ECONOMIC ANALYSIS

A. Introduction

1. The World Development Indicators show that the urbanization rate of Bhutan increased from 25.4% in 2000 to 38.4% in 2017.[1] The government's support has been traditionally directed towards the larger towns of Thimphu and Phuentsholing causing unbalanced urbanization. To address this concern the Government of Bhutan has requested financing from the Asian Development Bank (ADB) for the proposed Secondary Towns Urban Development Project to support urban infrastructure development in three secondary towns.[2] The project aims to improve the quality, reliability, and sustainability of urban infrastructure in three secondary towns of Bhutan, with the following outputs: (i) urban infrastructure expanded and/or upgraded, and (ii) capacity of institutions and local communities strengthened. The project will focus on developing urban basic infrastructure, including (i) water supply in all three towns, (ii) sewerage in Samdrup Jongkhar, and (iii) urban drainage and road development in Sarpang.

B. Project Rationale

2. The rationale for government involvement is sound as the proposed project focuses mainly on basic urban services (water supply, sewerage, and urban roads and drainage) where there is natural monopoly in the sector(s) and the services provided are public goods managed by the government. The major urban infrastructure development policies of the government include Bhutan 2020: A Vision for Peace, Prosperity and Happiness (1999);[3] Bhutan Water Policy;[4] Municipal Finance Policy (2012);[5] and Thromde Rules (2011).[6] The government has implemented various infrastructure projects financed by ADB and other external agencies.[7] In addition, the government has already created the project management unit and three project implementation units to implement the project, underlining the capacity of the government to manage the project.

3. **Demand analysis**. The average water supply in the project towns varies only between 45 liters per capita per day (lpcd) and 122 lpcd, less than the recommended minimum required 135 lpcd.[8] There is no sewerage system in Samdrup Jongkhar. In Sarpang, the flash flood that occurred in 2016 washed out most of the infrastructure, including drainage facilities.

4. **Least-cost analysis.** The subprojects proposed have considered cost-effectiveness by comparing various technical alternatives in the detailed designs. The least-cost analysis has considered gravity-based zoning, selection of pipe material to withstand the terrain issues, and wastewater collection methodology. Based on the comparison study, the subprojects were found to be the most economical option for meeting demand in terms of scale, technology, and timing.

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1 World Bank. World Development Indicators (accessed 29 November 2017).
2 Although there is no official definition of secondary towns in Bhutan, these can be considered as a group of around 30 towns (excluding Thimphu and Phuentsholing) with populations of around 4,000 or more. Samdrup Jongkhar and Sarpang are identified as growth centers in the south, while Trashigang is the largest town in the east.
3 Government of Bhutan. Planning Commission. 1999. *Bhutan 2020: A Vision for Peace, Prosperity and Happiness.* Thimphu.
4 Government of Bhutan. National Environment Commission. 2007. *Bhutan Water Policy.* Thimphu.
5 Government of Bhutan. Ministry of Works and Human Settlement. 2012. *Thromde Finance Policy.* Thimphu.
6 Government of Bhutan. Ministry of Works and Human Settlement. 2011. *Thromde Rules.* Thimphu.
7 For urban sector projects, refer to Development Coordination (accessible from the list of linked documents in Appendix 2 of the report and recommendation of the President).
8 Minimum water supply requirement recommended for urban areas in Bhutan by the Ministry of Works and Human Settlements.

5. **Affordability analysis.** As of 2017, households in the project towns spend about 0.1%–0.3% of their income on water supply and sewerage, and this is estimated to change to 0.1%–0.4% in 2024 (Table 1). Thus, the estimated average household expenditure for water supply and sewerage was found to be less than the accepted level of 5% of the total household income in all income categories of the project towns, and this underlines the affordability for the beneficiaries.[9]

Table 1: Water and Sewerage Charges and Usage, and Average Household Income
(Nu per month)

Item	Existing (2017)			Proposed (2024)[a]		
	Sarpang[e]	Samdrup Jongkhar	Trashigang	Sarpang	Samdrup Jongkhar	Trashigang
Water bill (per household)[b]		17.9	20.6	32.3	31.1	30.2
Sewerage bill (per household)[c]		5.4	6.2	9.7	9.3	9.1
Total		**23.3**	**26.8**	**42.0**	**40.4**	**39.3**
Household income - slum[d]	8,333.0	8,333.0	8,333.0	11,726.0	11,726.0	11,726.0
% of all bills		**0.3**	**0.3**	**0.4**	**0.3**	**0.3**
Household income - nonslum[d]	15,367.0	44,118.0	31,076.0	21,622.0	62,078.0	43,727.0
% of all bills		**0.1**	**0.1**	**0.2**	**0.1**	**0.1**

[a] 2024 is the operation start year for the project.
[b] Annual growth rate of 5% for household income is assumed from 2017. A 20% tariff increase every 5 years is based on discussions with officials from project towns and past tariff increase of Thimphu.
[c] Sewerage charge is 30% of the monthly water bill.
[d] Adopted from the poverty and social assessment report under ADB. Kingdom of Bhutan: Improved Urban Environmental Infrastructure Project – updated to 2017 using 5% annual growth rate. For slum households, Nu0.1 million was considered as annual household income in 2017.
[e] There is no tariff in Sarpang at present, it is planned to be introduced in 2018.
Source: Government of Bhutan, Ministry of Works and Human Settlements. 2008. *Bhutan National Urban Strategy*. Thimphu.

