

ECONOMIC ANALYSIS

A. Introduction

1. The proposed project will support the Government of Nepal in expanding access to community-managed water supply and sanitation (WSS) in 20 project municipalities through about 22 subprojects, and in strengthening institutional and community capacity, sustainable service delivery, and project development. Under the sector loan modality, the economic analysis was carried out for three sample water supply subprojects in Charikot, Pragatinagar, and Subhaghat for which detailed engineering designs had been completed. The economic analysis of the remaining subprojects will be conducted during the implementation based on the approach used for the sample subprojects.

B. Rationale

2. **Rationale for the government intervention.** The rationale for government involvement is sound because the project focuses on basic urban WSS services where (i) there is a natural monopoly as the responsibility only belongs to the public sector and (ii) the services provided are public goods managed by the government. Insufficient tariff levels to cover the full costs and large upfront investment costs could not attract private sector investment to water supply and sanitation projects, and this also justifies the government's involvement in the project.

3. **Government capacity and associated policy.** The government has implemented various projects financed by the Asian Development Bank (ADB) and other external agencies in the areas of tourism, highways, irrigation, power, and urban development.¹ The existing project management office (PMO) for the ongoing Third Small Towns Water Supply and Sanitation Sector Project² will also implement the proposed project, which underlines the capacity of the government to manage the project. Major urban development policies of the government are the (i) Water Resources Act, 1992;³ (ii) National Urban Water Supply and Sanitation Sector Policy, 2009;⁴ and (iii) Water, Sanitation and Hygiene Sector Status Report, 2016.⁵

C. Demand Analysis

4. The current water supply in the three project municipalities where the sample subprojects are planned is found to be inadequate. The current water consumption in those municipalities is estimated at 40.9 litres per capita per day (lpcd) in Charikot, at 70.0 lpcd in Pragatinagar, and at 49 lpcd in Subhaghat, less than the recommended minimum of 100 lpcd.⁶ Also, the current water supply in those municipalities is estimated at only at 24.2 lpcd in Charikot, 9.5 lpcd in Pragatinagar, and 1.3 lpcd in Subhaghat. For the additional water, most households have depended on costly and unhealthy other sources such as bore wells, springs, and bottled water (Table 1). Once the operation of the project starts, an average of 100 lpcd will be supplied to those

¹ ADB has provided assistance to Nepal totaling \$5.23 billion since 1966. Major projects funded by ADB are: (i) Subregional Transport Facilitation, (ii) Power Transmission and Distribution Efficiency Enhancement Project, (iii) Rural Connectivity Improvement Project, (iv) Small Towns Water Supply and Sanitation Sector Project, (v) Second Small Towns Water Supply and Sanitation Sector Project, and (vi) Third Small Towns Water Supply and Sanitation Sector Project. Major projects funded by the World Bank are: (i) Nepal Fiscal Reforms, (ii) Road Sector Development Project, and (iii) Nepal-India Electricity Transmission and Trade Project.

² ADB. [Nepal: Third Small Towns Water Supply and Sanitation Sector Project](#).

³ The act provides state ownership over water resources and governs national water resources.

⁴ The policy outlines the delivery of safe, reliable, and enhanced WSS services at affordable prices.

⁵ The report provides inputs to annual and medium-term planning processes in the WSS subsectors in Nepal.

⁶ Government of Nepal. 2017. *National Urban Development Strategy 2017*. Kathmandu.

project municipalities. Willingness to make use of the household connections for water supply was found to be strong—97% in Charikot, 100% in Praghathinagar, and 89% in Subhaghat.⁷ All the above underlines the demand for the water supply subprojects proposed under the project.

Table 1: Demand and Beneficiaries of Sample Subprojects

Municipality	2018 (base year)				2024 (start of operations)	
	Population	Water consumption (lpcd)			Population	Water consumption and water supply (lpcd)
		Total	Water supply	Other sources		
Charikot	22,755	40.9	24.2	16.7	25,852	100
Pragathinagar	12,735	70.0	9.5	60.5	17,794	100
Subhaghat	16,672	49.0	1.3	47.7	20,539	100

lpcd = liter per capita per day

Source: Asian Development Bank estimates.

D. Alternative Analysis

5. The sample subprojects were carefully prepared for cost effectiveness, operation and maintenance (O&M) capacity, and safety to beneficiaries after comparing them with alternative solutions in the detailed project report. The alternative analysis considered (i) gravity-based zoning and (ii) selection of pipe material to withstand the terrain issues. Based on the comparison study, the sample subprojects were found to be the most economical option for meeting demand in terms of materials, technology, and timing.

