ECONOMIC ANALYSIS

A. Introduction

1. Timor-Leste has been experiencing steady urban growth.[1] This is putting increased pressure on the country's water services, which are operating beyond their intended capacities. Excessive leakage and operational issues such as a lack of chemicals to treat water and a dilapidated network are resulting in unreliable and unsafe water supply. Climate change will likely increase the frequency of rainfall, the severity of floods, and the length and severity of droughts in Timor-Leste. Maintaining good health and hygiene will become even more challenging in areas that have only limited access to safe water.

2. To facilitate sustainable economic growth, the project will support the Government of Timor-Leste to provide safe, reliable, and affordable water supply and sanitation to urban households and commercial users.[2] The project will help the country achieve inclusive and sustainable access to water supply and sanitation services. Its outputs are: (i) regulatory environment improved; (ii) water supply and sanitation infrastructure improved; and (iii) institutional effectiveness improved. The project will finance the following: (i) construction of new water supply storage and treatment facilities, (ii) rehabilitation and expansion of the water supply distribution network forming district metered areas, (iii) installation of meters for all household connections, and (iv) construction of public toilet facilities and septage treatment facilities.

3. The project will help strengthen the regulatory and institutional capacity of both the Ministry of Public Works (MPW); each project city's Municipal Water, Sanitation, and Environment Services (SMASA); and the newly established state-owned water utility, Bee Timor-Leste (BTL), in service delivery, planning, financial management, operation and maintenance (O&M). It will likewise support the project cities in developing and approving institutional development roadmaps that will guide the transition of water supply and sanitation services from multiple providers to a single new a state-owned water utility, Bee Timor-Leste. To ensure efficient delivery of services, the project will help enhance the capacity of the MPW and the SMASAs to plan, operate, and maintain water supply and sanitation infrastructure over the long term. It will build community awareness on key sustainability themes such as water use, water conservation, health, hygiene and sanitation.

B. Demand Analysis

4. **Limited access to piped water supply and poor sanitation**. Although 91% of the country's urban dwellers have some access to improved water supply, only a third have access to a piped water supply network.[3] Existing municipal water supply systems in the project areas have more limited coverage (26% of households) and offer poor and unreliable water services. [4] Households in project areas mainly rely on costly or unsafe sources of water such as bottled

[1] According to the 2015 Census, since 2008, the urban population has grown at a rate of 4.2% per annum and represents about 30% of the total population. Government of Timor-Leste. 2015. *Timor-Leste Census*. Dili.

[2] The proposed project coverage includes seven *sucos* (villages) in three secondary cities: Fuiloro in Lospalos; Babulo, Holarua, and Letefoho in Same; and Caraubalo, Uma Quic, and Uma Uain Craic in Viqueque.

[3] Improved water sources include pipe in dwelling, public taps, piped wells or boreholes, protected dug wells, and improved rainwater collection systems. Piped water supply is nonpotable and limited to only a few hours per week. Government of Timor-Leste. 2015. *Timor-Leste Census*. Dili.

[4] Based on data collected from the Water Supply and Sanitation Investment Project socioeconomic household survey in 2020. The survey was conducted over a sample of 420 household respondents (confidence level-95%, margin of error-5%) that were selected through a two-stage cluster sampling procedure across the seven project villages.

water, shallow well springs, neighbors' taps, or public tanks. In households without in-house water sources, women and girls bear primary responsibility for collecting water (footnote 4). Although most have access to improved toilet facilities, these toilets are exclusively connected to septic systems, as wastewater networks are lacking. Since there are no septage treatment plants in the project areas, there is no solution to safely disposing of and treating fecal sludge. This contributes to the contamination of the environment, especially ground and surface waters. Toilets in public areas such as schools are also lacking.

5. **High incidence of waterborne diseases**. In Timor-Leste, 11% of children under 5 years of age have had diarrhea.[5] Poor sanitation and hygiene and contaminated water cause waterborne diseases such as diarrhea, schistosomiasis, malaria, and dengue. Despite reasonable water treatment practices, households in project areas report high incidence of waterborne diseases including in children under 5. Poor access to clean running water for handwashing and food preparation also allows infectious diseases to spread. Increasing people's access to safe and reliable water sources will be fundamental to curbing the spread of the coronavirus disease (COVID-19) and addressing future health emergencies.

