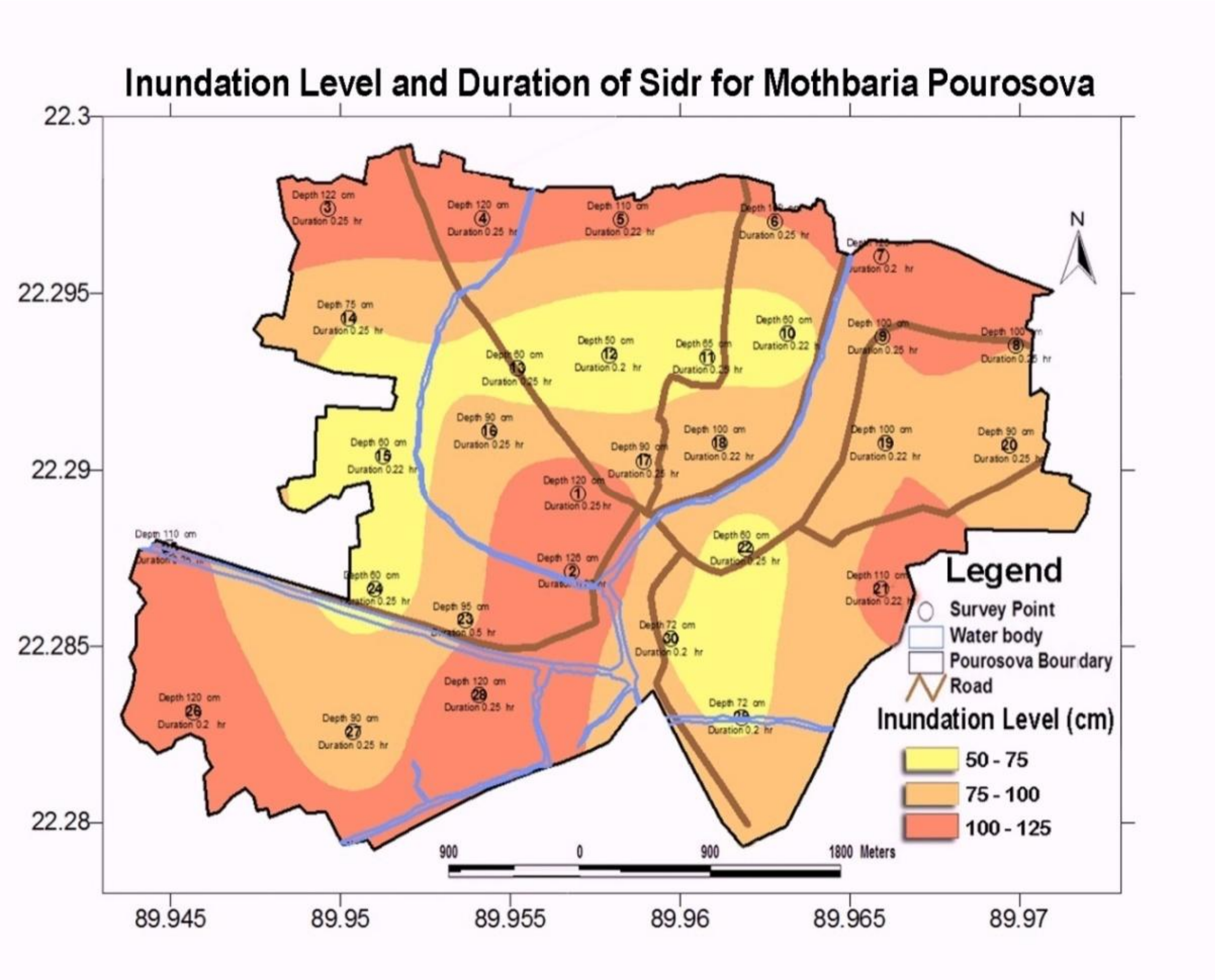

Source: PPTA Consultant.

**Figure-III.4(b): Inundation due to Extreme Tidal Flooding in 2012 in Mathbaria Pourashava**




Source: PPTA Consultant.

**Figure III.4(c): Mathbaria Inundation Map due to Storm Surge Flooding Associated with**




**Sidr**

Source: PPTA Consultant.

## III.4 Possible Inundation based on Model Design Storms for 2012 and 2050 and Drainage Congestion

81. The drainage and flood control component of the PPTA investigated the potential impact of drainage congestion on flooding in Amtali, Galachipa and Piropur in 2012 (base year) and 2050 (projection year), using respective Digital Elevation Models (DEM) and projection of rainfall by 2050. However, assessment of the impact in Mathbaria was not possible because the DEM was not available.

82. The results of the study are shown in **Table III.3** and are illustrated in **Figures III.5 – III.7**. They should, however, be treated with caution. This is because of insufficient data about factors such as interruptions in natural drainage patterns due to elevated road levels, tertiary and secondary drains redirecting water into other catchments, the topography outside the pourashava boundaries, etc. The large amount of flooding shown in the southwest and southeast of Galachipa is an example of the latter, and is considered highly unlikely because the land outside the pourashava is low lying. However no data could be obtained to determine the extent the respective catchments and their DEMs.

83. As shown in the figures and Table III.3, and as might be expected, the flooded area has increased in each pourashava. Also, what is most noticeable is the increase in the area flooded more than 25 cm deep (6.5-7.6%). The cause of this increase in the flood area is attributed to the increase of monsoon rainfall. Of course the increase of flood area is a function of the topography, but as 25 cm is the depth at which the flooding causes significant physical and economic impacts any action that can minimise these impacts will be helpful.

84. Important essential infrastructure and services such as water supply, sanitation, roads, and properties will be at increased risk, with consequent human and economic impacts due to increased area and level of monsoon flooding. Moreover, the number and intensity may increase in the future causing more frequent floods with higher damage and loss.

**Table III.3: Inundation Areas and Depths, 2012 and 2050 - Amtali, Galachipa and Pirojpur**

| Town | Flooding | 2012 | | 2050 | | Change in area (%) |
|---|---|---|---|---|---|---|
| | | Area flooded (ha) | % total area | Area flooded (ha) | % total area | |
| Amtali | not flooded | 236 | 36% | 201.4 | 31% | -5.3% |
| | flooded | 414.4 | 64% | 449.3 | 69% | 5.4% |
| | flooded 0-25 cm | 367.2 | 56% | 352.9 | 54% | -2.2% |
| | flooded >25 cm | 47.2 | 7% | 96.4 | 15% | 7.6% |
| Galachipa | not flooded | 142 | 46% | 124.3 | 40% | -5.7% |
| | flooded | 167.1 | 54% | 184.8 | 60% | 5.7% |
| | flooded 0-25 cm | 113.7 | 37% | 111.4 | 36% | -0.7% |
| | flooded >25 cm | 53.4 | 17% | 73.4 | 24% | 6.5% |
| Pirojpur (urban core catchments) | not flooded | 455.7 | 61% | 405 | 54% | -6.8% |
| | flooded | 292.4 | 39% | 343.1 | 46% | 6.8% |
| | flooded 0-25 cm | 236.7 | 32% | 238.1 | 32% | 0.2% |
| | flooded >25 cm | 55.7 | 7% | 105 | 14% | 6.6% |

Source: PPTA Consultant.

**Figure III.5: 1:10 Year Design Storm Inundation due to Drainage Congestion in Amtali, in 2012 (a) and 2050 (b)**

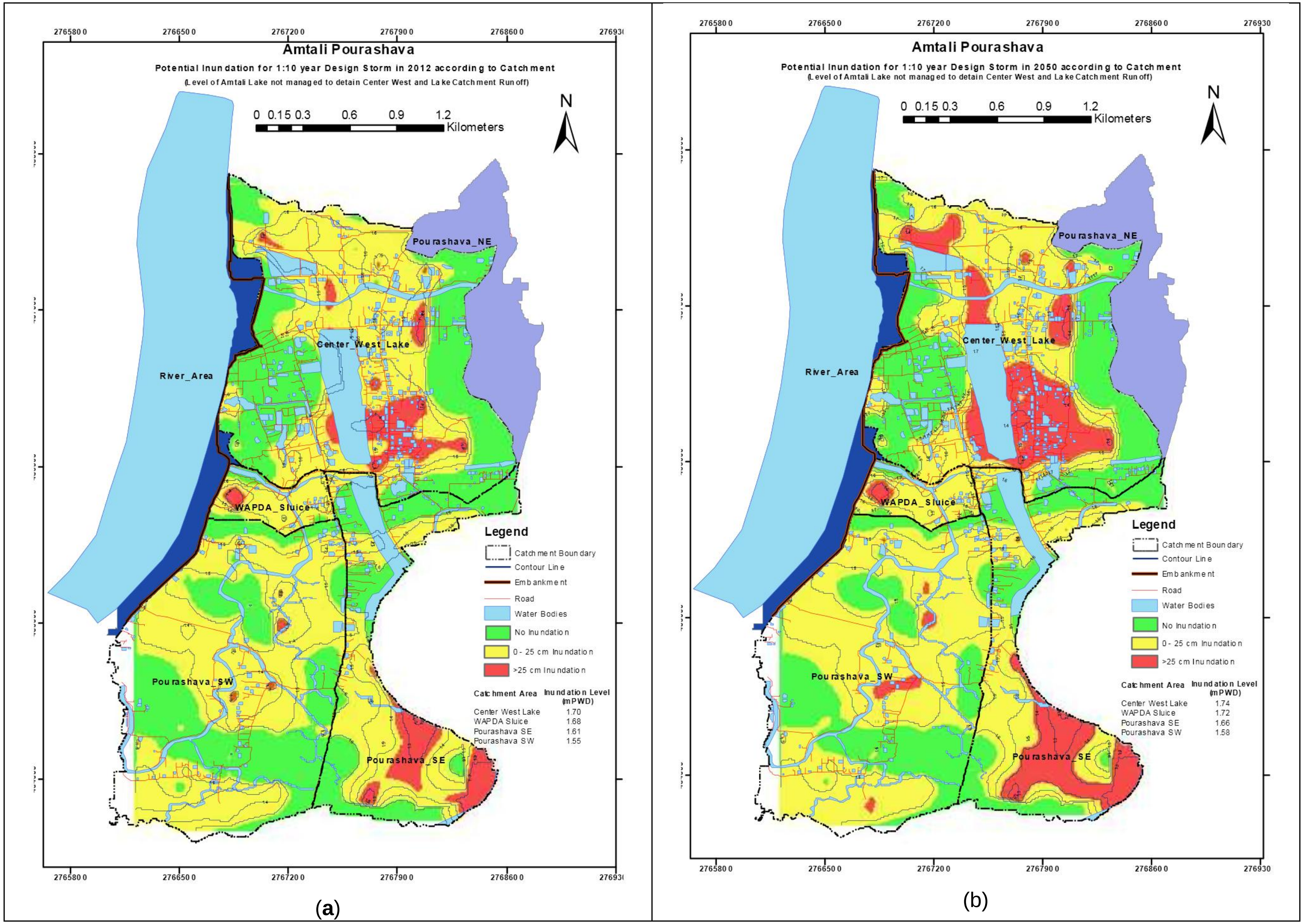
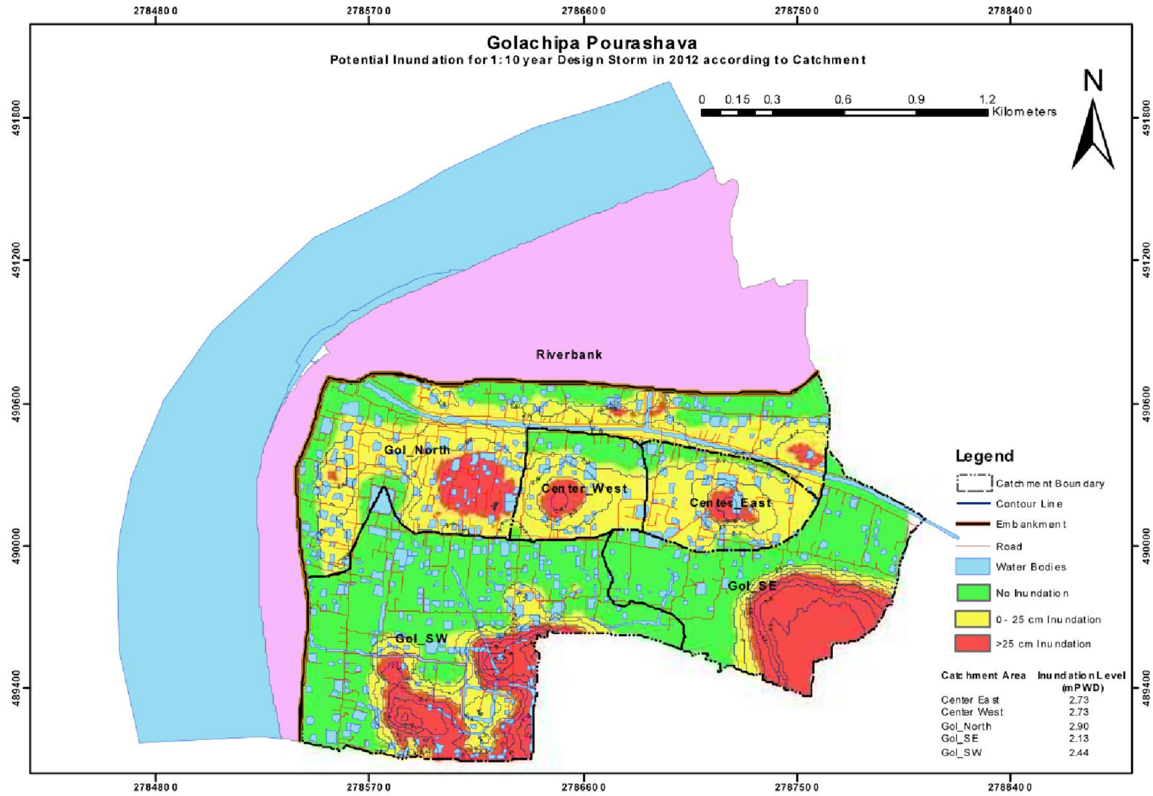
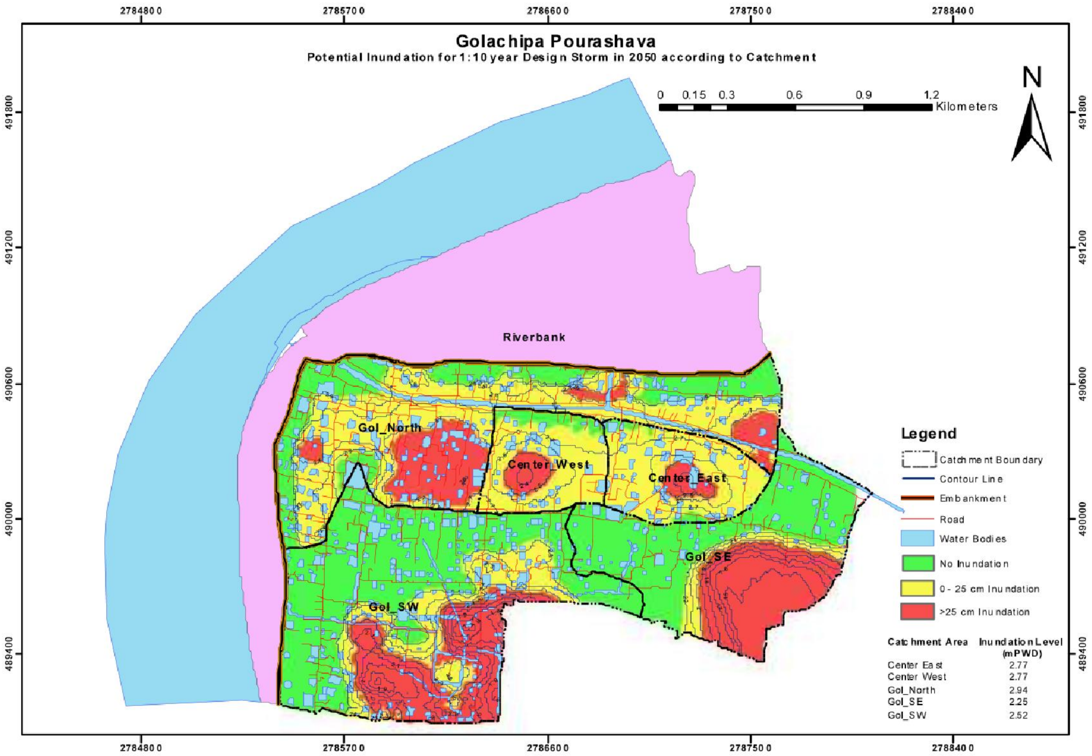


**Figure III.6: 1:10 Year Design Storm Inundation due to Drainage Congestion in Galachipa, in 2012 (a) and 2050 (b)**



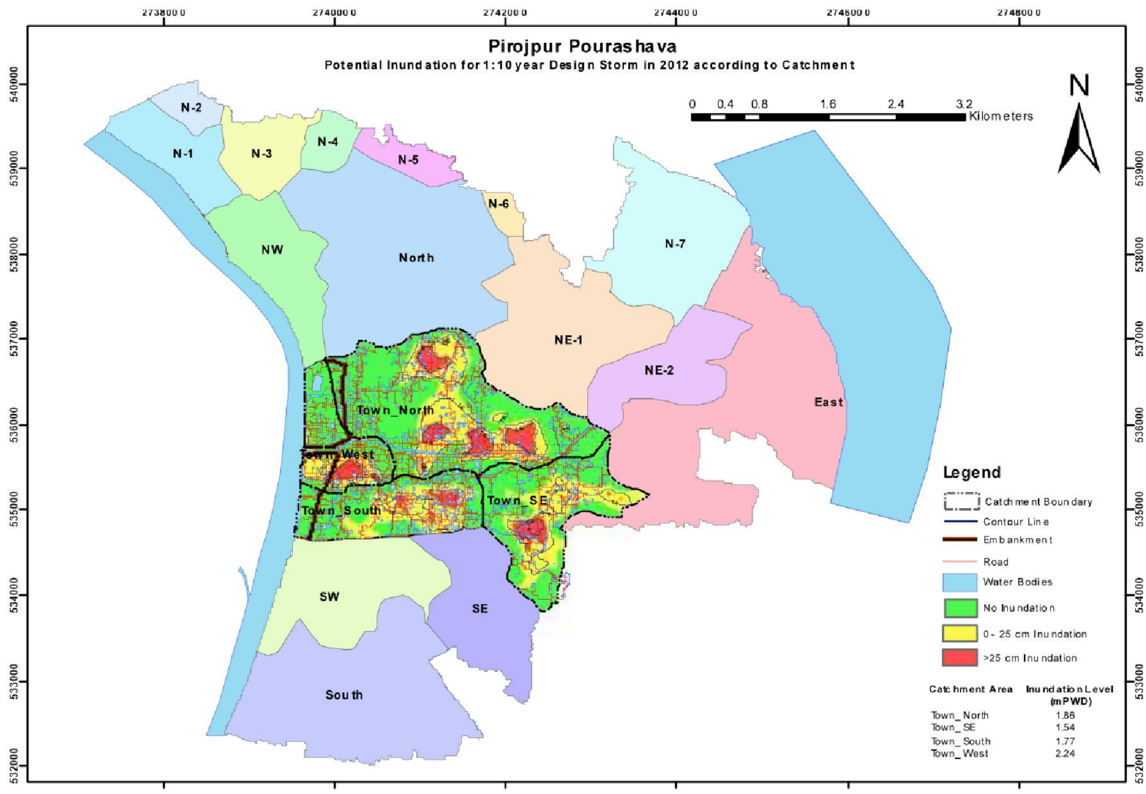

(a)



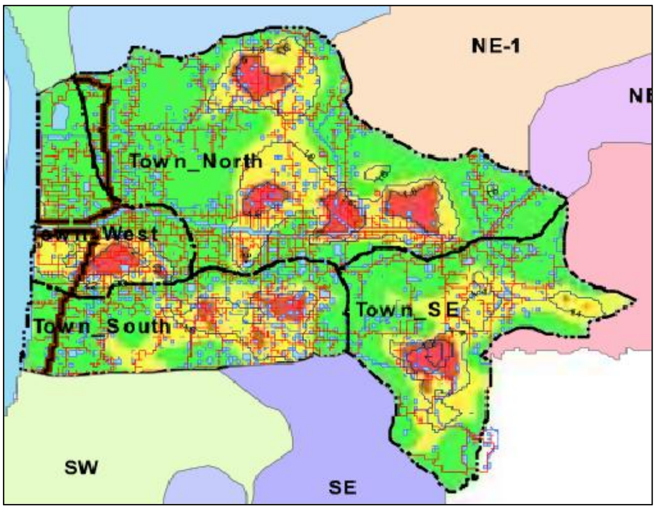

(b)

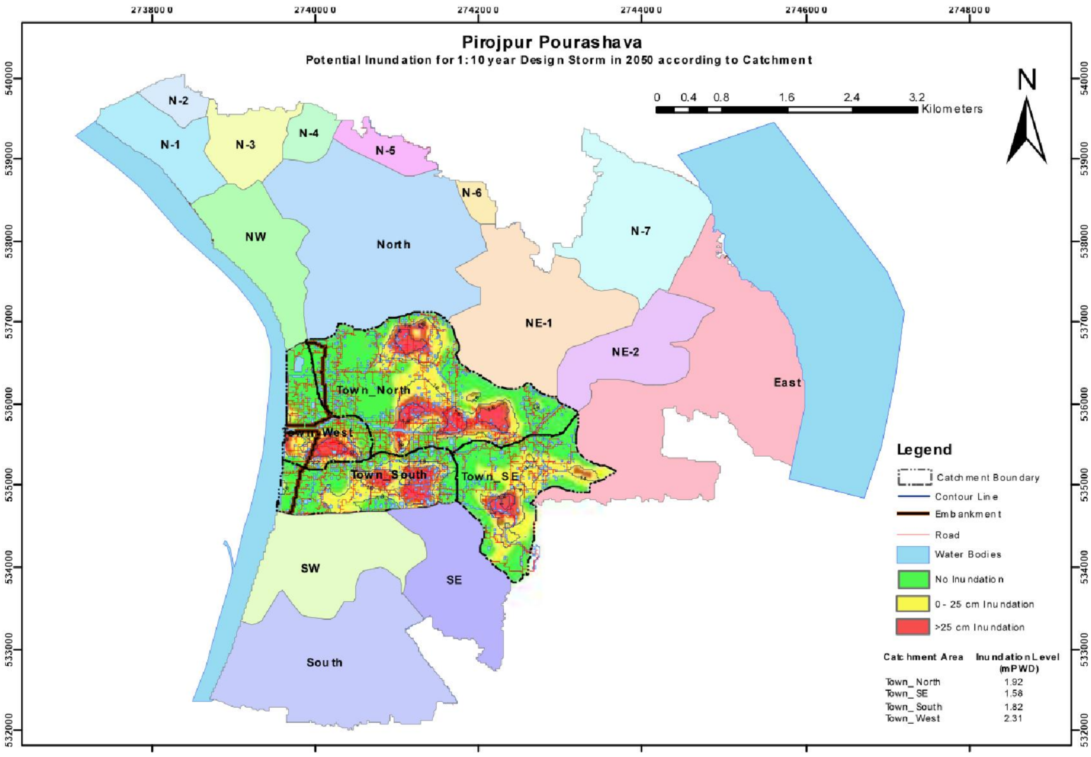
Source: PPTA Consultant.

**Figure III.7: 1:10 Year Design Storm Inundation due to Drainage Congestion in Pirojpur, in 2012 (a) and 2050 (b)**

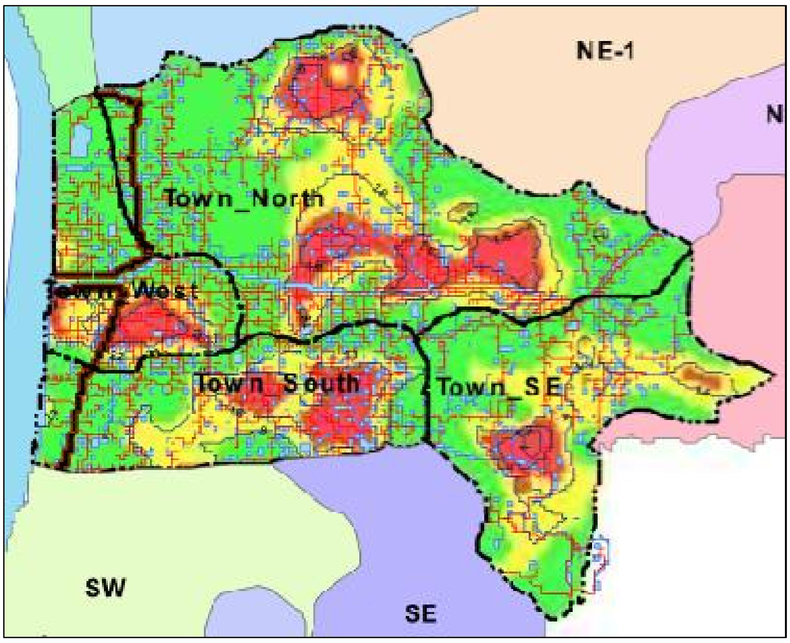



(a)




Pirojpur Pourashava
Potential Inundation for 1:10 year Design Storm in 2050 according to Catchment
0 0.4 0.8 1.6 2.4 3.2 Kilometers
N
N-1
N-2
N-3
N-4
N-5
N-6
N-7
NW
North
NE-1
NE-2
East
Town_North
Town_West
Town_South
Town_SE
SW
SE
South
Legend
Catchment Boundary
Contour Line
Embankment
Road
Water Bodies
No Inundation
0 - 25 cm Inundation
>25 cm Inundation
Catchment Area
Inundation Level (mPWD)
Town_North 1.92
Town_SE 1.58
Town_South 1.82
Town_West 2.31

(b)


NE-1
Town_North
Town_West
Town_South
Town_SE
SW
SE

## III.5 Analysis of Cyclone Impacts

85. The PPTA estimated the probability per year of different categories of tropical cyclones using the future scenarios of tropical cyclone intensity of different categories relative to the statistics of the decade 1991-2000, which was a relatively normal period in terms of the distribution of tropical cyclone intensity. The results of the future cyclone probability estimate were given in Table III.1. The results show a shift in frequencies of low intensity cyclones towards higher intensity. The probability of category- 5 cyclones is considerably higher in 2050 when the probability of category-0 cyclone declines to 0.1.

### III.5.1 Approach and Methodology of Tropical Cyclone Damage Assessment and Projection of Damages for Future up to 2050

86. The basic principles of loss and damage assessment of the tropical cyclone impacts and developing future projections include the following steps:

- Assessment of damage values from the damage data for Sidr, Aila and Mahasen provided by the pourashavas and obtained from the CDTA final report. Data of Mahasen was available only for Galachipa. The data for Mothbaria was not available.
- Assess the wind speed experienced by the pourashavas based on the distance of the pourashavas from the track and from landfall point.
- The damage values have then been related with the assessed wind speed to generate damage function.
- The probability matrix generated for future tropical cyclones have been used to determine the average wind speed for the decades beginning from 2011-2020 up to 2041-2050. The total decadal values of wind speed are then translated to damage value.

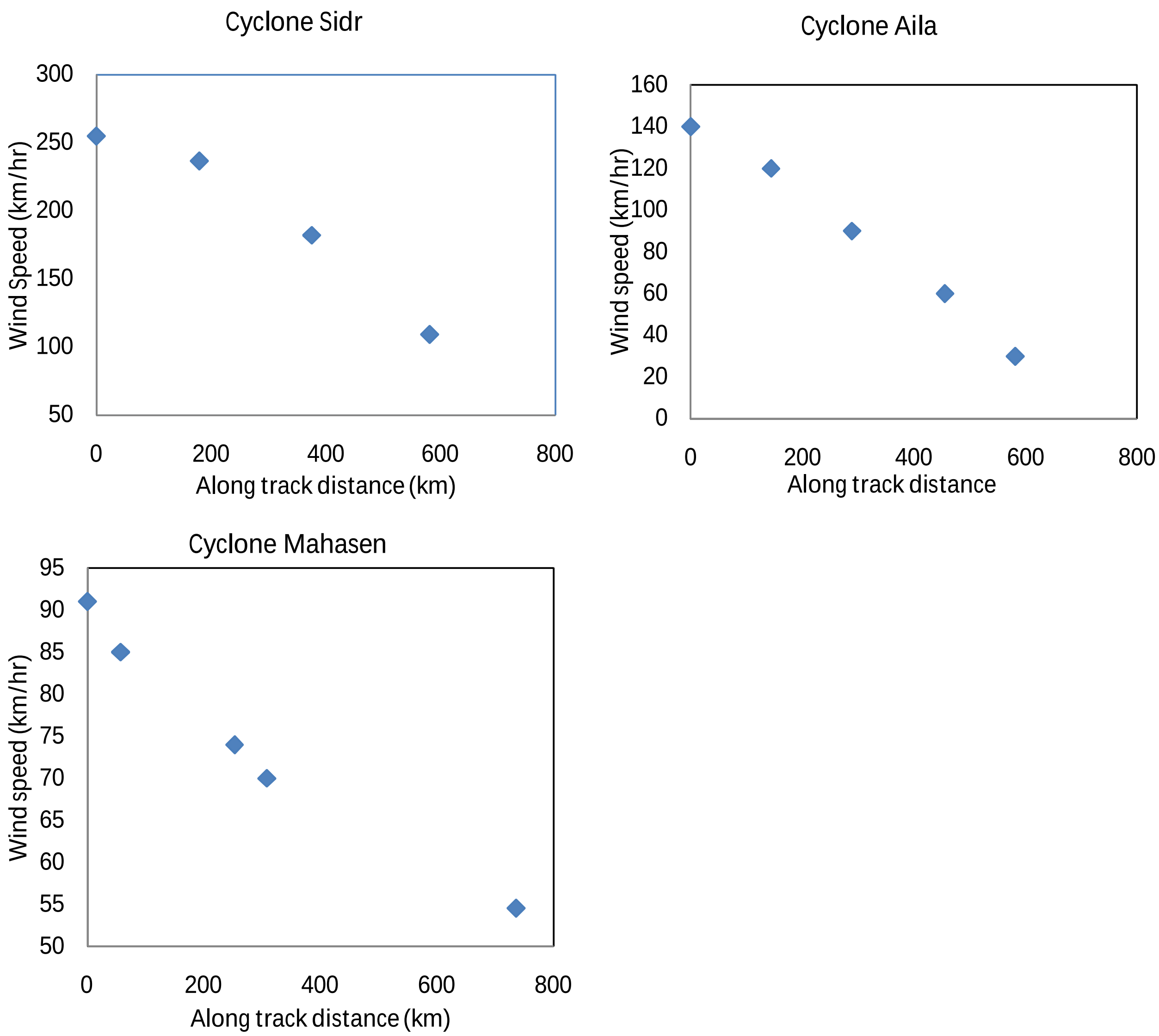
87. **Figure III.8** shows the process of attenuation of the cyclone winds as a function of the distance of the inland travel for the cyclones Sidr, Aila and Mahasen. The functions are not uniform but still it shows certain patterns helpful to estimate the wind speed for inland places of interest.

88. **Figure III.9** shows the radial distribution of maximum wind speed of these cyclones with different intensities. It shows that the maximum wind is obtained near the eye of the cyclone within 20-150 km from the centre depending on the intensity of the cyclones. These two graphs are the basis for estimating the wind speeds in the respective study pourashavas **(Table III.4)** for the cyclones under consideration. Then the wind speed and the cost of damages are used to set the damage functions for the individual pourashava under study.

89. The cyclone damage assessment of the pourashavas was prepared based on the damage data of the pourashavas for cyclones Sidr, Aila and Mahasen. The data for Galachipa was provided by the pourashava to the PPTA team for these cyclones. The data of Pirojpur and Amtoli was available from the CDTA final report for Sidr and Aila. The wind-damage function was developed for the individual pourashava, which was then applied for Mahasen for estimating damage cost of pourashavas Pirojpur and Amtoli.

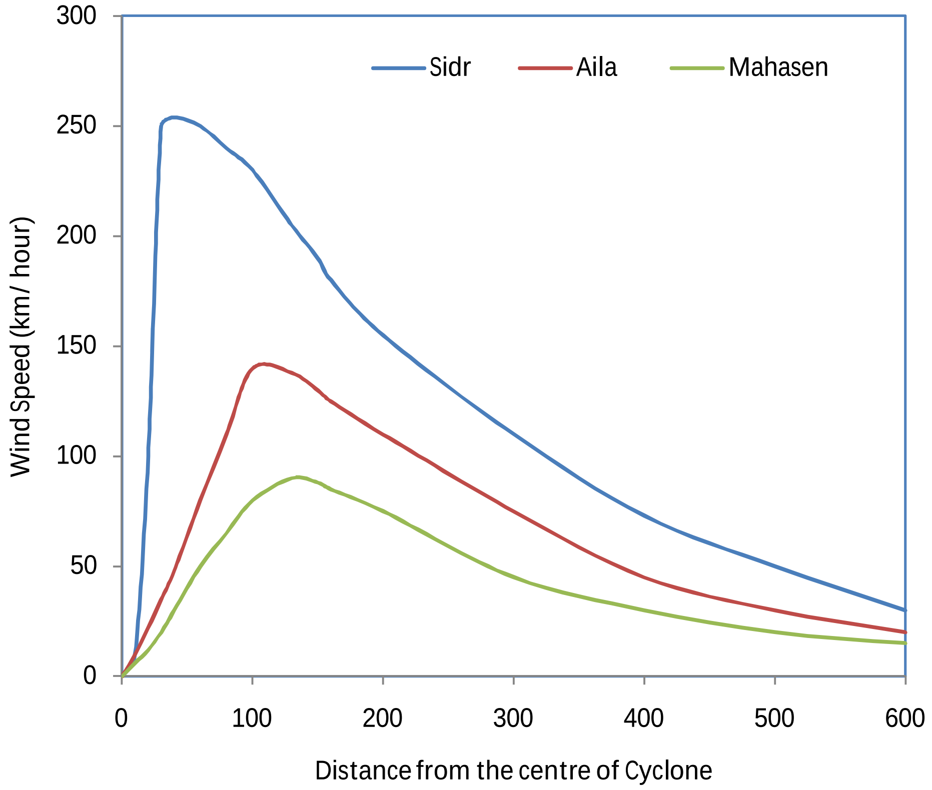
90. Damage data are not available for Mathbaria. To estimate the damage cost for Mothbaria, the damage cost of Galachipa was converted to per capita cost and then the wind-damage function applied to get the per capita damage cost of Mathbaria. The per capita damage cost was multiplied by the population of Mathbaria to determine the estimated Mathbaria damage costs. Since the pourashavas are located in the same region and are close to each other, the above technique is assumed to produce good results.

**Figure III.8: Attenuation of Wind Speed of Tropical Cyclones with the Inward Travel of the Cyclone (Examples of Sidr, Aila and Mahasen)**




Source: PPTA Consultant.

**Figure III.9: Radial Distribution of the Maximum Wind of a Radially Symmetric Cyclonic Vortices like Sidr, Aila and Mahasen**




Source: PPTA Consultant.

**Table III.4: Distance along the Track at Perpendicular Point from the Pourashavas and the Distance of the Track from the Pourashavas**

**Sidr** (distance is expressed in km)

| Pourashava | Distance along track from landfall point (km) | Perpendicular distance from pouroshava (km) | Maximum wind speed (km/hr) at pourashava |
|---|---|---|---|
| Galachipa | 30 | 60 | 235 |
| Amtoli | 40 | 25 | 230 |
| Mothbaria | 50 | 10 | 225 |
| Pirojpur | 80 | 20 | 220 |

**Aila**

| Pourashava | Distance from landfall point along track (km) | Perpendicular distance from pourashava (km) | Maximum wind speed (km/hr) |
|---|---|---|---|
| Galachipa | 60 | 220 | 115 |
| Amtoli | 74 | 185 | 120 |
| Mothbaria | 89 | 156 | 125 |
| Pirojpur | 110 | 160 | 120 |

**Mahasen**

| Pourashava | Distance from along track landfall point (km) | Perpendicular distance from pourashava (km) | Maximum wind speed (km/hr) |
|---|---|---|---|
| Galachipa | 14 | 13 | 88 |
| Amtoli | 13 | 44 | 89 |
| Mothbaria | 11 | 77 | 75 |
| Pirojpur | 42 | 93 | 70 |

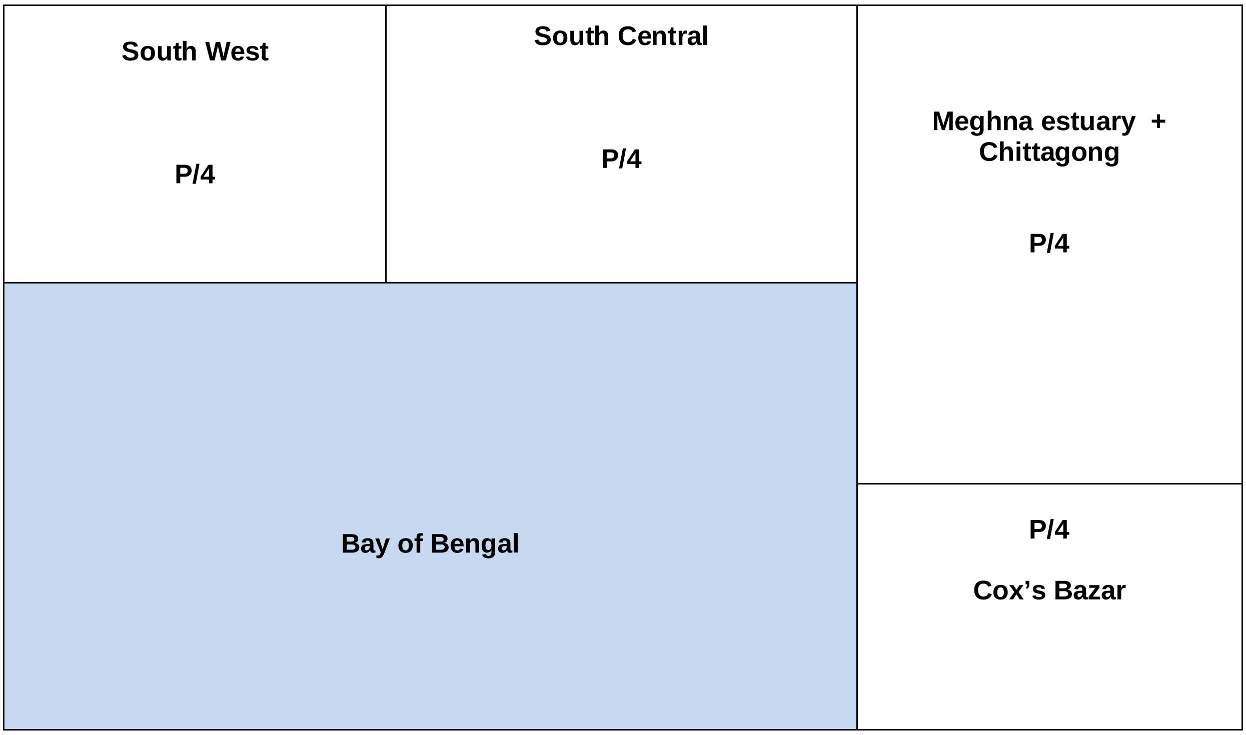
Source: PPTA Consultant.

### III.5.2 Prediction of Future Cyclone Damages

91. The probability of increased cyclone intensity for various categories of cyclones was used for the prediction of future damage cost. The derived future probability was estimated for whole coast zone. We derive the probability of the tropical cyclones impacting on the South Central zone that contains the study pourashavas. **Figure III.10** shows the sketch of the coastal zone with total probability of tropical cyclone occurrence of **P**.

92. If the total probability of cyclone landfall is considered **P**, then the contribution for each of the zones would be **P/4**. But for considering the impacts of the cyclones the probability of the concerned zone **(P/4)** together with assumed 50% contribution of the impacts on the concerned zone from the adjacent right and left divisions (**P/8+P/8=P/4**) constitute the total probability **P/2** impacting on the south central region. Thus the probability table now declines to the following if we consider the total impacts on the study area.

**Figure III.10: Sketch showing the Coastal Regions Corresponding to the Land Fall Zones**




Source: PPTA Consultant.

**Table III.5: Projection of Probability of Tropical Cyclones for the Future for Different Intensity Levels for the South-central Coast Region Covering the Study Pourashavas**

| Projection of probability of tropical cyclone incidence for future | | | | |
|---|---|---|---|---|
| **Categories** | **2011-2020** | **2021-2030** | **2030-2040** | **2040-2050** |
| Tropical Cyclonic storms Cat-0 ( 62-117 km/hr) | 0.2 | 0.2 | 0.1 | 0.05 |
| Cat-1 (118-153 km/hr) | 0.1 | 0.05 | 0.1 | 0.1 |
| Cat-2 (154-177 km/hr) | 0.1 | 0.05 | 0.05 | 0.1 |
| Cat-3 (178-207 km/hr) | 0.1 | 0.05 | 0.1 | 0.1 |
| Cat-4 (208-251 km/hr) | 0.1 | 0.2 | 0.2 | 0.15 |
| Cat-5 km/hr (speed>250 km/hr) | 0.05 | 0.1 | 0.1 | 0.15 |

Source: PPTA Consultant.

93. So the aggregated wind speed using category wise probability distribution is obtained as:

$$\overline{V} = \sum p_i v_i$$

where $p_i$ =probability of cyclone of $i_{th}$ category with central speed $v_i$ of that category.

94. The probability of each i category was used to obtain the aggregated wind speed for each pourashava for the years 2010, 2020 and so on up to 2050. Then the wind speed-damage functions of the individual pourashava were applied to obtain the damages against the aggregated wind speed for the respective time frame. The results are shown in **Table III.6**.

**Table III.6: Estimated Future Projection of Damages Caused by Tropical Cyclones**

(Million US$)

| **Pourashava** | **2010** | **2020** | **2030** | **2040** | **2050** |
|---|---|---|---|---|---|
| Galachipa | 2.51 | 2.85 | 3.07 | 3.62 | 4.43 |
| Amtoli | 3.48 | 3.87 | 4.12 | 4.40 | 5.53 |
| Mothbaria | 2.65 | 3.07 | 3.34 | 3.65 | 4.95 |
| Pirojpur | 2.58 | 3.00 | 3.31 | 4.20 | 5.81 |
| Total | 12.79 | 13.83 | 15.87 | 20.71 | 21.84 |

Source: PPTA Consultant.

## III.6 Saline Intrusion

95. The coastal zone of Bangladesh is vulnerable to increasing salinity over land, surface water and groundwater. The western part of the Bangladesh coastal zone has become highly vulnerable to salinity after the occurrence of Sidr and Aila when the storm surges carried huge masses of saline water to the land areas across the embankment by overtopping as well as breaching of embankments, along with damaging a number of sluice gates.

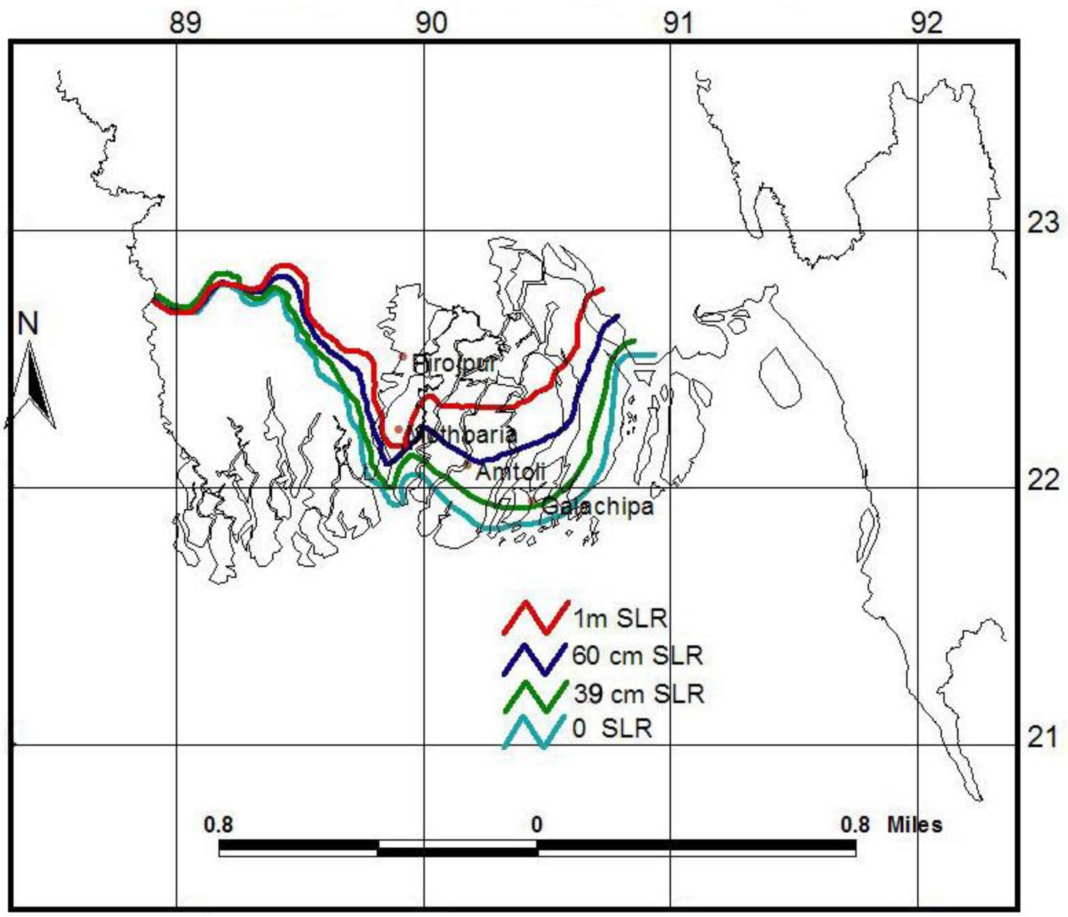
96. Movement of the salinity front has been enhanced for three reasons: (1) the drastic decrease of fresh water flow of the southern rivers (the distributaries of the river Ganges flowing to the Bay of Bengal) in the winter due to upstream withdrawal of water, which has

disturbed the natural balance of the tidal rivers; (2) sea level rise due to global warming and land subsidence, which has caused tidal waves to enter far north along the shallow coastal zone, especially in the western coastal zone; and, (3) occurrences of tropical cyclones with higher intensities causing high storm surges on top of the sea level rise, which carry huge masses of saline water to the land and also contaminates surface water sources.

97. The CDTA study referring to the work of CEGIS (2006) characterized the present and future salinity intrusion levels. Present conditions of salinity intrusion levels in the four CTIIP PPTA coastal towns are between 0-1 ppt. These levels will remain the same up to 2050 with a sea level rise of 32 cm. Even in 2100, with the sea level rise of 88 cm, the salinity intrusion level will remain between 0-1 ppt.

98. The landward progression of salinity lines at 5ppt at different sea level rise scenarios from SLR of 0 cm (present), 39 cm for 2050, 60 cm for 2065 and 100 cm for 2100, is shown on **Figure III.11**. The figure shows strong salinity intrusion by 2065 and 2100 over the central coastal zone, covering the study pauroshavas. It is seen that by 2050 Galachipa will be affected by 5 ppt salinity, and in 2065 Amtali, Galachipa and Mothbaria will be engulfed by the 5 ppt line. Pirojpur is found to be out of danger even by 2100.

**Figure III.11: Landward Movement of Equal Salinity Line (5 ppt) for Different Sea Level Rise Scenarios**




*(Source: Modified and redrawn from DoE, 2005 based on IWM data )*

99. Information collected by the consultants from the study towns indicates that Mathbaria and Pirojpur do not have a suitable groundwater aquifer for drinking water. However, other pourashavas under the study use groundwater for drinking. The current PPTA study recommends continuous monitoring of salinity both of the surface and ground water salinity levels to gain a better understanding of this highly important aspect of the coastal environment on human health and economic activity.

100. This aspect is discussed in detail in the report on Groundwater Resource Assessment for Coastal Areas of Bangladesh in **Annex E, Volume 5**. The report gives a detailed description of the groundwater characteristics and investigates the causes of increase of surface and groundwater salinity, along with an analysis of groundwater potential in Barisal Division. The report identifies climate change and sea level rise as one the vital factors causing enhanced salinity over the land surface and of surface and groundwater.

101. Along with numerous health impacts induced by drinking saline water are the hypertension and for pregnant women pre-eclampsia, early delivery and swelling of legs (Khan et al., 2011).[36] The salinity impact on health appears to be a serious problem for the coastal zone (Khatoon and Salehin, 2012).[37] However, the salinity of surface water and groundwater has not been an acute problem in the study pourashavas, except for the non-availability of fresh groundwater at Pirojpur and Mathbaria.

102. Sea level rise and increased storm surge height, along with exhaustive pumping of groundwater, poses future salinity risks over this area. However, groundwater recharging plants or managed aquifer recharge might help to enrich the groundwater aquifer as a future means of addressing increased groundwater salinity.

## III.7 Climate Change Adaptation in Coastal Towns

103. Considering the potential climate change impacts, as described in the previous sections, possible adaptation measures are outlined in **Table III.7**, based on guidance provided in the report of ADB TA7902-BAN (2012) and the data collected from field trips during the PPTA.

**Table III.7: Town Specific Climate Change and Adaptation (User Friendly Output for Climate Resilience)**

| **Pirojpur, Mathbaria, Amtali and Galachipa Pourashavas** | | | |
|---|---|---|---|
| **Climate element** | **Status of change** | **Impacts** | **Recommended adaptation** |
| Temperature | Current change: $0.4^0$ C during last 50 years<br>Future: $1.4^0$C by 2030 and $2.5^0$ C by 2050 | Infrastructure damaged by long exposure to heat, new concrete structures weakened due to poor curing. | Materials and design to be selected suitable for resilience of high temperature.<br>Placing and curing of concrete requires more water. |
| | | Surface water is rapidly evaporated affecting household water supplies and garden irrigation.<br>Due to heat, overall per capita water needs will increase.<br>Agriculture and fisheries suffer due to rise of temperature and greater | Water supply projects should include future increased demands in addition to that due to increase of population and future development.<br><br>Rainwater harvesting needs to be encouraged and suitable design may be prescribed for this purpose including making arrangements for rainwater preservation and use for domestic application. Reserve ponds may be dug to preserve rainwater for community use. |

36 Khan et al. 2011: Drinking water, salinity and maternal health in coastal Bangladesh: Implication of Climate Change. Environmental Health Perspectives 119(9):1328-1332.
37 Sayma Khatoon and Mashfique Salehin, 2012: Salinity constraints to different water uses. Bangladesh J. Sci. Res., 25 (1),33-42.

| Pirojpur, Mathbaria, Amtali and Galachipa Pourashavas | | | |
|---|---|---|---|
| **Climate element** | **Status of change** | **Impacts** | **Recommended adaptation** |
| | | salinity. | |
| | | High temperature affects health due to heat stroke, dehydration and facilitates diseases like diarrhea, asthma and heart and kidney failure. | Building design criteria should consider suitable factors to keep interiors cooler. Green coverage should be developed over suitable areas of the towns, so that there is a shielding against the incoming solar radiations that may to some extent provide comfort the people from heat. |
| Rainfall | Current trend: 25 cm in last 50 years<br>Wetter monsoon rainfall with future scenarios:<br>Increase of 13.5-19% in 2030<br><br>Increase of 22-25% in 2050<br><br>Increase of 27% in 2060 | Floods impacting infrastructures | Increased and more intensive rainfall will cause more floods inundating roads and yards, market places and other important areas. It is recommended that the infrastructure is built that the floods do not damage them or the water supply plants, reservoirs, pipe lines are not affected. |
| | | Reduced drainage channel size causes flooding | Larger, steeper or lined drains will be required to discharge excess storm water. The CTIIP towns' topography does not lend itself to steeper drainage with complex pumping or water management arrangements. Land availability for larger drain is also an issue. Keep drains free from waste and siltation. |
| | | Sanitation is damaged due to flood | Sanitation systems should be made climate resilient; especially should be installed above the flood level. |
| | | Sludge and solid waste management is affected | Sludge drying areas and solid waste landfills must be above flood inundation level or protected with embankments or linings to avoid. |
| | | Roads damaged due to more flooding and overtopping. | Ensure road is cambered as designed. Use concrete surfaced roads. Better compaction and use of stronger materials for road bases. Build more culverts and drainage for road base. . |
| Sea Level Rise (SLR)<br><br>Increase of Tidal Level | Current SLR: 4-6 mm/year | Infrastructure is heavily damaged | The infrastructure may need to be raised if not well protected by the embankment. |
| | Projection in 2030: 21 cm reference to land inside polders.<br><br>Projection in 2050: 39 cm reference to land inside polders.<br><br>Tidal Level will also increase due to SLR | Embankments also damaged by increased erosion induced by leaching and overtopping of water. | Raise and strengthen embankments. The embankments need to be protected from on the seaside through planting of trees and by other means of ecological and engineering measures. The areas that are not protected by polders may require sidewalls for tide and surge protection. |
| | | Housing is severely damaged<br><br>Inundate more areas by extreme high tides. | Housing should be of clustering types and be so designed that they are above the flood / surge level on higher plinth above extreme monsoon flood level on compacted soil with concreted perimeter case. The ground floor may be kept open for freely passing of the storm surge flow; the building materials are to be so chosen that the structure is able to sustain strong cyclone winds and thrust of storm surges. The extra protection due to sea level rise is to be undertaken. Climate and flood resilient Building Codes should be developed. |
| | | Water resources / supply sector is severely affected by storm | Ponds, installation site of deep tube wells, reservoirs and distribution lines should be made climate resilient considering the projected of sea level rise; |
| | | Sanitation | The sanitation system is to be made climate resilient considering sea level rise. |
| | | Sludge management<br>Solid waste dumping | Sludge disposal should be made in designated site with appropriate structure so that the tidal water and storm surges do not affect the system due to climate change enhanced sea level.<br>The climate resilience is to be considered for solid waste dumping stations considering extra floods and storm surges in future climate. |
| Tropical Cyclones and surges | Tropical cyclone intensity will rise and the destruction will be | All structural items as mentioned above are affected. | Extra precaution is to be taken because of higher surge levels and higher winds of the future cyclones.<br>The mangrove forests (green belt) may be developed outside the embankment and in the new islands as a |

| Pirojpur, Mathbaria, Amtali and Galachipa Pourashavas | | | |
|---|---|---|---|
| **Climate element** | **Status of change** | **Impacts** | **Recommended adaptation** |
| | severe due to wind and surges. The tropical cyclones may have wind up to 275km/hr in the future. | | protection measure against the impacts of tropical cyclones<br>Strengthen the tropical cyclone and storm surge forecasting and warning system.<br>Strengthen the relief and rehabilitation measures and take care for the injured people<br>Water supply and sanitation system are to be made climate resilient considering higher sea level and higher storm surges.<br>Infrastructure are to be made climate resilient |
| | | Large areas inundate with deep flooding and surges creating hazards to people, livestock and infrastructure. | Build more cyclone shelters with appropriate designs including emergency water and power supplies, toilets, better approach roads and shelter for animals. The refuge or Killas should be constructed near the shelters for sheltering livestock. |
| Salinity impacts | The 5ppt line will move further inland affecting the pourashavas of Amtali and Galachipa in 2050 and all these pourashavas and Mothbaria will come under this 5 ppt line in 2100. | Damages steel / metallic structures through rusting and reduces lives of such structures where metals are used.<br><br>Salinity induced by floods affects the material bonding of the concrete structures causing damages to such structures.<br><br>Adverse Impacts on Agriculture<br><br>Adverse impacts on human health like hypertension, heart diseases, asthma, strokes skin diseases. Pregnant women are especially impacted with increased risk of pre-eclamsia, early delivery and swelling legs. | Designs should consider this impact for undertaking the adaptation measures.<br><br>This aspect is important because salinity can affect all sorts of concrete structures.<br>May need to raise the areas where buildings will be constructed, so that monsoon floods do not affect the structures.<br><br>Agricultural land should be protected from the intrusion of saline water at high tides and storm surges by polders.<br><br>Should take appropriate engineering actions to reduce the salinity level of surface and ground water. The ground water monitoring system should be developed and ground water recharging plants needs to be developed in the appropriate areas. |

Source: PPTA Consultant.

# IV. CLIMATE RESILIENCE COST AND BENEFIT ASSESSMENTS

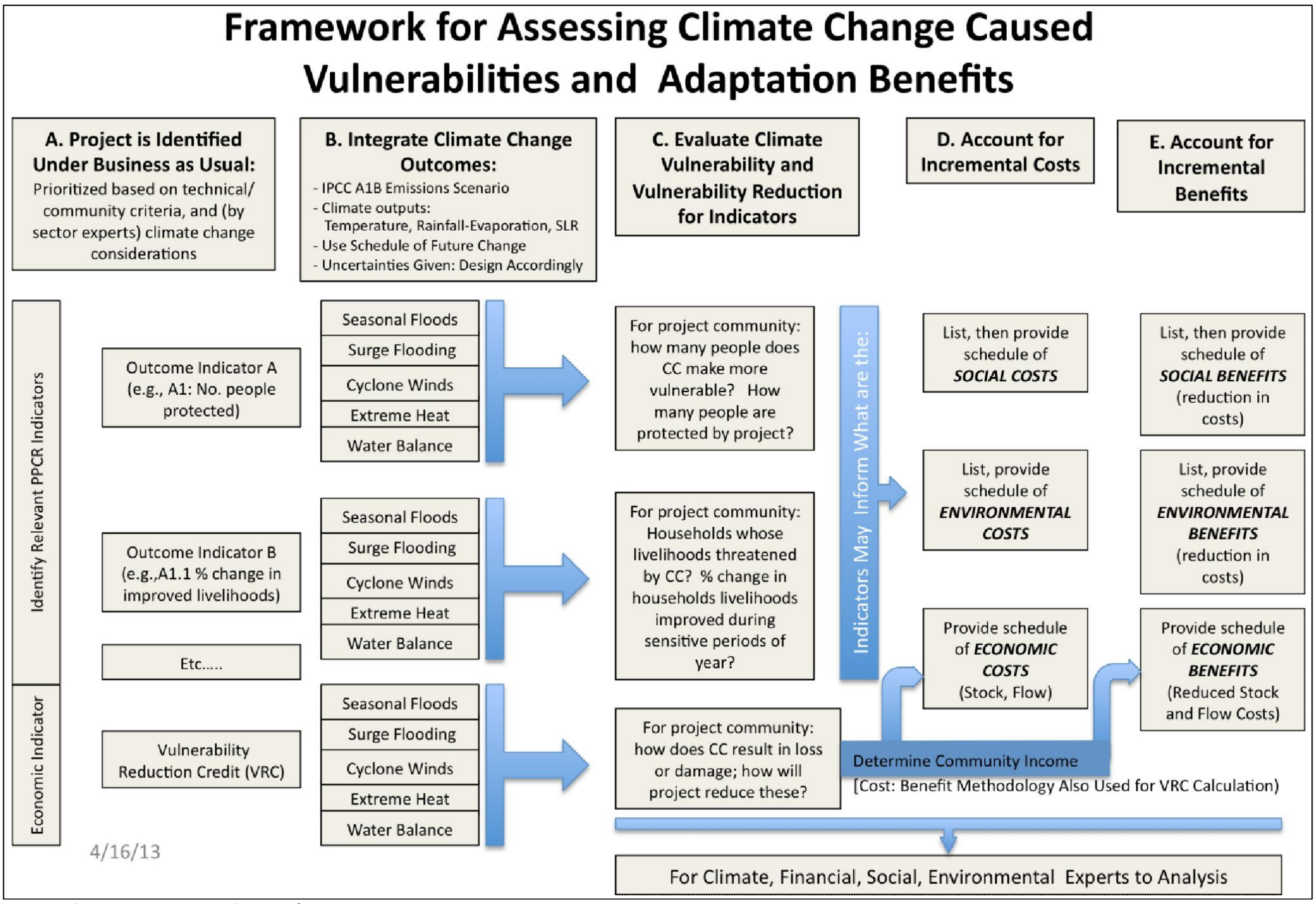
## IV.1 Scenarios for Cost:Benefit Assessment of the Climate Resilience Measures for Infrastructure

104. **Methodology:** The PPTA identified the losses and damages from climate change, and formulated a series of structural and non-structural measures to reduce these losses specifically related to climate change. The incremental costs of these measures were calculated, and then it was possible to assess both the economic, social and environmental costs and benefits of undertaking these measures. **Figure IV.1** outlines the broad process.

105. The PPTA evaluated the economic costs and benefits looking at both direct (stock) damage and loss, and indirect (flow) loss owing to lost productivity, health care costs, and reduced economic activity (see **Figure IV.2** for the process). Economic analyses were possible and performed for the water supply, sanitation, drainage and flood control, solid waster, cyclone shelter, bus terminals, markets, boat landings and road subprojects for each Pourashava.

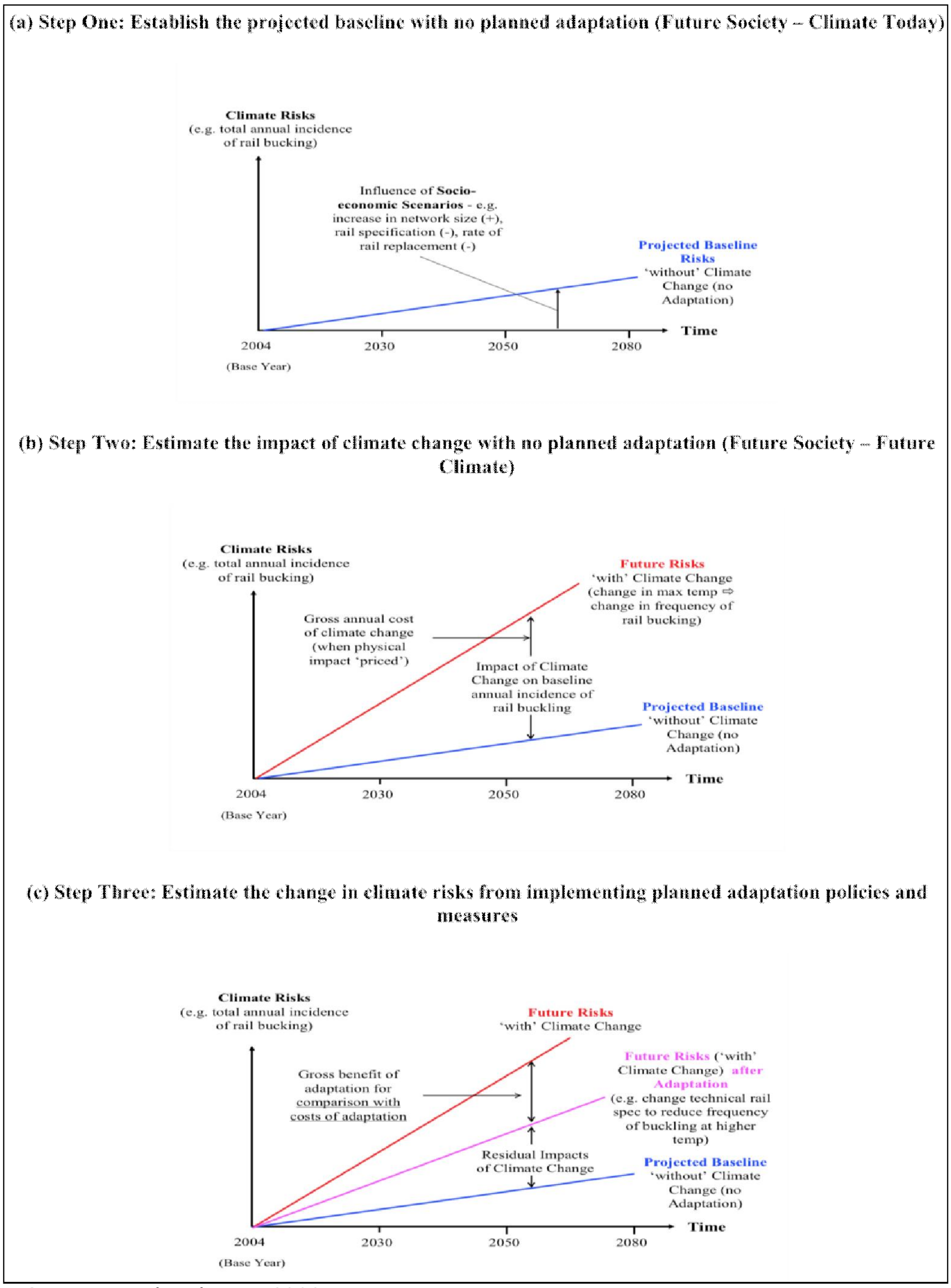
106. Social and environmental impacts of climate resilience are another priority addressed by the PPTA. While data was unavailable to quantify impacts, the consultant social safeguards and environmental specialists examined all climate resilient measures for the subprojects and articulated the potential impacts, positive and negative, from these measures.

**Figure IV.1: CTIIP Climate Assessment Framework**




Source: PPTA Consultant.

**Figure IV.1**: **Steps in Estimating the Impact of Climate Change and Adaptation Measures**




Source: Boyd and Hunt, 2006.

107. The analysis includes an alternative metric, based on the cost: benefit analysis but that also normalizes loss and damage for income levels. This measure, the vulnerability reduction credit (VRC), may be useful in comparing the relative scale of alternative climate resilience measures.

## IV.2 What Impacts can be Quantitatively and Economically Assessed

108. There are a number of challenges in this exercise, and not all vulnerabilities and impacts can be readily monetized or even quantified. In addition, assessing the damage and loss in economic terms is further challenging. The CDTA work was able to provide basic guidance for loss and damage owing to flooding, and some non-monetary views on damages impacting health. The PPTA employs these metrics and further quantifies and monetizes a number of impacts owing to health related costs and economic activity, vehicular operating costs and time saving, and opportunity costs of fetching water, for instance.

109. Owing to limited resources and limits to what can be quantified at this time, much vulnerability will neither be monetized nor even quantified. Cyclone shelters, for instance, do not have readily apparent economic flow streams. Of course, cyclone shelters are essential at protecting human health and life, but can the full set of benefits be monetized?

110. However, it was possible for the PPTA to perform an economic analysis on even the benefits of introducing cyclone shelter, and discovered that shelters have a good Economic Internal Rate of Return (EIRR) if we account for the reduced medical costs and reduced income owing to health impacts. A number of other very real impacts are highlighted in **Table IV.1**.

111. It is interesting to note that relatively few impacts could not be quantified, and even if not monetized for CTIIP's cost: benefit analyses, an economic value could be assigned to the vulnerabilities, by going beyond market prices and employing a variety of approaches including revealed preference, stated preference, and benefit transfer approaches.[38] Some of the few non-quantified vulnerabilities include impacts of climate change on river/canal transport. It is important, however, to indicate that just because there is a way to quantify (and monetize) vulnerability of most assets, including, for instance, religious and recreational assets like playing fields and mosques by considering loss of activity (number using playing fields or attending religious ceremonies), this does not necessarily reflect the full value of the asset.

112. As far as the PPTA is aware, many questions have not been addressed in practice for projects funded by PPCR. The baseline setting is one; while climate change has been underway for some time, most approaches to look at climate vulnerabilities start with the present. Hence, the "incremental costs and benefits" of climate adaptation are not fully accounted for, and thus the importance of PPCR funding is underestimated.

113. The anticipated results of this exercise, however, give a view towards how the adaptation measures will reduce vulnerabilities, and the extent to which this is the case. It will also result in a clearer adaptation strategy by giving additional tools to consider the relative costs and benefits of alternative measures, and, in conjunction with the community surveys of hazards and climate hazard mapping point out potential vulnerabilities that CTIIP interventions can address.

[38] See Vardakoulias, O., (2013), New Economics Foundation, "Valuing the environment in economics," *Economics in policy-making briefing* for a summary of alternative approaches to placing economic value on environmental assets, that may apply to the broad set of coastal town assets.

**Table IV.1 Coastal Town Assets, Their Vulnerabilities to Climate Change, and How We Can Assess Them**

| Coastal Town Assets | | Vulnerabilities | Can we Quantify Impacts? | Residual we cannot quantify | Rough Estimate of Asset Value of Residual | Can we Monetize? | Issues |
|---|---|---|---|---|---|---|---|
| Income, population and health | People's lives | Storm accidents/ disease/heat | Yes | NA | nil | No | |
| | People's health | Storm accidents/ disease/disability | Yes | If not clear cyclone event difficult to quantify | Very minor | Yes, possibly lost income and health costs | |
| | Wages | Lost to storms, flooding and sickness | Yes (most especially of the urban poor / slum dwellers) | Minor so will not quantify | Very minor | Yes, lost income | Need average incomes. Based on average loses through flooding (Khulna), SIDR PDNA |
| | Housing | Siting of assets. Loss and damage from cyclone winds and all flooding | Yes, especially katcha housing | Minor so will not quantify | Very minor | Yes, cost of damage to physical assets | Need asset values. Based on average loses through flooding (Khulna), SIDR PDNA. Need baseline data on wind damage |
| | Recreational assets | Siting of assets. Damage and loss of assets and activity | Yes, damage to physical assets | Minor so will not quantify | Very minor | No | Requires inventory/stock data, asset valuation for different classes of use/building, and damage (or proxy) estimates |
| | Religious assets | Siting of assets. Damage and loss of assets and activity | Yes, damage to physical assets | Loss of activity | Minor | Yes | Requires inventory/stock data, asset valuation and damage (or proxy) estimates |
| Infrastructure & services<br><br>Energy, water and sanitation, drainage | Water supply | Loss of power/ electricity supply<br>Flooding of facilities<br>Contamination of water supply by salinity and dirty water | Yes | NA | Nil | Yes (cost of lost or damaged assets) | Requires asset inventory, valuation for facilities, and damage (or proxy) estimates |

| Coastal Town Assets | | Vulnerabilities | Can we Quantify Impacts? | Residual we cannot quantify | Rough Estimate of Asset Value of Residual | Can we Monetize? | Issues |
|---|---|---|---|---|---|---|---|
| | Storm and waste water services | Flooded drains and submerged drains and associated infrastructure, e.g. pumping stations<br>Backlogging of stagnant water<br>Damage to properties and sanitation facilities.<br>Economic, financial, social, governance, health, education, etc., losses owing to lack of access (to schools, markets, etc.) during flood periods.<br>More complex and financially demanding infrastructure to operate and maintain.<br>Human resources at risk during flooding events | Yes, some, e.g. extent of flooded areas and frequency of flooding; losses to infrastructure, properties, assets, businesses, etc., can be measured, and damage to sanitation facilities<br><br>Possible to quantify lack of access to schools or markets. | Cannot easily quantify – social, governance, health, education impacts, etc. | Major – because of nr of & breadth of affected sectors, especially long-term, but very difficult to quantify | Yes<br>Some | During certain times of the year the low tide river levels will be higher than drain inverts, and it will be impossible for the towns to be drained by gravity<br>Situation will become more severe with time.<br>Data have to be collected and recorded, be reliable and easily accessible |
| | Solid waste | Siting and managing dumps and transfer systems | Yes (damage to physical assets – secondary transfer, (sanitary) landfill) | NA | Nil | Not yet | Coastal towns do not have operational SWM systems |
| | Electricity | Siting of critical assets.<br>Storm induced disruption to supply, heat induced increase in demand and load shedding | Yes, damage to physical assets (sub-stations, pylons and poles) | Impact of loss of energy supply on other activities | Relatively minor? | Yes (cost of lost or damaged assets) | Requires inventory/stock data, asset value, and damage (or proxy) estimates. |
| | Fuels | Siting of storage assets.<br>Disruption of supply, environmental impacts if released | Yes, could change demand and access | Loss of productivity | Relatively minor? | Yes (cost of lost or damaged assets) | Requires inventory/stock data, asset value, and damage (or proxy) estimates |

| Coastal Town Assets | | Vulnerabilities | Can we Quantify Impacts? | Residual we cannot quantify | Rough Estimate of Asset Value of Residual | Can we Monetize? | Issues |
|---|---|---|---|---|---|---|---|
| Transport | Roads and footpaths | Damage/loss of asset and loss of activity | As per roads sub-project | Can quantify all | NA | Yes | Requires asset value, and damage (or proxy) estimates and transport activity value. As per roads use road damage approach in CDTA report |
| | Rivers/canals | Loss of transport activity | Probably not | N/a | N/a | N/a | |
| | Boat Landings | Damage/loss of asset and loss of activity | Yes | NA | Nil | No | Requires asset value, and damage (or proxy) estimates and river transport activity value |
| | Bus deports | Damage/loss of asset and loss of activity | Yes | | | Yes | Requires asset value, and damage (or proxy) estimates and bus activity value |
| | Vehicles | Damage and loss of activity | Yes, but tangential link to spatial land use planning | N/a | N/a | N/a | |
| Land, agriculture and ecosystems | Farms | Loss of agricultural land for urban development. Siting of critical assets (storage) | Yes. Damage to physical assets (storage). Loss of livelihoods and income from conversion of agriculture land to other uses.<br><br>Indirect in that farm land in 'safe' areas may be required for new development | Reduction of food security | Minor | Yes, where storage facilities exist. | Requires asset value, and damage (or proxy) estimates. |
| | Fisheries | Damage and loss of productivity storms, flooding, droughts | Not applicable | NA | Nil | NA | |
| | Forests | Damage to forests, indirect ecosystem losses owing to storms, drought, floods, salinity | Maybe, loss of natural embankment protection and increased vulnerability arising there from | NA | Nil | Probably not | |
| | Indigenous Species | Loss of wildlife from storms, floods, salinity | Not applicable | NA | Nil | NA | |

| Coastal Town Assets | | Vulnerabilities | Can we Quantify Impacts? | Residual we cannot quantify | Rough Estimate of Asset Value of Residual | Can we Monetize? | Issues |
|---|---|---|---|---|---|---|---|
| Industry and Commerce | Buildings | Loss and damage from cyclone winds and all flooding | Yes | N/a | Nil | NA | Requires inventory/stock data, asset valuation for different classes of buildings, and damage (or proxy) estimates |
| | Other commercial assets/inventories | Loss and damage from cyclone winds and all flooding | Yes | NA | Nil | Yes, for damage to assets | Composite of critical facilities/assets above? |
| | Commercial income | Loss of income from lost access to business | Yes | NA | NA | Yes, but complex to calculate? | Economic activity lost for period when critical assets (WS, electricity, roads etc) are down |

Source: PPTA Consultant.

## IV.3 Social Costs and Benefits

114. The PPTA analysis considered what social costs and benefits the climate resilience measures may pose. Below is a discussion of impacts for each of the pilot towns, and accompanying tables **(Tables IV.2 to IV.5)**.

**Amtali:** Climate change resilience measures proposed for road improvements include increased road height, which are likely to lead to potential access barriers for the disabled and elderly.

115. For the proposed cyclone shelters, higher plinth levels and first floor base levels, use of tough/resistant building materials, use of stringent location criteria for cyclone shelters, planting of trees on upstream and windward sides of shelter, separate sections for men and women, safe place to store valuables, provision of water supply, sanitation and solar power, raised place for livestock to gather etc. are proposed for climate resilience. Barrier free access to the cyclone shelters and to the first floor of the buildings by the disabled and elderly, access to toilets for the disabled, elderly and young children, are issues that need to be dealt with in design, otherwise they may lead to access constraints. Wheelchairs/ crutches/ tricycles etc. are likely to require additional space, lack of which may prove a constraint for users. Likely positive impacts include access to more reliable basic services at the shelter (than pre-intervention period), enhanced safety and security for people’s lives and their belongings and increased safety for livestock wealth.

116. For drainage and flood control, the proposed design criteria are meant to address climate change resilience. Potential impacts of these measures include possible higher taxes to meet the higher costs of climate proofing and related loan repayment. Negative externalities will be offset by positive impacts such as reduced flooding and damage to life and property.

117. CC measures for water supply include OHTs designed to withstand cyclonic strong wind and provision of generator back-up to ensure power supply in case of power failure during disaster. Potential positive impacts include increased coverage / access to improved and more reliable system; lower level of disruptions/breakdowns in water supply in emergency situations; positive health impacts of availability of safe water even during emergency; while potential negative impacts include increased project cost translating into increased water tariffs/connection charges, which may be unaffordable for the poor.

118. No CC measures are proposed for sanitation or solid waste management in Amtali, hence no impacts are anticipated.

**Table IV.2: Amtali Social Impacts of Climate Resilient Measures**

| | Proposed components | Proposed CC adaptation | Potential social impacts of proposed components (short term) | Potential social impacts of proposed interventions (long term) | Potential impacts of climate resilience proposals |
|---|---|---|---|---|---|
| Roads | • Improvement of 8 existing roads (8.38 km, 3-8m wide)<br>• Provision of road side drains (3.05 km) | Raising of road heights<br>Additional strengthening in flood areas<br>150 mm plastic pipes for services<br>Cross drainage/culvert size as necessary | • Potential disruptions in access to shops/businesses, residences, schools, hospitals, markets etc.<br>• Potential temporary income losses for shops and businesses on narrow roads which will have to be closed during construction | • Savings in VOC and VOT for road users<br>• All weather (improved) access to hospitals, markets, schools, places of work etc. | • Access to road by disabled/elderly people will be affected (due to increased height) |
| Cyclone shelter | • Cyclone shelters (3 in no.) | • Raise base level of first floor by 200 m<br>• Raise plinth level<br>• Specific location criteria to be followed<br>• Planting trees on upstream and windward sides<br>• Separate sections for men and women; safe place for valuables etc.<br>• Use of resistant materials<br>• Water supply, sanitation, solar power<br>• Raised place where livestock can gather | • Disruptions in functioning of existing schools/madrassa where cyclone shelters proposed, during construction/repair work | • Improved facilities in existing schools | • Access to first floor of building by the disabled and elderly (likely to require additional design considerations)<br>• Toilets for disabled/elderly/children (design considerations will be required)<br>• Additional space requirements for wheel chairs/crutches/tricycles/carts<br>• Improved access to reliable basic services at cyclone shelter<br>• Enhanced safety and security for people's lives and belongings |

| | Proposed components | Proposed CC adaptation | Potential social impacts of proposed components (short term) | Potential social impacts of proposed interventions (long term) | Potential impacts of climate resilience proposals |
|---|---|---|---|---|---|
| | | | | | • Increased safety for livestock wealth |
| Solid waste Management | • Procurement of equipment | None | None | • Levy of charges for SWM vs. affordability<br>• Improved quality of life due to cleaner surroundings | • None |
| Drainage and flood control | • Improvements to 2.66 km drains<br>• Box culvert cleaning and gate repair (1)<br>• Maintenance equipment | Design criteria for increased climate resilience | • Impacts on canal bank dwellers (damage/loss of structures) and shops<br>• Potential loss of income for shops | • Reduced flooding and damage to life and property | • Citizens may be taxed higher amounts to meet the significantly higher cost of CC measures and associated loan repayment |
| Water supply | • Installation of 2 PTWs<br>• Construction of 2 OHTs<br>• Transmission and distribution pipelines (36.5 km)<br>• Replacement of existing 5 km distribution lines (50mm with 100 mm dia)<br>• Service connections (1560)<br>• Replacement of existing service connections (400)<br>• Water meters (1560)<br>• Bulk water meters (3)<br>• Hand deep tubewells (30)<br>• Mini water testing lab<br>• Logistics (incl. generators for existing and proposed | OHT designed to withstand cyclonic strong wind<br><br>Generators | • 1 PTW and 1 OHT proposed on govt. land; second PTW proposed on private land and OHT proposed at community graveyard. (No land acquisition/resettlement impacts envisaged as private landowner willing to donate land);<br>• Potential disruptions in access to piped water supply during construction work for households with existing connections<br>• Access to residences, shops/businesses, markets, schools and hospitals may be disrupted during pipe-laying work (esp. for transmission lines and for distribution lines on narrow | • Increased coverage of access to improved system<br>• More reliable service<br>• Positive health impacts of water testing/quality supply<br>• Potential negative health impacts of untreated supply from hand deep tubewells | • Increased project cost translating into higher water tariffs/connection charges, which may be unaffordable for the poor and vulnerable households<br>• Reduced incidence of disruption in water supply during disaster |

| | Proposed components | Proposed CC adaptation | Potential social impacts of proposed components (short term) | Potential social impacts of proposed interventions (long term) | Potential impacts of climate resilience proposals |
|---|---|---|---|---|---|
| | system) | | roads)<br>o Potential temporary loss of income for shops/businesses | | |
| Sanitation | • Public toilets: 4<br>• Community latrines: 10<br>• Truck mounted desludging equipment:1 | None | • Public toilets: Impact on structures and livelihoods of 2 encroachers (shops) on toilet proposed at Patuakhali bus stand; no IR impacts in case of toilets proposed on municipal land (at the Wood Market, Fish Market and Mango Market)<br>• Community toilets proposed on government land | • Increased access to safe sanitation by men and women<br>• Increased access to sanitation by poor households<br>• Increased access to sanitation by women and girl children<br>• Increased safety, security and dignity for women and girl children (who will not have to practice open defecation)<br>• Potential barriers to access by the disabled/elderly/young children due to inappropriate design<br>• Potential loss of livelihood of the poorest of the poor who are presently involved in manual desludging work<br>• Potential raising of health and societal status of manual workers engaged in desludging who are rehabilitated by project NGO<br>• Health benefits of improved sanitation for town population; related opportunity cost savings | None |

Note: km=kilometres, m=meters, NGO=non- governmental organisation, OHT=overhead tank, PTW= production tube well, SWM=solid waste management, SWTP=surface water treatment plant, VOC= vehicle operating costs; VOT=value of time.
Source: PPTA Consultant.

119. **Galachipa:** Climate change measures proposed for road improvements include increased road height, which are likely to lead to potential access barriers for the disabled and elderly.

120. For the proposed cyclone shelters, higher plinth levels and first floor base levels, use of tough/resistant building materials, use of stringent location criteria for cyclone shelters, planting of trees on upstream and windward sides of shelter, separate sections for men and women, safe place to store valuables, provision of water supply, sanitation and solar power, raised place for livestock to gather etc. are proposed for climate resilience. Barrier free access to the cyclone shelters and to the first floor of the buildings by the disabled and elderly, access to toilets for the disabled, elderly and young children, are issues that need to be dealt with in design, otherwise they may lead to access constraints. Wheelchairs/ crutches/ tricycles etc. are likely to require additional space, lack of which may prove a constraint for users. Likely positive impacts include access to more reliable basic services at the shelter (than pre-intervention period), enhanced safety and security for people's lives and their belongings and increased safety for livestock wealth.

121. For drainage and flood control, the proposed design criteria are meant to address climate change resilience. Potential impacts of these measures include possible higher taxes to meet the higher costs of climate proofing and related loan repayment. Negative externalities will be offset by positive impacts such as reduced flooding and damage to life and property.

122. CC measures for water supply include adequate drainage around PTWs for climate change resilience, OHTs designed to withstand cyclonic strong wind and provision of generator back-up to ensure power supply in case of power failure during disaster. Potential positive impacts include increased coverage of access to improved/more reliable water supply system; lower level of disruptions/breakdowns in water supply during incidents of cyclone; and positive health impacts of availability of safe water even during emergency, while potential negative impacts include increased project cost translating into increased water tariffs/connection charges, which may be unaffordable for the poor.

123. No CC measures are proposed for sanitation or solid waste management in Galachipa, hence no impacts are anticipated.

