ECONOMIC ANALYSIS

A. Economic Rationale

1. Out of the total population of about 150 million, the urban population is growing rapidly, from 20% in 1991 to 28% (42 million) in 2011.[1] Rapid urbanization is widening the deficit in infrastructure and services. Although urban poverty was reduced from 28.4% in 2005 to 21.3% in 2010,[2] many of the urban poor live in substandard housing conditions with poor infrastructure, often in disaster-prone areas.

2. *Pourashavas* (municipalities) are struggling to provide their citizens with key services including drinking water supply and sanitation, roads, solid waste management, drainage systems, and other municipal services such as kitchen markets, street lights, and bus terminals. Although coverage of drinking water supply reached 86% in urban areas in 2012 (85% for the whole country), access to piped water supply in household premises is provided to only 32% of the urban population, requiring significant improvement in service levels.[3] Only 55% of the urban population had access to improved sanitation facilities in 2012 (57% for the whole country), which is lower than the average in South Asia. Solid waste management is not systematic, and waste is often dumped in open areas, creating public health risks. Drainage is underdeveloped and poorly maintained, resulting in frequent waterlogging. Although improvements have been made through earlier projects, most *pourashavas* still need significant investment support to improve municipal service delivery.

3. The urban infrastructure improvement will be implemented in three phases under the project. The investment will cover road, drainage, water supply and sanitation, solid waste management, and other municipal service facilities such as kitchen markets, a bus and truck terminal, community halls, and street lighting.

B. Methodology

4. Economic analyses were carried out for subprojects in three sample *pourashavas* (Lalmonirhat, Magura, and Naogaon). The analyses were undertaken in accordance with the Asian Development Bank (ADB) *Guidelines for the Economic Analysis of Projects,*[4] *Guidelines for the Economic Analysis of Water Supply Projects,*[5] and *Framework for the Economic and Financial Appraisal of Urban Development Sector Projects.*[6] The subprojects analyzed involve road, drainage, water supply, and solid-waste management. Except for water supply, the subprojects analyzed will be implemented in the first phase of the project.

5. Alternative technically viable solutions that comply with environmental rules were assessed, in consultation with the *pourashavas* and other stakeholders, to ensure that a cost-effective option within the financing capacity of the *pourashavas* is proposed.

6. Benefits and costs were arrived at through comparison of the with- and without-project conditions. Benefits and costs were estimated over each subproject's estimated economic life at constant 2013 prices. All costs were valued using the domestic price numeraire. Economic

[1] Bangladesh Bureau of Statistics. 2012. *Population and Housing Census.* Dhaka.
[2] Bangladesh Bureau of Statistics. 2011. *Household Income and Expenditure Survey 2010*. Dhaka.
[3] World Health Organization and United Nations Children's Fund. 2014. *Progress on Drinking Water and Sanitation: 2014 Update*. New York.
[4] ADB. 2007. *Guidelines for the Economic Analysis of Projects*. Manila.
[5] ADB. 1998. *Guidelines for the Economic Analysis of Water Supply Projects*. Manila.
[6] ADB. 1994. *Framework for the Economic and Financial Appraisal of Urban Development Sector Projects.* Manila.

costs were derived from the technical team's financial estimates of capital and operation and maintenance (O&M) costs and adjusted for transfer payments and any other market distortions. Taxes and duties were excluded because they represent transfer payments. Traded goods, net of taxes and duties, were adjusted by the shadow exchange rate factor of 1.07 while a factor of 1.0 was applied for nontraded goods and skilled labor. A shadow wage rate factor of 0.94 was used for unskilled labor. These parameters are consistent with those used in recently approved ADB-financed projects in Bangladesh. The economic opportunity cost of capital of 12% was assumed for the analysis.

C. Economic Benefits

7. **Roads**. The road subprojects will involve improvement and/or construction of roads, culverts, roadside protection walls, footpaths, and related road structures. The subprojects will result in better road conditions, smoother road surfaces, and faster travel for all types of vehicles.

8. The economic benefits of the road subprojects were quantified in terms of reduction in vehicle operating costs (VOC) and savings in travel time costs (TTC). VOC[7] refers to the costs of operating a vehicle such as fuel, spare parts, depreciation, and crew costs. TTC[8] is the value of time spent on travelling that could be used in other economic activities. The VOC and TTC for each vehicle type were based on the most recent study[9] involving road user cost. The VOC and TTC calculated in the study were adjusted to 2013 prices in the analyses.