E. Sustainability Analysis

6. The financial sustainability of sample subprojects is an identified risk since the required revenue collection and periodic rate revisions may be delayed. The PMO will provide capacity building and hand-holding assistance and support the water users' and sanitation committees in tariff setting, revenue mobilization, awareness campaigns, and consultations to mitigate this risk.

F. Cost-benefit Analysis

7. The economic analysis assessed the economic viability of three sample water supply subprojects by their economic internal rate of return and their economic net present value in accordance with ADB guidelines—Economic Analysis of Water Supply Projects (1998) and the Guidelines for the Economic Analysis of the Projects (2017).⁸

8. **Economic costs.** The assumptions for the economic cost estimates are:

- (i) All costs are in 2018 constant prices and converted at \$1 = NRs103.0.
- (ii) All costs, including capital works and O&M, were valued using the domestic price numeraire; tradable inputs and unskilled labor costs were further adjusted by the shadow exchange rate factor of 1.08 (Table 2) and the shadow wage rate factor of 0.95.⁹

⁷ Government of Nepal, Department of Water Supply and Sewerage. 2016. *Final Socio-Economic Profile for Sample Project Towns*. Kathmandu

⁸ ADB. 1998. *Economic Analysis of Water Supply Projects*. Manila; and ADB. 2017. *Guidelines for the Economic Analysis of the Projects*. Manila.

⁹ The shadow wage rate factor of 0.95 was estimated by dividing \$2.6 per day (official minimum wage in Nepal for 2018) by \$2.7 per day (unskilled labor cost, using the practiced labor wage rate paid by contractors to unskilled laborers in sample municipalities).

- (iii) Economic costs of capital works and O&M were calculated from the financial cost estimates, excluding price contingencies, financial charges, and taxes and duties, but including physical contingencies (Table 3).
- (iv) The projections covered the period from 2018 to 2043, including 6 years of implementation, and assets created were assumed to have a 20-year lifespan.
- (v) The economic opportunity cost of capital is assumed at 9% in real terms.

Table 2: Standard Exchange Rate Factor

Item	2012	2013	2014	2015	Average
Exports: Government of Nepal (NRs10 millions)	7,012	8,532	9,199	7,692	8,109
Imports: Government of Nepal (NRs10 millions)	77,360	77,468	71,437	55,674	70,485
Customs duties: Government of Nepal (NRs10 millions)	7,782	7,053	6,413	5,433	6,670
Standard conversion factor	0.916	0.924	0.926	0.921	0.922
Standard exchange rate factor	1.09	1.08	1.08	1.09	1.08

Source: Government of Nepal, Ministry of Finance. 2017. *Economic Survey: Fiscal Year 2016-2017*. Kathmandu.

9. By excluding the financial charges, price contingencies, and taxes and duties, investment costs and physical contingencies were considered to estimate the economic costs. The foreign costs were separated and converted to economic costs using the shadow exchange rate factor of 1.08. In case of local costs, the component of unskilled labor (30%) was further segregated and converted to economic costs using the shadow wage rate factor of 0.95. By adding all the economic costs by component estimated separately (foreign cost, unskilled labor cost, and the remaining local cost), the economic costs are derived for each subproject, translating into 80.7% of the financial project costs (Table 3).

Table 3: Details of Project Costs for Sample Subprojects
(\$ million)

Sample Municipalities	Capital Costs		Operation and Maintenance Costs ^a		Implementation	Operation
	Project Costs	Economic Cost	Project Costs ^b	Economic Cost ^b		
Charikot	11.7	9.5	3.7	3.0	2018–2023	2024–2043
Pragatinagar	6.7	5.4	2.1	1.7		
Subhaghat	9.1	7.3	2.9	2.3		
Total	27.5	22.2	8.7	7.0		

^a An annual increase in operation and maintenance costs of 1% was considered for additional connections and equipment replacement.

^b Excludes taxes and duties, price contingencies, and financing charges.

Source: Asian Development Bank estimates.

10. **Economic benefits.** The average water consumption in three project municipalities is estimated at 40.9 lpcd in Charikot, 70.0 lpcd in Pragatinagar, and 49 lpcd in Subhaghat. The current water supply in those municipalities is 24.2 lpcd in Charikot, 9.5 lpcd in Pragatinagar, and 1.3 lpcd in Subhaghat. The project targets an increase of water supply to 100 lpcd by establishing the district metered area-based network with metered household connections. The beneficiaries in the three project municipalities are estimated to total 64,185 individuals in 2024. Savings in other resources, water collection time, and earnings loss during sick days related to the difference between existing water supply and consumption are considered as “non-incremental” benefits. In addition, water supply beyond the current consumption up to the proposed supply of 100 lpcd is treated as “incremental” benefits.