6. **Inadequate water supply and higher future demand.** Existing water supply in the proposed project villages is inadequate. On average, people in these villages consume only about 32.7 liters of water per capita per day (footnote 4), which is less than the level recommended by the World Health Organization (WHO) to fulfill all basic needs (100 liters per capita per day). This unmet water demand translates to more than 3,000 cubic meters (m^3)/day (3.2 million m^3/year in 2020). Furthermore, additional demand for water and sanitation services are expected with population growth and economic development. The population in the three project cities is expected to grow by 3.5% per year from 2020 (47,204) to 2030 (66,626) and by 3.3% per year from 2030 to 2040 (92,090).[6]

7. **High nonrevenue water**. About 60% of water in Timor-Leste is nonrevenue water (NRW) or water that is pumped but lost in the distribution system or unaccounted for.[7] NRW can occur through physical losses from leaking and/or broken pipes, which are caused by poor O&M, lack of active leakage control, and poor quality of underground assets. NRW losses could be higher in the project areas, which lack monitoring systems to measure NRW losses. Better NRW management is critical for protecting water resources, making cities more climate resilient, and allowing utilities to expand and improve service quality, enhance financial performance, and reduce energy consumption.

8. **Project coverage and beneficiaries**. The project will gradually cover all existing and future demand for improved piped water supply and sanitation services in project areas. Project infrastructure will supply water to cover the water needs (120 liters per capita per day) of more than 62,000 individuals by 2028 and more than 92,000 individuals by 2040 (Table 1).[8] The additional water supply enabled by the project will be sustained at the 2040 level until the end of the project's economic life.

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[5] Government of Timor-Leste, General Directorate of Statistics. 2018. *Timor-Leste Demographic Health Survey 2016*. Dili.

[6] General Directorate of Statistics. 2015. *Statistics Timor-Leste.* Dili; and Government of Timor-Leste. 2016. *District Capitals Water Supply and Sanitation Master Plan*. Dili.

[7] R. Liemberger and A. Wyatt. 2018. *Quantifying the Global Nonrevenue Water Problem.* Water Supply 19(3). pp. 831-837.

[8] Comparable to the average piped urban water consumption in Southeast Asia (e.g. 130 liters per capita per day in Salatiga City, Indonesia). C. Nauges and D. Whittington. 2010. *Estimation of Water Demand in Developing Countries. The World Bank Research Observer. 25(2). Pp. 263-294.*

Table 1: Beneficiaries and Domestic Water Demand in the Project Areas, 2040

City	No. of Beneficiaries	Water Demand (m^3/day)
Lospalos	39,873	4,785
Same	27,793	3,337
Viqueque	24,424	2,931
Total	92,090	11,052

lpcd = liters per capita per day. m^3/day = cubic meters per day.
Source: Asian Development Bank estimates.

C. Economic Analysis

9. **Cost–benefit analysis**. To assess its economic viability, the project's economic internal rate of return (EIRR) and economic net present value (ENPV) are calculated using a 9% discount rate, following the principles described in the Guidelines for the Economic Analysis of Projects of the Asian Development Bank (ADB).[9] The marginal economic cost and benefits of the project are calculated over a period of 35 years, including an 8-year implementation period. All economic costs and prices are expressed in constant 2020 prices and valued using the domestic price numeraire method.[10] While leaving nontraded components unadjusted, a shadow exchange rate factor (SERF) of 1.023 was applied to convert the financial prices of traded goods to economic prices and a shadow wage rate factor (SWRF) of 0.5 was applied to adjust unskilled labor cost.[11]

10. **Economic costs**. Project costs include capital and recurrent costs and exclude price contingencies, taxes, and interest charges. These costs mainly include the costs of rehabilitating and improving existing water supply storage and treatment facilities during 2021–2026, expanding the water supply distribution network, and installing meters for new and existing household connections. Tertiary pipes and fittings are assumed to have a useful economic life of 32 years after construction but require replacement of parts every 10 years beyond the project implementation period. Recurrent expenditures, which will continue after project implementation, include annual O&M costs for the water supply distribution network, including incremental pipes and connections.