6. **Financial sustainability.** The financial sustainability of the project towns is an identified risk, as the required revenue collection and rate revisions may be delayed. The project will provide capacity building assistance and support for revenue mobilization, awareness campaigns, and/or consultations to mitigate this risk. The existing practice of cross-subsidies among user groups and subprojects will also help mitigate risks related to financial sustainability.

C. Economic Analysis of Subprojects

7. The economic analysis assessed the economic viability of all the subprojects in terms of economic internal rate of return and economic net present value in accordance with ADB guidelines, including the Economic Analysis of Water Supply Projects and the Guidelines for the Economic Analysis of Projects.[10]

8. **Economic costs.** The assumptions for the economic costs estimates are as follows:
   (i) All costs are based on 2018 constant prices and converted at $1 = Nu65;
   (ii) Economic costs of capital works and O&M are calculated from the financial cost estimates. Price contingencies, financial charges, and taxes and duties are excluded but physical contingencies are included (Table 2);

[9] World Health Organization benchmark of expenditure at 5% of monthly household income. Water and Sanitation Program. 2011. *Cost Recovery in Urban Water Services: Select Experiences in Indian Cities*. New Delhi.
[10] ADB. 1998. *Economic Analysis of Water Supply Projects.* Manila; and ADB. 2017. *Guidelines for the Economic Analysis of Projects.* Manila.

(iii) All costs are valued using the domestic price numeraire. Tradable inputs are adjusted by the shadow exchange rate factor of 1.005, and a shadow wage rate of 0.93 is used for unskilled labor;[11]
(iv) The projections covered 31 years including 6 years of construction (2018–2023) and assets created were assumed to have a 25 year life-span upon completion; and
(v) The economic opportunity cost of capital is assumed at 9% in real terms.

Table 2: Details of Project Costs
($ million)

		Capital Costs		O&M Costs			
Subprojects	**Project Towns**	**Project Costs**	**Economic Cost[a]**	**Project Costs**	**Economic Cost[a]**	**Implementation**	**Operation**
Water supply	Sarpang	3.7	3.3	2.1	1.8	2018–2023	2024–2048
	Samdrup Jongkhar	3.4	3.1	1.9	1.7		
	Trashigang	1.9	1.7	1.1	0.9		
Sewerage	Samdrup Jongkhar	1.4	1.2	0.8	0.7		
Drainage/road	Sarpang	1.6	1.4	0.9	0.8		
Total		**12.0**	**10.7**	**6.8**	**5.9**		

O&M = operation and maintenance; [a] Excludes taxes and duties, price contingencies, and financing charges.
Source: Asian Development Bank estimates.

D. Water Supply Subprojects in Sarpang, Samdrup Jongkhar, and Trashigang

9. Water supply subprojects in the project towns include the construction of a raw water main, transmission main, treatment plant, and distribution network, designed to provide 135 lpcd, benefiting 27,328 people in 2024.[12] The current average per capita piped water supply is 45 lpcd in Sarpang, 67 lpcd in Samdrup Jongkhar, and 80 lpcd in Trashigang; total water consumption is 100 lpcd, 109 lpcd, and 100 lpcd, respectively.[13] The difference between the existing supply and the present consumption is considered as non-incremental benefits, and the supply beyond the existing consumption up to the target (135 lpcd) is treated as incremental benefits (Table 3).

Table 3: Economic Benefits of Water Supply Subprojects
($ million)

		Benefits (Net Present Value)		
Category	**Unit Rate**	**Sarpang**	**Samdrup Jongkhar**	**Trashigang**
A. Nonincremental benefits				
1. Savings in replaced water from other sources	$2.0/kl[a]	2.4	2.5	0.6
2. Savings in water collection time	$33.3/day[b]	0.5	0.8	0.4
3. Savings in earning loss during sick days	$101.81/HH/yr[c]	1.6	2.5	1.1
B. Incremental benefits				
1. Average unit based on the willingness to pay	$0.4/kl[d]	0.3	0.4	0.1