**Table IV.3: Galachipa Social Impacts of Climate Resilient Measures**

| | Proposed components | Proposed CC adaptation | Potential social impacts of proposed components (short term) | Potential social impacts of proposed interventions (long term) | Potential impacts of climate resilience proposals |
|---|---|---|---|---|---|
| Roads | • Improvement of 7 existing roads (7 km, 4-5m wide)<br>• Provision of road side drains (4.7 km)<br>• Provision of cross drain/culvert (29)<br>• Side protection works<br>• Tree plantations | Raising of road heights<br>Additional strengthening in flood areas<br>150 mm plastic pipes for services<br>Cross drainage/culvert size as necessary | • Potential disruptions in access to shops/businesses, residences, schools, hospitals, markets etc.<br>• Potential temporary income losses for shops and businesses on narrow roads which will have to be closed during construction | • Savings in VOC and VOT for road users<br>• All weather (improved) access to hospitals, markets, schools, places of work etc. | • Access to road by disabled/elderly people will be affected (due to increased height) |
| Cyclone shelter | • Cyclone shelters (3 in no.) | • Raise base level of first floor by 200 m<br>• Raise plinth level<br>• Specific location criteria to be followed<br>• Planting trees on upstream and windward sides<br>• Separate sections for men and women; safe place for valuables etc.<br>• Use of resistant materials<br>• Water supply, sanitation, solar power<br>• Raised place where livestock can gather | • Disruptions in functioning of existing schools where cyclone shelters proposed, during construction/repair work<br>• Two cyclone shelters proposed on government land (Barrack House and Degree College), another on madrassa land, hence no land acquisition/resettlement impact | • Improved facilities in existing schools | • Access to first floor of building by the disabled and elderly (likely to require additional design considerations)<br>• Toilets for disabled/elderly/children (design considerations will be required)<br>• Additional space requirements for wheel chairs/crutches/tricycles/carts<br>• Improved access to reliable basic services at cyclone shelter<br>• Enhanced safety and security for people's lives and belongings |

| | Proposed components | Proposed CC adaptation | Potential social impacts of proposed components (short term) | Potential social impacts of proposed interventions (long term) | Potential impacts of climate resilience proposals |
|---|---|---|---|---|---|
| | | | | | • Increased safety for livestock wealth |
| Solid waste Management | • Procurement of equipment | None | None | • Levy of charges for SWM vs. affordability<br>• Improved quality of life due to cleaner surroundings | • None |
| Drainage and flood control | • Improvements to 10.385 km channels and drains | Design criteria for increased climate resilience | • Impacts on canal bank dwellers (damage/loss of structures) and shops<br>• Potential loss of income for shops | • Reduced flooding and damage to life and property | • Citizens may be taxed higher amounts to meet the significantly higher cost of CC measures and associated loan repayment |
| Water supply | • Installation of 2 PTWs<br>• Construction of 1 OHT<br>• Transmission and distribution pipelines (25 km)<br>• Replacement of existing 4 km distribution lines (50mm with 100 mm dia)<br>• Service connections (2500)<br>• Replacement of existing service connections (600)<br>• Water meters (2500)<br>• Bulk water meters (4)<br>• Mini water testing lab<br>• Logistics (incl. generators for existing | Adequate drainage around PTW to ensure climate resilience<br><br>OHT designed to withstand cyclonic strong wind<br><br>Generators for back-up power during disaster/power failure | • PTWs and OHT proposed on govt. land (Govt. Degree College); no land acquisition/resettlement impacts envisaged<br>• Potential disruptions in access to piped water supply during construction work for households with existing connections<br>• Access to residences, shops/businesses, markets, schools and hospitals may be disrupted during pipe-laying work (esp. for transmission lines and for distribution lines on narrow roads)<br>o Potential temporary loss of income for shops/businesses | • Increased coverage of access to improved system<br><br>• More reliable service<br><br>• Positive health impacts of water testing/quality supply | • Increased project cost translating into higher water tariffs/connection charges, which may be unaffordable for the poor and vulnerable households<br>• Reduced incidence of disruption in water supply during disaster |

| | Proposed components | Proposed CC adaptation | Potential social impacts of proposed components (short term) | Potential social impacts of proposed interventions (long term) | Potential impacts of climate resilience proposals |
|---|---|---|---|---|---|
| | and proposed system) | | | | |
| Sanitation | • Public toilets: 6<br>• School latrines:3<br>• Community latrines: 8<br>• Truck mounted desludging equipment:1 | None | • All public toilets proposed on Govt land; no IR impacts envisaged<br>• 1 community toilet proposed on govt land | • Increased access to safe sanitation by men and women<br>• Increased access to sanitation by poor households<br>• Increased access to sanitation by women and girl children<br>• Increased safety, security and dignity for women and girl children (who will not have to practice open defecation)<br>• Potential barriers to access by the disabled/elderly/young children due to inappropriate design<br>• Potential loss of livelihood of the poorest of the poor who are presently involved in manual desludging work<br>• Potential raising of health and societal status of manual workers engaged in desludging who are rehabilitated by project NGO<br>• Health benefits of improved sanitation for town population; related opportunity cost savings | None |

Note: km=kilometres, m=meters, NGO=non- governmental organisation, OHT=overhead tank, PTW= production tube well, SWM=solid waste management, SWTP=surface water treatment plant, VOC= vehicle operating costs; VOT=value of time.
Source: PPTA Consultant.

124. **Pirojpur:** Climate change measures proposed for road improvements include increased roads height, which are likely to lead to potential access barriers for the disabled and elderly.

125. For the proposed bridges, strengthening of abutments and approaches is proposed, due to which project costs will increase, which may translate into higher burden on the taxpayer.

126. For the cyclone shelters, higher plinth levels and first floor base levels, use of tough/resistant building materials, use of stringent location criteria for cyclone shelters, planting of trees on upstream and windward sides of shelter, separate sections for men and women, safe place to store valuables, provision of water supply, sanitation and solar power, raised place for livestock to gather etc. are proposed for climate resilience. Barrier free access to the cyclone shelters and to the first floor of the buildings by the disabled and elderly, access to toilets for the disabled, elderly and young children, are issues that need to be dealt with in design, otherwise they may lead to access constraints. Wheelchairs/ crutches/ tricycles etc. are likely to require additional space, lack of which may prove as a constraint for users. Likely positive impacts include access to more reliable basic services at the shelter (than pre-intervention period), enhanced safety and security for people's lives and their belongings and increased safety for livestock wealth.

127. For drainage and flood control, the proposed design criteria are meant to address climate change resilience. Potential impacts of these measures include possible higher taxes to meet the higher costs of climate proofing and related loan repayment. Negative externalities will be offset by positive impacts such as reduced flooding and damage to life and property. The solid waste management component does not envisage any civil construction work, accordingly, no CC measures are proposed and impacts anticipated.

**IV.4: Pirojpur Social Impacts of Climate Resilient Measures**

| | Proposed components | Proposed CC adaptation | Potential social impacts of proposed components (short term) | Potential social impacts of proposed interventions (long term) | Potential impacts of climate resilience proposals |
|---|---|---|---|---|---|
| Roads | • Improvement of 17 existing roads (34.2 km, 3-3.7m wide)<br>• Provision of road side drains (4.6 km)<br>• Provision of cross drain/culvert (39)<br>• Side protection works<br>• Tree plantations | Raising of road heights<br>Additional strengthening in flood areas<br>150 mm plastic pipes for services<br>Cross drainage/culvert size as necessary | • Potential disruptions in access to shops/businesses, residences, schools, hospitals, markets etc.<br>• Potential temporary income losses for shops and businesses on narrow roads which will have to be closed during construction | • Savings in VOC and VOT for road users<br>• All weather (improved) access to hospitals, markets, schools, places of work etc. | • Access to road by disabled/elderly people will be affected (due to increased height) |
| Bridges | • Replacement of risky foot bridges with RCC bridges that permit vehicular access (4 bridges) | Strengthen abutments and approaches | • Loss of access to existing foot-bridge during construction | • Improved access to hospitals, markets, schools, places of work<br>• Ease of access for ambulances, fire engines, school buses/vans | • Increased project cost translating into higher burden on tax payers |
| Cyclone shelter | • Cyclone shelters (4 in no.) | • Raise base level of first floor by 200 m<br>• Raise plinth level<br>• Specific location criteria to be followed<br>• Planting trees on upstream and windward sides<br>• Separate sections for men and women; safe place for valuables etc.<br>• Use of resistant materials<br>• Water supply, | • Disruptions in functioning of existing schools (3 govt. schools and 1 madrassa) where cyclone shelters proposed, during construction/repair work | • Improved facilities in existing schools | • Access to first floor of building by the disabled and elderly (likely to require additional design considerations)<br>• Toilets for disabled/elderly/children (design considerations will be required)<br>• Additional space requirements for wheel chairs/crutches/tricycles/carts |

| | Proposed components | Proposed CC adaptation | Potential social impacts of proposed components (short term) | Potential social impacts of proposed interventions (long term) | Potential impacts of climate resilience proposals |
|---|---|---|---|---|---|
| | | sanitation, solar power<br>• Raised place where livestock can gather | | | • Improved access to reliable basic services at cyclone shelter<br>• Enhanced safety and security for people's lives and belongings<br>• Increased safety for livestock wealth |
| Solid waste Management | • Procurement of equipment | None | None | • Levy of charges for SWM vs. affordability<br>• Improved quality of life due to cleaner surroundings | • None |
| Drainage and flood control | • Improvements to 25.3 km channels and drains | Design criteria for increased climate resilience | • Impacts on canal bank dwellers (damage/loss of structures) and shops<br>• Potential loss of income for shops | • Reduced flooding and damage to life and property | • Citizens may be taxed higher amounts to meet the significantly higher cost of CC measures and associated loan repayment |

Note: km=kilometres, m=meters, NGO=non- governmental organisation, OHT=overhead tank, PTW= production tube well, SWM=solid waste management, SWTP=surface water treatment plant, VOC= vehicle operating costs; VOT=value of time.
Source: PPTA Consultant.

128. **Mathbaria:** Climate change measures proposed for road improvements include increased roads height, which are likely to lead to potential access barriers for the disabled and elderly.

129. For the proposed bridge, strengthening of abutments and approaches is proposed, due to which project costs will increase, which may translate into higher burden on the taxpayer.

130. For the proposed cyclone shelter, higher plinth levels and first floor base levels, use of tough/resistant building materials, use of stringent location criteria, planting of trees on upstream and windward sides of shelter, separate sections for men and women, safe place to store valuables, provision of water supply, sanitation and solar power, raised place for livestock to gather etc. are proposed for climate resilience. Barrier free access to the cyclone shelters and to the first floor of the buildings by the disabled and elderly, access to toilets for the disabled, elderly and young children, are issues that need to be dealt with in design, otherwise they may lead to access constraints. Wheelchairs/ crutches/ tricycles etc. are likely to require additional space, lack of which may prove a constraint for users. Likely positive impacts include access to more reliable basic services at the shelter (than pre-intervention period), enhanced safety and security for people's lives and their belongings and increased safety for livestock wealth.

131. For drainage and flood control, the proposed design criteria are meant to address climate change resilience. Potential impacts of these measures include possible higher taxes to meet the higher costs of climate proofing and related loan repayment. Negative externalities will be offset by positive impacts such as reduced flooding and damage to life and property.

132. CC measures for water supply include OHT designed to withstand cyclonic strong wind, water storage facility for emergency use after cyclone/storm surge, protection of SWTP compound from cyclone/storm surge and provision of generator back-up to ensure power supply in case of power failure during disaster. Potential positive impacts include access to a reliable water supply system for the town's residents at all times; positive health impacts of availability of safe water even during emergency; lower level of disruptions/breakdowns in water supply during incidents of cyclone; while potential negative impacts include Increased project cost translating into increased water tariffs/connection charges, which may be unaffordable for the poor.

133. No CC measures are proposed for sanitation or solid waste management in Mathbaria, hence no impacts are anticipated.

**Table IV.5: Mathbaria Social Impacts of Climate Resilient Measures**

| | Proposed components | Proposed CC adaptation | Potential social impacts of proposed components (short term) | Potential social impacts of proposed interventions (long term) | Potential impacts of climate resilience proposals |
|---|---|---|---|---|---|
| Roads | • Improvement of 5 existing roads (8 km, 3-5.5m wide)<br>• Cross drains/culvert (13)<br>• Provision of road side drains (9.8 km)<br>• Side protection works<br>• Tree plantations | Raising of road heights<br>Additional strengthening in flood areas<br>150 mm plastic pipes for services<br>Cross drainage/culvert size as necessary | • Potential disruptions in access to shops/businesses, residences, schools, hospitals, markets etc.<br>• Potential temporary income losses for shops and businesses on narrow roads which will have to be closed during construction | • Savings in VOC and VOT for road users<br>• All weather (improved) access to hospitals, markets, schools, places of work etc. | • Access to road by disabled/elderly people will be affected (due to increased height) |
| Bridge | • Replacement of risky foot bridge with RCC bridge that permits vehicular access (1 bridge) | Strengthen abutments and approaches | • Loss of access to existing foot-bridge during construction<br>• 1 structure likely to be affected (restaurant for working class with semi-permanent structure); even if ULB provides alternate space nearby, income losses during shifting envisaged | • Improved access to hospitals, markets, schools, places of work<br>• Ease of access for ambulances, fire engines, school buses/vans etc. | • Increased project cost translating into higher burden on tax payers |
| Cyclone shelter | • Cyclone shelters (1) | • Raise base level of first floor by 200 m<br>• Raise plinth level<br>• Specific location criteria to be followed<br>• Planting trees on upstream and windward sides<br>• Separate sections for men and women; safe place | • Disruption in functioning of existing school where cyclone shelter proposed, during construction/repair work | • Improved facilities in existing school | • Access to first floor of building by the disabled and elderly (likely to require additional design considerations)<br>• Toilets for disabled/elderly/children (design considerations will be required)<br>• Additional space |

| | Proposed components | Proposed CC adaptation | Potential social impacts of proposed components (short term) | Potential social impacts of proposed interventions (long term) | Potential impacts of climate resilience proposals |
|---|---|---|---|---|---|
| | | for valuables etc.<br>• Use of resistant materials<br>• Water supply, sanitation, solar power<br>• Raised place where livestock can gather | | | requirements for wheel chairs/crutches/tricycles/carts<br>• Improved access to reliable basic services at cyclone shelter<br>• Enhanced safety and security for people's lives and belongings<br>• Increased safety for livestock wealth |
| Solid waste Management | • Procurement of equipment | None | None | • Levy of charges for SWM vs. affordability<br>• Improved quality of life due to cleaner surroundings | • None |
| Drainage and flood control | • Improvements to 10.8 km drains<br>• Maintenance equipment | Design criteria for increased climate resilience | • Impacts on canal bank dwellers (damage/loss of structures) and shops<br>• Potential loss of income for shops | • Reduced flooding and damage to life and property | • Citizens may be taxed higher amounts to meet the significantly higher cost of CC measures and associated loan repayment |
| Water supply | • Construction of surface water treatment plant (1)<br>• Sedimentation pond (1)<br>• River intake (1)<br>• Pond intake (1)<br>• Overhead Tank (1, with capacity of 680 $m^3$<br>• Ground reservoir (1, with | OHT designed to withstand cyclonic strong wind<br>Water storage facility for | • Private land acquisition (10 acres) and involuntary resettlement impacts for SWTP<br>• Impacts during construction (intake) on down-stream and other users, mainly farmers | • Loss of productive land and income from agriculture for landowners, sharecroppers, agricultural labourers, if any<br>• Potential impacts on water availability for downstream and other users<br>• Access to reliable water supply | • Increased project cost translating into higher water tariffs/connection charges, which may be unaffordable for the poor and vulnerable households |

| | Proposed components | Proposed CC adaptation | Potential social impacts of proposed components (short term) | Potential social impacts of proposed interventions (long term) | Potential impacts of climate resilience proposals |
|---|---|---|---|---|---|
| | capacity of 2000 $m^3$<br>• Transmission and distribution pipelines (49 km)<br>• Service connections (3200)<br>• Water meters (3500<br>• Construction of protection embankment around SWTP compound (800 m)<br>• Resectioning of khal (3 km)<br>• Exploratory drilling<br>• Mini Water Testing Laboratory<br>• Pourashava Water Supply Office cum Residence<br>• Logistics, including generator for proposed system | emergency use after cyclone/storm surge.<br><br>Protection of SWTP compound from cyclone/storm surge<br><br>Generator for power backup for water supply if power supply infrastructures gets damaged by cyclone/storm | • Potential disruptions in access to piped water supply during construction work for households with existing connections<br>• Access to residences, shops/businesses, markets, schools and hospitals may be disrupted during pipe-laying work (esp. for transmission lines and for distribution lines on narrow roads)<br>o Potential temporary loss of income for shops/businesses | system in the town by all residents<br>• Positive health impacts of water testing/quality supply<br>• Increase in savings per household (as water charge per month envisaged will be lower than present direct opportunity cost for purchase of water) | • Reduced incidence of disruption in water supply during disaster |
| Sanitation | • Public toilets: 6<br>• School latrines:7<br>• Community latrines: 8<br>• Truck mounted desludging equipment:1 | None | • Proposed on govt. land/school land hence no IR impacts envisaged | • Increased access to safe sanitation by men and women<br>• Increased access to sanitation by poor households<br>• Increased access to sanitation by women and girl children<br>• Increased safety, security and dignity for women and girl children (who will not have to practice open defecation)<br>• Potential barriers to access by | None |

| | Proposed components | Proposed CC adaptation | Potential social impacts of proposed components (short term) | Potential social impacts of proposed interventions (long term) | Potential impacts of climate resilience proposals |
|---|---|---|---|---|---|
| | | | | the disabled/elderly/young children due to inappropriate design<br>• Potential loss of livelihood of the poorest of the poor who are presently involved in manual desludging work<br>• Potential raising of health and societal status of manual workers engaged in desludging who are rehabilitated by project NGO<br>• Health benefits of improved sanitation for town population; related opportunity cost savings | |

Note: km=kilometres, m=meters, NGO=non- governmental organisation, OHT=overhead tank, PTW= production tube well, SWM=solid waste management, SWTP=surface water treatment plant, VOC= vehicle operating costs; VOT=value of time.
Source: PPTA Consultant.

## IV.4 Environmental Costs and Benefits

134. ADB requires the consideration of environmental issues in all aspects of the Bank's operations, and the requirements for Environmental Assessment are described in ADB's Safeguard Policy Statement (SPS) (2009). The impacts of activities to be implemented under the sector loan were reviewed in accordance with the Environmental Review and Assessment Framework (EARF) prepared for the project. The environmental impacts without and with climate resilience considerations have been identified and assessed as part of the planning and design process.

135. Potential environmental impacts of the proposed infrastructures were examined using ADB's rapid environmental assessment checklists (REA) and were identified in relation to location, design, construction and operation of the improved infrastructure **(Table IV.6)**. Short-term negative impacts during the construction phase include disturbance to residents and businesses along the road alignments, traffic, sourcing of materials, cutting of trees, clearing of vegetation, and risks to workers and communities, disruption of watercourses, and visual and auditory disturbance due to the presence of machinery, construction workers, and associated equipment and community health and safety issues such as communicable disease associated with the influx of temporary construction labor. In addition, sediment and erosion from construction activities and storm water runoff may increase turbidity of surface waters. Solid waste may be generated during construction and maintenance of roads and associated structures. Significant quantities of rock and soil materials may be generated from earth moving during construction activities. These are common impacts of construction in urban areas, and there are well developed methods for their mitigation.

136. In the operational phase, all facilities and infrastructure will operate with routine maintenance, which should not affect the environment. Facilities will need to be repaired from time to time, but environmental impacts will be much less than those of the construction period as the work will be infrequent, affecting small areas only.

137. Potential impacts of the climate resilience measures were also assessed using ADB REA checklists. The specific environmental impacts are similar in all towns. Short-term negative impacts are the same but with increased demand for construction materials and time to complete the works. Potential long-term environmental impacts are positive; including: (i) mainstreaming climate risk reduction into infrastructure development ensures subprojects infrastructure are less vulnerable to floods, storm surge, landslides and impacts of other extreme weather events. (ii) improved climate change data management and availability resulting to improved risk assessment; (iii) improved environmental planning guidelines and procedures will be improved, and (iv) evidence-based decision making, with the application of climate impact and screening procedures emphasized as part of environmental assessment. The environmental impacts per proposed projects (excluding solid waste management and sanitation as there are no proposed climate resilience measures) are:

- Roads and bridges - Construction or widening of roads increases the amount of impermeable surface area which increases the rate of surface water runoff. Increased stormwater flow rates can lead to stream erosion and flooding.
- Cyclone shelters – Environmental enhancement by including tree-plantation
- Drainage and flood control - Increased stormwater flow rates can lead to stream erosion and flooding.
- Water supply - Reduced incidence of disruption in water supply and reduced water leaks and better water demand management. Increased groundwater abstraction and direct river water withdrawals were not considered in the study therefore the flow estimates should be considered optimistic. Nevertheless it

would be reasonable to conclude that climate resilience measures will not significantly affect the water availability of the proposed water supply systems.

138. Therefore climate resilience measures will benefit the general public by contributing to the long-term improvement of infrastructure and community livability in the project towns. The potential adverse environmental impacts are mainly related to the construction period, which can be minimized by the mitigating measures and environmentally sound engineering and construction practices.

**Table IV.6: Potential Environmental Impacts of Project Components: Immediate/Short-Term Impacts Before/During Implementation, Long-Term Impacts, and Impacts of Climate Resilience Proposals**

| Subproject | Proposed Components | | | | Proposed CC Adaptation | Overall Impacts of Each Subproject (with or without climate resilience measures) | | Impacts of Climate Resilience Measures |
|---|---|---|---|---|---|---|---|---|
| | Amtali | Galachipa | Mathbaria | Pirojpur | | Potential Environmental Impacts (Short-Term) | Potential Environmental Impacts (Long Term) | |
| All subprojects | • See details below | • See details below | • See details below | • See details below | • See details below | • During the construction phase, impacts include disturbance to residents and businesses along the road alignments, traffic, sourcing of materials, cutting of trees, clearing of vegetation, and risks to workers and communities. disruption of watercourses, and visual and auditory disturbance due to the presence of machinery, construction workers, and associated equipment. In addition, sediment and erosion from construction activities and stormwater runoff may increase turbidity of surface waters.<br>• Solid waste may be generated during construction and maintenance of roads and associated structures. Significant quantities of rock and soil materials may be generated from earth | • Solid waste generation , increased noise, dust, vibrations and air pollution, disturbance to community and occupational health and safety risks during operation | • Improved climate change data management and availability resulting to improved risk assessment.<br>• Improved environmental planning guidelines and procedures.<br>• Evidence-based decision making, with the application of climate impact and screening procedures emphasised as part of environmental assessment. |

| Subproject | Proposed Components | | | | Proposed CC Adaptation | Overall Impacts of Each Subproject (with or without climate resilience measures) | | Impacts of Climate Resilience Measures |
|---|---|---|---|---|---|---|---|---|
| | Amtali | Galachipa | Mathbaria | Pirojpur | | Potential Environmental Impacts (Short-Term) | Potential Environmental Impacts (Long Term) | |
| | | | | | | moving during construction activities. Community health and safety issues such as communicable disease associated with the influx of temporary construction labor.<br>• Construction site waste generation, soil erosion and sediment control from materials-sourcing areas and site preparation activities, fugitive dust and other emissions (e.g. from vehicle traffic, land clearing and movement, and materials stockpiles), noise from heavy equipment and truck traffic, and potential for hazardous materials and oil spills associated with heavy equipment operation and fueling activities. | | |
| Roads and bridges | • Improvement of 8 existing roads (8.38 km, 3-8m wide)<br>• Provision of road side drains (3.05 km) | • Improvement of 7 existing roads (7 km, 4-5m wide)<br>• Provision of road side drains (4.7 km)<br>• Provision of cross drain/culvert (29) | • Improvement of 5 existing roads (8 km, 3-5.5m wide)<br>• Cross drains/culvert (13)<br>• Provision of road side drains (9.8 km) | • Improvement of 17 existing roads (34.2 km, 3-3.7m wide)<br>• Provision of road side drains (4.6 km)<br>• Provision of cross drain/culvert (39) | • Raising of road heights<br>• Additional strengthening in flood areas<br>• 150 mm plastic pipes for services<br>• Cross drainage/culvert size as necessary | • Construction impacts | 1. In addition to above (all subprojects)<br>• Improved accessibility and motorability.<br>• Increased noise, dust and traffic due to increased road users.<br>• Unchecked growth of trees and plants can cover | • Increased requirement for construction materials<br>• Construction or widening of roads increases the amount of impermeable surface area, which increases the rate of surface water runoff. High storm water |

| Subproject | Proposed Components | | | | Proposed CC Adaptation | Overall Impacts of Each Subproject (with or without climate resilience measures) | | Impacts of Climate Resilience Measures |
|---|---|---|---|---|---|---|---|---|
| | Amtali | Galachipa | Mathbaria | Pirojpur | | Potential Environmental Impacts (Short-Term) | Potential Environmental Impacts (Long Term) | |
| | | • Side protection works<br>• Tree plantations | • Side protection works<br>• Tree plantations<br>• Replacement of risky foot bridge with RCC bridge that permits vehicular access (1 bridge) | • Side protection works<br>• Tree plantations<br>• Replacement of risky foot bridges with RCC bridges that permit vehicular access (4 bridges) | • For bridges, strengthen abutments and approaches | | signals and signs, restrict motorist visibility, and fall onto the road.<br>• Storm water from road drains may be contaminated with oil and grease, metals (e.g. lead, zinc, copper, cadmium, chromium, and nickel), particulate matter and other pollutants released by vehicles on the roadway.<br>• Paint waste may also be generated from road and bridge maintenance (e.g. due to removal of old paint from road stripping and bridges prior to re-painting).<br>• Significant community health and safety issues associated with road projects may also include: pedestrian safety, traffic safety, and emergency preparedness. | flow rates can lead to stream erosion and flooding.<br>• |
| Cyclone shelter | • Cyclone shelters (3 in no.) | • Cyclone shelters (3 in no.) | • Cyclone shelters (1 in no.) | • Cyclone shelters (4 in no.) | • Raise base level of first floor by 200 m<br>• Raise plinth level<br>• Specific location criteria to be followed<br>• Planting trees on upstream and windward sides | • Construction impacts | • Improved facilities in existing schools<br>• Increased demand on limited local infrastructure, including roads, water supply, and liquid effluent and solid waste disposal capacity, and increased stress on ecologically sensitive areas. | • Environmental enhancement by including tree-plantation |

| Subproject | Proposed Components | | | | Proposed CC Adaptation | Overall Impacts of Each Subproject (with or without climate resilience measures) | | Impacts of Climate Resilience Measures |
|---|---|---|---|---|---|---|---|---|
| | Amtali | Galachipa | Mathbaria | Pirojpur | | Potential Environmental Impacts (Short-Term) | Potential Environmental Impacts (Long Term) | |
| | | | | | • Separate sections for men and women; safe place for valuables etc.<br>• Use of resistant materials<br>• Water supply, sanitation, solar power<br>• Raised place where livestock can gather | | • Environmental issues associated with cyclone shelter facilities during operations include the following: resource consumption, emissions to air, wastewater, wastes and noise | |
| Solid waste Management | • Procurement of equipment | • Procurement of equipment | • Procurement of equipment | • Procurement of equipment | • None | • None | • Improved quality of life due to cleaner surroundings | • None |
| Drainage and flood control | • Improvements to 2.66 km drains<br>• Box culvert cleaning and gate repair (1)<br>• Maintenance equipment | • Improvements to 10.385 km channels and drains | • Improvements to 10.8 km drains<br>• Maintenance equipment | • Improvements to 25.3 km channels and drains | • Design criteria for increased climate resilience | • Construction impacts | • Storm water from road drains may be contaminated with oil and grease, metals (e.g. lead, zinc, copper, cadmium, chromium, and nickel), particulate matter and other pollutants released by vehicles on the roadway.<br>• Solid waste generation during operation and maintenance activities may include vegetation waste from maintenance activities; and sediment and sludge from storm water drainage system maintenance.<br>• Storm water runoff can be a potential contributor | • Increased requirement for construction materials<br>• High storm water flow rates can lead to stream erosion and flooding. |

| Subproject | Proposed Components | | | | Proposed CC Adaptation | Overall Impacts of Each Subproject (with or without climate resilience measures) | | Impacts of Climate Resilience Measures |
|---|---|---|---|---|---|---|---|---|
| | Amtali | Galachipa | Mathbaria | Pirojpur | | Potential Environmental Impacts (Short-Term) | Potential Environmental Impacts (Long Term) | |
| | | | | | | | to water quality degradation of receiving water bodies. | |
| Water supply | • Installation of 2 PTWs<br>• Construction of 2 OHTs<br>• Transmission and distribution pipelines (36.5 km)<br>• Replacement of existing 5 km distribution lines (50mm with 100 mm dia)<br>• Service connections (1560)<br>• Replacement of existing service connections (400)<br>• Water meters (1560)<br>• Bulk water meters (3)<br>• Hand deep tubewells (30)<br>• Mini water testing lab<br>• Logistics (incl. generators for existing and proposed | • Installation of 2 PTWs<br>• Construction of 1 OHT<br>• Transmission and distribution pipelines (25 km)<br>• Replacement of existing 4 km distribution lines (50mm with 100 mm dia)<br>• Service connections (2500)<br>• Replacement of existing service connections (600)<br>• Water meters (2500)<br>• Bulk water meters (4)<br>• Mini water testing lab<br>• Logistics (incl. generators for existing and proposed system) | • Construction of surface water treatment plant (1)<br>• Sedimentation pond (1)<br>• River intake (1)<br>• Pond intake (1)<br>• Overhead Tank (1, with capacity of 680 m3<br>• Ground reservoir (1, with capacity of 2000 m3<br>•<br>• Transmission and distribution pipelines (49 km)<br>• Service connections (3200)<br>• Water meters (3500<br>• Construction of protection embankment around SWTP compound (800 m) | | • OHT designed to withstand cyclonic strong wind<br>• Adequate drainage around PTW to ensure climate resilience<br>• Generators for back-up power during disaster/power failure<br>• Water storage facility for emergency use after cyclone/storm surge.<br>• Protection of SWTP compound from cyclone/storm surge | • Construction impacts | • Increased coverage of access to improved system<br>• More reliable service<br>• Positive health impacts of water testing/quality supply<br>• Potential negative health impacts of untreated supply from hand deep tube wells<br>• Solid and hazardous wastes generation during operation and maintenance activities<br>2.<br>3. | • Reduced incidence of disruption in water supply during disaster<br>• Reduced water leaks and better water demand management<br>• Increased groundwater abstraction and direct river water withdrawals were not considered in the study therefore the flow estimates should be considered optimistic. Nevertheless it would be reasonable to conclude that climate resilience measures will not significantly affect the water availability of the proposed water supply systems. |

| Subproject | Proposed Components | | | | Proposed CC Adaptation | Overall Impacts of Each Subproject (with or without climate resilience measures) | | Impacts of Climate Resilience Measures |
|---|---|---|---|---|---|---|---|---|
| | Amtali | Galachipa | Mathbaria | Pirojpur | | Potential Environmental Impacts (Short-Term) | Potential Environmental Impacts (Long Term) | |
| | system) | | • Resectioning of khal (3 km)<br>• Exploratory drilling<br>• Mini Water Testing Laboratory<br>• Pourashava Water Supply Office cum Residence<br>• Logistics, including generator for proposed system | | | | | |
| Sanitation | • Public toilets: 4<br>• Community latrines: 10<br>• Truck mounted desludging equipment:1 | • Public toilets: 6<br>• School latrines:3<br>• Community latrines: 8<br>• Truck mounted desludging equipment:1 | • Public toilets: 6<br>• School latrines:7<br>• Community latrines: 8<br>• Truck mounted desludging equipment:1 | • | Locating sanitation facilities above flood-prone areas | • Construction impacts | • Increased access to sanitation by men and women<br>• Improved over-all environmental conditionas<br>• Solid and hazardous wastes generation during operation and maintenance activities | Improved over-all environmental and health conditions and reduced water and sanitation related diseases |

Source: PPTA Consultant.

## IV.5 Economic Costs and Benefits

139. The economic costs and benefits for CTIIP's projects' climate resilience measures are overall very attractive. The CTIIP infrastructure investments have uniformly attractive EIRRs **(Table IV.7)**. Water investments cost 293 million BDT but resulted in EIRRs varying between 14 and 121%. One urban planning intervention, introducing climate resilient building codes, was assessed in aggregate for the four towns and resulted in the most significant levels of loss and damage reduction, but had a modest EIRR of 17%.

140. Further summaries of the cost benefit analyses, by project types and town, are in **Tables IV.8 to IV.13**. Detailed spreadsheets outlining the EIRR analysis and the assumptions regarding costs and benefits are in **Appendix 1**. However, note that the economic cost:benefit analyses (for climate resilience measures) were run with the data available at the time, and do not incorporate changes in the project scope and costs that were made during the ADB final review mission in June/July 2013.

**Table IV.7: EIRRs for Different Climate Resilient Measures**

| Project Type | Amtali | Galachipa | Mathbaria | Pirojpur |
|---|---|---|---|---|
| Water Supply | 23% | 19% | 14% | 48% |
| Sanitation | 41% | 47% | 47% | 37% |
| Drainage/Flood Control | 28% | 26% | 37% | 89% |
| Solid Waste | 22% | 30% | 46% | 59% |
| Roads | 29% | 28% | 32% | 21% |
| Bridges | 47% | 68% | 118% | 121% |
| Cyclone Shelters | 20% | 26% | 33% | 24% |
| Boat Landing Stations | 25% | 67% | 41% | 69% |
| Markets | 50% | 62% | 59% | 49% |
| Bus Terminals | | 47% | 91% | |
| Building Codes | 17% | | | |

Source: PPTA Consultant.

## Table IV.8 Economic Costs:Benefits for Pourashava: Amtali

| | Cumulative Project Life Loss/Damage (million BDT, no discount rate) | | | | | Cumulative Project Costs (million BDT, no discount rate) | | | Economic Returns of Project (million BDT, million USD) | | | Vulnerability Reduction Credits (VRCs) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sector | Baseline Loss/ Damage With Climate Change | Project (no climate resilience) Loss/ Damage With Climate Change | Project (with climate resilience) Loss/ Damage With Climate Change | Net Reduction in Loss/ Damage from Project (with climate resilience) | Net Reduction in Loss/ Damage from Climate Resilience Measures | Cumulative Project Costs (no climate resilience) | Cumulative Project Costs (with climate resilience) | Cumulative Incremental Costs of climate resilience | NPV of climate resilience measures | EIRR of climate resilience measures | NPV (3%, USD of climate resilience measures | Cumulative VRCs | USD/ VRC |
| **Water Supply** | 1583.5 | 392.7 | 92.4 | 1491.1 | 300.3 | 237.4 | 322.2 | 84.8 | 122.5 | 23% | $1.57 | 217956.1 | $5.00 |
| **Sanitation** | 80.8 | 12.1 | 6.0 | 74.9 | 6.1 | 19.8 | 22.1 | 2.3 | 4.8 | 41% | $0.06 | 8505.9 | $3.44 |
| **Drainage/ Flood Control** | 671.7 | 136.5 | 49.7 | 622.0 | 86.8 | 80.6 | 100.2 | 19.6 | 68.9 | 28% | $0.89 | 122545.1 | $2.05 |
| **Solid Waste** | 47.9 | 12.0 | 3.5 | 44.4 | 8.4 | 14.3 | 18.1 | 3.9 | 2.5 | 22% | $0.03 | 4497.5 | $11.03 |
| **Roads** | 1246.8 | 231.6 | 89.4 | 1157.4 | 142.2 | 171.6 | 207.1 | 35.5 | 70.7 | 29% | $0.91 | 125790.6 | $3.62 |
| **Bridges** | 217.9 | 63.4 | 14.5 | 203.5 | 48.9 | 33.2 | 36.6 | 3.4 | 29.5 | 47% | $0.38 | 52389.2 | $0.83 |
| **Cyclone Shelters** | 730.2 | 109.5 | 54.0 | 676.2 | 55.5 | 171.0 | 193.6 | 22.4 | 46.2 | 20% | $0.59 | 82122.9 | $3.50 |
| **Boat Landing Stations** | 36.8 | 9.2 | 2.7 | 34.1 | 6.5 | 7.6 | 10.3 | 2.5 | 2.6 | 25% | $0.03 | 4550.5 | $7.18 |
| **Markets** | 90.8 | 18.2 | 6.7 | 84.1 | 11.4 | 10.8 | 12.4 | 1.6 | 9.7 | 50% | $0.13 | 17316.3 | $1.20 |
| **Town Total:** | **4706.48** | **985.05** | **318.97** | **4387.51** | **666.08** | **746.27** | **922.60** | **175.89** | **357.35** | | **$4.59** | **635674.2** | |

## Table IV.9 Economic Costs:Benefits for Pourashava: Galachipa

| | Cumulative Project Life Loss/Damage (million BDT, no discount rate) | | | | | Cumulative Project Costs (million BDT, no discount rate) | | | Economic Returns of Project (million BDT, million USD) | | | Vulnerability Reduction Credits (VRCs) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sector** | Baseline Loss/ Damage With Climate Change | Project (no climate resilience) Loss/ Damage With Climate Change | Project (with climate resilience) Loss/ Damage With Climate Change | Net Reduction in Loss/ Damage from Project (with climate resilience) | Net Reduction in Loss/ Damage from Climate Resilience Measures | Cumulative Project Costs (no climate resilience) | Cumulative Project Costs (with climate resilience) | Cumulative Incremental Costs of climate resilience | NPV of climate resilience measures | EIRR of climate resilience measures | NPV (3%, USD of climate resilience measures | Cumulative VRCs | USD/ VRC |
| **Water Supply** | 3195530.0 | 3194766.9 | 3194725.4 | 804.6 | 41.5 | 112.5 | 189.2 | 35.1 | 26.0 | 19% | $0.33 | 50809.2 | $8.88 |
| **Sanitation** | 110.3 | 13.3 | 8.2 | 102.2 | 5.1 | 19.1 | 21.6 | 2.4 | 5.3 | 47% | $0.07 | 10401.6 | $2.97 |
| **Drainage/ Flood Control** | 2499.0 | 548.3 | 184.9 | 2314.1 | 363.4 | 302.6 | 361.9 | 59.3 | 195.0 | 26% | $2.51 | 380442.5 | $2.00 |
| **Solid Waste** | 56.3 | 17.2 | 4.2 | 52.1 | 13.0 | 14.3 | 18.1 | 3.9 | 3.9 | 30% | $0.05 | 7531.7 | $6.59 |
| **Roads** | 1091.5 | 291.9 | 82.2 | 1009.2 | 209.7 | 271.5 | 311.1 | 39.6 | 112.3 | 28% | $1.44 | 219058.3 | $2.32 |
| **Bridges** | 386.2 | 169.4 | 25.6 | 360.6 | 143.7 | 58.9 | 64.8 | 5.9 | 90.2 | 68% | $1.16 | 176077.0 | $0.43 |
| **Cyclone Shelters** | 760.9 | 114.1 | 56.3 | 704.6 | 57.8 | 149.3 | 165.9 | 16.5 | 56.3 | 26% | $0.72 | 109778.2 | $1.94 |
| **Boat Landing Stations** | 75.0 | 17.5 | 5.5 | 69.4 | 11.9 | 6.6 | 7.5 | 0.9 | 10.1 | 67% | $0.13 | 19783.9 | $0.61 |
| **Markets** | 134.2 | 28.0 | 9.9 | 124.3 | 18.0 | 12.7 | 14.7 | 1.9 | 15.6 | 62% | $0.20 | 30488.5 | $0.81 |
| **Bus Terminal** | 69.1 | 13.8 | 5.1 | 64.0 | 8.7 | 22.6 | 24.8 | 2.1 | 6.1 | 47% | $0.08 | 11991.3 | $2.25 |
| **Town Total:** | **3200712.5** | **3195980.3** | **3195107.4** | **5605.1** | **872.9** | **970.0** | **1179.5** | **167.7** | **520.9** | | **$6.69** | **1016362.2** | |

## Table IV.10 Economic Costs:Benefits for Pourashava: Mathbaria

| | Cumulative Project Life Loss/Damage (million BDT, no discount rate) | | | | | Cumulative Project Costs (million BDT, no discount rate) | | | Economic Returns of Project (million BDT, million USD) | | | Vulnerability Reduction Credits (VRCs) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sector** | Baseline Loss/ Damage With Climate Change | Project (no climate resilience) Loss/ Damage With Climate Change | Project (with climate resilience) Loss/ Damage With Climate Change | Net Reduction in Loss/ Damage from Project (with climate resilience) | Net Reduction in Loss/ Damage from Climate Resilience Measures | Cumulative Project Costs (no climate resilience) | Cumulative Project Costs (with climate resilience) | Cumulative Incrementa l Costs of climate resilience | NPV of climate resilience measures | EIRR of climate resilience measures | NPV (3%, USD of climate resilience measures | Cumulative VRCs | USD/ VRC |
| **Water Supply** | 2098.1 | 169.6 | 154.2 | 1943.9 | 15.4 | 396.1 | 483.3 | 87.2 | 18.3 | 14% | $0.23 | 20684.6 | $54.17 |
| **Sanitation** | 157.2 | 17.2 | 11.6 | 145.5 | 5.6 | 28.3 | 27.3 | -1.1 | 12.9 | 47% | $0.17 | 14588.4 | -$0.96 |
| **Drainage/ Flood Control** | 4005.7 | 1374.9 | 296.4 | 3709.3 | 1078.5 | 545.5 | 663.2 | 117.6 | 633.0 | 37% | $8.13 | 716795.1 | $2.11 |
| **Solid Waste** | 74.2 | 22.7 | 5.5 | 68.7 | 17.2 | 14.3 | 18.1 | 3.9 | 6.7 | 46% | $0.09 | 7599.2 | $6.53 |
| **Roads** | 2682.9 | 462.7 | 190.8 | 2492.1 | 271.9 | 374.9 | 414.3 | 39.4 | 6.7 | 31.9% | $0.09 | 7599.2 | $66.67 |
| **Bridges** | 895.5 | 678.6 | 59.5 | 836.0 | 619.2 | 116.8 | 128.6 | 11.8 | 401.8 | 118% | $5.16 | 454916.0 | $0.33 |
| **Cyclone Shelters** | 1018.7 | 152.8 | 75.4 | 943.3 | 77.4 | 149.3 | 165.9 | 16.5 | 80.9 | 33% | $1.04 | 91596.7 | $2.32 |
| **Boat Landing Stations** | 27.2 | 6.8 | 2.0 | 25.2 | 4.8 | 4.7 | 5.4 | 0.7 | 3.6 | 41% | $0.05 | 4093.5 | $2.10 |
| **Markets** | 110.6 | 22.1 | 8.2 | 102.4 | 13.9 | 10.8 | 12.4 | 1.6 | 12.3 | 59% | $0.16 | 13879.9 | $1.49 |
| **Bus Terminal** | 142.7 | 28.5 | 10.6 | 132.1 | 18.0 | 22.6 | 24.8 | 2.1 | 15.5 | 91% | $0.20 | 17567.9 | $1.53 |
| **Town Total:** | **11212.7** | **2936.0** | **814.1** | **10398.7** | **2121.9** | **1663.3** | **1943.3** | **279.7** | **1191.6** | | **$0.00** | **1349320.4** | |

## Table IV.11 Economic Costs:Benefits for Pourashava: Pirojpur

| | Cumulative Project Life Loss/Damage (million BDT, no discount rate) | | | | | Cumulative Project Costs (million BDT, no discount rate) | | | Economic Returns of Project (million BDT, million USD) | | | Vulnerability Reduction Credits (VRCs) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sector** | Baseline Loss/ Damage With Climate Change | Project (no climate resilience) Loss/ Damage With Climate Change | Project (with climate resilience) Loss/ Damage With Climate Change | Net Reduction in Loss/ Damage from Project (with climate resilience) | Net Reduction in Loss/ Damage from Climate Resilience Measures | Cumulative Project Costs (no climate resilience) | Cumulative Project Costs (with climate resilience) | Cumulative Incremental Costs of climate resilience | NPV of climate resilience measures | EIRR of climate resilience measures | NPV (3%, USD of climate resilience measures | Cumulative VRCs | USD/ VRC |
| **Water Supply** | 3350.6 | 1163.3 | 265.8 | 3084.8 | 897.6 | 594.4 | 570.5 | 86.7 | 580.0 | 48% | $7.45 | 1125494.2 | $0.99 |
| **Sanitation** | 88.3 | 11.3 | 6.5 | 81.8 | 4.8 | 22.5 | 23.7 | 1.1 | 5.9 | 37% | $0.08 | 11495.6 | $1.25 |
| **Drainage/ Flood Control** | 5321.0 | 2460.8 | 393.7 | 4927.2 | 2067.1 | 347.3 | 421.4 | 74.1 | 1353.5 | 89% | $17.39 | 2626308.0 | $0.36 |
| **Solid Waste** | 90.0 | 27.5 | 6.7 | 83.4 | 20.8 | 14.3 | 18.1 | 3.9 | 9.2 | 59% | $0.12 | 17915.4 | $2.77 |
| **Roads** | 5825.9 | 816.0 | 405.9 | 5420.0 | 410.1 | 500.6 | 597.5 | 96.9 | 199.6 | 21% | $2.56 | 387315.6 | $3.21 |
| **Bridges** | 895.8 | 678.9 | 59.5 | 836.3 | 619.4 | 113.9 | 125.3 | 11.4 | 402.3 | 121% | $5.17 | 780609.4 | $0.19 |
| **Cyclone Shelters** | 962.1 | 144.3 | 71.2 | 890.9 | 73.1 | 199.1 | 221.2 | 22.0 | 70.0 | 24% | $0.90 | 135846.6 | $2.08 |
| **Boat Landing Stations** | 47.5 | 11.9 | 3.5 | 44.0 | 8.4 | 4.8 | 5.4 | 0.6 | 6.9 | 69% | $0.09 | 13379.0 | $0.59 |
| **Markets** | 194.6 | 40.6 | 14.4 | 180.2 | 26.1 | 24.4 | 28.2 | 3.7 | 21.6 | 49% | $0.28 | 41996.4 | $1.13 |
| **Bus Terminal** | | | | | | | | | | | | | |
| **Town Total:** | **16775.8** | **5354.5** | **1227.2** | **15548.6** | **0.0** | **1821.2** | **2011.3** | **300.4** | **2649.2** | | **$0.00** | **5140360.3** | |

## Table IV.12 Economic Costs:Benefits for All coastal towns

| | **Cumulative Project Life Loss/Damage (million BDT, no discount rate)** | | | | | **Cumulative Project Costs (million BDT, no discount rate)** | | | **Economic Returns of Project (million BDT, million USD)** | | | **Vulnerability Reduction Credits (VRCs)** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sector** | Baseline Loss/ Damage With Climate Change | Project (no climate resilience) Loss/ Damage With Climate Change | Project (with climate resilience) Loss/ Damage With Climate Change | Net Reduction in Loss/ Damage from Project (with climate resilience) | Net Reduction in Loss/ Damage from Climate Resilience Measures | Cumulative Project Costs (no climate resilience) | Cumulative Project Costs (with climate resilience) | Cumulative Incremental Costs of climate resilience | NPV of climate resilience measures | EIRR of climate resilience measures | NPV (3%, USD of climate resilience measures | Cumulative VRCs | USD/ VRC |
| **Water Supply** | 3202562.1 | 3196492.5 | 3195237.7 | 7324.4 | 1254.8 | 1340.4 | 1565.1 | 293.8 | 746.9 | 104% | $9.60 | 1270209.3 | $2.97 |
| **Sanitation** | 436.7 | 53.9 | 32.3 | 404.3 | 21.6 | 89.6 | 94.7 | 4.7 | 28.9 | 172% | $0.37 | 49184.9 | $1.23 |
| **Drainage/ Flood Control** | 12497.4 | 4520.4 | 924.8 | 11572.6 | 3595.7 | 1276.0 | 1546.6 | 270.6 | 2250.4 | 180% | $28.92 | 3827262.9 | $0.91 |
| **Solid Waste** | 268.3 | 79.3 | 19.9 | 248.5 | 59.5 | 57.1 | 72.6 | 15.4 | 22.3 | 158% | $0.29 | 37980.6 | $5.22 |
| **Roads** | 10847.1 | 1802.1 | 768.3 | 10078.8 | 1033.8 | 1318.6 | 1530.0 | 211.4 | 389.3 | 111% | $5.00 | 662084.5 | $4.10 |
| **Bridges** | 2395.5 | 1590.2 | 159.1 | 2236.4 | 1431.2 | 322.8 | 355.3 | 32.5 | 923.7 | 354% | $11.87 | 1571008.5 | $0.27 |
| **Cyclone Shelters** | 3471.9 | 520.8 | 256.9 | 3215.0 | 263.9 | 668.8 | 746.7 | 77.5 | 253.3 | 103% | $3.26 | 430837.9 | $2.31 |
| **Boat Landing Stations** | 186.5 | 45.4 | 13.8 | 172.7 | 31.6 | 23.6 | 28.5 | 4.8 | 23.2 | 201% | $0.30 | 39468.9 | $1.55 |
| **Markets** | 530.2 | 108.8 | 39.2 | 491.0 | 69.5 | 58.6 | 67.6 | 8.9 | 59.3 | 220% | $0.76 | 100785.3 | $1.13 |
| **Bus Terminal** | 211.8 | 42.4 | 15.7 | 196.1 | 26.7 | 45.2 | 49.6 | 4.2 | 0.2 | 137% | $0.00 | 29559.3 | $1.82 |
| **Building Codes** | | | | | | | | | 2999.4 | | | 5101021.2 | $0.00 |
| **Town Total:** | **3233407.5** | **3205255.9** | **3197467.6** | **35939.9** | **7788.2** | **5200.7** | **6056.7** | **923.7** | **7697.0** | | **$60.36** | **13119403. 4** | |

## Table IV.13: Economic Costs:Benefits for Project Types Summary Sheets

### Project Type: Water

| Figures in millions BDT | Amtali | Galachipa | Mathbaria | Pirojpur | All Towns |
|---|---|---|---|---|---|
| Cumulative Project Costs (without climate resilience) | 237.43 | 112.49 | 396.10 | 594.35 | 1340.37 |
| Cumulative Project Costs (with climate resilience) | 322.21 | 189.15 | 483.30 | 570.46 | 1565.13 |
| Cumulative Incremental Climate Costs | 84.79 | 35.11 | 87.20 | 86.66 | 293.77 |
| NPV (3%, USD) of Climate Resilience | $1.57 | $0.33 | $0.23 | $7.45 | 9.60 |
| EIRR of Climate Resilience Measures | 23% | 19% | 14% | 48% | |
| Cumulative VRCs | 217,956 | 50,809 | 20,685 | 1,125,494 | 1414944 |
| USD/VRC | $5.00 | $8.88 | $54.17 | $0.99 | 0.08 |

### Project Type: Sanitation

| Figures in millions BDT | Amtali | Galachipa | Mathbaria | Pirojpur | All Towns |
|---|---|---|---|---|---|
| Cumulative Project Costs (without climate resilience) | 19.76 | 19.09 | 28.27 | 22.46 | 89.58 |
| Cumulative Project Costs (with climate resilience) | 22.12 | 21.57 | 27.33 | 23.68 | 94.719 |
| Cumulative Incremental Climate Costs | 2.275 | 2.40 | -1.08 | 1.12 | 4.71 |
| NPV (3%, USD) of Climate Resilience | $0.06 | $0.07 | $0.17 | $0.08 | 0.37 |
| EIRR of Climate Resilience Measures | 41% | 47% | 47% | 37% | |
| Cumulative VRCs | 8,506 | 10,402 | 14,588 | 11,496 | 44991 |
| USD/VRC | $3.44 | $2.97 | -$0.96 | $1.25 | 0.10 |

### Project Type: Drainage/flood control

| Figures in millions BDT | Amtali | Galachipa | Mathbaria | Pirojpur | All Towns |
|---|---|---|---|---|---|
| Cumulative Project Costs (without climate resilience) | 80.60 | 302.55 | 545.52 | 347.30 | 1275.98 |
| Cumulative Project Costs (with climate resilience) | 100.15 | 361.86 | 663.16 | 421.41 | 1546.60 |
| Cumulative Incremental Climate Costs | 19.55 | 59.31 | 117.64 | 74.11 | 270.62 |
| NPV (3%, USD) of Climate Resilience | $0.89 | $2.51 | $8.13 | $17.39 | 28.92 |
| EIRR of Climate Resilience Measures | 28% | 26% | 37% | 89% | |
| Cumulative VRCs | 122,545 | 380,443 | 716,795 | 2,626,308 | 3846091 |
| USD/VRC | $2.05 | $2.00 | $2.11 | $0.36 | 0.09 |

### Project Type: Solid waste

| Figures in millions BDT | Amtali | Galachipa | Mathbaria | Pirojpur | All Towns |
|---|---|---|---|---|---|
| Cumulative Project Costs (without climate resilience) | 14.28 | 14.28 | 14.28 | 14.28 | 57.14 |
| Cumulative Project Costs (with climate resilience) | 18.14 | 18.14 | 18.14 | 18.14 | 72.59 |
| Cumulative Incremental Climate Costs | 3.86 | 3.86 | 3.86 | 3.86 | 15.44 |
| NPV (3%, USD) of Climate Resilience | $0.03 | $0.05 | $0.09 | $0.12 | 0.29 |
| EIRR of Climate Resilience Measures | 22% | 30% | 46% | 59% | |
| Cumulative VRCs | 4,497 | 7,532 | 7,599 | 17,915 | 37544 |
| USD/VRC | $11.03 | $6.59 | $6.53 | $2.77 | 0.09 |

### Project Type: Roads

| Figures in millions BDT | Amtali | Galachipa | Mathbaria | Pirojpur | All Towns |
|---|---|---|---|---|---|
| Cumulative Project Costs (without climate resilience) | 171.64 | 271.49 | 374.87 | 500.57 | 1318.59 |
| Cumulative Project Costs (with climate resilience) | 207.12 | 311.06 | 414.29 | 597.47 | 1529.96 |
| Cumulative Incremental Climate Costs | 35.48 | 39.56 | 39.42 | 96.89 | 211.36 |
| NPV (3%, USD) of Climate Resilience | $0.91 | $1.44 | $0.09 | $2.56 | 5.00 |
| EIRR of Climate Resilience Measures | 29% | 28% | 31.9% | 21% | |
| Cumulative VRCs | 125,791 | 219,058 | 7,599 | 387,316 | 739764 |
| USD/VRC | $3.62 | $2.32 | $66.67 | $3.21 | 0.08 |

### Project Type: Bridges

| Figures in millions BDT | Amtali | Galachipa | Mathbaria | Pirojpur | All Towns |
|---|---|---|---|---|---|
| Cumulative Project Costs (without climate resilience) | 33.21 | 58.87 | 116.82 | 113.89 | 322.81 |
| Cumulative Project Costs (with climate resilience) | 36.59 | 64.81 | 128.59 | 125.27 | 355.27 |
| Cumulative Incremental Climate Costs | 3.37 | 5.94 | 11.76 | 11.37 | 32.46 |
| NPV (3%, USD) of Climate Resilience | $0.38 | $1.16 | $5.16 | $5.17 | 11.87 |
| EIRR of Climate Resilience Measures | 47% | 68% | 118% | 121% | |
| Cumulative VRCs | 52,389 | 176,077 | 454,916 | 780,609 | 1463992 |
| USD/VRC | $0.83 | $0.43 | $0.33 | $0.19 | 0.10 |

## Project Type: Cyclone shelters

| Figures in millions BDT | Amtali | Galachipa | Mathbaria | Pirojpur | All Towns |
|---|---|---|---|---|---|
| Cumulative Project Costs (without climate resilience) | 170.96 | 149.34 | 149.34 | 199.12 | 668.76 |
| Cumulative Project Costs (with climate resilience) | 193.58 | 165.93 | 165.93 | 221.24 | 746.70 |
| Cumulative Incremental Climate Costs | 22.39 | 16.53 | 16.53 | 22.04 | 77.49 |
| NPV (3%, USD) of Climate Resilience | $0.59 | $0.72 | $1.04 | $0.90 | 3.26 |
| EIRR of Climate Resilience Measures | 20% | 26% | 33% | 24% | |
| Cumulative VRCs | 82,123 | 109,778 | 91,597 | 135,847 | 419344 |
| USD/VRC | $3.50 | $1.94 | $2.32 | $2.08 | 0.09 |

## Project Type: Boat landing stations

| Figures in millions BDT | Amtali | Galachipa | Mathbaria | Pirojpur | All Towns |
|---|---|---|---|---|---|
| Cumulative Project Costs (without climate resilience) | 7.62 | 6.57 | 4.69 | 4.75 | 23.64 |
| Cumulative Project Costs (with climate resilience) | 10.26 | 7.52 | 5.37 | 5.37 | 28.53 |
| Cumulative Incremental Climate Costs | 2.54 | 0.93 | 0.66 | 0.61 | 4.76 |
| NPV (3%, USD) of Climate Resilience | $0.03 | $0.13 | $0.05 | $0.09 | 0.30 |
| EIRR of Climate Resilience Measures | 25% | 67% | 41% | 69% | |
| Cumulative VRCs | 4,550 | 19,784 | 4,093 | 13,379 | 41807 |
| USD/VRC | $7.18 | $0.61 | $2.10 | $0.59 | 0.09 |

**Project Type: Markets**

| Figures in millions BDT | Amtali | Galachipa | Mathbaria | Pirojpur | All Towns |
|---|---|---|---|---|---|
| Cumulative Project Costs (without climate resilience) | 10.75 | 12.68 | 10.75 | 24.40 | 58.59 |
| Cumulative Project Costs (with climate resilience) | 12.39 | 14.65 | 12.39 | 28.17 | 67.61 |
| Cumulative Incremental Climate Costs | 1.61 | 1.92 | 1.61 | 3.69 | 8.85 |
| NPV (3%, USD) of Climate Resilience | $0.13 | $0.20 | $0.16 | $0.28 | 0.76 |
| EIRR of Climate Resilience Measures | 50% | 62% | 59% | 49% | |
| Cumulative VRCs | 17,316 | 30,488 | 13,880 | 41,996 | 103681 |
| USD/VRC | $1.20 | $0.81 | $1.49 | $1.13 | 0.09 |

**Project Type: Bus Terminal**

| Figures in millions BDT | Amtali | Galachipa | Mathbaria | Pirojpur | All Towns |
|---|---|---|---|---|---|
| Cumulative Project Costs (without climate resilience) | | 22.62 | 22.62 | | 45.24 |
| Cumulative Project Costs (with climate resilience) | | 24.78 | 24.78 | | 49.57 |
| Cumulative Incremental Climate Costs | | 2.09 | 2.09 | | 4.19 |
| NPV (3%, USD) of Climate Resilience | | $0.08 | -$0.20 | | -0.12 |
| EIRR of Climate Resilience Measures | | 47% | 91% | | |
| Cumulative VRCs | | 11,991 | 17,568 | | 29559 |
| USD/VRC | | $2.25 | $1.53 | | -0.05 |

Source: PPTA Consultant.

## IV.6 Vulnerability Reduction Credit Analysis

141. One means of evaluating the climate adaptation impacts of projects is using the vulnerability reduction credit (VRC™) approach.[39] A VRC is a credit for "work done" in reducing vulnerability. VRCs are output based, issued periodically, post hoc, after auditing of vulnerability reduction measures that have been and are being implemented. But, VRC issuance levels may be estimated based in part on a climate resiliency cost: benefit analysis as performed for the CTIIP project.

142. Each VRC has a nominal value of €50, and the number of VRCs that may be generated is a function of the VRCs' nominal value, the project's Avoided Impact Cost (AIC) and an (Income Equalization Factor (IEF):

$$\textit{No. of VRCs} = \frac{AIC \times IEF}{€50}$$

143. AICs are the damage or loss, as calculated by the PPTA.

144. The Income Equalization Factor is employed to reflect that monetary losses from damage to livelihood and property reflects local asset values, which are lower in poorer communities. The IEF aims to normalize economic losses of these poorer communities. The IEF uses the World Bank's gross national income threshold for lower-to-upper middle-income countries ($4,085 per capita) as its benchmark. The IEF is a threshold, below the (currently) $4,085, the IEF is >1. For instance for a community with per capita income of a little over $500, the IEF would be 8, meaning 8 times more VRCs would be issued than for a project that reduces loss or damage from climate change in a community with a per capita income of $4,085.

145. The IEF was estimated at the town level using the PPTA Socio-Economic Survey results. The IEF, as seen in **Table IV.14**, varies considerably with Mathbaria having the lowest factor and Galachipa the highest.

**Table IV.14: Income Equalization Factor per CTIIP Town**

| Town | Income Equalization Factor (IEF) |
|---|---|
| Amtali | 8.81 |
| Galachipa | 9.66 |
| Mathbaria | 5.61 |
| Pirojpur | 9.60 |

Source: PPTA Consultant.

[39] See Schultz, K., "Financing climate adaptation with a credit mechanism: initial considerations," *Climate Policy*, 12(2012) 187-197. The term "vulnerability reduction credits" and "VRC" is a trademark of Climate Mitigation Works Limited, a private limited company registered in England and Wales, Registration no. 49006591. The methodology employed is illustrative only and is not an approved mechanism of the UNFCCC or any other body. The Higher Ground Foundation is currently developing a high-level framework and baseline methodologies for VRCs.

146. **Table IV.14** and **Figure IV.3** show that Pirojpur generates the majority of all VRCs and has significantly lower costs (of the incremental investment in climate resilience, not the net present value which is always positive for CTIIP climate resilience measures) per VRC. The largest source of VRCs generated by measure was from changes in the building codes to make buildings more climate resilient, followed by drainage and flood control (see **Figure IV.4**).

**Figure IV.3:**

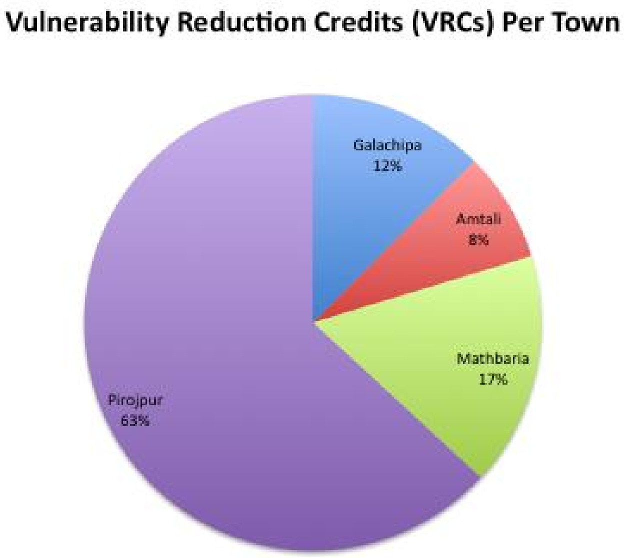
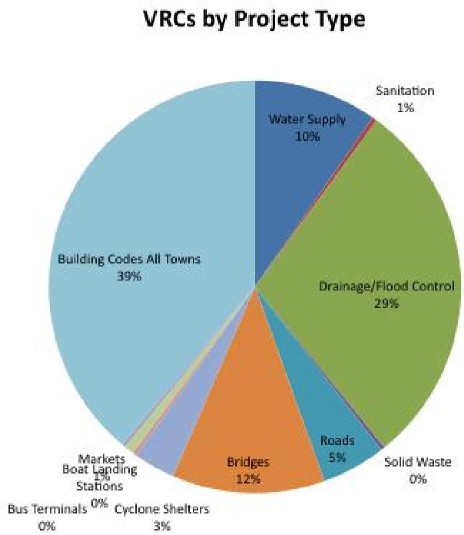



**Figure IV.4:**



147. The PPTA estimates that the projects in the four towns have the potential to generate 12.5 million VRCs **(Table IV.15)**. The analysis assumes that VRCs are generated from the "climate resilient" measures. There is further reduction in loss or damage from the basic infrastructure investments without consideration of climate change. To be conservative in this analysis, these reductions in loss or damage are not counted as climate vulnerability reduction.[40]

148. There is also a wide range of vulnerability reduction costs per VRC generated between the different project types. Some activities such as making bus terminals and solid waste management were the most expensive in relative terms, while the cheapest measures were making bridges climate resilient, and drainage and flood control, both under one dollar. Building codes, the projected largest source of climate vulnerability reduction, were more expensive than average, at $2.74/VRC. Note that the estimate of building code costs includes not just the administrative costs to the pourashavas, but also the costs to the regulated parties - the building owners in additional materials and labor needed to construct climate resilient buildings. It's also important to note that the analysis of building codes is only available for all four towns, the analysis assumes that the building codes are performed entirely for "climate resilience" reasons, and the incremental costs equal the total costs. As there may be other benefits besides climate related ones (better structural integrity may result in several potential non-climate resilient benefits), this probably means that the costs of climate resilience are overestimated.

149. All of these estimates are just a starting point in understanding the potential impact these projects shall have in reducing climate vulnerabilities. Improved monitoring and evaluation of climate changes and impacts will result in significantly improved data to assess impact. Nonetheless, they demonstrate the considerable benefits the CTIIP subprojects may bring resulting from the attention paid to climate resilience in the projects' design.

**Table IV.15: VRCs and Incremental Costs for Climate Resilience and VRCs**

| Town | VRCs Generated | Incremental Costs for Climate Resilience (Million $US) | $US/VRC |
|---|---|---|---|
| Galachipa | 1,016,362 | 2.155 | $2.12 |
| Amtali | 635,674 | 2.260 | $3.56 |
| Mathbaria | 1,349,320 | 3.594 | $2.66 |
| Pirojpur | 5,140,360 | 3.860 | $0.75 |
| TOTAL | 8,141,717 | 11.870 | $1.46 |
| TOTAL (WITH BUILDING CODES) | 12,559,000 | 34.371 | $2.74 |

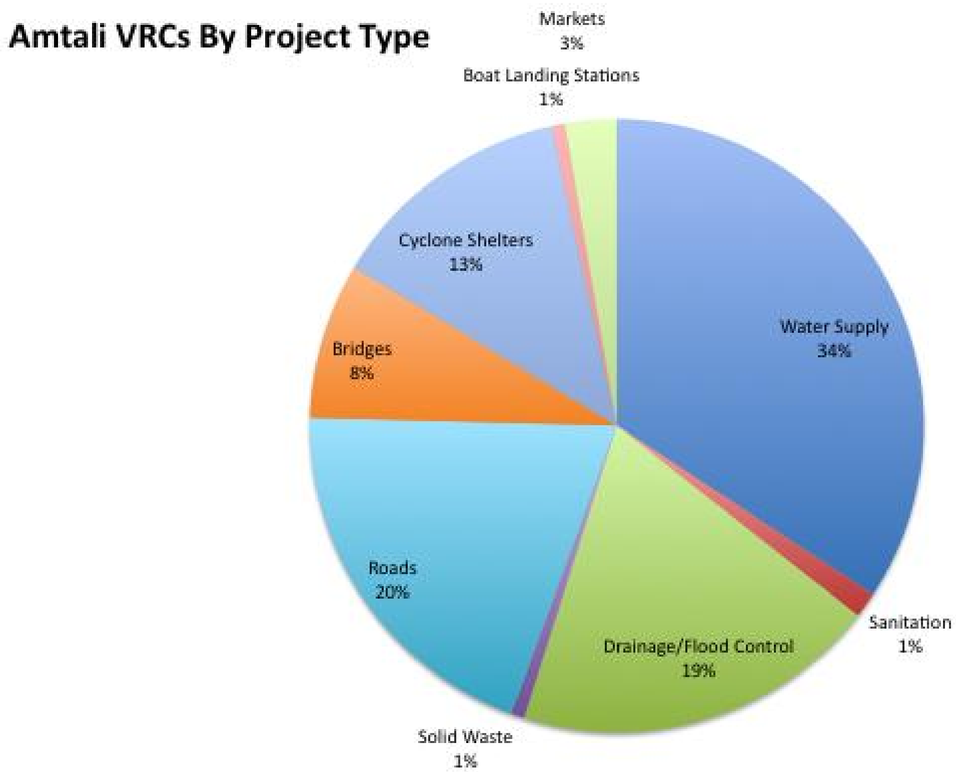
Source: PPTA Consultant.

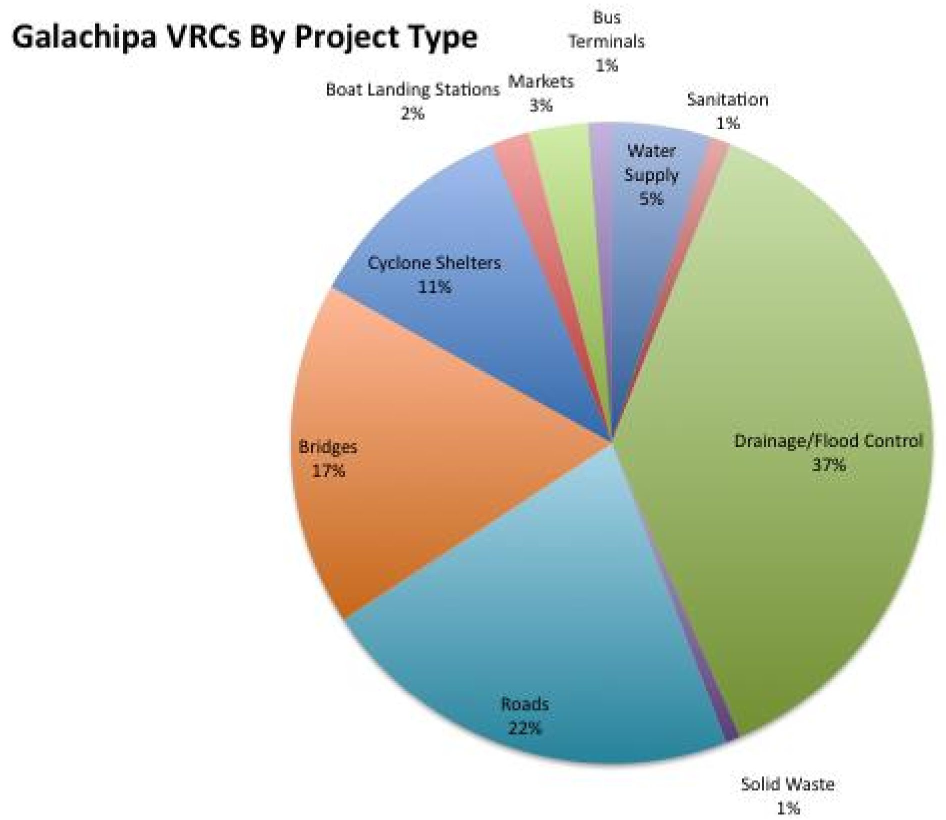
40 See Chapter I on the strategy and how these base level investments may be reducing the "adaptation deficit," a necessary, but not sufficient precursor to reducing climate vulnerabilities.

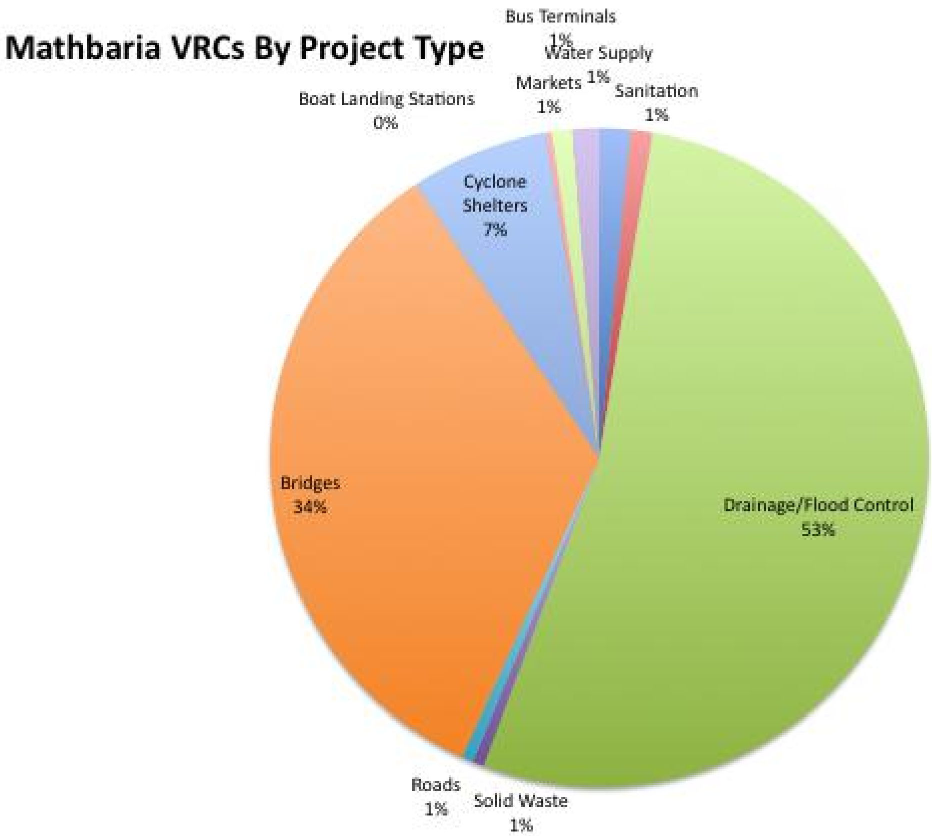
**Table IV.16: VRCS and Costs By Project Type**

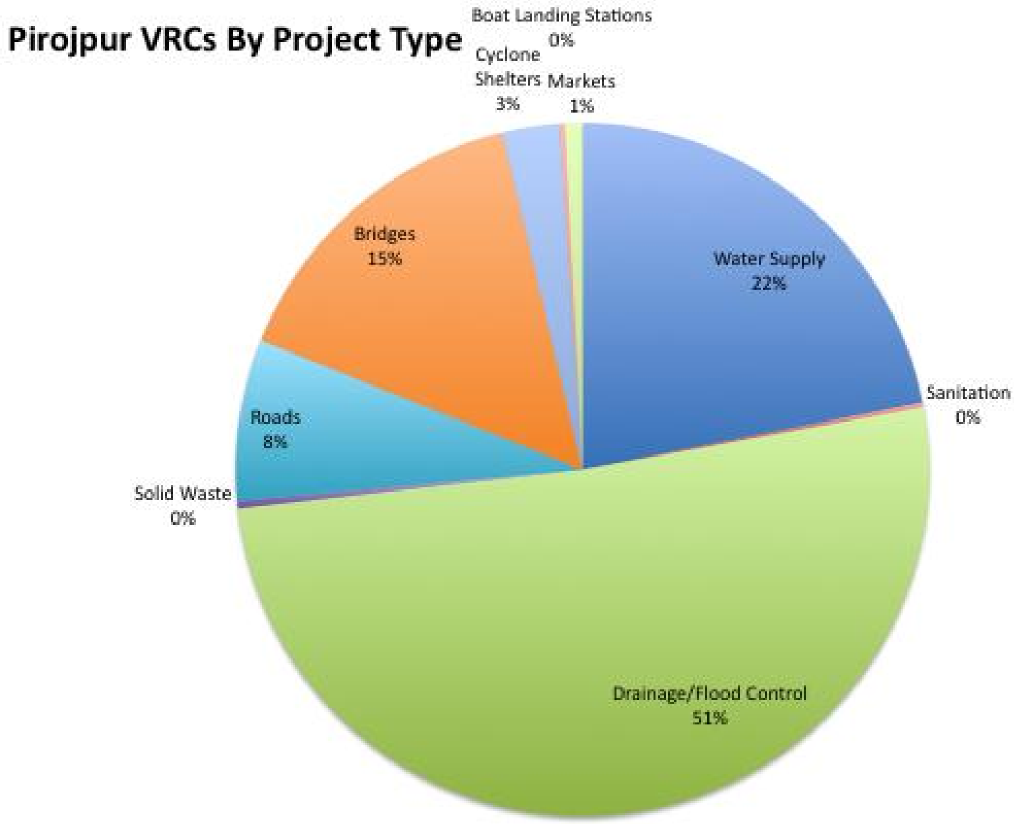
| Project Measure | VRCS | Total Climate Resilience Incremental Costs (Million $US) | $US/VRC |
|---|---|---|---|
| Water Supply | 1,270,209 | 3.775 | $2.97 |
| Sanitation | 49,185 | 0.061 | $1.23 |
| Drainage/Flood Control | 3,827,263 | 3.478 | $0.91 |
| Solid Waste | 37,981 | 0.198 | $5.22 |
| Roads | 662,084 | 2.716 | $4.10 |
| Bridges | 1,571,009 | 0.417 | $0.27 |
| Cyclone Shelters | 430,838 | 0.996 | $2.31 |
| Boat Landing Stations | 39,469 | 0.061 | $1.55 |
| Markets | 100,785 | 0.114 | $1.13 |
| Bus Terminals | 29,559 | 0.05 | $0.01 |
| Building Codes | 5,101,021 | 22.501 | $0.95 |
| TOTAL | 12,559,000 | 34.371 | $2.97 |

**Figure IV.5: VRCs Generated by Project Type for Each Town**




Galachipa VRCs By Project Type
Bus Terminals 1%
Boat Landing Stations 2%
Markets 3%
Sanitation 1%
Water Supply 5%
Cyclone Shelters 11%
Bridges 17%
Drainage/Flood Control 37%
Roads 22%
Solid Waste 1%


Mathbaria VRCs By Project Type
Bus Terminals 1%
Water Supply 1%
Markets 1%
Sanitation 1%
Boat Landing Stations 0%
Cyclone Shelters 7%
Bridges 34%
Drainage/Flood Control 53%
Roads 1%
Solid Waste 1%


Pirojpur VRCs By Project Type
Boat Landing Stations
0%
Cyclone
Shelters
3%
Markets
1%
Water Supply
22%
Sanitation
0%
Drainage/Flood Control
51%
Solid Waste
0%
Roads
8%
Bridges
15%

# V. COMMUNITY PERCEPTIONS OF CLIMATE CHANGE AND DISASTER RISK IN STUDY POURASHAVAS

## V.1 Introduction

150. The Coastal Towns Infrastructure Improvement Project (CTIIP) offers to reduce the vulnerability of subject communities to climate change impacts through a combination of infrastructure improvements, non-structural measures, and capacity building. For each town, it will be important to understand how possible climate changes will impact community wellbeing, and consider the existing infrastructure, town management practices, and institutional capacities from not only science and engineering based perspectives, but also how local citizens view their vulnerabilities, often as a reflection of existing climatic stresses that may intensify in the future. This is important for several reasons:

- To identify vulnerabilities. Communities that already face climate - related stresses are often best placed to point to the ways they are vulnerable, where they are vulnerable, and who is more vulnerable.
- To prioritize vulnerabilities. While outside experts may have useful tools to model and understand future climate, impacts, and the way engineering, planning, and town management practices may be improved, local citizens know best their own vulnerabilities, fears, and their extent.
- To understand existing resilience capacities. Surveying a broad cross section of the community is a tool to understand gaps and capacities; thus establishing a better baseline and plan to improve resilience that capitalizes on capacities and focuses on filling gaps.
- To create a benchmark for monitoring and evaluating project progress, and to inform formation of town-level theories of change.
- To demonstrate through action that the town's people are not only the ultimate beneficiaries, but also the stakeholders in the CTIIP.

151. The aim of the survey and mapping exercise was not to develop a controlled, statistically sound view of disaster, disaster preparedness, and climate change views of the communities. The aim was more journalistic: to get the views, in a reasonably systematic way (in order to compare views within and between towns, genders, class, etc.) what are the key personal experiences, issues and touching points regarding disaster, disaster preparedness and response.

152. CTIIP PPTA climate change consultants visited Mathbaria and Amtali in March, and Pirojpur and Galachipa in May

## V.2. Methodology

153. The process had several key components:

- For each town investigated, the starting point was gathering information on the town from literature, and meeting with Pourashava officials and other local "experts" (NGOs, Cyclone Preparedness Programme staff, etc) to understand how infrastructure, municipal services, town planning, and disaster risk management (DRM) are undertaken and what are viewed as priority vulnerabilities (wards, populations, infrastructure, etc.) and proposed project options.
- Then the investigators travel throughout the town, focusing more on the wards viewed as more vulnerable, and approach as wide a set of people as possible to interview them on their experiences and views on climate-related disasters and

climate change. The survey includes questions drawn up in advance and pertinent details of each respondent (e.g., name, age, sex, religion, occupation, dwelling, town ward).

- Finally, one neighborhood is selected for a “community hazard mapping” exercise. The investigators identify a location and ask people to join in the mapping. The investigators present a map with key infrastructure (roads, canals, and some key structures), they then ask the participants to identify the most important missing features for the ward: important public buildings, houses, parks, drains, etc. Finally, the participants go through the main hazards (in all cases, these were cyclone (wind, flooding) and tidal flooding during monsoon season), and point out what is impacted.

154. The approach evolved over time. The investigators discovered some questions were redundant, and that community mapping could only be undertaken for a relatively small area. Often, the area where community participants could give well informed views were only parts of a pourashava ward.

155. The need to obtain community based data on inundation became clear for the second field trip to Pirojpur and Galachipa. The questionnaire was modified (see below) and a larger sampling of community members from throughout the pourashavas were asked for recollected water inundation levels following Cyclone Sidr and the highest tidal flood and monsoon season flood and asked to show this, which the investigators mapped and input into a GIS system. This became the starting point for a survey of the remaining towns and work to project future inundation levels on GIS.

156. Below are the separate reports for a) Mathbaria and Amtali, and b) Pirojpur and Galachipa.

157. Field Trip Objectives:

A. Better understanding of towns: structure, governance, infrastructure, disaster risk management (DRM) systems, climate vulnerability/hazards, and adaptation options;

B. Meet a cross section of community and understand how they perceive their vulnerabilities, infrastructure and services priorities, and possible approaches to reduce (climate) vulnerabilities;

C. Develop an indicative, community based hazard maps for a vulnerable neighborhood in each town.

D. With B above, view sites of CTIIP priority one structural projects and consider potential climate vulnerabilities on site, interview local people in these areas view climate and disaster risk.

E. Survey local people (n=30) to establish a baseline for cyclone damage (Cyclone Sidr), tidal and monsoon flooding levels and duration (worst event witnessed in 2012) in order to create model for future anticipated flood levels/durations.