11. **Economic Benefits.** The project's economic benefits will mainly flow from increased access to safe, reliable, and affordable water supply and sanitation services. Without the project, household beneficiaries would continue to rely on costly, unreliable, and unsafe water sources and sanitation services. By allowing easy access to safe and clean water for drinking and other uses, the project will prevent waterborne diseases and bring down the direct and indirect costs of obtaining water. Economic benefits from increased consumption of improved water and sanitation services were quantified in terms of (i) direct consumer gains from incremental water supply, (ii) avoided health costs from preventing waterborne disease, and (iii) avoided costs and time savings from switching to an improved water supply. Increases in water supply capacity and demand over the project's economic life were considered in the calculations. Estimates rely on household-level survey data collected across the project areas, along with other studies and some assumptions (footnote 4).

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[9] ADB. 2017. *Guidelines for the Economic Analysis of Projects.* Manila; and ADB. 1994*. Framework for the Economic and Financial Appraisal of Urban Development Sector Projects.* Manila.

[10] The domestic price numeraire method uses the domestic price level as the common base for aggregating costs and benefits. While leaving nontraded components unadjusted, this method converts the financial prices of traded goods to economic prices by applying a shadow exchange rate factor (1.023) and shadow wage rate factor (0.5).

[11] The SERF is based on Table 1 of ADB SERF 5-year estimates. The SWRF is applied in other ADB projects in Timor-Leste (e.g. the Baucau to Viqueque Highway Project and the Dili Urban Water Supply Sector Project).

12. Consumer benefits from incremental water consumption were estimated by multiplying the incremental volume of water consumed by households with the project by their willingness-to-pay for improved water services. Additional income from increased number of domestic connections was also considered Health costs are avoided by lowering waterborne disease incidence and preventing child deaths related to waterborne diseases through better access to safe and clean household water for drinking, food preparation, and improved hygiene.[12] Avoided waterborne disease-related costs are measured in terms of averted discounted disability-adjusted life years (DALYs) and avoided treatment costs.[13] The value of time and cost savings from switching to piped water is estimated by multiplying average savings by the number of household beneficiaries. [14]

13. **Economic internal rate of return**. As shown in Tables 2 and 3, the project's ENPV is estimated at $10.9 million, and the EIRR is 11.9%, which is above the 9% minimum required threshold for ADB water projects. An EIRR above the minimum required threshold indicates that the project is economically viable or that the value of the project's expected economic benefits is above the investment's opportunity cost. The full economic benefits of the project are expected to be significantly higher once the analysis includes other unquantified benefits such as quality-of-life improvements (especially among women and children), private sector development, land value improvement, job creation, and gains derived from reducing water losses, energy use, plastic waste, and water pollution.

14. **Sensitivity Analysis**. To confirm the project's economic viability and assess how it will be affected by changes in key variables, a sensitivity analysis was conducted by considering: (i) a 10% decrease in revenue, (ii) a 10% increase in capital costs, (iii) a 10% increase in O&M costs, and (iv) an implementation delay of 1 year. Sensitivity analysis indicated that the project's economic viability is robust to the negative scenarios examined.

Table 2: Sensitivity Analysis

Scenario	EIRR (%)	ENPV ($ million)	SI	SV (%)
Base case	11.9	10.9		
Scenario 1: 10% decrease in revenue	11.5	9.6	1.2	83.1
Scenario 2: 10% increase in capital costs	10.6	6.8	3.8	26.4
Scenario 3: 10% increase in O&M costs	11.6	10.0	0.8	122.5
Scenario 4: Implementation delay by one year	10.3	5.4		

ENPV = economic net present value, EIRR = economic internal rate of return, SI = sensitivity indicator, SV = switching value.
Source: Asian Development Bank estimates.

[12] Diarrhea cases prevented = 1.3 cases/capita per year. Child deaths prevented = 2.9 per 1,000 live births. World Bank. 2011. *Water and Sanitation to Reduce Child Mortality: The Impact and Cost of Water and Sanitation Infrastructure.* Washington, DC.