Table 4: Economic Benefits of the Water Supply Component
(\$ million)

Category	Unit Rate	Total Economic Net Present Value		
		Charikot	Pragatinagar	Subhaghat
A. Non-Incremental Benefits				

Category	Unit Rate	Total Economic Net Present Value		
		Charikot	Pragatinagar	Subhaghat
a. Savings in other resources ^a	\$153.6/HH/yr	4.6	4.1	4.3
b. Savings in water collection time ^b	\$131.7/HH/yr	4.0	3.5	3.7
c. Savings in earnings loss during sick days ^c	\$27.0/HH/yr	0.8	0.7	0.7
B. Incremental Benefits				
a. Unit rate based on the willingness to pay	\$0.3/kl ^d	1.0	0.4	0.7

HH = household, kl = kiloliter, yr = year.

^a Average water consumption from bottled water amounts to 9.8 kl of annual water consumption at NRs1,200.0/kl; 66.6 kl of annual water consumption comes from other sources such as dug well, bore well, and hand pump at NRs60.7/kl. The unit rate of annual savings in resource costs thanks to water supply were estimated at NRs15,822.4/HH/yr (\$153.6/HH/yr). Given the unit rate and the expected number of total beneficiary households, the total economic net present value of savings in other resources was estimated at \$4.6 million in Charikot, \$4.1 million in Pragatinagar, and \$4.3 million in Subhaghat.

^b Households spend an average of 2.4 hours per day on water collection, and 1.9 hours per day are estimated to be saved. The unit rate of annual savings in water collection time is estimated at NRs13,562.2/HH/yr (\$131.7/HH/yr), based on the time value of NRs19.1 for unskilled labor during nonworking hours. Given the unit rate and the expected number of total beneficiary households, the total economic net present value (ENPV) of savings in other resources was estimated at \$4.0 million in Charikot, \$3.5 million in Pragatinagar, and \$3.7 million in Subhaghat.

^c With an average daily income per household of NRs1,233.9 (NRs535.6 for the 7% of poor households and NRs1,286.5 for the 93% of non-poor households) and average 9 working days lost in a year, the average annual earnings loss because of water-borne diseases for a household's earning member was estimated at the unit rate of NRs11,105.2/HH/yr. Of the savings in earnings loss, 25% was assigned to water supply (NRs2,776.3/HH/yr or \$27.0/HH/yr). Given the unit rate and expected number of total beneficiary households, the total ENPV of savings in earnings loss during sick days was estimated at \$0.8 million in Charikot, \$0.7 million in Pragatinagar, and \$0.7 million in Subhaghat.

^d Given the unit rate of willingness to pay (NRs28.1/kl or \$0.3/kl) surveyed in 2015 and incremental water supply (difference between the current consumption and the targeted water supply of 100 lpcd), the total ENPV of project municipalities was estimated at 1.0 million in Charikot, 0.4 million in Pragatinagar, and 0.7 million in Subhaghat.

Sources: Department of Water Supply and Sewerage. 2015. *Detailed project reports*. Kathmandu; World Bank. 2009. *Water, Sanitation, and Hygiene Interventions to Combat Childhood Diarrhoea in Developing Countries*. Washington, DC; Department of Water Supply and Sewerage. 2015. *Baseline socio-economic survey reports for sample towns*. Kathmandu.

11. **Results of cost–benefit analysis.** The results of the cost–benefit analysis show all three sample WSS subprojects to be economically viable with economic internal rates of return (12.3%–16.4%) that are higher than the economic opportunity cost of capital, estimated at 9.0% (Table 5). The project's economic viability increases if unquantifiable benefits such as environmental improvements are included in the analysis.

G. Sensitivity Analysis

12. A sensitivity analysis of three sample WSS subprojects was also conducted to assess the effect of adverse changes in key variables, such as (i) a capital cost overrun of 20%, (ii) an overrun in operation and management costs of 20%, (iii) a decline in estimated benefits of 20%, (iv) a 1-year delay of implementation, and (v) all of the above downside risks combined. The sensitivity analysis revealed that the results are satisfactory, except under the scenario of all downside risks combined for one sample subproject (Table 5).

Table 5: Economic Internal Rate of Return and Sensitivity Analysis
(\$ million)

Scenario	Charikot			Pragatinagar			Subhaghat		
	EIRR (%)	ENPV	Switching Value	EIRR (%)	ENPV	Switching Value	EIRR (%)	ENPV	Switching Value
Base case	12.3	2.6		16.4	4.3		14.0	3.4	
Construction cost (+20%)	10.3	1.2	36.9%	14.4	3.5	107.9%	12.0	2.3	61.9%
O&M cost (+20%)	12.1	2.4	322.8%	16.2	4.2	944.1%	13.8	3.2	541.8%

Scenario	Charikot			Pragatinagar			Subhaghat		
	EIRR (%)	ENPV	Switching Value	EIRR (%)	ENPV	Switching Value	EIRR (%)	ENPV	Switching Value
Benefit (-20%)	9.7	0.5	24.9%	13.8	2.5	49.2%	11.4	1.5	35.7%
1-year delay of operation	12.1	2.1		16.2	3.6		13.8	2.8	
All combined	7.4	(1.1)		11.5	1.3		9.1	0.1	

() = negative, EIRR = economic internal rate of return, ENPV = economic net present value.