### V.3 Mathbaria

Date: 21-22 March 2013
Town: Mathbaria

| Date/Time | Location | Participants | Purpose, Outcomes |
|---|---|---|---|
| 21.03.13 Thursday 10:30 | Pourashava Mayor's Office | Al Hajj Rafiuddin Ahmed Ferdouse, Mayor, Abdus Salek, Executive Engineer, Shah Alam, Accounts, Harun or Rashid, Secretary General, Councilors, Most Wards (NAMES) | Discuss our purpose and meeting/data needs, overview from mayor of his priorities, views on infrastructure needs and disaster experiences and disaster management. |
| 12:00 | Pourashava Offices | Md. Abdul Latif, Cyclone Preparedness Program (CPP). | Discuss activities of his program, especially |
| 14:00 | Town survey: Wards 1, 3, and 2 | Local community: foot survey of entire town, "random" survey of broad cross section of community | See survey report. |
| 22.03.13, Friday | | | |
| 9:00 | Ward 1: In front of house in north part of ward | Salek, Community members (see list in report) | See mapping report |
| 10:30 | Ward 1: near main road further south part of ward | Salek, Community (see list in report) | See mapping report |
| After prayer | Mayor's office | Mayor, Mathbaria Pouroshava and LGED Project Director, Abul Bashar for debriefing and discussion of findings | Discussed water supply issues, need to raise embankments. PD indicated to mayor need a study on deep underground water resources, ADB suggests do several test wells. |

### Community Survey – Mathbaria – 21 March 2013

21 March 2013
Town: Mathbaria
Surveyors: Dewan Quadir, Karl Schultz

| Name | Age | Sex | Occupation | Religion | Disability? | Neighborhood | Type of Dwelling? | Notes |
|---|---|---|---|---|---|---|---|---|
| 1. Ali Akbar | 65 | M | Farmer | Islam | No | 1.5 km away from town | 2 Story Brick Building | |
| 2.Shahadat Hossain | 43 | M | Small businessman - poutry and wood | Islam | No | 100 m from spot Ward 1 | Tin shed/wooden frame | |
| 3.Shahanaz Parveen | 36 | F | Housewife helping husband's business | Islam | No | In home Ward 1 | Tin shed/wooden frame | Wife of No. 2 |
| 4.Popy | 12 | F | Student | Islam | No | Slum in Ward 3 | Slum | |
| 5.Sharaju | 70 | F | Elderly | Hindu | No | Slum in Ward 3 | Slum | |
| 6. Md. Tarikazzamman | 37 | M | Lecturer in Higher Secondary | Islam | No | Ward 2 | Brick building | |
| 7. Gouranga Lal Karmaker | 66 | M | Gold merchant | Hindu | No | Ward 2 | Strong tin shed | |
| 8.Tutamber Hossain | 70 | M | Social work and Porashava Counciller | Islam | No | Ward 1 | Wooden house with tin | |

| Questions | Respondent (code) | Responses |
|---|---|---|
| **Mathbaria Respondents 1-5** | | |
| 1. What does disaster mean? | 1 | Storms, storm surge flooding, rain flooding, temperature highs |
| | 2 | Storm, monsoon flood |
| | 3 | When there is problem with sudden loss |
| | 4 | Can't answer |
| | 5 | Crisis, like Sidr |
| 2. What are the most common disasters faced by your area? | 1 | Storms, storm surges, rain flooding, high temperature |
| | 2 | 2007 Sidr |
| | 3 | Sidr |
| | 4 | Sidr |
| | 5 | 1970, 2007, 2009 cyclones |
| 3. Have you been in a disaster(s) in this town? [List disaster, when it happened.] How did it affect you and the town? | 1 | Yes |
| | 2 | Yes |
| | 3 | Yes |
| | 4 | Yes |
| | 5 | Yes |
| 4. Were you prepared for the disaster? How did you prepare? | 1 | Prepared and lived in the house, stored food, damaged |
| | 2 | Prepared and was in the house, struggling with Sidr |
| | 3 | Prepared and was at home |
| | 4 | Prepared and was in nearby hospital |
| | 5 | Prepared and was in nearby hospital |
| 5. Do you know about any early warning/signal system available? What is it? | 1 | Yes, through television and government loudspeaker |
| | 2 | Yes, through loudspeaker |
| | 3 | Yes, through loudspeaker |
| | 4 | Yes, through loudspeaker |
| | 5 | No knowledge |
| 6. How did you react to the latest disaster? | 1 | Lived in the house |
| | 2 | Lived in the house |
| | 3 | Lived in the house |
| | 4 | Went to hospital |
| | 5 | Went to hospital |
| 7. What was destroyed or services interrupted? | 1 | Agriculture crops, fish in pond, trees, animals, water supply |
| | 2 | 500 chicken, house damaged, fish in pond, agricultural crops |
| | 3 | Same as above |
| | 4 | Houses, properties, poultry, cows |
| | 5 | Cow died, houses damaged, poultry died (40) |
| 8. Who/how did others (municipal government, aid agencies, etc.) help in disaster response. Was it adequate, if | 1 | No accepted any help |
| | 2 | Got 500 taka from Pourashava, also got food |
| | 3 | Got 500 taka from Pourashava, also got food |

| Questions | Respondent (code) | Responses |
|---|---|---|
| **Mathbaria Respondents 1-5** | | |
| not how not? | 4 | Food, water delivered by government and NGO |
| | 5 | Food, water |
| 9. Did you recover fully over the course of the next year? How did this happen? If not, in what ways did you not recover fully? | 1 | Yes |
| | 2 | Still in financial stress and in debt |
| | 3 | Does not know much |
| | 4 | Still in stress and debt |
| | 5 | Lives on daily work |
| 10. Did you or your family get sick during the disaster? What illness, for how long? Mortality or permanent damage? | 1 | No |
| | 2 | Yes - mother got sick, all got some stomach problem |
| | 3 | 90% got stomach problem |
| | 4 | Stomach sickness and skin diseases |
| | 5 | Stomach sickness and skin diseases |

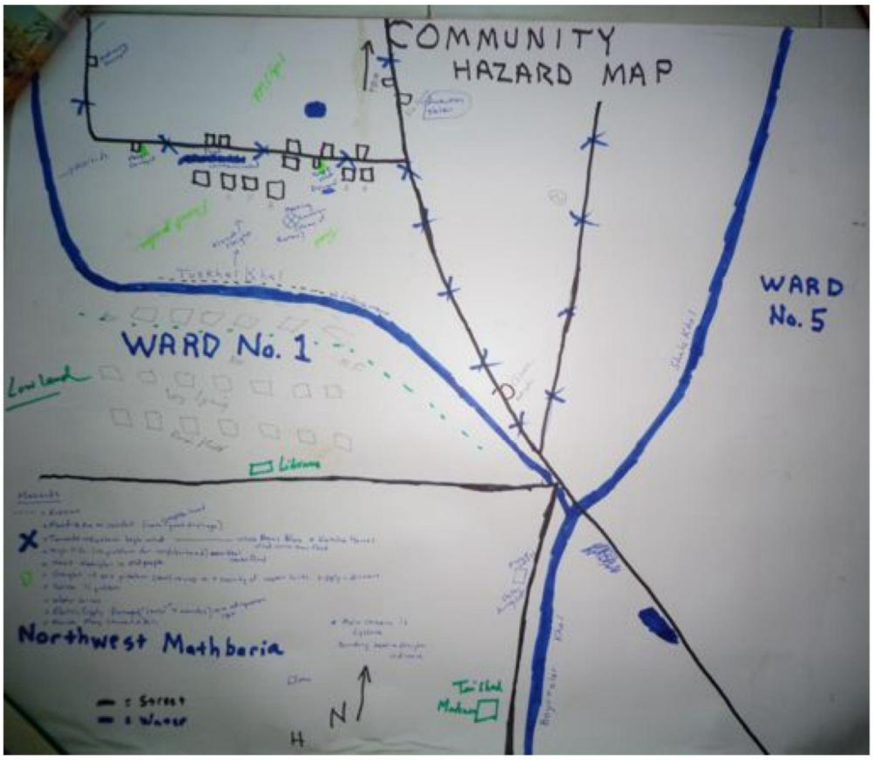
| | | |
|---|---|---|
| **Mathbaria Respondents 6 - 10** | | |
| 1. What does disaster mean? | 6 | Flooding with tide, storm and surges |
| | 7 | Flood (tidal) from rivers and storms and surges |
| | 8 | Bad weather affecting people |
| 2. What are the most common disasters faced by your area? | 6 | Sidr and Aida most common |
| | 7 | Flood with tide, Aila and Sidr |
| | 8 | 1970, 2007, 2009 cyclones |
| 3. Have you been in a disaster(s) in this town? [List disaster, when it happened.] How did it affect you and the town? | 6 | Yes |
| | 7 | Yes |
| | 8 | Yes |
| 4. Were you prepared for the disaster? How did you prepare? | 6 | Not much preparedness, was at home |
| | 7 | Loudspeaker announcement at 6 pm, Sidr hit at 9:30 pm (not enough time) |
| | 8 | Not much time to prepare |
| 5. Do you know about any early warning/signal system available? What is it? | 6 | No |
| | 7 | Not much, but when an 8-10 signal number (most extreme storms( then understand |
| | 8 | Some idea |
| 6. How did you react to the latest disaster? | 6 | Was in own brick building |
| | 7 | Was at home, in brick wall house |
| | 8 | Initially, at home, then shifted to mosque |
| 7. What was destroyed or services interrupted? | 6 | All katcha (tin) houses and trees damaged |
| | 7 | Houses and 66 trees, fish in ponds |
| | 8 | Houses and trees damaged |
| 8. Who/how did others (municipal government, aid | 6 | Did not require help, but other |
| | 7 | Did not require, but the other affected people are supported |

| | | |
|---|---|---|
| agencies, etc.) help in disaster response. Was it adequate, if not how not? | 8 | Councillor helped people |
| 9. Did you recover fully over the course of the next year? How did this happen? If not, in what ways did you not recover fully? | 6 | Recovered Fully |
| | 7 | Fully Recovered |
| | 8 | Fully recovered |
| 10. Did you or your family get sick during the disaster? What illness, for how long? Mortality or permanent damage? | 6 | No. |
| | 7 | Diarrhoea |
| | 8 | Sick due to water supply |

### Community Hazard Mapping – Mathbaria – 22 March 2013

22 March 2013, 8:30- 10:00 am
Neighborhood: Ward 1 North of the Tuskhal Khal
Town: Mathbaria
Surveyors: Dewan Quadir, Karl Schultz

| Name | Age | Sex | Occupation | Religion | Disability? | Type of Dwelling? | Notes |
|---|---|---|---|---|---|---|---|
| 1. Sriti Majume | 42 | F | Housewife | Hindu | No | Tin shed house | Embankment for nearest river is 5 km away |
| 2.Ali Haider | 42 | M | Farmer and businessman | Islam | No | Tin shed/wooden frame | Embankment for nearest river is 5 km away |
| 3.Ranjit Majunder | 71 | M | Retired School Headmaster | Hindu | No | Tin shed | There is a road that protects to some extent |
| 4.Parul Majunder | 67 | F | Housewife | Hindu | No | Tin shed | |
| 5.Shikha Rami Majunder | 45 | F | Housewife | Hindu | No | Tin shed | |
| 6. Abdus Salam | 58 | M | Retired Govt. Auditor | Islam | No | Semi Paka | |
| 7. Sarmi Majumdu | 13 | F | Student | Hindu | No | Brick building | |
| 8.Aditi Majender | 14 | M | Student | Hindu | No | Semi Paka | |


COMMUNITY
HAZARD MAP
WARD No. 1
WARD No. 5
Northwest Mathberia
Low Land
N

**Points Arising - Mathbaria**

- Mayor interested in big infrastructure projects, also wants improved power supply, cyclone shelters and water supply. He states that maintenance is an inherited problem and lacks revenue for sufficient maintenance, but his priority appears to be on big infrastructure.

- Cyclone preparedness office is underfunded and focus is on disaster warning (which seems to be effective), reportedly lacks resources for disaster preparedness activities, logistics support. Would like to have awareness seminars, other awareness programs.

- Water supply appears to be an important priority; lack of knowledge of deep water resources needs to be addressed.

- Consultant synthesis: Mothbaria has a problem with water supply, lacks DRM at pourashava level, and many wards are highly vulnerable to future cyclone and tidal flooding events. Note roads are significantly worse than in either Amtali or Patuakali.

## V.4 Amtali

Date: 22-24 March 2013
Town: Amtali

| Date/Time | Location | Participants | Purpose, Outcomes |
|---|---|---|---|
| 22.03.13, Friday 17:00 | Amtali Pourashava Offices | Md. Moazzen Hossain Farhad, 1st Council Mayor (councilor for Ward 9),<br>Mos. Nazmun Nahar, Councilor Ward 4,<br>Amal Krishna Saha, Secretary of Pourashava | Discussed purpose of visit, people we need to meet, etc. |
| 22.03.13 Saturday | | | |
| 9:00 | NGO NSS | Shahabudda Parna, Executive Director, NSS, Syeda Manira Sultan, Field Facilitator, NSS, Saha,<br>Akm Reaz Uddin Mazumder, Superintendent, Pourashava Water Supply | Discussed their overall mandate (rural development, including DRM). Went through detailed process they undertook to develop an Oxfam supported Participatory Vulnerability and Capacity Assessment (PVCA) followed by a Risk Reduction Action Plan (RRAP)for a Union outside of Amtali, that included participatory risk mapping.<br><br>Discussed DRM in Amtali including gaps:<br>- Cyclone shelter design issues (women uncomfortable with lack of separation, cattle not able to be protected, no security for food or place to store valuables). Discussed reality that Pourashava Disaster Management Committee has not met for “a long time” and lack of budget for cyclone preparedness. |
| 14:00 | Disaster Risk Survey of Wards 4 and 5 | Local community: foot survey of town with focus on Wards 5, 4, “random” survey of broad cross section of community (see survey notes for names, etc.)<br>Saha,<br>Nahar, Councillor, Ward 4 | See survey report. |
| 24.03.13, Sunday | | | |
| 9:00 | Survey of Wards 8 and 9 | Md. Mizannuzzaman, Assistant Engineer,<br>Afroj Jahan Tania, Sub Assistant Engineer,<br>Md. Moazzen Hossain Khan Councillor, Ward 8<br>Farhad, Councillor, Ward 9 | See survey report. |
| 10:30 | Ward 4 house front | Mizannuzzaman, Tania<br>Group of neighbors from Ward 4 (see map notes) | Participatory Community Hazard Mapping, Ward 4. See report. |
| 13:00 | Pourashava Offices | Mizannuzzaman, Tania, and Mamunur Rassid, Head Assistant Engineer. Later joined by Saha. | Discussed priorities: drainage, water, cyclone shelters, afforestation, embankment improvement. Regarding maintenance, 25 day laborers remove solid waste (80% of time) and clean drains (20%). The cost appears to be about 2.3 million taka/year for labor and 600,000 taka for the Belcha hand pushed carts that are used to move solid waste. This is only about 20% of the Pourashava budget. |

**Community Survey – Amtali – 23-24 March 2013**

23 - 24 March 2013
Town: Amtali
Surveyors: Dewan Quadir, Karl Schultz

| Name | Age | Sex | Occupation | Religion | Disability? | Neighborhood | Type of Dwelling? | Notes |
|---|---|---|---|---|---|---|---|---|
| 1. Md. Mostofa | 38 | M | Tea Stall | Islam | N | Ward 1 | Wooden with tin roof | Lives inside embankment but close to it |
| 2.Wadud Khan | 40 | M | Veterinary Doctor | Islam | N | Ward 1 | Semi-Paka | |
| 3.Nazul Islam | 60 | M | Ex Councillor, Social Worker and Businessman | Islam | N | Ward 1 | Tin shed with cement floor | |
| 4.Rabeya | 70 | M | Widower | Islam | N | Ward 4 | Tin house | |
| 5.Purnima Das | 40 | F | Housewife | Hindu | N | Ward 4 | Tin house | She has good number of chickens and three boats |
| 6. Shikka Rani Das | 35 | F | Housewife | Hindu | N | Ward 4 | Tin house | She has no possessions |
| 7.Kamla Begun | 27 | F | Work as a maidservant | Islam | N | Ward 4 | Rental house (implied poor structure) | She had nice house with furniture and tv. All lost in Sidr. |
| 8.Tapan Ch Das | 45 | M | Fisherman | Hindu | N | Ward 4 | Tin house | |
| 9.Adus Sadter Dazi | 45 | M | Businessman | Islam | N | Ward 8 | Semi-Paka | |
| 10.Abdul Aziz Howlader | 60 | M | Fisherman | Islam | N | Ward 8 | Wood and tin | |
| 11. Md. Nasir Mridha | 46 | M | Businessman | Islam | N | Ward 9 | Wood and tin | |

| Questions | Respondent (code) | Responses |
|---|---|---|
| **Amtali, Respondents 1-5** | | |
| 1. What does disaster mean? | 1 | Storms, floods which take away everything |
| | 2 | Droughts, storms, excess rainfall, etc. is disaster |
| | 3 | Wind, storm surge, fire, electrical, etc. |
| | 4 | No idea |
| | 5 | Cyclone Sidr |
| 2. Have you been in a disaster(s) in this town? [List disaster, when it happened.] How did it affect you and the town? | 1 | Yes. Destructed houses, fishes, trees, etc. |
| | 2 | Yes. Destructed houses, plants, fishes, trees, etc |
| | 3 | Yes. Serious impacts at 9:40 pm and ended at 11 pm. |
| | 4 | Yes. |
| | 5 | In town. |
| 3. Were you prepared for the disaster? How did you prepare? | 1 | Did not think that it will be so furious and was reluctant to react. |
| | 2 | Prepared; informed by TV and Red Crescent |
| | 3 | - |
| | 4 | Yes, prepared. |
| | 5 | Yes, but did not guess how serious it was. |
| 4. Do you know about any early warning/signal system available? | 1 | Yes, through TV and megaphone announcement |
| | 2 | Yes. |

| Questions | Respondent (code) | Responses |
|---|---|---|
| **Amtali, Respondents 1-5** | | |
| What is it? | 3 | - |
| | 4 | Yes, prepared. |
| | 5 | No. |
| 5. How did you react to the latest disaster? | 1 | Same as 3, struggled with water until it receded. |
| | 2 | Was ready to leave and left shelter at 9 pm. |
| | 3 | Reacted late because there was embankment protection, which later broke. |
| | 4 | Group shelter in Awami (political party) Office. |
| | 5 | Group shelter in Awami (political party) Office. |
| 6. What was destroyed or services interrupted? | 1 | Houses, fish, animals, birds, trees, and other household resources. |
| | 2 | Embankment broke, and surge entered. |
| | 3 | - |
| | 4 | House and plants and other destroyed. |
| | 5 | House damaged. |
| 7. Who/how did others (municipal government, aid agencies, etc.) help in disaster response. Was it adequate, if not how not? | 1 | Got some money and food help. |
| | 2 | Helped to the extent possible by government and NGOs |
| | 3 | Government and NGOs helped a lot |
| | 4 | Yes. |
| | 5 | Taka 5000 and food, VGF card (food card for government supplied food) |
| 8. Did you recover fully over the course of the next year? How did this happen? If not, in what ways did you not recover fully? | 1 | Not recovered yet. Poor and lost about 100,000 taka during Sidr. |
| | 2 | 50% recovered. |
| | 3 | 60% recovered. |
| | 4 | 50% recovered. |
| | 5 | 50% recovered. |
| 9. Did you or your family get sick during the disaster? What illness, for how long? Mortality or permanent damage? | 1 | Yes, sick with stomach and skin disease, fever. |
| | 2 | Not much. |
| | 3 | No. |
| | 4 | Yes, diarrhoea |
| | 5 | No |
| 10. Do you think that it is getter hotter over the last 20 years? | 1 | Hotter weather and less rainfall in some parts of the year |
| | 2 | Hotter weather |
| | 3 | Yes, hotter |
| | 4 | Yes, hotter |
| | 5 | Yes, hotter |
| 11. Do you think the number of sever cyclones is increasing? | 1 | Yes, the frequency of surges (cyclones) has increased |
| | 2 | Yes |
| | 3 | 1965, 1970, 1988, 1991,1996, 2007, 2009 |
| | 4 | - |
| | 5 | - |

| Questions | Respondent (code) | Responses |
|---|---|---|
| **Amtali, Respondents 1-5** | | |
| 12. Do you think the tidal levels have gotten higher over the last 20 years? | 1 | Yes, by 2-3 feet |
| | 2 | Yes, by 2 feet |
| | 3 | Yes by 3 - 3.5 feet |
| | 4 | Yes |
| | 5 | Yes |

| Questions | Respondent (code) | Responses |
|---|---|---|
| **Amtali, Respondents 6 - 10** | | |
| 1. What does disaster mean? | 6 | Flood, water |
| | 7 | Flood that creates damage, sickness |
| | 8 | Inundation by bad weather like Sidr, Aila |
| | 9 | Flood |
| | 10 | Now disaster is prevailing because of population decreasing and resources decreasing |
| 2. Have you been in a disaster(s) in this town? [List disaster, when it happened.] How did it affect you and the town? | 6 | Yes |
| | 7 | Yes |
| | 8 | Yes |
| | 9 | Yes |
| | 10 | Yes in Aila, no in Sidr |
| 3. Were you prepared for the disaster? How did you prepare? | 6 | Yes |
| | 7 | Did not believe the warning |
| | 8 | Did not understand that disaster really would come |
| | 9 | Yes, went to tower building prior to cyclone hitting |
| | 10 | Yes, houses destroyed and animals |
| 4. Do you know about any early warning/signal system available? What is it? | 6 | Yes |
| | 7 | Yes |
| | 8 | Yes |
| | 9 | Alerted by Red Crescent |
| | 10 | Alerted by Red Crescent |
| 5. How did you react to the latest disaster? | 6 | Shelter in Awami League Office |
| | 7 | Deluxe Hotel |
| | 8 | Bandan Primary School |
| | 9 | Went to shelter quite ahead of time |
| | 10 | Went to shelter at the beginning of disaster |
| 6. What was destroyed or services interrupted? | 6 | Houses |
| | 7 | Everything included house, chicken and duck |
| | 8 | House and household properties destroyed |
| | 9 | House destroyed |

| Questions | Respondent (code) | Responses |
|---|---|---|
| **Amtali, Respondents 6 - 10** | | |
| | 10 | House, plants, etc. destroyed |
| 7. Who/how did others (municipal government, aid agencies, etc.) help in disaster response. Was it adequate, if not how not? | 6 | Yes, taka 6000, VGF card, and Save the Children card |
| | 7 | Yes |
| | 8 | Yes, taka 5000, VGF card and Save the Children card |
| | 9 | No, did not get any help because his share was allotted to another person |
| | 10 | VGF card for food and water |
| 8. Did you recover fully over the course of the next year? How did this happen? If not, in what ways did you not recover fully? | 6 | 50% |
| | 7 | Not much |
| | 8 | 60% |
| | 9 | 60% |
| | 10 | 70% |
| 9. Did you or your family get sick during the disaster? What illness, for how long? Mortality or permanent damage? | 6 | No |
| | 7 | Diarrhoea; the son suffered a lot |
| | 8 | Diarrhoea, spent money for treatment |
| | 9 | Diarrhoea, recovered slowly |
| | 10 | No |
| 10. Do you think that it is getter hotter over the last 20 years? | 6 | Yes |
| | 7 | Hotter |
| | 8 | Don’t know |
| | 9 | Yes, hotter |
| | 10 | Yes |
| 11. Do you think the number of severe cyclones is increasing? | 6 | No. |
| | 7 | No. |
| | 8 | Yes. |
| | 9 | Yes |
| | 10 | Yes |
| 12. Do you think the tidal levels have gotten higher over the last 20 years? | 6 | Increased |
| | 7 | Increased much |
| | 8 | Yes, increased |
| | 9 | Yes, increased |
| | 10 | Yes, 2 - 2.5 feet |

| Questions | Respondent (code) | Responses |
|---|---|---|
| **Amtali, Respondent 11** | | |
| 1. What does disaster mean? | 11 | Flood and destruction of properties |
| 2. Have you been in a disaster(s) in this town? [List disaster, when it happened.] How did it affect you and the town? | 11 | Wind, storm, flood, hurricane |

| Questions | Respondent (code) | Responses |
|---|---|---|
| **Amtali, Respondent 11** | | |
| | | |
| 3. Were you prepared for the disaster? How did you prepare? | 11 | Yes |
| 4. Do you know about any early warning/signal system available? What is it? | 11 | Yes |
| 5. How did you react to the latest disaster? | 11 | Went to shelter at a distant place |
| 6. What was destroyed or services interrupted? | 11 | Animals, rice field, fish, birds, plants |
| 7. Who/how did others (municipal government, aid agencies, etc.) help in disaster response. Was it adequate, if not how not? | 11 | Taka 5000 and no VGF |
| 8. Did you recover fully over the course of the next year? How did this happen? If not, in what ways did you not recover fully? | 11 | Yes. |
| 9. Did you or your family get sick during the disaster? What illness, for how long? Mortality or permanent damage? | 11 | Stomach diseases |
| 10. Do you think that it is getter hotter over the last 20 years? | 11 | Yes, hotter |
| 11. Do you think the number of sever cyclones is increasing? | 11 | No |
| 12. Do you think the tidal levels have gotten higher over the last 20 years? | 11 | Yes, now more area is inundated by tides |

## Community Hazard Mapping – Amtali – 24 March 2013

24 March 2013
Town: Amtali
Surveyors: Dewan Quadir, Karl Schultz

| Name | Age | Sex | Occupation |
|---|---|---|---|
| 1. Adwr Rashid Mridhe | 70 | M | Business |
| 2. Minara Begum | 35 | F | Housewife |
| 3. Md. Abul Hassan | 52 | M | Business |
| 4. Obaidul Islam Shujan | 21 | M | Student |
| 5. Anju Rani Pal | 33 | F | Housewife |
| 6. Nasrin | 13 | F | Student |
| 7. Md. Delwen | 52 | M | Business |
| 8. Sabi Rani Seal | 45 | F | Housewife |
| 9. Sabi Rani Seal | 35 | F | Housewife |


N
Trees
T-Tidal flood
Flash

**Points Arising – Amtali**

- Mayor was away but consultant team was well taken care of by Secretary (who participated in most activities) and other staff and a number of council members.
- Survey outcomes showed significant issues with storm vulnerability in Wards 1, 4, 5, 8, and 9. Wards 8 and 9 in particular faced significant fatalities (7 and 5, respectively) during Cyclone Sidr. Sluice gate and bridge in Ward 8 failed and fleeing citizens fell into canal, dying. Fishermen at sea from Ward 9 died.
- No full-fledged cyclone shelters; many citizens must rely upon goodwill of neighbors with brick structures. Multi-purpose shelters with storage and separate rooms/latrines for men women throughout town appear to be priority investment.
- Local level DRM could be improved through preparatory awareness raising and cyclone shelter investments are key: many survey respondents indicated they did not leave upon receiving warning before Sidr. NSS staff identified several reasons why: (1) did not want to leave possessions - fear of theft, (2) no place to secure valuables in shelters, (4) no place for cattle, and (5) women did not want to be in un-separated cyclone shelters.
- Maintenance (only counting manual labor and hand carts) is about 20% of total Paurashava budget - could this be a priority for enhancing? Assistant engineer believes infrastructure higher priority but evidence of blocked drains, etc. might indicate value in enhanced maintenance.
- Consultant Synthesis: widespread but uneven vulnerability to cyclones and tidal floods, an acute need for shelters along with water supply, in particular this relates to wards 4, 8 and 9. An acknowledgement that DRM is only reactive and not functional at pourshava level until after a disaster. A demonstrated need for more and more appropriate cyclone shelters.

## V.5 Pirojpur

### Community Survey – Pirojpur – 3-4 May 2

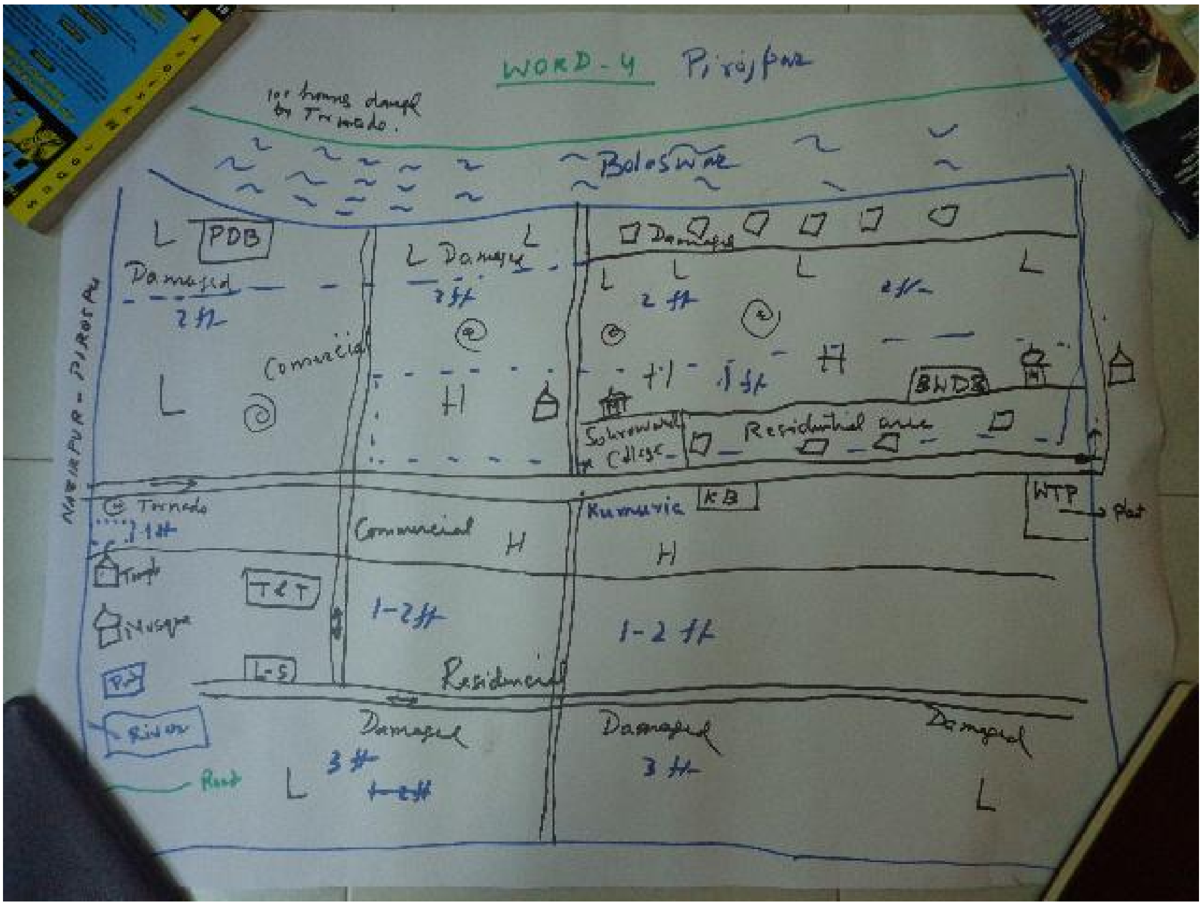
Surveyors: Dewan Quadir, Karl Schultz

| Pirojpur | | | Is the parameter increasing? 1=increased, 0= not increased | | | | Got signal (1=yes) | | Damages (1=yes) | | Got any assist-ance (1=yes) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. | Name-Age-Occupation-Sex | Ward no. | Rain | Tide | Temper-ature | Tropical Cyclone | Sidr/Aila | How reacted | Houses | Health / Sick-ness | | Recovery Time |
| 1 | Anwar Hossain Howleder-55-nothing-male | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | Not yet |
| 2 | Modasser Ali-82-business-male | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | Not yet |
| 3 | Mowlana Nurul Haque-55-super-male | 3 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | Not yet |
| 4 | Md Chan Khan-45-farmer-male | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 5 | Hamida-female-30 | 9 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | Not recovered |
| 6 | Marium-female-18 | 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | Not recovered |
| 7 | Masum Khan-44-male-business | 8 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | | | Not recovered |
| 8 | Matiur Rahma-70-male-business | 8 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 |
| 9 | Henuara Begum-35;fem(slum dweller) right on bank | 5 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | Not recovered |
| | | % res-ponse | 78 | 89 | 89 | 100 | 67 | 67 | 89 | 22 | 33 | 22 |

1=yes and 0=no

### Community Hazard Mapping – Pirojipur – 4 May 2013

4 May 2013, 11:00 am
Neighborhood: Ward 4 in a tea shop
Surveyors: Dewan Quadir, Karl Schultz
Community Mappers:




**Points Arising - Pirojpur**

- A relatively low number of respondents (68%) reported that they received warning of past cyclones. The pourashava reported that a cyclone preparedness official lost his job owing to the low level of warning prior to Cyclone Sidr. While some respondents indicated they did not require assistance, only 33% received post-disaster aid.

- Pirojpur, however, is less vulnerable to storm surges than the other pilot towns owing to its location further upstream from the Bay of Bengal. However, 89% reported damages from Sidr, and only 22% of community respondents reported that they had recovered. But on a positive note, only 22% reported sickness following Sidr in their household.

- The vast majority of respondents though climate changes (monsoon rainfall, tidal flooding, temperature) had increased over the past 20 years, and all respondents indicated that cyclones intensity/frequency had increased.

- Our survey of 30 locations demonstrated that many areas suffer significant damage and during survey interviews a respondent reported that the seawall in Ward 5 constructed 25 years ago was no longer sufficient to protect against tidal and cyclone surges.

## V.6 Galachipa

### Community Survey – Galachipa – 5 May 2013

Surveyors: Dewan Quadir, Karl Schultz

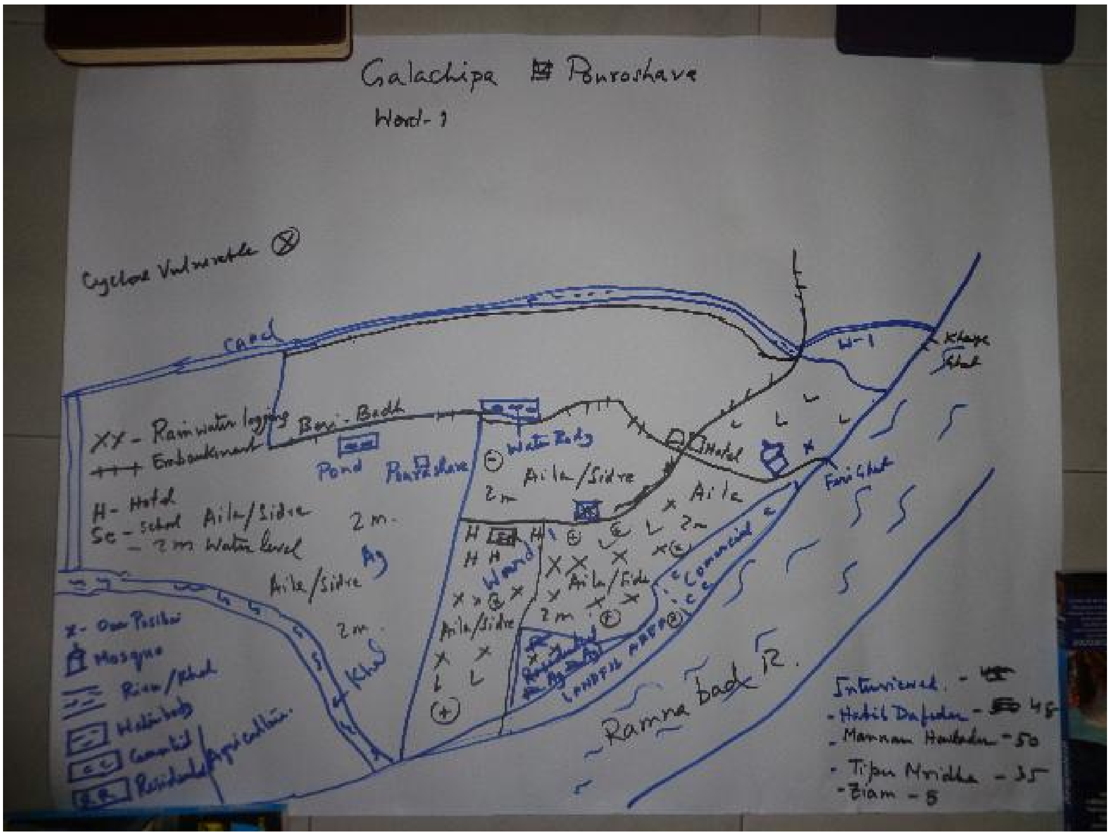
| Galachipa | | | Is the parameter increasing? | | | | Got signal | How | Damages to | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. | Name-Age-Occupation-Sex | Ward no. | Rain | Tide | Temperature | Tropical Cyclone | Sidr/Aila | reacted | Houses | Sickness | Help | Recovery time |
| 1 | Md Harunor Rashid-55-male-Business | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 2 | Nurul Islam-40-male-local police | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1.5 |
| 3 | Zakir Matabbar-28-male-business | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.1 |
| 4 | Md Ismail-65-male-civil worker | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | not yet |
| 5 | Maksuda-45-helper in College-female | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0.1 |
| 6 | Gauranga Lal Saha-88-male-business | 7 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0.1 |
| 7 | Abdur Razzaque | 8 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | not yet |
| 8 | Saleha Begum | 8 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | not yet |
| | **% response** | | 100 | 62.5 | 100 | 87.5 | 87.5 | 75 | 87.5 | 75 | 50 | 62.5 |

1=yes and 0=no

### Community Hazard Mapping – Galachipa – 5 May 2013

5 May 2013, 11:00 am
Neighborhood: Ward 1 outside embankment in shop
Surveyors: Dewan Quadir, Karl Schultz
Community Mappers:

Habib Dafundar, 46
Mansour Habadou, 50
Tyipu Rhida, 35
Ziam, 8




**Points Arising - Galachipa**

- One third of town's residents live outside the embankment. In the hazard mapping exercise it became clear that not only storm surge/tidal flooding impacts Ward 1's residents living outside the embankment, but (owing to limited drainage) monsoon flooding/waterlogging is also a problem.
- Following a moderate pre-monsoon rainfall of less than one hour, the slum dwellers in Ward 8 (inside the polder) faced inundation. They reported that their neighborhood is permanently inundated for six months during/after the monsoon season.
- Overall, survey of inundation patterns demonstrated that while areas outside the embankment might be more vulnerable to storm surge flooding, the duration of inundation in many of the areas inside the polders was much longer.
- In spite of a larger proportion of slum dwellers, Galachipa residents reported higher rates of disaster warning (87%) than in Pirojpur. Damage to houses and sickness in households were both very high following Sidr (87% and 75%, respectively).

# VI. GUIDELINES FOR MAINSTREAMING CLIMATE CHANGE INTO INFRASTRUCTURE DESIGNS

## VI.1 Introduction

158. This document details the particular vulnerabilities of CTIIP infrastructure, and outlines options for making it climate resilient. It concludes by presenting CTIIP's proposed design adaptations for each sector (water, drainage, etc.

## VI.2 Climate Impact Assumptions

159. The Coastal Town Infrastructure Improvement Project (CTIIP) has provided annual time series climate outputs for sea level rise (including subsidence and sedimentation), temperature, monsoon season rainfall, and probability of cyclones of different intensities.

160. The temperature, rainfall and sea level rise (SLR) projections are based on the IPCC AR4 projections. The subsidence of the delta over the coastal zone has been assumed to be 3 mm/year over the coastal zone. And an assumption of sedimentation levels of 1 mm/rate within the polders has been made for calculation of net sea level rise. It is important to note that a town not protected by polder will have very low sedimentation because the concreted areas of the town do not accumulate significant levels of sediment. Thus the team applies the same assumption for both poldered and unpoldered towns. The Bangladesh National Adaptation Programme of Action (NAPA) (2005) assumed a sea level rise of 32 cm by 2050 while CEIP (2011) has considered 50 cm of SLR for the same time frame. Neither of these studies provided any background documentation supporting how they arrived at these figures. CTIIP has arrived at net SLR (SLR for global warming (IPCC) + subsidence – sedimentation) of 39.4 cm. The coastal towns are vulnerable to additional inundation due to sea level rise, higher storm surges from more intense tropical cyclones and from higher sea levels. Thus damages to roads, infrastructure, housing and other buildings, water supply and sanitation will increase, without climate adaptation.

161. CTIIP has also provided its engineers with a mandate to use a 25 year project life but to design with consideration to relevant climate outputs out to 2050, especially where siting decisions are being made that will likely result in an infrastructure "footprint" extending well beyond 25 years.

### A. Infrastructure and the Systemic Vulnerability of Coastal Towns

162. CCRIP's Climate Assessment and Adaptation Strategy notes that the in-service performance and hence the vulnerability of infrastructure to climatic impacts, may be considered to be a function of a series of impacting factors; collectively known as the "Infrastructure Environment."[41] Infrastructure environment factors include:

- Construction materials,
- Climate,
- Surface and sub-surface hydrology,
- Terrain,
- Sub-grade and foundation conditions, and,
- Level of use for infrastructure.

163. Other factors may come into play depending on the sub-project type and design, but

[41] CCRIP, p. 12.

in general these factors determine the level of vulnerability of the infrastructure, and thus are also critical to consider in project design.

## B. CTIIP Project Vulnerabilities

### 1. Municipal Infrastructure

164. **Roads.** The major effects of climate change on roads infrastructure are described in the table below:

**Table VI.1: Climate impacts on roads**

| No. | Climate Change Effect | Effect on Roads |
|---|---|---|
| 1 | Temperature rise:<br>0.7-1.6$^0$C by 2030 and 1.2-2.4$^0$ C by 2050 | • Infrastructure damaged by contraction and expansion due to long exposure to heat, new concrete structures weakened due to poor curing.<br>• In case of bituminous carpeting road, road materials will loss bonding and be damaged due to heat. |
| 2 | Rainfall: Current trend: 25 cm in last 50 years.<br>Wetter monsoon rainfall with future scenarios:<br>2030 with increase of 10-12%,<br>2050 with increase of 22-24% | • Roads damaged due to more flooding and overtopping.<br>• Erosion of embankment faces;<br>• Pavement edge failure;<br>4. |
| 3 | Sea Level Rise (SLR):<br>Current SLR: 4-6 mm/year.<br>SLR in 2030: 21 cm reference surface to land inside polder<br>SLR in 2050: 39 cm relative to land surface inside polder. | • Roads damaged due to more flooding and inundation.<br>• Erosion of embankment faces;<br>• Pavement edge failure; |
| 4 | Tropical Cyclone : Intensity 0f cyclone and storm surge will increase. | • Roads and infrastructures damaged due to storm surge inundation; |

165. **Bridges.** The major effects of climate change on bridge infrastructure are described in the table below:

**Table VI.2: Climate impacts on bridges**

| No. | Climate Change Effect | Effect on Bridge |
|---|---|---|
| 1 | Rainfall: Current trend: 25 cm in last 50 years.<br>Wetter monsoon rainfall with future scenarios:<br>2030 with increase of 10-12%,<br>2050 with increase of 22-24% | • Bridge approaches damaged due to more flooding and overtopping. |
| 2 | Sea Level Rise (SLR):<br>Current SLR: 4-6 mm/year.<br>SLR in 2030: 21 cm reference surface to land inside polder<br>SLR in 2050: 39 cm relative to land surface inside polder. | • Due to inundation of bridge deck slab, the materials of expansion-joint and girder-base decayed and loss durability. |
| 3 | Tropical Cyclone: Intensity 0f cyclone and storm surge will increase. | • Minor infrastructures like railing of bridge damaged due to heavy wind with surges.<br>• Side of approaches damaged due to storm surge inundation. |

166. **Cyclone shelters.** The major effects of climate change on cyclone shelter are described in the table below:

**Table VI.3: Climate impacts on cyclone shelters**

| No. | Climate Change Effect | Effect on Bridge |
| --- | --- | --- |
| 1 | Rainfall: Current trend: 25 cm in last 50 years.<br>Wetter monsoon rainfall with future scenarios:<br>2030 with increase of 10-12%,<br>2050 with increase of 22-24% | • The floor of cyclone shelters can be inundated by flooding due to extreme rainfall. |
| 2 | Sea Level Rise (SLR):<br>Current SLR: 4-6 mm/year.<br>SLR in 2030: 21 cm reference surface to land inside polder<br>SLR in 2050: 39 cm relative to land surface inside polder. | • The floor of cyclone shelters can be inundated by flooding with sea level rise. |
| 3 | Tropical Cyclone: Intensity 0f cyclone and storm surge will increase. | • The floor of cyclone shelter can be flooded by storm surge.<br>• The super structure can be damaged due to strong wind. |

### 2. Drainage and Flood Control

167. The main effects of climate change on drainage and flood control infrastructure and services are described in **Table VI.4**.

168. Other factors that will have a possible effect on drainage and flood control infrastructure and services are described in **Table VI.5**.

**Table VI.4: Possible Actions to Mitigate against Projected Effects of Climate Change on Drainage and Flood Control Infrastructure and Improve Climate Resilience**

| No. | Climate change effect | Projected effects on drainage and flood control |
|---|---|---|
| 1 | Increased rainfall quantity & runoff:<br>- up to as much as 27% in individual events by 2050<br>- up to 8% overall by 2050 | ▪ Increased runoff volumes:<br>o during individual storms<br>o overall during season<br>• Increased river and tidal levels, due to increased runoff volumes (see also (2))<br>• Increased frequency, area, depth and duration of flooding where:<br>o local drain capacity is insufficient due to:<br>▪ under-design<br>▪ encroachments<br>o local drain capacity is sufficient but is reduced by:<br>▪ inadequate capacity downstream, including encroachments, outfall vents<br>▪ adverse water levels downstream, due flooding, river and/or sea-level rise ((2) also)<br>▪ poor maintenance<br>▪ unsuitable operation, e.g. irrigation water<br>▪ blockage during operation<br>o flooding in an adjacent catchment flows into the area, adding to local runoff to be disposed of |
| 2 | Sea level rise (SLR)<br>5. up to almost 40 cm by 2050 relative to levels inside polder[42]:<br>29 cm SLR<br>10 cm land settlement | • Low and high tide, river & *khal* levels rise:<br>o reducing efficiency of present channels, culverts, outfall vents, etc. as:<br>▪ discharge capacities reduce (hydraulic gradients reduce)<br>▪ operating/discharge times decrease (as river and tide levels increase)<br>o preventing discharge if tide levels rise above in polder-levels – may be short, medium or long-term depending on local situation, e.g. low land, tidal status – springs, neaps, season, special events, etc., e.g. river levels are at highest during monsoon<br>o increasing tidal flooding (as levels rise above channel banks, primary flood defences, etc.)<br>o increasing possible flooding due to storm surges (will depend on tide level, plus defence levels, storm intensity, path, etc.)<br>• River dimensions, alignments and/or sedimentation change as energy levels change, most likely contributing to the above effects<br>• Increased flood frequency, area, depth, duration |
| 3 | Increased frequency of severe cyclones | Increased frequency of flooding due to storm surge:<br>very local, i.e. adjacent to storm & surge location<br>short-term, but scale, etc., according to storm characteristics, location, etc.,<br>increasing in frequency, depth, area, etc., as sea levels and storm intensities rise<br>Damage to infrastructure, due to wind and/or waves<br>Will worsen any existing flooding attributable to:<br>increased rainfall<br>- wide-scale, and potentially significant<br>- medium/long-term, especially if locality is already flooded<br>sea level rise |

Source: PPTA Consultant.

[42] CDTA estimates vary from 32 cm by 2050 and 88 cm by 2100 (Revised DFR, Annex II) to 0.1 m for the Baleswa and Kocha rivers at Projpur and 0.2.m for the Payra and Ramnabad rivers at Amtali and Galachipa respectively by 2046-55 (Revised DFR, Annex IV).

**Table VI.5: Actions to Mitigate against Other Factors that may affect Drainage/Flood Control Infrastructure and Climate Resilience**

| No. | Impact Factor | Effect |
|---|---|---|
| 1 | Construction materials' quality | Locally available natural materials are not highly resilient.<br>o fine soft sand, may be contaminated by salt<br>o locally produced bricks generally non-uniform non-engineering quality<br>o local aggregate for concrete made from broken bricks, variable size, shape quality and durability<br>o water may be saline<br>Sharp sand and stone aggregate have to be imported. |
| 2 | Flat topography | • Channel and drain gradients may have to be steeper than the natural gradients, increasing frequency and duration of localised flooding during adverse conditions. |
| 3 | Rising temperatures | • Placing concrete and using cement mortar will not be possible during very high temperatures.<br>• Curing will require more water to reduce heat gain and counter water loss.<br>• Runoff containing high proportions of wastewater may become septic more quickly, attacking non-sulphate resisting concrete and cement mortar. |
| 4 | Runoff | • May contain domestic wastewater, which may become septic if it cannot be disposed of within a reasonable time, attacking concrete and mortar. |
| 5 | Flooding | • Drains may be submerged for longer periods of time, weakening low grade materials and construction, supporting soils, etc.<br>• Risk of infrastructure 'floating' during sudden changes in water levels (surface water levels reduce rapidly but groundwater levels remain high) |

Source: PPTA Consultant.

### 3. Water Supply and Sanitation

169. The major effects of climate change on water supply and sanitation infrastructure and services are described in **Table IVI.6**:

**Table VI.6: Climate impacts on water supply and sanitation**

| No. | Climate Change Effect | Effect on Water Supply and Sanitation |
|---|---|---|
| 1 | Temperature rise: 0.6-1.4$^0$C by 2030 and 1.2-2.4$^0$ C by 2050 | • Surface water is rapidly evaporated affecting household water supplies and irrigation. The open water bodies will be dried up and dependence on piped water supply will increase.<br>• Due to heat, overall per capita water needs will increase as the consumers will drink more water and have both and wash repeatedly.<br>6. |
| 2 | Rainfall: Current trend: 25 cm in last 50 years<br>Wetter monsoon rainfall with future scenarios:<br>2030 with increase of 1-5%, 2050 with increase of 5-8% | • Increased and more intensive rainfall will cause more floods inundating water supply infrastructure such as production tube well, pump house etc.<br>• Sanitation infrastructures such as toilet, septic tank, soak well, pits will be inundated and the contents may come out causing health hazards. |
| 3 | Sea Level Rise (SLR):<br>Current SLR: 4-6 mm/year<br>Projection in 2030: 11-21 cm with reference to land inside | • Water supply infrastructure such as production tube well, pump house etc. will be inundated.<br>• Sanitation infrastructure such as toilets, septic tanks, soak wells, pits will be inundated. |

| No. | Climate Change Effect | Effect on Water Supply and Sanitation |
|---|---|---|
| | polders. Tidal Level will also increase due to SLR. | |
| 4 | Tropical Cyclone: Intensity will rise and the destruction will be severe due to wind and surges. | • Water supply over head tank and other superstructures will be damaged/ collapsed due to cyclone/storm surge. |

### VI.3 Adaptation

170. As outlined in CCRIP, there are three general options that may be undertaken in the urban infrastructure environment to address climate change:

- Engineering (structural),
- Non-engineering (soft, or non-structural such as capacity building, improved maintenance, or providing technical tools or community awareness), and
- Do nothing.

171. As noted in the introduction, CTIIP, is an infrastructure project, and will budget a majority of incremental costs of climate change investment to infrastructure, but activities will also include considerable efforts in softer areas, such as knowledge generation and capacity building. Investments will include:

- Assessing how infrastructure investments will be “climate proofed” (= mainstreaming minimum),
- Assessing how the “adaptation deficit” can be overcome in both reducing hard infrastructure deficits (e.g., inadequate sanitation that makes some communities more vulnerable) and policy, legal, financial and institutional deficits (e.g., lack of local capacity and finance to plan and manage for disaster risks, etc.).

172. The other aspect to adaptation is considering the vulnerabilities, and, based in part of cost: benefit analyses, determining if interventions are justified. If not, then “do nothing” may be appropriate.

173. CRRIP outlines some general options, including general infrastructure climate strengthening, rehabilitation of current designs, or polder-protected or partially protected climate resilience.

174. The first two technical options are self-explanatory. The third issue is related to general infrastructure interventions that result in protection, not just of a particular structure, but for all assets within a polder or benefitting, for instance, from improved drainage.

175. The CTIIP does not have a mandate to improve embankments, but it may undertake improved drainage and flood control, and thus this strategy is undertaken. Other than that, the other way that CTIIP is able to support broad-based protection of the coastal communities is through a series of non-structural interventions, including community awareness raising of disaster risk, encourage climate resilient land use planning and building codes, improved local level disaster risk management, and implementation of a revolving climate adaptation fund, managed locally.

## A. Infrastructure: Climate Resilience Options and Measures Proposed by CTIIP

### 1. Municipal Infrastructure

176. **Roads.** The key proposed climate resilience measures associated with roads interventions are:

- road level rise as required;
- increase of bitumen carpeting (BC) thickness;
- ensure proper compaction;
- prefer cement concrete (CC) pavement where there are threats of inundation;
- provision of temperature reinforcement in CC pavement to minimize expansion and contraction;
- provision of hard shoulder along the pavement where there are threats of inundation;
- construction of cross-drains as required;
- guide wall to protect erosion and sliding in case of CC road;
- turf and tree plantation along the roads.

177. CC roads will be damaged due to expansion and contraction with temperature fluctuation. Providing temperature reinforcement in the concrete pavement may protect against this threat.

178. In the case of a bituminous carpeting road, the road material will lose bonding and be damaged due to heat. This can be avoided by selecting CC pavement in place of bituminous pavement in case of new road construction.

179. Roads will be damaged by more flooding and overtopping due to extreme rainfall. This can be avoided by raising the road level. It is suggested to raise the road level by 600 mm above normal flood level. Sea level rise is another threat to the road as it may cause damage to the road by inundation. Therefore, road level will be further raised by 200mm. (Note: for some inside roads it may not be possible to raise them in practice; instead it is advised to raise gradually by overlaying base course during the time of maintenance after every few years).

180. Tropical cyclones and storm surges may cause of damage to roads and road structures like culverts, cross-drains, etc. The bitumen road cannot withstand if it is under water for a certain period of time. These kinds of threats can be avoided by constructing CC pavement instead of bituminous pavement.

181. Provision of hard shoulders for BC roads, brick masonry guide wall for BC road will be constructed along the road alignment, turfing on embankment slope and tree plantation if possible along the road embankment will be done in order to protect the road from tropical cyclones and storm surges.

182. **Bridges.** The key proposed climate resilience measures associated with bridges interventions are:

- maintain rise of deck slab of bridge and pile length needed to be increased;
- ensure proper compaction and hard shoulder in approaches;
- guide wall at tow of approaches to protect erosion of approaches.

183. Approach roads of bridges will be damaged due to extreme rainfall and storm surge inundation. This can be protected by providing proper compaction, hard shoulder and guide-

wall at tow of approaches.

184. Inundation of bridges can be avoided by considering future sea levels appropriately.

185. Bridge piles need to be increased at the top and be designed as required.

186. **Cyclone shelters.** The key proposed climate resilience measures associated with cyclone shelters interventions are:

- ensure ground floor open, .i.e. free from any partition walls;
- arrangement of shelter on 1$^{st}$ and 2$^{nd}$ during cyclonic disaster;
- considered wind speed 260 km/hour for designing of the cyclone shelter building;
- ensure best quality items like doors, windows and utilities for defense against wind and storms.

187. The floor should be free from any partition wall for hindrance of water flow in ground floor. This will eliminate the thrust from flooding water on structures.

### 2. Drainage and Flood Control

188. Possible actions to mitigate against the main projected effects of climate change on drainage and flood control infrastructure and services are described in **Table VI.7**.

189. Two incremental stages have been adopted for costing purposes:

(i) Design to the current best practice standard and in line with the current LGED guidelines[43] for a 25-year design period.
(ii) Design as (i) but taking account of the projected climate change impacts up to 2050.[44]

190. Possible actions to mitigate against other factors that will affect drainage and flood control infrastructure and climate resilience are described in **Table VI.8**.

[43] Urban Drainage Manual, May 1998
[44] The projected rainfall intensity for a 1:10 year design storm by 2050 is only about 1% greater than the intensity for the same storm in 2030. It is therefore considered more cost-effective to plan and develop infrastructure for 2050 immediately than develop it in two stages.

**Table VI.7: Possible Actions to Mitigate against Projected Effects of Climate Change on Drainage and Flood Control Infrastructure and Improve Climate Resilience**

| No. | Climate Change Effect | Possible Mitigating Actions |
|---|---|---|
| 1 | Increased rainfall quantity & runoff: | - increase infrastructure capacity, e.g. channels, bridges, culverts, regulating structures, outfall vents, etc. (levels to take account of sea level rise)<br>- create capacity to detain runoff as necessary, e.g. ponds, open spaces, channels, *khals*, etc.<br>- isolate/protect vulnerable catchments and sub-catchments, to reduce flooding from adjacent catchments, especially if large in area and volume and impacts are less serious, e.g. agricultural land<br>- actively managing runoff and discharges, according to needs, adverse impacts, etc.<br>- improve O&M, organisational capacity, resource allocation, etc.<br>- work with relevant stakeholders to manage water use and flood discharges more effectively<br>- improve collection and disposal of solid waste<br>- control encroachments<br>- improve public behaviour through active and prolonged information, education and communication campaigns to reduce uncontrolled solid waste disposal, encroachments, damage to infrastructure, unregulated development in key areas, etc., supported by enforcement. |
| 2 | Sea level rise (SLR) | - raise existing flood defences to requisite levels and building new flood defences on unprotected tidal channels and *khals*<br>- improve drainage infrastructure and detention capacity as required (see (1))<br>- improve O&M, organisational capacity, resource allocation, etc.<br>- work with relevant stakeholders, e.g. BWDB, landowners, water user groups, farmers associations, etc., to ensure their actions contribute as required. |
| 3 | Increased frequency of severe cyclones | - enhance flood defence levels and strengthen to the requisite levels according to location, etc., e.g. urban areas should have higher and stronger levels of protection than rural areas<br>- improve infrastructure and detention capacity and protecting/isolating catchments as appropriate (see (1))<br>- improve O&M of defences and drainage, organisational capacity, resource allocation, etc.,<br>- work with relevant stakeholders, e.g. BWDB, etc., to ensure their actions contribute as best possible. |

Source: PPTA Consultant.

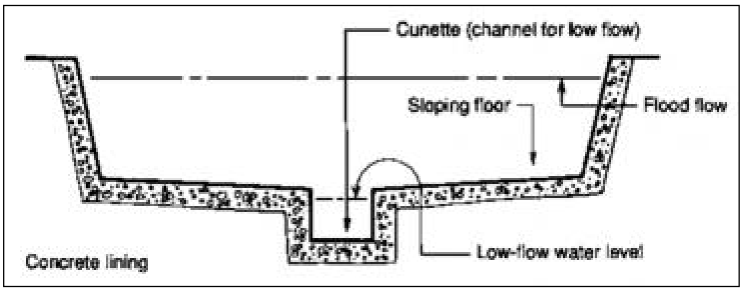
**Table VI.8: Actions to Mitigate against Other Factors that may affect Drainage/Flood Control Infrastructure and Climate Resilience**

| No. | Impact Factor | Mitigating action |
|---|---|---|
| 1 | Construction materials' quality | - Choose most durable materials possible, even if higher cost, e.g. concrete, high quality bricks.<br>- Monitor and control construction quality |
| 2 | Flat topography | - Shorten drainage routes<br>- Avoid downstream constrictions, etc.<br>- Retain and upgrade existing natural drainage routes and channels. |

| No. | Impact Factor | Mitigating action |
|---|---|---|
| | | - Maximise runoff and water-level regulation, and detention capacity; regulate land development as required.<br>- Consider short to medium-term pumping, using mobile/emergency pumps wherever appropriate. |
| 3 | Rising temperatures | - Execute works during most favourable times of year and day.<br>- Monitor and control preparing, placing and curing concrete and mortar, to ensure placement, etc., during most favourable times.<br>- Use plain high-quality un-rendered brickwork and high quality cement mortar in preference to rendered low-grade bricks<br>- Use sulphate resisting cement in vulnerable locations (higher heat gain during curing) or cement containing fly-ash (less heat gain, so preferred). |
| 4 | Runoff | - Require separate arrangements for disposal of faecally-contaminated wastewater.<br>- Use trapezoidal section drains with small low-flow section (cunette) for low flows **(Figure VI.1)**<br>- Line drains to achieve higher discharge velocities without increasing risk of scour, etc. |
| 5 | Flooding | - Choose durable materials, preferably concrete or high quality bricks<br>- Ensure high quality construction<br>- Consider short to medium-term pumping (mobile/emergency pumps)<br>- Check and design against possible floating in various operating scenarios (hydrostatic pressure). |

Source: PPTA Consultant.

**Figure VI.1: Trapezoidal Drainage Channel with Low-level Section for Low Volume Flows**




Source: WHO

### 3. Water and Sanitation

191. The key proposed climate resilience measures associated with water supply and sanitation interventions are:

- increased water demand due to temperature rise;
- measures will be taken to protect water supply infrastructure such as production tube well, pump house etc. from flooding due to intensive rainfall;
- sanitation structures will be implemented above flood level;
- superstructures will be strong to cope with cyclone;
- proposed surface water treatment plant (SWTP) plant will be protected from cyclone /storm surge;

- water storage provision for emergency use;
- emergency power back up.

192. Water supply projects should include future increased demands for temperature rise, in addition to that due to increase of population and future development. For water demand projections, a 15% increased water demand due to temperature rise prediction (1.2-2.4$^0$ C by 2050) will be taken into account.

193. Measures will be taken to protect water supply infrastructure such as production tube wells, pump houses, etc. from flooding due to intensive rainfall. It is recommended to keep the upper well casing of tube well 1.5 m extended from the ground so that floodwater cannot move inside the well. The pump house will be constructed above flood level.

194. Sanitation systems should be installed above the flood level, for climate resilience.

195. The cyclonic strong wind will be taken into account during detailed design of the structures such as overhead tanks, pump houses, etc. to make them strong enough to withstand cyclones and to be climate resilient.

196. The proposed SWTP (at Mathbaria) will be protected from cyclones, storm surges, etc. An earthen embankment of height 4.0m above mean sea level with CC block pitching, will be constructed along the boundary of the compound. The width of the embankment crest will be 3 m, and the outside slope and inside slope will be 1:2 and 1:1 respectively.

197. River and pond water gets saline during cyclones and storm surges. A ground reservoir of capacity 2,000 $m^3$ is proposed for the provision of water storage for emergency use after big cyclone /storm surges.

198. Provision for power backup (generator) to keep the water supply operational if the normal power supply gets interrupted/stopped from the National Grid during cyclones/storms.

## B. Nonstructural Measures: Climate Resilience Options and Measures Proposed by CTIIP

199. For the purposes of this project, non-structural measures mean all activities besides hard capital investment. Measures will be divided between those that provide community/town-wide benefits in reducing climate vulnerabilities, and those that are associated with particular infrastructure investments.

### 1. Integrating Non-Structural Measures in Subproject Designs

200. The integration of the knowledge, services, resources, monitoring and policy/planning in with specific projects is critical if the measures are to be grounded in reality and provide value added for the projects.

201. The sector (water and sanitation, drainage, etc.) and process (governance, social, etc.) experts from the CTIIP PPTA project identified relevant non-structural measures to accompany the infrastructure investments. As the CTIIP is a mainstream urban sector investment project, it is important that capacity building focus on working with the institutions and individuals directly responsible for managing infrastructure and services. As staff turnover can be an issue, the capacity building needs to be sustainable, meaning a plan needs to be taken seriously by the institutions involved for how new staff learn and act on past knowledge and practices. Much capacity building can deteriorate without management

support and resources. As these are identified as deficient at the pourashava level, this is one of the greatest risks.

202. As such, for each subproject identified, the design considers the above issues and come up with appropriate, project specific non-structural needs, and determine if these are subproject specific or if they can be serviced by more central activities. For instance, a water supply project may need to integrate operations with early warning systems or flood inundation monitoring, or it may be something undertaken and managed directly by staff involved in water supply operations. Conversely, some centralized non-structural activities may need to tap subproject staff to secure data or require monitoring reports at regular intervals.

203. **Table VI.9** identifies and specifies the non-structural interventions that go along with the infrastructure investments. Further details of these interventions are found in **Volume I Section 5: Proposed Infrastructure Subprojects**.

**Table VI.9: Nonstructural Measures by Sector and Subproject**

| Nonstructural Measures by Sector and Subproject | | |
|---|---|---|
| **Infrastructure Project** | **What is/are the Non-Structural Intervention(s)?** | **What Resources are Required? (Financial/Human/Policy/ Regulation/Capacity)** |
| Water:<br>- Groundwater extraction | Maintain pumps. | Operating costs, operator and inspector, monitoring reporting, training on monitoring, etc. |
| - Surface water extraction | Maintain pumps and treatment facilities, ensure supply of chemicals. | Operating costs, operator and inspector, monitoring reporting, training on monitoring, etc. |
| Sanitation | Maintenance of facilities, de-sludging of septic tanks services. | Operating costs, operator and inspector, monitoring reporting, training on monitoring, etc. |
| Storm water drainage:<br>- Drains | Keeping drains clear. Do not throw garbage into drains. Raise awareness. Land use development planning. Prevent encroachments, IEC programmes on solid waste management and land use development. | Training/capacity/finance, human resources, regulation. |
| - Flood control | Agree and implement arrangements to minimize impacts of demand for irrigation water on urban flooding. Strengthen sluice management committees, make accountable to statutory bodies. Develop and implement differentiated flood management plans, according to needs and priorities. IEC programmes on flood management. Consider in zoning/ land use plans, polder development plans. | Human resources, trainging/capacity, finance, regulation (byelaws), policies. |
| Roads | Driving to enhance fuel efficiency. | Capacity |

| Nonstructural Measures by Sector and Subproject | | |
|---|---|---|
| **Infrastructure Project** | **What is/are the Non-Structural Intervention(s)?** | **What Resources are Required? (Financial/Human/Policy/ Regulation/Capacity)** |
| Cyclone Shelters | Raise awareness on use and upkeep. Practice drills (school children, other institutions or groups). | Include upkeep in DRM TOR.<br>Incremental maintenance funding from DRM funds.<br>Use CSOs for drills with DRM oversight. |
| Boat Landings | Raise awareness on climate change issues. Training of boat staff in cyclone safety. Planning for new boat landings. | Capacity |
| Slum Improvement | Community participation in planning, design, construction and operation. Raise cyclone safety and health, and hygiene and awareness. | Financial/Policy/Regulation/Capacity |
| Overall | Green construction techniques, e.g.<br>- use "green" materials;<br>- minimize concrete use;<br>- use human labor rather than machines where possible (also has poverty alleviation/ social benefits). | Financial/Human |

### 2. General, Community/Town-Wide Nonstructural Measures

204. Investments in infrastructure are not sustainable if they are not supported by a combination of methodical and continuous management and maintenance. Broader physical and institutional contexts also support or threaten a project's capacity to provide sustained service delivery. Hence CTIIP subprojects need to be supported by capacity building, ancillary investment in "soft" and non-structural measures and capital, and policies and management commitment to sustain operations and maintenance under good practices, and sometimes new and sustained financial resources. Climate changes pose additional risks to infrastructure investments and may demand additional non-structural measures, either from the onset or as climatic changes emerge over time.

205. It is important to consider non-structural climate vulnerability reduction measures in coastal towns as fitting within a broader framework of national and international mechanisms. These mechanisms, defined broadly, include financial resources, policy frameworks such as legislation and regulation, research and know-how, incentives for change, and systems of accountability will be important for the resilience and sustainability of the project. New and emerging resources and approaches need to be embraced, promoted and supported if they can address uncertainties or barriers to the investment's sustainability and climate resilience. The following are some key resources the project shall, where appropriate, integrate and leverage into project design and implementation.

206. **Financial resources, mechanisms, and incentives:** CTIIP's sustainability and long-term climate resilience depends on resources throughout the operational life of each subproject. This includes supporting the additional capital and operational expenses of infrastructure-based municipal investment and systems, and resources to minimize and

cover the public costs of climate-related loss and damage.

207. There are a number of international financing mechanisms available to support projects that enhance climate resilience. The project financing plan includes funding from the Pilot Project for Climate Resilience (PPCR). PPCR covers the incremental costs of projects to be "climate proofed." As such, the aim is to "mainstream" climate adaptation into the broader development framework. The climate adaptation strategy section in this report discusses PPCR in further detail and how incremental costs will be calculated for project designs. [45]

208. New domestic and international financing mechanisms may be tapped in the future. The Bangladesh Climate Change Trust Fund (BCCTF) is funded by the government and could possibly be an option for sustained resourcing for CTIIP projects and capacity building; as could the multi-donor funded Bangladesh Climate Change Resilience Fund (BCCRF) that may provide grant support to civil society and private sector to, among other things, create "grassroots mechanisms" for community resilience. The proposed Local Disaster Risk Reduction Fund (LDRRF) managed by the Comprehensive Disaster Management Programme (CDMP) is another potential source of funds.LDRRF proposes to encourage sustainable investments by incorporating a trust fund to manage on-going upkeep. The poor upkeep of existing infrastructure (including, for instance, encroachments on canals by footpaths, houses, dams to create fishponds, and garbage disposal) is often a greater cause of climate vulnerability than the absence of infrastructure. As such, mechanisms like that proposed for the LDRRF that offer revenue for operations and maintenance can play a crucial role.

209. Beyond having the resources to maintain infrastructure, creating a financial incentive to sustain climate vulnerability reduction is the ultimate aim. There are also initiatives underway promoting instruments that credit outcome based climate vulnerability reduction. With public or private demand for these instruments, they could provide CTIIP investments with a future revenue stream to incentivize and support robust operations and maintenance of infrastructure projects.

210. For some CTIIP interventions, local level self-funding may be the most sustainable strategy. Efficiency and sustainability in water supply infrastructure can be brought about with robust financial management and monitoring of water supply which is presently a weakness in the pilot pourashavas.

211. An important component of climate resilience and disaster risk management is supporting community-based adaptation projects. As noted by Heltberg et. al, "support for adaptation should play to the strengths of community-based approaches, in particular local grounding. Small community-based projects are a viable means of supporting adaptation … although some regions may need to build the capacity of potential providers.[46] They note that grounding in local socioeconomic and climatic realities; use of local knowledge; and synergies between adaptation and development. Adaptation funding regimes should seek to exploit and promote these strengths, and communities should be involved in identifying local causes of vulnerability and in devising responses.[47]

212. Locally managed funds have been successful in serving as a route to pro-poor urban

[45] See CDTA, 2013, Final Report, page 18.

[46] Heltberg, R., et al, (2010) Community-based Adaptation: Lessons from the Development Marketplace 2009 on Adaptation to Climate Change, Social Dimensions of Climate Change Program, Paper No. 122/June 2010.

[47] See Asian Coalition for Housing Rights (ACHR), Housing by People in Asia, No. 17, November 2007, and andUN HABITAT, Housing the Poor in Asian Cities (2008), Quick Guides for Policymakers, 5, for further information and strategies for housing finance for the poor, that may apply to community based climate adaptation finance.

development, having channelled tens of millions of dollars to low-income neighborhood groups, providing accountability and decision-making power to often marginalized people. Development funds at the town-level can be jointly managed by communities and the pourashava in order to facilitate collaboration and capacity building.[48]

213. Funding community level climate adaptation measures using locally managed funds is a relevant approach. The IIED is currently working to provide local finance though such a fund in north Kenya.[49] Community level adaptation is an important tool requiring local level resources to be efficient, effective, and sustainable.

214. CTIIP shall design and work with local communities to set up and provide seed funding for “pro-poor community managed adaptation funds.”

215. **Policies:** The Government of Bangladesh has been actively promoting climate adaptation and disaster risk management through a number of policy instruments that the CTIIP should leverage and promote.

216. The recently passed Disaster Management Act, discussed further in the next section, is encouraging a variety of policy changes that may improve the sustainability of CTIIP subprojects. The Act encourages greater attention to comprehensive disaster management over disaster response. A draft National Disaster Management Policy has been formulated, and, in addition to proposals for a disaster management fund, the Act specifically gives local disaster management committees additional authority.

217. Interviews with Pourashava officials and community organizations (see **Section VI, Volume 5**) demonstrated that local level disaster risk management is largely inactive and local level cyclone preparedness is limited primarily to disaster warning, without resources going to awareness raising and disaster risk reduction. Pourashava officials and officials at the Comprehensive Disaster Management Programme (CDMP) acknowledge this.

218. The central government in recent consultations has identified improved local level disaster management as a priority. The CDMP is undertaking work enhance local capacity, through training on use of the Local Government Self Assessment tool to identify gaps in local urban risk reduction. Further details are noted in the following section.

219. **Urban Planning:** Urban planning is another important tool—between policy and management—that can guide climate adaptation. There are four relevant planning functions:

1. Controlling land use by preventing development in areas of high risk and in areas that exacerbate levels of risk,
2. Promoting, directing and facilitating development in areas of least risk and that are compatible with a climate resilient urban development strategy,
3. Allocating and reserving sufficient land for critical climate resilient infrastructure (such as water supply, drainage and roads) including sufficient rights-of-way and land availability, and
4. Identifying, on a continual basis, priority capital investments (for both new infrastructure and rehabilitation of existing infrastructure, and including ‘natural’ eco-systems infrastructure).

220. Chapter VII analyzes the status of planning in the pilot cities, and details further how the above four functions could result in more climate resilient Pourashavas. One specific recommendation to note is to develop ‘Climate Change Adaptation Building Standards’. While these would not have legal force, developed on the basis of local knowledge of the five

[48] Mitlin, D., 2013, Locally managed funds: a route to pro-poor urban development, IIED Briefing, May 2013.
[49] Ibid.

coastal towns, these could provide a short, user-friendly and straightforward guide to ensuring adaptation measures on individual sites and buildings. The PPTA performed a cost:benefit analysis of this option and found favourable returns on the costs imposed by such standards (see **Volume 7: Economic and Financial Analyses**). Adopting climate resilient building codes also resulted in the largest quantity of estimated vulnerability reduction credits of all options assessed.

221. **Technical Tools for Climate Preparedness:** As noted in the field survey report (**Volume 5, Section V**), before Cyclone Sidr many residents either did not receive warning or if they did ignored it, as they thought is might be a false alarm. A priority should be strengthening the monitoring and warning system to improve the prediction systems for weather, rainfall and cyclones and floods improve the warning and preparedness to effective and trust worthy level.

222. For the development of improved vulnerability assessments and local level adaptation plans and projects, research is needed to downscale the future prediction from the GCMs using high resolution dynamical models, such as PRECIS to local level scenarios at required time horizon. Climate investigators should have free access to the high-resolution model data generated in the national institutes. A climate database of the results containing future scenarios of the downscaled climate parameters needs to be generated and archived and be made easily available to the development projects engaged in developing climate resilience. In fact, this task is of utmost interest for the nation for implementing large number of projects dealing climate resilience.

223. An important recommendation from the CDTA report is the importance of setting up a system of monitoring flood inundation patterns during extreme rainfall events to make more reliable estimates of flood prone areas.

224. The project provides emphasis of mapping of the monsoon flood inundation, inundation level due storm surges by Cyclone Sidr and extreme tidal inundations are required to be performed as baseline scenarios of these disasters, which needs to be followed by inundation mapping at 2050 for the selected towns. The GIS technology and availability of up to date DEM would ensure the quality of the results of the baseline study and future scenarios.

225. The damage and losses assessment for the changed climate scenarios in 2050 and further for the study pourashavas is an important task to be performed.

226. **Community Level Awareness Building, Especially for Poorer and Marginalized Groups:** Specific support in raising awareness and building capacity to adapt to climate change and disaster risk management is lacking for the most vulnerable communities (slums, those outside the embankments, and possibly women, children, elderly, and disabled). The community survey and community hazard mapping instigated by CTIIP clearly indicated that:

> "Vulnerable communities had lower quality of housing: most damage occurred to the poorest quality housing (wood/tin).
> Poor communities (slums) higher vulnerability: they have poorer housing, and for our survey and mapping were more likely to be in hazard prone areas, such as outside of embankments.
> Individual and household coping mechanisms, such as savings, were scarcer and more fragile for poorer communities.
> Warning systems in poorer communities appeared weaker, with fewer reporting early warning, and often warnings were ignored."

227. While many of the above set of non-structural measures will service all subprojects

that CTIIP supports in a "centralized" way, the integration of the knowledge, services, resources, monitoring and policy/planning in with specific projects is critical if the measures are to be grounded in reality and provide value added for the projects.

228. Furthermore, it is clear that the fishing community faces particular vulnerability to cyclones. This was supported by interviews of fishermen who were impacted during Cyclone Sidr. In addition, the vulnerability of the fishing community and the need for improved warning systems for this community were issues raised by the Director General of the Bangladesh Department of Disaster Management. Establishing an improved a warning system for coastal area fishermen is thus another priority non-structural issue for CTIIP.

229. To address the lack of community knowledge and awareness of climate change and climate-related hazards, the CTIIP will develop a comprehensive community based community awareness program in each town, develop a fishing community warning system, and establish community based hazard mapping an planning, that can not only help identify climate vulnerabilities, but also options to redress these, that in turn could be funded by the locally managed climate funds discussed above.

230. **Disaster Preparedness Capacity Building:** Interviews with pourashava officials and community organizations (see Volume 5, section V, Community Perceptions of Climate Change and Disaster Risk in Study Pourashavas) demonstrated that local level disaster risk management is largely inactive and local level cyclone preparedness is limited primarily to disaster warning, without resources going to awareness raising and disaster risk reduction. Pourashava officials and officials at the Comprehensive Disaster Management Programme (CDMP) acknowledge this, and none of the four pilot towns have active Pourashava Disaster Management Committees. The central government in recent consultations has identified improved local level disaster management as a priority.

231. The Bangladesh Department of Disaster Management Director General noted that organization of these committees was the responsibility of pourashava civil servants (Secretaries) who had many mandates and were rotated between towns on a regular basis.

232. Creating an active, resourced and effective Pourashava Disaster Management Committee (PDMC) is a key element in making local level disaster management a reality.

233. The CTIIP shall support the PDMCs through a program of capacity building, including providing the often rotated civil servants and local officials with orientation tools, and providing technical support to the committees to give them know-how and advice on options to guide local level disaster management.

### 3. Implementing Non-Structural Measures

234. As described above, non-structural measures related to climate adaptation are found in the subproject designs, in the urban planning program of activities (see Chapter 8, Volume 1), and specific climate and disaster management measures are integrated into a package of activities as outlined in **Table VI.10**.

**Figure VI.10: Overview of the Climate Change and Disaster Preparedness Technical Assistance Component**

**Objective: Strengthen Pourashava and community level preparedness for climate change, in all CTIIP towns**

| Component A | Component B | Component C | Component D |
|---|---|---|---|
| **Climate and disaster technical tools to inform adaptation and DRM decision making** | **Community-level awareness raising and warning systems for climate hazards and resilience options,** especially for the poor and marginalized | **Disaster preparedness** through support for Pourashava level Disaster Risk Management Committees | Resource pro-poor, community level adaptation through **locally managed climate resilience funds** |
| **Outputs**<br>Downscaled climate model outputs<br>Improved tropical cyclone projections<br>Flood inundation monitoring and mapping<br>Cyclone and flood loss and damage assessments/tools | **Outputs**<br>Community awareness raising events<br>Fishing community early warning system<br>Community DRM hazard mapping and planning | **Outputs**<br>Orientation system for new civil servants/officials<br>Technical support for DRM Committees | **Outputs**<br>Funds Design/Management Plans<br>Locally managed funds for each subject pourashava |

Source: PPTA Consultant.

235. While the training of experts, officials, and the community is important, it is far from sufficient. Considerable technical expertise and sustainable resourcing of Bangladesh/pourashava or central ministry expertise will be required, along with financial resources to fund the creation of modeling, monitoring, and evaluation infrastructure. Commitment by government offices to provide staff and implement policies to enable the above non-structural measures is also important, and a key component of the capacity building work will be working through how the above big issues can be “mainstreamed” into government policy. This may only be done if both the policy and the internal/external incentive regime are put in place.

# VII. GUIDELINES FOR MAINSTREAMING CLIMATE CHANGE INTO URBAN PLANNING

## VII.1 The Urban Planning Approach to Climate Change Resilience

236. At the most fundamental level, planning requires formulating responses to future opportunities and challenges. Urban planning does this most significantly through the use and control of land, and the policies and investment programmes that enhance the management of urban areas. As such climate change is simply an additional consideration in the planning process (along with the range of all other planning considerations). Many actions that seek to enhance the resilience of urban areas are consistent with 'routine' planning responsibilities:

- Minimising and/or improving land development activities that occur in flood and slope hazard areas
- Improving infrastructure for storm water management, solid and liquid waste management, access to safe drinking water and the movement of goods and people
- Protecting habitats and environmentally sensitive areas
- Supporting economic development and improving quality of life
- Supporting more sustainable development.[50]

237. There is broad consensus internationally that urban planning has a fundamental role to play in responding to climate change and managing risk. Planners, planning and plans have an important contribution to increasing the resilience of urban areas.

238. The basic foundation is the straightforward relationship of ensuring (new) development is located in those areas that are least vulnerable to the impacts of climate change. This is particularly pronounced in the coastal zone of Bangladesh for seasonal flooding and water logging, cyclonic storm surges, and reducing the risks posed by landslide. Achieving this has multiple benefits in:

- Reducing damage and losses
- Reducing the loss of life, disability and illness
- Helping protect livelihoods
- Supporting more rapid post-disaster recovery

239. Planning systems and processes differ between countries, but most balance the need to **control** development (through land use plans and administrative planning control systems) and **enabling / facilitating** development (for example through local area urban renewal or providing land and/or basic infrastructure to encourage development in particular places). Urban climate resilience in Bangladesh will require the following functions are enhanced and/or built into the development of the system:

- Controlling land use by preventing development in areas of high risk and in areas that exacerbate levels of risk
- Promoting, directing and facilitating development in areas of least risk, and that are compatible with a climate resilient urban development strategy
- Allocating and reserving sufficient land for critical climate resilient infrastructure (such as water supply, drainage and roads) including sufficient rights-of-way and land availability

[50] 'Planning for Climate Change: A Strategic, Values-based Approach for Urban Planners', UN-HABITAT (2012)

- Identifying, on a continual basis, priority capital investments (for both new infrastructure and rehabilitation of existing infrastructure, including 'natural' eco-systems 'infrastructure' such as forest and mangrove).

240. With these functions in mind, increasing resilience in planning requires looking at the main suite of planning instruments and tools, and the capacity required to effectively operate an urban planning system (these are addressed in the TA Component, Volume 1 Main Report):

- Land use plans, and complementary plans (such as drainage, solid waste management, water supply and wastewater management and master plans).
- Controlling development and building standards.
- Programming climate resilient infrastructure investments.

### VII.2 Urban Master/ Land Use Plans

241. Land-use planning and plans are fundamental tools for mainstreaming climate change and disaster risk reduction into urban development processes. Land use plans influence the location, type, design, quality, and (in principle) timing of development. By addressing climate change risk in urban plans the role of (risk based) planning becomes a means for:

- Introducing a non-structural approach that identifies the safest locations and regulations for guiding urban development and therefore contributing to reducing the loss of life and damage to property and other physical assets
- Informing all urban projects (scale, nature and location) of climate related issues, and therefore mainstreaming land use planning in infrastructure projects that reduce episodic and everyday risk limiting expose of high concentrations of economic assets and population (especially the poor) to disaster risks
- Strengthening disaster risk reduction measures by controlling or prohibiting development in hazard-prone areas, assessing measures required to facilitate rescue operations (such as clearly demarcated and protected 'escape' routes), and providing full consideration of safe 'refuge' areas (including shelters and the use of elevated areas such as embankments and roads)
- Identifying least risk areas in order to prioritize immediate investments in urban development and infrastructure projects, including the location of critical facilities (water supply, SWM, health and education, transmission of electricity)
- Predicting and providing the means of future climate resilient infrastructure measures through the demarcation of public land and rights-of-way, and the need for land assembly (involving the purchase of private land) where required
- Supporting local ecoonmic development through a systematic risk-based approach to planning and future investment.[51]

242. Master plans are being developed for most urban areas in Bangladesh. This provides an excellent opportunity for mainstreaming climate change in these plans, and in urban planning more generally. These plans identify cyclones and flooding as two major events faced on a regular basis, and reference hazard types in the analysis of critical planning issues of the pourashava.[52] The plans provide instructions on building cyclone resilient structures for the safety of people and property. The plans reference the need for multi-purpose cyclone shelters, raised roads, forestry and riverside tree plantation, adequate

[51] World Bank (2013) 'Building Urban Resilience: Principles, Tools and Practice', edited by Abhas Jha, Todd Miner and Zuzana Stanton-Geddes, World Bank. (p.26).
[52] Volume 2 Annex B.1 'Review of Urban Planning in Study Pourashavas'.

drainage facilities, rainwater harvesting and community facilities for public safety against climate change disasters (cyclones, flooding, tidal inundation, etc.). Purpose built cyclone shelters are considered insufficient to provide equitable access for populations in different areas of the towns; similarly education facilities that can be used as cyclone shelters are not appropriately located for adequate access to all sections of the respective town's population. Whilst all the master plans flag the need to build cyclone and flood resilient public facilities in the future, they do not make any specific proposals on rehabilitation of major physical infrastructure or facilities except for roads and embankments.

243. There will need to be a pragmatic approach to the development of climate resilient land use plans with an eye firmly on the practicality and likelihood of implementation: it is critically important to appreciate that 'plans' are just one of the building blocks of climate resilient planning and must be in step with other the other blocks **(Table VII.1)** reflecting the capacity to operate and enforce a planning system and to bring forward investments. The core areas that should be considered are:

- Including user-friendly additions on climate change projections and scenarios and the impact on the spatial development of the pourashava.
- Revising and simplifying land use zoning (for example, red zones where buildings are prohibited, blue zones conditionally permitted and so on).
- Ensuring the location of critical facilities and buildings, transmission-distribution systems (electricity) and storage (i.e. fuels and food) are not in hazardous zones
- Or where necessary allocating land for the development or relocation of this critical infrastructure, and/or anticipating the need for land assembly to provide adequate space for such facilities.
- Verifying that natural assets (ponds, khals, natural barriers, green/open spaces) are adequately protected from encroachment and destruction
- Reserving rights-of-way for the future planned provision of infrastructure (such as roads, drains and embankments) critical for climate resilience.
- Verifying and re-enforcing 'no development' zones, and zones for urban development and expansion in safe(r) areas.
- Encouraging, within reason, higher densities and 'compaction' in areas that are least vulnerable and best protected (by embankments, polders, location).
- But balancing compaction with the need to avoid densely developed areas impeding escape routes and access to emergency equipment (fire fighting, ambulance, search and rescue operations).

**Table VII.1: Building Climate Resilient Urban Planning**

| **What measures enhance and mainstream climate resilience of urban planning?** | | | |
|---|---|---|---|
| **Climate Sensitive Land Use / Master Plans** built or revised on the basis of climate change vulnerability and adaptation assessments | **Planning and building control adapted to climate change** that can be implemented and is enforceable | Straight-forward and continual **infrastructure investment programming methods that prioritise climate adapted investments** that are affordable and sustainable | **Sufficient capacity and skills** (of the pourashava and individuals) **in urban planning** to effectively run the planning system, and to make it a joint, multi-stakeholder, enterprise |

244. Climate proofing these plans will require revision on the basis of a vulnerability and adaptation assessment consisting of:

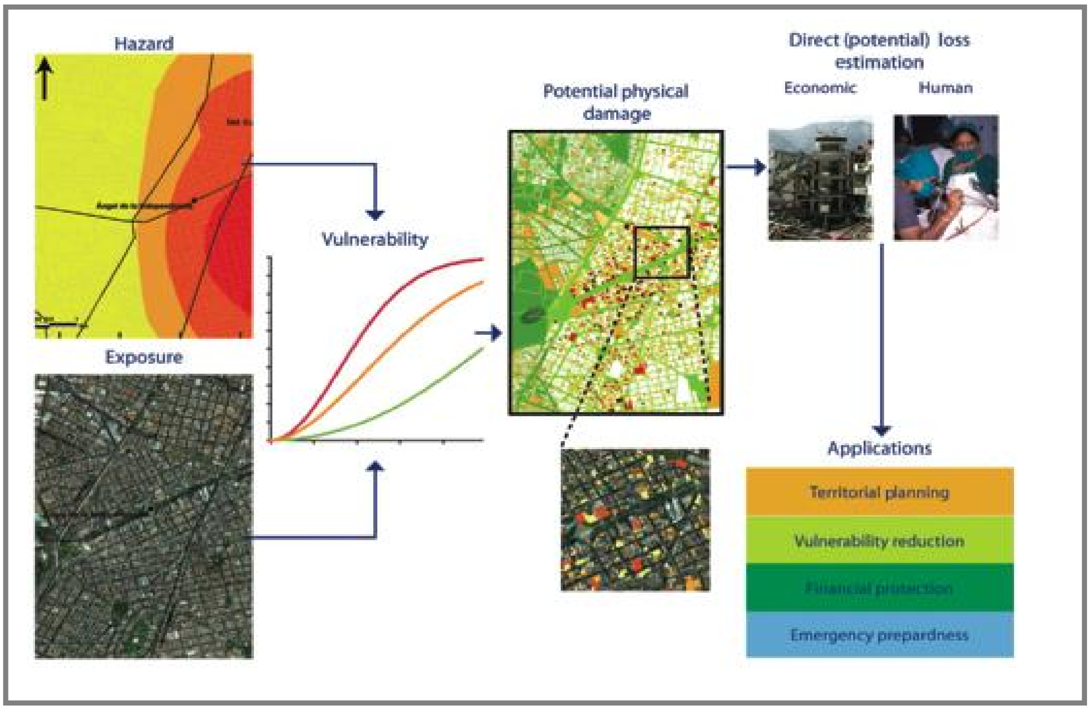
- Climate change projections and scenarios (II and III)
- Vulnerability assessment (vulnerability profiling and hazard mapping)
- Master plan revision (as necessary) based on projections and vulnerability assessments

245. In line with current international experience and practice this would, in outline terms, consist of:[53]

**Step 1 Assessing pourashavas' exposure to hazards**

This requires identifying the projected local climate change impact, based on existing climate data, people's account of changing weather patterns and projected climate change trends (**Figure VII.1**). For the four phase 1 CTIIP coastal towns this is established in sub-sections II and III, with an initial survey of community perceptions reported in sub-section V, in this 'Climate Change Assessment and Adaptation Strategy' (Volume 5).