9. Traffic counts to determine the without-project situation of a selected road[10] were conducted twice, once on a market day and once on a nonmarket day, from 6 am to 10 pm. All types of traffic, motorized and nonmotorized, passing through a selected neutral point at the middle of the total length of the selected road were counted.

10. Savings in VOC and TTC would accrue from improvement in the road conditions' roughness measured by international rough index. The benefits are assumed to increase at the rate corresponding to the traffic growth rate of 6% annually. The benefits are estimated to be one-third of the total benefits in the first year, two-thirds in the second year, and full benefits from the third year onwards. During the construction period, an increase in VOC and TTC due to disruptions is assumed in the analysis at 10% of preproject VOC and TTC. Table 1 summarizes the economic benefits of the selected roads analyzed.

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[7] According to the Local Government Engineering Department (LGED) vehicle category, vehicular traffic includes trucks, buses, utility vehicles, cars, auto rickshaws, motorcycles, cycle rickshaws, and animal carts.

[8] TTC varies between different vehicle types according to the socio-economic characteristics of the occupants and their trip purpose. TTCs are expressed as hourly values per vehicle with assumed average occupancies for each vehicle type. The economic wage rates of vehicle occupants are assessed and their average rates are estimated to reflect the value of time of occupants in different vehicles. An assessment of the number of travellers in work time and nonwork time is made for each vehicle type. Nonwork time is valued at 35% in the analysis.

[9] LGED. 2009. *Road User Cost Study for LGED Roads, Final Report*. The study was undertaken in various regions in the country for sample roads to estimate a common national set of VOC and TTC according to vehicle types along LGED roads.

[10] Out of the 30 road subprojects to be implemented in the first phase from the three sample *pourashavas*, three out of nine roads in Naogaon, four out of seven roads in Lalmonirhat, and four out 14 roads in Magura were selected for economic analysis. The selection was based on systematic random sampling which was submitted to ADB and subsequently approved.

Table 1: Economic Benefits in Selected Roads

Pourashava / Subproject	Pre-Project AADT	Savings in VOC (Tk/km/day) Normal[11]	Generated[12]	Total	Savings in TTC (Tk/km/day) Normal[13]	Generated[14]	Total
Naogaon							
Road No. 2	602	1,051	476	**1,527**	393	228	**621**
Road No. 5	818	1,439	583	**2,022**	679	358	**1,037**
Road No. 17	709	1,259	510	**1,769**	435	234	**669**
Lalmonirhat							
Road No. 1	593	1,025	461	**1,486**	380	221	**601**
Road No. 4	617	1,085	488	**1,573**	428	234	**662**
Road No. 7	631	1,245	522	**1,768**	679	358	**1,037**
Road No. 9	590	1,002	445	**1,447**	372	214	**586**
Magura							
Road No. 2	593	1,025	461	**1,486**	380	221	**601**
Road No. 4	402	709	320	**1,029**	319	181	**500**
Road No. 6	452	736	343	**1,080**	294	223	**518**
Road No. 13	923	1,582	637	**2,219**	715	393	**1,108**

AADT = annual average daily traffic, km = kilometer, TTC = travel time cost, VOC = vehicle operating cost.
Source: ADB fact finding mission estimates, 2014.

11. **Drainage**. The drainage subprojects will improve the drainage system, reduce waterlogging and flooding, and improve the environment, living conditions, and public health in the subproject areas. The socio-economic surveys and discussions with *pourashava* officials and focus groups revealed that large parts of the subproject areas experience regular waterlogging and flooding during the monsoon season and this causes damage to properties and losses from disruption of economic activities.

12. The economic benefits of the drainage subprojects were quantified in terms of reduction of damages to properties due to flooding. Reduction of losses from disruption of economic activities due to flooding is not easily quantifiable and not accounted for in the analysis. In each drainage subproject,[15] the catchment area affected by flooding was identified and assessed in consultation with *pourashava* officials. The estimated reduction of damage to properties due to flooding were calculated separately for houses, roadside shops, establishments, and roads from the information provided by and in consultation with *pourashava* officials. Table 2 summarizes the estimated reduction of damages per hectare, in 2013 economic prices, of the selected drains analyzed.