Source: Asian Development Bank estimates.

Table 6: Costs and Benefits Streams – Combined for Three Sample Subprojects
(\$ million)

Year	Charikot			Pragatinagar			Subhaghat		
	Costs	Benefits	Net Benefits	Costs	Benefits	Net Benefits	Costs	Benefits	Net Benefits
2018	0.35	-	(0.35)	0.20	-	(0.20)	0.27	-	(0.27)
2019	2.25	-	(2.25)	1.28	-	(1.28)	1.74	-	(1.74)
2020	2.34	-	(2.34)	1.33	-	(1.33)	1.81	-	(1.81)
2021	1.93	-	(1.93)	1.09	-	(1.09)	1.49	-	(1.49)
2022	1.11	-	(1.11)	0.63	-	(0.63)	0.85	-	(0.85)
2023	1.50	-	(1.50)	0.85	-	(0.85)	1.16	-	(1.16)
2024	0.14	1.65	1.50	0.08	1.05	0.97	0.11	1.34	1.23
2025	0.14	1.68	1.54	0.08	1.11	1.03	0.11	1.39	1.28
2026	0.14	1.72	1.57	0.08	1.17	1.09	0.11	1.44	1.32
2027	0.14	1.75	1.61	0.08	1.24	1.16	0.11	1.49	1.37
2028	0.14	1.79	1.64	0.08	1.31	1.23	0.11	1.54	1.43
2029	0.15	1.83	1.68	0.08	1.38	1.30	0.11	1.59	1.48
2030	0.15	1.87	1.72	0.08	1.46	1.38	0.11	1.65	1.54
2031	0.15	1.90	1.76	0.08	1.55	1.46	0.11	1.71	1.59
2032	0.15	1.94	1.80	0.08	1.64	1.55	0.11	1.77	1.65
2033	0.15	1.99	1.84	0.08	1.73	1.65	0.11	1.83	1.72
2034	0.15	2.03	1.88	0.08	1.83	1.74	0.12	1.90	1.78
2035	0.15	2.07	1.92	0.09	1.93	1.85	0.12	1.96	1.85
2036	0.15	2.11	1.96	0.09	2.05	1.96	0.12	2.03	1.92
2037	0.15	2.16	2.01	0.09	2.16	2.08	0.12	2.10	1.99
2038	0.15	2.20	2.05	0.09	2.29	2.20	0.12	2.18	2.06
2039	0.15	2.25	2.10	0.09	2.42	2.33	0.12	2.26	2.14
2040	0.15	2.30	2.14	0.09	2.56	2.47	0.12	2.34	2.22
2041	0.15	2.35	2.19	0.09	2.70	2.62	0.12	2.42	2.30
2042	0.16	2.40	2.24	0.09	2.86	2.77	0.12	2.50	2.38
2043	0.16	2.45	2.29	0.09	3.02	2.93	0.12	2.59	2.47
Total	12.46	40.44	27.98	7.07	7.46	30.39	9.63	38.01	28.38
ENPV	7.80	10.39	2.58	4.43	8.72	4.29	6.03	9.39	3.35
EIRR			12.3%			16.4%			14.0%

EIRR = economic internal rate of return, ENPV = economic net present value.

Source: Asian Development Bank estimates.

H. Distribution Analysis

13. The proportion of project net benefits accruing to the poor was calculated. To distribute net economic benefits, stakeholders were grouped into households, unskilled labor, municipalities, and the government. A town-wise poverty level was used to estimate the share of households' and municipalities' net benefit to the poor; country-level poverty was used to estimate the government's share of net benefit to the poor; and 100% of unskilled labor benefit was assigned to the poor. The analysis shows that the poverty impact ratio is 15.5% for Charikot, 3.4% for Pragatinagar, and 7.0% for Subhaghat. Considering the present share of the urban population living below the poverty line—11.4% in Charikot, 1.8% in Pragatinagar, and 5.1% in Subhaghat¹⁰—the project is expected to benefit the poor considerably.

¹⁰ Department of Water Supply and Sewerage. 2016. *Final Socio-Economic Profile for Sample Project Towns*. Kathmandu.