**Figure VII.1: Risk-based Urban Planning**




Source: World Bank (2013) 'Building Urban Resilience: Principles, Tools and Practice'

[53] The consideration of DRR in land use planning is already underway in Bangladesh. An initial scoping report and final report ('Integrating DRR into Land Use Planning in Bangladesh', April 2013, UDD) and outline framework for integrating DRR in land use planning will be elaborated in a 'guideline' over the coming year. The work is supported by ADPC. Section VII (Volume 5) has been developed within the overall thrust of the recommendations on specific steps for integrating DRR in land use planning at the local level, namely: (a) activate municipal council, (b) prepare land use planning guidelines and standards, (c) establish a local level land use and DRR database, (d) analyse guidelines and databases, (e) categorize and classify land use, (f) develop a land use matrix of compatible uses, (g) develop zoning regulation and development control, (h) develop disaster risk criteria consisting of a hazard inventory and hazard map, (i) risk assess, (j) formulate a local land use plan, disaster management plan, and action plans, (k) build awareness amongst stakeholders.

**Step 2 Assessing pourashavas' sensitivity to climate change**

This requires reviewing and assessing the degree to which different sectors, areas, facilities and communities will be impacted on by climate change. It is a risk assessment applied to land use planning (thus 'risk based land use planning). It assesses the:

(a) Overall vulnerability of the pourashava.
(b) Vulnerability of sectors and critical infrastructure.
(c) Vulnerability of places with emphasis on those areas that are especially exposed and sensitive to climate change impacts (frequently referred to as 'hot spots')[54]. In the coastal zone these will generally be those areas outside embankments and occupied by the urban poor.

Critically, these vulnerabilities must be mapped, so that 'hazard maps' can provide a basis for re-examining and, as necessary, revising land use zoning and land allocation. A matrix with common questions for screening the climate resilience of master plans in included as **Appendix 2**.

**Step 3 Formulating responses through participatory planning for climate change adaptation**

The significance of participation in the development of plans is already well established in Bangladesh.[55] The technical detail of assessing exposure (climate change projections) and sensitivity (through vulnerability) must be tempered through participation and decision-making on appropriate, affordable and sustainable responses. This must include the urban poor who are generally are most exposed and at the greatest risk from climate change.

**Step 4 Reviewing and revising the pourashava master plan**

With vulnerability and adaptation assessments in place, pourashavas are in position to revise their master plans on the basis of informed risk-based analysis (as discussed above). Evaluating the revision, and therefore the climate resilience of the master plan, must include assessing the degree to which the following questions can be answered:

- Does the master plan now include user-friendly additions on **climate change projections and scenarios** and the impact on the spatial development of the pourashava? Does it provide sufficient climate resilience evidence and explanation for the plan policies and proposals?
- Does the **land use zoning** now clearly reflect climate resilience considerations through a straightforward identification of zones where development is prohibited, is conditionally allowed and where new development is encoraged?
- Are all **critical facilities and buildings** (including schools, health centres and shelters), transmission-distribution systems (electricity) and storage (i.e. fuels and food) located in least risk areas? If not does the plan now make provision (land availability for siting and supporting infrastructure) for the relocation of such facilities?

[54] Two good resources of relevance to the Bangladesh context and for shaping these approaches are found in: 'Developing Local Climate Change Plans: A Guide for Cities in Developing Countries', UN-HABITAT and IIED (2012), and 'Sorsogon City Climate Change Vulnerability and Adaptation Assessment', UN-HABITAT (2010).

[55] This includes the development of master plans, the significant participation required in the development of UGIIP-2 participating pourashavas' Pourashava Development Plans, and as anticipated by the draft National Urban Sector Policy.

- Is there adequate demarcation of, policy for, and practical actions for the protection and enhancement of the so-called '**natural infrastructure assets'** that protects the pourashava including ponds, khals, natural barriers (such as forests), green/open spaces (that act as natural drainage areas)?
- Have **rights-of-way for future planned climate resilience measures** been adequately reserved (such as roads, drains and embankments) and demarcated on land use plans? provision of infrastructure critical for climate resilience?
- Are there sufficient plan policies for encouraging (within reason) **higher density in those areas least at risk** and best protected from climate change impacts?
- Are **escape routes and refuge shelters** adequately demarcated in the land use plan, and proposals for their protection and enhancement adequately addressed (for roads that will include protection from new development impeding their effectiveness)? Are additional refuge areas, such as embankments and elevated roads, adequately identified, protected and enhanced?
- Has a straightforward means of **monitoring the plan and evaluating its utility in protecting the pourashava** against climate change impacts been developed?
- Has the revised master plan been summarised in a **concise and easy-to-understand brochure that explains the need and approach to planning for climate change**? Has the pourashava developed actions for advertising, sharing and explaining the revised plan (with citizens and businesses)?

## VII.3 Planning and Building Control

246. The control of urban development through planning and building control are distinct practices.

247. Urban development control is a core urban planning activity that addresses both site specific (for example building set backs, the intensity of site use through floor area ratios, building heights etc) and wider planning and design issues (for example use, impacts on landscape and environment, and the relationship to the transport network). Building control is tangential to urban planning and is focused on the structural integrity of a building (ensuring buildings are safe, accessible and efficient and conform to construction standards).

248. Current planning practice in Bangladesh has focused on the latter – building permits – which is used as a proxy planning permission.[56] Whilst both control mechanisms are important for enhancing climate change resilience, building standards and control that are adapted to the projected impacts of climate change are fundamental. Building codes, are generally considered as the most effective tools to safeguard the lives and property against major disasters like earthquakes and cyclones. Non-compliance of buildings to building codes has been demonstrated as the cause of structural failure in Bangladesh (and under normal conditions).

249. The approach to proofing building standards and the building permit system will necessarily involve an experimental (trail-and-error) approach that will need to be adjusted on the basis of experience. There is no silver bullet to ensuring compliance.

[56] This will change once the new Urban and Regional Planning Act becomes legislation.

250. **Step 1 Develop 'Climate Change Adaptation Building Standards':**

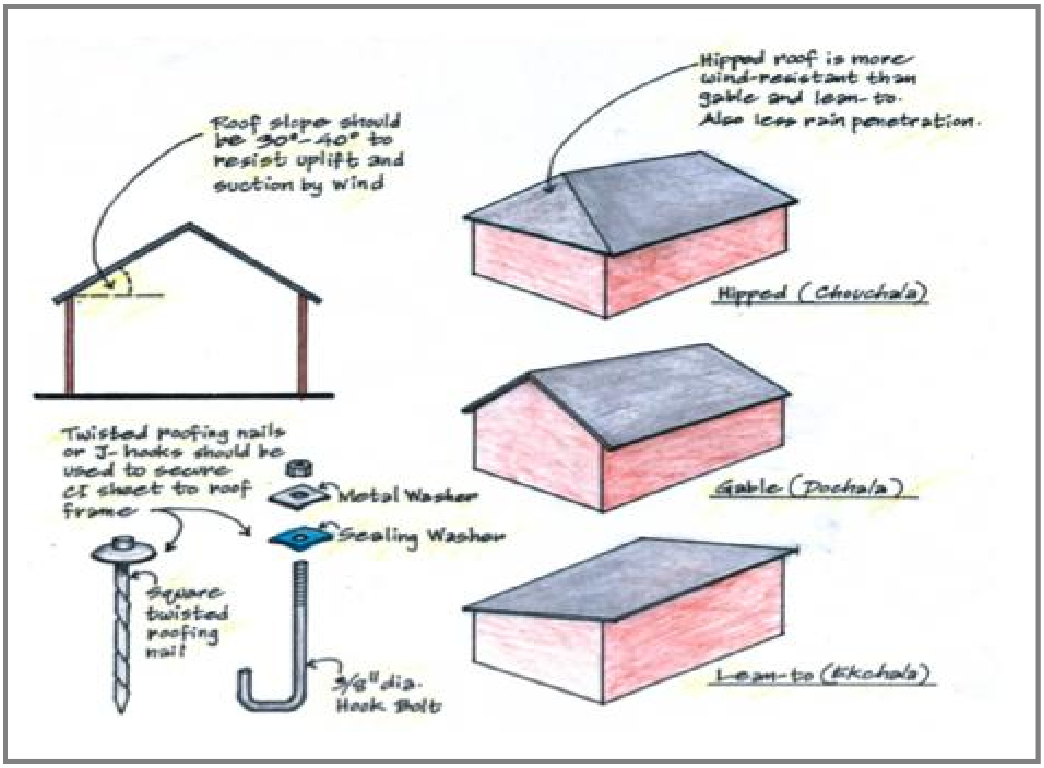
The Bangladesh National Building Control (2006, 2013 revision pending) applies to all pourashavas in Bangladesh. However, it is necessary to ensure that this code is adequately understood, locally adapted (developed on the basis of local knowledge) and in a user-friendly format for ready application at the pourashava level.[57] We recommend supplementary guidance based on the revised BNBC (2013). These would not have legal force but provide a straightforward guide to ensuring adaptation measures on individual sites and buildings.

In doing so it is necessary to apply some simple principles, to ensure the regulations are:

(a) Realistic (given economic, environmental and technology constraints) in the coastal zone, and reflective of the vernacular architectural style
(b) Relevant to current building practice and technology in the coastal zone (encompassing both the design of buildings and the materials used). This includes incorporating local knowledge sufficiently in the development of the building standards.
(c) Updated regularly in line with the latest developments in understanding of projected climate change projections and the impact on coastal towns (most especially flooding and wind damage) – currently this indicates an increase in monsoon rainfall, a SLR of 17.5-39 cm and an increase in the number and intensity of cyclones (covered in section II and III) – and in line with the most effective means of building adaptation.
(d) Understood and accepted by technical professionals (including pourashava engineers, planners, architects and surveyors), applicants for building permits and the general public. BNBC is heavily biased to engineering, but it is important that the principles and approach is more easily digested.
(e) Adhered to with controls based on a system weighted to incentives, but with adequate punitive measures where building regulations are ignored
(f) Enforced in order to avoid the building permit system being ignored and/or failing into disrepute (addressed below).[58]

[57] It is widely accepted that building codes are commonly overly complicated/scientific, but need to be easily understood and user friendly (UNISDR).
[58] Drawing on the ISDR 'Living with Risk: A Review of Global Risk Reduction Initiatives' (2004)

**Figure VII.2: Straightforward design guidance can encourage greater climate change resilient structures**




Source: 'Handbook on Design and Construction of Housing for Flood-prone Rural Areas of Bangladesh' (2005), Asian Disaster Preparedness Center

251. **Step 2 Review and strengthen planning and building control systems and enforcement:**

The application and enforcement of planning (especially in conformity to pourashava master plans) building regulations is crucial.

In general development control and enforcement systems rely on a balance between appropriate regulation, public awareness and citizen pressure. Few, if any systems are immune from the breaking of rules. If anything, a cultural disposition to compliance or non-compliance - which can be very localized - is more significant especially in a context of limited capacity and resources to effectively manage an enforcement system. One thing is clear (from international experience), there is no silver bullet to ensuring compliance.

Appropriately enhancing the capacity and efficiency of the development control and enforcement system in the coastal towns (as in other pourashavas) should be based on four main principles:

(a) Use existing mechanisms effectively and build on existing practice
(b) Ensure optimal transparency and accountability to engender confidence in the system as equitable and fair
(c) Use a mix of carrots and sticks to reward compliance and penalize non-compliance
(d) Recognize, and work within, the existing and projected constraints in capacity to operate the local planning system.

**Table VII.2: Recommended actions for strengthening control and enforcement systems**

| Recommended action | Reasons for implementation |
|---|---|
| Ensure the Standing Committee on Urban Planning, Urban Services and Development is approving building permits | • This is a statutory responsibility under the Local Government (Pourashava) Act, 2009.<br>• Building and planning permissions require the highest level of accountability possible, with ultimate responsibility held by democratically elected and accountable councillors |
| Ensure oversight roles for TLCC and WLCC | • Whilst decisions are rightly held by elected representatives additional measures to strengthen transparency and accountability should be considered.<br>• T/WLCC mechanisms have proved effective in introducing checks and balances in local governance.<br>• TLCC should play an oversight role. Each TLCC meeting should be presented with recommendations of applications.<br>• WLCC are, to some extent, the 'eyes and ears' of the pourashava and could play an important role in ensuring conformity to permissions and 'policing' unlawful development. |
| Introduce standardized records and reporting | • Currently there is neither consideration to the broader planning and environmental issues, nor a standardized approach to reviewing these issues, and reporting on them.<br>• A standardized checklist for review may be helpful in screening applications and focusing attention on any potential climate change considerations. This might range from commenting on the potential for rainwater harvesting on larger proposed developments to the localized impacts on drainage.<br>• Simple reporting standards will help support consistency in the consideration of applications and decision-making. |
| Introduce standardized forms | • Pourashavas follow a similar approach in recording, cataloguing and registering building permit applications, but there is variance between pourashavas.<br>• Building permit forms and information required differs between pourashava, and the permit itself is not standardized.<br>• It is part of a broader approach to supporting the development of a more efficient urban planning and enforcement system sub-regionally and nationally. |
| Introduce computerized records | • As coastal towns grow and the pressure of development intensifies, the computerization of records will support more efficient management and monitoring of the building permit/development control system.<br>• Future dividends could also arise from linking permit applications and approvals to GIS, and in the future to publicly accessible on-line information as access to computers increases. |
| Increase accessibility to, and transparency of, building permits granted | • The location and nature of applications for building permit should be routinely advertised at both the town level (most suitability outside the pourashava building as is currently done with the sign-boarding of the Citizens' Charter) and at the ward level through the use of, or introduction of, signboards.<br>• The register should be publicly accessible and the right of scrutiny advertised in the pourashava. |
| Ramp up public awareness activities on urban planning and building regulations | • Awareness campaigns are already practiced in the coastal towns pourashavas.<br>• The approaches adopted should be extended to building the understanding and appreciation of rules, the need for conformity to the master plan and the challenge of climate change.<br>• This should target all those involved in the building and construction process. |

| Recommended action | Reasons for implementation |
|---|---|
| Test incentives to encourage conformity to planning and building regulations | • Punitive enforcement measures and 'peer pressure' will go some way to ensuring master plan conformity and compliance with building rules. But additional measures to encourage compliance could also be tested.<br>• Full and verified conformity might include reduced fees (rebate), short holding tax 'holidays', awards and showcasing of outstanding design: most urban areas display a level of vernacular style and built-form plagiarism which at its best results in the copying of good examples (for example buildings that successfully integrate rainwater harvesting, or reduced construction and maintenance cost whilst increasing resilience).<br>• Incentives to informal sector home builders should also be considered (although outside the regulatory net, supporting the design and construction of climate resilient informal housing will help reduce damage and loss of property, and loss of life and illness resulting from climate events). |

## VII.4 Prioritizing and Programming Climate Resilient Infrastructure Investments

252. Land use master plans with medium to long-term horizons, whilst significant in setting a strategic framework for land use, are generally **reactive**: plans seek to control urban development through land use zoning levers and demarcate areas for new development. The speed of urban development often outstrips the ability of plans and planning to keep pace.

253. Whilst master plans do identify investment needs they are characterised by largely unstructured (in terms of priority and phasing), and unbudgeted lists of infrastructure needs. Often land and rights-of-way/reserve (roads, drainage and utilities) requirements are not geographically specified on land use plans. The usefulness of these plans in terms of **proactive** climate change resilience is therefore sub-optimal.

254. In the dynamic environment of urban change and development in Bangladesh, a means of identifying high priority strategic investments on a continual basis is needed: in the context of climate change those investments that best enhance urban resilience. There is a need to bridge the gap between the 'wish-list' of infrastructure needs and the reality of funding these from municipal finances (including the need to fund operating and maintenance of existing infrastructure assets) and potential for private financing.

**Table VII.3: Indicative Capital Investment Planning for Climate Change Resilience**

| Capital investment planning for climate change resilience | | |
|---|---|---|
| *What level of investment can your pourashava afford and sustain?* | *What investments does your pourashava need to make to enhance climate resilience?* | *What adaptation investments are agreed priorities and will be implemented?* |
| **Asses Municipal Finances and Asset Management** | **Identify and Prioritise Strategic Climate Change Adaptation Projects** | **Programme Climate Change Adaptation Projects** |
| **1 - Financial Assessment**<br>Local government revenues / expenditures / assets (cash)<br>Local government debt (outstanding loan value, annual interest, annual principal) | **4 - Project Identification (Structured List)**<br>Compile structured list of strategic projects based on master plans and supplementary strategies and plans (the 'wish lists') | **6 - Consolidation and finalisation of the investment package**<br>Stakeholder consultations<br>Investment programme (1 year to 3 years) |
| **2 - Asset Management Plan**<br>Inventory of municipal infrastructure and conditions analysis (i.e. good, reasonable, poor)<br>Operation and maintenance plan and budget | **5 - Project Prioritisation (Short List)**<br>Prioritise / score projects against criteria (purpose; desired impact – social, economic, environmental; implementation feasibility)<br>Match projects against the municipal budget (capital + recurrent costs)<br>Short-list of project (undertake detailed social and environmental screening and impact assessments as required) | |
| **3 - Investment Budget Forecast**<br>Recurrent revenue minus recurrent expenditure = net operating surplus/deficit + other sources = capital revenue | | |

255. Such planning instruments are generally referred to as 'capital investment plans'. The GOB / ADB Urban Governance Infrastructure Improvement Project (UGIIP) Pourashava Development Plans have presented one model of such investment plans as a multi-dimensional approach to plan formulation, and linking municipal financing to project identification.

256. The recently developed LGED framework for the development of a municipal level capital investment planning process (short to medium range rolling capital investment plans) - referred to as **Municipal Investment Plans -** provide a template that can, in principle, be adapted to climate change adaptation planning.[59] The generic guidelines are designed to:

- Complement and support the master plans by strengthening implementation of prioritised climate resilient infrastructure
- Adjust and adapt to specific economic, environmental and social conditions (which would include climate change in the coastal zone)
- Take long listed (master plan) investment projects through a prioritization and pre-feasibility screening
- Better select priority candidate projects in the context of local development priorities, and before full appraisal commences on larger strategic investments (capital investments that is relatively expensive, do not occur annually, will last a long time,

59 LGED (2012) 'Combined Urban Infrastructure Development Guidelines', prepared for the Local Government Engineering Department (Bangladesh) and World Bank review of the Municipal Services Project.

result in a fixed asset with recurrent operations and maintenance costs)

- Structure projects (the capacity to finance future capital projects and impact of projects on the local government budget), prioritise projects – against the vision, goals and objectives of the pourashava and programme projects – in a short-term capital investment plan (that is reviewed annually), typically 3 to 5 years and renewable annually.
- Link capital costs of new investment to asset (O&M) management (lifecycle costs)
- Adopt well-worn principles, methods and tools in participatory urban planning and management that have been under implementation for 20-years plus.

257. **Appendix 3** provides an indicative step-wise guide.[60]

[60] LGED (2012) 'Combined Urban Infrastructure Development Guidelines', prepared for the Local Government Engineering Department (Bangladesh) and World Bank review of the Municipal Services Project. The advantages of the guidelines are, in principle: (i) designed to be developed in a reasonable timeframe and with the full participation of the pourashava, (ii) builds on the most successful aspects of PDP development (such as visioning and the central involvement of the TLCC), and therefore builds on the practicability of planning in Bangladesh urban centers, (iii) provides a logical next step to acting on vulnerability and adaptation assessments as part of the capital investment plan (as opposed to requiring separate Municipal Adaptation Plans), (iv) provides prioritization methods that will allow for top-listing climate change resilience investments, (v) designed to be used on a continual process (reviewed annually, with substantial reviews every 3 to 5 years), (vi) supports the development of capacity of the pourashava for planned investment and preparation of pre-feasibility assessments, (vii) integrates an asset management approach that can be readily tied to DRM investments (condition assessments and O&M plans), (viii) provides straightforward methods for calculating the lifecycle costs of infrastructure options (based on capital investment, average lifespan, yearly depreciation and yearly maintenance) could readily be applied to identifying incremental costs of responding to climate change (the resilience increment), and (ix) has in-built assessment of capacity needs and financial resourcing.

## APPENDIX 1: ECONOMIC ANALYSIS SREADSHEETS

# 1. 1. Water Supply in Amtoli Paurashava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| **Sector:** | **Water Supply** | | | | | | | | | | | | |
| **Investigator(s):** | **Zhangir** | | | | | | | | | | | | |
| **Town:** | **Amtali** | | | | | | | | | | | | |
| **Project:** | **Water Supply for Town** | | | | | | | | | | | | |
| **Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries):** | **85% of the town population covered under piped water supply system** | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2,015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | **All figures are in million BDT** | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | None | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | **Time to fetch water** | 9.39 | 11.47 | 13.69 | 16.03 | 18.51 | 20.81 | 21.45 | 22.09 | 22.85 | 23.60 | 24.36 | 25.12 |
| Economic Variable 2: | **Cost of storage tanks including cleaning** | 15.00 | 3.33 | 3.54 | 3.75 | 3.96 | 3.67 | 1.03 | 1.02 | 1.21 | 1.21 | 1.21 | 1.21 |
| Economic Variable 3: | **Cost of water purification** | 4.23 | 4.44 | 4.65 | 4.86 | 5.07 | 5.22 | 5.38 | 5.53 | 5.68 | 5.84 | 5.99 | 6.14 |
| Economic Variable 4: | **Purchase costs of water** | 6.15 | 7.51 | 8.96 | 10.50 | 12.12 | 13.62 | 14.04 | 14.46 | 14.96 | 15.45 | 15.95 | 16.44 |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **34.8** | **26.8** | **30.8** | **35.1** | **39.7** | **43.3** | **41.9** | **43.1** | **44.7** | **46.1** | **47.5** | **48.9** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | **Time to fetch water** | 1.9 | 2.3 | 2.7 | 3.2 | 3.7 | 4.2 | 4.3 | 4.4 | 4.6 | 4.7 | 4.9 | 5.0 |
| Economic Variable 2: | **Cost of storage tanks including cleaning** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 3: | **Cost of water purification** | 3.2 | 3.2 | 3.3 | 3.3 | 3.4 | 3.3 | 3.4 | 3.5 | 3.6 | 3.7 | 3.8 | 3.9 |
| Economic Variable 4: | **Purchase costs of water** | 1.2 | 1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 2.8 | 2.9 | 3.0 | 3.1 | 3.2 | 3.3 |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **6.3** | **7.0** | **7.8** | **8.6** | **9.5** | **10.2** | **10.5** | **10.9** | **11.2** | **11.5** | **11.9** | **12.2** |
| **Vulnerability Impacts with Climate Change and Project** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | **Time to fetch water** | 9.4 | 11.5 | 13.7 | 0.0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Economic Variable 2: | **Cost of storage tanks including cleaning** | 15.0 | 3.3 | 3.5 | 0.0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Economic Variable 3: | **Cost of water purification** | 4.2 | 4.4 | 4.7 | 0.0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Economic Variable 4: | **Purchase costs of water** | 6.1 | 7.5 | 9.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **34.8** | **26.8** | **30.8** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | **Time to fetch water** | 0.0 | 0.0 | 0.0 | 16.0 | 18.5 | 20.8 | 21.4 | 22.1 | 22.8 | 23.6 | 24.4 | 25.1 |
| Economic Variable 2: | **Cost of storage tanks including cleaning** | 0.0 | 0.0 | 0.0 | 3.7 | 4.0 | 3.7 | 1.0 | 1.0 | 1.2 | 1.2 | 1.2 | 1.2 |
| Economic Variable 3: | **Cost of water purification** | 0.0 | 0.0 | 0.0 | 4.9 | 5.1 | 5.2 | 5.4 | 5.5 | 5.7 | 5.8 | 6.0 | 6.1 |
| Economic Variable 4: | **Purchase costs of water** | 0.0 | 0.0 | 0.0 | 10.5 | 12.1 | 13.6 | 14.0 | 14.5 | 15.0 | 15.5 | 15.9 | 16.4 |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **0.0** | **0.0** | **0.0** | **35.1** | **39.7** | **43.3** | **41.9** | **43.1** | **44.7** | **46.1** | **47.5** | **48.9** |
| | | 1000000 | | | | | | | | | | | |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 34.02 | BDT 68.03 | BDT 68.03 | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | | BDT 2.59 | BDT 2.59 | BDT 2.59 | BDT 2.59 | BDT 2.59 | BDT 2.59 | BDT 2.59 | BDT 2.59 | BDT 2.59 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT 38.34 | BDT 76.68 | BDT 76.68 | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | | BDT 5.02 | BDT 5.02 | BDT 5.02 | BDT 5.02 | BDT 5.02 | BDT 5.02 | BDT 5.02 | BDT 5.02 | BDT 5.02 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | BDT 4.32 | BDT 8.64 | BDT 8.64 | BDT 0.00 | BDT 0.00 | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **O & M Incremental Costs:** | | | | | BDT 2.43 | BDT 2.43 | BDT 2.43 | BDT 2.43 | BDT 2.43 | BDT 2.43 | BDT 2.43 | BDT 2.43 | BDT 2.43 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 38.34** | **-BDT 76.68** | **-BDT 76.68** | **BDT 30.12** | **BDT 34.64** | **BDT 38.30** | **BDT 36.87** | **BDT 38.07** | **BDT 39.68** | **BDT 41.08** | **BDT 42.49** | **BDT 43.89** |
| | | | | | | | | | | | | | |
| **Project without CC Net Economic Flows** | | -BDT 34.02 | -BDT 68.03 | -BDT 68.03 | BDT 23.92 | BDT 27.59 | BDT 30.49 | BDT 28.76 | BDT 29.65 | BDT 30.91 | BDT 31.96 | BDT 33.02 | BDT 34.08 |
| | | | | | | | | | | | | | |
| **Project ONLY CC Net Economic Flows** | | -BDT 4.32 | -BDT 8.64 | -BDT 8.64 | BDT 3.77 | BDT 4.62 | BDT 5.37 | BDT 5.68 | BDT 5.99 | BDT 6.34 | BDT 6.69 | BDT 7.04 | BDT 7.39 |

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| **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **2036** | **2037** | **2038** | **2039** | **2040** | **2041** | **2042** | **Total (Taka 2013)** | | | |
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| 25.87 | 26.63 | 27.38 | 28.39 | 29.40 | 30.40 | 31.41 | 32.41 | 33.41 | 34.42 | 35.42 | 36.42 | 37.41 | 38.44 | 39.49 | 40.56 | 41.67 | 798.51 | | | |
| 1.21 | 1.21 | 1.20 | 1.61 | 1.61 | 1.61 | 1.60 | 1.60 | 1.60 | 1.60 | 1.60 | 1.60 | 1.60 | 1.64 | 1.68 | 1.72 | 1.76 | 66.57 | | | |
| 6.29 | 6.45 | 6.60 | 6.80 | 7.00 | 7.20 | 7.39 | 7.59 | 7.79 | 7.99 | 8.19 | 8.39 | 8.59 | 8.79 | 9.00 | 9.21 | 9.43 | 195.74 | | | |
| 16.94 | 17.43 | 17.93 | 18.59 | 19.24 | 19.90 | 20.56 | 21.22 | 21.87 | 22.53 | 23.18 | 23.84 | 24.49 | 25.16 | 25.85 | 26.55 | 27.28 | 522.71 | | | |
| **50.3** | **51.7** | **53.1** | **55.4** | **57.2** | **59.1** | **61.0** | **62.8** | **64.7** | **66.5** | **68.4** | **70.2** | **72.1** | **74.0** | **76.0** | **78.0** | **80.1** | **1583.5** | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| 5.2 | 5.3 | 5.5 | 5.7 | 5.9 | 6.1 | 6.3 | 6.5 | 6.7 | 6.9 | 7.1 | 7.3 | 7.5 | 7.7 | 7.9 | 8.1 | 8.3 | 159.7 | | | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.6 | | | |
| 4.0 | 4.1 | 4.2 | 4.4 | 4.5 | 4.6 | 4.7 | 4.9 | 5.0 | 5.1 | 5.2 | 5.4 | 5.5 | 5.6 | 5.8 | 5.9 | 6.0 | 126.8 | | | |
| 3.4 | 3.5 | 3.6 | 3.7 | 3.8 | 4.0 | 4.1 | 4.2 | 4.4 | 4.5 | 4.6 | 4.8 | 4.9 | 5.0 | 5.2 | 5.3 | 5.5 | 104.5 | | | |
| **12.6** | **12.9** | **13.3** | **13.8** | **14.2** | **14.7** | **15.1** | **15.6** | **17.7** | **16.5** | **17.0** | **17.4** | **17.9** | **18.4** | **18.8** | **19.3** | **19.8** | **392.7** | | | |
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| | | | | | | | | | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 34.6 | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 21.9 | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13.3 | | | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 22.6 | | | |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **92.4** | | | |
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| | | | | | | | | | | | | | | | | | | | | |
| 25.9 | 26.6 | 27.4 | 28.4 | 29.4 | 30.4 | 31.4 | 32.4 | 33.4 | 34.4 | 35.4 | 36.4 | 37.4 | 38.4 | 39.5 | 40.6 | 41.7 | 764.0 | | | |
| 1.2 | 1.2 | 1.2 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.7 | 1.7 | 1.8 | 44.7 | | | |
| 6.3 | 6.4 | 6.6 | 6.8 | 7.0 | 7.2 | 7.4 | 7.6 | 7.8 | 8.0 | 8.2 | 8.4 | 8.6 | 8.8 | 9.0 | 9.2 | 9.4 | 182.4 | | | |
| 16.9 | 17.4 | 17.9 | 18.6 | 19.2 | 19.9 | 20.6 | 21.2 | 21.9 | 22.5 | 23.2 | 23.8 | 24.5 | 25.2 | 25.8 | 26.6 | 27.3 | 500.1 | | | |
| **50.3** | **51.7** | **53.1** | **55.4** | **57.2** | **59.1** | **61.0** | **62.8** | **64.7** | **66.5** | **68.4** | **70.2** | **72.1** | **74.0** | **76.0** | **78.0** | **80.1** | **1491.2** | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | BDT 170.09 | | | |
| BDT 2.59 | BDT 2.59 | BDT 2.59 | BDT 2.59 | BDT 2.59 | BDT 2.59 | BDT 2.59 | BDT 2.59 | BDT 2.59 | BDT 2.59 | BDT 2.59 | BDT 2.59 | BDT 2.59 | BDT 2.59 | BDT 2.59 | BDT 2.59 | BDT 2.59 | BDT 67.34 | | | |
| | | | | | | | | | | | | | | | | | BDT 237.43 | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | BDT 191.69 | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BDT 5.02 | BDT 5.02 | BDT 5.02 | BDT 5.02 | BDT 5.02 | BDT 5.02 | BDT 5.02 | BDT 5.02 | BDT 5.02 | BDT 5.02 | BDT 5.02 | BDT 5.02 | BDT 5.02 | BDT 5.02 | BDT 5.02 | BDT 5.02 | BDT 5.02 | BDT 130.52 | | | |
| | | | | | | | | | | | | | | | | | BDT 322.21 | | | |
| | | | | | | | | | | | | | | | | | | Figures are in Millions: | | |
| | | | | | | | | | | | | | | | | | BDT 21.61 | | TK:USD: | 0.01285 |
| BDT 2.43 | BDT 2.43 | BDT 2.43 | BDT 2.43 | BDT 2.43 | BDT 2.43 | BDT 2.43 | BDT 2.43 | BDT 2.43 | BDT 2.43 | BDT 2.43 | BDT 2.43 | BDT 2.43 | BDT 2.43 | BDT 2.43 | BDT 2.43 | BDT 2.43 | BDT 63.18 | **EIRR** | **NPV (3%)** | **NPV(3%) in USD** |
| | | | | | | | | | | | | | | | | | BDT 84.79 | | | |
| **BDT 45.29** | **BDT 46.69** | **BDT 48.09** | **BDT 50.36** | **BDT 52.23** | **BDT 54.09** | **BDT 55.95** | **BDT 57.80** | **BDT 59.66** | **BDT 61.52** | **BDT 63.37** | **BDT 65.22** | **BDT 67.07** | **BDT 69.01** | **BDT 70.99** | **BDT 73.03** | **BDT 75.12** | **BDT 1,168.94** | **18%** | **BDT 630.94** | **$8.11** |
| | | | | | | | | | | | | | | | | | | | | |
| BDT 35.13 | BDT 36.18 | BDT 37.23 | BDT 39.04 | BDT 40.45 | BDT 41.85 | BDT 43.25 | BDT 44.64 | BDT 44.44 | BDT 47.44 | BDT 48.83 | BDT 50.23 | BDT 51.62 | BDT 53.09 | BDT 54.59 | BDT 56.13 | BDT 57.71 | BDT 882.14 | **16%** | **BDT 468.66** | **$6.02** |
| | | | | | | | | | | | | | | | | | | | | |
| BDT 7.73 | BDT 8.08 | BDT 8.43 | BDT 8.89 | BDT 9.35 | BDT 9.81 | BDT 10.27 | BDT 10.73 | BDT 12.79 | BDT 11.65 | BDT 12.11 | BDT 12.57 | BDT 13.02 | BDT 13.49 | BDT 13.97 | BDT 14.47 | BDT 14.97 | BDT 223.62 | **23%** | **BDT 122.53** | **$1.57** |

| | |
|---|---|
| | **Assumptions: (with CCR)** |
| 1 | Time to fetch water has been assessed based on the SEWTP report timing of 18 minutes per HH |
| 2 | Cost of storage Tanks considered @ 8200 BDT as per SEWTP report for HHs shifting to piped water supply |
| 3 | Cost of purification - BDT 119 per month per HH as per SEWTP report - for 50% of HHs |
| 4 | Purchase of water @ 100 BDT per KL - 20% used for drinking purpose |
| | |
| | **Assumptions: (without CCR)** |
| 1 | Time to fetch water has been assessed based on the SEWTP report timing of 18 minutes per HH - **20% less vulnerability loss reduction as compared with CCR scenario** |
| 2 | Cost of storage Tanks considered @ 8200 BDT as per SEWTP report for HHs shifting to piped water supply - **No Change** |
| 3 | Cost of purification - BDT 119 per month per HH as per SEWTP report - for 50% of HHs **20% less vulnerability loss reduction as compared with CCR scenario** |
| 4 | Purchase of water @ 100 BDT per KL - 20% used for drinking purpose **- 20% less vulnerability loss reduction as compared with CCR scenario** |
| | |
| | **Common to both** |
| 1 | Capex with CCR and without CCR as per technical team estimate |
| 2 | Opex with CCR and without CCR as per technical team estimate |
| | |

## 1.2. Sanitation in Amtoli Paurashava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Sanitation | | | | | | | | | | | | |
| Investigator(s): | Zhangir | | | | | | | | | | | | |
| Town: | Amtali | | | | | | | | | | | | |
| Project: | Sanitation for Town | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | part of town | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Variable 1: | | | | | | | | | | | | | |
| Economic Variable 2: | | | | | | | | | | | | | |
| Economic Variable 3: | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 1.2 | 1.2 | 1.2 | 1.2 | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 | 1.4 | 1.4 | 1.4 |
| Economic Variable 2: | Saved Medical Cost | 1.8 | 1.8 | 1.9 | 1.9 | 1.9 | 2.0 | 2.0 | 2.1 | 2.1 | 2.2 | 2.2 | 2.2 |
| Economic Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **3.0** | **3.0** | **3.1** | **3.1** | **3.2** | **3.3** | **3.3** | **3.4** | **3.5** | **3.5** | **3.6** | **3.7** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Vulnerability 1: (e.g. road damage owing to floods) | | | | | | | | | | | | | |
| Economic Vulnerability 2: | | | | | | | | | | | | | |
| Economic Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 0.17 | 0.18 | 0.18 | 0.18 | 0.19 | 0.19 | 0.20 | 0.20 | 0.20 | 0.21 | 0.21 | 0.22 |
| Economic Variable 2: | Saved Medical Cost | 0.27 | 0.28 | 0.28 | 0.29 | 0.29 | 0.30 | 0.30 | 0.31 | 0.32 | 0.32 | 0.33 | 0.34 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **0.44** | **0.45** | **0.46** | **0.47** | **0.48** | **0.49** | **0.50** | **0.51** | **0.52** | **0.53** | **0.54** | **0.55** |
| **Vulnerability Impacts with Climate Change and Project** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 1.2 | 1.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 2: | Saved Medical Cost | 1.8 | 1.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **3.0** | **3.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 0.0 | 0.0 | 1.2 | 1.2 | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 | 1.4 | 1.4 | 1.4 |
| Economic Variable 2: | Saved Medical Cost | 0.0 | 0.0 | 1.9 | 1.9 | 1.9 | 2.0 | 2.0 | 2.1 | 2.1 | 2.2 | 2.2 | 2.2 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **0.0** | **0.0** | **3.1** | **3.1** | **3.2** | **3.3** | **3.3** | **3.4** | **3.5** | **3.5** | **3.6** | **3.7** |
| | | 1000000 | | | | | | | | | | | |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 6.24 | BDT 4.16 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | BDT 0.47 | BDT | BDT | BDT | BDT | BDT | BDT | BDT | BDT | BDT |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 | 0.47 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT 6.64 | BDT 4.42 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | BDT 0.40 | BDT 0.26 | BDT 0.00 | BDT 0.00 | BDT 0.00 | | | | | | | |
| **O & M Incremental Costs:** | | | | | BDT 0.09 | BDT 0.09 | BDT 0.09 | BDT 0.09 | BDT 0.09 | BDT 0.09 | BDT 0.09 | BDT 0.09 | BDT 0.09 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 6.64** | **-BDT 4.42** | **BDT 2.53** | **BDT 2.59** | **BDT 2.65** | **BDT 2.72** | **BDT 2.78** | **BDT 2.85** | **BDT 2.92** | **BDT 2.99** | **BDT 3.06** | **BDT 3.13** |
| | | | | | | | | | | | | | |
| **Project without CC Net Economic Flows** | | -BDT 6.24 | -BDT 4.16 | BDT 2.15 | BDT 2.20 | BDT 2.26 | BDT 2.31 | BDT 2.37 | BDT 2.42 | BDT 2.48 | BDT 2.54 | BDT 2.60 | BDT 2.66 |
| | | | | | | | | | | | | | |
| **Project ONLY CC Net Economic Flows** | | -BDT 0.40 | -BDT 0.26 | BDT 0.38 | BDT 0.30 | BDT 0.31 | BDT 0.32 | BDT 0.33 | BDT 0.34 | BDT 0.35 | BDT 0.36 | BDT 0.37 | BDT 0.38 |

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| **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **Total (Taka 2013)** |
| | | | | | | | | | | |
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| | | | | | | | | | | |
| | | | | | | | | | | |
| 1.5 | 1.5 | 1.5 | 1.6 | 1.6 | 1.6 | 1.7 | 1.7 | 1.7 | 1.8 | BDT 31.7 |
| 2.3 | 2.3 | 2.4 | 2.4 | 2.5 | 2.5 | 2.6 | 2.6 | 2.7 | 2.7 | BDT 49.1 |
| | | | | | | | | | | |
| **3.8** | **3.8** | **3.9** | **4.0** | **4.1** | **4.1** | **4.2** | **4.3** | **4.4** | **4.5** | **80.8** |
| | | | | | | | | | | |
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| | | | | | | | | | | |
| 0.22 | 0.23 | 0.23 | 0.23 | 0.24 | 0.24 | 0.25 | 0.25 | 0.26 | 0.26 | BDT 4.8 |
| 0.34 | 0.35 | 0.36 | 0.36 | 0.37 | 0.38 | 0.39 | 0.39 | 0.40 | 0.41 | BDT 7.4 |
| | | | | | | | | | | |
| **0.56** | **0.57** | **0.59** | **0.60** | **0.61** | **0.62** | **0.63** | **0.65** | **0.66** | **0.67** | **12.12** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 2.3 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 3.6 |
| | | | | | | | | | | 0 |
| | | | | | | | | | | 0.0 |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **6.0** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 1.5 | 1.5 | 1.5 | 1.6 | 1.6 | 1.6 | 1.7 | 1.7 | 1.7 | 1.8 | BDT 29.3 |
| 2.3 | 2.3 | 2.4 | 2.4 | 2.5 | 2.5 | 2.6 | 2.6 | 2.7 | 2.7 | BDT 45.5 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | | | | | | |
| **3.8** | **3.8** | **3.9** | **4.0** | **4.1** | **4.1** | **4.2** | **4.3** | **4.4** | **4.5** | **74.9** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 10.40 |
| BDT 0.47 | BDT 0.47 | BDT 0.47 | BDT 0.47 | BDT 0.47 | BDT 0.47 | BDT 0.47 | BDT 0.47 | BDT 0.47 | BDT 0.47 | BDT 9.36 |
| | | | | | | | | | | BDT 19.76 |
| | | | | | | | | | | |
| | | | | | BDT 0.00 | | | | | BDT 11.06 |
| BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 11.06 |
| | | | | | | | | | | BDT 22.12 |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 0.66 |
| BDT 0.09 | BDT 0.09 | BDT 0.09 | BDT 0.09 | BDT 0.09 | BDT 0.09 | BDT 0.09 | BDT 0.09 | BDT 0.09 | BDT 0.09 | BDT 1.62 |
| | | | | | | | | | | BDT 2.28 |
| **BDT 3.20** | **BDT 3.28** | **BDT 3.35** | **BDT 3.43** | **BDT 3.51** | **BDT 3.59** | **BDT 3.68** | **BDT 3.76** | **BDT 3.85** | **BDT 3.93** | 22% |
| | | | | | | | | | | |
| BDT 2.72 | BDT 2.79 | BDT 2.85 | BDT 2.92 | BDT 2.99 | BDT 3.06 | BDT 3.13 | BDT 3.20 | BDT 3.27 | BDT 3.35 | 20% |
| | | | | | | | | | | |
| BDT 0.39 | BDT 0.40 | BDT 0.42 | BDT 0.43 | BDT 0.44 | BDT 0.45 | BDT 0.46 | BDT 0.48 | BDT 0.49 | BDT 0.50 | 41% |

| | |
|---|---|
| | **Assumptions for With CCR** |
| 1 | Saved Income Loss - HH monthly income - BDT 13,841, days lost due to sickness - 2.5 days considered as per SEWTP report |
| 2 | Saved Medical Cost - HH monthly expenditure on health - BDT 1097 considered as per SEWTP report @ 30% for sanitation |
| | |
| | **Assumptions for Without CCR** |
| 1 | Saved Income Loss - HH monthly income - BDT 13,841, days lost due to sickness - 2.5 days considered as per SEWTP report - NO Change |
| 2 | Saved Medical Cost - HH monthly expenditure on health - BDT 1097 considered as per SEWTP report @ 30% for sanitation - **15% less vulnerability loss reduction as compared with CCR scenario** |
| | |
| | **Common to both** |
| 1 | Capex with CCR and without CCR as per technical team estimate |
| 2 | Opex with CCR and without CCR as per technical team estimate |
| | |

## 1.3. Drainage and Flood control in Amtoli Pauroshava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Drainage and Flood Control | | | | | | | | | | | | |
| Investigator(s): | Muhibullah / Paul Dean | | | | | | | | | | | | |
| Town: | Mathbaria | | | | | | | | | | | | |
| Project: | Drainage and Flood Control for Town | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Whole town | | | | | | | | | | | | |
| | **Year** | **Year** | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. road damage owing to floods) | Property Damage | 13.5 | 13.8 | 14.0 | 14.3 | 14.6 | 14.9 | 15.2 | 15.5 | 15.8 | 16.1 | 16.5 | 16.8 |
| Vulnerability 2: | Property Repair | 0.8 | 0.8 | 0.8 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 1.0 | 1.0 | 1.0 |
| | Property Clean Up | 4.7 | 4.8 | 4.9 | 5.0 | 5.1 | 5.2 | 5.3 | 5.4 | 5.5 | 5.6 | 5.8 | 5.9 |
| Vulnerability 3: etc…. | Road Damage / Repair | 1.0 | 1.0 | 1.0 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | 1.2 |
| | Agriculture Loss | 1.9 | 2.0 | 2.0 | 2.1 | 2.1 | 2.1 | 2.2 | 2.2 | 2.3 | 2.3 | 2.4 | 2.4 |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. economic damage due to delays, congestion, road closure) | Loss of Income due to sick days | 1.6 | 1.6 | 1.6 | 1.6 | 1.7 | 1.7 | 1.7 | 1.8 | 1.8 | 1.9 | 1.9 | 1.9 |
| Vulnerability 2: (e.g. extra maintenance/repair costs w.o. investment) | Loss of business income | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |
| Vulnerability 3: etc. | Medical Cost | 0.3 | 0.3 | 0.3 | 0.3 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **24.6** | **25.1** | **25.6** | **26.1** | **26.6** | **27.2** | **27.7** | **28.3** | **28.8** | **29.4** | **30.0** | **30.6** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. road damage owing to floods) | Property Damage | 3.4 | 3.5 | 3.5 | 3.6 | 3.7 | 3.8 | 3.8 | 3.9 | 4.0 | 4.1 | 4.2 | 4.2 |
| Vulnerability 2: | Property Repair | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.3 |
| | Property Clean Up | 1.2 | 1.2 | 1.2 | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 | 1.4 | 1.4 | 1.4 | 1.5 |
| Vulnerability 3: etc…. | Road Damage / Repair | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| | Agriculture Loss | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. economic damage due to delays, congestion, road closure) | Loss of Income due to sick days | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Vulnerability 2: (e.g. extra maintenance/repair costs w.o. investment) | Loss of business income | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Vulnerability 3: etc. | Medical Cost | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **5.0** | **5.1** | **5.2** | **5.3** | **5.4** | **5.5** | **5.6** | **5.7** | **5.9** | **6.0** | **6.1** | **6.2** |
| **Vulnerability Impacts with Project with CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. road damage owing to floods) | Property Damage | 13.5 | 13.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 2: | Property Repair | 0.8 | 0.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Property Clean Up | 4.7 | 4.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 3: etc…. | Road Damage / Repair | 1.0 | 1.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Agriculture Loss | 1.9 | 2.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. economic damage due to delays, congestion, road closure) | Loss of Income due to sick days | 1.6 | 1.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 2: (e.g. extra maintenance/repair costs w.o. investment) | Loss of business income | 0.8 | 0.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 3: etc. | Medical Cost | 0.3 | 0.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **24.6** | **25.1** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Impact of Project on Reduced Vulnerability** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced costs of road damage owing to floods) | Property Damage | 0.0 | 0.0 | 14.0 | 14.3 | 14.6 | 14.9 | 15.2 | 15.5 | 15.8 | 16.1 | 16.5 | 16.8 |
| Vulnerability 2: | Property Repair | 0.0 | 0.0 | 0.8 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 1.0 | 1.0 | 1.0 |
| Vulnerability 3: etc…. | Property Clean Up | 0.0 | 0.0 | 4.9 | 5.0 | 5.1 | 5.2 | 5.3 | 5.4 | 5.5 | 5.6 | 5.8 | 5.9 |
| | Road Damage / Repair | 0.0 | 0.0 | 1.0 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | 1.2 |
| | Agriculture Loss | 0.0 | 0.0 | 2.0 | 2.1 | 2.1 | 2.1 | 2.2 | 2.2 | 2.3 | 2.3 | 2.4 | 2.4 |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced economic damage due to delays, congestion, road closure) | Loss of Income due to sick days | 0.0 | 0.0 | 1.6 | 1.6 | 1.7 | 1.7 | 1.7 | 1.8 | 1.8 | 1.9 | 1.9 | 1.9 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vulnerability 2: (e.g. reduced extra maintenance/repair costs versus w.o. investment) | Loss of business income | 0.0 | 0.0 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |
| Vulnerability 3: etc. | Medical Cost | 0.0 | 0.0 | 0.3 | 0.3 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| **Annual Total Reduced Damage/Loss/Extra Costs:** | | **0.0** | **0.0** | **25.6** | **26.1** | **26.6** | **27.2** | **27.7** | **28.3** | **28.8** | **29.4** | **30.0** | **30.6** |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 42.47 | BDT 28.31 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | BDT 0.35 | BDT 0.35 | BDT 0.35 | BDT 0.35 | BDT 0.35 | BDT 0.35 | BDT 0.35 | BDT 0.35 | BDT 0.59 | BDT 0.59 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT 52.63 | BDT 35.09 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | BDT 0.43 | BDT 0.43 | BDT 0.43 | BDT 0.43 | BDT 0.43 | BDT 0.43 | BDT 0.43 | BDT 0.43 | BDT 0.75 | BDT 0.75 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | BDT 10.16 | BDT 6.77 | | | | | | | | | | |
| **O & M Incremental Costs:** | | | | BDT 0.08 | BDT 0.08 | BDT 0.08 | BDT 0.08 | BDT 0.08 | BDT 0.08 | BDT 0.08 | BDT 0.08 | BDT 0.16 | BDT 0.16 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 52.63** | **-BDT 35.09** | **BDT 25.17** | **BDT 25.68** | **BDT 26.20** | **BDT 26.74** | **BDT 27.28** | **BDT 27.84** | **BDT 28.40** | **BDT 28.98** | **BDT 29.25** | **BDT 29.85** |
| | | | | | | | | | | | | | |
| **Project without CC Net Economic Flows** | | -BDT 42.47 | -BDT 28.31 | BDT 20.05 | BDT 20.46 | BDT 20.88 | BDT 21.30 | BDT 21.73 | BDT 22.18 | BDT 22.63 | BDT 23.09 | BDT 23.31 | BDT 23.79 |
| | | | | | | | | | | | | | |
| **Project ONLY CC Net Economic Flows** | | -BDT 10.16 | -BDT 6.77 | BDT 5.12 | BDT 5.22 | BDT 5.33 | BDT 5.44 | BDT 5.55 | BDT 5.66 | BDT 5.77 | BDT 5.89 | BDT 5.93 | BDT 6.05 |

| 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | Total (Taka 2013) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | | | | | | |
| 17.1 | 17.5 | 17.8 | 18.2 | 18.5 | 18.9 | 19.3 | 19.7 | 20.1 | 20.5 | 368.4 |
| 1.0 | 1.0 | 1.1 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | 1.2 | 22.1 |
| 6.0 | 6.1 | 6.2 | 6.4 | 6.5 | 6.6 | 6.7 | 6.9 | 7.0 | 7.2 | 129.0 |
| 1.3 | 1.3 | 1.3 | 1.3 | 1.4 | 1.4 | 1.4 | 1.5 | 1.5 | 1.5 | 27.3 |
| 2.5 | 2.5 | 2.6 | 2.6 | 2.7 | 2.7 | 2.8 | 2.8 | 2.9 | 2.9 | 53.1 |
| | | | | | | | | | | |
| 2.0 | 2.0 | 2.0 | 2.1 | 2.1 | 2.2 | 2.2 | 2.3 | 2.3 | 2.4 | 42.4 |
| 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 20.6 |
| 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 8.8 |
| **31.2** | **31.8** | **32.5** | **33.1** | **33.8** | **34.5** | **35.1** | **35.8** | **36.6** | **37.3** | **671.7** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.8 | 4.9 | 5.0 | 5.1 | 5.2 | 93.1 |
| 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 5.6 |
| 1.5 | 1.5 | 1.6 | 1.6 | 1.6 | 1.7 | 1.7 | 1.7 | 1.8 | 1.8 | 32.3 |
| 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 5.5 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | | | | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **6.3** | **6.5** | **6.6** | **6.7** | **6.9** | **7.0** | **7.1** | **7.3** | **7.4** | **7.6** | **136.5** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27.3 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.6 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9.5 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.9 |
| | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.1 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.5 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.7 |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **49.7** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 17.1 | 17.5 | 17.8 | 18.2 | 18.5 | 18.9 | 19.3 | 19.7 | 20.1 | 20.5 | 341.2 |
| 1.0 | 1.0 | 1.1 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | 1.2 | 20.5 |
| 6.0 | 6.1 | 6.2 | 6.4 | 6.5 | 6.6 | 6.7 | 6.9 | 7.0 | 7.2 | 119.5 |
| 1.3 | 1.3 | 1.3 | 1.3 | 1.4 | 1.4 | 1.4 | 1.5 | 1.5 | 1.5 | 25.3 |
| 2.5 | 2.5 | 2.6 | 2.6 | 2.7 | 2.7 | 2.8 | 2.8 | 2.9 | 2.9 | 49.2 |
| | | | | | | | | | | |
| 2.0 | 2.0 | 2.0 | 2.1 | 2.1 | 2.2 | 2.2 | 2.3 | 2.3 | 2.4 | 39.2 |
| 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 19.1 |
| 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 8.2 |
| **31.2** | **31.8** | **32.5** | **33.1** | **33.8** | **34.5** | **35.1** | **35.8** | **36.6** | **37.3** | **622.0** |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 70.79 |
| BDT 0.59 | BDT 0.59 | BDT 0.59 | BDT 0.59 | BDT 0.59 | BDT 0.59 | BDT 0.59 | BDT 0.59 | BDT 0.59 | BDT 0.59 | BDT 9.81 |
| | | | | | | | | | | BDT 80.60 |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 87.72 |
| BDT 0.75 | BDT 0.75 | BDT 0.75 | BDT 0.75 | BDT 0.75 | BDT 0.75 | BDT 0.75 | BDT 0.75 | BDT 0.75 | BDT 0.75 | BDT 12.43 |
| | | | | | | | | | | BDT 100.16 |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 16.94 |
| BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 2.62 |
| | | | | | | | | | | BDT 19.56 |
| **BDT 30.46** | **BDT 31.08** | **BDT 31.72** | **BDT 32.37** | **BDT 33.03** | **BDT 33.70** | **BDT 34.39** | **BDT 35.10** | **BDT 35.81** | **BDT 36.55** | **26%** |
| | | | | | | | | | | |
| BDT 24.28 | BDT 24.78 | BDT 25.29 | BDT 25.80 | BDT 26.33 | BDT 26.87 | BDT 27.42 | BDT 27.98 | BDT 28.55 | BDT 29.13 | **26%** |
| | | | | | | | | | | |
| BDT 6.18 | BDT 6.30 | BDT 6.43 | BDT 6.56 | BDT 6.70 | BDT 6.84 | BDT 6.98 | BDT 7.12 | BDT 7.26 | BDT 7.41 | **28%** |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Assumptions and workings for with CCR** | | | | | | | | | |
| | | **Source of Data / Assumption** | | | | | Unit | Total | | |
| | | | | | Affected as per SEWTP | | Repair / Damage Cost | | | |
| 1 | Number of properties | Drainage Team and SEWTP report | Number | 4251 | 20.60% | 876 | | 19.0 | | |
| 2 | Loss of Income | | BDT Million | | | | | 2.3 | | |
| | Number of Households | Drainage Team and SEWTP | Number | 3787 | 59.70% | 432 | | | | |
| | Number of days of flooding | SEWTP report | Days | | | 11.4 | | | | |
| | Household Income | SEWTP report | BDT | | | 13841 | 5260 | | | |
| | Average Household Expenditure on Health | SEWTP report | BDT | | | 1097 | | | | |
| 3 | Saved Medical Cost | | | | | | | 0.2 | | |
| 4 | Loss of Business Income | | | | | | | 0.8 | | |
| | Average monthly expenditure | SEWTP report | BDT | | | 9606 | 2555 | | | |
| 5 | Agricultural Loss | Drainage Team | Acre | | 74.11067194 | | | | | |
| | Average Yield per acre | Drainage Team | tonne | | 1.5 | | | | | |
| | Average support price | Drainage Team | BDT / Tonne | | 17500 | | | | | |
| | Agricultural Loss | | BDT Million | | | | | 1.9 | | |
| 6 | Road Damage | Drainage Team | Kilometre | | 2.5 | | | | | |
| | Repair cost | Drainage Team | BDT/Kilometre | | 0.4 | | | | | |
| | Road Damage Cost | | | | | | | 1.0 | | |
| | | | | | | | | | | |
| | **Assessment of Repair / Damage Cost** | Drainage Team | | | | | | | | |
| | Depth | Comm'l | Public | Katcha | Pakka | Semi Pakka | | | | |
| | < 0.25m inundation | 36 | 19 | 146 | 14 | 54 | 269 | 46% | 876 | 404 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | > 0.25 m inundation | 41 | 22 | 171 | 16 | 64 | 314 | 54% | | 472 |
| | Total | 77 | 41 | 317 | 30 | 118 | 583 | | | |
| | | | | | | | | | | |
| | < 0.25m inundation | 54 | 29 | 219 | 21 | 81 | 404 | | | |
| | > 0.25 m inundation | 62 | 33 | 257 | 24 | 96 | 472 | | | |
| | | | | | | | 876 | | | |
| | | Commercial | Public | Katcha | Pakka | Semi Pakka | | | | |
| | Averagae Area in Sq m | 93 | 46 | 9 | 70 | 28 | | | | |
| | Total Area Waterlogged in sq m | 5019 | 1348 | 2036 | 1464 | 2259 | 12125 | | | |
| | Total Area inundated in sq m | 5763 | 1534 | 2389 | 1673 | 2677 | 14036 | | | |
| | | | | | | | 26161 | | | |
| | Constuction cost | **CDTA Report** | | | | | | | | |
| | BDT/sq m | 21516.8 | 21516.8 | 12910.08 | 21516.8 | 17213.44 | | | source CDTA reports | |
| | Repair Cost @ 6% | **CDTA Report** | | | | | | | source CDTA reports | |
| | BDT/sq m | 1291.008 | 1291.008 | 774.6048 | 1291.008 | 1032.8064 | | | | |
| | Clean Up cost | **CDTA Report** | | | | | | | | |
| | BDT/property | 15000 | 12000 | 2000 | 9000 | 5000 | | | source CDTA reports | |
| | | | | | | | BDT Million | | | |
| | Damage Cost | 6.2 | 1.65 | 1.542 | 1.8 | 2.304 | 13.496 | | | |
| | Repair Cost | 0.372 | 0.099 | 0.09252 | 0.108 | 0.13824 | 0.80976 | | | |
| | Clean up cost | 1.74 | 0.744 | 0.952 | 0.405 | 0.885 | 4.726 | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | **For Without CCR scenario** | | | | | | | | | |
| | | | | | | | | | | |
| | **Stock damages for properties - 25% less vulnerability loss reduction as compared with CCR scenario** | | | | | | | | | |
| | **Rest same - No change** | | | | | | | | | |
| | | | | | | | | | | |
| | **Common to both** | | | | | | | | | |
| 1 | Capex with CCR and without CCR as per technical team estimate | | | | | | | | | |
| 2 | Opex with CCR and without CCR as per technical team estimate | | | | | | | | | |

# 1.4. Solid waste in Amtoli Paurashava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Solid Waste | | | | | | | | | | | | |
| Investigator(s): | Nesar | | | | | | | | | | | | |
| Town: | Amtali | | | | | | | | | | | | |
| Project: | Solid Waste | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Full Town | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. road damage owing to floods) | | | | | | | | | | | | | |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. economic damage due to delays, congestion, road closure) | Time Savings | 1.5 | 1.6 | 1.6 | 1.6 | 1.7 | 1.7 | 1.7 | 1.8 | 1.8 | 1.8 | 1.9 | 1.9 |
| Vulnerability 2: (e.g. extra maintenance/repair costs w.o. investment) | Saved Medical Cost | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **1.8** | **1.8** | **1.8** | **1.9** | **1.9** | **1.9** | **2.0** | **2.0** | **2.1** | **2.1** | **2.1** | **2.2** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced costs of road damage owing to floods) | | | | | | | | | | | | | |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced economic damage due to delays, congestion, road closure) | Time Savings | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.5 | 0.5 | 0.5 |
| Vulnerability 2: (e.g. reduced extra maintenance/repair costs versus w.o. investment) | Saved Medical Cost | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss/Extra Costs:** | | **0.4** | **0.4** | **0.5** | **0.5** | **0.5** | **0.5** | **0.5** | **0.5** | **0.5** | **0.5** | **0.5** | **0.5** |
| **Vulnerability Impacts with Project with CC resilient measures** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced costs of road damage owing to floods) | | | | | | | | | | | | | |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced economic damage due to delays, congestion, road closure) | Time Savings | 1.5 | 1.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Vulnerability 2: (e.g. reduced extra maintenance/repair costs versus w.o. investment) | Saved Medical Cost | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss/Extra Costs:** | | **1.8** | **1.8** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Impact of Project on Reduced Vulnerability** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced costs of road damage owing to floods) | | | | | | | | | | | | | |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced economic damage due to delays, congestion, road closure) | Time Savings | 0.0 | 0.0 | 1.6 | 1.6 | 1.7 | 1.7 | 1.7 | 1.8 | 1.8 | 1.8 | 1.9 | 1.9 |
| Vulnerability 2: (e.g. reduced extra maintenance/repair costs versus w.o. investment) | Saved Medical Cost | 0.0 | 0.0 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss/Extra Costs:** | | **0.0** | **0.0** | **1.8** | **1.9** | **1.9** | **1.9** | **2.0** | **2.0** | **2.1** | **2.1** | **2.1** | **2.2** |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 4.48 | BDT 2.99 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT 4.91 | BDT 3.27 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | BDT 0.43 | BDT 0.29 | | | | | | | | | | |
| **O & M Incremental Costs:** | | | | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 4.91** | **-BDT 3.27** | **BDT 1.33** | **BDT 1.36** | **BDT 1.40** | **BDT 1.44** | **BDT 1.48** | **BDT 1.52** | **BDT 1.56** | **BDT 1.60** | **BDT 1.64** | **BDT 1.68** |
| | | | | | | | | | | | | | |
| **Project without CC Net Economic Flows** | | -BDT 4.48 | -BDT 2.99 | BDT 1.03 | BDT 1.06 | BDT 1.08 | BDT 1.11 | BDT 1.14 | BDT 1.17 | BDT 1.20 | BDT 1.23 | BDT 1.26 | BDT 1.30 |
| | | | | | | | | | | | | | |
| **Project ONLY CC Net Economic Flows** | | -BDT 0.43 | -BDT 0.29 | BDT 0.14 | BDT 0.15 | BDT 0.16 | BDT 0.17 | BDT 0.18 | BDT 0.19 | BDT 0.20 | BDT 0.21 | BDT 0.22 | BDT 0.23 |

| 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | Total (Taka 2013) |
|---|---|---|---|---|---|---|---|---|---|---|
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| 1.9 | 2.0 | 2.0 | 2.1 | 2.1 | 2.1 | 2.2 | 2.2 | 2.3 | 2.3 | 42 |
| 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 6 |
| | | | | | | | | | | |
| **2.2** | **2.3** | **2.3** | **2.4** | **2.4** | **2.5** | **2.5** | **2.6** | **2.6** | **2.7** | **47.9** |
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| 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.6 | 0.6 | 0.6 | 10 |
| 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 2 |
| | | | | | | | | | | |
| **0.6** | **0.6** | **0.6** | **0.6** | **0.6** | **0.6** | **0.6** | **0.6** | **0.7** | **0.7** | **12.0** |
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| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| | | | | | | | | | | |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **3.5** |
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| | | | | | | | | | | |
| 1.9 | 2.0 | 2.0 | 2.1 | 2.1 | 2.1 | 2.2 | 2.2 | 2.3 | 2.3 | 39 |
| 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 6 |

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|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| **2.2** | **2.3** | **2.3** | **2.4** | **2.4** | **2.5** | **2.5** | **2.6** | **2.6** | **2.7** | **44.4** |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 7.47 |
| BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 6.82 |
| | | | | | | | | | | BDT 14.29 |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 8.19 |
| BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 9.96 |
| | | | | | | | | | | BDT 18.15 |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 0.72 |
| BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 3.14 |
| | | | | | | | | | | BDT 3.86 |
| **BDT 1.73** | **BDT 1.77** | **BDT 1.82** | **BDT 1.86** | **BDT 1.91** | **BDT 1.96** | **BDT 2.01** | **BDT 2.06** | **BDT 2.11** | **BDT 2.16** | **16.2%** |
| | | | | | | | | | | |
| BDT 1.33 | BDT 1.36 | BDT 1.40 | BDT 1.43 | BDT 1.47 | BDT 1.50 | BDT 1.54 | BDT 1.58 | BDT 1.61 | BDT 1.65 | **13.7%** |
| | | | | | | | | | | |
| BDT 0.24 | BDT 0.25 | BDT 0.26 | BDT 0.28 | BDT 0.29 | BDT 0.30 | BDT 0.31 | BDT 0.32 | BDT 0.34 | BDT 0.35 | **22.1%** |
| | | | | | | | | | | |

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|---|---|
| | **Assumptions and workings** |
| | |
| 1 | **Assumptions for With CCR** |
| | Saved Income Loss - HH monthly income - BDT 13,841 as per SEWTP report, Time savings - 1 minute per day considered |
| | Saved Medical Cost - HH monthly expenditure on health - BDT 1097 considered as per SEWTP report @ 5% for solid waste |
| | |
| 2 | **Assumptions for Without CCR** |
| | Number of households - **25% less vulnerability loss reduction as compared with CCR scenario** |
| | |
| | |
| 3 | **Common to both** |
| | Capex with CCR and without CCR as per technical team estimate |
| | Opex with CCR and without CCR as per technical team estimate |

## 1.5. Roads in Amtoli Paurashava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Roads | | | | | | | | | | | | |
| Investigator(s): | Nesar | | | | | | | | | | | | |
| Town: | Amtali | | | | | | | | | | | | |
| Project: | Roads and Bridges (12.19 kilometers of Road ) | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Refer Location Map and list of roads | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **If no future Climate Change: (Baseline vulnerability no future CC)** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Damage due to Floods (% of project roads) | | 8.47 | 8.72 | 8.90 | 9.07 | 9.25 | 7.54 | 7.68 | 7.83 | 7.98 | 8.12 | 6.20 | 6.32 |
| Vulnerability 2: | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 14.62 | 14.91 | 15.21 | 15.51 | 15.82 | 16.14 | 16.46 | 16.79 | 17.13 | 17.47 | 17.82 | 18.17 |
| Time Savings | | 21.13 | 21.55 | 21.98 | 22.42 | 22.87 | 23.33 | 23.80 | 24.27 | 24.76 | 25.25 | 25.76 | 26.27 |
| | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **44.21** | **45.18** | **46.09** | **47.00** | **47.94** | **47.01** | **47.94** | **48.89** | **49.86** | **50.84** | **49.78** | **50.76** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Damage due to Floods (% of project roads) | | 8.47 | 8.72 | 8.90 | 9.07 | 9.25 | 7.54 | 7.68 | 7.83 | 7.98 | 8.12 | 6.20 | 6.32 |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 14.62 | 14.91 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Time Savings | | 21.13 | 21.55 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **44.21** | **45.18** | **8.90** | **9.07** | **9.25** | **7.54** | **7.68** | **7.83** | **7.98** | **8.12** | **6.20** | **6.32** |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Damage due to Floods (% of project roads) | | 8.47 | 8.72 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 14.62 | 14.91 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Time Savings | | 21.13 | 21.55 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss/Extra Costs:** | | **44.21** | **45.18** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** |
| **Reduced Stock Damage/Loss (damage** | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **to roads, etc.):** | | | | | | | | | | | | | |
| Damage due to Floods (% of project roads) | | 0.00 | 0.00 | 8.90 | 9.07 | 9.25 | 7.54 | 7.68 | 7.83 | 7.98 | 8.12 | 6.20 | 6.32 |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 0.00 | 0.00 | 15.21 | 15.51 | 15.82 | 16.14 | 16.46 | 16.79 | 17.13 | 17.47 | 17.82 | 18.17 |
| Time Savings | | 0.00 | 0.00 | 21.98 | 22.42 | 22.87 | 23.33 | 23.80 | 24.27 | 24.76 | 25.25 | 25.76 | 26.27 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **0.0** | **0.0** | **46.1** | **47.0** | **47.9** | **47.0** | **47.9** | **48.9** | **49.9** | **50.8** | **49.8** | **50.8** |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | 88.22 | 58.81 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | 1.11843641 | 1.11843641 | 1.11843641 | 1.11843641 | 1.11843641 | 1.11843641 | 1.11843641 | 1.11843641 | 1.11843641 | 1.11843641 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | 101.60 | 67.74 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | 1.717478319 | 1.717478319 | 1.717478319 | 1.717478319 | 1.717478319 | 1.717478319 | 1.717478319 | 1.717478319 | 1.717478319 | 1.717478319 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | 13.38351303 | 8.922342021 | | | | | | | | | | |
| **O & M Incremental Costs:** | | | | 0.599041909 | 0.599041909 | 0.599041909 | 0.599041909 | 0.599041909 | 0.599041909 | 0.599041909 | 0.599041909 | 0.599041909 | 0.599041909 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 101.60** | **-BDT 67.74** | **BDT 44.37** | **BDT 45.29** | **BDT 46.22** | **BDT 45.29** | **BDT 46.22** | **BDT 47.17** | **BDT 48.14** | **BDT 49.13** | **BDT 48.06** | **BDT 49.05** |
| | | | | | | | | | | | | | |
| **Project without cc Net Economic Flows** | | -BDT 88.22 | -BDT 58.81 | BDT 36.07 | BDT 36.82 | BDT 37.57 | BDT 38.35 | BDT 39.14 | BDT 39.94 | BDT 40.76 | BDT 41.60 | BDT 42.46 | BDT 43.33 |
| | | | | | | | | | | | | | |
| **CC Net Economic Flows** | | -BDT 13.38 | -BDT 8.92 | BDT 8.30 | BDT 8.47 | BDT 8.65 | BDT 6.94 | BDT 7.08 | BDT 7.23 | BDT 7.38 | BDT 7.52 | BDT 5.61 | BDT 5.72 |

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| **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **2036** | **2037** | **Total (Taka 2013)** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 6.43 | 6.55 | 6.66 | 4.52 | 4.60 | 4.68 | 4.76 | 4.84 | 4.93 | 5.01 | 5.09 | 5.18 | 159.34 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 18.54 | 18.91 | 19.29 | 19.67 | 20.07 | 20.47 | 20.88 | 21.29 | 21.72 | 22.15 | 22.60 | 23.05 | 444.68 |
| 26.80 | 27.33 | 27.88 | 28.44 | 29.01 | 29.59 | 30.18 | 30.78 | 31.40 | 32.03 | 32.67 | 33.32 | 642.79 |
| | | | | | | | | | | | | |
| **51.77** | **52.79** | **53.83** | **52.63** | **53.67** | **54.74** | **55.82** | **56.92** | **58.04** | **59.19** | **60.36** | **61.55** | **1246.81** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 6.43 | 6.55 | 6.66 | 4.52 | 4.60 | 4.68 | 4.76 | 4.84 | 4.93 | 5.01 | 5.09 | 5.18 | 159.34 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 29.53 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 42.68 |
| | | | | | | | | | | | | |
| **6.43** | **6.55** | **6.66** | **4.52** | **4.60** | **4.68** | **4.76** | **4.84** | **4.93** | **5.01** | **5.09** | **5.18** | **231.55** |
| | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17.19 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 29.53 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 42.68 |
| | | | | | | | | | | | | |
| **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **89.40** |
| | | | | | | | | | | | | |
| 6.43 | 6.55 | 6.66 | 4.52 | 4.60 | 4.68 | 4.76 | 4.84 | 4.93 | 5.01 | 5.09 | 5.18 | 142.15 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 18.54 | 18.91 | 19.29 | 19.67 | 20.07 | 20.47 | 20.88 | 21.29 | 21.72 | 22.15 | 22.60 | 23.05 | 415.15 |
| 26.80 | 27.33 | 27.88 | 28.44 | 29.01 | 29.59 | 30.18 | 30.78 | 31.40 | 32.03 | 32.67 | 33.32 | 600.11 |
| | | | | | | | | | | | | |
| **51.8** | **52.8** | **53.8** | **52.6** | **53.7** | **54.7** | **55.8** | **56.9** | **58.0** | **59.2** | **60.4** | **61.5** | **1157.4** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | BDT 147.03 |
| 1.11843641 | 1.11843641 | 1.11843641 | 1.11843641 | 1.11843641 | 1.11843641 | 1.11843641 | 1.11843641 | 1.11843641 | 1.11843641 | 1.11843641 | 1.11843641 | BDT 24.61 |
| | | | | | | | | | | BDT 1.12 | | BDT 171.64 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | BDT 169.34 |
| 1.717478319 | 1.717478319 | 1.717478319 | 1.717478319 | 1.717478319 | 1.717478319 | 1.717478319 | 1.717478319 | 1.717478319 | 1.717478319 | 1.717478319 | 1.717478319 | BDT 37.78 |
| | | | | | | | | | | BDT 1.72 | | BDT 207.12 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | BDT 22.31 |
| 0.599041909 | 0.599041909 | 0.599041909 | 0.599041909 | 0.599041909 | 0.599041909 | 0.599041909 | 0.599041909 | 0.599041909 | 0.599041909 | 0.599041909 | 0.599041909 | BDT 13.18 |
| | | | | | | | | | | BDT 0.60 | | BDT 35.48 |
| **BDT 50.05** | **BDT 51.07** | **BDT 52.11** | **BDT 50.91** | **BDT 51.96** | **BDT 53.02** | **BDT 54.10** | **BDT 55.20** | **BDT 56.33** | **BDT 57.47** | **BDT 58.64** | **BDT 59.83** | **23.9%** |
| | | | | | | | | | | | | |
| BDT 44.22 | BDT 45.12 | BDT 46.05 | BDT 46.99 | BDT 47.95 | BDT 48.94 | BDT 49.94 | BDT 50.96 | BDT 52.00 | BDT 53.06 | BDT 54.14 | BDT 55.25 | **23.2%** |
| | | | | | | | | | | | | |
| BDT 5.83 | BDT 5.95 | BDT 6.07 | BDT 3.92 | BDT 4.00 | BDT 4.08 | BDT 4.16 | BDT 4.25 | BDT 4.33 | BDT 4.41 | BDT 4.50 | BDT 4.58 | **29.0%** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Assumptions and Workings** | | | | | | | |
| 1 | Stock Damage - considered @ 5% for first five years, 4% next five years, 3% for the next five years and 2% thereafter of the Project roads length of 12.19 kilometers as per the technical team estimate | | | | | | | |
| 2 | Vehicle Operating Costs: See workings below | | | | | | | |
| 3 | Time Savings - See workings below | | | | | | | |
| | | | | | | | | |
| | **Economc Benefit Cost Calculation** | | | | | | | |
| | Days | 300 | 250 | (Rickshaw) | | | | |
| | Road Length in Kilometers | 12.19 | source - technical team | | | | | |
| | | | **Light Vehicle** | | | **Heavy Vehicle** | | **Total** |
| | | | **Car/Taxi** | **Baby Taxi** | **Motor Cycle** | **Bus** | **Truck** | |
| | Traffic Volume | No./ Day | 110 | 200 | 1200 | 150 | 100 | 1760 |
| | **Without Project** | | | | | | | |
| | Operating Cost | Tk./Vehicle | 17.2 | 8 | 2.4 | 18.5 | 21 | |
| | Total Operating Cost | Tk./Year | 6,919,044 | 5,851,200 | 10,532,160 | 10,148,175 | 7,679,700 | 41,130,279 |
| | **with Project** | | | | | | | |
| | Operating Cost | Tk./Vehicle | 10 | 4 | 1.5 | 13 | 16 | |
| | Total Operating Cost | Tk./Year | 4,022,700 | 2,925,600 | 6,582,600 | 7,131,150 | 5,851,200 | 26,513,250 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Savings per Year** | | **2,896,344** | **2,925,600** | **3,949,560** | **3,017,025** | **1,828,500** | **14,617,029** |
| | | | | | | | | |
| | **Rickshaw** | **Trips** | **Minutes per km.** | **Earnings per Km . (Tk.)** | **Earning per Minute (Tk.)** | | | |
| | **Without Project** | 2000 | | | | | | |
| | Time taken to travel | | 12.5 | 13 | 1.04 | | | |
| | | | | | | | | |
| | **with Project** | | | | | | | |
| | Time taken to travel | | 7.5 | 13 | 1.73 | | | |
| | | | | | | | | |
| | Benefit/saving | | 5 | 0 | 0.69 | | | |
| | Road length (Km) | | | | 12.19 | | | |
| | Savings per trip | | | | 42.26 | | | |
| | **Yearly Savings** | | | | | | | **21,129,333** |
| | **Damage to property due to Floods** | | | | | | | **see below** |
| | **Total Savings** | | | | | | | **35,746,362** |
| | | | | | | | | |
| | | | | | | | | |
| | **Without CCR** | | | | | | | |
| | | | | | | | | |
| | **Vulnerability loss due Stock damages will not be prevented without CCR** | | | | | | | |
| | | | | | | | | |
| | **Common to both** | | | | | | | |
| 1 | Capex with CCR and without CCR as per technical team estimate | | | | | | | |
| 2 | Opex with CCR and without CCR as per technical team estimate | | | | | | | |
| | | | | | | | | |

# 1.6. Bridges in Amtoli Paurashava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Roads | | | | | | | | | | | | |
| Investigator(s): | Nesar | | | | | | | | | | | | |
| Town: | Amtali | | | | | | | | | | | | |
| Project: | Roads and Bridges (12.19 kilometers of Road ) | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Refer Location Map and list of roads | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **If no future Climate Change: (Baseline vulnerability no future CC)** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Damage due to Floods (% of project roads) | | | | | | | | | | | | | |
| Vulnerability 2: | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Time Savings | | 7.15 | 7.30 | 7.44 | 7.59 | 7.74 | 7.90 | 8.06 | 8.22 | 8.38 | 8.55 | 8.72 | 8.90 |
| | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **7.16** | **7.31** | **7.45** | **7.60** | **7.75** | **7.91** | **8.07** | **8.23** | **8.39** | **8.56** | **8.73** | **8.91** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Damage due to Floods (% of project roads) | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc.… | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 0.01 | 0.01 | 0.002355 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Time Savings | | 7.15 | 7.30 | 1.78848 | 1.82 | 1.86 | 1.90 | 1.94 | 1.97 | 2.01 | 2.05 | 2.10 | 2.14 |
| | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **7.16** | **7.31** | **1.79** | **1.83** | **1.86** | **1.90** | **1.94** | **1.98** | **2.02** | **2.06** | **2.10** | **2.14** |
| **Vulnerability Impacts with Climate Change and Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Damage due to Floods (% of project roads) | | 0.00 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc.… | | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 0.01 | 0.01 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Time Savings | | 7.15 | 7.30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Annual Total Reduced Damage/Loss/Extra Costs:** | | **7.16** | **7.31** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Damage due to Floods (% of project roads) | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Time Savings | | 0.00 | 0.00 | 7.44 | 7.59 | 7.74 | 7.90 | 8.06 | 8.22 | 8.38 | 8.55 | 8.72 | 8.90 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **0.0** | **0.0** | **7.5** | **7.6** | **7.8** | **7.9** | **8.1** | **8.2** | **8.4** | **8.6** | **8.7** | **8.9** |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | 18.11 | 12.07 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | 0.137761478 | 0.137761478 | 0.137761478 | 0.137761478 | 0.137761478 | 0.137761478 | 0.137761478 | 0.137761478 | 0.137761478 | 0.137761478 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | 19.95 | 13.30 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | 0.15177112 | 0.15177112 | 0.15177112 | 0.15177112 | 0.15177112 | 0.15177112 | 0.15177112 | 0.15177112 | 0.15177112 | 0.15177112 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | 1.841767848 | 1.227845232 | | | | | | | | | | |
| **O & M Incremental Costs:** | | | | 0.014009642 | 0.014009642 | 0.014009642 | 0.014009642 | 0.014009642 | 0.014009642 | 0.014009642 | 0.014009642 | 0.014009642 | 0.014009642 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 19.95** | **-BDT 13.30** | **BDT 7.30** | **BDT 7.45** | **BDT 7.60** | **BDT 7.76** | **BDT 7.92** | **BDT 8.08** | **BDT 8.24** | **BDT 8.41** | **BDT 8.58** | **BDT 8.75** |
| | | | | | | | | | | | | | |
| **Project without cc Net Economic Flows** | | -BDT 18.11 | -BDT 12.07 | BDT 7.31 | BDT 7.46 | BDT 7.62 | BDT 7.77 | BDT 7.93 | BDT 8.09 | BDT 8.26 | BDT 8.42 | BDT 8.59 | BDT 8.77 |
| | | | | | | | | | | | | | |
| **CC Net Economic Flows** | | -BDT 1.84 | -BDT 1.23 | BDT 1.78 | BDT 1.81 | BDT 1.85 | BDT 1.89 | BDT 1.92 | BDT 1.96 | BDT 2.00 | BDT 2.04 | BDT 2.08 | BDT 2.13 |

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| **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **2036** | **2037** | **Total (Taka 2013)** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | 0.00 |
| | | | | | | | | | | | | |
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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.29 |
| 9.07 | 9.25 | 9.44 | 9.63 | 9.82 | 10.02 | 10.22 | 10.42 | 10.63 | 10.84 | 11.06 | 11.28 | 217.64 |
| | | | | | | | | | | | | |
| **9.08** | **9.27** | **9.45** | **9.64** | **9.83** | **10.03** | **10.23** | **10.44** | **10.64** | **10.86** | **11.07** | **11.30** | **217.92** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | | | | | | | | | | |
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| | | | | | | | | | | | | |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.08 |
| 2.18 | 2.22 | 2.27 | 2.31 | 2.36 | 2.41 | 2.46 | 2.50 | 2.55 | 2.61 | 2.66 | 2.71 | 63.27 |
| | | | | | | | | | | | | |
| **2.18** | **2.23** | **2.27** | **2.32** | **2.36** | **2.41** | **2.46** | **2.51** | **2.56** | **2.61** | **2.66** | **2.71** | **63.36** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.02 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14.45 |
| | | | | | | | | | | | | |
| **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **14.47** |
| | | | | | | | | | | | | |
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| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.27 |
| 9.07 | 9.25 | 9.44 | 9.63 | 9.82 | 10.02 | 10.22 | 10.42 | 10.63 | 10.84 | 11.06 | 11.28 | 203.18 |
| | | | | | | | | | | | | |
| **9.1** | **9.3** | **9.5** | **9.6** | **9.8** | **10.0** | **10.2** | **10.4** | **10.6** | **10.9** | **11.1** | **11.3** | **203.5** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | 30.18 |
| 0.137761478 | 0.137761478 | 0.137761478 | 0.137761478 | 0.137761478 | 0.137761478 | 0.137761478 | 0.137761478 | 0.137761478 | 0.137761478 | 0.137761478 | 0.137761478 | 3.03 |
| | | | | | | | | | | BDT 0.14 | | BDT 33.22 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | 33.25 |
| 0.15177112 | 0.15177112 | 0.15177112 | 0.15177112 | 0.15177112 | 0.15177112 | 0.15177112 | 0.15177112 | 0.15177112 | 0.15177112 | 0.15177112 | 0.15177112 | 3.34 |
| | | | | | | | | | | BDT 0.15 | | BDT 36.59 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | 3.07 |
| 0.014009642 | 0.014009642 | 0.014009642 | 0.014009642 | 0.014009642 | 0.014009642 | 0.014009642 | 0.014009642 | 0.014009642 | 0.014009642 | 0.014009642 | 0.014009642 | 0.31 |
| | | | | | | | | | | BDT 0.01 | | BDT 3.38 |
| **BDT 8.93** | **BDT 9.11** | **BDT 9.30** | **BDT 9.49** | **BDT 9.68** | **BDT 9.88** | **BDT 10.08** | **BDT 10.28** | **BDT 10.49** | **BDT 10.71** | **BDT 10.92** | **BDT 11.14** | **21.1%** |
| | | | | | | | | | | | | |
| BDT 8.95 | BDT 9.13 | BDT 9.31 | BDT 9.50 | BDT 9.70 | BDT 9.89 | BDT 10.09 | BDT 10.30 | BDT 10.51 | BDT 10.72 | BDT 10.94 | BDT 11.16 | **23.0%** |
| | | | | | | | | | | | | |
| BDT 2.17 | BDT 2.21 | BDT 2.26 | BDT 2.30 | BDT 2.35 | BDT 2.40 | BDT 2.44 | BDT 2.49 | BDT 2.54 | BDT 2.59 | BDT 2.65 | BDT 2.70 | **47.1%** |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Assumptions and Workings** | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| 1 | Vehicle Operating Costs: See workings below | | | | | | | | | | | | | | | |
| 2 | Time Savings - See workings below | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | **Economc Benefit Cost** | | | | | | | | | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Calculation** | | | | | | | |
| | Days | 300 | | | | | | |
| | Bridges Length in Kilometers | 0.1 | source - technical team | | | | | |
| | | | **Light Vehicle** | | | **Heavy Vehicle** | | **Total** |
| | | | **Car/Taxi** | **Baby Taxi** | **Motor Cycle** | **Bus** | **Truck** | |
| | Traffic Volume | No./ Day | 20 | 20 | 100 | 0 | 0 | 140 |
| | **Without Project** | | | | | | | |
| | Operating Cost | Tk./Vehicle | 17.2 | 8 | 2.4 | 18.5 | 21 | |
| | Total Operating Cost | Tk./Year | 10,320 | 4,800 | 7,200 | - | - | 22,320 |
| | **with Project** | | | | | | | |
| | Operating Cost | Tk./Vehicle | 10 | 4 | 1.5 | 13 | 16 | |
| | Total Operating Cost | Tk./Year | 6,000 | 2,400 | 4,500 | - | - | 12,900 |
| | **Savings per Year** | | **4,320** | **2,400** | **2,700** | **-** | **-** | **9,420** |
| | | | | | | | | |
| | **Rickshaw** | **Trips** | **Minutes** | **Earnings per** | **Earning per** | | | |
| | | | **per km.** | **Km . (Tk.)** | **Minute (Tk.)** | | | |
| | **Without Project** | 9200 | | | | | | |
| | Time taken to travel | | 12.5 | 14 | 1.12 | | | |
| | | | | | | | | |
| | **with Project** | | | | | | | |
| | Time taken to travel | | 3.5 | 14 | 4.00 | | | |
| | | | | | | | | |
| | Benefit/saving | | 9 | 0 | 2.88 | | | |
| | Road length (Km) | | | | 0.1 | | | |
| | Savings per trip | | | | 2.59 | | | |
| | **Yearly Savings** | | | | | | | **7,153,920** |
| | **Damage to property due to Floods** | | | | | | | **see below** |
| | **Total Savings** | | | | | | | **7,163,340** |
| | | | | | | | | |
| | | | | | | | | |
| | **Without CCR** | | | | | | | |
| | | | | | | | | |
| | **25% less vulnerability loss reduction as compared with CCR scenario** | | | | | | | |
| | | | | | | | | |
| | **Common to both** | | | | | | | |
| 1 | Capex with CCR and without CCR as per technical team estimate | | | | | | | |
| 2 | Opex with CCR and without CCR as per technical team estimate | | | | | | | |

| **Operating Cost Workings** | | | | |
|---|---|---|---|---|
| *w/o project* | Car | Truck | M/Cycle | Baby Taxi |
| Cost of fuel per litre - BDT | 100 | 70 | 100 | 100 |
| Maintenance BDT | 20 | 14 | 20 | 20 |
| Total BDT | 120 | 84 | 120 | 120 |
| Number of kilometers | 7 | 4 | 50 | 15 |
| Per Kilometer Operating cost | 17.1 | 21.0 | 2.4 | 8.0 |
| | | | | |
| *With project* | Car | Truck | M/Cycle | Baby Taxi |
| Cost of fuel per litre - BDT | 100 | 70 | 100 | 100 |
| Maintenance BDT | 10 | 10 | 10 | 10 |
| Total BDT | 110 | 80 | 110 | 110 |
| Number of kilometers | 10 | 5 | 65 | 30 |
| Per Kilometer Operating cost | 11.0 | 16.0 | 1.7 | 3.7 |