13. **Water supply**. The proposed water supply subproject in Lalmonirhat involves the improvement of existing production tube wells and replacement of bulk water meters, installation of water level indicators in overhead tanks, improvement of the distribution network with replacement of distribution pipes, leak detection and repair of distribution system, installation of service connections and water meters,[16] establishment of a mini water quality testing laboratory,

[11] Preproject AADT multiplied by (preproject VOC minus post-project VOC). Preproject AADT is based on actual traffic count.
[12] 50% of (post-project AADT minus preproject AADT) multiplied by (preproject VOC minus post-project VOC). Post-project AADT is estimated by multiplying preproject AADT by LGED standard coefficient factor by vehicle type established in a 2009 study to calculate post-project AADT.
[13] Preproject AADT multiplied by (preproject travel time minus post-project travel time) multiplied by TTC.
[14] 50% of (post-project AADT minus preproject AADT) multiplied by (preproject travel time minus post-project travel time) multiplied by TTC.
[15] Out of the 13 drainage subprojects to be implemented in the first phase from the three sample *pourashavas*, two out of two drains in Naogaon, two out of three drains in Lalmonirhat, and three out of eight drains in Magura were selected for economic analysis. The selection was based on systematic random sampling which was submitted to ADB and subsequently approved.
[16] Presently, there is no metering in water production and distribution. Water is billed based on the diameter size of distribution connection pipe. A water metering system will be introduced under the project.

provision of tools and equipment, and other improvement works to provide better quality of water and service to customers.

14. The results of the willingness to pay (WTP) survey were used as a proxy in quantifying the economic benefits (i.e., health benefits, resource savings from fetching water from nonpiped sources, and consumer satisfaction) from the proposed subproject. Benefits from new customers were quantified based on the average WTP amount of Tk133 per month by households not currently connected to the piped water supply system. Benefits from existing customers (about 26% of total households in the subproject area based on the survey results) were quantified based on their average WTP amount of Tk159 per month for an improved water supply system. The benefits were projected based on the assumption that 90% of the population in the subproject area will be served by the subproject by 2030.

15. **Solid waste management**. The proposed solid waste management subproject in Magura involves the provision of 2,000 bins, six rickshaw vans, two trailers with one tractor, one dump truck, and construction of sanitary landfill with site embankment, liner facility, leachate collection and treatment facility, composting and medical waste collection, and treatment facility. The subproject will bring about quality improvements in public health and the environment. Benefits will accrue to the community as a whole, both poor and rich, and not only to the direct beneficiaries of the waste collection services as the interventions are a public good.

16. The results of the WTP survey revealed that households are willing to pay an average of Tk20 per month for solid waste management service. The very low amount that households are willing to pay could be due to the fact that the existing service is being provided free of charge. The economic benefits from the improved solid waste management system were instead conservatively quantified in terms of productivity gains estimated at Tk2.187 million per year[17] and avoided medical costs estimated at Tk8.87 million per year.[18]

Table 2: Economic Benefits in Selected Drains

***Pourashava* / Subproject**	**Length of Drain** (km)	**Catchment Area** (ha)	**Reduction in Damages / Ha** (Tk million)	**Total Annual Benefits** (Tk million)
Naogaon				
Drain No. 1	1.800	200	0.056	**11.198**
Drain No. 3	0.600	100	0.029	**2.862**
Lalmonirhat				
Drain No. 3	1.500	200	0.011	**2.240**
Drain No. 4	0.500	100	0.010	**1.046**
Magura				
Drain No. 1	1.239	150	0.014	**2.100**
Drain No. 3	0.400	100	0.008	**0.811**
Drain No. 8	0.324	90	0.009	**0.823**

ha = hectare, km = kilometer.
Source: ADB fact finding mission estimates, 2014.

[17] Based on survey results, an average of 0.6 days/month/household is lost because of sickness. It is assumed that 15% of lost days are due to poor solid-waste management service. Productivity gain, valued at the unskilled labor economic rate of Tk300/day, is assumed to benefit 30% of 22,500 households in subproject areas.