HH = household, kl = kiloliter, yr = year.
[a] The average cost of replaced water is estimated at Nu127.3/kl ($2.0/kl). This is based on the following: 62.1% of consumed water from hand pumps at Nu125.8/kl, 31.0% of consumed water from dug wells at Nu111.2/kl, and 6.9% of consumed water from private vendors at Nu213.6/kl.
[b] With daily average time savings of 0.3 hours/household and average time value for unskilled labor during nonworking hours of $0.3/hour, annual time savings are $33.3/household. Source: Baseline survey 2015 and discussion with project town officials.
[c] At $27.2 of average daily household income x 15 sick days x 25% of income loss assigned to water supply = $101.81/household/year. Source: World Bank. 2015. *Water, Sanitation and Hygiene Interventions to Combat Childhood Diarrhea in Developing Countries*. New Delhi.

[11] (i) Government of Bhutan, Bhutan Ministry of Finance. 2016, Estimated using the data available at '*National Revenue Report 2014–2015 Th*imphu. (ii) The shadow wage factor (0.93) was estimated by dividing $3.08 per day (minimum wage in Bhutan) into $3.31 per day (based on wage rate paid by contractors to unskilled laborers).
[12] Existing population of three towns is 18,500. The Ministry of Works and Human Settlements is adopting 135 lpcd for urban water supply design works in Bhutan.
[13] Estimated from baseline assessment survey (2015) and the input from project preparatory technical assistance team.

[d] The willingness to pay of $0.4/kl in Thimphu (2018) was considered for the analysis as there is no willingness-to-pay data available for project towns. Source: Demand for piped drinking water and a formal sewer system in Bhutan Dendup, N. & Tshering, K. 2018. *Environmental Economics and Policy Studies* Volume 20.

Source: ADB. Kingdom of Bhutan: Improved Urban Environmental Infrastructure Project.

E. Sewerage Subproject in Samdrup Jongkhar

10. Sewerage subprojects include construction of 4.5 kilometers (km) of sewerage pipes, and construction of access roads and drainage. Project interventions will help to improve the sanitation environment resulting in the reduction of waterborne diseases and savings in the annual recurring cost of cleaning existing septic tanks, apart from the qualitative benefits (Table 4).

Table 4: Economic Benefits of Sewerage Subprojects

($ million)

Category	Unit Rate	Benefits (Net Present Value)
1. Savings in annual maintenance of septic tanks	$117.7/household/year[a]	0.5
2. Savings in earning loss related to waterborne diseases	$175.1/household/year[b]	0.7

[a] With $123.1 as the operation and maintenance cost for a septic tank with 95% usage, and $15.4 as the annual operation and maintenance for low-cost sanitation with 5% usage, the average annual maintenance cost savings is estimated at $117.7/household/year. Source: ADB. 2016. *Poverty and Social Assessment Report*. Consultant's report. Manila (TA 8551-BHU, Volume 6: Samdrup Jongkhar town).

[b] At $27.2 of average daily household income x 15 sick days x 43% of income loss assigned to water supply = $175.1/household/year. Source: World Bank. 2015. *Water, Sanitation and Hygiene Interventions to Combat Childhood Diarrhea in Developing Countries*. New Delhi.

F. Drainage and Road Subprojects in Sarpang

11. Subprojects on drainage and roads include construction and rehabilitation of 3.74 km of roads and 9.18 km of drainage system in Sarpang, benefiting 3,229 people in 2024. Improved roads will enhance the road surface quality, benefiting road users with reduced vehicle operating cost and travel time. Similarly, the drains improvement will help to reduce flood damage in the region and the resultant frequent road damage (Table 5).

Table 5: Economic Benefits of Drainage and Road Subprojects

($ million)

Category	Unit Rate	Benefits (Net Present Value)
1. Savings in vehicle operating and travel time costs	$0.5 million/year[a]	3.4
2. Avoided flood damage cost	$4.6/household/year[b]	0.1
3. Savings in annual road maintenance cost	$0.1 million/year[c]	0.1

[a] With the per capita trip rate of 0.5 day and the average trip length of 0.8 kilometers (km), 0.16 million vehicle km of annual vehicular trips and 0.19 million km of passenger walk trips are estimated for 3,229 people in 2024. Improvement in urban roads is expected to increase the average speed, resulting in savings in vehicle operating costs and travel time. These together will result in annual savings in vehicle operating costs of $0.3 million and travel time cost at $0.2 million. Source: ADB. 2016. *Interim Report*. Consultant's report. Manila (TA 8551-BHU).

[b] Average annual flood mitigation cost of $4.6/householdyear. Source: PPTA team discussion with project town officials.

[c] With the assumption of 50% reduction in annual maintenance cost for 9.18 km of road where drainage is provided.

Source: World Bank studies (2014. Strom Water Drainage project in Chennai City and 2016. Flood mitigation management study for Amaravati Capital City in Andhra Pradesh).