# 1.7. Cyclone Shelters in Amtoli Paurashava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Cyclone Shelters | | | | | | | | | | | | |
| Investigator(s): | Nesar Ahmed | | | | | | | | | | | | |
| Town: | Amtali | | | | | | | | | | | | |
| Project: | Cyclone Shelters for Town | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Full Town | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Variable 1: | | | | | | | | | | | | | |
| Economic Variable 2: | | | | | | | | | | | | | |
| Economic Variable 3: | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 24.9 | 25.4 | 25.9 | 26.4 | 27.0 | 27.5 | 28.1 | 28.6 | 29.2 | 29.8 | 30.4 | 31.0 |
| Economic Variable 2: | Saved Medical Cost | 1.8 | 1.9 | 1.9 | 1.9 | 2.0 | 2.0 | 2.1 | 2.1 | 2.2 | 2.2 | 2.2 | 2.3 |
| Economic Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **26.7** | **27.3** | **27.8** | **28.4** | **29.0** | **29.5** | **30.1** | **30.7** | **31.3** | **32.0** | **32.6** | **33.3** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Vulnerability 1: (e.g. road damage owing to floods) | | | | | | | | | | | | | |
| Economic Vulnerability 2: | | | | | | | | | | | | | |
| Economic Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 3.74 | 3.81 | 3.89 | 3.97 | 4.05 | 4.13 | 4.21 | 4.29 | 4.38 | 4.47 | 4.56 | 4.65 |
| Economic Variable 2: | Saved Medical Cost | 0.28 | 0.28 | 0.29 | 0.29 | 0.30 | 0.30 | 0.31 | 0.32 | 0.32 | 0.33 | 0.34 | 0.34 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **4.01** | **4.09** | **4.17** | **4.26** | **4.34** | **4.43** | **4.52** | **4.61** | **4.70** | **4.80** | **4.89** | **4.99** |
| **Vulnerability Impacts with Climate Change and Project** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 24.9 | 25.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 2: | Saved Medical Cost | 1.8 | 1.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **26.7** | **27.3** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 0.0 | 0.0 | 25.9 | 26.4 | 27.0 | 27.5 | 28.1 | 28.6 | 29.2 | 29.8 | 30.4 | 31.0 |
| Economic Variable 2: | Saved Medical Cost | 0.0 | 0.0 | 1.9 | 1.9 | 2.0 | 2.0 | 2.1 | 2.1 | 2.2 | 2.2 | 2.2 | 2.3 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **0.0** | **0.0** | **27.8** | **28.4** | **29.0** | **29.5** | **30.1** | **30.7** | **31.3** | **32.0** | **32.6** | **33.3** |
| | | 1000000 | | | | | | | | | | | |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 96.69 | BDT 64.46 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | BDT 0.49 | BDT 0.49 | BDT 0.49 | BDT 0.49 | BDT 0.49 | BDT 0.49 | BDT 0.49 | BDT 0.49 | BDT 0.49 | BDT 0.49 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT 107.44 | BDT 71.62 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | BDT 0.73 | BDT 0.73 | BDT 0.73 | BDT 0.73 | BDT 0.73 | BDT 0.73 | BDT 0.73 | BDT 0.73 | BDT 0.73 | BDT 0.73 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CAPEX Project Incremental Costs** | | BDT 10.74 | BDT 7.16 | BDT 0.00 | BDT 0.00 | BDT 0.00 | | | | | | | |
| **O & M Incremental Costs:** | | | | | BDT 0.24 | BDT 0.24 | BDT 0.24 | BDT 0.24 | BDT 0.24 | BDT 0.24 | BDT 0.24 | BDT 0.24 | BDT 0.24 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 107.44** | **-BDT 71.62** | **BDT 27.10** | **BDT 27.66** | **BDT 28.23** | **BDT 28.81** | **BDT 29.40** | **BDT 30.00** | **BDT 30.62** | **BDT 31.24** | **BDT 31.88** | **BDT 32.53** |
| | | | | | | | | | | | | | |
| **Project without CC Net Economic Flows** | | -BDT 96.69 | -BDT 64.46 | BDT 23.17 | BDT 23.64 | BDT 24.12 | BDT 24.61 | BDT 25.12 | BDT 25.63 | BDT 26.15 | BDT 26.68 | BDT 27.23 | BDT 27.78 |
| **Project ONLY CC Net Economic Flows** | | -BDT 10.74 | -BDT 7.16 | BDT 3.94 | BDT 3.79 | BDT 3.87 | BDT 3.96 | BDT 4.05 | BDT 4.14 | BDT 4.23 | BDT 4.32 | BDT 4.42 | BDT 4.52 |

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| **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **Total (Taka 2013)** |
| | | | | | | | | | | |
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| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 31.6 | 32.2 | 32.9 | 33.5 | 34.2 | 34.9 | 35.6 | 36.3 | 37.0 | 37.8 | BDT 680.1 |
| 2.3 | 2.4 | 2.4 | 2.5 | 2.5 | 2.6 | 2.6 | 2.7 | 2.7 | 2.8 | BDT 50.1 |
| | | | | | | | | | | |
| **33.9** | **34.6** | **35.3** | **36.0** | **36.7** | **37.5** | **38.2** | **39.0** | **39.7** | **40.5** | **730.2** |
| | | | | | | | | | | |
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| | | | | | | | | | | |
| 4.74 | 4.83 | 4.93 | 5.03 | 5.13 | 5.23 | 5.34 | 5.44 | 5.55 | 5.66 | BDT 102.0 |
| 0.35 | 0.36 | 0.36 | 0.37 | 0.38 | 0.39 | 0.39 | 0.40 | 0.41 | 0.42 | BDT 7.5 |
| | | | | | | | | | | |
| **5.09** | **5.19** | **5.29** | **5.40** | **5.51** | **5.62** | **5.73** | **5.85** | **5.96** | **6.08** | **109.54** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 50.3 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 3.7 |
| | | | | | | | | | | 0 |
| | | | | | | | | | | 0.0 |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **54.0** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 31.6 | 32.2 | 32.9 | 33.5 | 34.2 | 34.9 | 35.6 | 36.3 | 37.0 | 37.8 | BDT 629.8 |
| 2.3 | 2.4 | 2.4 | 2.5 | 2.5 | 2.6 | 2.6 | 2.7 | 2.7 | 2.8 | BDT 46.4 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **33.9** | **34.6** | **35.3** | **36.0** | **36.7** | **37.5** | **38.2** | **39.0** | **39.7** | **40.5** | **676.2** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 161.2 |
| BDT 0.49 | BDT 0.49 | BDT 0.49 | BDT 0.49 | BDT 0.49 | BDT 0.49 | BDT 0.49 | BDT 0.49 | BDT 0.49 | BDT 0.49 | BDT 9.8 |
| | | | | | | | | | | **BDT 170.96** |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | BDT 0.00 | | | | | BDT 179.1 |
| BDT 0.73 | BDT 0.73 | BDT 0.73 | BDT 0.73 | BDT 0.73 | BDT 0.73 | BDT 0.73 | BDT 0.73 | BDT 0.73 | BDT 0.73 | BDT 14.5 |
| | | | | | | | | | | **BDT 193.59** |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 17.9 |
| BDT 0.24 | BDT 0.24 | BDT 0.24 | BDT 0.24 | BDT 0.24 | BDT 0.24 | BDT 0.24 | BDT 0.24 | BDT 0.24 | BDT 0.24 | BDT 4.5 |
| | | | | | | | | | | **BDT 22.39** |
| **BDT 33.20** | **BDT 33.88** | **BDT 34.57** | **BDT 35.28** | **BDT 36.00** | **BDT 36.73** | **BDT 37.48** | **BDT 38.24** | **BDT 39.02** | **BDT 39.82** | 15% |
| | | | | | | | | | | |
| BDT 28.35 | BDT 28.92 | BDT 29.51 | BDT 30.11 | BDT 30.72 | BDT 31.35 | BDT 31.98 | BDT 32.63 | BDT 33.30 | BDT 33.97 | 14% |
| | | | | | | | | | | |
| BDT 4.62 | BDT 4.72 | BDT 4.82 | BDT 4.93 | BDT 5.04 | BDT 5.15 | BDT 5.26 | BDT 5.37 | BDT 5.49 | BDT 5.61 | 20% |
| | | | | | | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| | **Assumptions for With CCR** | | | | |
| 1 | Saved Income Loss - See Workings below | | | | |
| 2 | Saved Medical Cost - See Workings Below | | | | |
| | | | | | |
| | **Assumptions for Without CCR** | | | | |
| 1 | Saved Income Loss - See Workings below | | | | |
| 2 | Saved Medical Cost - See Workings Below | | | | |
| | | | | | |
| | **Common to both** | | | | |
| 1 | Capex with CCR and without CCR as per technical team estimate | | | | |
| 2 | Opex with CCR and without CCR as per technical team estimate | | | | |
| | | | | | |
| | **Economc Benefit Cost Calculation - With CCR** | | | | |
| | Number of cyclone shelters | 6 | | | |
| | Capacity of cyclone shelters | 1200 | | | |
| | | | | | |
| | Monthly HH Income | BDT | 13841 | | |
| | HH Size | Number | 4 | | |
| | Number of days saved | Number | 15 | | |
| | Additional persons accessing CS | Number | 7200 | | |
| | Number of cyclones per year | Number | 2 | | |
| | Saved Medical Cost per HH | BDT | 1020 | | |
| | | | | | |
| | **Savings:** | | | | |
| | Loss of Income per cyclone | BDT | **12,456,900** | | |
| | Medical Cost Per cyclone | BDT | **918,000** | | |
| | | | | | |
| | **Yearly Savings** | | | | **26,749,800** |
| | **Total Savings** | | | | **26,749,800** |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | **Economc Benefit Cost Calculation - Without CCR** | | | | |
| | Number of cyclone shelters | **6** | | | |
| | Capacity of cyclone shelters | **1020** | | | |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| | Monthly HH Income | BDT | 13841 | | |
| | HH Size | Number | 4 | | |
| | Number of days saved | Number | 15 | | |
| | Additional persons accessing CS | Number | 6120 | | |
| | Number of cyclones per year | Number | 2 | | |
| | Saved Medical Cost per HH | BDT | 1020 | | |
| | | | | | |
| | **Savings:** | | | | |
| | Loss of Income per HH | BDT | **10,588,365** | | |
| | Medical Cost Per HH | BDT | **780,300** | | |
| | | | | | |
| | **Yearly Savings** | | | | **22,737,330** |
| | **Total Savings** | | | | **22,737,330** |

# 1.8. Boat landing stations in Amtoli Paurashava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Boat Landing Stations | | | | | | | | | | | | |
| Investigator(s): | Nesar Ahmed | | | | | | | | | | | | |
| Town: | Amtali | | | | | | | | | | | | |
| Project: | For Town | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Full Town | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Variable 1: | | | | | | | | | | | | | |
| Economic Variable 2: | | | | | | | | | | | | | |
| Economic Variable 3: | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Time Savings | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| Economic Variable 2: | Saved Medical Cost | 1.0 | 1.0 | 1.0 | 1.0 | 1.1 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | 1.2 |
| Economic Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **1.3** | **1.4** | **1.4** | **1.4** | **1.5** | **1.5** | **1.5** | **1.5** | **1.6** | **1.6** | **1.6** | **1.7** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Vulnerability 1: (e.g. road damage owing to floods) | | | | | | | | | | | | | |
| Economic Vulnerability 2: | | | | | | | | | | | | | |
| Economic Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Time Savings | 0.09 | 0.09 | 0.09 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.11 | 0.11 | 0.11 | 0.11 |
| Economic Variable 2: | Saved Medical Cost | 0.25 | 0.25 | 0.26 | 0.26 | 0.27 | 0.27 | 0.28 | 0.28 | 0.29 | 0.29 | 0.30 | 0.31 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **0.34** | **0.34** | **0.35** | **0.36** | **0.36** | **0.37** | **0.38** | **0.39** | **0.39** | **0.40** | **0.41** | **0.42** |
| **Vulnerability Impacts with Climate Change and Project** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Time Savings | 0.4 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 2: | Saved Medical Cost | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **1.3** | **1.4** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | Time Savings | 0.0 | 0.0 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| Economic Variable 2: | Saved Medical Cost | 0.0 | 0.0 | 1.0 | 1.0 | 1.1 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | 1.2 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **0.0** | **0.0** | **1.4** | **1.4** | **1.5** | **1.5** | **1.5** | **1.5** | **1.6** | **1.6** | **1.6** | **1.7** |
| | | | | | | | | | | | | | |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 4.48 | BDT 2.99 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT 4.91 | BDT 3.27 | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **O & M with CC Adaptation:** | | | | BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 0.10 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | BDT 0.43 | BDT 0.29 | | | | | | | | | | |
| **O & M Incremental Costs:** | | | | | BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 0.10 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 4.91** | **-BDT 3.27** | **BDT 1.30** | **BDT 1.33** | **BDT 1.35** | **BDT 1.38** | **BDT 1.41** | **BDT 1.44** | **BDT 1.47** | **BDT 1.51** | **BDT 1.54** | **BDT 1.57** |
| | | | | | | | | | | | | | |
| **Project without CC Net Economic Flows** | | -BDT 4.48 | -BDT 2.99 | BDT 1.04 | BDT 1.06 | BDT 1.09 | BDT 1.11 | BDT 1.13 | BDT 1.15 | BDT 1.18 | BDT 1.20 | BDT 1.22 | BDT 1.25 |
| | | | | | | | | | | | | | |
| **Project ONLY CC Net Economic Flows** | | -BDT 0.43 | -BDT 0.29 | BDT 0.25 | BDT 0.17 | BDT 0.17 | BDT 0.18 | BDT 0.19 | BDT 0.19 | BDT 0.20 | BDT 0.21 | BDT 0.22 | BDT 0.23 |

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| **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **Total (Taka 2013)** |
| | | | | | | | | | | |
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| | | | | | | | | | | |
| 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | BDT 9.8 |
| 1.3 | 1.3 | 1.3 | 1.3 | 1.4 | 1.4 | 1.4 | 1.4 | 1.5 | 1.5 | BDT 27.0 |
| | | | | | | | | | | |
| **1.7** | **1.7** | **1.8** | **1.8** | **1.8** | **1.9** | **1.9** | **2.0** | **2.0** | **2.0** | **36.8** |
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| 0.11 | 0.12 | 0.12 | 0.12 | 0.12 | 0.13 | 0.13 | 0.13 | 0.13 | 0.14 | BDT 2.5 |
| 0.31 | 0.32 | 0.33 | 0.33 | 0.34 | 0.35 | 0.35 | 0.36 | 0.37 | 0.37 | BDT 6.7 |
| | | | | | | | | | | |
| **0.43** | **0.44** | **0.44** | **0.45** | **0.46** | **0.47** | **0.48** | **0.49** | **0.50** | **0.51** | **9.19** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 0.7 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 2.0 |
| | | | | | | | | | | 0 |
| | | | | | | | | | | 0.0 |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **2.7** |
| | | | | | | | | | | |
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| | | | | | | | | | | |
| 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | BDT 9.1 |
| 1.3 | 1.3 | 1.3 | 1.3 | 1.4 | 1.4 | 1.4 | 1.4 | 1.5 | 1.5 | BDT 25.0 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **1.7** | **1.7** | **1.8** | **1.8** | **1.8** | **1.9** | **1.9** | **2.0** | **2.0** | **2.0** | **34.1** |

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| | | | | | | | | | | |
| | | | | | | | | | | BDT 7.5 |
| BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.2 |
| | | | | | | | | | | BDT 7.62 |
| | | | | | | | | | | |
| | | | | | BDT 0.00 | | | | | BDT 8.2 |
| BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 2.1 |
| | | | | | | | | | | BDT 10.26 |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 0.7 |
| BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 0.10 | BDT 1.8 |
| | | | | | | | | | | BDT 2.54 |
| **BDT 1.60** | **BDT 1.64** | **BDT 1.67** | **BDT 1.71** | **BDT 1.75** | **BDT 1.78** | **BDT 1.82** | **BDT 1.86** | **BDT 1.90** | **BDT 1.94** | 15% |
| | | | | | | | | | | |
| BDT 1.27 | BDT 1.30 | BDT 1.33 | BDT 1.35 | BDT 1.38 | BDT 1.41 | BDT 1.44 | BDT 1.46 | BDT 1.49 | BDT 1.52 | 13% |
| | | | | | | | | | | |
| BDT 0.23 | BDT 0.24 | BDT 0.25 | BDT 0.26 | BDT 0.27 | BDT 0.28 | BDT 0.29 | BDT 0.30 | BDT 0.31 | BDT 0.32 | 25% |

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| | **Assumptions for With CCR** | | | | |
| 1 | Time Savings - See Workings below | | | | |
| 2 | Saved Medical Cost - See Workings Below | | | | |
| | | | | | |
| | **Assumptions for Without CCR** | | | | |
| 1 | Time Savings - See Workings below | | | | |
| 2 | Saved Medical Cost - See Workings Below | | | | |
| | | | | | |
| | **Common to both** | | | | |
| 1 | Capex with CCR and without CCR as per technical team estimate | | | | |
| 2 | Opex with CCR and without CCR as per technical team estimate | | | | |
| | | | | | |
| | | | | | |
| | **Economc Benefit Cost Calculation - With CCR** | | | | |
| | Number of Boat Landings | 30 | | | |
| | Capacity of Boat Landings | 20 | | | |
| | | | | | |
| | Monthly HH Income | BDT | 13841 | | |
| | HH Size | Number | 4.3 | | |
| | Number of days travel | Number | 300 | | |
| | Additional persons accessing BLS | Number | 600 | | |
| | Time saved per person | minutes | 2 | | |
| | Saved Medical Cost per HH | BDT | 1097 | | |
| | Avoided injury | % | 0.5 | | |
| | **Savings:** | | | | |
| | Time Savings per person per year | BDT | **2** | | |
| | Medical Cost Savings per person per year | BDT | **5** | | |
| | **Yearly Time Savings** | | | | **360,000** |
| | **Yearly Medical Cost Savings** | | | | **987,300** |
| | **Total Savings** | | | | **1,347,300** |
| | | | | | |
| | | | | | |
| | | | | | |
| | **Economc Benefit Cost Calculation Without CCR** | | | | |
| | #REF! | 30 | | | |
| | #REF! | 15 | | | |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| | Monthly HH Income | BDT | 13841 | | |
| | HH Size | Number | 4.3 | | |
| | Number of days travel | Number | 300 | | |
| | Additional persons accessing BLS | Number | 450 | | |
| | Time saved per person | minutes | 2 | | |
| | Saved Medical Cost per HH | BDT | 1097 | | |
| | Avoided injury | % | 0.5 | | |
| | **Savings:** | | | | |
| | Time Savings per person per year | BDT | **2** | | |
| | Medical Cost Savings per person per year | BDT | **5** | | |
| | **Yearly Time Savings** | | | | **270,000** |
| | **Yearly Medical Cost Savings** | | | | **740,475** |
| | **Total Savings** | | | | **1,010,475** |

## 1.9. Markets in Amtoli Paurashava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Markets | | | | | | | | | | | | |
| Investigator(s): | Nesar Ahmed | | | | | | | | | | | | |
| Town: | Amtali | | | | | | | | | | | | |
| Project: | For Town | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Full Town | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Variable 1: | | | | | | | | | | | | | |
| Economic Variable 2: | | | | | | | | | | | | | |
| Economic Variable 3: | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Save Business Income Loss | 3.3 | 3.4 | 3.5 | 3.5 | 3.6 | 3.7 | 3.7 | 3.8 | 3.9 | 4.0 | 4.1 | 4.1 |
| Economic Variable 2: | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **3.3** | **3.4** | **3.5** | **3.5** | **3.6** | **3.7** | **3.7** | **3.8** | **3.9** | **4.0** | **4.1** | **4.1** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Vulnerability 1: (e.g. road damage owing to floods) | | | | | | | | | | | | | |
| Economic Vulnerability 2: | | | | | | | | | | | | | |
| Economic Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Save Business Income Loss | 0.67 | 0.68 | 0.69 | 0.71 | 0.72 | 0.73 | 0.75 | 0.76 | 0.78 | 0.79 | 0.81 | 0.83 |
| Economic Variable 2: | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **0.67** | **0.68** | **0.69** | **0.71** | **0.72** | **0.73** | **0.75** | **0.76** | **0.78** | **0.79** | **0.81** | **0.83** |
| **Vulnerability Impacts with Climate Change and Project** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Save Business Income Loss | 3.3 | 3.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 2: | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **3.3** | **3.4** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | Time Savings | 0.0 | 0.0 | 3.5 | 3.5 | 3.6 | 3.7 | 3.7 | 3.8 | 3.9 | 4.0 | 4.1 | 4.1 |
| Economic Variable 2: | Saved Medical Cost | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **0.0** | **0.0** | **3.5** | **3.5** | **3.6** | **3.7** | **3.7** | **3.8** | **3.9** | **4.0** | **4.1** | **4.1** |
| | | | | | | | | | | | | | |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 6.14 | BDT 4.09 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT 6.75 | BDT 4.50 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | BDT 0.61 | BDT 0.41 | | | | | | | | | | |
| **O & M Incremental Costs:** | | | | | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 6.75** | **-BDT 4.50** | **BDT 3.40** | **BDT 3.47** | **BDT 3.54** | **BDT 3.61** | **BDT 3.69** | **BDT 3.76** | **BDT 3.84** | **BDT 3.92** | **BDT 4.00** | **BDT 4.08** |
| **Project without CC Net Economic Flows** | | -BDT 6.14 | -BDT 4.09 | BDT 2.74 | BDT 2.80 | BDT 2.85 | BDT 2.91 | BDT 2.97 | BDT 3.03 | BDT 3.09 | BDT 3.15 | BDT 3.22 | BDT 3.28 |
| **Project ONLY CC Net Economic Flows** | | -BDT 0.61 | -BDT 0.41 | BDT 0.66 | BDT 0.64 | BDT 0.66 | BDT 0.67 | BDT 0.69 | BDT 0.70 | BDT 0.72 | BDT 0.73 | BDT 0.75 | BDT 0.76 |

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| **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **Total (Taka 2013)** |
| | | | | | | | | | | |
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| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.7 | 4.8 | 4.9 | 5.0 | BDT 90.8 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 0.0 |
| | | | | | | | | | | |
| **4.2** | **4.3** | **4.4** | **4.5** | **4.6** | **4.7** | **4.7** | **4.8** | **4.9** | **5.0** | **90.8** |
| | | | | | | | | | | |
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| | | | | | | | | | | |
| 0.84 | 0.86 | 0.88 | 0.90 | 0.91 | 0.93 | 0.95 | 0.97 | 0.99 | 1.01 | BDT 18.2 |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | BDT 0.0 |
| | | | | | | | | | | |
| **0.84** | **0.86** | **0.88** | **0.90** | **0.91** | **0.93** | **0.95** | **0.97** | **0.99** | **1.01** | **18.15** |
| | | | | | | | | | | |
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| | | | | | | | | | | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 6.7 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 0.0 |
| | | | | | | | | | | 0 |
| | | | | | | | | | | 0.0 |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **6.7** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.7 | 4.8 | 4.9 | 5.0 | BDT 84.1 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 0.0 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **4.2** | **4.3** | **4.4** | **4.5** | **4.6** | **4.7** | **4.7** | **4.8** | **4.9** | **5.0** | **84.1** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 10.2 |
| BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.5 |
| | | | | | | | | | | BDT 10.75 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | BDT 0.00 | | | | | BDT 11.3 |
| BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 1.1 |
| | | | | | | | | | | BDT 12.40 |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 1.0 |
| BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.6 |
| | | | | | | | | | | BDT 1.61 |
| **BDT 4.16** | **BDT 4.24** | **BDT 4.33** | **BDT 4.42** | **BDT 4.51** | **BDT 4.60** | **BDT 4.69** | **BDT 4.79** | **BDT 4.88** | **BDT 4.98** | 28% |
| | | | | | | | | | | |
| BDT 3.35 | BDT 3.42 | BDT 3.48 | BDT 3.55 | BDT 3.63 | BDT 3.70 | BDT 3.77 | BDT 3.85 | BDT 3.93 | BDT 4.01 | 25% |
| | | | | | | | | | | |
| BDT 0.78 | BDT 0.80 | BDT 0.82 | BDT 0.83 | BDT 0.85 | BDT 0.87 | BDT 0.89 | BDT 0.91 | BDT 0.93 | BDT 0.95 | 50% |

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|---|---|---|---|---|---|
| | **Assumptions for With CCR** | | | | |
| 1 | Save Business Income Loss - See Workings below | | | | |
| | | | | | |
| | | | | | |
| | **Assumptions for Without CCR** | | | | |
| 1 | Save Business Income Loss - See Workings below | | | | |
| | | | | | |
| | | | | | |
| | **Common to both** | | | | |
| 1 | Capex with CCR and without CCR as per technical team estimate | | | | |
| 2 | Opex with CCR and without CCR as per technical team estimate | | | | |
| | | | | | |
| | | | | | |
| | **Economc Benefit Cost Calculation - With CCR** | | | | |
| | Number of Markets | 1 | | | |
| | Number of Traders | 20 | | | |
| | | | | | |
| | Monthly HH Expenditure | BDT | 9606 | | |
| | HH Size | Number | 4.3 | | |
| | Number of days shopping | Number | 300 | | |
| | Additional HHs accessing Market | Number/day | 60 | | |
| | % of Expenditure spent in Market | % | 50% | | |
| | | | | | |
| | | | | | |
| | **Savings:** | | | | |
| | Average business generated in a day | BDT | **11,084** | | |
| | | | | | |
| | **Yearly Buiness Income Loss Savings** | | | | **3,325,154** |
| | | | | | - |
| | **Total Savings** | | | | **3,325,154** |
| | | | | | |
| | | | | | |
| | | | | | |
| | **Economc Benefit Cost Calculation Without CCR** | | | | |
| | #REF! | 1 | | | |
| | #REF! | 16 | | | |
| | | | | | |
| | Monthly HH Expenditure | BDT | 9606 | | |
| | HH Size | Number | 4.3 | | |
| | Number of days shopping | Number | 300 | | |
| | Additional HHs accessing Market | Number/day | 48 | | |
| | % of Expenditure spent in Market | % | 50% | | |
| | | | | | |
| | | | | | |
| | **Savings:** | | | | |
| | Economic Variable 2: | BDT | **8,867** | | |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| | **Yearly Buiness Income Loss Savings** | | | | **2,660,123** |
| | | | | | **-** |
| | **Total Savings** | | | | **2,660,123** |

# 2.1. Water Supply in Galachipa Pauroshava

| Coastal Towns Infrastructure Improvement Programme | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sector: | Water Supply | | | | | | | | | | | | |
| Investigator(s): | Zhangir | | | | | | | | | | | | |
| Town: | Galachipa | | | | | | | | | | | | |
| Project: | Water Supply for Town | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | 85% of the town population covered under piped water supply system | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2,015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | None | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | **Time to fetch water** | 6.68 | 8.13 | 9.63 | 11.18 | 12.78 | 14.43 | 14.63 | 14.83 | 15.20 | 15.58 | 15.96 | 16.33 |
| Economic Variable 2: | **Cost of storage tanks including cleaning** | 3194682.62 | 0.70 | 0.72 | 0.74 | 0.76 | 0.79 | 0.10 | 0.09 | 0.18 | 0.18 | 0.18 | 0.18 |
| Economic Variable 3: | **Cost of water purification** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Economic Variable 4: | **Purchase costs of water** | 4.63 | 5.63 | 6.67 | 7.75 | 8.86 | 10.00 | 10.14 | 10.28 | 10.54 | 10.80 | 11.06 | 11.32 |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **3194693.9** | **14.5** | **17.0** | **19.7** | **22.4** | **25.2** | **24.9** | **25.2** | **25.9** | **26.6** | **27.2** | **27.8** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | **Time to fetch water** | 1.2 | 1.4 | 1.7 | 2.0 | 2.3 | 2.5 | 2.6 | 2.6 | 2.7 | 2.7 | 2.8 | 2.9 |
| Economic Variable 2: | **Cost of storage tanks including cleaning** | 3194679.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 3: | **Cost of water purification** | | | | | | | | | | | | |
| Economic Variable 4: | **Purchase costs of water** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **3194680.6** | **1.4** | **1.7** | **2.0** | **2.3** | **2.5** | **2.6** | **2.6** | **2.7** | **2.7** | **2.8** | **2.9** |
| **Vulnerability Impacts with Climate Change and Project** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | **Time to fetch water** | 6.7 | 8.1 | 9.6 | 0.0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Economic Variable 2: | **Cost of storage tanks including cleaning** | 3194682.6 | 0.7 | 0.7 | 0.0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Economic Variable 3: | **Cost of water purification** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Economic Variable 4: | **Purchase costs of water** | 4.6 | 5.6 | 6.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **3194693.9** | **14.5** | **17.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | **Time to fetch water** | 0.0 | 0.0 | 0.0 | 11.2 | 12.8 | 14.4 | 14.6 | 14.8 | 15.2 | 15.6 | 16.0 | 16.3 |
| Economic Variable 2: | **Cost of storage tanks including cleaning** | 0.0 | 0.0 | 0.0 | 0.7 | 0.8 | 0.8 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 |
| Economic Variable 3: | **Cost of water purification** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 4: | **Purchase costs of water** | 0.0 | 0.0 | 0.0 | 7.7 | 8.9 | 10.0 | 10.1 | 10.3 | 10.5 | 10.8 | 11.1 | 11.3 |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **0.0** | **0.0** | **0.0** | **19.7** | **22.4** | **25.2** | **24.9** | **25.2** | **25.9** | **26.6** | **27.2** | **27.8** |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 22.50 | BDT 45.00 | BDT 45.00 | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | | BDT 1.60 | BDT 1.60 | BDT 1.60 | BDT 1.60 | BDT 1.60 | BDT 1.60 | BDT 1.60 | BDT 1.60 | BDT 1.60 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT 23.91 | BDT 47.81 | BDT 47.81 | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | | BDT 2.68 | BDT 2.68 | BDT 2.68 | BDT 2.68 | BDT 2.68 | BDT 2.68 | BDT 2.68 | BDT 2.68 | BDT 2.68 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | BDT 1.41 | BDT 2.81 | BDT 2.81 | BDT 0.00 | BDT 0.00 | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **O & M Incremental Costs:** | | | | | BDT 1.08 | BDT 1.08 | BDT 1.08 | BDT 1.08 | BDT 1.08 | BDT 1.08 | BDT 1.08 | BDT 1.08 | BDT 1.08 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 23.91** | **-BDT 47.81** | **-BDT 47.81** | **BDT 16.99** | **BDT 19.72** | **BDT 22.54** | **BDT 22.19** | **BDT 22.52** | **BDT 23.25** | **BDT 23.88** | **BDT 24.52** | **BDT 25.15** |
| | | | | | | | | | | | | | |
| **Project without CC Net Economic Flows** | | -BDT 22.50 | -BDT 45.00 | -BDT 45.00 | BDT 16.10 | BDT 18.54 | BDT 21.08 | BDT 20.69 | BDT 20.98 | BDT 21.64 | BDT 22.21 | BDT 22.78 | BDT 23.35 |
| | | | | | | | | | | | | | |
| **Project ONLY CC Net Economic Flows** | | -BDT 1.41 | -BDT 2.81 | -BDT 2.81 | BDT 0.89 | BDT 1.17 | BDT 1.47 | BDT 1.50 | BDT 1.54 | BDT 1.60 | BDT 1.67 | BDT 1.74 | BDT 1.80 |

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| **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **2036** | **2037** | **2038** | **2039** | **2040** | **2041** | **2042** | **Total (Taka 2013)** |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 16.70 | 17.07 | 17.44 | 17.88 | 18.31 | 18.74 | 19.17 | 19.60 | 20.02 | 20.45 | 20.87 | 21.29 | 21.72 | 22.14 | 22.58 | 23.02 | 23.47 | 495.83 |
| 0.18 | 0.18 | 0.18 | 0.21 | 0.21 | 0.21 | 0.21 | 0.20 | 0.00 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.21 | 0.21 | 0.22 | 3194690.45 |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 11.58 | 11.83 | 12.09 | 12.39 | 12.69 | 12.99 | 13.29 | 13.58 | 13.88 | 14.17 | 14.47 | 14.76 | 15.05 | 15.35 | 15.65 | 15.96 | 16.27 | 343.67 |
| **28.5** | **29.1** | **29.7** | **30.5** | **31.2** | **31.9** | **32.7** | **33.4** | **33.9** | **34.8** | **35.5** | **36.3** | **37.0** | **37.7** | **38.4** | **39.2** | **40.0** | **3195530.0** |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 2.9 | 3.0 | 3.1 | 3.2 | 3.2 | 3.3 | 3.4 | 3.5 | 3.5 | 3.6 | 3.7 | 3.8 | 3.8 | 3.9 | 4.0 | 4.1 | 4.1 | 87.50 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3194679.42 |
| | | | | | | | | | | | | | | | | | 0.00 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00 |
| **2.9** | **3.0** | **3.1** | **3.2** | **3.2** | **3.3** | **3.4** | **3.5** | **3.5** | **3.6** | **3.7** | **3.8** | **3.8** | **3.9** | **4.0** | **4.1** | **4.1** | **3194766.9** |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24.43 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3194684.03 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 16.93 |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **3194725.4** |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 16.7 | 17.1 | 17.4 | 17.9 | 18.3 | 18.7 | 19.2 | 19.6 | 20.0 | 20.4 | 20.9 | 21.3 | 21.7 | 22.1 | 22.6 | 23.0 | 23.5 | 471.40 |
| 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.0 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 6.42 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00 |
| 11.6 | 11.8 | 12.1 | 12.4 | 12.7 | 13.0 | 13.3 | 13.6 | 13.9 | 14.2 | 14.5 | 14.8 | 15.1 | 15.3 | 15.7 | 16.0 | 16.3 | 326.73 |
| **28.5** | **29.1** | **29.7** | **30.5** | **31.2** | **31.9** | **32.7** | **33.4** | **33.9** | **34.8** | **35.5** | **36.3** | **37.0** | **37.7** | **38.4** | **39.2** | **40.0** | **804.6** |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | 112.49 |
| BDT 1.60 | BDT 1.60 | BDT 1.60 | BDT 1.60 | BDT 1.60 | BDT 1.60 | BDT 1.60 | BDT 1.60 | BDT 1.60 | BDT 1.60 | BDT 1.60 | BDT 1.60 | BDT 1.60 | BDT 1.60 | BDT 1.60 | BDT 1.60 | BDT 1.60 | 41.55 |
| | | | | | | | | | | | | | | | | | BDT 112.49 |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | 119.53 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BDT 2.68 | BDT 2.68 | BDT 2.68 | BDT 2.68 | BDT 2.68 | BDT 2.68 | BDT 2.68 | BDT 2.68 | BDT 2.68 | BDT 2.68 | BDT 2.68 | BDT 2.68 | BDT 2.68 | BDT 2.68 | BDT 2.68 | BDT 2.68 | BDT 2.68 | 69.63 |
| | | | | | | | | | | | | | | | | | BDT 189.15 |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | 7.04 |
| BDT 1.08 | BDT 1.08 | BDT 1.08 | BDT 1.08 | BDT 1.08 | BDT 1.08 | BDT 1.08 | BDT 1.08 | BDT 1.08 | BDT 1.08 | BDT 1.08 | BDT 1.08 | BDT 1.08 | BDT 1.08 | BDT 1.08 | BDT 1.08 | BDT 1.08 | 28.08 |
| | | | | | | | | | | | | | | | | | BDT 35.12 |
| **BDT 25.78** | **BDT 26.41** | **BDT 27.03** | **BDT 27.80** | **BDT 28.53** | **BDT 29.26** | **BDT 29.98** | **BDT 30.71** | **BDT 31.22** | **BDT 32.15** | **BDT 32.86** | **BDT 33.58** | **BDT 34.29** | **BDT 35.02** | **BDT 35.76** | **BDT 36.52** | **BDT 37.28** | 17% |
| | | | | | | | | | | | | | | | | | |
| BDT 23.91 | BDT 24.47 | BDT 25.03 | BDT 25.72 | BDT 26.38 | BDT 27.03 | BDT 27.68 | BDT 28.33 | BDT 28.77 | BDT 29.62 | BDT 30.26 | BDT 30.90 | BDT 31.54 | BDT 32.19 | BDT 32.86 | BDT 33.53 | BDT 34.22 | 17% |
| | | | | | | | | | | | | | | | | | |
| BDT 1.87 | BDT 1.93 | BDT 2.00 | BDT 2.07 | BDT 2.15 | BDT 2.23 | BDT 2.30 | BDT 2.38 | BDT 2.45 | BDT 2.53 | BDT 2.60 | BDT 2.68 | BDT 2.75 | BDT 2.83 | BDT 2.90 | BDT 2.98 | BDT 3.06 | 19% |

| | |
|---|---|
| | **Assumptions: (with CCR)** |
| 1 | Time to fetch water has been assessed based on the SEWTP report timing of 14 minutes per HH |
| 2 | Cost of storage Tanks considered @ 2320 BDT as per SEWTP report for HHs shifting to piped water supply |
| 3 | Cost of purification - BDT 0 per month per HH as per SEWTP report - not considered |
| 4 | Purchase of water @ 100 BDT per KL - 20% used for drinking purpose |
| | |
| | **Assumptions: (without CCR)** |
| 1 | Time to fetch water has been assessed based on the SEWTP report timing of 18 minutes per HH - **20% less vulnerability loss reduction as compared with CCR scenario** |
| 2 | Cost of storage Tanks considered @ 2320 BDT as per SEWTP report for HHs shifting to piped water supply - **No Change** |
| 3 | Cost of purification - Not Applicable |
| 4 | Purchase of water @ 100 BDT per KL - 20% used for drinking purpose **- 20% less vulnerability loss reduction as compared with CCR scenario** |
| | |
| | **Common to both** |
| 1 | Capex with CCR and without CCR as per technical team estimate |
| 2 | Opex with CCR and without CCR as per technical team estimate |

## 2.2. Sanitation in Galachipa Paurosava

| Coastal Towns Infrastructure Improvement Programme | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sector: | Sanitation | | | | | | | | | | | | |
| Investigator(s): | Zhangir | | | | | | | | | | | | |
| Town: | Galachipa | | | | | | | | | | | | |
| Project: | Sanitation for Town | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | part of town | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Variable 1: | | | | | | | | | | | | | |
| Economic Variable 2: | | | | | | | | | | | | | |
| Economic Variable 3: | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 0.8 | 0.8 | 0.8 | 0.8 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 1.0 | 1.0 | 1.0 |
| Economic Variable 2: | Saved Medical Cost | 3.2 | 3.3 | 3.4 | 3.4 | 3.5 | 3.6 | 3.7 | 3.7 | 3.8 | 3.9 | 4.0 | 4.0 |
| Economic Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **4.0** | **4.1** | **4.2** | **4.3** | **4.4** | **4.5** | **4.6** | **4.6** | **4.7** | **4.8** | **4.9** | **5.0** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Vulnerability 1: (e.g. road damage owing to floods) | | | | | | | | | | | | | |
| Economic Vulnerability 2: | | | | | | | | | | | | | |
| Economic Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Economic Variable 2: | Saved Medical Cost | 0.49 | 0.50 | 0.51 | 0.52 | 0.53 | 0.54 | 0.55 | 0.56 | 0.57 | 0.58 | 0.59 | 0.60 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **0.49** | **0.50** | **0.51** | **0.52** | **0.53** | **0.54** | **0.55** | **0.56** | **0.57** | **0.58** | **0.59** | **0.60** |
| **Vulnerability Impacts with Climate Change and Project** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 0.8 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 2: | Saved Medical Cost | 3.2 | 3.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **4.0** | **4.1** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 0.0 | 0.0 | 0.8 | 0.8 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 1.0 | 1.0 | 1.0 |
| Economic Variable 2: | Saved Medical Cost | 0.0 | 0.0 | 3.4 | 3.4 | 3.5 | 3.6 | 3.7 | 3.7 | 3.8 | 3.9 | 4.0 | 4.0 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **0.0** | **0.0** | **4.2** | **4.3** | **4.4** | **4.5** | **4.6** | **4.6** | **4.7** | **4.8** | **4.9** | **5.0** |
| | | 1000000 | | | | | | | | | | | |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 5.94 | BDT 3.96 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | BDT 0.46 | BDT | BDT | BDT | BDT | BDT | BDT | BDT | BDT | BDT |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 0.46 | 0.46 | 0.46 | 0.46 | 0.46 | 0.46 | 0.46 | 0.46 | 0.46 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT 6.32 | BDT 4.21 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | BDT 0.54 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | BDT 0.38 | BDT 0.25 | BDT 0.00 | BDT 0.00 | BDT 0.00 | | | | | | | |
| **O & M Incremental Costs:** | | | | | BDT 0.09 | BDT 0.09 | BDT 0.09 | BDT 0.09 | BDT 0.09 | BDT 0.09 | BDT 0.09 | BDT 0.09 | BDT 0.09 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 6.32** | **-BDT 4.21** | **BDT 3.66** | **BDT 3.74** | **BDT 3.82** | **BDT 3.91** | **BDT 4.00** | **BDT 4.09** | **BDT 4.18** | **BDT 4.28** | **BDT 4.37** | **BDT 4.47** |
| | | | | | | | | | | | | | |
| **Project without CC Net Economic Flows** | | -BDT 5.94 | -BDT 3.96 | BDT 3.24 | BDT 3.31 | BDT 3.39 | BDT 3.47 | BDT 3.54 | BDT 3.62 | BDT 3.71 | BDT 3.79 | BDT 3.87 | BDT 3.96 |
| | | | | | | | | | | | | | |
| **Project ONLY CC Net Economic Flows** | | -BDT 0.38 | -BDT 0.25 | BDT 0.42 | BDT 0.33 | BDT 0.34 | BDT 0.35 | BDT 0.36 | BDT 0.37 | BDT 0.38 | BDT 0.39 | BDT 0.41 | BDT 0.42 |

| 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | Total (Taka 2013) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
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| | | | | | | | | | | |
| 1.0 | 1.0 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | BDT 21.8 |
| 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | 4.5 | 4.6 | 4.7 | 4.8 | 4.9 | BDT 88.5 |
| | | | | | | | | | | |
| **5.1** | **5.2** | **5.3** | **5.4** | **5.5** | **5.7** | **5.8** | **5.9** | **6.0** | **6.1** | **110.3** |
| | | | | | | | | | | |
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| | | | | | | | | | | |
| | | | | | | | | | | |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | BDT 0.0 |
| 0.62 | 0.63 | 0.64 | 0.65 | 0.67 | 0.68 | 0.69 | 0.71 | 0.72 | 0.74 | BDT 13.3 |
| | | | | | | | | | | |
| **0.62** | **0.63** | **0.64** | **0.65** | **0.67** | **0.68** | **0.69** | **0.71** | **0.72** | **0.74** | **13.28** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 1.6 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 6.6 |
| | | | | | | | | | | 0 |
| | | | | | | | | | | 0.0 |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **8.2** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 1.0 | 1.0 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | BDT 20.2 |
| 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | 4.5 | 4.6 | 4.7 | 4.8 | 4.9 | BDT 82.0 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **5.1** | **5.2** | **5.3** | **5.4** | **5.5** | **5.7** | **5.8** | **5.9** | **6.0** | **6.1** | **102.2** |
| | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | | | | | | BDT 9.9 |
| BDT 0.46 | BDT 0.46 | BDT 0.46 | BDT 0.46 | BDT 0.46 | BDT 0.46 | BDT 0.46 | BDT 0.46 | BDT 0.46 | BDT 0.46 | BDT 9.2 |
| | | | | | | | | | | **BDT 19.09** |
| | | | | | | | | | | |
| | | | | | BDT 0.00 | | | | | BDT 10.5 |
| BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 11.1 |
| | | | | | | | | | | **BDT 21.58** |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 0.6 |
| BDT 0.09 | BDT 0.09 | BDT 0.09 | BDT 0.09 | BDT 0.09 | BDT 0.09 | BDT 0.09 | BDT 0.09 | BDT 0.09 | BDT 0.09 | BDT 1.8 |
| | | | | | | | | | | **BDT 2.40** |
| **BDT 4.57** | **BDT 4.68** | **BDT 4.78** | **BDT 4.89** | **BDT 5.00** | **BDT 5.11** | **BDT 5.22** | **BDT 5.34** | **BDT 5.45** | **BDT 5.57** | 31% |
| | | | | | | | | | | |
| BDT 4.05 | BDT 4.14 | BDT 4.23 | BDT 4.33 | BDT 4.42 | BDT 4.52 | BDT 4.62 | BDT 4.72 | BDT 4.82 | BDT 4.93 | 30% |
| | | | | | | | | | | |
| BDT 0.43 | BDT 0.44 | BDT 0.46 | BDT 0.47 | BDT 0.48 | BDT 0.49 | BDT 0.51 | BDT 0.52 | BDT 0.54 | BDT 0.55 | 47% |

| | |
|---|---|
| | **Assumptions for With CCR** |
| 1 | Saved Income Loss - HH monthly income - BDT 13,167, days lost due to sickness - 2.1 days considered as per SEWTP report |
| 2 | Saved Medical Cost - HH monthly expenditure on health - BDT 1126 considered as per SEWTP report @ 30% for sanitation |
| | |
| | **Assumptions for Without CCR** |
| 1 | Saved Income Loss - HH monthly income - BDT 13,167, days lost due to sickness - 2.1 days considered as per SEWTP report - NO Change |
| 2 | Saved Medical Cost - HH monthly expenditure on health - BDT 1097 considered as per SEWTP report @ 30% for sanitation - **15% less vulnerability loss reduction as compared with CCR scenario** |
| | |
| | **Common to both** |
| 1 | Capex with CCR and without CCR as per technical team estimate |
| 2 | Opex with CCR and without CCR as per technical team estimate |

## 2.3 Drainage/ Flood control in Galachipa Paurosava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Drainage and Flood Control | | | | | | | | | | | | |
| Investigator(s): | Muhibullah / Paul Dean | | | | | | | | | | | | |
| Town: | Galachipa | | | | | | | | | | | | |
| Project: | Drainage and Flood Control for Town | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Whole town | | | | | | | | | | | | |
| | **Year** | **Year** | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. road damage owing to floods) | Property Damage | 18.8 | 19.2 | 19.6 | 20.0 | 20.4 | 20.8 | 21.2 | 21.6 | 22.0 | 22.5 | 22.9 | 23.4 |
| Vulnerability 2: | Property Repair | 1.1 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 | 1.4 |
| | Property Clean Up | 13.6 | 13.9 | 14.2 | 14.5 | 14.8 | 15.1 | 15.4 | 15.7 | 16.0 | 16.3 | 16.6 | 17.0 |
| Vulnerability 3: etc…. | Road Damage / Repair | 0.8 | 0.8 | 0.8 | 0.8 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 1.0 | 1.0 | 1.0 |
| | Agriculture Loss | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.7 | 4.8 | 4.9 | 5.0 | 5.1 | 5.2 |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. economic damage due to delays, congestion, road closure) | Loss of Income due to sick days | 31.1 | 31.7 | 32.3 | 33.0 | 33.6 | 34.3 | 35.0 | 35.7 | 36.4 | 37.1 | 37.9 | 38.6 |
| Vulnerability 2: (e.g. extra maintenance/repair costs w.o. investment) | Loss of business income | 19.2 | 19.6 | 20.0 | 20.4 | 20.8 | 21.3 | 21.7 | 22.1 | 22.6 | 23.0 | 23.5 | 23.9 |
| Vulnerability 3: etc. | Medical Cost | 2.7 | 2.7 | 2.8 | 2.8 | 2.9 | 2.9 | 3.0 | 3.1 | 3.1 | 3.2 | 3.2 | 3.3 |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **91.5** | **93.4** | **95.2** | **97.1** | **99.1** | **101.1** | **103.1** | **105.2** | **107.3** | **109.4** | **111.6** | **113.8** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. road damage owing to floods) | Property Damage | 18.8 | 19.2 | 5.5 | 5.7 | 5.8 | 5.9 | 6.0 | 6.1 | 6.2 | 6.4 | 6.5 | 6.6 |
| Vulnerability 2: | Property Repair | 1.1 | 1.2 | 0.3 | 0.3 | 0.3 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| | Property Clean Up | 13.6 | 13.9 | 3.9 | 3.9 | 4.0 | 4.1 | 4.2 | 4.3 | 4.4 | 4.4 | 4.5 | 4.6 |
| Vulnerability 3: etc…. | Road Damage / Repair | 0.8 | 0.8 | 0.8 | 0.8 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 1.0 | 1.0 | 1.0 |
| | Agriculture Loss | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.7 | 4.8 | 4.9 | 5.0 | 5.1 | 5.2 |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. economic damage due to delays, congestion, road closure) | Loss of Income due to sick days | 31.1 | 31.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Vulnerability 2: (e.g. extra maintenance/repair costs w.o. investment) | Loss of business income | 19.2 | 19.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Vulnerability 3: etc. | Medical Cost | 2.7 | 2.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **91.5** | **93.4** | **15.0** | **15.3** | **15.6** | **15.9** | **16.2** | **16.5** | **16.8** | **17.2** | **17.5** | **17.9** |
| **Vulnerability Impacts with Project with CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. road damage owing to floods) | Property Damage | 18.8 | 19.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 2: | Property Repair | 1.1 | 1.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Property Clean Up | 13.6 | 13.9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 3: etc…. | Road Damage / Repair | 0.8 | 0.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Agriculture Loss | 4.2 | 4.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. economic damage due to delays, congestion, road closure) | Loss of Income due to sick days | 31.1 | 31.7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 2: (e.g. extra maintenance/repair costs w.o. investment) | Loss of business income | 19.2 | 19.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 3: etc. | Medical Cost | 2.7 | 2.7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **91.5** | **93.4** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Impact of Project on Reduced Vulnerability** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced costs of road damage owing to floods) | Property Damage | 0.0 | 0.0 | 19.6 | 20.0 | 20.4 | 20.8 | 21.2 | 21.6 | 22.0 | 22.5 | 22.9 | 23.4 |
| Vulnerability 2: | Property Repair | 0.0 | 0.0 | 1.2 | 1.2 | 1.2 | 1.2 | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 | 1.4 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vulnerability 3: etc…. | Property Clean Up | 0.0 | 0.0 | 14.2 | 14.5 | 14.8 | 15.1 | 15.4 | 15.7 | 16.0 | 16.3 | 16.6 | 17.0 |
| | Road Damage / Repair | 0.0 | 0.0 | 0.8 | 0.8 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 1.0 | 1.0 | 1.0 |
| | Agriculture Loss | 0.0 | 0.0 | 4.4 | 4.5 | 4.6 | 4.7 | 4.7 | 4.8 | 4.9 | 5.0 | 5.1 | 5.2 |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced economic damage due to delays, congestion, road closure) | Loss of Income due to sick days | 0.0 | 0.0 | 32.3 | 33.0 | 33.6 | 34.3 | 35.0 | 35.7 | 36.4 | 37.1 | 37.9 | 38.6 |
| Vulnerability 2: (e.g. reduced extra maintenance/repair costs versus w.o. investment) | Loss of business income | 0.0 | 0.0 | 20.0 | 20.4 | 20.8 | 21.3 | 21.7 | 22.1 | 22.6 | 23.0 | 23.5 | 23.9 |
| Vulnerability 3: etc. | Medical Cost | 0.0 | 0.0 | 2.8 | 2.8 | 2.9 | 2.9 | 3.0 | 3.1 | 3.1 | 3.2 | 3.2 | 3.3 |
| **Annual Total Reduced Damage/Loss/Extra Costs:** | | **0.0** | **0.0** | **95.2** | **97.1** | **99.1** | **101.1** | **103.1** | **105.2** | **107.3** | **109.4** | **111.6** | **113.8** |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 163.33 | BDT 108.89 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | BDT 1.07 | BDT 1.07 | BDT 1.07 | BDT 1.07 | BDT 1.07 | BDT 1.07 | BDT 1.07 | BDT 1.07 | BDT 1.82 | BDT 1.82 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT 194.80 | BDT 129.87 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | BDT 1.27 | BDT 1.27 | BDT 1.27 | BDT 1.27 | BDT 1.27 | BDT 1.27 | BDT 1.27 | BDT 1.27 | BDT 2.25 | BDT 2.25 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | BDT 31.47 | BDT 20.98 | | | | | | | | | | |
| **O & M Incremental Costs:** | | | | BDT 0.21 | BDT 0.21 | BDT 0.21 | BDT 0.21 | BDT 0.21 | BDT 0.21 | BDT 0.21 | BDT 0.21 | BDT 0.44 | BDT 0.44 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 194.80** | **-BDT 129.87** | **BDT 93.97** | **BDT 95.87** | **BDT 97.82** | **BDT 99.80** | **BDT 101.82** | **BDT 103.88** | **BDT 105.99** | **BDT 108.13** | **BDT 109.34** | **BDT 111.57** |
| | | | | | | | | | | | | | |
| **Project without CC Net Economic Flows** | | -BDT 163.33 | -BDT 108.89 | BDT 79.22 | BDT 80.83 | BDT 82.46 | BDT 84.13 | BDT 85.84 | BDT 87.58 | BDT 89.35 | BDT 91.16 | BDT 92.25 | BDT 94.13 |
| | | | | | | | | | | | | | |
| **Project ONLY CC Net Economic Flows** | | -BDT 31.47 | -BDT 20.98 | BDT 14.75 | BDT 15.05 | BDT 15.35 | BDT 15.66 | BDT 15.98 | BDT 16.31 | BDT 16.64 | BDT 16.97 | BDT 17.09 | BDT 17.44 |

| **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **Total (Taka 2013)** |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| 25.3 | 25.8 | 26.3 | 26.9 | 27.4 | 27.9 | 28.5 | 513.3 |
| 1.5 | 1.5 | 1.6 | 1.6 | 1.6 | 1.7 | 1.7 | 30.8 |
| 18.4 | 18.7 | 19.1 | 19.5 | 19.9 | 20.3 | 20.7 | 372.4 |
| 1.1 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | 21.8 |
| 5.7 | 5.8 | 5.9 | 6.0 | 6.1 | 6.3 | 6.4 | 115.1 |
| | | | | | | | |
| 41.8 | 42.6 | 43.5 | 44.3 | 45.2 | 46.1 | 47.1 | 847.7 |
| 25.9 | 26.4 | 27.0 | 27.5 | 28.0 | 28.6 | 29.2 | 525.4 |
| 3.6 | 3.6 | 3.7 | 3.8 | 3.9 | 3.9 | 4.0 | 72.5 |
| **123.2** | **125.7** | **128.2** | **130.7** | **133.4** | **136.0** | **138.7** | **2499.0** |
| | | | | | | | |
| | | | | | | | |
| 7.2 | 7.3 | 7.5 | 7.6 | 7.8 | 7.9 | 8.1 | 172.6 |
| 0.4 | 0.4 | 0.4 | 0.5 | 0.5 | 0.5 | 0.5 | 10.4 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5.0 | 5.1 | 5.2 | 5.3 | 5.4 | 5.5 | 5.6 | 121.4 |
| 1.1 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | 21.8 |
| 5.7 | 5.8 | 5.9 | 6.0 | 6.1 | 6.3 | 6.4 | 115.1 |
| | | | | | | | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 62.7 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 38.9 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.4 |
| **19.3** | **19.7** | **20.1** | **20.5** | **20.9** | **21.4** | **21.8** | **548.3** |
| | | | | | | | |
| | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38.0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.3 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27.6 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.6 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.5 |
| | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 62.7 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38.9 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5.4 |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **184.9** |
| | | | | | | | |
| | | | | | | | |
| 25.3 | 25.8 | 26.3 | 26.9 | 27.4 | 27.9 | 28.5 | 475.3 |
| 1.5 | 1.5 | 1.6 | 1.6 | 1.6 | 1.7 | 1.7 | 28.5 |
| 18.4 | 18.7 | 19.1 | 19.5 | 19.9 | 20.3 | 20.7 | 344.9 |
| 1.1 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | 20.2 |
| 5.7 | 5.8 | 5.9 | 6.0 | 6.1 | 6.3 | 6.4 | 106.6 |
| | | | | | | | |
| 41.8 | 42.6 | 43.5 | 44.3 | 45.2 | 46.1 | 47.1 | 784.9 |
| 25.9 | 26.4 | 27.0 | 27.5 | 28.0 | 28.6 | 29.2 | 486.6 |
| 3.6 | 3.6 | 3.7 | 3.8 | 3.9 | 3.9 | 4.0 | 67.1 |
| **123.2** | **125.7** | **128.2** | **130.7** | **133.4** | **136.0** | **138.7** | **2314.1** |
| | | | | | | | |
| | | | | | | | 272.2 |
| BDT 1.82 | BDT 1.82 | BDT 1.82 | BDT 1.82 | BDT 1.82 | BDT 1.82 | BDT 1.82 | 30.3 |
| | | | | | | | **BDT 302.55** |
| | | | | | | | |
| | | | | | | | 324.7 |
| BDT 2.25 | BDT 2.25 | BDT 2.25 | BDT 2.25 | BDT 2.25 | BDT 2.25 | BDT 2.25 | 37.2 |
| | | | | | | | **BDT 361.87** |
| | | | | | | | |
| | | | | | | | 52.4 |
| BDT 0.44 | BDT 0.44 | BDT 0.44 | BDT 0.44 | BDT 0.44 | BDT 0.44 | BDT 0.44 | 6.9 |
| | | | | | | | **BDT 59.31** |
| **BDT 120.95** | **BDT 123.42** | **BDT 125.93** | **BDT 128.49** | **BDT 131.11** | **BDT 133.78** | **BDT 136.50** | **27%** |
| | | | | | | | |
| BDT 102.04 | BDT 104.12 | BDT 106.24 | BDT 108.40 | BDT 110.60 | BDT 112.85 | BDT 115.15 | **27%** |
| | | | | | | | |
| BDT 18.91 | BDT 19.30 | BDT 19.69 | BDT 20.09 | BDT 20.51 | BDT 20.92 | BDT 21.35 | **26%** |

| | |
|---|---|
| | **Assumptions and workings for with CCR** |
| | |
| | |
| 1 | Number of properties |
| 2 | Loss of Income |
| | Number of Households |
| | Number of days of flooding |
| | Household Income |
| | Average Household Expenditure on Health |

| | |
|---|---|
| 3 | Saved Medical Cost |
| 4 | Loss of Business Income |
| | Average monthly expenditure |
| 5 | Agricultural Loss |
| | Average Yield per acre |
| | Average support price |
| | Agricultural Loss |
| 6 | Road Damage |
| | Repair cost |
| | Road Damage Cost |
| | |
| | **Assessment of Repair / Damage Cost** |
| | Depth |
| | < 0.25 m inundation |
| | > 0.25 m inundation |
| | > 0.75 m inundation |
| | Total |
| | < 0.25 |
| | > 0.25 |
| | > 0.75 m inundation |
| | |
| | Averagae Area in Sq m |
| | Total Area Waterlogged in sq m |
| | Total Area inundated in sq m |
| | |
| | Constuction cost |
| | BDT/sq m |
| | Repair Cost @ 6% |
| | BDT/sq m |
| | Clean Up cost |
| | BDT/property |
| | |
| | Damage Cost |
| | Repair Cost |
| | Clean up cost |
| | |
| | |
| | **For Without CCR scenario** |
| | |
| | **Stock damages for properties - 25% less vulnerability loss reduction as compared with CCR scenario** |
| | **Rest same - No change** |
| | |
| | |
| | **Common to both** |
| 1 | Capex with CCR and without CCR as per technical team estimate |
| 2 | Opex with CCR and without CCR as per technical team estimate |

# 2.4 Solid waste in Galachipa Paurosava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Solid Waste | | | | | | | | | | | | |
| Investigator(s): | Nesar | | | | | | | | | | | | |
| Town: | Galachipa | | | | | | | | | | | | |
| Project: | Solid Waste | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Full Town | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. road damage owing to floods) | | | | | | | | | | | | | |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. economic damage due to delays, congestion, road closure) | Time Savings | 1.8 | 1.8 | 1.9 | 1.9 | 1.9 | 2.0 | 2.0 | 2.0 | 2.1 | 2.1 | 2.2 | 2.2 |
| Vulnerability 2: (e.g. extra maintenance/repair costs w.o. investment) | Saved Medical Cost | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **2.1** | **2.1** | **2.1** | **2.2** | **2.2** | **2.3** | **2.3** | **2.4** | **2.4** | **2.5** | **2.5** | **2.6** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced costs of road damage owing to floods) | | | | | | | | | | | | | |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced economic damage due to delays, congestion, road closure) | Time Savings | 1.8 | 1.8 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.6 |
| Vulnerability 2: (e.g. reduced extra maintenance/repair costs versus w.o. investment) | Saved Medical Cost | 0.3 | 0.3 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss/Extra Costs:** | | **2.1** | **2.1** | **0.5** | **0.5** | **0.6** | **0.6** | **0.6** | **0.6** | **0.6** | **0.6** | **0.6** | **0.6** |
| **Vulnerability Impacts with Project with CC resilient measures** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced costs of road damage owing to floods) | | | | | | | | | | | | | |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced economic damage due to delays, congestion, road closure) | Time Savings | 1.8 | 1.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Vulnerability 2: (e.g. reduced extra maintenance/repair costs versus w.o. investment) | Saved Medical Cost | 0.3 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss/Extra Costs:** | | **2.1** | **2.1** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Impact of Project on Reduced Vulnerability** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced costs of road damage owing to floods) | | | | | | | | | | | | | |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced economic damage due to delays, congestion, road closure) | Time Savings | 0.0 | 0.0 | 1.9 | 1.9 | 1.9 | 2.0 | 2.0 | 2.0 | 2.1 | 2.1 | 2.2 | 2.2 |
| Vulnerability 2: (e.g. reduced extra maintenance/repair costs versus w.o. investment) | Saved Medical Cost | 0.0 | 0.0 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss/Extra Costs:** | | **0.0** | **0.0** | **2.1** | **2.2** | **2.2** | **2.3** | **2.3** | **2.4** | **2.4** | **2.5** | **2.5** | **2.6** |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 4.48 | BDT 2.99 | | | | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **O & M without CC Adaptation:** | | | | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT 4.91 | BDT 3.27 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | BDT 0.43 | BDT 0.29 | | | | | | | | | | |
| **O & M Incremental Costs:** | | | | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 4.91** | **-BDT 3.27** | **BDT 1.65** | **BDT 1.69** | **BDT 1.73** | **BDT 1.78** | **BDT 1.82** | **BDT 1.87** | **BDT 1.92** | **BDT 1.96** | **BDT 2.01** | **BDT 2.06** |
| | | | | | | | | | | | | | |
| **Project without CC Net Economic Flows** | | -BDT 4.48 | -BDT 2.99 | BDT 1.27 | BDT 1.30 | BDT 1.33 | BDT 1.37 | BDT 1.40 | BDT 1.43 | BDT 1.47 | BDT 1.51 | BDT 1.54 | BDT 1.58 |
| | | | | | | | | | | | | | |
| **Project ONLY CC Net Economic Flows** | | -BDT 0.43 | -BDT 0.29 | BDT 0.22 | BDT 0.23 | BDT 0.24 | BDT 0.25 | BDT 0.27 | BDT 0.28 | BDT 0.29 | BDT 0.30 | BDT 0.31 | BDT 0.33 |

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| **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **Total (Taka 2013)** |
| | | | | | | | | | | |
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| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 2.3 | 2.3 | 2.4 | 2.4 | 2.4 | 2.5 | 2.5 | 2.6 | 2.6 | 2.7 | 48.7 |
| 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 7.6 |
| | | | | | | | | | | |
| **2.6** | **2.7** | **2.7** | **2.8** | **2.8** | **2.9** | **2.9** | **3.0** | **3.1** | **3.1** | **56.3** |
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| 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.7 | 0.7 | 14.9 |
| 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 2.3 |
| | | | | | | | | | | |
| **0.7** | **0.7** | **0.7** | **0.7** | **0.7** | **0.7** | **0.7** | **0.8** | **0.8** | **0.8** | **17.2** |
| | | | | | | | | | | |
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| | | | | | | | | | | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.6 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 |
| | | | | | | | | | | |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **4.2** |

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| | | | | | | | | | | |
| 2.3 | 2.3 | 2.4 | 2.4 | 2.4 | 2.5 | 2.5 | 2.6 | 2.6 | 2.7 | 45.1 |
| 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 7.0 |
| | | | | | | | | | | |
| **2.6** | **2.7** | **2.7** | **2.8** | **2.8** | **2.9** | **2.9** | **3.0** | **3.1** | **3.1** | **52.1** |
| | | | | | | | | | | |
| | | | | | | | | | | 7.5 |
| BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | 6.8 |
| | | | | | | | | | | **BDT 14.29** |
| | | | | | | | | | | |
| | | | | | | | | | | 8.2 |
| BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | 10.0 |
| | | | | | | | | | | **BDT 18.15** |
| | | | | | | | | | | |
| | | | | | | | | | | 0.7 |
| BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | 3.1 |
| | | | | | | | | | | **BDT 3.86** |
| **BDT 2.12** | **BDT 2.17** | **BDT 2.22** | **BDT 2.28** | **BDT 2.33** | **BDT 2.39** | **BDT 2.45** | **BDT 2.50** | **BDT 2.56** | **BDT 2.63** | **19.7%** |
| | | | | | | | | | | |
| BDT 1.62 | BDT 1.66 | BDT 1.70 | BDT 1.74 | BDT 1.78 | BDT 1.82 | BDT 1.87 | BDT 1.91 | BDT 1.96 | BDT 2.00 | **16.8%** |
| | | | | | | | | | | |
| BDT 0.34 | BDT 0.35 | BDT 0.37 | BDT 0.38 | BDT 0.39 | BDT 0.41 | BDT 0.42 | BDT 0.44 | BDT 0.45 | BDT 0.47 | **30.3%** |

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|---|---|
| | **Assumptions and workings** |
| | |
| | **Assumptions for With CCR** |
| 1 | Saved Income Loss - HH monthly income - BDT 13,167 as per SEWTP report, Time savings - 1 minute per day considered |
| 2 | Saved Medical Cost - HH monthly expenditure on health - BDT 1126 considered as per SEWTP report @ 5% for solid waste |
| | |
| | **Assumptions for Without CCR** |
| 1 | Number of households - **25% less vulnerability loss reduction as compared with CCR scenario** |
| | |
| | |
| | **Common to both** |
| 1 | Capex with CCR and without CCR as per technical team estimate |
| 2 | Opex with CCR and without CCR as per technical team estimate |
| | |

## 2.5. Roads in Galachipa Paurosava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Roads | | | | | | | | | | | | |
| Investigator(s): | Nesar | | | | | | | | | | | | |
| Town: | Galachipa | | | | | | | | | | | | |
| Project: | Roads (14.766 kilometers of Road) | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Refer Location Map and list of roads | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **If no future Climate Change: (Baseline vulnerability no future CC)** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | 4 | | | | | 3 | |
| Damage due to Floods (% of project roads) | | 12.49 | 12.87 | 13.12 | 13.38 | 13.64 | 11.12 | 11.33 | 11.55 | 11.76 | 11.98 | 9.15 | 9.32 |
| Vulnerability 2: | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 4.26 | 4.34 | 4.43 | 4.52 | 4.61 | 4.70 | 4.79 | 4.89 | 4.99 | 5.09 | 5.19 | 5.29 |
| Time Savings | | 23.89 | 24.37 | 24.86 | 25.36 | 25.86 | 26.38 | 26.91 | 27.45 | 28.00 | 28.56 | 29.13 | 29.71 |
| | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | 40.64 | 41.58 | 42.41 | 43.25 | 44.11 | 42.20 | 43.04 | 43.88 | 44.75 | 45.63 | 43.47 | 44.32 |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Damage due to Floods (% of project roads) | | 12.49 | 12.87 | 13.12 | 13.38 | 13.64 | 11.12 | 11.33 | 11.55 | 11.76 | 11.98 | 9.15 | 9.32 |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 4.26 | 4.34 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Time Savings | | 23.89 | 24.37 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | 40.64 | 41.58 | 13.12 | 13.38 | 13.64 | 11.12 | 11.33 | 11.55 | 11.76 | 11.98 | 9.15 | 9.32 |
| **Vulnerability Impacts with Climate Change and Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Damage due to Floods (% of project roads) | | 12.49 | 12.87 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 4.26 | 4.34 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Time Savings | | 23.89 | 24.37 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss/Extra Costs:** | | 40.64 | 41.58 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Damage due to Floods (% of project roads) | | 0.00 | 0.00 | 13.12 | 13.38 | 13.64 | 11.12 | 11.33 | 11.55 | 11.76 | 11.98 | 9.15 | 9.32 |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 0.00 | 0.00 | 4.43 | 4.52 | 4.61 | 4.70 | 4.79 | 4.89 | 4.99 | 5.09 | 5.19 | 5.29 |
| Time Savings | | 0.00 | 0.00 | 24.86 | 25.36 | 25.86 | 26.38 | 26.91 | 27.45 | 28.00 | 28.56 | 29.13 | 29.71 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vulnerability 3: etc. | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **0.0** | **0.0** | **42.4** | **43.3** | **44.1** | **42.2** | **43.0** | **43.9** | **44.7** | **45.6** | **43.5** | **44.3** |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | 128.49 | 85.66 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | 149.86 | 99.91 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | 21.36450704 | 14.24300469 | | | | | | | | | | |
| **O & M Incremental Costs:** | | | | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 149.86** | **-BDT 99.91** | **BDT 39.62** | **BDT 40.47** | **BDT 41.32** | **BDT 39.42** | **BDT 40.25** | **BDT 41.10** | **BDT 41.96** | **BDT 42.84** | **BDT 40.68** | **BDT 41.54** |
| | | | | | | | | | | | | |
| **Project without cc Net Economic Flows** | | -BDT 128.49 | -BDT 85.66 | BDT 26.68 | BDT 27.27 | BDT 27.87 | BDT 28.48 | BDT 29.10 | BDT 29.73 | BDT 30.38 | BDT 31.04 | BDT 31.71 | BDT 32.40 |
| | | | | | | | | | | | | |
| **CC Net Economic Flows** | | -BDT 21.36 | -BDT 14.24 | BDT 12.94 | BDT 13.20 | BDT 13.46 | BDT 10.94 | BDT 11.15 | BDT 11.37 | BDT 11.58 | BDT 11.80 | BDT 8.97 | BDT 9.14 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |
| **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **2036** | **2037** | **Total (Taka 2013)** |
| | | | | | | | | | | | | |
| | | | 2 | | | | | | | | | |
| 9.49 | 9.66 | 9.83 | 6.67 | 6.79 | 6.90 | 7.02 | 7.15 | 7.27 | 7.39 | 7.51 | 7.64 | 235.02 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 5.40 | 5.51 | 5.62 | 5.73 | 5.84 | 5.96 | 6.08 | 6.20 | 6.33 | 6.45 | 6.58 | 6.71 | 129.51 |
| 30.30 | 30.91 | 31.53 | 32.16 | 32.80 | 33.46 | 34.13 | 34.81 | 35.51 | 36.22 | 36.94 | 37.68 | 726.93 |
| | | | | | | | | | | | | |
| 45.19 | 46.08 | 46.98 | 44.56 | 45.43 | 46.32 | 47.23 | 48.16 | 49.10 | 50.06 | 51.04 | 52.03 | **1091.45** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 9.49 | 9.66 | 9.83 | 6.67 | 6.79 | 6.90 | 7.02 | 7.15 | 7.27 | 7.39 | 7.51 | 7.64 | 235.02 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.60 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 48.27 |
| | | | | | | | | | | | | |
| 9.49 | 9.66 | 9.83 | 6.67 | 6.79 | 6.90 | 7.02 | 7.15 | 7.27 | 7.39 | 7.51 | 7.64 | **291.89** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25.35 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.60 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 48.27 |
| | | | | | | | | | | | | |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **82.22** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 9.49 | 9.66 | 9.83 | 6.67 | 6.79 | 6.90 | 7.02 | 7.15 | 7.27 | 7.39 | 7.51 | 7.64 | 209.67 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 5.40 | 5.51 | 5.62 | 5.73 | 5.84 | 5.96 | 6.08 | 6.20 | 6.33 | 6.45 | 6.58 | 6.71 | 120.91 |
| 30.30 | 30.91 | 31.53 | 32.16 | 32.80 | 33.46 | 34.13 | 34.81 | 35.51 | 36.22 | 36.94 | 37.68 | 678.66 |

| | | | | | | | | | | | | |
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| | | | | | | | | | | | | |
| **45.2** | **46.1** | **47.0** | **44.6** | **45.4** | **46.3** | **47.2** | **48.2** | **49.1** | **50.1** | **51.0** | **52.0** | **1009.2** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | 214.16 |
| 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 57.34 |
| | | | | | | | | | | | | **BDT 271.50** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | 249.76 |
| 2.8 | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 | 61.30 |
| | | | | | | | | | | | | **BDT 311.07** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | 35.61 |
| 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 3.96 |
| | | | | | | | | | | | | **BDT 39.57** |
| **BDT 42.40** | **BDT 43.29** | **BDT 44.19** | **BDT 41.77** | **BDT 42.65** | **BDT 43.54** | **BDT 44.45** | **BDT 45.37** | **BDT 46.31** | **BDT 47.27** | **BDT 48.25** | **BDT 49.25** | **14.5%** |
| | | | | | | | | | | | | |
| BDT 33.10 | BDT 33.81 | BDT 34.54 | BDT 35.28 | BDT 36.04 | BDT 36.81 | BDT 37.60 | BDT 38.41 | BDT 39.23 | BDT 40.06 | BDT 40.92 | BDT 41.79 | **12.3%** |
| | | | | | | | | | | | | |
| BDT 9.31 | BDT 9.48 | BDT 9.65 | BDT 6.49 | BDT 6.61 | BDT 6.72 | BDT 6.84 | BDT 6.97 | BDT 7.09 | BDT 7.21 | BDT 7.33 | BDT 7.46 | **28.5%** |

| | **Assumptions and Workings** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | Stock Damage - considered @ 5% for first five years, 4% next five years, 3% for the next five years and 2% thereafter of the Project roads length of 12.19 kilometers as per the technical team estimate | | | | | | | |
| 2 | Vehicle Operating Costs: See workings below | | | | | | | |
| 3 | Time Savings - See workings below | | | | | | | |
| | | | | | | | | |
| | **Economc Benefit Cost Calculation** | | | | | | | |
| | Days | 300 | 300 | (Rickshaw) | | | | |
| | Road Length | 14.766 | | | | | | |
| | | | **Light Vehicle** | | | **Heav Vehicle** | | **Total** |
| | | | **Car/Taxi** | **Baby Taxi** | **Motor Cycle** | **Bus** | **Truck** | |
| | Traffic Volume | No./ Day | 45 | 64 | 300 | 2 | 20 | 431 |
| | **Without Project** | | | | | | | |
| | Operating Cost | Tk./Vehicle | 17.2 | 8 | 2.4 | 18.5 | 21 | |
| | Total Operating Cost | Tk./Year | 3,428,665 | 2,268,058 | 3,189,456 | 163,903 | 1,860,516 | 10,910,597 |
| | **with Project** | | | | | | | |
| | Operating Cost | Tk./Vehicle | 10 | 4 | 1.5 | 13 | 16 | |
| | Total Operating Cost | Tk./Year | 1,993,410 | 1,134,029 | 1,993,410 | 115,175 | 1,417,536 | 6,653,560 |
| | **Savings per Year** | | **1,435,255** | **1,134,029** | **1,196,046** | **48,728** | **442,980** | **4,257,038** |
| | | | | | | | | |
| | **Rickshaw** | **Trips** | **Minutes per km.** | **Earnings per Km . (Tk.)** | **Earning per Minute (Tk.)** | | | |
| | **Without Project** | 1556 | | | | | | |
| | Time taken to travel | | 12.5 | 13 | 1.04 | | | |
| | | | | | | | | |
| | **with Project** | | | | | | | |
| | Time taken to travel | | 7.5 | 13 | 1.73 | | | |
| | | | | | | | | |
| | Benefit/saving | | 5 | 0 | 0.69 | | | |
| | Road length (Km) | | | | 14.766 | | | |
| | Savings per trip | | | | 51.19 | | | |

| | Full Town | Project Area | Number of times | | | |
|---|---|---|---|---|---|---|
| | | 25% | 3 | | | |
| 2 wheeler | 400 | 100 | 300 | | | |
| auto rickshaw | 10 | 2.5 | 7.5 | | | |
| cars and jeeps | 60 | 15 | 45 | | | |
| Tractor | 20 | 5 | 15 | | | |
| Bus / Mini Bus | 2 | 0.5 | 1.5 | | | |
| Trucks | 7 | 1.75 | 5.25 | | | |
| Tempos | 85 | 21.25 | 63.75 | | | |
| Cycle Rickshaw | 500 | 125 | 375 | | | |
| | | | | | | |
| Operating Cost | | | | | | |
| Fuel | 1375 | | | | | |
| Maintenance | 833 | | | | | |
| Total | 2208 | | | | | |
| | | | | | | |
| per day | 73.6 | | | | | |
| | | | | | | |
| w/o project | | Car | | Truck | M/Cycle | Baby Taxi |
| Cost of fuel | | 100 | Litre | 70 | 100 | 100 |
| Maintenance | | 20 | | 14 | 20 | 20 |
| Total | | 120 | | 84 | 120 | 120 |
| Number of | | 7 | | 4 | 50 | 15 |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | kilometers | | | | | | | | | |
| | **Yearly Savings** | | | | | | | **23,894,932** | | | Per Kilometer Operating cost | | | 17.14285714 | | 21 | | 2.4 | | 8 |
| | **Damage to property due to Floods** | | | | | | | **see below** | | | | | | | | | | | | |
| | **Total Savings** | | | | | | | **28,151,970** | | | | | | | | | | | | |
| | | | | | | | | | | | With project | | | Car | | Truck | | M/Cycle | | Baby Taxi |
| | | | | | | | | | | | Cost of fuel | | | 100 | Litre | 70 | | 100 | | 100 |
| | | | | | | | | | | | Maintenance | | | 10 | | 10 | | 10 | | 10 |
| | | | | | | | | | | | Total | | | 110 | | 80 | | 110 | | 110 |
| | | | | | | | | | | | Number of kilometers | | | 10 | | 5 | | 65 | | 30 |
| | | | | | | | | | | | Per Kilometer Operating cost | | | 11 | | 16 | | 1.692307692 | | 3.666666667 |
| | **Common to both** | | | | | | | | | | | | | | | | | | | |
| 1 | Capex with CCR and without CCR as per technical team estimate | | | | | | | | | | | | | | | | | | | |
| 2 | Opex with CCR and without CCR as per technical team estimate | | | | | | | | | | | | | | | | | | | |

## 2.6. Bridges in Galachipa Paurosava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Roads | | | | | | | | | | | | |
| Investigator(s): | Nesar | | | | | | | | | | | | |
| Town: | Galachipa | | | | | | | | | | | | |
| Project: | Bridges | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Refer Location Map and list of roads | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **If no future Climate Change: (Baseline vulnerability no future CC)** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Damage due to Floods (% of project roads) | | | | | | | | | | | | | |
| Vulnerability 2: | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 0.07 | 0.07 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.09 | 0.09 | 0.09 | 0.09 |
| Time Savings | | 12.62 | 12.88 | 13.13 | 13.40 | 13.66 | 13.94 | 14.22 | 14.50 | 14.79 | 15.09 | 15.39 | 15.70 |
| | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | 12.70 | 12.95 | 13.21 | 13.47 | 13.74 | 14.02 | 14.30 | 14.58 | 14.88 | 15.17 | 15.48 | 15.79 |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Damage due to Floods (% of project roads) | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 0.07 | 0.07 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| Time Savings | | 12.62 | 12.88 | 5.24 | 5.35 | 5.46 | 5.56 | 5.68 | 5.79 | 5.91 | 6.02 | 6.14 | 6.27 |
| | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | 12.70 | 12.95 | 5.26 | 5.37 | 5.48 | 5.59 | 5.70 | 5.81 | 5.93 | 6.05 | 6.17 | 6.29 |
| **Vulnerability Impacts with Climate Change and Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Damage due to Floods (% of project roads) | | 0.00 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 0.07 | 0.07 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Time Savings | | 12.62 | 12.88 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss/Extra Costs:** | | 12.70 | 12.95 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Damage due to Floods (% of project roads) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vulnerability 2: | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | |
| Vehicle Operating Costs | 0.00 | 0.00 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.09 | 0.09 | 0.09 | 0.09 |
| Time Savings | 0.00 | 0.00 | 13.13 | 13.40 | 13.66 | 13.94 | 14.22 | 14.50 | 14.79 | 15.09 | 15.39 | 15.70 |
| Vulnerability 3: etc. | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | **0.0** | **0.0** | **13.2** | **13.5** | **13.7** | **14.0** | **14.3** | **14.6** | **14.9** | **15.2** | **15.5** | **15.8** |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | 33.45878258 | 22.30585505 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | 0.141393608 | 0.141393608 | 0.141393608 | 0.141393608 | 0.141393608 | 0.141393608 | 0.141393608 | 0.141393608 | 0.141393608 | 0.141393608 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | 36.84 | 24.56 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | 0.155662688 | 0.155662688 | 0.155662688 | 0.155662688 | 0.155662688 | 0.155662688 | 0.155662688 | 0.155662688 | 0.155662688 | 0.155662688 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | 3.38 | 2.25 | | | | | | | | | | |
| **O & M Incremental Costs:** | | | 0.01 | 0.01426908 | 0.01426908 | 0.01426908 | 0.01426908 | 0.01426908 | 0.01426908 | 0.01426908 | 0.01426908 | 0.01426908 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | **-BDT 36.84** | **-BDT 24.56** | **BDT 13.05** | **BDT 13.32** | **BDT 13.59** | **BDT 13.86** | **BDT 14.14** | **BDT 14.43** | **BDT 14.72** | **BDT 15.02** | **BDT 15.32** | **BDT 15.63** |
| | | | | | | | | | | | | |
| **Project without cc Net Economic Flows** | -BDT 33.46 | -BDT 22.31 | BDT 13.07 | BDT 13.33 | BDT 13.60 | BDT 13.88 | BDT 14.16 | BDT 14.44 | BDT 14.73 | BDT 15.03 | BDT 15.34 | BDT 15.64 |
| | | | | | | | | | | | | |
| **CC Net Economic Flows** | -BDT 3.38 | -BDT 2.25 | BDT 5.25 | BDT 5.36 | BDT 5.46 | BDT 5.57 | BDT 5.68 | BDT 5.80 | BDT 5.91 | BDT 6.03 | BDT 6.15 | BDT 6.28 |