[18] Based on survey results, the average medical cost due to sickness is Tk730/month/household. Avoided medical costs due to poor solid-waste management service, valued at 15% of the average medical cost, is assumed to benefit 30% of 22,500 households in subproject areas.

D. Results of Economic Analysis

17. The results of the analysis,[19] summarized in Table 3, show that the proposed subprojects are economically viable. Their base economic internal rates of return range from 12.03% to 27.86%, above their assumed economic opportunity cost of capital of 12.00%. The sensitivity analysis indicates that the proposed subprojects are most sensitive generally to a reduction in benefits.[20] These results, however, are most likely underestimated, since the subprojects have benefits that are not easily quantifiable and not accounted for in the analysis.[21]

Table 3: Economic Internal Rate of Return and Sensitivity Analysis

	Base Case		EIRR Sensitivity			Switching Values		
***Pourashava* / Subproject**	**NPV** (Tk million)	**EIRR** (%)	**+ 10% Costs** (%)	**–10% Benefits** (%)	**Both** (%)	**Increase in Costs** (%)	**Decrease in Benefits** (%)	**Both** (%)
Lalmonirhat								
Road No. 1	2.47	15.56	14.06	13.90	12.47	23.72	21.50	11.51
Road No. 4	6.31	18.48	16.82	16.65	15.08	39.19	35.53	19.05
Road No. 7	3.94	16.42	14.82	14.66	13.15	27.63	25.07	13.52
Road No. 9	4.27	17.00	15.41	15.24	13.72	31.38	28.45	15.24
Drain No. 3	16.10	16.99	15.27	15.09	13.43	28.98	26.23	14.03
Drain No. 4	7.62	19.15	17.25	16.74	15.30	37.69	29.66	18.55
Water Supply	45.25	26.33	22.69	23.02	19.69	39.32	43.26	21.59
Magura								
Road No. 2	0.57	12.83	11.48	11.34	10.04	6.13	5.56	2.97
Road No. 4	2.75	15.88	14.24	14.07	12.50	23.71	21.49	11.50
Road No. 6	0.84	16.67	15.01	14.84	13.24	28.06	25.43	13.61
Road No. 13	3.50	20.30	18.54	18.36	16.69	47.23	42.82	22.96
Drain No. 1	15.36	16.22	14.52	14.35	12.77	24.87	22.57	12.22
Drain No. 3	5.96	23.05	20.90	20.69	18.70	51.56	46.81	25.43
Drain No. 8	6.05	22.00	19.92	19.71	17.49	48.26	43.81	22.20
Solid Waste	1.58	18.41	16.50	16.31	14.49	33.59	30.46	16.35
Naogaon								
Road No. 2	0.01	12.03	10.72	10.58	7.81	0.22	0.20	0.07
Road No. 5	5.73	18.39	16.82	16.66	13.41	40.74	36.94	12.82
Road No. 17	2.18	23.96	21.99	21.79	19.92	60.71	55.06	29.61
Drain No. 1	81.92	27.86	25.36	25.10	22.80	63.41	57.58	31.34
Drain No. 3	20.63	16.02	14.31	14.14	12.54	23.53	21.36	11.56

EIRR = economic internal rate of return, NPV = net present value discounted at 12%.
Source: ADB fact finding mission estimates, 2014.

E. Subprojects Economic Sustainability

18. Unless the *pourashavas* are financially healthy enough to sustain the subprojects' O&M, the economic benefits assumed in the analysis would not materialize. The results of the projected financial performance of the *pourashavas* show that the *pourashavas* are projected to have operating surpluses in each year over the forecast period when the subprojects' facilities become operational. The economic sustainability of the subprojects would require, however, that *pourashavas'* income sources continually grow and improve to keep pace with the rising operating costs due to inflation.

[19] The analysis includes resettlement costs, in economic prices, which include business losses due to construction activity, calculated based on the actual income of the identified affected vendors multiplied by the maximum length of business disruption.

[20] At detailed design stage, subprojects will be reviewed and measures will be put in place for cost minimization and control and maximization of benefits.

[21] Excluded in the analysis are reduced accident costs and pedestrian time savings for road subprojects, reduced losses from disruption of economic activities due to flooding for drainage subprojects, and reduced environmental degradation for the solid-waste management subproject.