G. Economic Feasibility Results

12. The economic analysis shows all subprojects to be economically viable, with the calculated economic internal rate of return exceeding the economic opportunity cost of capital of 9%. Results of the sensitivity analysis are also satisfactory against all downside risks, except for the sewerage subproject (Tables 6 and 7).

Table 6: Economic Internal Rate of Return and Sensitivity Analysis

($ million)

	Overall			Water Supply			Sewerage			Drainage/Road		
Item	EIRR (%)	ENPV	SV (%)	EIRR (%)	ENPV	SV (%)	EIRR (%)	ENPV	SV (%)	EIRR (%)	ENPV	SV (%)
Base case	15.3	8.3		14.9	5.9		9.2	0.1		21.0	2.3	
Construction cost (+20%)	13.4	6.6	99.4	13.1	4.7	94.2	7.9	(0.2)	19.5	18.7	2.1	31.1
O&M cost (+20%)	15.1	8.0	616.2	14.7	5.7	583.7	9.0	0.0	20.0	20.8	2.3	32.7
Benefit (–20%)	12.9	4.7	46.1	12.6	3.3	44.8	7.3	(0.2)	19.4	18.0	1.6	27.5
1-year delay	15.1	7.7		14.7	5.5		8.8	(0.0)		20.9	2.3	
Combined	10.8	2.3		10.5	1.5		5.2	(0.5)		15.7	1.3	

( ) = negative, EIRR = economic internal rate of return, ENPV = economic net present value, O&M = operation and maintenance, SV = switching value (this is the value of the variable at which the project investment decision is changed).
Source: Asian Development Bank estimates.

Table 7: Combined Costs and Benefits Streams

($ million)

	Costs			Benefits				Net
Year	Construction	O&M	Total	Water Supply	Sewerage	Drainage	Total	Benefits
2018	1.1		1.1					(1.1)
2019	3.6		3.6					(3.6)
2020	3.1		3.1					(3.1)
2021	1.8		1.8					(1.8)
2022	0.7		0.7					(0.7)
2023	0.3		0.3					(0.3)
2024		0.2	0.2	1.7	0.1	0.5	2.4	2.2
2025		0.2	0.2	1.8	0.1	0.5	2.5	2.3
2026		0.2	0.2	1.8	0.2	0.6	2.5	2.3
2027		0.2	0.2	1.9	0.2	0.6	2.6	2.4
2028		0.2	0.2	1.9	0.2	0.6	2.7	2.5
2029		0.2	0.2	2.0	0.2	0.6	2.7	2.5
2030		0.2	0.2	2.1	0.2	0.6	2.8	2.6
2031		0.2	0.2	2.1	0.2	0.6	2.9	2.7
2032		0.2	0.2	2.2	0.2	0.6	3.0	2.7
2033		0.2	0.2	2.2	0.2	0.6	3.0	2.8
2034		0.2	0.2	2.3	0.2	0.6	3.1	2.9
2035		0.2	0.2	2.3	0.2	0.6	3.2	3.0
2036		0.2	0.2	2.4	0.2	0.7	3.3	3.0
2037		0.2	0.2	2.5	0.2	0.7	3.3	3.1
2038		0.2	0.2	2.5	0.2	0.7	3.4	3.2
2039		0.2	0.2	2.6	0.2	0.7	3.5	3.3
2040		0.2	0.2	2.7	0.2	0.7	3.6	3.4
2041		0.3	0.3	2.8	0.2	0.7	3.7	3.5
2042		0.3	0.3	2.9	0.2	0.7	3.8	3.6
2043		0.3	0.3	2.9	0.2	0.7	3.9	3.7
2044		0.3	0.3	3.0	0.3	0.7	4.0	3.8
2045		0.3	0.3	3.1	0.3	0.8	4.2	3.9
2046		0.3	0.3	3.2	0.3	0.8	4.2	4.0
2047		0.3	0.3	4.9	0.6	0.8	6.3	6.0
2048		0.3	0.3	6.8	0.9	0.8	8.4	8.2
Total	**10.6**	**6.0**	**16.6**	**66.8**	**6.0**	**16.5**	**89.2**	**72.7**
ENPV	**8.3**	**1.3**	**9.7**	**13.2**	**1.1**	**3.6**	**17.9**	**8.3**
EIRR								**15.3%**

( ) =negative, EIRR = economic internal rate of return, ENPV = economic net present value, O&M = operation and maintenance.
Source: Asian Development Bank estimates.

H. Distribution Analysis

13. The poverty impact ratio of 18.1% reveals considerable benefits to the poor given the present percentage of people living below the poverty line in Bhutan (8.2%)[14]

[14] 2017. Government of Bhutan. National Statistics Bureau. *Poverty Analysis Report.* Thimphu.