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| | | | | | | | | | | | | |
| **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **2036** | **2037** | **Total (Taka 2013)** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | 0.00 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 0.09 | 0.09 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.11 | 0.11 | 0.11 | 0.11 | 0.11 | 2.22 |
| 16.01 | 16.33 | 16.66 | 16.99 | 17.33 | 17.68 | 18.03 | 18.39 | 18.76 | 19.13 | 19.52 | 19.91 | 384.03 |
| | | | | | | | | | | | | |
| 16.10 | 16.42 | 16.75 | 17.09 | 17.43 | 17.78 | 18.13 | 18.50 | 18.87 | 19.24 | 19.63 | 20.02 | 386.25 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | | | | | | | | | | |

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| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.71 |
| 6.39 | 6.52 | 6.65 | 6.78 | 6.92 | 7.06 | 7.20 | 7.34 | 7.49 | 7.64 | 7.79 | 7.95 | 168.65 |
| | | | | | | | | | | | | |
| 6.42 | 6.55 | 6.68 | 6.81 | 6.95 | 7.09 | 7.23 | 7.37 | 7.52 | 7.67 | 7.82 | 7.98 | 169.36 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.15 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25.50 |
| | | | | | | | | | | | | |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 25.65 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 0.09 | 0.09 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.11 | 0.11 | 0.11 | 0.11 | 0.11 | 2.07 |
| 16.01 | 16.33 | 16.66 | 16.99 | 17.33 | 17.68 | 18.03 | 18.39 | 18.76 | 19.13 | 19.52 | 19.91 | 358.53 |
| | | | | | | | | | | | | |
| **16.1** | **16.4** | **16.8** | **17.1** | **17.4** | **17.8** | **18.1** | **18.5** | **18.9** | **19.2** | **19.6** | **20.0** | **360.6** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | 55.76 |
| 0.141393608 | 0.141393608 | 0.141393608 | 0.141393608 | 0.141393608 | 0.141393608 | 0.141393608 | 0.141393608 | 0.141393608 | 0.141393608 | 0.141393608 | 0.141393608 | 3.11 |
| | | | | | | | | | | | | **BDT 58.88** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | 61.39 |
| 0.155662688 | 0.155662688 | 0.155662688 | 0.155662688 | 0.155662688 | 0.155662688 | 0.155662688 | 0.155662688 | 0.155662688 | 0.155662688 | 0.155662688 | 0.155662688 | 3.42 |
| | | | | | | | | | | | | **BDT 64.82** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | 5.63 |
| 0.01426908 | 0.01426908 | 0.01426908 | 0.01426908 | 0.01426908 | 0.01426908 | 0.01426908 | 0.01426908 | 0.01426908 | 0.01426908 | 0.01426908 | 0.01426908 | 0.31 |
| | | | | | | | | | | | | **BDT 5.94** |
| **BDT 15.95** | **BDT 16.27** | **BDT 16.60** | **BDT 16.93** | **BDT 17.27** | **BDT 17.62** | **BDT 17.98** | **BDT 18.34** | **BDT 18.71** | **BDT 19.09** | **BDT 19.47** | **BDT 19.87** | **20.5%** |
| | | | | | | | | | | | | |
| BDT 15.96 | BDT 16.28 | BDT 16.61 | BDT 16.95 | BDT 17.29 | BDT 17.64 | BDT 17.99 | BDT 18.35 | BDT 18.72 | BDT 19.10 | BDT 19.49 | BDT 19.88 | **22.3%** |
| | | | | | | | | | | | | |
| BDT 6.40 | BDT 6.53 | BDT 6.66 | BDT 6.80 | BDT 6.93 | BDT 7.07 | BDT 7.21 | BDT 7.36 | BDT 7.50 | BDT 7.66 | BDT 7.81 | BDT 7.96 | **68.2%** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Assumptions and Workings** | | | | | | | |
| | | | | | | | | |
| 1 | Vehicle Operating Costs: See workings below | | | | | | | |
| 2 | Time Savings - See workings below | | | | | | | |
| | | | | | | | | |
| | **Economc Benefit Cost Calculation** | | | | | | | |
| | Days | 300 | | | | | | |
| | Bridges Length in Kilometers | 0.4 | source - technical team | | | | | |
| | | | **Light Vehicle** | | | **Heavy Vehicle** | | **Total** |
| | | | **Car/Taxi** | **Baby Taxi** | **Motor Cycle** | **Bus** | **Truck** | |
| | Traffic Volume | No./ Day | 10 | 100 | 150 | 0 | 0 | 260 |
| | **Without Project** | | | | | | | |
| | Operating Cost | Tk./Vehicle | 17.2 | 8 | 2.4 | 18.5 | 21 | |
| | Total Operating Cost | Tk./Year | 20,640 | 96,000 | 43,200 | - | - | 159,840 |
| | **with Project** | | | | | | | |
| | Operating Cost | Tk./Vehicle | 10 | 4 | 1.5 | 13 | 16 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Total Operating Cost | Tk./Year | 12,000 | 48,000 | 27,000 | - | - | 87,000 |
| | **Savings per Year** | | **8,640** | **48,000** | **16,200** | **-** | **-** | **72,840** |
| | | | | | | | | |
| | **Rickshaw** | **Trips** | **Minutes** | **Earnings per** | **Earning per** | | | |
| | | | **per km.** | **Km . (Tk.)** | **Minute (Tk.)** | | | |
| | **Without Project** | 5600 | | | | | | |
| | Time taken to travel | | 12.5 | 13 | 1.04 | | | |
| | | | | | | | | |
| | **with Project** | | | | | | | |
| | Time taken to travel | | 4 | 13 | 3.25 | | | |
| | | | | | | | | |
| | Benefit/saving | | 8.5 | 0 | 2.21 | | | |
| | Road length (Km) | | | | 0.4 | | | |
| | Savings per trip | | | | 7.51 | | | |
| | **Yearly Savings** | | | | | | | **12,623,520** |
| | **Damage to property due to Floods** | | | | | | | **see below** |
| | **Total Savings** | | | | | | | **12,696,360** |
| | | | | | | | | |
| | | | | | | | | |
| | **Without CCR** | | | | | | | |
| | | | | | | | | |
| | **25% less vulnerability loss reduction as compared with CCR scenario** | | | | | | | |
| | | | | | | | | |
| | **Common to both** | | | | | | | |
| 1 | Capex with CCR and without CCR as per technical team estimate | | | | | | | |
| 2 | Opex with CCR and without CCR as per technical team estimate | | | | | | | |

## 2.7. Cyclone Shelters in Galachapa paurosava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Cyclone Shelters | | | | | | | | | | | | |
| Investigator(s): | Nesar Ahmed | | | | | | | | | | | | |
| Town: | Galachipa | | | | | | | | | | | | |
| Project: | Cyclone Shelters for Town | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Full Town | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Variable 1: | | | | | | | | | | | | | |
| Economic Variable 2: | | | | | | | | | | | | | |
| Economic Variable 3: | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 25.7 | 26.2 | 26.7 | 27.2 | 27.8 | 28.3 | 28.9 | 29.5 | 30.1 | 30.7 | 31.3 | 31.9 |
| Economic Variable 2: | Saved Medical Cost | 2.2 | 2.2 | 2.3 | 2.3 | 2.4 | 2.4 | 2.5 | 2.5 | 2.6 | 2.6 | 2.7 | 2.7 |
| Economic Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **27.9** | **28.4** | **29.0** | **29.6** | **30.2** | **30.8** | **31.4** | **32.0** | **32.7** | **33.3** | **34.0** | **34.7** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Vulnerability 1: (e.g. road damage owing to floods) | | | | | | | | | | | | | |
| Economic Vulnerability 2: | | | | | | | | | | | | | |
| Economic Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 3.85 | 3.93 | 4.01 | 4.09 | 4.17 | 4.25 | 4.34 | 4.42 | 4.51 | 4.60 | 4.69 | 4.79 |
| Economic Variable 2: | Saved Medical Cost | 0.33 | 0.34 | 0.34 | 0.35 | 0.36 | 0.36 | 0.37 | 0.38 | 0.39 | 0.39 | 0.40 | 0.41 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **4.18** | **4.26** | **4.35** | **4.44** | **4.53** | **4.62** | **4.71** | **4.80** | **4.90** | **5.00** | **5.10** | **5.20** |
| **Vulnerability Impacts with Climate Change and Project** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 25.7 | 26.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 2: | Saved Medical Cost | 2.2 | 2.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **27.9** | **28.4** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 0.0 | 0.0 | 26.7 | 27.2 | 27.8 | 28.3 | 28.9 | 29.5 | 30.1 | 30.7 | 31.3 | 31.9 |
| Economic Variable 2: | Saved Medical Cost | 0.0 | 0.0 | 2.3 | 2.3 | 2.4 | 2.4 | 2.5 | 2.5 | 2.6 | 2.6 | 2.7 | 2.7 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **0.0** | **0.0** | **29.0** | **29.6** | **30.2** | **30.8** | **31.4** | **32.0** | **32.7** | **33.3** | **34.0** | **34.7** |
| | | 1000000 | | | | | | | | | | | |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 82.88 | BDT 55.25 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 0.56 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT 92.09 | BDT 61.39 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 0.62 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | BDT 9.21 | BDT 6.14 | BDT 0.00 | BDT 0.00 | BDT 0.00 | | | | | | | |
| **O & M Incremental Costs:** | | | | | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 92.09** | **-BDT 61.39** | **BDT 28.37** | **BDT 28.95** | **BDT 29.55** | **BDT 30.15** | **BDT 30.77** | **BDT 31.39** | **BDT 32.03** | **BDT 32.69** | **BDT 33.35** | **BDT 34.03** |
| | | | | | | | | | | | | | |
| **Project without CC Net Economic Flows** | | -BDT 82.88 | -BDT 55.25 | BDT 24.09 | BDT 24.58 | BDT 25.08 | BDT 25.60 | BDT 26.12 | BDT 26.65 | BDT 27.20 | BDT 27.75 | BDT 28.32 | BDT 28.90 |
| | | | | | | | | | | | | | |
| **Project ONLY CC Net Economic Flows** | | -BDT 9.21 | -BDT 6.14 | BDT 4.29 | BDT 4.31 | BDT 4.40 | BDT 4.49 | BDT 4.58 | BDT 4.68 | BDT 4.77 | BDT 4.87 | BDT 4.97 | BDT 5.07 |

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| | | | | | | | | | | |
| **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **Total (Taka 2013)** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 32.6 | 33.2 | 33.9 | 34.6 | 35.2 | 36.0 | 36.7 | 37.4 | 38.2 | 38.9 | BDT 700.9 |
| 2.8 | 2.8 | 2.9 | 3.0 | 3.0 | 3.1 | 3.1 | 3.2 | 3.3 | 3.3 | BDT 59.9 |
| | | | | | | | | | | |
| **35.3** | **36.1** | **36.8** | **37.5** | **38.3** | **39.0** | **39.8** | **40.6** | **41.4** | **42.2** | **760.9** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 4.88 | 4.98 | 5.08 | 5.18 | 5.29 | 5.39 | 5.50 | 5.61 | 5.72 | 5.84 | BDT 105.1 |
| 0.42 | 0.43 | 0.43 | 0.44 | 0.45 | 0.46 | 0.47 | 0.48 | 0.49 | 0.50 | BDT 9.0 |
| | | | | | | | | | | |
| **5.30** | **5.41** | **5.52** | **5.63** | **5.74** | **5.85** | **5.97** | **6.09** | **6.21** | **6.34** | **114.13** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 51.9 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 4.4 |
| | | | | | | | | | | 0 |
| | | | | | | | | | | 0.0 |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **56.3** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 32.6 | 33.2 | 33.9 | 34.6 | 35.2 | 36.0 | 36.7 | 37.4 | 38.2 | 38.9 | BDT 649.1 |
| 2.8 | 2.8 | 2.9 | 3.0 | 3.0 | 3.1 | 3.1 | 3.2 | 3.3 | 3.3 | BDT 55.5 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **35.3** | **36.1** | **36.8** | **37.5** | **38.3** | **39.0** | **39.8** | **40.6** | **41.4** | **42.2** | **704.6** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 138.1 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 11.2 |
| | | | | | | | | | | **BDT 149.34** |
| | | | | | | | | | | |
| | | | | | BDT 0.00 | | | | | BDT 153.5 |
| BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 12.5 |
| | | | | | | | | | | **BDT 165.93** |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 15.3 |
| BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 1.2 |
| | | | | | | | | | | **BDT 16.53** |
| **BDT 34.72** | **BDT 35.43** | **BDT 36.15** | **BDT 36.89** | **BDT 37.64** | **BDT 38.40** | **BDT 39.18** | **BDT 39.98** | **BDT 40.79** | **BDT 41.62** | 18% |
| | | | | | | | | | | |
| BDT 29.49 | BDT 30.09 | BDT 30.70 | BDT 31.32 | BDT 31.96 | BDT 32.61 | BDT 33.28 | BDT 33.95 | BDT 34.64 | BDT 35.35 | 17% |
| | | | | | | | | | | |
| BDT 5.18 | BDT 5.28 | BDT 5.39 | BDT 5.50 | BDT 5.61 | BDT 5.73 | BDT 5.85 | BDT 5.97 | BDT 6.09 | BDT 6.21 | 26% |

| | | | | | |
|---|---|---|---|---|---|
| | **Assumptions for With CCR** | | | | |
| 1 | Saved Income Loss - See Workings below | | | | |
| 2 | Saved Medical Cost - See Workings Below | | | | |
| | | | | | |
| | **Assumptions for Without CCR** | | | | |
| 1 | Saved Income Loss - See Workings below | | | | |
| 2 | Saved Medical Cost - See Workings Below | | | | |
| | | | | | |
| | **Common to both** | | | | |
| 1 | Capex with CCR and without CCR as per technical team estimate | | | | |
| 2 | Opex with CCR and without CCR as per technical team estimate | | | | |
| | | | | | |
| | **Economc Benefit Cost Calculation - With CCR** | | | | |
| | Number of cyclone shelters | 6 | | | |
| | Capacity of cyclone shelters | 1300 | | | |
| | | | | | |
| | Monthly HH Income | BDT | 13167 | | |
| | HH Size | Number | 4 | | |
| | Number of days saved | Number | 15 | | |
| | Additional persons accessing CS | Number | 7800 | | |
| | Number of cyclones per year | Number | 2 | | |
| | Saved Medical Cost per HH | BDT | 1126 | | |
| | | | | | |
| | **Savings:** | | | | |
| | Loss of Income per cyclone | BDT | **12,837,825** | | |
| | Medical Cost Per cyclone | BDT | **1,097,850** | | |
| | | | | | |
| | **Yearly Savings** | | | | **27,871,350** |
| | **Total Savings** | | | | **27,871,350** |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | **Economc Benefit Cost Calculation - Without CCR** | | | | |
| | Number of cyclone shelters | **6** | | | |
| | Capacity of cyclone shelters | **1105** | | | |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| | Monthly HH Income | BDT | 13167 | | |
| | HH Size | Number | 4 | | |
| | Number of days saved | Number | 15 | | |
| | Additional persons accessing CS | Number | 6630 | | |
| | Number of cyclones per year | Number | 2 | | |
| | Saved Medical Cost per HH | BDT | 1126 | | |
| | | | | | |
| | **Savings:** | | | | |
| | Loss of Income per HH | BDT | **10,912,151** | | |
| | Medical Cost Per HH | BDT | **933,173** | | |
| | | | | | |
| | **Yearly Savings** | | | | **23,690,648** |
| | **Total Savings** | | | | **23,690,648** |

## 2.8. Boat Landing Stations in Galachipa Paurasava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Boat Landing Stations | | | | | | | | | | | | |
| Investigator(s): | Nesar Ahmed | | | | | | | | | | | | |
| Town: | Galachipa | | | | | | | | | | | | |
| Project: | For Town | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Full Town | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Variable 1: | | | | | | | | | | | | | |
| Economic Variable 2: | | | | | | | | | | | | | |
| Economic Variable 3: | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Time Savings | 0.7 | 0.7 | 0.7 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.9 | 0.9 | 0.9 |
| Economic Variable 2: | Saved Medical Cost | 2.0 | 2.1 | 2.1 | 2.2 | 2.2 | 2.2 | 2.3 | 2.3 | 2.4 | 2.4 | 2.5 | 2.5 |
| Economic Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **2.7** | **2.8** | **2.9** | **2.9** | **3.0** | **3.0** | **3.1** | **3.2** | **3.2** | **3.3** | **3.3** | **3.4** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Vulnerability 1: (e.g. road damage owing to floods) | | | | | | | | | | | | | |
| Economic Vulnerability 2: | | | | | | | | | | | | | |
| Economic Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Time Savings | 0.17 | 0.17 | 0.17 | 0.18 | 0.18 | 0.19 | 0.19 | 0.19 | 0.20 | 0.20 | 0.20 | 0.21 |
| Economic Variable 2: | Saved Medical Cost | 0.47 | 0.48 | 0.49 | 0.50 | 0.51 | 0.52 | 0.53 | 0.54 | 0.55 | 0.57 | 0.58 | 0.59 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **0.64** | **0.65** | **0.67** | **0.68** | **0.69** | **0.71** | **0.72** | **0.74** | **0.75** | **0.77** | **0.78** | **0.80** |
| **Vulnerability Impacts with Climate Change and Project** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Time Savings | 0.7 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 2: | Saved Medical Cost | 2.0 | 2.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **2.7** | **2.8** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | Time Savings | 0.0 | 0.0 | 0.7 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.9 | 0.9 | 0.9 |
| Economic Variable 2: | Saved Medical Cost | 0.0 | 0.0 | 2.1 | 2.2 | 2.2 | 2.2 | 2.3 | 2.3 | 2.4 | 2.4 | 2.5 | 2.5 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **0.0** | **0.0** | **2.9** | **2.9** | **3.0** | **3.0** | **3.1** | **3.2** | **3.2** | **3.3** | **3.3** | **3.4** |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 3.87 | BDT 2.58 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT 4.30 | BDT 2.86 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | BDT 0.02 | BDT 0.02 | BDT 0.02 | BDT 0.02 | BDT 0.02 | BDT 0.02 | BDT 0.02 | BDT 0.02 | BDT 0.02 | BDT 0.02 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | BDT | BDT | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0.43 | 0.29 | | | | | | | | | | |
| **O & M Incremental Costs:** | | | | | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 4.30** | **-BDT 2.86** | **BDT 2.84** | **BDT 2.90** | **BDT 2.96** | **BDT 3.01** | **BDT 3.08** | **BDT 3.14** | **BDT 3.20** | **BDT 3.26** | **BDT 3.33** | **BDT 3.40** |
| **Project without CC Net Economic Flows** | | -BDT 3.87 | -BDT 2.58 | BDT 2.18 | BDT 2.23 | BDT 2.27 | BDT 2.32 | BDT 2.37 | BDT 2.41 | BDT 2.46 | BDT 2.51 | BDT 2.56 | BDT 2.61 |
| **Project ONLY CC Net Economic Flows** | | -BDT 0.43 | -BDT 0.29 | BDT 0.66 | BDT 0.66 | BDT 0.67 | BDT 0.68 | BDT 0.70 | BDT 0.71 | BDT 0.73 | BDT 0.74 | BDT 0.76 | BDT 0.77 |

| 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | Total (Taka 2013) |
|---|---|---|---|---|---|---|---|---|---|---|
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| 0.9 | 0.9 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.1 | 1.1 | BDT 19.7 |
| 2.6 | 2.6 | 2.7 | 2.7 | 2.8 | 2.8 | 2.9 | 3.0 | 3.0 | 3.1 | BDT 55.3 |
| | | | | | | | | | | |
| **3.5** | **3.6** | **3.6** | **3.7** | **3.8** | **3.8** | **3.9** | **4.0** | **4.1** | **4.2** | **75.0** |
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| 0.21 | 0.22 | 0.22 | 0.23 | 0.23 | 0.24 | 0.24 | 0.24 | 0.25 | 0.25 | BDT 4.6 |
| 0.60 | 0.61 | 0.62 | 0.64 | 0.65 | 0.66 | 0.68 | 0.69 | 0.70 | 0.72 | BDT 12.9 |
| | | | | | | | | | | |
| **0.81** | **0.83** | **0.85** | **0.86** | **0.88** | **0.90** | **0.92** | **0.93** | **0.95** | **0.97** | **17.50** |
| | | | | | | | | | | |
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| | | | | | | | | | | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 1.5 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 4.1 |
| | | | | | | | | | | 0 |
| | | | | | | | | | | 0.0 |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **5.5** |
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| | | | | | | | | | | |
| 0.9 | 0.9 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.1 | 1.1 | BDT 18.2 |
| 2.6 | 2.6 | 2.7 | 2.7 | 2.8 | 2.8 | 2.9 | 3.0 | 3.0 | 3.1 | BDT 51.2 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **3.5** | **3.6** | **3.6** | **3.7** | **3.8** | **3.8** | **3.9** | **4.0** | **4.1** | **4.2** | **69.4** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 6.4 |
| BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.1 |
| | | | | | | | | | | **BDT 6.58** |
| | | | | | | | | | | |
| | | | | | BDT 0.00 | | | | | BDT 7.2 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| BDT 0.02 | BDT 0.02 | BDT 0.02 | BDT 0.02 | BDT 0.02 | BDT 0.02 | BDT 0.02 | BDT 0.02 | BDT 0.02 | BDT 0.02 | BDT 0.4 |
| | | | | | | | | | | **BDT 7.53** |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 0.7 |
| BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.2 |
| | | | | | | | | | | **BDT 0.94** |
| **BDT 3.47** | **BDT 3.54** | **BDT 3.61** | **BDT 3.68** | **BDT 3.75** | **BDT 3.83** | **BDT 3.90** | **BDT 3.98** | **BDT 4.06** | **BDT 4.15** | 35% |
| | | | | | | | | | | |
| BDT 2.66 | BDT 2.72 | BDT 2.77 | BDT 2.83 | BDT 2.88 | BDT 2.94 | BDT 3.00 | BDT 3.06 | BDT 3.12 | BDT 3.19 | 30% |
| | | | | | | | | | | |
| BDT 0.79 | BDT 0.81 | BDT 0.82 | BDT 0.84 | BDT 0.86 | BDT 0.87 | BDT 0.89 | BDT 0.91 | BDT 0.93 | BDT 0.95 | 67% |

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|---|---|---|---|---|---|
| | **Assumptions for With CCR** | | | | |
| 1 | Time Savings - See Workings below | | | | |
| 2 | Saved Medical Cost - See Workings Below | | | | |
| | | | | | |
| | **Assumptions for Without CCR** | | | | |
| 1 | Time Savings - See Workings below | | | | |
| 2 | Saved Medical Cost - See Workings Below | | | | |
| | | | | | |
| | **Common to both** | | | | |
| 1 | Capex with CCR and without CCR as per technical team estimate | | | | |
| 2 | Opex with CCR and without CCR as per technical team estimate | | | | |
| | | | | | |
| | | | | | |
| | **Economc Benefit Cost Calculation - With CCR** | | | | |
| | Number of Boat Landings | 40 | | | |
| | Capacity of Boat Landings | 30 | | | |
| | | | | | |
| | Monthly HH Income | BDT | 13167 | | |
| | HH Size | Number | 4.3 | | |
| | Number of days travel | Number | 300 | | |
| | Additional persons accessing BLS | Number | 1200 | | |
| | Time saved per person | minutes | 2 | | |
| | Saved Medical Cost per HH | BDT | 1126 | | |
| | Avoided injury | % | 0.5 | | |
| | **Savings:** | | | | |
| | Time Savings per person per year | BDT | **2** | | |
| | Medical Cost Savings per person per year | BDT | **6** | | |
| | **Yearly Time Savings** | | | | **720,000** |
| | **Yearly Medical Cost Savings** | | | | **2,026,800** |
| | **Total Savings** | | | | **2,746,800** |
| | | | | | |
| | | | | | |
| | | | | | |
| | **Economc Benefit Cost Calculation Without CCR** | | | | |
| | Indicator B4 Leverage PPCR funds against public/private investments in sector | 40 | | | |
| | Indicator B5 Quality/extent climate instruments/investment models developed and tested | 23 | | | |
| | | | | | |
| | Monthly HH Income | BDT | 13167 | | |

| | | | | | |
|---|---|---|---|---|---|
| | HH Size | Number | 4.3 | | |
| | Number of days travel | Number | 300 | | |
| | Additional persons accessing BLS | Number | 920 | | |
| | Time saved per person | minutes | 2 | | |
| | Saved Medical Cost per HH | BDT | 1126 | | |
| | Avoided injury | % | 0.5 | | |
| | **Savings:** | | | | |
| | Time Savings per person per year | BDT | **2** | | |
| | Medical Cost Savings per person per year | BDT | **6** | | |
| | **Yearly Time Savings** | | | | **552,000** |
| | **Yearly Medical Cost Savings** | | | | **1,553,880** |
| | **Total Savings** | | | | **2,105,880** |

## 2.9. Markets in Galachipa Paurasova

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Markets | | | | | | | | | | | | |
| Investigator(s): | Nesar Ahmed | | | | | | | | | | | | |
| Town: | Galachipa | | | | | | | | | | | | |
| Project: | For Town | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Full Town | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Variable 1: | | | | | | | | | | | | | |
| Economic Variable 2: | | | | | | | | | | | | | |
| Economic Variable 3: | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Save Business Income Loss | 4.9 | 5.0 | 5.1 | 5.2 | 5.3 | 5.4 | 5.5 | 5.6 | 5.8 | 5.9 | 6.0 | 6.1 |
| Economic Variable 2: | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **4.9** | **5.0** | **5.1** | **5.2** | **5.3** | **5.4** | **5.5** | **5.6** | **5.8** | **5.9** | **6.0** | **6.1** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Vulnerability 1: (e.g. road damage owing to floods) | | | | | | | | | | | | | |
| Economic Vulnerability 2: | | | | | | | | | | | | | |
| Economic Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Save Business Income Loss | 1.02 | 1.04 | 1.07 | 1.09 | 1.11 | 1.13 | 1.15 | 1.18 | 1.20 | 1.22 | 1.25 | 1.27 |
| Economic Variable 2: | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **1.02** | **1.04** | **1.07** | **1.09** | **1.11** | **1.13** | **1.15** | **1.18** | **1.20** | **1.22** | **1.25** | **1.27** |
| **Vulnerability Impacts with Climate Change and Project** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Save Business Income Loss | 4.9 | 5.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 2: | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **4.9** | **5.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | Time Savings | 0.0 | 0.0 | 5.1 | 5.2 | 5.3 | 5.4 | 5.5 | 5.6 | 5.8 | 5.9 | 6.0 | 6.1 |
| Economic Variable 2: | Saved Medical Cost | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **0.0** | **0.0** | **5.1** | **5.2** | **5.3** | **5.4** | **5.5** | **5.6** | **5.8** | **5.9** | **6.0** | **6.1** |
| | | | | | | | | | | | | | |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 7.24 | BDT 4.83 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT 7.98 | BDT 5.32 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | BDT 0.74 | BDT 0.49 | | | | | | | | | | |
| **O & M Incremental Costs:** | | | | | BDT 0.04 | BDT 0.04 | BDT 0.04 | BDT 0.04 | BDT 0.04 | BDT 0.04 | BDT 0.04 | BDT 0.04 | BDT 0.04 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 7.98** | **-BDT 5.32** | **BDT 5.05** | **BDT 5.15** | **BDT 5.25** | **BDT 5.36** | **BDT 5.47** | **BDT 5.58** | **BDT 5.69** | **BDT 5.81** | **BDT 5.92** | **BDT 6.04** |
| **Project without CC Net Economic Flows** | | -BDT 7.24 | -BDT 4.83 | BDT 4.02 | BDT 4.10 | BDT 4.18 | BDT 4.27 | BDT 4.35 | BDT 4.44 | BDT 4.53 | BDT 4.62 | BDT 4.71 | BDT 4.81 |
| **Project ONLY CC Net Economic Flows** | | -BDT 0.74 | -BDT 0.49 | BDT 1.03 | BDT 1.01 | BDT 1.03 | BDT 1.06 | BDT 1.08 | BDT 1.10 | BDT 1.13 | BDT 1.15 | BDT 1.17 | BDT 1.20 |

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| **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **Total (Taka 2013)** |
| | | | | | | | | | | |
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| | | | | | | | | | | |
| 6.2 | 6.4 | 6.5 | 6.6 | 6.7 | 6.9 | 7.0 | 7.2 | 7.3 | 7.5 | BDT 134.2 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 0.0 |
| | | | | | | | | | | |
| **6.2** | **6.4** | **6.5** | **6.6** | **6.7** | **6.9** | **7.0** | **7.2** | **7.3** | **7.5** | **134.2** |
| | | | | | | | | | | |
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| | | | | | | | | | | |
| 1.30 | 1.32 | 1.35 | 1.38 | 1.41 | 1.43 | 1.46 | 1.49 | 1.52 | 1.55 | BDT 28.0 |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | BDT 0.0 |
| | | | | | | | | | | |
| **1.30** | **1.32** | **1.35** | **1.38** | **1.41** | **1.43** | **1.46** | **1.49** | **1.52** | **1.55** | **27.96** |
| | | | | | | | | | | |
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| | | | | | | | | | | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 9.9 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 0.0 |
| | | | | | | | | | | 0 |
| | | | | | | | | | | 0.0 |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **9.9** |
| | | | | | | | | | | |
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| | | | | | | | | | | |
| 6.2 | 6.4 | 6.5 | 6.6 | 6.7 | 6.9 | 7.0 | 7.2 | 7.3 | 7.5 | BDT 124.3 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 0.0 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **6.2** | **6.4** | **6.5** | **6.6** | **6.7** | **6.9** | **7.0** | **7.2** | **7.3** | **7.5** | **124.3** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 12.1 |
| BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.6 |
| | | | | | | | | | | **BDT 12.69** |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | BDT 0.00 | | | | | BDT 13.3 |
| BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 1.3 |
| | | | | | | | | | | **BDT 14.65** |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 1.2 |
| BDT 0.04 | BDT 0.04 | BDT 0.04 | BDT 0.04 | BDT 0.04 | BDT 0.04 | BDT 0.04 | BDT 0.04 | BDT 0.04 | BDT 0.04 | BDT 0.7 |
| | | | | | | | | | | **BDT 1.93** |
| **BDT 6.17** | **BDT 6.29** | **BDT 6.42** | **BDT 6.55** | **BDT 6.68** | **BDT 6.82** | **BDT 6.95** | **BDT 7.09** | **BDT 7.24** | **BDT 7.38** | 33% |
| | | | | | | | | | | |
| BDT 4.90 | BDT 5.00 | BDT 5.10 | BDT 5.21 | BDT 5.31 | BDT 5.42 | BDT 5.53 | BDT 5.64 | BDT 5.75 | BDT 5.87 | 30% |
| | | | | | | | | | | |
| BDT 1.23 | BDT 1.25 | BDT 1.28 | BDT 1.30 | BDT 1.33 | BDT 1.36 | BDT 1.39 | BDT 1.42 | BDT 1.45 | BDT 1.48 | 62% |

| | | | | | |
|---|---|---|---|---|---|
| | **Assumptions for With CCR** | | | | |
| 1 | Save Business Income Loss - See Workings below | | | | |
| | | | | | |
| | | | | | |
| | **Assumptions for Without CCR** | | | | |
| 1 | Save Business Income Loss - See Workings below | | | | |
| | | | | | |
| | | | | | |
| | **Common to both** | | | | |
| 1 | Capex with CCR and without CCR as per technical team estimate | | | | |
| 2 | Opex with CCR and without CCR as per technical team estimate | | | | |
| | | | | | |
| | | | | | |
| | **Economc Benefit Cost Calculation - With CCR** | | | | |
| | Number of Markets | 1 | | | |
| | Number of Traders | 24 | | | |
| | | | | | |
| | Monthly HH Expenditure | BDT | 11834 | | |
| | HH Size | Number | 4.3 | | |
| | Number of days shopping | Number | 300 | | |
| | Additional HHs accessing Market | Number/day | 72 | | |
| | % of Expenditure spent in Market | % | 50% | | |
| | | | | | |
| | | | | | |
| | **Savings:** | | | | |
| | Average business generated in a day | BDT | **16,386** | | |
| | | | | | |
| | **Yearly Buiness Income Loss Savings** | | | | **4,915,662** |
| | | | | | **-** |
| | **Total Savings** | | | | **4,915,662** |
| | | | | | |
| | | | | | |
| | | | | | |
| | **Economc Benefit Cost Calculation Without CCR** | | | | |
| | Indicator B4 Leverage PPCR funds against public/private investments in sector | 1 | | | |
| | Indicator B5 Quality/extent climate instruments/investment models developed and tested | 19 | | | |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| | Monthly HH Expenditure | BDT | 11834 | | |
| | HH Size | Number | 4.3 | | |
| | Number of days shopping | Number | 300 | | |
| | Additional HHs accessing Market | Number/day | 57 | | |
| | % of Expenditure spent in Market | % | 50% | | |
| | | | | | |
| | | | | | |
| | **Savings:** | | | | |
| | Economic Variable 2: | BDT | **12,972** | | |
| | | | | | |
| | **Yearly Buiness Income Loss Savings** | | | | **3,891,565** |
| | | | | | **-** |
| | **Total Savings** | | | | **3,891,565** |

## 2.10. Bus Terminal in Galachipa Pauarasava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Bus Terminal | | | | | | | | | | | | |
| Investigator(s): | Nesar Ahmed | | | | | | | | | | | | |
| Town: | Galachipa | | | | | | | | | | | | |
| Project: | For Town | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Full Town | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Variable 1: | | | | | | | | | | | | | |
| Economic Variable 2: | | | | | | | | | | | | | |
| Economic Variable 3: | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Time Savings | 2.5 | 2.6 | 2.6 | 2.7 | 2.7 | 2.8 | 2.9 | 2.9 | 3.0 | 3.0 | 3.1 | 3.1 |
| Economic Variable 2: | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **2.5** | **2.6** | **2.6** | **2.7** | **2.7** | **2.8** | **2.9** | **2.9** | **3.0** | **3.0** | **3.1** | **3.1** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Vulnerability 1: (e.g. road damage owing to floods) | | | | | | | | | | | | | |
| Economic Vulnerability 2: | | | | | | | | | | | | | |
| Economic Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Time Savings | 0.51 | 0.52 | 0.53 | 0.54 | 0.55 | 0.56 | 0.57 | 0.58 | 0.59 | 0.61 | 0.62 | 0.63 |
| Economic Variable 2: | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **0.51** | **0.52** | **0.53** | **0.54** | **0.55** | **0.56** | **0.57** | **0.58** | **0.59** | **0.61** | **0.62** | **0.63** |
| **Vulnerability Impacts with Climate Change and Project** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Time Savings | 2.5 | 2.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 2: | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **2.5** | **2.6** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | Input from | Socioeconomic Survey | | | | | | | | | |
| Economic Variable 1: | Time Savings | 0.0 | 0.0 | 2.6 | 2.7 | 2.7 | 2.8 | 2.9 | 2.9 | 3.0 | 3.0 | 3.1 | 3.1 |
| Economic Variable 2: | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **0.0** | **0.0** | **2.6** | **2.7** | **2.7** | **2.8** | **2.9** | **2.9** | **3.0** | **3.0** | **3.1** | **3.1** |
| | | | | | | | | | | | | | |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 4.48 | BDT 2.99 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 0.76 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT | BDT 3.27 | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 4.91 | | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | BDT 0.43 | BDT 0.29 | | | | | | | | | | |
| **O & M Incremental Costs:** | | | | | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 4.91** | **-BDT 3.27** | **BDT 1.80** | **BDT 1.86** | **BDT 1.91** | **BDT 1.97** | **BDT 2.02** | **BDT 2.08** | **BDT 2.14** | **BDT 2.20** | **BDT 2.26** | **BDT 2.32** |
| | | | | | | | | | | | | | |
| **Project without CC Net Economic Flows** | | -BDT 4.48 | -BDT 2.99 | BDT 1.35 | BDT 1.39 | BDT 1.44 | BDT 1.48 | BDT 1.52 | BDT 1.57 | BDT 1.62 | BDT 1.66 | BDT 1.71 | BDT 1.76 |
| | | | | | | | | | | | | | |
| **Project ONLY CC Net Economic Flows** | | -BDT 0.43 | -BDT 0.29 | BDT 0.45 | BDT 0.39 | BDT 0.40 | BDT 0.41 | BDT 0.43 | BDT 0.44 | BDT 0.45 | BDT 0.46 | BDT 0.47 | BDT 0.48 |

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| | | | | | | | | | | |
| **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **Total (Taka 2013)** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 3.2 | 3.3 | 3.3 | 3.4 | 3.5 | 3.5 | 3.6 | 3.7 | 3.8 | 3.8 | BDT 69.1 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 0.0 |
| | | | | | | | | | | |
| **3.2** | **3.3** | **3.3** | **3.4** | **3.5** | **3.5** | **3.6** | **3.7** | **3.8** | **3.8** | **69.1** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 0.64 | 0.66 | 0.67 | 0.68 | 0.70 | 0.71 | 0.72 | 0.74 | 0.75 | 0.77 | BDT 13.8 |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | BDT 0.0 |
| | | | | | | | | | | |
| **0.64** | **0.66** | **0.67** | **0.68** | **0.70** | **0.71** | **0.72** | **0.74** | **0.75** | **0.77** | **13.82** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 5.1 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 0.0 |
| | | | | | | | | | | 0 |
| | | | | | | | | | | 0.0 |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **5.1** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 3.2 | 3.3 | 3.3 | 3.4 | 3.5 | 3.5 | 3.6 | 3.7 | 3.8 | 3.8 | BDT 64.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 0.0 |
| | | | | | | | | | | |
| | | | | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **3.2** | **3.3** | **3.3** | **3.4** | **3.5** | **3.5** | **3.6** | **3.7** | **3.8** | **3.8** | **64.0** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 7.5 |
| BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 15.2 |
| | | | | | | | | | | **BDT 22.62** |
| | | | | | | | | | | |
| | | | | | BDT 0.00 | | | | | BDT 8.2 |
| BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 16.6 |
| | | | | | | | | | | **BDT 24.79** |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 0.7 |
| BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 1.4 |
| | | | | | | | | | | **BDT 2.10** |
| **BDT 2.38** | **BDT 2.45** | **BDT 2.51** | **BDT 2.58** | **BDT 2.65** | **BDT 2.72** | **BDT 2.79** | **BDT 2.86** | **BDT 2.93** | **BDT 3.01** | 22% |
| | | | | | | | | | | |
| BDT 1.81 | BDT 1.86 | BDT 1.92 | BDT 1.97 | BDT 2.02 | BDT 2.08 | BDT 2.14 | BDT 2.19 | BDT 2.25 | BDT 2.31 | 18% |
| | | | | | | | | | | |
| BDT 0.50 | BDT 0.51 | BDT 0.52 | BDT 0.54 | BDT 0.55 | BDT 0.56 | BDT 0.58 | BDT 0.59 | BDT 0.61 | BDT 0.62 | 47% |

| | | | | | |
|---|---|---|---|---|---|
| | **Assumptions for With CCR** | | | | |
| 1 | Save Business Income Loss - See Workings below | | | | |
| | | | | | |
| | | | | | |
| | **Assumptions for Without CCR** | | | | |
| 1 | Save Business Income Loss - See Workings below | | | | |
| | | | | | |
| | | | | | |
| | **Common to both** | | | | |
| 1 | Capex with CCR and without CCR as per technical team estimate | | | | |
| 2 | Opex with CCR and without CCR as per technical team estimate | | | | |
| | | | | | |
| | | | | | |
| | **Economc Benefit Cost Calculation - With CCR** | | | | |
| | Number of Bus Terminal | 1 | | | |
| | Number of Buses - Additional | 40 | | | |
| | | | | | |
| | Monthly HH Income | BDT | 13167 | | |
| | HH Size | Number | 4.3 | | |
| | Number of days travel | Number | 300 | | |
| | Number of passengers per bus | Number/day | 40 | | |
| | Time savings | minute | 5.00 | | |
| | | | | | |
| | | | | | |
| | **Savings:** | | | | |
| | Average time savings in a day | BDT | **211** | | |
| | | | | | |
| | **Yearly Time Savings** | | | | **2,532,115** |
| | | | | | **-** |
| | **Total Savings** | | | | **2,532,115** |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | **Economc Benefit Cost Calculation Without CCR** | | | | |

| | | | | | |
|---|---|---|---|---|---|
| | Number of Bus Terminal | 1 | | | |
| | Number of Buses - Additional | 32 | | | |
| | | | | | |
| | Monthly HH Income | BDT | 13167 | | |
| | HH Size | Number | 4.3 | | |
| | Number of days travel | Number | 300 | | |
| | Number of passengers per bus | Number/day | 40 | | |
| | Time savings | minute | 5 | | |
| | | | | | |
| | | | | | |
| | **Savings:** | | | | |
| | Average time savings in a day | BDT | **211** | | |
| | | | | | |
| | **Yearly Time Savings** | | | | **2,025,692** |
| | **Yearly Medical Cost Savings** | | | | **-** |
| | **Total Savings** | | | | **2,025,692** |

## 1.1. Water supply in Mathbaria Paurashava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Water Supply | | | | | | | | | | | | |
| Investigator(s): | Zhangir | | | | | | | | | | | | |
| Town: | Mathbaria | | | | | | | | | | | | |
| Project: | Water Supply for Town | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | 85% of the town population covered under piped water supply system | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2,015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | None | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | **Time to fetch water** | 18.41 | 20.21 | 22.07 | 23.98 | 24.42 | 24.89 | 25.36 | 25.83 | 26.30 | 26.77 | 27.24 | 27.71 |
| Economic Variable 2: | **Cost of storage tanks including cleaning** | 10.65 | 1.04 | 1.07 | 1.10 | 0.25 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 |
| Economic Variable 3: | **Cost of water purification** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Economic Variable 4: | **Purchase costs of water** | 24.49 | 26.88 | 29.35 | 31.89 | 32.47 | 33.09 | 33.72 | 34.35 | 34.97 | 35.60 | 36.22 | 36.85 |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **53.5** | **48.1** | **52.5** | **57.0** | **57.1** | **58.3** | **59.4** | **60.4** | **61.5** | **62.6** | **63.7** | **64.8** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | **Time to fetch water** | 3.5 | 3.9 | 4.2 | 4.6 | 4.7 | 4.7 | 4.8 | 4.9 | 5.0 | 5.1 | 5.2 | 5.3 |
| Economic Variable 2: | **Cost of storage tanks including cleaning** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 3: | **Cost of water purification** | | | | | | | | | | | | |
| Economic Variable 4: | **Purchase costs of water** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **3.5** | **3.9** | **4.2** | **4.6** | **4.7** | **4.7** | **4.8** | **4.9** | **5.0** | **5.1** | **5.2** | **5.3** |
| **Vulnerability Impacts with Climate Change and Project** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | **Time to fetch water** | 18.4 | 20.2 | 22.1 | 0.0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Economic Variable 2: | **Cost of storage tanks including cleaning** | 10.6 | 1.0 | 1.1 | 0.0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Economic Variable 3: | **Cost of water purification** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Economic Variable 4: | **Purchase costs of water** | 24.5 | 26.9 | 29.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **53.5** | **48.1** | **52.5** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | **Time to fetch water** | 0.0 | 0.0 | 0.0 | 24.0 | 24.4 | 24.9 | 25.4 | 25.8 | 26.3 | 26.8 | 27.2 | 27.7 |
| Economic Variable 2: | **Cost of storage tanks including cleaning** | 0.0 | 0.0 | 0.0 | 1.1 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| Economic Variable 3: | **Cost of water purification** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 4: | **Purchase costs of water** | 0.0 | 0.0 | 0.0 | 31.9 | 32.5 | 33.1 | 33.7 | 34.3 | 35.0 | 35.6 | 36.2 | 36.8 |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **0.0** | **0.0** | **0.0** | **57.0** | **57.1** | **58.3** | **59.4** | **60.4** | **61.5** | **62.6** | **63.7** | **64.8** |
| | | 1000 | | | | | | | | | | | |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 59.03 | BDT 118.07 | BDT 118.07 | BDT 0.00 | | | | | | | | |
| **O & M without CC Adaptation:** | | **BDT 0.00** | 0 | BDT 0.00 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT 73.67 | BDT 147.33 | BDT 147.33 | BDT 0.00 | | | | | | | | |
| **O & M with CC Adaptation:** | | **BDT 0.00** | 0 | BDT 0.00 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CAPEX Project Incremental Costs** | | BDT 14.63 | BDT 29.27 | BDT 29.27 | BDT 0.00 | BDT 0.00 | | | | | | | |
| **O & M Incremental Costs:** | | | | | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 73.67** | **-BDT 147.33** | **-BDT 147.33** | **BDT 52.55** | **BDT 52.72** | **BDT 53.83** | **BDT 54.93** | **BDT 56.03** | **BDT 57.12** | **BDT 58.22** | **BDT 59.31** | **BDT 60.41** |
| | | | | | | | | | | | | | |
| **Project without CC Net Economic Flows** | | -BDT 59.03 | -BDT 118.07 | -BDT 118.07 | BDT 48.52 | BDT 48.61 | BDT 49.63 | BDT 50.64 | BDT 51.65 | BDT 52.65 | BDT 53.66 | BDT 54.67 | BDT 55.67 |
| **Project ONLY CC Net Economic Flows** | | -BDT 14.63 | -BDT 29.27 | -BDT 29.27 | BDT 4.03 | BDT 4.11 | BDT 4.20 | BDT 4.29 | BDT 4.38 | BDT 4.47 | BDT 4.56 | BDT 4.65 | BDT 4.74 |

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| **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **2036** | **2037** | **2038** | **2039** | **2040** | **2041** | **2042** | **Total (Taka 2013)** |
| | | | | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | | | | |
| 28.18 | 28.65 | 30.94 | 31.54 | 32.14 | 32.73 | 33.33 | 33.93 | 34.52 | 35.12 | 35.71 | 38.45 | 39.08 | 39.72 | 40.37 | 41.04 | 41.71 | 890.34 |
| 0.27 | 0.27 | 1.32 | 0.34 | 0.34 | 0.34 | 0.34 | 0.34 | 0.00 | 0.34 | 0.34 | 1.58 | 0.37 | 0.37 | 0.38 | 0.38 | 0.39 | 23.78 |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 37.48 | 38.10 | 41.15 | 41.94 | 42.73 | 43.53 | 44.32 | 45.11 | 45.91 | 46.70 | 47.49 | 51.13 | 51.97 | 52.82 | 53.69 | 54.57 | 55.47 | 1183.97 |
| **65.9** | **67.0** | **73.4** | **73.8** | **75.2** | **76.6** | **78.0** | **79.4** | **80.4** | **82.2** | **83.6** | **91.2** | **91.4** | **92.9** | **94.4** | **96.0** | **97.6** | **2098.1** |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 5.4 | 5.5 | 5.9 | 6.0 | 6.1 | 6.2 | 6.3 | 6.5 | 6.6 | 6.7 | 6.8 | 7.3 | 7.4 | 7.6 | 7.7 | 7.8 | 7.9 | 169.59 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00 |
| | | | | | | | | | | | | | | | | | 0.00 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00 |
| **5.4** | **5.5** | **5.9** | **6.0** | **6.1** | **6.2** | **6.3** | **6.5** | **6.6** | **6.7** | **6.8** | **7.3** | **7.4** | **7.6** | **7.7** | **7.8** | **7.9** | **169.6** |
| | | | | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 60.70 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12.76 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 80.71 |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **154.2** |
| | | | | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | | | | |
| 28.2 | 28.7 | 30.9 | 31.5 | 32.1 | 32.7 | 33.3 | 33.9 | 34.5 | 35.1 | 35.7 | 38.4 | 39.1 | 39.7 | 40.4 | 41.0 | 41.7 | 829.64 |
| 0.3 | 0.3 | 1.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.0 | 0.3 | 0.3 | 1.6 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 11.01 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00 |
| 37.5 | 38.1 | 41.1 | 41.9 | 42.7 | 43.5 | 44.3 | 45.1 | 45.9 | 46.7 | 47.5 | 51.1 | 52.0 | 52.8 | 53.7 | 54.6 | 55.5 | 1103.26 |
| **65.9** | **67.0** | **73.4** | **73.8** | **75.2** | **76.6** | **78.0** | **79.4** | **80.4** | **82.2** | **83.6** | **91.2** | **91.4** | **92.9** | **94.4** | **96.0** | **97.6** | **1943.9** |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | 295.17 |
| BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | 100.93 |
| | | | | | | | | | | **3.9** | | | | | | | **BDT 396.10** |
| | | | | | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | 368.33 |
| BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | 114.97 |
| | | | | | | | | | | **4.4** | | | | | | | **BDT 483.31** |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | 73.16 |
| BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | 14.04 |
| | | | | | | | | | | **0.5** | | | | | | | **BDT 87.20** |
| **BDT 61.51** | **BDT 62.60** | **BDT 68.99** | **BDT 69.40** | **BDT 70.79** | **BDT 72.18** | **BDT 73.57** | **BDT 74.96** | **BDT 76.01** | **BDT 77.74** | **BDT 79.13** | **BDT 86.73** | **BDT 86.99** | **BDT 88.49** | **BDT 90.02** | **BDT 91.57** | **BDT 93.14** | 14% |
| | | | | | | | | | | | | | | | | | |
| BDT 56.68 | BDT 57.69 | BDT 63.64 | BDT 63.94 | BDT 65.21 | BDT 66.49 | BDT 67.76 | BDT 69.04 | BDT 69.97 | BDT 71.59 | BDT 72.87 | BDT 79.95 | BDT 80.08 | BDT 81.46 | BDT 82.87 | BDT 84.29 | BDT 85.74 | 16% |
| | | | | | | | | | | | | | | | | | |
| BDT 4.83 | BDT 4.92 | BDT 5.35 | BDT 5.47 | BDT 5.58 | BDT 5.69 | BDT 5.81 | BDT 5.92 | BDT 6.04 | BDT 6.15 | BDT 6.26 | BDT 6.78 | BDT 6.90 | BDT 7.03 | BDT 7.15 | BDT 7.28 | BDT 7.40 | 5% |
| | | | | | | | | | | | | | | | | | |

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|---|---|
| | **Assumptions: (with CCR)** |
| 1 | Time to fetch water has been assessed based on the SEWTP report timing of 21 minutes per HH |
| 2 | Cost of storage Tanks considered @ 3463 BDT as per SEWTP report for HHs shifting to piped water supply |
| 3 | Cost of purification - BDT 0 per month per HH as per SEWTP report - not considered |
| 4 | Purchase of water @ 237 BDT per KL - 20% used for drinking purpose - Pourashava |
| | |
| | **Assumptions: (without CCR)** |
| 1 | Time to fetch water has been assessed based on the SEWTP report timing of 21 minutes per HH - **20% less vulnerability loss reduction as compared with CCR scenario** |
| 2 | Cost of storage Tanks considered @ 3463 BDT as per SEWTP report for HHs shifting to piped water supply - **No Change** |
| 3 | Cost of purification - Not Applicable |
| 4 | Purchase of water @ 237 BDT per KL - 20% used for drinking purpose **- 20% less vulnerability loss reduction as compared with CCR scenario** |
| | |
| | **Common to both** |
| 1 | Capex with CCR and without CCR as per technical team estimate |
| 2 | Opex with CCR and without CCR as per technical team estimate |
| | |

# 1.2. Sanitation in Mathbaria Paurashava

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Sanitation | | | | | | | | | | | | |
| Investigator(s): | Zhangir | | | | | | | | | | | | |
| Town: | Mathbaria | | | | | | | | | | | | |
| Project: | Sanitation for Town | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | part of town | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Variable 1: | | | | | | | | | | | | | |
| Economic Variable 2: | | | | | | | | | | | | | |
| Economic Variable 3: | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 1.6 | 1.6 | 1.6 | 1.7 | 1.7 | 1.7 | 1.8 | 1.8 | 1.8 | 1.9 | 1.9 | 1.9 |
| Economic Variable 2: | Saved Medical Cost | 4.2 | 4.3 | 4.4 | 4.5 | 4.5 | 4.6 | 4.7 | 4.8 | 4.9 | 5.0 | 5.1 | 5.2 |
| Economic Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **5.8** | **5.9** | **6.0** | **6.1** | **6.2** | **6.4** | **6.5** | **6.6** | **6.7** | **6.9** | **7.0** | **7.2** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Vulnerability 1: (e.g. road damage owing to floods) | | | | | | | | | | | | | |
| Economic Vulnerability 2: | | | | | | | | | | | | | |
| Economic Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Economic Variable 2: | Saved Medical Cost | 0.63 | 0.64 | 0.66 | 0.67 | 0.68 | 0.70 | 0.71 | 0.72 | 0.74 | 0.75 | 0.77 | 0.78 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **0.63** | **0.64** | **0.66** | **0.67** | **0.68** | **0.70** | **0.71** | **0.72** | **0.74** | **0.75** | **0.77** | **0.78** |
| **Vulnerability Impacts with Climate Change and Project** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 1.6 | 1.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 2: | Saved Medical Cost | 4.2 | 4.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **5.8** | **5.9** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 0.0 | 0.0 | 1.6 | 1.7 | 1.7 | 1.7 | 1.8 | 1.8 | 1.8 | 1.9 | 1.9 | 1.9 |
| Economic Variable 2: | Saved Medical Cost | 0.0 | 0.0 | 4.4 | 4.5 | 4.5 | 4.6 | 4.7 | 4.8 | 4.9 | 5.0 | 5.1 | 5.2 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **0.0** | **0.0** | **6.0** | **6.1** | **6.2** | **6.4** | **6.5** | **6.6** | **6.7** | **6.9** | **7.0** | **7.2** |
| | | 1000000 | | | | | | | | | | | |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CAPEX Project Costs without CC Adaptation:** | | BDT 8.79 | BDT 5.86 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | BDT 0.68 | BDT 0.68 | BDT 0.68 | BDT 0.68 | BDT 0.68 | BDT 0.68 | BDT 0.68 | BDT 0.68 | BDT 0.68 | BDT 0.68 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT 9.60 | BDT 6.40 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | BDT 0.83 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | BDT 0.81 | BDT 0.54 | BDT 0.00 | BDT 0.00 | BDT 0.00 | | | | | | | |
| **O & M Incremental Costs:** | | | | | -BDT 0.13 | -BDT 0.13 | -BDT 0.13 | -BDT 0.13 | -BDT 0.13 | -BDT 0.13 | -BDT 0.13 | -BDT 0.13 | -BDT 0.13 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 9.60** | **-BDT 6.40** | **BDT 5.16** | **BDT 5.56** | **BDT 5.68** | **BDT 5.80** | **BDT 5.93** | **BDT 6.06** | **BDT 6.19** | **BDT 6.33** | **BDT 6.47** | **BDT 6.61** |
| | | | | | | | | | | | | | |
| **Project without CC Net Economic Flows** | | -BDT 8.79 | -BDT 5.86 | BDT 4.65 | BDT 4.76 | BDT 4.87 | BDT 4.98 | BDT 5.09 | BDT 5.21 | BDT 5.33 | BDT 5.45 | BDT 5.57 | BDT 5.69 |
| | | | | | | | | | | | | | |
| **Project ONLY CC Net Economic Flows** | | -BDT 0.81 | -BDT 0.54 | BDT 0.51 | BDT 0.92 | BDT 0.94 | BDT 0.95 | BDT 0.97 | BDT 0.98 | BDT 0.99 | BDT 1.01 | BDT 1.02 | BDT 1.04 |

| 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | Total (Taka 2013) |
|---|---|---|---|---|---|---|---|---|---|---|
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| | | | | | | | | | | |
| 2.0 | 2.0 | 2.1 | 2.1 | 2.1 | 2.2 | 2.2 | 2.3 | 2.3 | 2.4 | BDT 42.5 |
| 5.3 | 5.4 | 5.5 | 5.7 | 5.8 | 5.9 | 6.0 | 6.1 | 6.2 | 6.4 | BDT 114.7 |
| | | | | | | | | | | |
| **7.3** | **7.4** | **7.6** | **7.7** | **7.9** | **8.1** | **8.2** | **8.4** | **8.6** | **8.7** | **157.2** |
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| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | BDT 0.0 |
| 0.80 | 0.82 | 0.83 | 0.85 | 0.87 | 0.88 | 0.90 | 0.92 | 0.94 | 0.96 | BDT 17.2 |
| | | | | | | | | | | |
| **0.80** | **0.82** | **0.83** | **0.85** | **0.87** | **0.88** | **0.90** | **0.92** | **0.94** | **0.96** | **17.20** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 3.1 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 8.5 |
| | | | | | | | | | | 0 |
| | | | | | | | | | | 0.0 |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **11.6** |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 2.0 | 2.0 | 2.1 | 2.1 | 2.1 | 2.2 | 2.2 | 2.3 | 2.3 | 2.4 | BDT 39.3 |
| 5.3 | 5.4 | 5.5 | 5.7 | 5.8 | 5.9 | 6.0 | 6.1 | 6.2 | 6.4 | BDT 106.2 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **7.3** | **7.4** | **7.6** | **7.7** | **7.9** | **8.1** | **8.2** | **8.4** | **8.6** | **8.7** | **145.5** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 14.7 |
| BDT 0.68 | BDT 0.68 | BDT 0.68 | BDT 0.68 | BDT 0.68 | BDT 0.68 | BDT 0.68 | BDT 0.68 | BDT 0.68 | BDT 0.68 | BDT 13.6 |
| | | | | | | | | | | **28.3** |
| | | | | | | | | | | |
| | | | | | BDT 0.00 | | | | | BDT 16.0 |
| BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 11.3 |
| | | | | | | | | | | **27.3** |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 1.3 |
| -BDT 0.13 | -BDT 0.13 | -BDT 0.13 | -BDT 0.13 | -BDT 0.13 | -BDT 0.13 | -BDT 0.13 | -BDT 0.13 | -BDT 0.13 | -BDT 0.13 | -BDT 2.4 |
| | | | | | | | | | | **-1.1** |
| **BDT 6.75** | **BDT 6.89** | **BDT 7.04** | **BDT 7.20** | **BDT 7.35** | **BDT 7.51** | **BDT 7.67** | **BDT 7.83** | **BDT 8.00** | **BDT 8.17** | 30% |
| | | | | | | | | | | |
| BDT 5.82 | BDT 5.95 | BDT 6.08 | BDT 6.22 | BDT 6.36 | BDT 6.50 | BDT 6.64 | BDT 6.79 | BDT 6.94 | BDT 7.09 | 29% |
| | | | | | | | | | | |
| BDT 1.05 | BDT 1.07 | BDT 1.09 | BDT 1.10 | BDT 1.12 | BDT 1.14 | BDT 1.16 | BDT 1.17 | BDT 1.19 | BDT 1.21 | 47% |

| | |
|---|---|
| | **Assumptions for With CCR** |
| 1 | Saved Income Loss - HH monthly income - BDT 21,744, days lost due to sickness - 1.8 days considered as per SEWTP report |
| 2 | Saved Medical Cost - HH monthly expenditure on health - BDT 1061 considered as per SEWTP report @ 30% for sanitation |
| | |
| | **Assumptions for Without CCR** |
| 1 | Saved Income Loss - HH monthly income - BDT 21,744, days lost due to sickness - 1.8 days considered as per SEWTP report - NO Change |
| 2 | Saved Medical Cost - HH monthly expenditure on health - BDT 1061 considered as per SEWTP report @ 30% for sanitation - **15% less vulnerability loss reduction as compared with CCR scenario** |
| | |
| | **Common to both** |
| 1 | Capex with CCR and without CCR as per technical team estimate |
| 2 | Opex with CCR and without CCR as per technical team estimate |
| | |

# 1.3. Drainage/ Flood control in Mothbaria Paurashava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Drainage and Flood Control | | | | | | | | | | | | |
| Investigator(s): | Muhibullah / Paul Dean | | | | | | | | | | | | |
| Town: | Mathbaria | | | | | | | | | | | | |
| Project: | Drainage and Flood Control for Town | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Whole town | | | | | | | | | | | | |
| | **Year** | **Year** | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. road damage owing to floods) | Property Damage | 41.4 | 42.3 | 43.1 | 44.0 | 44.8 | 45.7 | 46.7 | 47.6 | 48.5 | 49.5 | 50.5 | 51.5 |
| Vulnerability 2: | Property Repair | 2.5 | 2.5 | 2.6 | 2.6 | 2.7 | 2.7 | 2.8 | 2.9 | 2.9 | 3.0 | 3.0 | 3.1 |
| | Property Clean Up | 13.2 | 13.4 | 13.7 | 14.0 | 14.3 | 14.5 | 14.8 | 15.1 | 15.4 | 15.7 | 16.1 | 16.4 |
| Vulnerability 3: etc…. | Road Damage / Repair | 4.0 | 4.1 | 4.2 | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.8 | 4.9 | 5.0 |
| | Agriculture Loss | 22.7 | 23.2 | 23.6 | 24.1 | 24.6 | 25.1 | 25.6 | 26.1 | 26.6 | 27.1 | 27.7 | 28.2 |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. economic damage due to delays, congestion, road closure) | Loss of Income due to sick days | 41.1 | 41.9 | 42.7 | 43.6 | 44.5 | 45.4 | 46.3 | 47.2 | 48.1 | 49.1 | 50.1 | 51.1 |
| Vulnerability 2: (e.g. extra maintenance/repair costs w.o. investment) | Loss of business income | 19.9 | 20.3 | 20.7 | 21.1 | 21.5 | 21.9 | 22.4 | 22.8 | 23.3 | 23.7 | 24.2 | 24.7 |
| Vulnerability 3: etc. | Medical Cost | 2.0 | 2.0 | 2.1 | 2.1 | 2.2 | 2.2 | 2.3 | 2.3 | 2.3 | 2.4 | 2.4 | 2.5 |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **146.7** | **149.7** | **152.7** | **155.7** | **158.8** | **162.0** | **165.2** | **168.6** | **171.9** | **175.4** | **178.9** | **182.4** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. road damage owing to floods) | Property Damage | 41.4 | 42.3 | 12.1 | 12.3 | 12.6 | 12.8 | 13.1 | 13.3 | 13.6 | 13.9 | 14.1 | 14.4 |
| Vulnerability 2: | Property Repair | 2.5 | 2.5 | 0.7 | 0.7 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.9 |
| | Property Clean Up | 13.2 | 13.4 | 3.8 | 3.9 | 4.0 | 4.1 | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 |
| Vulnerability 3: etc…. | Road Damage / Repair | 4.0 | 4.1 | 4.2 | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.8 | 4.9 | 5.0 |
| | Agriculture Loss | 22.7 | 23.2 | 23.6 | 24.1 | 24.6 | 25.1 | 25.6 | 26.1 | 26.6 | 27.1 | 27.7 | 28.2 |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. economic damage due to delays, congestion, road closure) | Loss of Income due to sick days | 41.1 | 41.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Vulnerability 2: (e.g. extra maintenance/repair costs w.o. investment) | Loss of business income | 19.9 | 20.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Vulnerability 3: etc. | Medical Cost | 2.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **146.7** | **149.7** | **44.4** | **45.3** | **46.2** | **47.1** | **48.0** | **49.0** | **50.0** | **51.0** | **52.0** | **53.0** |
| **Vulnerability Impacts with Project with CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. road damage owing to floods) | Property Damage | 41.4 | 42.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 2: | Property Repair | 2.5 | 2.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Property Clean Up | 13.2 | 13.4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 3: etc…. | Road Damage / Repair | 4.0 | 4.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Agriculture Loss | 22.7 | 23.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. economic damage due to delays, congestion, road closure) | Loss of Income due to sick days | 41.1 | 41.9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 2: (e.g. extra maintenance/repair costs w.o. investment) | Loss of business income | 19.9 | 20.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 3: etc. | Medical Cost | 2.0 | 2.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **146.7** | **149.7** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Impact of Project on Reduced Vulnerability** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced costs of road damage owing to floods) | Property Damage | 0.0 | 0.0 | 43.1 | 44.0 | 44.8 | 45.7 | 46.7 | 47.6 | 48.5 | 49.5 | 50.5 | 51.5 |
| Vulnerability 2: | Property Repair | 0.0 | 0.0 | 2.6 | 2.6 | 2.7 | 2.7 | 2.8 | 2.9 | 2.9 | 3.0 | 3.0 | 3.1 |
| Vulnerability 3: etc…. | Property Clean Up | 0.0 | 0.0 | 13.7 | 14.0 | 14.3 | 14.5 | 14.8 | 15.1 | 15.4 | 15.7 | 16.1 | 16.4 |
| | Road Damage / Repair | 0.0 | 0.0 | 4.2 | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.8 | 4.9 | 5.0 |
| | Agriculture Loss | 0.0 | 0.0 | 23.6 | 24.1 | 24.6 | 25.1 | 25.6 | 26.1 | 26.6 | 27.1 | 27.7 | 28.2 |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced economic damage due to delays, congestion, road closure) | Loss of Income due to sick days | 0.0 | 0.0 | 42.7 | 43.6 | 44.5 | 45.4 | 46.3 | 47.2 | 48.1 | 49.1 | 50.1 | 51.1 |
| Vulnerability 2: (e.g. reduced extra maintenance/repair costs versus w.o. investment) | Loss of business income | 0.0 | 0.0 | 20.7 | 21.1 | 21.5 | 21.9 | 22.4 | 22.8 | 23.3 | 23.7 | 24.2 | 24.7 |
| Vulnerability 3: etc. | Medical Cost | 0.0 | 0.0 | 2.1 | 2.1 | 2.2 | 2.2 | 2.3 | 2.3 | 2.3 | 2.4 | 2.4 | 2.5 |
| **Annual Total Reduced Damage/Loss/Extra Costs:** | | **0.0** | **0.0** | **152.7** | **155.7** | **158.8** | **162.0** | **165.2** | **168.6** | **171.9** | **175.4** | **178.9** | **182.4** |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 301.70 | BDT 201.13 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | BDT 1.35 | BDT 1.35 | BDT 1.35 | BDT 1.35 | BDT 1.35 | BDT 1.35 | BDT 1.35 | BDT 1.35 | BDT 2.65 | BDT 2.65 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT 364.03 | BDT 242.69 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | BDT 1.63 | BDT 1.63 | BDT 1.63 | BDT 1.63 | BDT 1.63 | BDT 1.63 | BDT 1.63 | BDT 1.63 | BDT 3.61 | BDT 3.61 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | BDT 62.33 | BDT 41.55 | | | | | | | | | | |
| **O & M Incremental Costs:** | | | | BDT 0.28 | BDT 0.28 | BDT 0.28 | BDT 0.28 | BDT 0.28 | BDT 0.28 | BDT 0.28 | BDT 0.28 | BDT 0.96 | BDT 0.96 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 364.03** | **-BDT 242.69** | **BDT 151.03** | **BDT 154.08** | **BDT 157.19** | **BDT 160.37** | **BDT 163.61** | **BDT 166.92** | **BDT 170.29** | **BDT 173.73** | **BDT 175.25** | **BDT 178.83** |
| | | | | | | | | | | | | | |
| **Project without CC Net Economic Flows** | | -BDT 301.70 | -BDT 201.13 | BDT 106.92 | BDT 109.08 | BDT 111.29 | BDT 113.55 | BDT 115.84 | BDT 118.19 | BDT 120.58 | BDT 123.02 | BDT 124.21 | BDT 126.74 |
| | | | | | | | | | | | | | |
| **Project ONLY CC Net Economic Flows** | | -BDT 62.33 | -BDT 41.55 | BDT 44.11 | BDT 45.00 | BDT 45.90 | BDT 46.82 | BDT 47.77 | BDT 48.73 | BDT 49.71 | BDT 50.71 | BDT 51.05 | BDT 52.09 |

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|---|---|---|---|---|---|---|---|---|---|---|
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| | | | | | | | | | | |
| **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **Total (Taka 2013)** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 52.5 | 53.6 | 54.7 | 55.8 | 56.9 | 58.0 | 59.2 | 60.4 | 61.6 | 62.8 | 1131.1 |
| 3.2 | 3.2 | 3.3 | 3.3 | 3.4 | 3.5 | 3.6 | 3.6 | 3.7 | 3.8 | 67.9 |
| 16.7 | 17.0 | 17.4 | 17.7 | 18.1 | 18.4 | 18.8 | 19.2 | 19.6 | 20.0 | 359.4 |
| 5.1 | 5.2 | 5.3 | 5.4 | 5.5 | 5.6 | 5.7 | 5.8 | 5.9 | 6.1 | 109.2 |
| 28.8 | 29.4 | 29.9 | 30.5 | 31.2 | 31.8 | 32.4 | 33.1 | 33.7 | 34.4 | 619.6 |
| | | | | | | | | | | |
| 52.1 | 53.2 | 54.2 | 55.3 | 56.4 | 57.5 | 58.7 | 59.9 | 61.1 | 62.3 | 1121.7 |
| 25.2 | 25.7 | 26.2 | 26.7 | 27.3 | 27.8 | 28.4 | 28.9 | 29.5 | 30.1 | 542.1 |
| 2.5 | 2.6 | 2.6 | 2.7 | 2.8 | 2.8 | 2.9 | 2.9 | 3.0 | 3.0 | 54.7 |
| **186.1** | **189.8** | **193.6** | **197.5** | **201.4** | **205.5** | **209.6** | **213.8** | **218.0** | **222.4** | **4005.7** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 14.7 | 15.0 | 15.3 | 15.6 | 15.9 | 16.2 | 16.6 | 16.9 | 17.2 | 17.6 | 376.8 |
| 0.9 | 0.9 | 0.9 | 0.9 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.1 | 22.6 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 4.7 | 4.8 | 4.9 | 4.9 | 5.0 | 5.1 | 5.3 | 5.4 | 5.5 | 5.6 | 119.6 |
| 5.1 | 5.2 | 5.3 | 5.4 | 5.5 | 5.6 | 5.7 | 5.8 | 5.9 | 6.1 | 109.2 |
| 28.8 | 29.4 | 29.9 | 30.5 | 31.2 | 31.8 | 32.4 | 33.1 | 33.7 | 34.4 | 619.6 |
| | | | | | | | | | | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 83.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 40.1 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4.0 |
| **54.1** | **55.2** | **56.3** | **57.4** | **58.6** | **59.7** | **60.9** | **62.2** | **63.4** | **64.7** | **1374.9** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 83.7 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5.0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 26.6 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.1 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 45.8 |
| | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 83.0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 40.1 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4.0 |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **296.4** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 52.5 | 53.6 | 54.7 | 55.8 | 56.9 | 58.0 | 59.2 | 60.4 | 61.6 | 62.8 | 1047.4 |
| 3.2 | 3.2 | 3.3 | 3.3 | 3.4 | 3.5 | 3.6 | 3.6 | 3.7 | 3.8 | 62.8 |
| 16.7 | 17.0 | 17.4 | 17.7 | 18.1 | 18.4 | 18.8 | 19.2 | 19.6 | 20.0 | 332.8 |
| 5.1 | 5.2 | 5.3 | 5.4 | 5.5 | 5.6 | 5.7 | 5.8 | 5.9 | 6.1 | 101.1 |
| 28.8 | 29.4 | 29.9 | 30.5 | 31.2 | 31.8 | 32.4 | 33.1 | 33.7 | 34.4 | 573.7 |
| | | | | | | | | | | |
| 52.1 | 53.2 | 54.2 | 55.3 | 56.4 | 57.5 | 58.7 | 59.9 | 61.1 | 62.3 | 1038.7 |
| 25.2 | 25.7 | 26.2 | 26.7 | 27.3 | 27.8 | 28.4 | 28.9 | 29.5 | 30.1 | 501.9 |
| 2.5 | 2.6 | 2.6 | 2.7 | 2.8 | 2.8 | 2.9 | 2.9 | 3.0 | 3.0 | 50.7 |
| **186.1** | **189.8** | **193.6** | **197.5** | **201.4** | **205.5** | **209.6** | **213.8** | **218.0** | **222.4** | **3709.3** |
| | | | | | | | | | | |
| | | | | | | | | | | 502.8 |
| BDT 2.65 | BDT 2.65 | BDT 2.65 | BDT 2.65 | BDT 2.65 | BDT 2.65 | BDT 2.65 | BDT 2.65 | BDT 2.65 | BDT 2.65 | 42.7 |
| | | | | | | | | | | **545.5** |
| | | | | | | | | | | |
| | | | | | | | | | | 606.7 |
| BDT 3.61 | BDT 3.61 | BDT 3.61 | BDT 3.61 | BDT 3.61 | BDT 3.61 | BDT 3.61 | BDT 3.61 | BDT 3.61 | BDT 3.61 | 56.4 |
| | | | | | | | | | | **663.2** |
| | | | | | | | | | | |
| | | | | | | | | | | 103.9 |
| BDT 0.96 | BDT 0.96 | BDT 0.96 | BDT 0.96 | BDT 0.96 | BDT 0.96 | BDT 0.96 | BDT 0.96 | BDT 0.96 | BDT 0.96 | 13.8 |
| | | | | | | | | | | **117.6** |
| **BDT 182.48** | **BDT 186.20** | **BDT 190.00** | **BDT 193.87** | **BDT 197.82** | **BDT 201.85** | **BDT 205.96** | **BDT 210.15** | **BDT 214.42** | **BDT 218.78** | **23%** |
| | | | | | | | | | | |
| BDT 129.33 | BDT 131.97 | BDT 134.66 | BDT 137.41 | BDT 140.21 | BDT 143.07 | BDT 145.98 | BDT 148.95 | BDT 151.99 | BDT 155.08 | **20%** |
| | | | | | | | | | | |
| BDT 53.15 | BDT 54.23 | BDT 55.33 | BDT 56.46 | BDT 57.61 | BDT 58.78 | BDT 59.97 | BDT 61.19 | BDT 62.44 | BDT 63.70 | **37%** |

| | **Assumptions and workings for with CCR** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **Source of Data / Assumption** | | | | | Unit | Total | | |
| | | | | | Affected as per SEWTP | | Repair / Damage Cost | | | |
| 1 | Number of properties | Drainage Team and SEWTP report | Number | 5000 | 51.10% | 2555 | | 57.1 | | |
| 2 | Loss of Income | | BDT Million | | | | 26238 | 41.1 | | |
| | Number of Households | Drainage Team and SEWTP | Number | 4000 | 80.00% | 1566 | | | | |
| | Number of days of flooding | SEWTP report | Days | | | 36.2 | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Household Income | SEWTP report | BDT | | | 21744 | | | | |
| | Average Household Expenditure on Health | SEWTP report | BDT | | | 1061 | | | | |
| 3 | Saved Medical Cost | | | | | | | 2.0 | | |
| 4 | Loss of Business Income | | | | 68.40% | | 14827 | 19.9 | | |
| | Average monthly expenditure | SEWTP report | BDT | | | 17554 | | | | |
| 5 | Agricultural Loss | Drainage Team | Acre | | 864.6245059 | | | | | |
| | Average Yield per acre | Drainage Team | tonne | | 1.5 | | | | | |
| | Average support price | Drainage Team | BDT / Tonne | | 17500 | | | | | |
| | Agricultural Loss | | BDT Million | | | | | 22.7 | | |
| 6 | Road Damage | Drainage Team | Kilometre | | 10 | | | | | |
| | Repair cost | Drainage Team | BDT/Kilometre | | 0.4 | | | | | |
| | Road Damage Cost | | | | | | | 4.0 | | |
| | | | | | | | | | | |
| | **Assessment of Repair / Damage Cost** | Drainage Team | | | | | | | | |
| | Depth | Comm'l | Public | Katcha | Pakka | Semi Pakka | | | | |
| | < 0.25 m inundation | 121 | 58 | 568 | 62 | 207 | 1016 | 41% | 2555 | 1053 |
| | > 0.25 m inundation | 173 | 82 | 810 | 89 | 295 | 1449 | 59% | | 1502 |
| | > 0.75 m inundation | 0 | 0 | 0 | 0 | 0 | 0 | 0% | | 0 |
| | Total | 294 | 140 | 1378 | 151 | 502 | 2465 | | | |
| | < 0.25 | 125 | 60 | 589 | 64 | 215 | 1053 | | | |
| | > 0.25 | 179 | 85 | 840 | 92 | 306 | 1502 | | | |
| | > 0.75 m inundation | | | | | | | | | |
| | | | | | | | 2555 | | | |
| | Averagae Area in Sq m | 93 | 46 | 9 | 70 | 28 | | | | |
| | Total Area Waterlogged in sq m | 11619 | 2789 | 5475 | 4462 | 5995 | 30339 | | | |
| | Total Area inundated in sq m | 16638 | 3950 | 7808 | 6414 | 8533 | 43343 | | | |
| | | | | | | | 73682 | | | |
| | Constuction cost | **CDTA Report** | | | | | | | | |
| | BDT/sq m | 21516.8 | 21516.8 | 12910.08 | 21516.8 | 17213.44 | | | source CDTA reports | |
| | Repair Cost @ 6% | **CDTA Report** | | | | | | | source CDTA reports | |
| | BDT/sq m | 1291.008 | 1291.008 | 774.6048 | 1291.008 | 1032.8064 | | | | |
| | Clean Up cost | **CDTA Report** | | | | | | | | |
| | BDT/property | 15000 | 12000 | 2000 | 9000 | 5000 | | | source CDTA reports | |
| | | | | | | | BDT Million | | | |
| | Damage Cost | 17.9 | 4.25 | 5.04 | 6.9 | 7.344 | 41.434 | | | |
| | Repair Cost | 1.074 | 0.255 | 0.3024 | 0.414 | 0.44064 | 2.48604 | | | |
| | Clean up cost | 4.56 | 1.74 | 2.858 | 1.404 | 2.605 | 13.167 | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | **For Without CCR scenario** | | | | | | | | | |
| | | | | | | | | | | |
| | **Stock damages for properties - 25% less vulnerability loss reduction as compared with CCR scenario** | | | | | | | | | |
| | **Rest same - No change** | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | **Common to both** | | | | | | | | | |
| 1 | Capex with CCR and without CCR as per technical team estimate | | | | | | | | | |
| 2 | Opex with CCR and without CCR as per technical team estimate | | | | | | | | | |
| | | | | | | | | | | |
| | **Assumptions and workings for without CCR** | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | Unit | Total | | |
| | | | | | Affected as per SE | | Repair / Damage Cost | | | |
| | Number of properties | | Number | 5000 | 0.511 | 1916 | | 42.8 | | |
| | Loss of Income | | BDT Million | | | | 26238 | 41.1 | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Number of Households | | Number | 4000 | 0.8 | 1566 | | | | |
| | Number of days of flooding | | Days | | | 27.4 | | | | |
| | Household Income | | BDT | | | 21744 | | | | |
| | Average Household Expenditure on Health | | BDT | | | 1061 | | | | |
| | Saved Medical Cost | | | | | | | 1.5 | | |
| | Loss of Business Income | | | 0 | 0.684 | | 11223 | 15.0 | | |
| | Average monthly expenditure | | BDT | | | 17554 | | | | |
| | Agricultural Loss | | Acre | 0 | 864.6245059 | | | | | |
| | Average Yield per acre | | tonne | | 1.5 | | | | | |
| | Average support price | | BDT / Tonne | | 17500 | | | | | |
| | Agricultural Loss | | BDT Million | | | | | 22.7 | | |
| | Road Damage | | Kilometre | | 10 | | | | | |
| | Repair cost | | BDT/Kilometre | | 0.4 | | | | | |
| | Road Damage Cost | | | | | | | 4.0 | | |
| | | | | | | | | | | |
| | Assessment of Repair / Damage Cost | | | | | | | | | |
| | Depth | Comm'l | Public | Katcha | Pakka | Semi Pakka | | | | |
| | < 0.25 m inundation | 121 | 58 | 568 | 62 | 207 | 1016 | 41% | 1916 | 790 |
| | > 0.25 m inundation | 173 | 82 | 810 | 89 | 295 | 1449 | 59% | | 1126 |
| | > 0.75 m inundation | 0 | 0 | 0 | 0 | 0 | 0 | 0% | | 0 |
| | Total | 294 | 140 | 1378 | 151 | 502 | 2465 | | | |
| | < 0.25 | 94 | 45 | 442 | 48 | 161 | 790 | | | |
| | > 0.25 | 134 | 64 | 629 | 69 | 229 | 1125 | | | |
| | > 0.75 m inundation | | | | | | | | | |
| | 0 | | | | | | 1915 | | | |
| | Averagae Area in Sq m | 93 | 46 | 9 | 70 | 28 | | | | |
| | Total Area Waterlogged in sq m | 8737 | 2091 | 4108 | 3346 | 4490 | 22773 | | | |
| | Total Area inundated in sq m | 12455 | 2974 | 5847 | 4810 | 6386 | 32472 | | | |
| | 0 | | | | | | 55245.20375 | | | |
| | Constuction cost | | | | | | | | | |
| | BDT/sq m | 21516.8 | 21516.8 | 12910.08 | 21516.8 | 17213.44 | | | source CDTA reports | |
| | Repair Cost @ 6% | | | | | | | | source CDTA reports | |
| | BDT/sq m | 1291.008 | 1291.008 | 774.6048 | 1291.008 | 1032.8064 | | | | |
| | Clean Up cost | | | | | | | | | |
| | BDT/property | 15000 | 12000 | 2000 | 9000 | 5000 | | | source CDTA reports | |
| | 0 | | | | | | BDT Million | | | |
| | Damage Cost | 13.4 | 3.2 | 3.774 | 5.175 | 5.496 | 31.045 | | | |
| | Repair Cost | 0.804 | 0.192 | 0.22644 | 0.3105 | 0.32976 | 1.8627 | | | |
| | Clean up cost | 3.42 | 1.308 | 2.142 | 1.053 | 1.95 | 9.873 | | | |

# 1.4. Solid waste in Mothbaria Paurashava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Solid Waste | | | | | | | | | | | | |
| Investigator(s): | Nesar | | | | | | | | | | | | |
| Town: | Mathbaria | | | | | | | | | | | | |
| Project: | Solid Waste | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Full Town | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. road damage owing to floods) | | | | | | | | | | | | | |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. economic damage due to delays, congestion, road closure) | Time Savings | 2.5 | 2.5 | 2.6 | 2.6 | 2.7 | 2.8 | 2.8 | 2.9 | 2.9 | 3.0 | 3.0 | 3.1 |
| Vulnerability 2: (e.g. extra maintenance/repair costs w.o. investment) | Saved Medical Cost | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **2.7** | **2.8** | **2.8** | **2.9** | **2.9** | **3.0** | **3.1** | **3.1** | **3.2** | **3.2** | **3.3** | **3.4** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced costs of road damage owing to floods) | | | | | | | | | | | | | |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced economic damage due to delays, congestion, road closure) | Time Savings | 2.5 | 2.5 | 0.6 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.8 | 0.8 |
| Vulnerability 2: (e.g. reduced extra maintenance/repair costs versus w.o. investment) | Saved Medical Cost | 0.2 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss/Extra Costs:** | | **2.7** | **2.8** | **0.7** | **0.7** | **0.7** | **0.7** | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** |
| **Vulnerability Impacts with Project with CC resilient measures** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced costs of road damage owing to floods) | | | | | | | | | | | | | |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced economic damage due to delays, congestion, road closure) | Time Savings | 2.5 | 2.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Vulnerability 2: (e.g. reduced extra maintenance/repair costs versus w.o. investment) | Saved Medical Cost | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss/Extra Costs:** | | **2.7** | **2.8** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Impact of Project on Reduced Vulnerability** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced costs of road damage owing to floods) | | | | | | | | | | | | | |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced economic damage due to delays, congestion, road closure) | Time Savings | 0.0 | 0.0 | 2.6 | 2.6 | 2.7 | 2.8 | 2.8 | 2.9 | 2.9 | 3.0 | 3.0 | 3.1 |
| Vulnerability 2: (e.g. reduced extra maintenance/repair costs versus w.o. investment) | Saved Medical Cost | 0.0 | 0.0 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss/Extra Costs:** | | **0.0** | **0.0** | **2.8** | **2.9** | **2.9** | **3.0** | **3.1** | **3.1** | **3.2** | **3.2** | **3.3** | **3.4** |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 4.48 | BDT 2.99 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT 4.91 | BDT 3.27 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | BDT 0.43 | BDT 0.29 | | | | | | | | | | |
| **O & M Incremental Costs:** | | | | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 4.91** | **-BDT 3.27** | **BDT 2.33** | **BDT 2.39** | **BDT 2.44** | **BDT 2.50** | **BDT 2.56** | **BDT 2.62** | **BDT 2.69** | **BDT 2.75** | **BDT 2.81** | **BDT 2.88** |
| | | | | | | | | | | | | | |
| **Project without CC Net Economic Flows** | | -BDT 4.48 | -BDT 2.99 | BDT 1.78 | BDT 1.82 | BDT 1.86 | BDT 1.91 | BDT 1.95 | BDT 2.00 | BDT 2.05 | BDT 2.09 | BDT 2.14 | BDT 2.19 |
| | | | | | | | | | | | | | |
| **Project ONLY CC Net Economic Flows** | | -BDT 0.43 | -BDT 0.29 | BDT 0.39 | BDT 0.41 | BDT 0.42 | BDT 0.44 | BDT 0.45 | BDT 0.47 | BDT 0.48 | BDT 0.50 | BDT 0.51 | BDT 0.53 |
| | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|
| **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **Total (Taka 2013)** |
| | | | | | | | | | | |
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| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 3.2 | 3.2 | 3.3 | 3.4 | 3.4 | 3.5 | 3.6 | 3.6 | 3.7 | 3.8 | 68.1 |
| 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 6.0 |
| | | | | | | | | | | |
| **3.4** | **3.5** | **3.6** | **3.7** | **3.7** | **3.8** | **3.9** | **4.0** | **4.0** | **4.1** | **74.2** |
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| 0.8 | 0.8 | 0.8 | 0.8 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 20.8 |
| 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 1.8 |
| | | | | | | | | | | |
| **0.9** | **0.9** | **0.9** | **0.9** | **0.9** | **1.0** | **1.0** | **1.0** | **1.0** | **1.0** | **22.7** |
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| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 |
| | | | | | | | | | | |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **5.5** |
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| | | | | | | | | | | |
| 3.2 | 3.2 | 3.3 | 3.4 | 3.4 | 3.5 | 3.6 | 3.6 | 3.7 | 3.8 | 63.1 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 5.6 |
| | | | | | | | | | | |
| **3.4** | **3.5** | **3.6** | **3.7** | **3.7** | **3.8** | **3.9** | **4.0** | **4.0** | **4.1** | **68.7** |
| | | | | | | | | | | |
| | | | | | | | | | | 7.5 |
| BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | 6.8 |
| | | | | | | | | | | **14.3** |
| | | | | | | | | | | |
| | | | | | | | | | | 8.2 |
| BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | 10.0 |
| | | | | | | | | | | **18.1** |
| | | | | | | | | | | |
| | | | | | | | | | | 0.7 |
| BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | 3.1 |
| | | | | | | | | | | **3.9** |
| **BDT 2.95** | **BDT 3.02** | **BDT 3.09** | **BDT 3.16** | **BDT 3.23** | **BDT 3.31** | **BDT 3.38** | **BDT 3.46** | **BDT 3.54** | **BDT 3.62** | **26.6%** |
| | | | | | | | | | | |
| BDT 2.24 | BDT 2.30 | BDT 2.35 | BDT 2.40 | BDT 2.46 | BDT 2.51 | BDT 2.57 | BDT 2.63 | BDT 2.69 | BDT 2.75 | **22.8%** |
| | | | | | | | | | | |
| BDT 0.55 | BDT 0.56 | BDT 0.58 | BDT 0.60 | BDT 0.62 | BDT 0.64 | BDT 0.66 | BDT 0.68 | BDT 0.69 | BDT 0.72 | **46.3%** |

| | |
|---|---|
| | **Assumptions and workings** |
| | |
| | **Assumptions for With CCR** |
| 1 | Saved Income Loss - HH monthly income - BDT 21,744 as per SEWTP report, Time savings - 1 minute per day considered |
| 2 | Saved Medical Cost - HH monthly expenditure on health - BDT 1061considered as per SEWTP report @ 5% for solid waste |
| | |
| | **Assumptions for Without CCR** |
| 1 | Number of households - **25% less vulnerability loss reduction as compared with CCR scenario** |
| | |
| | |
| | **Common to both** |
| 1 | Capex with CCR and without CCR as per technical team estimate |
| 2 | Opex with CCR and without CCR as per technical team estimate |
| | |

## 1.5. Roads in Mothbaria Pourashava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Roads | | | | | | | | | | | | |
| Investigator(s): | Nesar | | | | | | | | | | | | |
| Town: | Mathbaria | | | | | | | | | | | | |
| Project: | Roads (21.525 kilometers of Road) | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Refer Location Map and list of roads | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **If no future Climate Change: (Baseline vulnerability no future CC)** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | 4 | | | | | 3 | |
| Damage due to Floods (% of project roads) | | 16.20 | 16.69 | 17.02 | 17.35 | 17.69 | 14.42 | 14.70 | 14.98 | 15.26 | 15.54 | 11.87 | 12.09 |
| Vulnerability 2: | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 27.79 | 28.34 | 28.91 | 29.49 | 30.08 | 30.68 | 31.29 | 31.92 | 32.55 | 33.21 | 33.87 | 34.55 |
| Time Savings | | 50.39 | 51.39 | 52.42 | 53.47 | 54.54 | 55.63 | 56.74 | 57.88 | 59.03 | 60.22 | 61.42 | 62.65 |
| | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | 94.37 | 96.42 | 98.35 | 100.31 | 102.30 | 100.73 | 102.73 | 104.77 | 106.85 | 108.96 | 107.16 | 109.28 |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Damage due to Floods (% of project roads) | | 16.20 | 16.69 | 17.02 | 17.35 | 17.69 | 14.42 | 14.70 | 14.98 | 15.26 | 15.54 | 11.87 | 12.09 |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 27.79 | 28.34 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Time Savings | | 50.39 | 51.39 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | 94.37 | 96.42 | 17.02 | 17.35 | 17.69 | 14.42 | 14.70 | 14.98 | 15.26 | 15.54 | 11.87 | 12.09 |
| **Vulnerability Impacts with Climate Change and Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Damage due to Floods (% of project roads) | | 16.20 | 16.69 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 27.79 | 28.34 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Time Savings | | 50.39 | 51.39 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss/Extra Costs:** | | 94.37 | 96.42 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Damage due to Floods (% of project roads) | | 0.00 | 0.00 | 17.02 | 17.35 | 17.69 | 14.42 | 14.70 | 14.98 | 15.26 | 15.54 | 11.87 | 12.09 |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from** | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 0.00 | 0.00 | 28.91 | 29.49 | 30.08 | 30.68 | 31.29 | 31.92 | 32.55 | 33.21 | 33.87 | 34.55 |
| Time Savings | | 0.00 | 0.00 | 52.42 | 53.47 | 54.54 | 55.63 | 56.74 | 57.88 | 59.03 | 60.22 | 61.42 | 62.65 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **0.0** | **0.0** | **98.3** | **100.3** | **102.3** | **100.7** | **102.7** | **104.8** | **106.8** | **109.0** | **107.2** | **109.3** |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | 168.52 | 112.35 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | 4.3 | 4.3 | 4.3 | 4.3 | 4.3 | 4.3 | 4.3 | 4.3 | 4.3 | 4.3 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | 194.37 | 129.58 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | 4.1 | 4.1 | 4.1 | 4.1 | 4.1 | 4.1 | 4.1 | 4.1 | 4.1 | 4.1 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | 25.84614214 | 17.23076143 | | | | | | | | | | |
| **O & M Incremental Costs:** | | | | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 194.37** | **-BDT 129.58** | **BDT 94.24** | **BDT 96.20** | **BDT 98.20** | **BDT 96.62** | **BDT 98.62** | **BDT 100.66** | **BDT 102.74** | **BDT 104.85** | **BDT 103.05** | **BDT 105.18** |
| | | | | | | | | | | | | | |
| **Project without cc Net Economic Flows** | | -BDT 168.52 | -BDT 112.35 | BDT 77.06 | BDT 78.68 | BDT 80.34 | BDT 82.03 | BDT 83.76 | BDT 85.52 | BDT 87.32 | BDT 89.15 | BDT 91.02 | BDT 92.92 |
| | | | | | | | | | | | | | |
| **CC Net Economic Flows** | | -BDT 25.85 | -BDT 17.23 | BDT 17.35 | BDT 17.68 | BDT 18.02 | BDT 14.75 | BDT 15.03 | BDT 15.31 | BDT 15.59 | BDT 15.87 | BDT 12.20 | BDT 12.42 |

| 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | Total (Taka 2013) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |
| | | | 2 | | | | | | | | | |
| 12.31 | 12.53 | 12.75 | 8.65 | 8.80 | 8.96 | 9.11 | 9.27 | 9.43 | 9.59 | 9.75 | 9.91 | 304.82 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 35.24 | 35.94 | 36.66 | 37.40 | 38.14 | 38.91 | 39.68 | 40.48 | 41.29 | 42.11 | 42.96 | 43.81 | 845.28 |
| 63.90 | 65.18 | 66.48 | 67.81 | 69.17 | 70.55 | 71.96 | 73.40 | 74.87 | 76.37 | 77.90 | 79.45 | 1532.83 |
| | | | | | | | | | | | | |
| 111.45 | 113.65 | 115.89 | 113.86 | 116.11 | 118.41 | 120.76 | 123.15 | 125.58 | 128.07 | 130.60 | 133.18 | **2682.93** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 12.31 | 12.53 | 12.75 | 8.65 | 8.80 | 8.96 | 9.11 | 9.27 | 9.43 | 9.59 | 9.75 | 9.91 | 304.82 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 56.13 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 101.78 |
| | | | | | | | | | | | | |
| 12.31 | 12.53 | 12.75 | 8.65 | 8.80 | 8.96 | 9.11 | 9.27 | 9.43 | 9.59 | 9.75 | 9.91 | **462.73** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 32.88 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 56.13 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 101.78 |
| | | | | | | | | | | | | |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **190.79** |
| | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |
| 12.31 | 12.53 | 12.75 | 8.65 | 8.80 | 8.96 | 9.11 | 9.27 | 9.43 | 9.59 | 9.75 | 9.91 | 271.94 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 35.24 | 35.94 | 36.66 | 37.40 | 38.14 | 38.91 | 39.68 | 40.48 | 41.29 | 42.11 | 42.96 | 43.81 | 789.16 |
| 63.90 | 65.18 | 66.48 | 67.81 | 69.17 | 70.55 | 71.96 | 73.40 | 74.87 | 76.37 | 77.90 | 79.45 | 1431.05 |
| | | | | | | | | | | | | |
| **111.4** | **113.6** | **115.9** | **113.9** | **116.1** | **118.4** | **120.8** | **123.1** | **125.6** | **128.1** | **130.6** | **133.2** | **2492.1** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | 280.87 |
| 4.3 | 4.3 | 4.3 | 4.3 | 4.3 | 4.3 | 4.3 | 4.3 | 4.3 | 4.3 | 4.3 | 4.3 | 94.00 |
| | | | | | | | | | | | | **BDT 374.87** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | 323.95 |
| 4.1 | 4.1 | 4.1 | 4.1 | 4.1 | 4.1 | 4.1 | 4.1 | 4.1 | 4.1 | 4.1 | 4.1 | 90.35 |
| | | | | | | | | | | | | **BDT 414.30** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | 43.08 |
| -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -3.65 |
| | | | | | | | | | | | | **BDT 39.42** |
| **BDT 107.34** | **BDT 109.54** | **BDT 111.79** | **BDT 109.75** | **BDT 112.01** | **BDT 114.31** | **BDT 116.65** | **BDT 119.04** | **BDT 121.48** | **BDT 123.96** | **BDT 126.49** | **BDT 129.07** | **26.3%** |
| | | | | | | | | | | | | |
| BDT 94.87 | BDT 96.85 | BDT 98.87 | BDT 100.94 | BDT 103.04 | BDT 105.19 | BDT 107.37 | BDT 109.61 | BDT 111.89 | BDT 114.21 | BDT 116.58 | BDT 118.99 | **25.6%** |
| | | | | | | | | | | | | |
| BDT 12.64 | BDT 12.86 | BDT 13.08 | BDT 8.98 | BDT 9.13 | BDT 9.29 | BDT 9.44 | BDT 9.60 | BDT 9.76 | BDT 9.92 | BDT 130.76 | BDT 133.34 | **31.9%** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Assumptions and Workings** | | | | | | | |
| 1 | Stock Damage - considered @ 5% for first five years, 4% next five years, 3% for the next five years and 2% thereafter of the Project roads length of 21.525 kilometers as per the technical team estimate | | | | | | | |
| 2 | Vehicle Operating Costs: See workings below | | | | | | | |
| 3 | Time Savings - See workings below | | | | | | | |
| | | | | | | | | |
| | **Economc Benefit Cost Calculation** | | | | | | | |
| | Days | 300 | 300 | (Rickshaw) | | | | |
| | Road Length | 21.525 | | | | | | |
| | | | **Light Vehicle** | | | **Heavy Vehicle** | | **Total** |
| | | | **Car/Taxi** | **Baby Taxi** | **Motor Cycle** | **Bus** | **Truck** | |
| | Traffic Volume | No./ Day | 14 | 123 | 2800 | 140 | 84 | 3161 |
| | **Without Project** | | | | | | | |
| | Operating Cost | Tk./Vehicle | 17.2 | 8 | 2.4 | 18.5 | 21 | |
| | Total Operating Cost | Tk./Year | 1,554,966 | 6,354,180 | 43,394,400 | 16,724,925 | 11,391,030 | 79,419,501 |
| | **with Project** | | | | | | | |
| | Operating Cost | Tk./Vehicle | 10 | 4 | 1.5 | 13 | 16 | |
| | Total Operating Cost | Tk./Year | 904,050 | 3,177,090 | 27,121,500 | 11,752,650 | 8,678,880 | 51,634,170 |
| | **Savings per Year** | | **650,916** | **3,177,090** | **16,272,900** | **4,972,275** | **2,712,150** | **27,785,331** |
| | | | | | | | | |
| | **Rickshaw** | **Trips** | **Minutes** | **Earnings per** | **Earning per** | | | |
| | | | **per km.** | **Km . (Tk.)** | **Minute (Tk.)** | | | |
| | **Without Project** | 1330 | | | | | | |
| | Time taken to travel | | 12.5 | 22 | 1.76 | | | |
| | | | | | | | | |
| | **with Project** | | | | | | | |
| | Time taken to travel | | 7.5 | 22 | 2.93 | | | |
| | | | | | | | | |
| | Benefit/saving | | 5 | 0 | 1.17 | | | |
| | Road length (Km) | | | | 21.525 | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Savings per trip | | | | 126.28 | | | |
| | **Yearly Savings** | | | | | | | **50,385,720** |
| | **Damage to property due to Floods** | | | | | | | **see below** |
| | **Total Savings** | | | | | | | **78,171,051** |
| | | | | | | | | |
| | | | | | | | | |
| | **Common to both** | | | | | | | |
| 1 | Capex with CCR and without CCR as per technical team estimate | | | | | | | |
| 2 | Opex with CCR and without CCR as per technical team estimate | | | | | | | |

## 1.6 Bridges in Mathbaria Paurashava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Roads | | | | | | | | | | | | |
| Investigator(s): | Nesar | | | | | | | | | | | | |
| Town: | Mathbaria | | | | | | | | | | | | |
| Project: | Bridges | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Refer Location Map and list of roads | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **If no future Climate Change: (Baseline vulnerability no future CC)** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Damage due to Floods (% of project roads) | | | | | | | | | | | | | |
| Vulnerability 2: | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 0.23 | 0.23 | 0.24 | 0.24 | 0.25 | 0.25 | 0.26 | 0.26 | 0.27 | 0.27 | 0.28 | 0.28 |
| Time Savings | | 29.21 | 29.79 | 30.39 | 30.99 | 31.61 | 32.25 | 32.89 | 33.55 | 34.22 | 34.91 | 35.60 | 36.32 |
| | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **29.44** | **30.02** | **30.63** | **31.24** | **31.86** | **32.50** | **33.15** | **33.81** | **34.49** | **35.18** | **35.88** | **36.60** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Damage due to Floods (% of project roads) | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 0.23 | 0.23 | 0.18 | 0.19 | 0.19 | 0.19 | 0.20 | 0.20 | 0.21 | 0.21 | 0.21 | 0.22 |
| Time Savings | | 29.21 | 29.79 | 22.50 | 22.95 | 23.41 | 23.87 | 24.35 | 24.84 | 25.34 | 25.84 | 26.36 | 26.89 |
| | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **29.44** | **30.02** | **22.68** | **23.13** | **23.60** | **24.07** | **24.55** | **25.04** | **25.54** | **26.05** | **26.57** | **27.11** |
| **Vulnerability Impacts with Climate** | | | | | | | | | | | | | |

| **Change and Project** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | |
| Damage due to Floods (% of project roads) | 0.00 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 2: | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | |
| Vehicle Operating Costs | 0.23 | 0.23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Time Savings | 29.21 | 29.79 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 3: etc. | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss/Extra Costs:** | **29.44** | **30.02** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | |
| Damage due to Floods (% of project roads) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vulnerability 2: | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | |
| Vehicle Operating Costs | 0.00 | 0.00 | 0.24 | 0.24 | 0.25 | 0.25 | 0.26 | 0.26 | 0.27 | 0.27 | 0.28 | 0.28 |
| Time Savings | 0.00 | 0.00 | 30.39 | 30.99 | 31.61 | 32.25 | 32.89 | 33.55 | 34.22 | 34.91 | 35.60 | 36.32 |
| Vulnerability 3: etc. | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | **0.0** | **0.0** | **30.6** | **31.2** | **31.9** | **32.5** | **33.1** | **33.8** | **34.5** | **35.2** | **35.9** | **36.6** |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | 68.26819491 | 45.51212994 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | 0.138477527 | 0.138477527 | 0.138477527 | 0.138477527 | 0.138477527 | 0.138477527 | 0.138477527 | 0.138477527 | 0.138477527 | 0.138477527 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | 75.14 | 50.10 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | 0.152424904 | 0.152424904 | 0.152424904 | 0.152424904 | 0.152424904 | 0.152424904 | 0.152424904 | 0.152424904 | 0.152424904 | 0.152424904 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | 6.88 | 4.58 | | | | | | | | | | |
| **O & M Incremental Costs:** | | | 0.01 | 0.013947377 | 0.013947377 | 0.013947377 | 0.013947377 | 0.013947377 | 0.013947377 | 0.013947377 | 0.013947377 | 0.013947377 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | **-BDT 75.14** | **-BDT 50.10** | **BDT 30.47** | **BDT 31.09** | **BDT 31.71** | **BDT 32.35** | **BDT 33.00** | **BDT 33.66** | **BDT 34.34** | **BDT 35.03** | **BDT 35.73** | **BDT 36.45** |
| | | | | | | | | | | | | |
| **Project without cc Net Economic Flows** | -BDT 68.27 | -BDT 45.51 | BDT 30.49 | BDT 31.10 | BDT 31.72 | BDT 32.36 | BDT 33.01 | BDT 33.67 | BDT 34.35 | BDT 35.04 | BDT 35.74 | BDT 36.46 |
| | | | | | | | | | | | | |
| **CC Net Economic Flows** | -BDT 6.88 | -BDT 4.58 | BDT 22.67 | BDT 23.12 | BDT 23.58 | BDT 24.05 | BDT 24.54 | BDT 25.03 | BDT 25.53 | BDT 26.04 | BDT 26.56 | BDT 27.09 |

| 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | Total (Taka 2013) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | 0.00 |
| 0.29 | 0.30 | 0.30 | 0.31 | 0.31 | 0.32 | 0.33 | 0.33 | 0.34 | 0.35 | 0.35 | 0.36 | 6.97 |
| 37.04 | 37.78 | 38.54 | 39.31 | 40.10 | 40.90 | 41.71 | 42.55 | 43.40 | 44.27 | 45.15 | 46.06 | 888.53 |
| **37.33** | **38.08** | **38.84** | **39.62** | **40.41** | **41.22** | **42.04** | **42.88** | **43.74** | **44.62** | **45.51** | **46.42** | **895.50** |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 0.22 | 0.23 | 0.23 | 0.24 | 0.24 | 0.25 | 0.25 | 0.26 | 0.26 | 0.27 | 0.27 | 0.28 | 5.47 |
| 27.42 | 27.97 | 28.53 | 29.10 | 29.68 | 30.28 | 30.88 | 31.50 | 32.13 | 32.77 | 33.43 | 34.10 | 673.15 |
| **27.65** | **28.20** | **28.76** | **29.34** | **29.93** | **30.53** | **31.14** | **31.76** | **32.39** | **33.04** | **33.70** | **34.38** | **678.62** |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.46 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 59.00 |
| **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **59.46** |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 0.29 | 0.30 | 0.30 | 0.31 | 0.31 | 0.32 | 0.33 | 0.33 | 0.34 | 0.35 | 0.35 | 0.36 | 6.51 |
| 37.04 | 37.78 | 38.54 | 39.31 | 40.10 | 40.90 | 41.71 | 42.55 | 43.40 | 44.27 | 45.15 | 46.06 | 829.53 |
| **37.3** | **38.1** | **38.8** | **39.6** | **40.4** | **41.2** | **42.0** | **42.9** | **43.7** | **44.6** | **45.5** | **46.4** | **836.0** |
| | | | | | | | | | | | | 113.78 |
| 0.138477527 | 0.138477527 | 0.138477527 | 0.138477527 | 0.138477527 | 0.138477527 | 0.138477527 | 0.138477527 | 0.138477527 | 0.138477527 | 0.138477527 | 0.138477527 | 3.05 |
| | | | | | | | | | | | | **BDT 116.83** |
| | | | | | | | | | | | | 125.24 |
| 0.152424904 | 0.152424904 | 0.152424904 | 0.152424904 | 0.152424904 | 0.152424904 | 0.152424904 | 0.152424904 | 0.152424904 | 0.152424904 | 0.152424904 | 0.152424904 | 3.35 |
| | | | | | | | | | | | | **BDT 128.59** |
| | | | | | | | | | | | | 11.46 |
| 0.013947377 | 0.013947377 | 0.013947377 | 0.013947377 | 0.013947377 | 0.013947377 | 0.013947377 | 0.013947377 | 0.013947377 | 0.013947377 | 0.013947377 | 0.013947377 | 0.31 |
| | | | | | | | | | | | | **BDT 11.77** |
| **BDT 37.18** | **BDT 37.93** | **BDT 38.69** | **BDT 39.46** | **BDT 40.26** | **BDT 41.07** | **BDT 41.89** | **BDT 42.73** | **BDT 43.59** | **BDT 44.46** | **BDT 45.36** | **BDT 46.27** | **23.0%** |
| BDT 37.19 | BDT 37.94 | BDT 38.70 | BDT 39.48 | BDT 40.27 | BDT 41.08 | BDT 41.90 | BDT 42.74 | BDT 43.60 | BDT 44.48 | BDT 45.37 | BDT 46.28 | **25.0%** |
| BDT 27.63 | BDT 28.19 | BDT 28.75 | BDT 29.33 | BDT 29.91 | BDT 30.51 | BDT 31.12 | BDT 31.74 | BDT 32.38 | BDT 33.03 | BDT 33.69 | BDT 34.36 | **117.9%** |

| # | Item | | Light Vehicle | | | Heavy Vehicle | | Total |
|---|---|---|---|---|---|---|---|---|
| | **Assumptions and Workings** | | | | | | | |
| 1 | Vehicle Operating Costs: See workings below | | | | | | | |
| 2 | Time Savings - See workings below | | | | | | | |
| | **Economc Benefit Cost Calculation** | | | | | | | |
| | Days | 300 | | | | | | |
| | Bridges Length in Kilometers | 0.25 | source - technical team | | | | | |
| | | | **Light Vehicle** | | | **Heavy Vehicle** | | **Total** |
| | | | **Car/Taxi** | **Baby Taxi** | **Motor Cycle** | **Bus** | **Truck** | |
| | Traffic Volume | No./ Day | 50 | 550 | 550 | 0 | 0 | 1150 |
| | **Without Project** | | | | | | | |
| | Operating Cost | Tk./Vehicle | 17.2 | 8 | 2.4 | 18.5 | 21 | |
| | Total Operating Cost | Tk./Year | 64,500 | 330,000 | 99,000 | - | - | 493,500 |
| | **with Project** | | | | | | | |
| | Operating Cost | Tk./Vehicle | 10 | 4 | 1.5 | 13 | 16 | |
| | Total Operating Cost | Tk./Year | 37,500 | 165,000 | 61,875 | - | - | 264,375 |
| | **Savings per Year** | | **27,000** | **165,000** | **37,125** | **-** | **-** | **229,125** |
| | **Rickshaw** | **Trips** | **Minutes per km.** | **Earnings per Km . (Tk.)** | **Earning per Minute (Tk.)** | | | |
| | **Without Project** | 12250 | | | | | | |
| | Time taken to travel | | 12.5 | 22 | 1.76 | | | |
| | **with Project** | | | | | | | |
| | Time taken to travel | | 4 | 22 | 5.50 | | | |
| | Benefit/saving | | 8.5 | 0 | 3.74 | | | |
| | Road length (Km) | | | | 0.25 | | | |
| | Savings per trip | | | | 7.95 | | | |
| | **Yearly Savings** | | | | | | | **29,207,063** |
| | **Damage to property due to Floods** | | | | | | | **see below** |
| | **Total Savings** | | | | | | | **29,436,188** |
| | **Without CCR** | | | | | | | |
| | **25% less vulnerability loss reduction as compared with CCR scenario** | | | | | | | |
| | **Common to both** | | | | | | | |
| 1 | Capex with CCR and without CCR as per technical team estimate | | | | | | | |
| 2 | Opex with CCR and without CCR as per technical team estimate | | | | | | | |

| **Operating Cost Workings** | | | | |
|---|---|---|---|---|
| *w/o project* | Car | Truck | M/Cycle | Baby Taxi |
| Cost of fuel per litre - BDT | 100 | 70 | 100 | 100 |
| Maintenance BDT | 20 | 14 | 20 | 20 |
| Total BDT | 120 | 84 | 120 | 120 |
| Number of kilometers | 7 | 4 | 50 | 15 |
| Per Kilometer Operating cost | 17.1 | 21.0 | 2.4 | 8.0 |
| *With project* | Car | Truck | M/Cycle | Baby Taxi |
| Cost of fuel per litre - BDT | 100 | 70 | 100 | 100 |
| Maintenance BDT | 10 | 10 | 10 | 10 |
| Total BDT | 110 | 80 | 110 | 110 |
| Number of kilometers | 10 | 5 | 65 | 30 |
| Per Kilometer Operating cost | 11.0 | 16.0 | 1.7 | 3.7 |

# 1.7. Cyclone Shelters in MAthbaria Paurashava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Cyclone Shelters | | | | | | | | | | | | |
| Investigator(s): | Nesar Ahmed | | | | | | | | | | | | |
| Town: | Mathbaria | | | | | | | | | | | | |
| Project: | Cyclone Shelters for Town | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Full Town | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Variable 1: | | | | | | | | | | | | | |
| Economic Variable 2: | | | | | | | | | | | | | |
| Economic Variable 3: | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 35.6 | 36.3 | 37.0 | 37.8 | 38.5 | 39.3 | 40.1 | 40.9 | 41.7 | 42.5 | 43.4 | 44.2 |
| Economic Variable 2: | Saved Medical Cost | 1.7 | 1.8 | 1.8 | 1.8 | 1.9 | 1.9 | 2.0 | 2.0 | 2.0 | 2.1 | 2.1 | 2.2 |
| Economic Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **37.3** | **38.1** | **38.8** | **39.6** | **40.4** | **41.2** | **42.0** | **42.9** | **43.7** | **44.6** | **45.5** | **46.4** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Vulnerability 1: (e.g. road damage owing to floods) | | | | | | | | | | | | | |
| Economic Vulnerability 2: | | | | | | | | | | | | | |
| Economic Vulnerability 3: etc.… | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 5.34 | 5.44 | 5.55 | 5.66 | 5.78 | 5.89 | 6.01 | 6.13 | 6.25 | 6.38 | 6.51 | 6.64 |
| Economic Variable 2: | Saved Medical Cost | 0.26 | 0.27 | 0.27 | 0.28 | 0.28 | 0.29 | 0.29 | 0.30 | 0.31 | 0.31 | 0.32 | 0.32 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **5.60** | **5.71** | **5.82** | **5.94** | **6.06** | **6.18** | **6.30** | **6.43** | **6.56** | **6.69** | **6.82** | **6.96** |
| **Vulnerability Impacts with Climate Change and Project** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 35.6 | 36.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 2: | Saved Medical Cost | 1.7 | 1.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **37.3** | **38.1** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 0.0 | 0.0 | 37.0 | 37.8 | 38.5 | 39.3 | 40.1 | 40.9 | 41.7 | 42.5 | 43.4 | 44.2 |
| Economic Variable 2: | Saved Medical Cost | 0.0 | 0.0 | 1.8 | 1.8 | 1.9 | 1.9 | 2.0 | 2.0 | 2.0 | 2.1 | 2.1 | 2.2 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **0.0** | **0.0** | **38.8** | **39.6** | **40.4** | **41.2** | **42.0** | **42.9** | **43.7** | **44.6** | **45.5** | **46.4** |
| | | 1000000 | | | | | | | | | | | |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 82.88 | BDT 55.25 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 0.56 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT 92.09 | BDT 61.39 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 0.62 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | BDT 9.21 | BDT 6.14 | BDT 0.00 | BDT 0.00 | BDT 0.00 | | | | | | | |
| **O & M Incremental Costs:** | | | | | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 92.09** | **-BDT 61.39** | **BDT 38.20** | **BDT 38.98** | **BDT 39.77** | **BDT 40.58** | **BDT 41.40** | **BDT 42.24** | **BDT 43.10** | **BDT 43.97** | **BDT 44.87** | **BDT 45.78** |
| | | | | | | | | | | | | | |
| **Project without CC Net Economic Flows** | | -BDT 82.88 | -BDT 55.25 | BDT 32.44 | BDT 33.10 | BDT 33.77 | BDT 34.46 | BDT 35.16 | BDT 35.88 | BDT 36.60 | BDT 37.35 | BDT 38.11 | BDT 38.88 |
| | | | | | | | | | | | | | |
| **Project ONLY CC Net Economic Flows** | | -BDT 9.21 | -BDT 6.14 | BDT 5.76 | BDT 5.82 | BDT 5.93 | BDT 6.06 | BDT 6.18 | BDT 6.31 | BDT 6.43 | BDT 6.57 | BDT 6.70 | BDT 6.84 |

| 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | Total (Taka 2013) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 45.1 | 46.0 | 46.9 | 47.9 | 48.8 | 49.8 | 50.8 | 51.8 | 52.9 | 53.9 | BDT 971.3 |
| 2.2 | 2.2 | 2.3 | 2.3 | 2.4 | 2.4 | 2.5 | 2.5 | 2.6 | 2.6 | BDT 47.4 |
| | | | | | | | | | | |
| **47.3** | **48.3** | **49.2** | **50.2** | **51.2** | **52.3** | **53.3** | **54.4** | **55.5** | **56.6** | **1,018.7** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 6.77 | 6.90 | 7.04 | 7.18 | 7.33 | 7.47 | 7.62 | 7.78 | 7.93 | 8.09 | BDT 145.7 |
| 0.33 | 0.34 | 0.34 | 0.35 | 0.36 | 0.36 | 0.37 | 0.38 | 0.39 | 0.39 | BDT 7.1 |
| | | | | | | | | | | |
| **7.10** | **7.24** | **7.39** | **7.53** | **7.68** | **7.84** | **7.99** | **8.15** | **8.32** | **8.48** | **152.81** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 71.9 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 3.5 |
| | | | | | | | | | | 0 |
| | | | | | | | | | | 0.0 |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **75.4** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 45.1 | 46.0 | 46.9 | 47.9 | 48.8 | 49.8 | 50.8 | 51.8 | 52.9 | 53.9 | BDT 899.5 |
| 2.2 | 2.2 | 2.3 | 2.3 | 2.4 | 2.4 | 2.5 | 2.5 | 2.6 | 2.6 | BDT 43.9 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **47.3** | **48.3** | **49.2** | **50.2** | **51.2** | **52.3** | **53.3** | **54.4** | **55.5** | **56.6** | **943.3** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 138.1 |
| BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 0.56 | BDT 11.2 |
| | | | | | | | | | | **BDT 149.34** |
| | | | | | | | | | | |
| | | | | | BDT 0.00 | | | | | BDT 153.5 |
| BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 0.62 | BDT 12.5 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | **BDT 165.93** |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 15.3 |
| BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 1.2 |
| | | | | | | | | | | **BDT 16.53** |
| **BDT 46.70** | **BDT 47.65** | **BDT 48.62** | **BDT 49.60** | **BDT 50.61** | **BDT 51.63** | **BDT 52.68** | **BDT 53.74** | **BDT 54.83** | **BDT 55.94** | 23% |
| | | | | | | | | | | |
| BDT 39.67 | BDT 40.47 | BDT 41.29 | BDT 42.13 | BDT 42.98 | BDT 43.85 | BDT 44.74 | BDT 45.65 | BDT 46.57 | BDT 47.52 | 22% |
| | | | | | | | | | | |
| BDT 6.97 | BDT 7.12 | BDT 7.26 | BDT 7.41 | BDT 7.56 | BDT 7.71 | BDT 7.87 | BDT 8.03 | BDT 8.19 | BDT 8.36 | 33% |

| | | | | | |
|---|---|---|---|---|---|
| | **Assumptions for With CCR** | | | | |
| 1 | Saved Income Loss - See Workings below | | | | |
| 2 | Saved Medical Cost - See Workings Below | | | | |
| | | | | | |
| | **Assumptions for Without CCR** | | | | |
| 1 | Saved Income Loss - See Workings below | | | | |
| 2 | Saved Medical Cost - See Workings Below | | | | |
| | | | | | |
| | **Common to both** | | | | |
| 1 | Capex with CCR and without CCR as per technical team estimate | | | | |
| 2 | Opex with CCR and without CCR as per technical team estimate | | | | |
| | | | | | |
| | **Economc Benefit Cost Calculation - With CCR** | | | | |
| | Number of cyclone shelters | 6 | | | |
| | Capacity of cyclone shelters | 1200 | | | |
| | | | | | |
| | Monthly HH Income | BDT | 21744 | | |
| | HH Size | Number | 4.4 | | |
| | Number of days saved | Number | 15 | | |
| | Additional persons accessing CS | Number | 7200 | | |
| | Number of cyclones per year | Number | 2 | | |
| | Saved Medical Cost per HH | BDT | 1061 | | |
| | | | | | |
| | **Savings:** | | | | |
| | Loss of Income per cyclone | BDT | **17,790,545** | | |
| | Medical Cost Per cyclone | BDT | **868,091** | | |
| | | | | | |
| | **Yearly Savings** | | | | **37,317,272** |
| | **Total Savings** | | | | **37,317,272** |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | **Economc Benefit Cost Calculation - Without CCR** | | | | |
| | Number of cyclone shelters | **6** | | | |
| | Capacity of cyclone shelters | **1020** | | | |
| | | | | | |
| | Monthly HH Income | BDT | 21744 | | |
| | HH Size | Number | 4.4 | | |
| | Number of days saved | Number | 15 | | |
| | Additional persons accessing CS | Number | 6120 | | |
| | Number of cyclones per year | Number | 2 | | |
| | Saved Medical Cost per HH | BDT | 1061 | | |
| | | | | | |
| | **Savings:** | | | | |
| | Loss of Income per HH | BDT | **15,121,964** | | |
| | Medical Cost Per HH | BDT | **737,877** | | |
| | | | | | |
| | **Yearly Savings** | | | | **31,719,682** |
| | **Total Savings** | | | | **31,719,682** |

# 1.8. Boat landing stations in Mothbaria

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Boat Landing Stations | | | | | | | | | | | | |
| Investigator(s): | Nesar Ahmed | | | | | | | | | | | | |
| Town: | Mathbaria | | | | | | | | | | | | |
| Project: | For Town | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Full Town | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Variable 1: | | | | | | | | | | | | | |
| Economic Variable 2: | | | | | | | | | | | | | |
| Economic Variable 3: | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Time Savings | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| Economic Variable 2: | Saved Medical Cost | 0.6 | 0.6 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.8 | 0.8 | 0.8 |
| Economic Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **1.0** | **1.0** | **1.0** | **1.1** | **1.1** | **1.1** | **1.1** | **1.1** | **1.2** | **1.2** | **1.2** | **1.2** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Vulnerability 1: (e.g. road damage owing to floods) | | | | | | | | | | | | | |
| Economic Vulnerability 2: | | | | | | | | | | | | | |
| Economic Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Time Savings | 0.09 | 0.09 | 0.09 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.11 | 0.11 | 0.11 | 0.11 |
| Economic Variable 2: | Saved Medical Cost | 0.16 | 0.16 | 0.17 | 0.17 | 0.17 | 0.18 | 0.18 | 0.18 | 0.19 | 0.19 | 0.19 | 0.20 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **0.25** | **0.25** | **0.26** | **0.26** | **0.27** | **0.28** | **0.28** | **0.29** | **0.29** | **0.30** | **0.30** | **0.31** |
| **Vulnerability Impacts with Climate Change and Project** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Time Savings | 0.4 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 2: | Saved Medical Cost | 0.6 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **1.0** | **1.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | Time Savings | 0.0 | 0.0 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| Economic Variable 2: | Saved Medical Cost | 0.0 | 0.0 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.8 | 0.8 | 0.8 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **0.0** | **0.0** | **1.0** | **1.1** | **1.1** | **1.1** | **1.1** | **1.1** | **1.2** | **1.2** | **1.2** | **1.2** |
| | | | | | | | | | | | | | |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 2.76 | BDT 1.84 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.00 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT | BDT 2.05 | | | | | | | | | | |

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| | | 3.07 | | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | BDT 0.31 | BDT 0.20 | | | | | | | | | | |
| **O & M Incremental Costs:** | | | | | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 3.07** | **-BDT 2.05** | **BDT 1.02** | **BDT 1.04** | **BDT 1.07** | **BDT 1.09** | **BDT 1.11** | **BDT 1.13** | **BDT 1.15** | **BDT 1.18** | **BDT 1.20** | **BDT 1.23** |
| | | | | | | | | | | | | | |
| **Project without CC Net Economic Flows** | | -BDT 2.76 | -BDT 1.84 | BDT 0.77 | BDT 0.79 | BDT 0.80 | BDT 0.82 | BDT 0.84 | BDT 0.85 | BDT 0.87 | BDT 0.89 | BDT 0.91 | BDT 0.92 |
| | | | | | | | | | | | | | |
| **Project ONLY CC Net Economic Flows** | | -BDT 0.31 | -BDT 0.20 | BDT 0.25 | BDT 0.25 | BDT 0.25 | BDT 0.26 | BDT 0.26 | BDT 0.27 | BDT 0.28 | BDT 0.28 | BDT 0.29 | BDT 0.29 |

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| **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **Total (Taka 2013)** |
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| 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | BDT 9.8 |
| 0.8 | 0.8 | 0.8 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 1.0 | BDT 17.4 |
| | | | | | | | | | | |
| **1.3** | **1.3** | **1.3** | **1.3** | **1.4** | **1.4** | **1.4** | **1.5** | **1.5** | **1.5** | **27.2** |
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| 0.11 | 0.12 | 0.12 | 0.12 | 0.12 | 0.13 | 0.13 | 0.13 | 0.13 | 0.14 | BDT 2.5 |
| 0.20 | 0.21 | 0.21 | 0.21 | 0.22 | 0.22 | 0.23 | 0.23 | 0.24 | 0.24 | BDT 4.3 |
| | | | | | | | | | | |
| **0.32** | **0.32** | **0.33** | **0.34** | **0.34** | **0.35** | **0.36** | **0.36** | **0.37** | **0.38** | **6.80** |
| | | | | | | | | | | |
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| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 0.7 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 1.3 |
| | | | | | | | | | | 0 |
| | | | | | | | | | | 0.0 |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **2.0** |
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| 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | BDT 9.1 |
| 0.8 | 0.8 | 0.8 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 1.0 | BDT 16.1 |

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| **1.3** | **1.3** | **1.3** | **1.3** | **1.4** | **1.4** | **1.4** | **1.5** | **1.5** | **1.5** | **25.2** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 4.6 |
| BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.1 |
| | | | | | | | | | | **BDT 4.70** |
| | | | | | | | | | | |
| | | | | | BDT 0.00 | | | | | BDT 5.1 |
| BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.3 |
| | | | | | | | | | | **BDT 5.38** |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 0.5 |
| BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.2 |
| | | | | | | | | | | **BDT 0.67** |
| **BDT 1.25** | **BDT 1.28** | **BDT 1.30** | **BDT 1.33** | **BDT 1.36** | **BDT 1.38** | **BDT 1.41** | **BDT 1.44** | **BDT 1.47** | **BDT 1.50** | 19% |
| | | | | | | | | | | |
| BDT 0.94 | BDT 0.96 | BDT 0.98 | BDT 1.00 | BDT 1.02 | BDT 1.04 | BDT 1.06 | BDT 1.08 | BDT 1.11 | BDT 1.13 | 16% |
| | | | | | | | | | | |
| BDT 0.30 | BDT 0.31 | BDT 0.31 | BDT 0.32 | BDT 0.33 | BDT 0.33 | BDT 0.34 | BDT 0.35 | BDT 0.35 | BDT 0.36 | 41% |

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| | **Assumptions for With CCR** | | | | |
| 1 | Time Savings - See Workings below | | | | |
| 2 | Saved Medical Cost - See Workings Below | | | | |
| | | | | | |
| | **Assumptions for Without CCR** | | | | |
| 1 | Time Savings - See Workings below | | | | |
| 2 | Saved Medical Cost - See Workings Below | | | | |
| | | | | | |
| | **Common to both** | | | | |
| 1 | Capex with CCR and without CCR as per technical team estimate | | | | |
| 2 | Opex with CCR and without CCR as per technical team estimate | | | | |
| | | | | | |
| | | | | | |
| | **Economc Benefit Cost Calculation - With CCR** | | | | |
| | Number of Boat Landings | 20 | | | |
| | Capacity of Boat Landings | 20 | | | |
| | | | | | |
| | Monthly HH Income | BDT | 21744 | | |
| | HH Size | Number | 4.3 | | |
| | Number of days travel | Number | 300 | | |
| | Additional persons accessing BLS | Number | 400 | | |
| | Time saved per person | minutes | 2 | | |
| | Saved Medical Cost per HH | BDT | 1061 | | |
| | Avoided injury | % | 0.5 | | |
| | **Savings:** | | | | |
| | Time Savings per person per year | BDT | **3** | | |
| | Medical Cost Savings per person per year | BDT | **5** | | |
| | **Yearly Time Savings** | | | | **360,000** |
| | **Yearly Medical Cost Savings** | | | | **636,600** |
| | **Total Savings** | | | | **996,600** |
| | | | | | |
| | | | | | |
| | | | | | |
| | **Economc Benefit Cost Calculation Without CCR** | | | | |
| | Indicator B4 Leverage PPCR funds against public/private investments in sector | 20 | | | |
| | Indicator B5 Quality/extent climate instruments/investment models developed and tested | 15 | | | |

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|---|---|---|---|---|---|
| | | | | | |
| | Monthly HH Income | BDT | 21744 | | |
| | HH Size | Number | 4.3 | | |
| | Number of days travel | Number | 300 | | |
| | Additional persons accessing BLS | Number | 300 | | |
| | Time saved per person | minutes | 2 | | |
| | Saved Medical Cost per HH | BDT | 1061 | | |
| | Avoided injury | % | 0.5 | | |
| | **Savings:** | | | | |
| | Time Savings per person per year | BDT | **3** | | |
| | Medical Cost Savings per person per year | BDT | **5** | | |
| | **Yearly Time Savings** | | | | **270,000** |
| | **Yearly Medical Cost Savings** | | | | **477,450** |
| | **Total Savings** | | | | **747,450** |

## 1.9. Markets in Mothbaria Paurashava

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Markets | | | | | | | | | | | | |
| Investigator(s): | Nesar Ahmed | | | | | | | | | | | | |
| Town: | Mathbaria | | | | | | | | | | | | |
| Project: | For Town | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Full Town | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Variable 1: | | | | | | | | | | | | | |
| Economic Variable 2: | | | | | | | | | | | | | |
| Economic Variable 3: | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Save Business Income Loss | 4.1 | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.7 | 4.8 | 4.9 | 5.0 |
| Economic Variable 2: | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **4.1** | **4.1** | **4.2** | **4.3** | **4.4** | **4.5** | **4.6** | **4.7** | **4.7** | **4.8** | **4.9** | **5.0** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Vulnerability 1: (e.g. road damage owing to floods) | | | | | | | | | | | | | |
| Economic Vulnerability 2: | | | | | | | | | | | | | |
| Economic Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Save Business Income Loss | 0.81 | 0.83 | 0.84 | 0.86 | 0.88 | 0.89 | 0.91 | 0.93 | 0.95 | 0.97 | 0.99 | 1.01 |
| Economic Variable 2: | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **0.81** | **0.83** | **0.84** | **0.86** | **0.88** | **0.89** | **0.91** | **0.93** | **0.95** | **0.97** | **0.99** | **1.01** |
| **Vulnerability Impacts with Climate Change and Project** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Save Business Income Loss | 4.1 | 4.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 2: | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **4.1** | **4.1** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | Time Savings | 0.0 | 0.0 | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.7 | 4.8 | 4.9 | 5.0 |
| Economic Variable 2: | Saved Medical Cost | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **0.0** | **0.0** | **4.2** | **4.3** | **4.4** | **4.5** | **4.6** | **4.7** | **4.7** | **4.8** | **4.9** | **5.0** |
| | | | | | | | | | | | | | |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 6.14 | BDT 4.09 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT 6.75 | BDT 4.50 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CAPEX Project Incremental Costs** | | BDT 0.61 | BDT 0.41 | | | | | | | | | | |
| **O & M Incremental Costs:** | | | | | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 6.75** | **-BDT 4.50** | **BDT 4.16** | **BDT 4.24** | **BDT 4.33** | **BDT 4.42** | **BDT 4.50** | **BDT 4.60** | **BDT 4.69** | **BDT 4.78** | **BDT 4.88** | **BDT 4.98** |
| **Project without CC Net Economic Flows** | | -BDT 6.14 | -BDT 4.09 | BDT 3.35 | BDT 3.41 | BDT 3.48 | BDT 3.55 | BDT 3.62 | BDT 3.70 | BDT 3.77 | BDT 3.85 | BDT 3.92 | BDT 4.00 |
| **Project ONLY CC Net Economic Flows** | | -BDT 0.61 | -BDT 0.41 | BDT 0.81 | BDT 0.80 | BDT 0.81 | BDT 0.83 | BDT 0.85 | BDT 0.87 | BDT 0.89 | BDT 0.91 | BDT 0.93 | BDT 0.95 |
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| **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **Total (Taka 2013)** |
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| 5.1 | 5.2 | 5.3 | 5.5 | 5.6 | 5.7 | 5.8 | 5.9 | 6.0 | 6.1 | BDT 110.6 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 0.0 |
| | | | | | | | | | | |
| **5.1** | **5.2** | **5.3** | **5.5** | **5.6** | **5.7** | **5.8** | **5.9** | **6.0** | **6.1** | **110.6** |
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| 1.03 | 1.05 | 1.07 | 1.09 | 1.11 | 1.13 | 1.16 | 1.18 | 1.20 | 1.23 | BDT 22.1 |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | BDT 0.0 |
| | | | | | | | | | | |
| **1.03** | **1.05** | **1.07** | **1.09** | **1.11** | **1.13** | **1.16** | **1.18** | **1.20** | **1.23** | **22.12** |
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| | | | | | | | | | | |
| | | | | | | | | | | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 8.2 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 0.0 |
| | | | | | | | | | | 0 |
| | | | | | | | | | | 0.0 |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **8.2** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 5.1 | 5.2 | 5.3 | 5.5 | 5.6 | 5.7 | 5.8 | 5.9 | 6.0 | 6.1 | BDT 102.4 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 0.0 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **5.1** | **5.2** | **5.3** | **5.5** | **5.6** | **5.7** | **5.8** | **5.9** | **6.0** | **6.1** | **102.4** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 10.2 |
| BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.5 |
| | | | | | | | | | | **BDT 10.75** |
| | | | | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | BDT 0.00 | | | | | BDT 11.3 |
| BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 1.1 |
| | | | | | | | | | | **BDT 12.40** |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 1.0 |
| BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.03 | BDT 0.6 |
| | | | | | | | | | | **BDT 1.61** |
| **BDT 5.08** | **BDT 5.18** | **BDT 5.29** | **BDT 5.39** | **BDT 5.50** | **BDT 5.62** | **BDT 5.73** | **BDT 5.84** | **BDT 5.96** | **BDT 6.08** | 33% |
| | | | | | | | | | | |
| BDT 4.08 | BDT 4.17 | BDT 4.25 | BDT 4.34 | BDT 4.42 | BDT 4.51 | BDT 4.60 | BDT 4.70 | BDT 4.79 | BDT 4.89 | 30% |
| | | | | | | | | | | |
| BDT 0.97 | BDT 0.99 | BDT 1.01 | BDT 1.03 | BDT 1.05 | BDT 1.07 | BDT 1.09 | BDT 1.12 | BDT 1.14 | BDT 1.17 | 59% |

| | | | | | |
|---|---|---|---|---|---|
| | **Assumptions for With CCR** | | | | |
| 1 | Save Business Income Loss - See Workings below | | | | |
| | | | | | |
| | | | | | |
| | **Assumptions for Without CCR** | | | | |
| 1 | Save Business Income Loss - See Workings below | | | | |
| | | | | | |
| | | | | | |
| | **Common to both** | | | | |
| 1 | Capex with CCR and without CCR as per technical team estimate | | | | |
| 2 | Opex with CCR and without CCR as per technical team estimate | | | | |
| | | | | | |
| | | | | | |
| | **Economc Benefit Cost Calculation - With CCR** | | | | |
| | Number of Markets | 1 | | | |
| | Number of Traders | 20 | | | |
| | | | | | |
| | Monthly HH Expenditure | BDT | 17554 | | |
| | HH Size | Number | 4.3 | | |
| | Number of days shopping | Number | 300 | | |
| | Additional HHs accessing Market | Number/day | 40 | | |
| | % of Expenditure spent in Market | % | 50% | | |
| | | | | | |
| | | | | | |
| | **Savings:** | | | | |
| | Average business generated in a day | BDT | **13,503** | | |
| | | | | | |
| | **Yearly Buiness Income Loss Savings** | | | | **4,050,923** |
| | | | | | **-** |
| | **Total Savings** | | | | **4,050,923** |
| | | | | | |
| | | | | | |
| | | | | | |
| | **Economc Benefit Cost Calculation Without CCR** | | | | |
| | Number of Markets | 1 | | | |
| | Number of Traders | 16 | | | |
| | | | | | |
| | Monthly HH Expenditure | BDT | 17554 | | |
| | HH Size | Number | 4.3 | | |
| | Number of days shopping | Number | 300 | | |
| | Additional HHs accessing Market | Number/day | 32 | | |

| | | | | | |
|---|---|---|---|---|---|
| | % of Expenditure spent in Market | % | 50% | | |
| | | | | | |
| | | | | | |
| | **Savings:** | | | | |
| | Economic Variable 2: | BDT | **10,802** | | |
| | | | | | |
| | **Yearly Buiness Income Loss Savings** | | | | **3,240,738** |
| | | | | | **-** |
| | **Total Savings** | | | | **3,240,738** |

# 1.10. Bus Terminal in Mathbaria Paurashava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Bus Terminal | | | | | | | | | | | | |
| Investigator(s): | Nesar Ahmed | | | | | | | | | | | | |
| Town: | Mathbaria | | | | | | | | | | | | |
| Project: | For Town | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Full Town | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Variable 1: | | | | | | | | | | | | | |
| Economic Variable 2: | | | | | | | | | | | | | |
| Economic Variable 3: | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Time Savings | 5.2 | 5.3 | 5.4 | 5.5 | 5.7 | 5.8 | 5.9 | 6.0 | 6.1 | 6.2 | 6.4 | 6.5 |
| Economic Variable 2: | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **5.2** | **5.3** | **5.4** | **5.5** | **5.7** | **5.8** | **5.9** | **6.0** | **6.1** | **6.2** | **6.4** | **6.5** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Vulnerability 1: (e.g. road damage owing to floods) | | | | | | | | | | | | | |
| Economic Vulnerability 2: | | | | | | | | | | | | | |
| Economic Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Time Savings | 1.05 | 1.07 | 1.09 | 1.11 | 1.13 | 1.15 | 1.18 | 1.20 | 1.22 | 1.25 | 1.27 | 1.30 |
| Economic Variable 2: | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **1.05** | **1.07** | **1.09** | **1.11** | **1.13** | **1.15** | **1.18** | **1.20** | **1.22** | **1.25** | **1.27** | **1.30** |
| **Vulnerability Impacts with Climate Change and Project** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Time Savings | 5.2 | 5.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 2: | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **5.2** | **5.3** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Time Savings | 0.0 | 0.0 | 5.4 | 5.5 | 5.7 | 5.8 | 5.9 | 6.0 | 6.1 | 6.2 | 6.4 | 6.5 |
| Economic Variable 2: | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **0.0** | **0.0** | **5.4** | **5.5** | **5.7** | **5.8** | **5.9** | **6.0** | **6.1** | **6.2** | **6.4** | **6.5** |
| | | | | | | | | | | | | | |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 4.48 | BDT 2.99 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 0.76 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT 4.91 | BDT 3.27 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | BDT 0.43 | BDT 0.29 | | | | | | | | | | |
| **O & M Incremental Costs:** | | | | | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 4.91** | **-BDT 3.27** | **BDT 4.61** | **BDT 4.72** | **BDT 4.83** | **BDT 4.94** | **BDT 5.06** | **BDT 5.17** | **BDT 5.29** | **BDT 5.42** | **BDT 5.54** | **BDT 5.67** |
| | | | | | | | | | | | | | |
| **Project without CC Net Economic Flows** | | -BDT 4.48 | -BDT 2.99 | BDT 3.59 | BDT 3.68 | BDT 3.77 | BDT 3.86 | BDT 3.95 | BDT 4.05 | BDT 4.14 | BDT 4.24 | BDT 4.34 | BDT 4.44 |
| **Project ONLY CC Net Economic Flows** | | -BDT 0.43 | -BDT 0.29 | BDT 1.01 | BDT 0.96 | BDT 0.99 | BDT 1.01 | BDT 1.03 | BDT 1.06 | BDT 1.08 | BDT 1.10 | BDT 1.13 | BDT 1.15 |

7.

| 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | Total (Taka 2013) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 6.6 | 6.8 | 6.9 | 7.0 | 7.2 | 7.3 | 7.5 | 7.6 | 7.8 | 7.9 | BDT 142.7 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 0.0 |
| | | | | | | | | | | |
| **6.6** | **6.8** | **6.9** | **7.0** | **7.2** | **7.3** | **7.5** | **7.6** | **7.8** | **7.9** | **142.7** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 1.33 | 1.35 | 1.38 | 1.41 | 1.44 | 1.46 | 1.49 | 1.52 | 1.55 | 1.58 | BDT 28.5 |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | BDT 0.0 |
| | | | | | | | | | | |
| **1.33** | **1.35** | **1.38** | **1.41** | **1.44** | **1.46** | **1.49** | **1.52** | **1.55** | **1.58** | **28.54** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 10.6 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 0.0 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **10.6** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 6.6 | 6.8 | 6.9 | 7.0 | 7.2 | 7.3 | 7.5 | 7.6 | 7.8 | 7.9 | BDT 132.1 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 0.0 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **6.6** | **6.8** | **6.9** | **7.0** | **7.2** | **7.3** | **7.5** | **7.6** | **7.8** | **7.9** | **132.1** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 7.5 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 0.76 | BDT 15.2 |
| | | | | | | | | | | **BDT 22.62** |
| | | | | | | | | | | |
| | | | | | BDT 0.00 | | | | | BDT 8.2 |
| BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 16.6 |
| | | | | | | | | | | **BDT 24.79** |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 0.7 |
| BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 1.4 |
| | | | | | | | | | | **BDT 2.10** |
| **BDT 5.80** | **BDT 5.93** | **BDT 6.07** | **BDT 6.20** | **BDT 6.35** | **BDT 6.49** | **BDT 6.64** | **BDT 6.78** | **BDT 6.94** | **BDT 7.09** | 46% |
| | | | | | | | | | | |
| BDT 4.55 | BDT 4.65 | BDT 4.76 | BDT 4.87 | BDT 4.98 | BDT 5.10 | BDT 5.21 | BDT 5.33 | BDT 5.46 | BDT 5.58 | 41% |
| | | | | | | | | | | |
| BDT 1.18 | BDT 1.21 | BDT 1.23 | BDT 1.26 | BDT 1.29 | BDT 1.32 | BDT 1.35 | BDT 1.38 | BDT 1.41 | BDT 1.44 | 91% |
| | | | | | | | | | | |

8.

9.

10.

11.

| | | | | | |
|---|---|---|---|---|---|
| | **Assumptions for With CCR** | | | | |
| 1 | Save Business Income Loss - See Workings below | | | | |
| | | | | | |
| | | | | | |
| | **Assumptions for Without CCR** | | | | |
| 1 | Save Business Income Loss - See Workings below | | | | |
| | | | | | |
| | | | | | |
| | **Common to both** | | | | |
| 1 | Capex with CCR and without CCR as per technical team estimate | | | | |
| 2 | Opex with CCR and without CCR as per technical team estimate | | | | |
| | | | | | |
| | | | | | |
| | **Economc Benefit Cost Calculation - With CCR** | | | | |
| | | | | | |
| | Number of Bus Terminal | 1 | | | |
| | Number of Buses - Additional | 50 | | | |
| | | | | | |
| | Monthly HH Income | BDT | 21744 | | |
| | HH Size | Number | 4.3 | | |
| | Number of days travel | Number | 300 | | |
| | Number of passengers per bus | Number/day | 40 | | |
| | Time savings | minute | 5.00 | | |
| | | | | | |
| | | | | | |
| | **Savings:** | | | | |
| | Average time savings in a day | BDT | **348** | | |
| | | | | | |
| | **Yearly Time Savings** | | | | **5,226,923** |
| | | | | | **-** |
| | **Total Savings** | | | | **5,226,923** |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| | **Economc Benefit Cost Calculation Without CCR** | | | | |
| | Number of Bus Terminal | 1 | | | |
| | Number of Buses - Additional | 40 | | | |
| | | | | | |
| | Monthly HH Income | BDT | 21744 | | |
| | HH Size | Number | 4.3 | | |
| | Number of days travel | Number | 300 | | |
| | Number of passengers per bus | Number/day | 40 | | |
| | Time savings | minute | 5 | | |
| | | | | | |
| | | | | | |
| | **Savings:** | | | | |
| | Average time savings in a day | BDT | **348** | | |
| | | | | | |
| | **Yearly Time Savings** | | | | **4,181,538** |
| | **Yearly Medical Cost Savings** | | | | **-** |
| | **Total Savings** | | | | **4,181,538** |

12.

# 4.1. Water Supply in Pairojpur Paurashava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Water Supply | | | | | | | | | | | | |
| Investigator(s): | Zhangir | | | | | | | | | | | | |
| Town: | Pirojpur | | | | | | | | | | | | |
| Project: | Water Supply for Town | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | 90% of the town population covered under piped water supply system | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2,015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | None | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | **Time to fetch water** | 17.70 | 20.30 | 22.96 | 25.69 | 28.48 | 28.77 | 29.04 | 29.31 | 29.81 | 30.31 | 30.81 | 31.30 |
| Economic Variable 2: | **Cost of storage tanks including cleaning** | 25.81 | 3.78 | 3.88 | 3.98 | 4.07 | 0.42 | 0.40 | 0.39 | 0.73 | 0.73 | 0.72 | 0.72 |
| Economic Variable 3: | **Cost of water purification** | 35.55 | 36.11 | 36.67 | 37.22 | 37.78 | 38.35 | 38.93 | 39.50 | 40.08 | 40.65 | 41.23 | 41.80 |
| Economic Variable 4: | **Purchase costs of water** | 18.30 | 20.98 | 23.73 | 26.55 | 29.44 | 29.73 | 30.02 | 30.30 | 30.81 | 31.33 | 31.84 | 32.36 |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **97.4** | **81.2** | **87.2** | **93.4** | **99.8** | **97.3** | **98.4** | **99.5** | **101.4** | **103.0** | **104.6** | **106.2** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | **Time to fetch water** | 17.7 | 20.3 | 23.0 | 25.7 | 28.5 | 28.8 | 29.0 | 29.3 | 29.8 | 30.3 | 30.8 | 31.3 |
| Economic Variable 2: | **Cost of storage tanks including cleaning** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 3: | **Cost of water purification** | 12.4 | 10.8 | 9.2 | 7.4 | 5.7 | 5.8 | 5.8 | 5.9 | 6.0 | 6.1 | 6.2 | 6.3 |
| Economic Variable 4: | **Purchase costs of water** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **30.1** | **31.1** | **32.1** | **33.1** | **34.1** | **34.5** | **34.9** | **35.2** | **35.8** | **36.4** | **37.0** | **37.6** |
| **Vulnerability Impacts with Climate Change and Project** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | **Time to fetch water** | 17.7 | 20.3 | 23.0 | 0.0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Economic Variable 2: | **Cost of storage tanks including cleaning** | 25.8 | 3.8 | 3.9 | 0.0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Economic Variable 3: | **Cost of water purification** | 35.6 | 36.1 | 36.7 | 0.0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Economic Variable 4: | **Purchase costs of water** | 18.3 | 21.0 | 23.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **97.4** | **81.2** | **87.2** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | **Time to fetch water** | 0.0 | 0.0 | 0.0 | 25.7 | 28.5 | 28.8 | 29.0 | 29.3 | 29.8 | 30.3 | 30.8 | 31.3 |
| Economic Variable 2: | **Cost of storage tanks including cleaning** | 0.0 | 0.0 | 0.0 | 4.0 | 4.1 | 0.4 | 0.4 | 0.4 | 0.7 | 0.7 | 0.7 | 0.7 |
| Economic Variable 3: | **Cost of water purification** | 0.0 | 0.0 | 0.0 | 37.2 | 37.8 | 38.4 | 38.9 | 39.5 | 40.1 | 40.7 | 41.2 | 41.8 |
| Economic Variable 4: | **Purchase costs of water** | 0.0 | 0.0 | 0.0 | 26.5 | 29.4 | 29.7 | 30.0 | 30.3 | 30.8 | 31.3 | 31.8 | 32.4 |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **0.0** | **0.0** | **0.0** | **93.4** | **99.8** | **97.3** | **98.4** | **99.5** | **101.4** | **103.0** | **104.6** | **106.2** |
| | | 1000 | | | | | | | | | | | |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 110.97 | BDT 166.04 | BDT 110.15 | BDT 110.15 | | | | | | | | |
| **O & M without CC Adaptation:** | | **BDT 0.00** | 0 | BDT 0.00 | | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT 110.97 | BDT 180.67 | BDT 139.41 | BDT 139.41 | | | | | | | | |
| **O & M with CC Adaptation:** | | **BDT 0.00** | 0 | BDT 0.00 | | BDT | BDT | BDT | BDT | BDT | BDT | BDT 4.42 | BDT 4.42 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 4.42 | 4.42 | 4.42 | 4.42 | 4.42 | 4.42 | | |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | BDT 0.00 | BDT 14.63 | BDT 29.27 | BDT 29.27 | BDT 0.00 | | | | | | | |
| **O & M Incremental Costs:** | | | | | | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 110.97** | **-BDT 180.67** | **-BDT 139.41** | **-BDT 45.98** | **BDT 95.35** | **BDT 92.85** | **BDT 93.97** | **BDT 95.08** | **BDT 97.01** | **BDT 98.60** | **BDT 100.18** | **BDT 101.76** |
| | | | | | | | | | | | | | |
| **Project without CC Net Economic Flows** | | -BDT 110.97 | -BDT 166.04 | -BDT 110.15 | -BDT 49.85 | BDT 61.74 | BDT 58.87 | BDT 59.63 | BDT 60.38 | BDT 61.73 | BDT 62.73 | BDT 63.73 | BDT 64.73 |
| | | | | | | | | | | | | | |
| **Project ONLY CC Net Economic Flows** | | BDT 0.00 | -BDT 14.63 | -BDT 29.27 | BDT 3.86 | BDT 33.61 | BDT 33.98 | BDT 34.34 | BDT 34.70 | BDT 35.28 | BDT 35.87 | BDT 36.45 | BDT 37.03 |

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| **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **2036** | **2037** | **2038** | **2039** | **2040** | **2041** | **2042** | **Total (Taka 2013)** |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 31.80 | 32.29 | 35.73 | 36.36 | 37.00 | 37.63 | 38.26 | 38.89 | 39.51 | 40.14 | 40.76 | 41.38 | 42.00 | 42.63 | 43.27 | 43.92 | 44.57 | 990.61 |
| 0.72 | 0.72 | 5.01 | 0.93 | 0.92 | 0.92 | 0.92 | 0.92 | 0.00 | 0.91 | 0.91 | 0.91 | 0.90 | 0.92 | 0.93 | 0.94 | 0.96 | 64.08 |
| 42.38 | 42.95 | 43.53 | 44.19 | 44.86 | 45.52 | 46.18 | 46.85 | 47.51 | 48.17 | 48.84 | 49.50 | 50.17 | 50.84 | 51.52 | 52.21 | 52.91 | 1272.01 |
| 32.87 | 33.37 | 36.93 | 37.58 | 38.24 | 38.89 | 39.54 | 40.19 | 40.84 | 41.49 | 42.13 | 42.77 | 43.41 | 44.06 | 44.72 | 45.39 | 46.07 | 1023.90 |
| **107.8** | **109.3** | **121.2** | **119.1** | **121.0** | **123.0** | **124.9** | **126.8** | **127.9** | **130.7** | **132.6** | **134.6** | **136.5** | **138.5** | **140.4** | **142.5** | **144.5** | **3350.6** |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 31.8 | 32.3 | 35.7 | 36.4 | 37.0 | 37.6 | 38.3 | 38.9 | 39.5 | 40.1 | 40.8 | 41.4 | 42.0 | 42.6 | 43.3 | 43.9 | 44.6 | 990.61 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00 |
| 6.4 | 6.4 | 4.4 | 4.4 | 4.5 | 4.6 | 4.6 | 4.7 | 4.8 | 4.8 | 4.9 | 5.0 | 5.0 | 5.1 | 5.2 | 5.2 | 5.3 | 172.72 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.00 |
| **38.2** | **38.7** | **40.1** | **40.8** | **41.5** | **42.2** | **42.9** | **43.6** | **44.3** | **45.0** | **45.6** | **46.3** | **47.0** | **47.7** | **48.4** | **49.1** | **49.9** | **1163.3** |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 60.96 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 33.48 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 108.33 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 63.00 |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **265.8** |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 31.8 | 32.3 | 35.7 | 36.4 | 37.0 | 37.6 | 38.3 | 38.9 | 39.5 | 40.1 | 40.8 | 41.4 | 42.0 | 42.6 | 43.3 | 43.9 | 44.6 | 929.66 |
| 0.7 | 0.7 | 5.0 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.0 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 1.0 | 30.60 |
| 42.4 | 43.0 | 43.5 | 44.2 | 44.9 | 45.5 | 46.2 | 46.8 | 47.5 | 48.2 | 48.8 | 49.5 | 50.2 | 50.8 | 51.5 | 52.2 | 52.9 | 1163.68 |
| 32.9 | 33.4 | 36.9 | 37.6 | 38.2 | 38.9 | 39.5 | 40.2 | 40.8 | 41.5 | 42.1 | 42.8 | 43.4 | 44.1 | 44.7 | 45.4 | 46.1 | 960.89 |
| **107.8** | **109.3** | **121.2** | **119.1** | **121.0** | **123.0** | **124.9** | **126.8** | **127.9** | **130.7** | **132.6** | **134.6** | **136.5** | **138.5** | **140.4** | **142.5** | **144.5** | **3084.8** |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | 497.30 |
| BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | BDT 3.88 | 97.05 |
| | | | | | | | | | | **3.9** | | | | | | | **BDT 594.35** |
| | | | | | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | 570.47 |
| BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 4.42 | BDT 0.00 |
| | | | | | | | | | | **4.4** | | | | | | | **BDT 570.47** |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | 73.16 |
| BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | 13.50 |
| | | | | | | | | | | **0.5** | | | | | | | **BDT 86.66** |
| **BDT 103.34** | **BDT 104.91** | **BDT 116.77** | **BDT 114.64** | **BDT 116.59** | **BDT 118.54** | **BDT 120.48** | **BDT 122.42** | **BDT 123.44** | **BDT 126.29** | **BDT 128.22** | **BDT 130.14** | **BDT 132.06** | **BDT 134.03** | **BDT 136.02** | **BDT 138.04** | **BDT 140.09** | 16% |
| | | | | | | | | | | | | | | | | | |
| BDT 65.73 | BDT 66.72 | BDT 77.23 | BDT 74.40 | BDT 75.65 | BDT 76.90 | BDT 78.15 | BDT 79.39 | BDT 79.72 | BDT 81.87 | BDT 83.11 | BDT 84.35 | BDT 85.58 | BDT 86.85 | BDT 88.14 | BDT 89.44 | BDT 90.76 | 12% |
| | | | | | | | | | | | | | | | | | |
| BDT 37.61 | BDT 38.19 | BDT 39.54 | BDT 40.24 | BDT 40.94 | BDT 41.64 | BDT 42.34 | BDT 43.03 | BDT 43.73 | BDT 44.42 | BDT 45.11 | BDT 45.79 | BDT 46.48 | BDT 47.18 | BDT 47.88 | BDT 48.60 | BDT 49.32 | 48% |

| | |
|---|---|
| | **Assumptions: (with CCR)** |
| 1 | Time to fetch water has been assessed based on the SEWTP report timing of 11.4 minutes per HH |
| 2 | Cost of storage Tanks considered @ 4740 BDT as per SEWTP report for HHs shifting to piped water supply |
| 3 | Cost of purification - BDT 80 per month per HH as per SEWTP report - not considered |
| 4 | Purchase of water @ 100 BDT per KL - 20% used for drinking purpose - Pourashava |
| | |
| | **Assumptions: (without CCR)** |
| 1 | Time to fetch water has been assessed based on the SEWTP report timing of 11.4 minutes per HH - **20% less vulnerability loss reduction as compared with CCR scenario** |
| 2 | Cost of storage Tanks considered @ 4740 BDT as per SEWTP report for HHs shifting to piped water supply - **No Change** |
| 3 | Purchase of water @ 100 BDT per KL - 20% used for drinking purpose **- 20% less vulnerability loss reduction as compared with CCR scenario** |
| 4 | Purchase of water @ 100 BDT per KL - 20% used for drinking purpose **- 20% less vulnerability loss reduction as compared with CCR scenario** |
| | |
| | **Common to both** |
| 1 | Capex with CCR and without CCR as per technical team estimate |
| 2 | Opex with CCR and without CCR as per technical team estimate |

# 4.2. Sanitation in Pirojpur Paurashava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Sanitation | | | | | | | | | | | | |
| Investigator(s): | Zhangir | | | | | | | | | | | | |
| Town: | Pirojpur | | | | | | | | | | | | |
| Project: | Sanitation for Town | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | part of town | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Variable 1: | | | | | | | | | | | | | |
| Economic Variable 2: | | | | | | | | | | | | | |
| Economic Variable 3: | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.6 | 0.6 | 0.6 | 0.6 |
| Economic Variable 2: | Saved Medical Cost | 2.8 | 2.8 | 2.9 | 2.9 | 3.0 | 3.0 | 3.1 | 3.2 | 3.2 | 3.3 | 3.4 | 3.4 |
| Economic Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **3.2** | **3.3** | **3.4** | **3.4** | **3.5** | **3.6** | **3.6** | **3.7** | **3.8** | **3.9** | **3.9** | **4.0** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Vulnerability 1: (e.g. road damage owing to floods) | | | | | | | | | | | | | |
| Economic Vulnerability 2: | | | | | | | | | | | | | |
| Economic Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Economic Variable 2: | Saved Medical Cost | 0.41 | 0.42 | 0.43 | 0.44 | 0.45 | 0.46 | 0.47 | 0.48 | 0.48 | 0.49 | 0.50 | 0.51 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **0.41** | **0.42** | **0.43** | **0.44** | **0.45** | **0.46** | **0.47** | **0.48** | **0.48** | **0.49** | **0.50** | **0.51** |
| **Vulnerability Impacts with Climate Change and Project** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 0.5 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 2: | Saved Medical Cost | 2.8 | 2.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **3.2** | **3.3** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 0.0 | 0.0 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.6 | 0.6 | 0.6 | 0.6 |
| Economic Variable 2: | Saved Medical Cost | 0.0 | 0.0 | 2.9 | 2.9 | 3.0 | 3.0 | 3.1 | 3.2 | 3.2 | 3.3 | 3.4 | 3.4 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **0.0** | **0.0** | **3.4** | **3.4** | **3.5** | **3.6** | **3.6** | **3.7** | **3.8** | **3.9** | **3.9** | **4.0** |
| | | 1000000 | | | | | | | | | | | |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 6.99 | BDT 4.66 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | BDT 0.54 | BDT | BDT | BDT | BDT | BDT | BDT | BDT | BDT | BDT |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 0.54 | 0.54 | 0.54 | 0.54 | 0.54 | 0.54 | 0.54 | 0.54 | 0.54 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT 7.52 | BDT 5.01 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | BDT 0.65 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | BDT 0.53 | BDT 0.36 | BDT 0.00 | BDT 0.00 | BDT 0.00 | | | | | | | |
| **O & M Incremental Costs:** | | | | | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 7.52** | **-BDT 5.01** | **BDT 2.72** | **BDT 2.88** | **BDT 2.95** | **BDT 3.02** | **BDT 3.09** | **BDT 3.16** | **BDT 3.24** | **BDT 3.31** | **BDT 3.39** | **BDT 3.47** |
| | | | | | | | | | | | | | |
| **Project without CC Net Economic Flows** | | -BDT 6.99 | -BDT 4.66 | BDT 2.39 | BDT 2.45 | BDT 2.51 | BDT 2.57 | BDT 2.64 | BDT 2.70 | BDT 2.76 | BDT 2.83 | BDT 2.90 | BDT 2.97 |
| | | | | | | | | | | | | | |
| **Project ONLY CC Net Economic Flows** | | -BDT 0.53 | -BDT 0.36 | BDT 0.32 | BDT 0.41 | BDT 0.42 | BDT 0.43 | BDT 0.44 | BDT 0.45 | BDT 0.46 | BDT 0.47 | BDT 0.48 | BDT 0.49 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **Total (Taka 2013)** |
| | | | | | | | | | | |
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| 0.6 | 0.6 | 0.6 | 0.6 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | BDT 13.0 |
| 3.5 | 3.6 | 3.6 | 3.7 | 3.8 | 3.9 | 3.9 | 4.0 | 4.1 | 4.2 | BDT 75.3 |
| | | | | | | | | | | |
| **4.1** | **4.2** | **4.3** | **4.4** | **4.4** | **4.5** | **4.6** | **4.7** | **4.8** | **4.9** | **88.3** |
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| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | BDT 0.0 |
| 0.52 | 0.54 | 0.55 | 0.56 | 0.57 | 0.58 | 0.59 | 0.60 | 0.62 | 0.63 | BDT 11.3 |
| | | | | | | | | | | |
| **0.52** | **0.54** | **0.55** | **0.56** | **0.57** | **0.58** | **0.59** | **0.60** | **0.62** | **0.63** | **11.30** |
| | | | | | | | | | | |
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| | | | | | | | | | | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 1.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 5.6 |
| | | | | | | | | | | 0 |
| | | | | | | | | | | 0.0 |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **6.5** |
| | | | | | | | | | | |
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| | | | | | | | | | | |
| 0.6 | 0.6 | 0.6 | 0.6 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | BDT 12.0 |
| 3.5 | 3.6 | 3.6 | 3.7 | 3.8 | 3.9 | 3.9 | 4.0 | 4.1 | 4.2 | BDT 69.8 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **4.1** | **4.2** | **4.3** | **4.4** | **4.4** | **4.5** | **4.6** | **4.7** | **4.8** | **4.9** | **81.8** |

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| | | | | | | | | | | |
| | | | | | | | | | | BDT 11.6 |
| BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 0.54 | BDT 10.8 |
| | | | | | | | | | | **22.5** |
| | | | | | | | | | | |
| | | | | | BDT 0.00 | | | | | BDT 12.5 |
| BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 0.55 | BDT 11.2 |
| | | | | | | | | | | **23.7** |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 0.9 |
| BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.2 |
| | | | | | | | | | | **1.1** |
| **BDT 3.55** | **BDT 3.63** | **BDT 3.72** | **BDT 3.80** | **BDT 3.89** | **BDT 3.98** | **BDT 4.07** | **BDT 4.16** | **BDT 4.25** | **BDT 4.35** | 21% |
| | | | | | | | | | | |
| BDT 3.04 | BDT 3.11 | BDT 3.18 | BDT 3.26 | BDT 3.33 | BDT 3.41 | BDT 3.49 | BDT 3.57 | BDT 3.65 | BDT 3.73 | 20% |
| | | | | | | | | | | |
| BDT 0.50 | BDT 0.51 | BDT 0.52 | BDT 0.53 | BDT 0.54 | BDT 0.56 | BDT 0.57 | BDT 0.58 | BDT 0.59 | BDT 0.60 | 37% |

| | |
|---|---|
| | **Assumptions for With CCR** |
| 1 | Saved Income Loss - HH monthly income - BDT 14,620, days lost due to sickness - 1.8 days considered as per SEWTP report |
| 2 | Saved Medical Cost - HH monthly expenditure on health - BDT 1533 considered as per SEWTP report @ 30% for sanitation |
| | |
| | **Assumptions for Without CCR** |
| 1 | Saved Income Loss - HH monthly income - BDT 14,620, days lost due to sickness - 1.8 days considered as per SEWTP report - NO Change |
| 2 | Saved Medical Cost - HH monthly expenditure on health - BDT 1533 considered as per SEWTP report @ 30% for sanitation - **15% less vulnerability loss reduction as compared with CCR scenario** |
| | |
| | **Common to both** |
| 1 | Capex with CCR and without CCR as per technical team estimate |
| 2 | Opex with CCR and without CCR as per technical team estimate |

## 4.3. Drainage/ Flood control in Pirojpur Paurashava

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Drainage and Flood Control | | | | | | | | | | | | |
| Investigator(s): | Muhibullah / Paul Dean | | | | | | | | | | | | |
| Town: | Pirojpur | | | | | | | | | | | | |
| Project: | Drainage and Flood Control for Town | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Whole town | | | | | | | | | | | | |
| | **Year** | **Year** | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. road damage owing to floods) | Property Damage | 50.9 | 51.9 | 53.0 | 54.0 | 55.1 | 56.2 | 57.3 | 58.5 | 59.7 | 60.9 | 62.1 | 63.3 |
| Vulnerability 2: | Property Repair | 3.1 | 3.1 | 3.2 | 3.2 | 3.3 | 3.4 | 3.4 | 3.5 | 3.6 | 3.7 | 3.7 | 3.8 |
| | Property Clean Up | 46.5 | 47.4 | 48.4 | 49.4 | 50.3 | 51.3 | 52.4 | 53.4 | 54.5 | 55.6 | 56.7 | 57.8 |
| Vulnerability 3: etc…. | Road Damage / Repair | 6.0 | 6.1 | 6.2 | 6.4 | 6.5 | 6.6 | 6.8 | 6.9 | 7.0 | 7.2 | 7.3 | 7.5 |
| | Agriculture Loss | 47.8 | 48.7 | 49.7 | 50.7 | 51.7 | 52.8 | 53.8 | 54.9 | 56.0 | 57.1 | 58.3 | 59.4 |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. economic damage due to delays, congestion, road closure) | Loss of Income due to sick days | 23.9 | 24.4 | 24.9 | 25.4 | 25.9 | 26.4 | 26.9 | 27.5 | 28.0 | 28.6 | 29.2 | 29.7 |
| Vulnerability 2: (e.g. extra maintenance/repair costs w.o. investment) | Loss of business income | 14.2 | 14.5 | 14.8 | 15.1 | 15.4 | 15.7 | 16.0 | 16.3 | 16.7 | 17.0 | 17.3 | 17.7 |
| Vulnerability 3: etc. | Medical Cost | 2.5 | 2.6 | 2.6 | 2.7 | 2.7 | 2.8 | 2.8 | 2.9 | 2.9 | 3.0 | 3.1 | 3.1 |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **194.9** | **198.8** | **202.8** | **206.8** | **211.0** | **215.2** | **219.5** | **223.9** | **228.4** | **232.9** | **237.6** | **242.4** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. road damage owing to floods) | Property Damage | 50.9 | 51.9 | 14.7 | 15.0 | 15.3 | 15.6 | 15.9 | 16.3 | 16.6 | 16.9 | 17.3 | 17.6 |
| Vulnerability 2: | Property Repair | 3.1 | 3.1 | 0.9 | 0.9 | 0.9 | 0.9 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.1 |
| | Property Clean Up | 46.5 | 47.4 | 13.5 | 13.8 | 14.0 | 14.3 | 14.6 | 14.9 | 15.2 | 15.5 | 15.8 | 16.1 |
| Vulnerability 3: etc…. | Road Damage / Repair | 6.0 | 6.1 | 6.2 | 6.4 | 6.5 | 6.6 | 6.8 | 6.9 | 7.0 | 7.2 | 7.3 | 7.5 |
| | Agriculture Loss | 47.8 | 48.7 | 49.7 | 50.7 | 51.7 | 52.8 | 53.8 | 54.9 | 56.0 | 57.1 | 58.3 | 59.4 |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. economic damage due to delays, congestion, road closure) | Loss of Income due to sick days | 23.9 | 24.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Vulnerability 2: (e.g. extra maintenance/repair costs w.o. investment) | Loss of business income | 14.2 | 14.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Vulnerability 3: etc. | Medical Cost | 2.5 | 2.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **194.9** | **198.8** | **85.1** | **86.8** | **88.5** | **90.3** | **92.1** | **93.9** | **95.8** | **97.7** | **99.7** | **101.7** |
| **Vulnerability Impacts with Project with CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. road damage owing to floods) | Property Damage | 50.9 | 51.9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 2: | Property Repair | 3.1 | 3.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Property Clean Up | 46.5 | 47.4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 3: etc…. | Road Damage / Repair | 6.0 | 6.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Agriculture Loss | 47.8 | 48.7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. economic damage due to delays, congestion, road closure) | Loss of Income due to sick days | 23.9 | 24.4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 2: (e.g. extra maintenance/repair costs w.o. investment) | Loss of business income | 14.2 | 14.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 3: etc. | Medical Cost | 2.5 | 2.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **194.9** | **198.8** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Impact of Project on Reduced Vulnerability** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Vulnerability 1: (e.g. reduced costs of road damage owing to floods) | Property Damage | 0.0 | 0.0 | 53.0 | 54.0 | 55.1 | 56.2 | 57.3 | 58.5 | 59.7 | 60.9 | 62.1 | 63.3 |
| Vulnerability 2: | Property Repair | 0.0 | 0.0 | 3.2 | 3.2 | 3.3 | 3.4 | 3.4 | 3.5 | 3.6 | 3.7 | 3.7 | 3.8 |
| Vulnerability 3: etc…. | Property Clean Up | 0.0 | 0.0 | 48.4 | 49.4 | 50.3 | 51.3 | 52.4 | 53.4 | 54.5 | 55.6 | 56.7 | 57.8 |
| | Road Damage / Repair | 0.0 | 0.0 | 6.2 | 6.4 | 6.5 | 6.6 | 6.8 | 6.9 | 7.0 | 7.2 | 7.3 | 7.5 |
| | Agriculture Loss | 0.0 | 0.0 | 49.7 | 50.7 | 51.7 | 52.8 | 53.8 | 54.9 | 56.0 | 57.1 | 58.3 | 59.4 |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced economic damage due to delays, congestion, road closure) | Loss of Income due to sick days | 0.0 | 0.0 | 24.9 | 25.4 | 25.9 | 26.4 | 26.9 | 27.5 | 28.0 | 28.6 | 29.2 | 29.7 |
| Vulnerability 2: (e.g. reduced extra maintenance/repair costs versus w.o. investment) | Loss of business income | 0.0 | 0.0 | 14.8 | 15.1 | 15.4 | 15.7 | 16.0 | 16.3 | 16.7 | 17.0 | 17.3 | 17.7 |
| Vulnerability 3: etc. | Medical Cost | 0.0 | 0.0 | 2.6 | 2.7 | 2.7 | 2.8 | 2.8 | 2.9 | 2.9 | 3.0 | 3.1 | 3.1 |
| **Annual Total Reduced Damage/Loss/Extra Costs:** | | **0.0** | **0.0** | **202.8** | **206.8** | **211.0** | **215.2** | **219.5** | **223.9** | **228.4** | **232.9** | **237.6** | **242.4** |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 179.44 | BDT 119.63 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | BDT 1.39 | BDT 1.39 | BDT 1.39 | BDT 1.39 | BDT 1.39 | BDT 1.39 | BDT 1.39 | BDT 1.39 | BDT 3.09 | BDT 3.09 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT 217.31 | BDT 144.87 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | BDT 1.77 | BDT 1.77 | BDT 1.77 | BDT 1.77 | BDT 1.77 | BDT 1.77 | BDT 1.77 | BDT 1.77 | BDT 3.75 | BDT 3.75 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | BDT 37.86 | BDT 25.24 | | | | | | | | | | |
| **O & M Incremental Costs:** | | | | BDT 0.38 | BDT 0.38 | BDT 0.38 | BDT 0.38 | BDT 0.38 | BDT 0.38 | BDT 0.38 | BDT 0.38 | BDT 0.66 | BDT 0.66 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 217.31** | **-BDT 144.87** | **BDT 201.01** | **BDT 205.07** | **BDT 209.21** | **BDT 213.43** | **BDT 217.73** | **BDT 222.12** | **BDT 226.60** | **BDT 231.17** | **BDT 233.85** | **BDT 238.60** |
| | | | | | | | | | | | |
| **Project without CC Net Economic Flows** | | -BDT 179.44 | -BDT 119.63 | BDT 116.32 | BDT 118.68 | BDT 121.08 | BDT 123.53 | BDT 126.03 | BDT 128.58 | BDT 131.17 | BDT 133.83 | BDT 134.83 | BDT 137.59 |
| | | | | | | | | | | | |
| **Project ONLY CC Net Economic Flows** | | -BDT 37.86 | -BDT 25.24 | BDT 84.69 | BDT 86.39 | BDT 88.13 | BDT 89.90 | BDT 91.70 | BDT 93.55 | BDT 95.42 | BDT 97.34 | BDT 99.02 | BDT 101.01 |

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| **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **Total (Taka 2013)** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 64.6 | 65.9 | 67.2 | 68.5 | 69.9 | 71.3 | 72.7 | 74.2 | 75.7 | 77.2 | 1390.0 |
| 3.9 | 4.0 | 4.0 | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | 4.5 | 4.6 | 83.4 |
| 59.0 | 60.2 | 61.4 | 62.6 | 63.8 | 65.1 | 66.4 | 67.8 | 69.1 | 70.5 | 1269.6 |
| 7.6 | 7.8 | 7.9 | 8.1 | 8.2 | 8.4 | 8.6 | 8.7 | 8.9 | 9.1 | 163.8 |
| 60.6 | 61.8 | 63.1 | 64.3 | 65.6 | 66.9 | 68.3 | 69.6 | 71.0 | 72.4 | 1304.7 |
| | | | | | | | | | | |
| 30.3 | 30.9 | 31.6 | 32.2 | 32.8 | 33.5 | 34.2 | 34.9 | 35.5 | 36.3 | 653.1 |
| 18.0 | 18.4 | 18.8 | 19.1 | 19.5 | 19.9 | 20.3 | 20.7 | 21.1 | 21.5 | 388.0 |
| 3.2 | 3.2 | 3.3 | 3.4 | 3.4 | 3.5 | 3.6 | 3.7 | 3.7 | 3.8 | 68.5 |
| **247.2** | **252.1** | **257.2** | **262.3** | **267.6** | **272.9** | **278.4** | **284.0** | **289.6** | **295.4** | **5321.0** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 18.0 | 18.3 | 18.7 | 19.1 | 19.4 | 19.8 | 20.2 | 20.6 | 21.0 | 21.5 | 460.7 |
| 1.1 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | 1.2 | 1.3 | 1.3 | 27.6 |
| 16.5 | 16.8 | 17.1 | 17.5 | 17.8 | 18.2 | 18.5 | 18.9 | 19.3 | 19.7 | 421.9 |
| 7.6 | 7.8 | 7.9 | 8.1 | 8.2 | 8.4 | 8.6 | 8.7 | 8.9 | 9.1 | 163.8 |
| 60.6 | 61.8 | 63.1 | 64.3 | 65.6 | 66.9 | 68.3 | 69.6 | 71.0 | 72.4 | 1304.7 |
| | | | | | | | | | | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 48.3 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 28.7 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.1 |
| **103.7** | **105.8** | **107.9** | **110.1** | **112.3** | **114.5** | **116.8** | **119.1** | **121.5** | **123.9** | **2460.8** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 102.9 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6.2 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 93.9 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12.1 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 96.5 |
| | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 48.3 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 28.7 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5.1 |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **393.7** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 64.6 | 65.9 | 67.2 | 68.5 | 69.9 | 71.3 | 72.7 | 74.2 | 75.7 | 77.2 | 1287.1 |
| 3.9 | 4.0 | 4.0 | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | 4.5 | 4.6 | 77.2 |
| 59.0 | 60.2 | 61.4 | 62.6 | 63.8 | 65.1 | 66.4 | 67.8 | 69.1 | 70.5 | 1175.6 |
| 7.6 | 7.8 | 7.9 | 8.1 | 8.2 | 8.4 | 8.6 | 8.7 | 8.9 | 9.1 | 151.7 |
| 60.6 | 61.8 | 63.1 | 64.3 | 65.6 | 66.9 | 68.3 | 69.6 | 71.0 | 72.4 | 1208.1 |
| | | | | | | | | | | |
| 30.3 | 30.9 | 31.6 | 32.2 | 32.8 | 33.5 | 34.2 | 34.9 | 35.5 | 36.3 | 604.7 |
| 18.0 | 18.4 | 18.8 | 19.1 | 19.5 | 19.9 | 20.3 | 20.7 | 21.1 | 21.5 | 359.3 |
| 3.2 | 3.2 | 3.3 | 3.4 | 3.4 | 3.5 | 3.6 | 3.7 | 3.7 | 3.8 | 63.4 |
| **247.2** | **252.1** | **257.2** | **262.3** | **267.6** | **272.9** | **278.4** | **284.0** | **289.6** | **295.4** | **4927.2** |
| | | | | | | | | | | |
| | | | | | | | | | | 299.1 |
| BDT 3.09 | BDT 3.09 | BDT 3.09 | BDT 3.09 | BDT 3.09 | BDT 3.09 | BDT 3.09 | BDT 3.09 | BDT 3.09 | BDT 3.09 | 48.2 |
| | | | | | | | | | | **347.3** |
| | | | | | | | | | | |
| | | | | | | | | | | 362.2 |
| BDT 3.75 | BDT 3.75 | BDT 3.75 | BDT 3.75 | BDT 3.75 | BDT 3.75 | BDT 3.75 | BDT 3.75 | BDT 3.75 | BDT 3.75 | 59.2 |
| | | | | | | | | | | **421.4** |
| | | | | | | | | | | |
| | | | | | | | | | | 63.1 |
| BDT 0.66 | BDT 0.66 | BDT 0.66 | BDT 0.66 | BDT 0.66 | BDT 0.66 | BDT 0.66 | BDT 0.66 | BDT 0.66 | BDT 0.66 | 11.0 |
| | | | | | | | | | | **74.1** |
| **BDT 243.44** | **BDT 248.39** | **BDT 253.43** | **BDT 258.57** | **BDT 263.82** | **BDT 269.17** | **BDT 274.63** | **BDT 280.20** | **BDT 285.88** | **BDT 291.67** | **46%** |
| | | | | | | | | | | |
| BDT 140.40 | BDT 143.27 | BDT 146.20 | BDT 149.19 | BDT 152.23 | BDT 155.34 | BDT 158.51 | BDT 161.74 | BDT 165.03 | BDT 168.40 | **34%** |
| | | | | | | | | | | |
| BDT 103.04 | BDT 105.12 | BDT 107.23 | BDT 109.39 | BDT 111.59 | BDT 113.84 | BDT 116.13 | BDT 118.46 | BDT 120.84 | BDT 123.27 | **89%** |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Assumptions and workings for with CCR** | | | | | | | | | |
| | | **Source of Data / Assumption** | | | | | Unit | Total | | |
| | | | | | Affected as per SEWTP | | Repair / Damage Cost | | | |
| 1 | Number of properties | Drainage Team and SEWTP report | Number | 17360 | 51.30% | 8906 | | 100.5 | | |
| 2 | Loss of Income | | BDT Million | | | | 2242 | 23.9 | | |
| | Number of Households | Drainage Team and SEWTP | Number | 22000 | 97.00% | 10670 | | | | |
| | Number of days of flooding | SEWTP report | Days | | | 4.6 | | | | |
| | Household Income | SEWTP report | BDT | | | 14620 | | | | |
| | Average Household Expenditure on Health | SEWTP report | BDT | | | 1533 | | | | |
| 3 | Saved Medical Cost | | | | | | | 2.5 | | |
| 4 | Loss of Business Income | | | | 93.50% | | 1382 | 14.2 | | |
| | Average monthly expenditure | SEWTP report | BDT | | | 12874 | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 5 | Agricultural Loss | Drainage Team | Acre | | 1820.652174 | | | | | |
| | Average Yield per acre | Drainage Team | tonne | | 1.5 | | | | | |
| | Average support price | Drainage Team | BDT / Tonne | | 17500 | | | | | |
| | Agricultural Loss | | BDT Million | | | | | 47.8 | | |
| 6 | Road Damage | Drainage Team | Kilometre | | 15 | | | | | |
| | Repair cost | Drainage Team | BDT/Kilometre | | 0.4 | | | | | |
| | Road Damage Cost | | | | | | | 6.0 | | |
| | | | | | | | | | | |
| | **Assessment of Repair / Damage Cost** | Drainage Team | | | | | | | | |
| | Depth | Comm'l | Public | Katcha | Pakka | Semi Pakka | | | | |
| | < 0.25 m inundation | 532 | 951 | 4231 | 524 | 795 | 7033 | 79% | 8906 | 7033 |
| | > 0.25 m inundation | 158 | 250 | 1102 | 143 | 220 | 1873 | 21% | | 1873 |
| | > 0.75 m inundation | 0 | 0 | 0 | 0 | 0 | 0 | 0% | | 0 |
| | Total | 690 | 1201 | 5333 | 667 | 1015 | 8906 | | | |
| | < 0.25 | 532 | 951 | 4231 | 524 | 795 | 7033 | | | |
| | > 0.25 | 158 | 250 | 1102 | 143 | 220 | 1873 | | | |
| | > 0.75 m inundation | | | | | | | | | |
| | | | | | | | 8906 | | | |
| | Averagae Area in Sq m | 93 | 46 | 9 | 70 | 28 | | | | |
| | Total Area Waterlogged in sq m | 49450 | 44198 | 39327 | 36530 | 22169 | 191673 | | | |
| | Total Area inundated in sq m | 14686 | 11619 | 10243 | 9969 | 6135 | 52652 | | | |
| | | | | | | | 244325 | | | |
| | Constuction cost | **CDTA Report** | | | | | | | | |
| | BDT/sq m | 21516.8 | 21516.8 | 12910.08 | 21516.8 | 17213.44 | | | source CDTA reports | |
| | Repair Cost @ 6% | **CDTA Report** | | | | | | | source CDTA reports | |
| | BDT/sq m | 1291.008 | 1291.008 | 774.6048 | 1291.008 | 1032.8064 | | | | |
| | Clean Up cost | **CDTA Report** | | | | | | | | |
| | BDT/property | 15000 | 12000 | 2000 | 9000 | 5000 | | | source CDTA reports | |
| | | | | | | | BDT Million | | | |
| | Damage Cost | 15.8 | 12.5 | 6.612 | 10.725 | 5.28 | 50.917 | | | |
| | Repair Cost | 0.948 | 0.75 | 0.39672 | 0.6435 | 0.3168 | 3.05502 | | | |
| | Clean up cost | 10.35 | 14.412 | 10.666 | 6.003 | 5.075 | 46.506 | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | **For Without CCR scenario** | | | | | | | | | |
| | | | | | | | | | | |
| | **Stock damages for properties - 25% less vulnerability loss reduction as compared with CCR scenario** | | | | | | | | | |
| | **Rest same - No change** | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | **Common to both** | | | | | | | | | |
| 1 | Capex with CCR and without CCR as per technical team estimate | | | | | | | | | |
| 2 | Opex with CCR and without CCR as per technical team estimate | | | | | | | | | |
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| | | | | | | | | | | |
| | **Assumptions and workings for without CCR** | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | Unit | Total | | |
| | | | | | Affected as per SE | | Repair / Damage | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Cost | | | |
| | Number of properties | | Number | 17360 | 0.513 | 6679 | | 75.4 | | |
| | Loss of Income | | BDT Million | | | | 2242 | 24.0 | | |
| | Number of Households | | Number | 22000 | 0.97 | 10725 | | | | |
| | Number of days of flooding | | Days | | | 4.6 | | | | |
| | Household Income | | BDT | | | 14620 | | | | |
| | Average Household Expenditure on Health | | BDT | | | 1533 | | | | |
| | Saved Medical Cost | | | | | | | 2.5 | | |
| | Loss of Business Income | | | 0 | 0.935 | | 1382 | 14.3 | | |
| | Average monthly expenditure | | BDT | | | 12874 | | | | |
| | Agricultural Loss | | Acre | 0 | 1820.652174 | | | | | |
| | Average Yield per acre | | tonne | | 1.5 | | | | | |
| | Average support price | | BDT / Tonne | | 17500 | | | | | |
| | Agricultural Loss | | BDT Million | | | | | 47.8 | | |
| | Road Damage | | Kilometre | | 15 | | | | | |
| | Repair cost | | BDT/Kilometre | | 0.4 | | | | | |
| | Road Damage Cost | | | | | | | 6.0 | | |
| | | | | | | | | | | |
| | Assessment of Repair / Damage Cost | | | | | | | | | |
| | Depth | Comm'l | Public | Katcha | Pakka | Semi Pakka | | | | |
| | < 0.25 m inundation | 532 | 951 | 4231 | 524 | 795 | 7033 | 79% | 6679 | 5274 |
| | > 0.25 m inundation | 158 | 250 | 1102 | 143 | 220 | 1873 | 21% | | 1405 |
| | > 0.75 m inundation | 0 | 0 | 0 | 0 | 0 | 0 | 0% | | 0 |
| | Total | 690 | 1201 | 5333 | 667 | 1015 | 8906 | | | |
| | < 0.25 | 399 | 713 | 3173 | 393 | 596 | 5274 | | | |
| | > 0.25 | 119 | 188 | 827 | 107 | 165 | 1406 | | | |
| | > 0.75 m inundation | | | | | | | | | |
| | 0 | | | | | | 6680 | | | |
| | Averagae Area in Sq m | 93 | 46 | 9 | 70 | 28 | | | | |
| | Total Area Waterlogged in sq m | 37087 | 33137 | 29493 | 27397 | 16620 | 143734 | | | |
| | Total Area inundated in sq m | 11061 | 8737 | 7687 | 7459 | 4601 | 39546 | | | |
| | 0 | | | | | | 183280.0416 | | | |
| | Constuction cost | | | | | | | | | |
| | BDT/sq m | 21516.8 | 21516.8 | 12910.08 | 21516.8 | 17213.44 | | | source CDTA reports | |
| | Repair Cost @ 6% | | | | | | | | source CDTA reports | |
| | BDT/sq m | 1291.008 | 1291.008 | 774.6048 | 1291.008 | 1032.8064 | | | | |
| | Clean Up cost | | | | | | | | | |
| | BDT/property | 15000 | 12000 | 2000 | 9000 | 5000 | | | source CDTA reports | |
| | 0 | | | | | | BDT Million | | | |
| | Damage Cost | 11.9 | 9.4 | 4.962 | 8.025 | 3.96 | 38.247 | | | |
| | Repair Cost | 0.714 | 0.564 | 0.29772 | 0.4815 | 0.2376 | 2.29482 | | | |
| | Clean up cost | 7.77 | 10.812 | 8 | 4.5 | 3.805 | 34.887 | | | |
| | | | | | | | | | | |

# 1.4. Solid waste in Pirojpur Paurashava

| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sector: | Solid Waste | | | | | | | | | | | | |
| Investigator(s): | Nesar | | | | | | | | | | | | |
| Town: | Pirojpur | | | | | | | | | | | | |
| Project: | Solid Waste | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Full Town | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. road damage owing to floods) | | | | | | | | | | | | | |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. economic damage due to delays, congestion, road closure) | Time Savings | 2.8 | 2.8 | 2.9 | 2.9 | 3.0 | 3.1 | 3.1 | 3.2 | 3.2 | 3.3 | 3.4 | 3.4 |
| Vulnerability 2: (e.g. extra maintenance/repair costs w.o. investment) | Saved Medical Cost | 0.5 | 0.5 | 0.5 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.7 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **3.3** | **3.4** | **3.4** | **3.5** | **3.6** | **3.6** | **3.7** | **3.8** | **3.9** | **3.9** | **4.0** | **4.1** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced costs of road damage owing to floods) | | | | | | | | | | | | | |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced economic damage due to delays, congestion, road closure) | Time Savings | 2.8 | 2.8 | 0.7 | 0.7 | 0.7 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.9 |
| Vulnerability 2: (e.g. reduced extra maintenance/repair costs versus w.o. investment) | Saved Medical Cost | 0.5 | 0.5 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss/Extra Costs:** | | **3.3** | **3.4** | **0.9** | **0.9** | **0.9** | **0.9** | **0.9** | **0.9** | **1.0** | **1.0** | **1.0** | **1.0** |
| **Vulnerability Impacts with Project with CC resilient measures** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced costs of road damage owing to floods) | | | | | | | | | | | | | |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced economic damage due to delays, congestion, road closure) | Time Savings | 2.8 | 2.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Vulnerability 2: (e.g. reduced extra maintenance/repair costs versus w.o. investment) | Saved Medical Cost | 0.5 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss/Extra Costs:** | | **3.3** | **3.4** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Impact of Project on Reduced Vulnerability** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced costs of road damage owing to floods) | | | | | | | | | | | | | |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vulnerability 1: (e.g. reduced economic damage due to delays, congestion, road closure) | Time Savings | 0.0 | 0.0 | 2.9 | 2.9 | 3.0 | 3.1 | 3.1 | 3.2 | 3.2 | 3.3 | 3.4 | 3.4 |
| Vulnerability 2: (e.g. reduced extra maintenance/repair costs versus w.o. investment) | Saved Medical Cost | 0.0 | 0.0 | 0.5 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.7 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss/Extra Costs:** | | **0.0** | **0.0** | **3.4** | **3.5** | **3.6** | **3.6** | **3.7** | **3.8** | **3.9** | **3.9** | **4.0** | **4.1** |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 4.48 | BDT 2.99 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT 4.91 | BDT 3.27 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | BDT 0.43 | BDT 0.29 | | | | | | | | | | |
| **O & M Incremental Costs:** | | | | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 4.91** | **-BDT 3.27** | **BDT 2.93** | **BDT 3.00** | **BDT 3.07** | **BDT 3.14** | **BDT 3.22** | **BDT 3.29** | **BDT 3.37** | **BDT 3.44** | **BDT 3.52** | **BDT 3.60** |
| | | | | | | | | | | | | | |
| **Project without CC Net Economic Flows** | | -BDT 4.48 | -BDT 2.99 | BDT 2.23 | BDT 2.28 | BDT 2.34 | BDT 2.39 | BDT 2.44 | BDT 2.50 | BDT 2.56 | BDT 2.61 | BDT 2.67 | BDT 2.73 |
| **Project ONLY CC Net Economic Flows** | | -BDT 0.43 | -BDT 0.29 | BDT 0.54 | BDT 0.56 | BDT 0.58 | BDT 0.60 | BDT 0.61 | BDT 0.63 | BDT 0.65 | BDT 0.67 | BDT 0.69 | BDT 0.71 |

| 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | Total (Taka 2013) |
|---|---|---|---|---|---|---|---|---|---|---|
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| | | | | | | | | | | |
| 3.5 | 3.6 | 3.7 | 3.7 | 3.8 | 3.9 | 4.0 | 4.0 | 4.1 | 4.2 | 75.6 |
| 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.8 | 0.8 | 0.8 | 0.8 | 14.4 |
| | | | | | | | | | | |
| **4.2** | **4.3** | **4.4** | **4.4** | **4.5** | **4.6** | **4.7** | **4.8** | **4.9** | **5.0** | **90.0** |
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| | | | | | | | | | | |
| 0.9 | 0.9 | 0.9 | 0.9 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 23.1 |
| 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 4.4 |
| | | | | | | | | | | |
| **1.0** | **1.1** | **1.1** | **1.1** | **1.1** | **1.2** | **1.2** | **1.2** | **1.2** | **1.2** | **27.5** |
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| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.6 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.1 |
| | | | | | | | | | | |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **6.7** |
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| | | | | | | | | | | |
| 3.5 | 3.6 | 3.7 | 3.7 | 3.8 | 3.9 | 4.0 | 4.0 | 4.1 | 4.2 | 70.0 |
| 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.8 | 0.8 | 0.8 | 0.8 | 13.4 |
| | | | | | | | | | | |
| **4.2** | **4.3** | **4.4** | **4.4** | **4.5** | **4.6** | **4.7** | **4.8** | **4.9** | **5.0** | **83.4** |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | | | | | | 7.5 |
| BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | BDT 0.34 | 6.8 |
| | | | | | | | | | | **14.3** |
| | | | | | | | | | | |
| | | | | | | | | | | 8.2 |
| BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | BDT 0.50 | 10.0 |
| | | | | | | | | | | **18.1** |
| | | | | | | | | | | |
| | | | | | | | | | | 0.7 |
| BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | BDT 0.16 | 3.1 |
| | | | | | | | | | | **3.9** |
| **BDT 3.68** | **BDT 3.77** | **BDT 3.85** | **BDT 3.94** | **BDT 4.03** | **BDT 4.12** | **BDT 4.21** | **BDT 4.31** | **BDT 4.40** | **BDT 4.50** | 32.2% |
| | | | | | | | | | | |
| BDT 2.80 | BDT 2.86 | BDT 2.92 | BDT 2.99 | BDT 3.05 | BDT 3.12 | BDT 3.19 | BDT 3.26 | BDT 3.33 | BDT 3.41 | **27.6%** |
| | | | | | | | | | | |
| BDT 0.73 | BDT 0.75 | BDT 0.77 | BDT 0.79 | BDT 0.82 | BDT 0.84 | BDT 0.86 | BDT 0.89 | BDT 0.91 | BDT 0.93 | **59.1%** |

| | |
|---|---|
| | **Assumptions and workings** |
| | |
| | **Assumptions for With CCR** |
| 1 | Saved Income Loss - HH monthly income - BDT 14,620 as per SEWTP report, Time savings - 1 minute per day considered |
| 2 | Saved Medical Cost - HH monthly expenditure on health - BDT 1533 considered as per SEWTP report @ 5% for solid waste |
| | |
| | **Assumptions for Without CCR** |
| 1 | Number of households - **25% less vulnerability loss reduction as compared with CCR scenario** |
| | |
| | |
| | **Common to both** |
| 1 | Capex with CCR and without CCR as per technical team estimate |
| 2 | Opex with CCR and without CCR as per technical team estimate |

## 1.5. Roads in Pirojpur Paurashava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Roads | | | | | | | | | | | | |
| Investigator(s): | Nesar | | | | | | | | | | | | |
| Town: | Pirojpur | | | | | | | | | | | | |
| Project: | Roads (21.525 kilometers of Road) | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Refer Location Map and list of roads | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **If no future Climate Change: (Baseline vulnerability no future CC)** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | 4 | | | | | 3 | |
| Damage due to Floods (% of project roads) | | 24.42 | 25.16 | 25.66 | 26.16 | 26.67 | 21.75 | 22.16 | 22.58 | 23.00 | 23.43 | 17.90 | 18.22 |
| Vulnerability 2: | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 59.10 | 60.28 | 61.49 | 62.72 | 63.97 | 65.25 | 66.56 | 67.89 | 69.25 | 70.63 | 72.04 | 73.49 |
| Time Savings | | 117.29 | 119.64 | 122.03 | 124.47 | 126.96 | 129.50 | 132.09 | 134.73 | 137.43 | 140.18 | 142.98 | 145.84 |
| | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | 200.82 | 205.08 | 209.18 | 213.35 | 217.61 | 216.50 | 220.81 | 225.20 | 229.68 | 234.24 | 232.92 | 237.55 |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Damage due to Floods (% of project roads) | | 24.42 | 25.16 | 25.66 | 26.16 | 26.67 | 21.75 | 22.16 | 22.58 | 23.00 | 23.43 | 17.90 | 18.22 |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 59.10 | 60.28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Time Savings | | 117.29 | 119.64 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | 200.82 | 205.08 | 25.66 | 26.16 | 26.67 | 21.75 | 22.16 | 22.58 | 23.00 | 23.43 | 17.90 | 18.22 |
| **Vulnerability Impacts with Climate Change and Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Damage due to Floods (% of project roads) | | 24.42 | 25.16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 59.10 | 60.28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Time Savings | | 117.29 | 119.64 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss/Extra Costs:** | | 200.82 | 205.08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Damage due to Floods (% of project roads) | | 0.00 | 0.00 | 25.66 | 26.16 | 26.67 | 21.75 | 22.16 | 22.58 | 23.00 | 23.43 | 17.90 | 18.22 |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from** | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 0.00 | 0.00 | 61.49 | 62.72 | 63.97 | 65.25 | 66.56 | 67.89 | 69.25 | 70.63 | 72.04 | 73.49 |
| Time Savings | | 0.00 | 0.00 | 122.03 | 124.47 | 126.96 | 129.50 | 132.09 | 134.73 | 137.43 | 140.18 | 142.98 | 145.84 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **0.0** | **0.0** | **209.2** | **213.4** | **217.6** | **216.5** | **220.8** | **225.2** | **229.7** | **234.2** | **232.9** | **237.6** |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | 236.91 | 157.94 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | 293.09 | 195.39 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | 56.17391937 | 37.44927958 | | | | | | | | | | |
| **O & M Incremental Costs:** | | | | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 293.09** | **-BDT 195.39** | **BDT 204.23** | **BDT 208.40** | **BDT 212.65** | **BDT 211.55** | **BDT 215.86** | **BDT 220.25** | **BDT 224.73** | **BDT 229.29** | **BDT 227.97** | **BDT 232.60** |
| | | | | | | | | | | | | | |
| **Project without cc Net Economic Flows** | | -BDT 236.91 | -BDT 157.94 | BDT 178.72 | BDT 182.39 | BDT 186.13 | BDT 189.95 | BDT 193.84 | BDT 197.82 | BDT 201.87 | BDT 206.00 | BDT 210.22 | BDT 214.52 |
| | | | | | | | | | | | | | |
| **CC Net Economic Flows** | | -BDT 56.17 | -BDT 37.45 | BDT 25.51 | BDT 26.01 | BDT 26.52 | BDT 21.60 | BDT 22.01 | BDT 22.43 | BDT 22.86 | BDT 23.28 | BDT 17.75 | BDT 18.08 |
| | | | | | | | | | | | | | |

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| | | | | | | | | | | | | |
| **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **2036** | **2037** | **Total (Taka 2013)** |
| | | | | | | | | | | | | |
| | | | 2 | | | | | | | | | |
| 18.56 | 18.89 | 19.23 | 13.04 | 13.27 | 13.50 | 13.74 | 13.97 | 14.21 | 14.45 | 14.70 | 14.94 | 459.64 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 74.96 | 76.45 | 77.98 | 79.54 | 81.13 | 82.76 | 84.41 | 86.10 | 87.82 | 89.58 | 91.37 | 93.20 | 1797.98 |
| 148.76 | 151.73 | 154.77 | 157.86 | 161.02 | 164.24 | 167.52 | 170.87 | 174.29 | 177.78 | 181.33 | 184.96 | 3568.28 |
| | | | | | | | | | | | | |
| 242.27 | 247.07 | 251.98 | 250.45 | 255.43 | 260.50 | 265.67 | 270.95 | 276.33 | 281.81 | 287.40 | 293.10 | **5825.91** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 18.56 | 18.89 | 19.23 | 13.04 | 13.27 | 13.50 | 13.74 | 13.97 | 14.21 | 14.45 | 14.70 | 14.94 | 459.64 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 119.39 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 236.93 |
| | | | | | | | | | | | | |
| 18.56 | 18.89 | 19.23 | 13.04 | 13.27 | 13.50 | 13.74 | 13.97 | 14.21 | 14.45 | 14.70 | 14.94 | **815.96** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 49.59 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 119.39 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 236.93 |
| | | | | | | | | | | | | |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **405.90** |

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| | | | | | | | | | | | | |
| 18.56 | 18.89 | 19.23 | 13.04 | 13.27 | 13.50 | 13.74 | 13.97 | 14.21 | 14.45 | 14.70 | 14.94 | 410.05 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 74.96 | 76.45 | 77.98 | 79.54 | 81.13 | 82.76 | 84.41 | 86.10 | 87.82 | 89.58 | 91.37 | 93.20 | 1678.60 |
| 148.76 | 151.73 | 154.77 | 157.86 | 161.02 | 164.24 | 167.52 | 170.87 | 174.29 | 177.78 | 181.33 | 184.96 | 3331.35 |
| | | | | | | | | | | | | |
| **242.3** | **247.1** | **252.0** | **250.4** | **255.4** | **260.5** | **265.7** | **270.9** | **276.3** | **281.8** | **287.4** | **293.1** | **5420.0** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | 394.85 |
| 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 105.72 |
| | | | | | | | | | | **4.8** | | **BDT 500.58** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | 488.48 |
| 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 108.99 |
| | | | | | | | | | | **5.0** | | **BDT 597.47** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | 93.62 |
| 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 3.27 |
| | | | | | | | | | | **0.1** | | **BDT 96.89** |
| **BDT 237.31** | **BDT 242.12** | **BDT 247.02** | **BDT 245.49** | **BDT 250.47** | **BDT 255.55** | **BDT 260.72** | **BDT 265.99** | **BDT 271.37** | **BDT 276.86** | **BDT 282.45** | **BDT 288.15** | **35.9%** |
| | | | | | | | | | | | | |
| BDT 218.91 | BDT 223.38 | BDT 227.94 | BDT 232.60 | BDT 237.35 | BDT 242.19 | BDT 247.13 | BDT 252.17 | BDT 257.31 | BDT 262.55 | BDT 267.90 | BDT 273.35 | **38.7%** |
| | | | | | | | | | | | | |
| BDT 18.41 | BDT 18.74 | BDT 19.08 | BDT 12.90 | BDT 13.12 | BDT 13.36 | BDT 13.59 | BDT 13.83 | BDT 14.06 | BDT 14.30 | BDT 14.55 | BDT 14.79 | **21.3%** |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Assumptions and Workings** | | | | | | | | | | | |
| 1 | Stock Damage - considered @ 5% for first five years, 4% next five years, 3% for the next five years and 2% thereafter of the Project roads length of 21.525 kilometers as per the technical team estimate | | | | | | | | | | | |
| 2 | Vehicle Operating Costs: See workings below | | | | | | | | | | | |
| 3 | Time Savings - See workings below | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | **Economc Benefit Cost Calculation** | | | | | | | | | | | |
| | Days | 300 | 300 | (Rickshaw) | | | | | | | | |
| | Road Length | 48.15 | | | | | | | | | | |
| | | | **Light Vehicle** | | | **Heavy Vehicle** | | **Total** | | Full Town | Project Area | Number of times |
| | | | **Car/Taxi** | **Baby Taxi** | **Motor Cycle** | **Bus** | **Truck** | | | | 35% | 2 |
| | Traffic Volume | No./ Day | 140 | 56 | 1330 | 175 | 140 | 1841 | 2 wheeler | 1900 | 665 | 1330 |
| | **Without Project** | | | | | | | | auto rickshaw | 300 | 105 | 210 |
| | Operating Cost | Tk./Vehicle | 17.2 | 8 | 2.4 | 18.5 | 21 | | cars and jeeps | 200 | 70 | 140 |
| | Total Operating Cost | Tk./Year | 34,783,560 | 6,471,360 | 46,108,440 | 46,765,688 | 42,468,300 | 176,597,348 | Tractor | 100 | 35 | 70 |
| | **with Project** | | | | | | | | Bus / Mini Bus | 250 | 87.5 | 175 |
| | Operating Cost | Tk./Vehicle | 10 | 4 | 1.5 | 13 | 16 | | Trucks | 100 | 35 | 70 |
| | Total Operating Cost | Tk./Year | 20,223,000 | 3,235,680 | 28,817,775 | 32,862,375 | 32,356,800 | 117,495,630 | Tempos | 80 | 28 | 56 |
| | **Savings per Year** | | | | | | | | Cycle | 2900 | 1015 | 2030 |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **14,560,560** | **3,235,680** | **17,290,665** | **13,903,313** | **10,111,500** | **59,101,718** | | | Rickshaw | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | **Rickshaw** | **Trips** | **Minutes** | **Earnings per** | **Earning per** | | | | | | Operating Cost | | | | | | | | | |
| | | | **per km.** | **Km . (Tk.)** | **Minute (Tk.)** | | | | | | Fuel | | 1375 | | | | | | | |
| | **Without Project** | 2030 | | | | | | | | | Maintenance | | 833 | | | | | | | |
| | Time taken to travel | | 12.5 | 15 | 1.2 | | | | | | Total | | 2208 | | | | | | | |
| | | | | | | | | | | | per day | | 73.6 | | | | | | | |
| | **with Project** | | | | | | | | | | | | | | | | | | | |
| | Time taken to travel | | 7.5 | 15 | 2.00 | | | | | | w/o project | | | Car | | Truck | | M/Cycle | | Baby Taxi |
| | | | | | | | | | | | Cost of fuel | | | 100 | Litre | 70 | | 100 | | 100 |
| | Benefit/saving | | 5 | 0 | 0.80 | | | | | | Maintenance | | | 20 | | 14 | | 20 | | 20 |
| | Road length (Km) | | | | 48.15 | | | | | | Total | | | 120 | | 84 | | 120 | | 120 |
| | Savings per trip | | | | 192.60 | | | | | | Number of kilometers | | | 7 | | 4 | | 50 | | 15 |
| | **Yearly Savings** | | | | | | | **117,293,400** | | | Per Kilometer Operating cost | | | 17.14285714 | | 21 | | 2.4 | | 8 |
| | **Damage to property due to Floods** | | | | | | | **see below** | | | | | | | | | | | | |
| | **Total Savings** | | | | | | | **176,395,118** | | | | | | | | | | | | |
| | | | | | | | | | | | With project | | | Car | | Truck | | M/Cycle | | Baby Taxi |
| | | | | | | | | | | | Cost of fuel | | | 100 | Litre | 70 | | 100 | | 100 |
| | | | | | | | | | | | Maintenance | | | 10 | | 10 | | 10 | | 10 |
| | | | | | | | | | | | Total | | | 110 | | 80 | | 110 | | 110 |
| | | | | | | | | | | | Number of kilometers | | | 10 | | 5 | | 65 | | 30 |
| | | | | | | | | | | | Per Kilometer Operating cost | | | 11 | | 16 | | 1.692307692 | | 3.666666667 |
| | **Common to both** | | | | | | | | | | | | | | | | | | | |
| 1 | Capex with CCR and without CCR as per technical team estimate | | | | | | | | | | | | | | | | | | | |
| 2 | Opex with CCR and without CCR as per technical team estimate | | | | | | | | | | | | | | | | | | | |

## 1.6. Bridges in Pirojpur Paurashava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Roads | | | | | | | | | | | | |
| Investigator(s): | Nesar | | | | | | | | | | | | |
| Town: | Pirojpur | | | | | | | | | | | | |
| Project: | Bridges | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Refer Location Map and list of roads | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **If no future Climate Change: (Baseline vulnerability no future CC)** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Damage due to Floods (% of project roads) | | | | | | | | | | | | | |
| Vulnerability 2: | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.10 |
| Time Savings | | 29.37 | 29.96 | 30.55 | 31.17 | 31.79 | 32.42 | 33.07 | 33.73 | 34.41 | 35.10 | 35.80 | 36.52 |
| | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | 29.45 | 30.03 | 30.64 | 31.25 | 31.87 | 32.51 | 33.16 | 33.82 | 34.50 | 35.19 | 35.89 | 36.61 |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Damage due to Floods (% of project roads) | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 0.08 | 0.08 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| Time Savings | | 29.37 | 29.96 | 22.67 | 23.12 | 23.58 | 24.05 | 24.53 | 25.02 | 25.52 | 26.04 | 26.56 | 27.09 |
| | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | 29.45 | 30.03 | 22.69 | 23.14 | 23.61 | 24.08 | 24.56 | 25.05 | 25.55 | 26.06 | 26.59 | 27.12 |
| **Vulnerability Impacts with Climate Change and Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Damage due to Floods (% of project roads) | | 0.00 | 0.00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 0.08 | 0.08 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Time Savings | | 29.37 | 29.96 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss/Extra Costs:** | | 29.45 | 30.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Damage due to Floods (% of project roads) | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vulnerability 2: | | | | | | | | | | | | | |
| Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Vehicle Operating Costs | | 0.00 | 0.00 | 0.08 | 0.08 | 0.08 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.10 |
| Time Savings | | 0.00 | 0.00 | 30.55 | 31.17 | 31.79 | 32.42 | 33.07 | 33.73 | 34.41 | 35.10 | 35.80 | 36.52 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **0.0** | **0.0** | **30.6** | **31.2** | **31.9** | **32.5** | **33.2** | **33.8** | **34.5** | **35.2** | **35.9** | **36.6** |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | 66.70269224 | 44.46846149 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | 0.124026841 | 0.124026841 | 0.124026841 | 0.124026841 | 0.124026841 | 0.124026841 | 0.124026841 | 0.124026841 | 0.124026841 | 0.124026841 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | 73.36 | 48.91 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | 0.136412402 | 0.136412402 | 0.136412402 | 0.136412402 | 0.136412402 | 0.136412402 | 0.136412402 | 0.136412402 | 0.136412402 | 0.136412402 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | 6.66 | 4.44 | | | | | | | | | | |
| **O & M Incremental Costs:** | | | | 0.01 | 0.012385561 | 0.012385561 | 0.012385561 | 0.012385561 | 0.012385561 | 0.012385561 | 0.012385561 | 0.012385561 | 0.012385561 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 73.36** | **-BDT 48.91** | **BDT 30.50** | **BDT 31.11** | **BDT 31.74** | **BDT 32.37** | **BDT 33.02** | **BDT 33.69** | **BDT 34.36** | **BDT 35.05** | **BDT 35.76** | **BDT 36.48** |
| | | | | | | | | | | | | | |
| **Project without cc Net Economic Flows** | | -BDT 66.70 | -BDT 44.47 | BDT 30.51 | BDT 31.12 | BDT 31.75 | BDT 32.39 | BDT 33.04 | BDT 33.70 | BDT 34.38 | BDT 35.07 | BDT 35.77 | BDT 36.49 |
| | | | | | | | | | | | | | |
| **CC Net Economic Flows** | | -BDT 6.66 | -BDT 4.44 | BDT 22.68 | BDT 23.13 | BDT 23.59 | BDT 24.07 | BDT 24.55 | BDT 25.04 | BDT 25.54 | BDT 26.05 | BDT 26.57 | BDT 27.10 |

| **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **2036** | **2037** | **Total (Taka 2013)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | 0.00 |
| | | | | | | | | | | | | |
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| | | | | | | | | | | | | |
| 0.10 | 0.10 | 0.10 | 0.10 | 0.11 | 0.11 | 0.11 | 0.11 | 0.12 | 0.12 | 0.12 | 0.12 | 2.36 |
| 37.25 | 37.99 | 38.75 | 39.53 | 40.32 | 41.12 | 41.95 | 42.78 | 43.64 | 44.51 | 45.40 | 46.31 | 893.44 |
| | | | | | | | | | | | | |
| 37.34 | 38.09 | 38.85 | 39.63 | 40.42 | 41.23 | 42.06 | 42.90 | 43.75 | 44.63 | 45.52 | 46.43 | **895.79** |
| | | | | | | | | | | | | |
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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.85 |
| 27.63 | 28.18 | 28.74 | 29.32 | 29.91 | 30.50 | 31.11 | 31.74 | 32.37 | 33.02 | 33.68 | 34.35 | 678.06 |
| | | | | | | | | | | | | |
| 27.66 | 28.21 | 28.78 | 29.35 | 29.94 | 30.54 | 31.15 | 31.77 | 32.41 | 33.06 | 33.72 | 34.39 | **678.91** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.00 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.16 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 59.32 |
| | | | | | | | | | | | | |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **59.48** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 0.10 | 0.10 | 0.10 | 0.10 | 0.11 | 0.11 | 0.11 | 0.11 | 0.12 | 0.12 | 0.12 | 0.12 | 2.20 |
| 37.25 | 37.99 | 38.75 | 39.53 | 40.32 | 41.12 | 41.95 | 42.78 | 43.64 | 44.51 | 45.40 | 46.31 | 834.11 |
| | | | | | | | | | | | | |
| **37.3** | **38.1** | **38.9** | **39.6** | **40.4** | **41.2** | **42.1** | **42.9** | **43.8** | **44.6** | **45.5** | **46.4** | **836.3** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | 111.17 |
| 0.124026841 | 0.124026841 | 0.124026841 | 0.124026841 | 0.124026841 | 0.124026841 | 0.124026841 | 0.124026841 | 0.124026841 | 0.124026841 | 0.124026841 | 0.124026841 | 2.73 |
| | | | | | | | | | | **0.1** | | **BDT 113.90** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | 122.27 |
| 0.136412402 | 0.136412402 | 0.136412402 | 0.136412402 | 0.136412402 | 0.136412402 | 0.136412402 | 0.136412402 | 0.136412402 | 0.136412402 | 0.136412402 | 0.136412402 | 3.00 |
| | | | | | | | | | | **0.1** | | **BDT 125.27** |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | 11.10 |
| 0.012385561 | 0.012385561 | 0.012385561 | 0.012385561 | 0.012385561 | 0.012385561 | 0.012385561 | 0.012385561 | 0.012385561 | 0.012385561 | 0.012385561 | 0.012385561 | 0.27 |
| | | | | | | | | | | **0.0** | | **BDT 11.37** |
| **BDT 37.21** | **BDT 37.95** | **BDT 38.72** | **BDT 39.49** | **BDT 40.29** | **BDT 41.09** | **BDT 41.92** | **BDT 42.76** | **BDT 43.62** | **BDT 44.49** | **BDT 45.39** | **BDT 46.30** | **23.5%** |
| | | | | | | | | | | | | |
| BDT 37.22 | BDT 37.97 | BDT 38.73 | BDT 39.51 | BDT 40.30 | BDT 41.11 | BDT 41.93 | BDT 42.77 | BDT 43.63 | BDT 44.51 | BDT 45.40 | BDT 46.31 | **25.6%** |
| | | | | | | | | | | | | |
| BDT 27.65 | BDT 28.20 | BDT 28.76 | BDT 29.34 | BDT 29.93 | BDT 30.53 | BDT 31.14 | BDT 31.76 | BDT 32.40 | BDT 33.04 | BDT 33.70 | BDT 34.38 | **120.5%** |

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| | **Assumptions and Workings** | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| 1 | Vehicle Operating Costs: See workings below | | | | | | | | | | | | | | | |
| 2 | Time Savings - See workings below | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | **Economc Benefit Cost Calculation** | | | | | | | | | | | | | | | |
| | Days | 300 | | | | | | | | | | | | | | |
| | Bridges Length in Kilometers | 0.25 | source - technical team | | | | | | | | | | | | | |
| | | | **Light Vehicle** | | | **Heavy Vehicle** | | **Total** | | | | | | | | |
| | | | **Car/Taxi** | **Baby Taxi** | **Motor Cycle** | **Bus** | **Truck** | | | | | | | | | |
| | Traffic Volume | No./ Day | 15 | 175 | 250 | 0 | 0 | 440 | | | | | | | | |
| | **Without Project** | | | | | | | | | | | | | | | |
| | Operating Cost | Tk./Vehicle | 17.2 | 8 | 2.4 | 18.5 | 21 | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total Operating Cost | Tk./Year | 19,350 | 105,000 | 45,000 | - | - | 169,350 | | | | | |
| | **with Project** | | | | | | | | | | | | |
| | Operating Cost | Tk./Vehicle | 10 | 4 | 1.5 | 13 | 16 | | | | | | |
| | Total Operating Cost | Tk./Year | 11,250 | 52,500 | 28,125 | - | - | 91,875 | | | | | |
| | **Savings per Year** | | **8,100** | **52,500** | **16,875** | **-** | **-** | **77,475** | | | | | |
| | | | | | | | | | **Operating Cost Workings** | | | | |
| | **Rickshaw** | **Trips** | **Minutes** | **Earnings per** | **Earning per** | | | | *w/o project* | Car | Truck | M/Cycle | Baby Taxi |
| | | | **per km.** | **Km . (Tk.)** | **Minute (Tk.)** | | | | Cost of fuel per litre - BDT | 100 | 70 | 100 | 100 |
| | **Without Project** | 14100 | | | | | | | Maintenance BDT | 20 | 14 | 20 | 20 |
| | Time taken to travel | | 12.5 | 15 | 1.2 | | | | Total BDT | 120 | 84 | 120 | 120 |
| | | | | | | | | | Number of kilometers | 7 | 4 | 50 | 15 |
| | **with Project** | | | | | | | | Per Kilometer Operating cost | 17.1 | 21.0 | 2.4 | 8.0 |
| | Time taken to travel | | 3.5 | 15 | 4.29 | | | | | | | | |
| | | | | | | | | | | | | | |
| | Benefit/saving | | 9 | 0 | 3.09 | | | | *With project* | Car | Truck | M/Cycle | Baby Taxi |
| | Road length (Km) | | | | 0.25 | | | | Cost of fuel per litre - BDT | 100 | 70 | 100 | 100 |
| | Savings per trip | | | | 6.94 | | | | Maintenance BDT | 10 | 10 | 10 | 10 |
| | **Yearly Savings** | | | | | | | **29,368,286** | Total BDT | 110 | 80 | 110 | 110 |
| | **Damage to property due to Floods** | | | | | | | **see below** | Number of kilometers | 10 | 5 | 65 | 30 |
| | **Total Savings** | | | | | | | **29,445,761** | Per Kilometer Operating cost | 11.0 | 16.0 | 1.7 | 3.7 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | **Without CCR** | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | **25% less vulnerability loss reduction as compared with CCR scenario** | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | **Common to both** | | | | | | | | | | | | |
| 1 | Capex with CCR and without CCR as per technical team estimate | | | | | | | | | | | | |
| 2 | Opex with CCR and without CCR as per technical team estimate | | | | | | | | | | | | |

# 1.7. Cyclone Shelter in Pirojpur Paurashava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Cyclone Shelters | | | | | | | | | | | | |
| Investigator(s): | Nesar Ahmed | | | | | | | | | | | | |
| Town: | Pirojpur | | | | | | | | | | | | |
| Project: | Cyclone Shelters for Town | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Full Town | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Variable 1: | | | | | | | | | | | | | |
| Economic Variable 2: | | | | | | | | | | | | | |
| Economic Variable 3: | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 31.9 | 32.5 | 33.2 | 33.9 | 34.5 | 35.2 | 35.9 | 36.6 | 37.4 | 38.1 | 38.9 | 39.7 |
| Economic Variable 2: | Saved Medical Cost | 3.3 | 3.4 | 3.5 | 3.5 | 3.6 | 3.7 | 3.8 | 3.8 | 3.9 | 4.0 | 4.1 | 4.2 |
| Economic Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **35.2** | **35.9** | **36.7** | **37.4** | **38.1** | **38.9** | **39.7** | **40.5** | **41.3** | **42.1** | **43.0** | **43.8** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Vulnerability 1: (e.g. road damage owing to floods) | | | | | | | | | | | | | |
| Economic Vulnerability 2: | | | | | | | | | | | | | |
| Economic Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 4.78 | 4.88 | 4.98 | 5.08 | 5.18 | 5.28 | 5.39 | 5.50 | 5.61 | 5.72 | 5.83 | 5.95 |
| Economic Variable 2: | Saved Medical Cost | 0.50 | 0.51 | 0.52 | 0.53 | 0.54 | 0.55 | 0.57 | 0.58 | 0.59 | 0.60 | 0.61 | 0.62 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **5.29** | **5.39** | **5.50** | **5.61** | **5.72** | **5.84** | **5.95** | **6.07** | **6.19** | **6.32** | **6.44** | **6.57** |
| **Vulnerability Impacts with Climate Change and Project** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 31.9 | 32.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 2: | Saved Medical Cost | 3.3 | 3.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **35.2** | **35.9** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | Saved Income Loss | 0.0 | 0.0 | 33.2 | 33.9 | 34.5 | 35.2 | 35.9 | 36.6 | 37.4 | 38.1 | 38.9 | 39.7 |
| Economic Variable 2: | Saved Medical Cost | 0.0 | 0.0 | 3.5 | 3.5 | 3.6 | 3.7 | 3.8 | 3.8 | 3.9 | 4.0 | 4.1 | 4.2 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **0.0** | **0.0** | **36.7** | **37.4** | **38.1** | **38.9** | **39.7** | **40.5** | **41.3** | **42.1** | **43.0** | **43.8** |
| | | 1000000 | | | | | | | | | | | |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 110.51 | BDT 73.67 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | BDT 0.75 | BDT 0.75 | BDT 0.75 | BDT 0.75 | BDT 0.75 | BDT 0.75 | BDT 0.75 | BDT 0.75 | BDT 0.75 | BDT 0.75 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT 122.78 | BDT 81.86 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | BDT 12.28 | BDT 8.19 | BDT 0.00 | BDT 0.00 | BDT 0.00 | | | | | | | |
| **O & M Incremental Costs:** | | | | | BDT 0.08 | BDT 0.08 | BDT 0.08 | BDT 0.08 | BDT 0.08 | BDT 0.08 | BDT 0.08 | BDT 0.08 | BDT 0.08 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 122.78** | **-BDT 81.86** | **BDT 35.84** | **BDT 36.57** | **BDT 37.32** | **BDT 38.08** | **BDT 38.86** | **BDT 39.65** | **BDT 40.46** | **BDT 41.29** | **BDT 42.13** | **BDT 42.99** |
| | | | | | | | | | | | | | |
| **Project without CC Net Economic Flows** | | -BDT 110.51 | -BDT 73.67 | BDT 30.42 | BDT 31.04 | BDT 31.68 | BDT 32.33 | BDT 32.99 | BDT 33.66 | BDT 34.35 | BDT 35.05 | BDT 35.77 | BDT 36.50 |
| | | | | | | | | | | | | | |
| **Project ONLY CC Net Economic Flows** | | -BDT 12.28 | -BDT 8.19 | BDT 5.42 | BDT 5.44 | BDT 5.56 | BDT 5.67 | BDT 5.79 | BDT 5.91 | BDT 6.03 | BDT 6.15 | BDT 6.28 | BDT 6.41 |

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| **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **Total (Taka 2013)** |
| | | | | | | | | | | |
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| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 40.5 | 41.3 | 42.1 | 42.9 | 43.8 | 44.7 | 45.6 | 46.5 | 47.4 | 48.3 | BDT 870.8 |
| 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.8 | 4.9 | 5.0 | 5.1 | BDT 91.3 |
| | | | | | | | | | | |
| **44.7** | **45.6** | **46.5** | **47.4** | **48.4** | **49.3** | **50.3** | **51.3** | **52.4** | **53.4** | **962.1** |
| | | | | | | | | | | |
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| | | | | | | | | | | |
| | | | | | | | | | | |
| 6.07 | 6.19 | 6.31 | 6.44 | 6.57 | 6.70 | 6.83 | 6.97 | 7.11 | 7.25 | BDT 130.6 |
| 0.64 | 0.65 | 0.66 | 0.68 | 0.69 | 0.70 | 0.72 | 0.73 | 0.75 | 0.76 | BDT 13.7 |
| | | | | | | | | | | |
| **6.70** | **6.84** | **6.98** | **7.11** | **7.26** | **7.40** | **7.55** | **7.70** | **7.86** | **8.01** | **144.31** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 64.4 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 6.8 |
| | | | | | | | | | | 0 |
| | | | | | | | | | | 0.0 |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **71.2** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 40.5 | 41.3 | 42.1 | 42.9 | 43.8 | 44.7 | 45.6 | 46.5 | 47.4 | 48.3 | BDT 806.4 |
| 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.8 | 4.9 | 5.0 | 5.1 | BDT 84.6 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **44.7** | **45.6** | **46.5** | **47.4** | **48.4** | **49.3** | **50.3** | **51.3** | **52.4** | **53.4** | **890.9** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 184.2 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| BDT 0.75 | BDT 0.75 | BDT 0.75 | BDT 0.75 | BDT 0.75 | BDT 0.75 | BDT 0.75 | BDT 0.75 | BDT 0.75 | BDT 0.75 | BDT 14.9 |
| | | | | | | | | | | **199.1** |
| | | | | | | | | | | |
| | | | | | BDT 0.00 | | | | | BDT 204.6 |
| BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 0.83 | BDT 16.6 |
| | | | | | | | | | | **221.2** |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 20.5 |
| BDT 0.08 | BDT 0.08 | BDT 0.08 | BDT 0.08 | BDT 0.08 | BDT 0.08 | BDT 0.08 | BDT 0.08 | BDT 0.08 | BDT 0.08 | BDT 1.6 |
| | | | | | | | | | | **22.0** |
| **BDT 43.87** | **BDT 44.76** | **BDT 45.67** | **BDT 46.60** | **BDT 47.55** | **BDT 48.52** | **BDT 49.51** | **BDT 50.51** | **BDT 51.54** | **BDT 52.59** | 17% |
| | | | | | | | | | | |
| BDT 37.24 | BDT 38.00 | BDT 38.78 | BDT 39.57 | BDT 40.38 | BDT 41.20 | BDT 42.04 | BDT 42.89 | BDT 43.77 | BDT 44.66 | 16% |
| | | | | | | | | | | |
| BDT 6.54 | BDT 6.67 | BDT 6.81 | BDT 6.95 | BDT 7.09 | BDT 7.24 | BDT 7.38 | BDT 7.54 | BDT 7.69 | BDT 7.85 | 24% |

| | | | | | |
|---|---|---|---|---|---|
| | **Assumptions for With CCR** | | | | |
| 1 | Saved Income Loss - See Workings below | | | | |
| 2 | Saved Medical Cost - See Workings Below | | | | |
| | | | | | |
| | **Assumptions for Without CCR** | | | | |
| 1 | Saved Income Loss - See Workings below | | | | |
| 2 | Saved Medical Cost - See Workings Below | | | | |
| | | | | | |
| | **Common to both** | | | | |
| 1 | Capex with CCR and without CCR as per technical team estimate | | | | |
| 2 | Opex with CCR and without CCR as per technical team estimate | | | | |
| | | | | | |
| | **Economc Benefit Cost Calculation - With CCR** | | | | |
| | Number of cyclone shelters | 8 | | | |
| | Capacity of cyclone shelters | 1200 | | | |
| | | | | | |
| | Monthly HH Income | BDT | 14620 | | |
| | HH Size | Number | 4.4 | | |
| | Number of days saved | Number | 15 | | |
| | Additional persons accessing CS | Number | 9600 | | |
| | Number of cyclones per year | Number | 2 | | |
| | Saved Medical Cost per HH | BDT | 1533 | | |
| | | | | | |
| | **Savings:** | | | | |
| | Loss of Income per cyclone | BDT | **15,949,091** | | |
| | Medical Cost Per cyclone | BDT | **1,672,364** | | |
| | | | | | |
| | **Yearly Savings** | | | | **35,242,910** |
| | **Total Savings** | | | | **35,242,910** |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | **Economc Benefit Cost Calculation - Without CCR** | | | | |
| | Number of cyclone shelters | **8** | | | |
| | Capacity of cyclone shelters | **1020** | | | |
| | | | | | |
| | Monthly HH Income | BDT | 14620 | | |
| | HH Size | Number | 4.4 | | |
| | Number of days saved | Number | 15 | | |
| | Additional persons accessing CS | Number | 8160 | | |

| | | | | | |
|---|---|---|---|---|---|
| | Number of cyclones per year | Number | 2 | | |
| | Saved Medical Cost per HH | BDT | 1533 | | |
| | | | | | |
| | **Savings:** | | | | |
| | Loss of Income per HH | BDT | **13,556,727** | | |
| | Medical Cost Per HH | BDT | **1,421,509** | | |
| | | | | | |
| | **Yearly Savings** | | | | **29,956,472** |
| | **Total Savings** | | | | **29,956,472** |

# 1.8. Boat landing stations in Pirojpur Paurashava

| Coastal Towns Infrastructure Improvement Programme | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sector: | Boat Landing Stations | | | | | | | | | | | | |
| Investigator(s): | Nesar Ahmed | | | | | | | | | | | | |
| Town: | Pirojpur | | | | | | | | | | | | |
| Project: | For Town | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Full Town | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Variable 1: | | | | | | | | | | | | | |
| Economic Variable 2: | | | | | | | | | | | | | |
| Economic Variable 3: | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Time Savings | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| Economic Variable 2: | Saved Medical Cost | 1.4 | 1.4 | 1.4 | 1.5 | 1.5 | 1.5 | 1.6 | 1.6 | 1.6 | 1.6 | 1.7 | 1.7 |
| Economic Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **1.7** | **1.8** | **1.8** | **1.8** | **1.9** | **1.9** | **2.0** | **2.0** | **2.0** | **2.1** | **2.1** | **2.2** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Vulnerability 1: (e.g. road damage owing to floods) | | | | | | | | | | | | | |
| Economic Vulnerability 2: | | | | | | | | | | | | | |
| Economic Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Time Savings | 0.09 | 0.09 | 0.09 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.11 | 0.11 | 0.11 | 0.11 |
| Economic Variable 2: | Saved Medical Cost | 0.34 | 0.35 | 0.36 | 0.37 | 0.37 | 0.38 | 0.39 | 0.40 | 0.40 | 0.41 | 0.42 | 0.43 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **0.43** | **0.44** | **0.45** | **0.46** | **0.47** | **0.48** | **0.49** | **0.50** | **0.51** | **0.52** | **0.53** | **0.54** |
| **Vulnerability Impacts with Climate Change and Project** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Time Savings | 0.4 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 2: | Saved Medical Cost | 1.4 | 1.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **1.7** | **1.8** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | Time Savings | 0.0 | 0.0 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| Economic Variable 2: | Saved Medical Cost | 0.0 | 0.0 | 1.4 | 1.5 | 1.5 | 1.5 | 1.6 | 1.6 | 1.6 | 1.6 | 1.7 | 1.7 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **0.0** | **0.0** | **1.8** | **1.8** | **1.9** | **1.9** | **2.0** | **2.0** | **2.0** | **2.1** | **2.1** | **2.2** |
| | | | | | | | | | | | | | |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 2.79 | BDT 1.86 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.00 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT 3.07 | BDT 2.05 | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **O & M with CC Adaptation:** | | | | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 |
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | BDT 0.28 | BDT 0.18 | | | | | | | | | | |
| **O & M Incremental Costs:** | | | | | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 3.07** | **-BDT 2.05** | **BDT 1.80** | **BDT 1.83** | **BDT 1.87** | **BDT 1.91** | **BDT 1.95** | **BDT 1.99** | **BDT 2.03** | **BDT 2.07** | **BDT 2.11** | **BDT 2.15** |
| | | | | | | | | | | | | | |
| **Project without CC Net Economic Flows** | | -BDT 2.79 | -BDT 1.86 | BDT 1.35 | BDT 1.38 | BDT 1.41 | BDT 1.44 | BDT 1.46 | BDT 1.49 | BDT 1.52 | BDT 1.55 | BDT 1.59 | BDT 1.62 |
| | | | | | | | | | | | | | |
| **Project ONLY CC Net Economic Flows** | | -BDT 0.28 | -BDT 0.18 | BDT 0.44 | BDT 0.45 | BDT 0.45 | BDT 0.46 | BDT 0.47 | BDT 0.48 | BDT 0.49 | BDT 0.50 | BDT 0.51 | BDT 0.52 |
| | | | | | | | | | | | | | |

| **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **Total (Taka 2013)** |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | BDT 9.8 |
| 1.7 | 1.8 | 1.8 | 1.9 | 1.9 | 1.9 | 2.0 | 2.0 | 2.1 | 2.1 | BDT 37.7 |
| | | | | | | | | | | |
| **2.2** | **2.3** | **2.3** | **2.3** | **2.4** | **2.4** | **2.5** | **2.5** | **2.6** | **2.6** | **47.5** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 0.11 | 0.12 | 0.12 | 0.12 | 0.12 | 0.13 | 0.13 | 0.13 | 0.13 | 0.14 | BDT 2.5 |
| 0.44 | 0.45 | 0.46 | 0.46 | 0.47 | 0.48 | 0.49 | 0.50 | 0.51 | 0.52 | BDT 9.4 |
| | | | | | | | | | | |
| **0.55** | **0.56** | **0.57** | **0.59** | **0.60** | **0.61** | **0.62** | **0.63** | **0.65** | **0.66** | **11.87** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 0.7 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 2.8 |
| | | | | | | | | | | 0 |
| | | | | | | | | | | 0.0 |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **3.5** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | BDT 9.1 |
| 1.7 | 1.8 | 1.8 | 1.9 | 1.9 | 1.9 | 2.0 | 2.0 | 2.1 | 2.1 | BDT 34.9 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **2.2** | **2.3** | **2.3** | **2.3** | **2.4** | **2.4** | **2.5** | **2.5** | **2.6** | **2.6** | **44.0** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 4.7 |
| BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.00 | BDT 0.1 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | **4.8** |
| | | | | | | | | | | |
| | | | | | BDT 0.00 | | | | | BDT 5.1 |
| BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.3 |
| | | | | | | | | | | **5.4** |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 0.5 |
| BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.01 | BDT 0.2 |
| | | | | | | | | | | **0.6** |
| **BDT 2.19** | **BDT 2.24** | **BDT 2.28** | **BDT 2.33** | **BDT 2.38** | **BDT 2.42** | **BDT 2.47** | **BDT 2.52** | **BDT 2.57** | **BDT 2.62** | 31% |
| | | | | | | | | | | |
| BDT 1.65 | BDT 1.68 | BDT 1.72 | BDT 1.75 | BDT 1.79 | BDT 1.82 | BDT 1.86 | BDT 1.90 | BDT 1.93 | BDT 1.97 | 27% |
| | | | | | | | | | | |
| BDT 0.54 | BDT 0.55 | BDT 0.56 | BDT 0.57 | BDT 0.58 | BDT 0.59 | BDT 0.60 | BDT 0.62 | BDT 0.63 | BDT 0.64 | 69% |

| | | | | | |
|---|---|---|---|---|---|
| | **Assumptions for With CCR** | | | | |
| 1 | Time Savings - See Workings below | | | | |
| 2 | Saved Medical Cost - See Workings Below | | | | |
| | | | | | |
| | **Assumptions for Without CCR** | | | | |
| 1 | Time Savings - See Workings below | | | | |
| 2 | Saved Medical Cost - See Workings Below | | | | |
| | | | | | |
| | **Common to both** | | | | |
| 1 | Capex with CCR and without CCR as per technical team estimate | | | | |
| 2 | Opex with CCR and without CCR as per technical team estimate | | | | |
| | | | | | |
| | | | | | |
| | **Economc Benefit Cost Calculation - With CCR** | | | | |
| | Number of Boat Landings | 30 | | | |
| | Capacity of Boat Landings | 20 | | | |
| | | | | | |
| | Monthly HH Income | BDT | 14620 | | |
| | HH Size | Number | 4.4 | | |
| | Number of days travel | Number | 300 | | |
| | Additional persons accessing BLS | Number | 600 | | |
| | Time saved per person | minutes | 2 | | |
| | Saved Medical Cost per HH | BDT | 1533 | | |
| | Avoided injury | % | 0.5 | | |
| | **Savings:** | | | | |
| | Time Savings per person per year | BDT | **2** | | |
| | Medical Cost Savings per person per year | BDT | **8** | | |
| | **Yearly Time Savings** | | | | **360,000** |
| | **Yearly Medical Cost Savings** | | | | **1,379,700** |
| | **Total Savings** | | | | **1,739,700** |
| | | | | | |
| | | | | | |
| | | | | | |
| | **Economc Benefit Cost Calculation Without CCR** | | | | |
| | Indicator B4 Leverage PPCR funds against public/private investments in sector | 30 | | | |
| | Indicator B5 Quality/extent climate instruments/investment models developed and tested | 15 | | | |
| | | | | | |
| | Monthly HH Income | BDT | 14620 | | |
| | HH Size | Number | 4.4 | | |
| | Number of days travel | Number | 300 | | |
| | Additional persons accessing BLS | Number | 450 | | |
| | Time saved per person | minutes | 2 | | |

| | | | | | |
|---|---|---|---|---|---|
| | Saved Medical Cost per HH | BDT | 1533 | | |
| | Avoided injury | % | 0.5 | | |
| | **Savings:** | | | | |
| | Time Savings per person per year | BDT | **2** | | |
| | Medical Cost Savings per person per year | BDT | **8** | | |
| | **Yearly Time Savings** | | | | **270,000** |
| | **Yearly Medical Cost Savings** | | | | **1,034,775** |
| | **Total Savings** | | | | **1,304,775** |

# 1.9. Markets in Pirojpur Paurashava

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Coastal Towns Infrastructure Improvement Programme** | | | | | | | | | | | | | |
| Sector: | Markets | | | | | | | | | | | | |
| Investigator(s): | Nesar Ahmed | | | | | | | | | | | | |
| Town: | Pirojpur | | | | | | | | | | | | |
| Project: | For Town | | | | | | | | | | | | |
| Project Boundary (area serviced by project: if possible, list wards or provide clear boundaries): | Full Town | | | | | | | | | | | | |
| | **Year** | | | | | | | | | | | | |
| **Inputs** | | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| **Baseline Projected with additional (future) Climate Change** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Variable 1: | | | | | | | | | | | | | |
| Economic Variable 2: | | | | | | | | | | | | | |
| Economic Variable 3: | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Save Business Income Loss | 7.1 | 7.3 | 7.4 | 7.6 | 7.7 | 7.9 | 8.0 | 8.2 | 8.4 | 8.5 | 8.7 | 8.9 |
| Economic Variable 2: | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **7.1** | **7.3** | **7.4** | **7.6** | **7.7** | **7.9** | **8.0** | **8.2** | **8.4** | **8.5** | **8.7** | **8.9** |
| **Vulnerability Impacts with Project w/o CC resilient measures** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | | | | | | | | | | | | | |
| Economic Vulnerability 1: (e.g. road damage owing to floods) | | | | | | | | | | | | | |
| Economic Vulnerability 2: | | | | | | | | | | | | | |
| Economic Vulnerability 3: etc…. | | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Save Business Income Loss | 1.49 | 1.52 | 1.55 | 1.58 | 1.61 | 1.64 | 1.67 | 1.71 | 1.74 | 1.78 | 1.81 | 1.85 |
| Economic Variable 2: | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vulnerability 3: etc. | | | | | | | | | | | | | |
| **Annual Total Baseline with future CC Damage/Loss/Extra Costs:** | | **1.49** | **1.52** | **1.55** | **1.58** | **1.61** | **1.64** | **1.67** | **1.71** | **1.74** | **1.78** | **1.81** | **1.85** |
| **Vulnerability Impacts with Climate Change and Project** | | | | | | | | | | | | | |
| **Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Flow Costs (cost impact from services disrupted):** | | | | | | | | | | | | | |
| Economic Variable 1: | Save Business Income Loss | 7.1 | 7.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 2: | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **7.1** | **7.3** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Vulnerability Reduction Owing to Project** | | | | | | | | | | | | | |
| **Reduced Stock Damage/Loss (damage to roads, etc.):** | **None** | | | | | | | | | | | | |
| **Reduced Flow Costs (cost impact from services disrupted):** | | | Input from Socioeconomic Survey | | | | | | | | | | |
| Economic Variable 1: | Time Savings | 0.0 | 0.0 | 7.4 | 7.6 | 7.7 | 7.9 | 8.0 | 8.2 | 8.4 | 8.5 | 8.7 | 8.9 |
| Economic Variable 2: | Saved Medical Cost | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Economic Variable 3: | | | | | | | | | | | | | |
| Economic Variable 4: | | | | | | | | | | | | | |
| **Annual Total Reduced Damage/Loss with Climate Change** | | **0.0** | **0.0** | **7.4** | **7.6** | **7.7** | **7.9** | **8.0** | **8.2** | **8.4** | **8.5** | **8.7** | **8.9** |
| | | | | | | | | | | | | | |
| **Project Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **CAPEX Project Costs without CC Adaptation:** | | BDT 13.94 | BDT 9.29 | | | | | | | | | | |
| **O & M without CC Adaptation:** | | | | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 |
| **Total Costs Without Climate Adaptation** | | | | | | | | | | | | | |
| **Project Costs With Climate Adpatation** | | | | | | | | | | | | | |
| **CAPEX Project Costs with CC Adaptation:** | | BDT 15.35 | BDT 10.23 | | | | | | | | | | |
| **O & M with CC Adaptation:** | | | | BDT 0.13 | BDT 0.13 | BDT 0.13 | BDT 0.13 | BDT 0.13 | BDT 0.13 | BDT 0.13 | BDT 0.13 | BDT 0.13 | BDT 0.13 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total Costs With Climate Adaptation** | | | | | | | | | | | | | |
| **Climate Adaptation Incremental Costs** | | | | | | | | | | | | | |
| **CAPEX Project Incremental Costs** | | BDT 1.41 | BDT 0.94 | | | | | | | | | | |
| **O & M Incremental Costs:** | | | | | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 |
| **Total Incremental Costs of Climate Adaptation** | | | | | | | | | | | | | |
| **Project w. CC Net Economic Flows** | | **-BDT 15.35** | **-BDT 10.23** | **BDT 7.29** | **BDT 7.44** | **BDT 7.59** | **BDT 7.74** | **BDT 7.90** | **BDT 8.06** | **BDT 8.22** | **BDT 8.39** | **BDT 8.56** | **BDT 8.74** |
| | | | | | | | | | | | | | |
| **Project without CC Net Economic Flows** | | -BDT 13.94 | -BDT 9.29 | BDT 5.81 | BDT 5.93 | BDT 6.05 | BDT 6.17 | BDT 6.30 | BDT 6.43 | BDT 6.55 | BDT 6.69 | BDT 6.82 | BDT 6.96 |
| | | | | | | | | | | | | | |
| **Project ONLY CC Net Economic Flows** | | -BDT 1.41 | -BDT 0.94 | BDT 1.47 | BDT 1.43 | BDT 1.47 | BDT 1.50 | BDT 1.53 | BDT 1.56 | BDT 1.60 | BDT 1.63 | BDT 1.67 | BDT 1.71 |

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|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | | | | | | |
| **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** | **Total (Taka 2013)** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 9.0 | 9.2 | 9.4 | 9.6 | 9.8 | 10.0 | 10.2 | 10.4 | 10.6 | 10.8 | BDT 194.6 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 0.0 |
| | | | | | | | | | | |
| **9.0** | **9.2** | **9.4** | **9.6** | **9.8** | **10.0** | **10.2** | **10.4** | **10.6** | **10.8** | **194.6** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 1.88 | 1.92 | 1.96 | 2.00 | 2.04 | 2.08 | 2.12 | 2.16 | 2.21 | 2.25 | BDT 40.6 |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | BDT 0.0 |
| | | | | | | | | | | |
| **1.88** | **1.92** | **1.96** | **2.00** | **2.04** | **2.08** | **2.12** | **2.16** | **2.21** | **2.25** | **40.55** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 14.4 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 0.0 |
| | | | | | | | | | | 0 |
| | | | | | | | | | | 0.0 |
| **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **14.4** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 9.0 | 9.2 | 9.4 | 9.6 | 9.8 | 10.0 | 10.2 | 10.4 | 10.6 | 10.8 | BDT 180.2 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | BDT 0.0 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **9.0** | **9.2** | **9.4** | **9.6** | **9.8** | **10.0** | **10.2** | **10.4** | **10.6** | **10.8** | **180.2** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 23.2 |
| BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 0.06 | BDT 1.2 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | **24.4** |
| | | | | | | | | | | |
| | | | | | BDT 0.00 | | | | | BDT 25.6 |
| BDT 0.13 | BDT 0.13 | BDT 0.13 | BDT 0.13 | BDT 0.13 | BDT 0.13 | BDT 0.13 | BDT 0.13 | BDT 0.13 | BDT 0.13 | BDT 2.6 |
| | | | | | | | | | | **28.2** |
| | | | | | | | | | | |
| | | | | | | | | | | BDT 2.4 |
| BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 0.07 | BDT 1.3 |
| | | | | | | | | | | **3.7** |
| **BDT 8.91** | **BDT 9.09** | **BDT 9.28** | **BDT 9.47** | **BDT 9.66** | **BDT 9.85** | **BDT 10.05** | **BDT 10.26** | **BDT 10.47** | **BDT 10.68** | 26% |
| | | | | | | | | | | |
| BDT 7.10 | BDT 7.24 | BDT 7.39 | BDT 7.54 | BDT 7.69 | BDT 7.85 | BDT 8.00 | BDT 8.16 | BDT 8.33 | BDT 8.50 | 23% |
| | | | | | | | | | | |
| BDT 1.74 | BDT 1.78 | BDT 1.82 | BDT 1.86 | BDT 1.90 | BDT 1.94 | BDT 1.98 | BDT 2.02 | BDT 2.07 | BDT 2.11 | 49% |

| | | | | | |
|---|---|---|---|---|---|
| | **Assumptions for With CCR** | | | | |
| 1 | Save Business Income Loss - See Workings below | | | | |
| | | | | | |
| | | | | | |
| | **Assumptions for Without CCR** | | | | |
| 1 | Save Business Income Loss - See Workings below | | | | |
| | | | | | |
| | | | | | |
| | **Common to both** | | | | |
| 1 | Capex with CCR and without CCR as per technical team estimate | | | | |
| 2 | Opex with CCR and without CCR as per technical team estimate | | | | |
| | | | | | |
| | | | | | |
| | **Economc Benefit Cost Calculation - With CCR** | | | | |
| | Number of Markets | 1 | | | |
| | Number of Traders | 48 | | | |
| | | | | | |
| | Monthly HH Expenditure | BDT | 12874 | | |
| | HH Size | Number | 4.3 | | |
| | Number of days shopping | Number | 300 | | |
| | Additional HHs accessing Market | Number/day | 96 | | |
| | % of Expenditure spent in Market | % | 50% | | |
| | | | | | |
| | | | | | |
| | **Savings:** | | | | |
| | Average business generated in a day | BDT | **23,767** | | |
| | | | | | |
| | **Yearly Buiness Income Loss Savings** | | | | **7,130,215** |
| | | | | | **-** |
| | **Total Savings** | | | | **7,130,215** |
| | | | | | |
| | | | | | |
| | | | | | |
| | **Economc Benefit Cost Calculation Without CCR** | | | | |
| | Number of Markets | 1 | | | |
| | Number of Traders | 38 | | | |
| | | | | | |
| | Monthly HH Expenditure | BDT | 12874 | | |
| | HH Size | Number | 4.3 | | |
| | Number of days shopping | Number | 300 | | |
| | Additional HHs accessing Market | Number/day | 76 | | |
| | % of Expenditure spent in Market | % | 50% | | |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | **Savings:** | | | | |
| | Economic Variable 2: | BDT | **18,816** | | |
| | | | | | |
| | **Yearly Buiness Income Loss Savings** | | | | **5,644,754** |
| | | | | | **-** |
| | **Total Savings** | | | | **5,644,754** |

## APPENDIX 2: DEVELOPING CLIMATE CHANGE RESILIENT MASTER PLANS[61]

| How Climate Change Resilient is Your Master Plan? | |
|---|---|
| **1.1 The Preparation Of Your Master Plan** | **Why you need to know?** |
| Was consultation on the plan sufficient? Does it reflect the actual and perceived climate change vulnerability impacts of citizens? How are these reflected? | Public consultation is principled approach in plan making process as it lays foundation for rationale decision making on the needs and demands of town dwellers for quality living. |
| Are the views of all sections of the pourashava's population included? | The views of all sections of the people help decision making for inclusive and sustainable development. |
| Was a vulnerability and disaster risk assessment (of any kid) carried out as a preparatory tool for identifying the pourashava's threat from climate change? | Vulnerability and risk assessments contribute to DRR by informing policy priorities and decisions on municipal expenditure. |
| Have climate change projections (local, regional or national) been used in the preparation of the plan? Are they included in the plan? | The projection is important to ascertain the planning standards that might make the coastal infrastructure resilient to climate change impacts. |
| **1.2 Your master plan** | **Why you need to know?** |
| Are the plans accurate? | If the plans are reasonably accurate, its implementation becomes easier. |
| Does the plan include a pourashava hazard profile map indicating areas of high vulnerability? | This should include identifying areas vulnerable to the impacts of climate change (flooding and storm surges) and impact scenarios (such as SLR) |
| Are 'hot spots' (those areas that are especially vulnerable to climate change) identified? | If such areas are clearly identified, measures can be sought for reducing the vulnerability. |
| Does the plan address the sub-regional context and how climate change will impact the sub-region? | Climate change impacts can be better understood and addressed in terms of regional and sub-regional contexts rather than a small area context, such as a coastal town. |
| Is the proposed zoning related to the impacts of climate change? If not, using professional judgement, is the proposed zoning suitable in the light of anticipated climate change impacts? | If the land use zoning can be made considering climate change impacts, its implementation is likely to be climate resilient. |
| Are there policies specifically addressed to climate change impacts and adaptation measures, and disaster risk management? | If plans are made in reference to policies that address the climate change and disaster issues, the plans are more likely to be effective for implementation. |
| Are natural (eco-system) measures considered in the plan as climate change adaptation measures? | This might include retention ponds, development free flood plains, planting (mangroves, trees etc), green and blue belts |
| Are the needs and vulnerability of the urban poor to climate change identified and addressed? Is the location of the urban poor clearly identified? Are these locations related to (mapped) climate change vulnerability? | The urban poor are likely to be located in the most vulnerable locations and protective measures and/or resettlement (and thus land availability) may be necessary. |
| Is critical (strategic) infrastructure identified in the plan? (A1 to A9 below). Are basic urban infrastructure and services addressed to consider the likely impacts of climate change and possible physical / land use planning responses? Is | Impacts of climate change and climate disasters can be magnified through a domino-effect of secondary and indirect losses caused when critical infrastructure and services fail following disaster.62 Protecting critical infrastructure must be made a priority. |

61 Volume 2 (Additional Appendices) B.3.

62 Critical Infrastructure and services include: (a) Cyclone shelters. (b) Electricity (generation, transmission and distribution infrastructure). (c) Gas and liquid fuels (storage, transport and distribution infrastructure). (d) Water supply and sanitation (collection, treatment, storage, transport and distribution infrastructure). (e) Food (storage). (f) Telecommunication (cable transmission and cellular telephone infrastructure). (g) Transport (road and river transport system). (h) Hospital and healthcare facilities and services. (i) Police and rule of law.

| How Climate Change Resilient is Your Master Plan? | |
|---|---|
| suitable land allocated to critical infrastructure where it is required, or where it is necessary to relocate infrastructure to less vulnerable areas? | |
| **A.1 Water Supply**<br>Does the plan address (for example): Protection of critical infrastructure (water storage) through structural enhancement and elevation? Control of groundwater extraction? Improved rainwater harvesting (and technologies)? | Water supply is considered especially vulnerable to climate change: Scarcity of fresh water, saline water intrusion, wider salinity contamination in the surface, ground and soil in the coastal zone, prolonged and widespread drought, increased urban water supply demand (domestic and industrial) due to higher temperatures, ineffective / inefficient rain harvesting, and Insufficient or poorly maintained production/deep tube wells. |
| **A.2 Drainage**<br>Does the plan consider whether (for example): Existing coastal and river embankments are adequate (including maintenance / rehabilitation)? The drainage system is adequate? Culverts and bridges are appropriately designed? Retention areas (ponds and overflow basins)? | SLR has been identified as a matter of 'grave concern' for Bangladesh. Increasing temperatures result in material expansion and will impact structures such embankments and culverts. Culverts and bridges that are inadequately designed. Frequent floods. Drainage congestion. River bank erosion. Infrastructure development reducing limited natural drainage. |
| **A.3 Sanitation**<br>Does the plan consider whether (for example): Sewage treatment facilities are appropriately designed, located and sufficiently resilient? Sanitation for the urban poor is adequately designed, affordable, and adapted (to the needs of the poor and CC)? | This is critical to public health. Problems include: Lack and/or vulnerability of sewage treatment facilities. Unsanitary disposal of sewer and septic tank sludge. Use of pit latrines and/or septic tanks susceptible to inundation. Contamination of shallow groundwater sources resulting from inundation induced seepage Lack or absence of, operable sanitation facilities following disaster. |
| | |

| How Climate Change Resilient is Your Master Plan? | |
|---|---|
| **A.4 Transport**<br>Does the plan consider whether (for example): Identification of strategic roads that must be protected? Road infrastructure is resilient to changing nature of hazards through adjusted design standards including all weather road network, road/embankment height enhancement, road cross drainage (culverts and regulators). | SLR/ increasing normal tide levels will flood more coastal zone land in terms of extent and inundation time – road infrastructure will be adversely affected. Roads are partially damaged when the surge height is less than 1 metre, and more fully damaged when inundation depths exceed 1 metre. |
| **A.5 Solid Waste Management**<br>Does the plan address whether (for example): There is an effective SWM system? The presence/absence of a sanitary landfill? The specifications for and location of a sanitary landfill where currently absent? | Of critical importance to public health. Core problems include poor or absent collection services with no landfill, and indiscriminate dumping of waste with knock-on impacts to choked drainage systems. |
| **A.6 Housing**<br>Does the plan address whether (for example): Housing is appropriately sited in relation to perceived/actual risks? New housing areas are appropriately located? Housing standards (rules and regulation) are appropriate? | Resilient housing is essential to protect lives and property from extreme weather events and climate change. |
| **A.7 Public Health**<br>Does the plan address whether (for example): Health clinics, hospital and other medical centres are appropriately located? These facilities considered as (additional) cyclone shelters? | Climate change related public health issues will increase (dengue, malaria, heat stress, greater intensity or spread of infectious diseases particularly cholera, diarrhoea, dysentery and typhoid) and protected facilities are critical in disaster / post-disaster contexts. |
| **A.8 Education Facilities**<br>Does the plan address whether (for example): Education facilities are appropriately located? These facilities considered as (additional) cyclone shelters? | The education of children may be affected for longer time, if facilities are not resilient enough to face climate change related disasters.<br>The facilities may also save lives and properties providing safe shelters during disasters. |
| **A.9 Disaster Risk Management**<br>Does the plan address whether (for example): Repair and rehabilitation of existing coastal and river embankments? Repair and rehabilitation of climate resilient urban drainage systems? Construction of multi-purpose shelters (as schools, clinics, community facilities etc)? DRM coordination and planning? Early warning systems and disaster drills? | Increased vulnerability to cyclones, floods and tidal wave surges that are more frequent and more intense. The lack of urban disaster risk management plans and local know-how. |
| Does the plan identify and promote good practice in relation to climate change? | This might include for example new or appropriate technology (sanitation, rain-harvesting, building technology and techniques) and community-based adaptation measures (already proven effective). |
| **The implementation of your master plan** | **Why you need to know?** |
| Does the plan include proposals for climate resilient infrastructure? | The Coastal Zone Policy, 2005 suggests for adopting measures considering climate change impacts and coastal zone economy, society and environment. |
| Do infrastructure investment proposals for municipal infrastructure (at city and ward level) take account of climate change projections and anticipated impacts? | To make coastal towns resilient to climate change impacts, the proposals for infrastructure development should be made considering the potential impacts of climate change. |
| If not, and based on professional judgement, are the proposed infrastructure investments suitable in the light of anticipated climate change impacts? | The proposals on infrastructure development might still be useful to address the climate change risks, even if the climate change impacts were not taken into consideration in the plan making process. |

| How Climate Change Resilient is Your Master Plan? | |
|---|---|
| Are there adequate processes for monitoring the plan and evaluating its level of climate resilience over time? | According to Urban Management Policy 1999, Land Use Plans shall be prepared by Pourashavas in consultations with local communities and shall be periodically updated. Such plans shall form the basis for all property and land development and the assessment of taxes. Each Pourashava and City Corporation shall endeavour to appoint a full time qualified Urban Planner to its staff for this purpose, and until such appointment is executed; such services shall be contracted out.<br>Category-A Pourashava has legal provision for employing an Urban Planner. |
| Is the plan sufficiently related to building codes? Have national codes been adapted to local circumstances? | Building codes and standards decrease (or increase) the vulnerability of households and wider community. |

# APPENDIX 3: INDICATIVE FRAMEWORK FOR DEVELOPMENT OF A MUNICIPAL INVESTMENT PLAN

| Stage | Step | Focus | Main Task | Stakeholder Involvement | Main Outputs | By week |
|---|---|---|---|---|---|---|
| PREPARE | 1 | Who will do it? | Form a Steering Group and allocate responsibilities | Steering Group | Clear Roles and Responsibilities | 2 |
| | 2 | What is to be done? | Agree a concise TOR to guide the work and agree objectives | Steering Group | Concise TOR (template attached) | 2 |
| | 3 | Who should be involved and how? | Agree who are stakeholders and they will involved in the process | Steering Group | Stakeholder Participation Strategy | 4 |
| ASSESS | 4 | Rapid Municipal Profiling | Agree what data is required and available and collate (start with, and update, the master plan where available) | Steering Group and Technical Working Group / TLCC | Pourashava profile. Maps and Tables | 7 |
| | 5 | Service and infrastructure Coverage and Gap Assessment | Assessment of basic service coverage | Stakeholder focus groups | Asset Inventory and Condition Assessment | 7 |
| | 6 | Asset Management Plan | Identify and asses the quality of infrastructure assets | Steering Group and Technical Working Group / TLCC | Maintenance Budget (Annual/3-year) | 9 |
| PRIORITISE | 7 | Setting a Vision, Goal and Priorities | Formulate the vision, goal and municipal priorities | Pourashava Consultation | Municipal Development Framework | 10 |
| | 8 | Project Identification | To identify the main capital investment needs | Steering Group and Technical Working Group / TLCC | Structured long list | 13 |
| | 9 | Project Prioritisation | Shortlist projects | Steering Group / Technical Working Group / TLCC | Structured short list | 15 |
| PACAKGE | 10 | Pre-Feasibility Screening | Preliminary Economic, Environmental, Social and Financial Assessment | Technical Working Group | Pre-Feasibility Study (PFS) (Investments) | 18 |
| | 11 | Finalisation of the capital investment plan | Finalisation of the Municipal Investment Plan | TLCC / Full Municipal Council | MIP (3 years) | 20 |