[13] DALYs = years of life lost (YLL) + years lived with disability (YLD). YLL ($0.2 million future income/child) is computed over all child deaths averted per year by adding the expected future income losses (GDP per capita) over the discounted average life years remaining per child. Following WHO guidelines on DALY discounting, a 3% of time discount rate is applied to the remaining life years. As a proxy for YLD, productivity losses averted is estimated by multiplying unproductive sick days due to diarrhea prevented by average daily wage of low-income group. Treatment cost savings are estimated by multiplying prevented cases of diarrhea by the average treatment cost per case. Baseline data based on household survey (footnote 4) and estimated treatment cost based on Barral et al.. Barral et al. 2020. Cost of illness for childhood diarrhea in low-and middle-income countries: a systematic review of evidence and modelled estimates. *BMS Public Health*. 20. pp. 1-13.

[14] Cost savings are calculated by multiplying the per capita cost of obtaining and treating water from alternative water sources by the number of beneficiaries. Baseline data is on household survey (footnote 4). Time spent on collecting water takes into consideration average time consumption for water collection, and the average female hourly wage and SWRF (0.5).

Table 3: Economic Internal Rate of Return

($ million)

Year	Economic Cost			Economic Benefits				Net Benefits
	Capital Cost	Recurrent Cost	Total Cost (A)	Incremental water consumption	DALYs and treatment cost savings	Water cost and time savings	Total Benefits (B)	(B) – (A)
2023	9.4	0.0	9.4	0.0	0.0	0.0	0.0	(9.4)
2024	11.1	0.0	11.1	0.0	0.0	0.0	0.0	(11.1)
2025	10.9	0.0	10.9	1.3	1.2	1.6	4.0	(6.9)
2026	10.8	0.0	10.8	1.2	1.7	2.2	5.0	(5.7)
2027	6.2	0.0	6.2	1.3	2.0	2.6	5.9	(0.4)
2028	0.5	1.5	2.0	1.3	2.1	2.7	6.0	4.0
2029	0.5	1.5	2.0	1.3	2.1	2.8	6.2	4.2
2030	0.0	1.3	1.3	1.3	2.2	2.9	6.4	5.1
2031	0.0	1.3	1.3	1.4	2.3	3.0	6.7	5.3
2032	0.0	1.3	1.3	1.4	2.4	3.1	6.9	5.6
2033	0.0	1.3	1.3	1.5	2.4	3.2	7.1	5.8
2034	0.0	1.3	1.3	1.5	2.5	3.3	7.3	6.0
2035	0.0	1.3	1.3	1.6	2.6	3.4	7.6	6.3
2036	0.0	1.3	1.3	1.6	2.7	3.5	7.8	6.5
2037	7.2	1.3	8.5	1.7	2.8	3.6	8.1	(0.4)
2038	0.0	1.3	1.3	1.7	2.9	3.8	8.3	7.0
2039	0.0	1.3	1.3	1.8	3.0	3.9	8.6	7.3
2040	0.0	1.3	1.3	1.8	3.1	4.0	8.9	7.6
2041	0.0	1.3	1.3	1.9	3.2	4.1	9.2	7.9
2042	0.0	1.3	1.3	1.8	3.2	4.1	9.1	7.8
2043	0.0	1.3	1.3	1.8	3.2	4.1	9.1	7.8
2044	0.0	1.3	1.3	1.8	3.2	4.1	9.1	7.8
2045	0.0	1.3	1.3	1.8	3.2	4.1	9.1	7.8
2046	0.0	1.3	1.3	1.8	3.2	4.1	9.1	7.8
2047	7.2	1.3	8.5	1.8	3.2	4.1	9.1	0.7
2048	0.0	1.3	1.3	1.8	3.2	4.1	9.1	7.8
2049	0.0	1.3	1.3	1.8	3.2	4.1	9.1	7.8
2050	0.0	1.3	1.3	1.8	3.2	4.1	9.1	7.8
2051	0.0	1.3	1.3	1.8	3.2	4.1	9.1	7.8
2052	0.0	1.3	1.3	1.8	3.2	4.1	9.1	7.8
2053	0.0	1.3	1.3	1.8	3.2	4.1	9.1	7.8
2054	0.0	1.3	1.3	1.8	3.2	4.1	9.1	7.8
2055	0.0	1.3	1.3	1.8	3.2	4.1	9.1	7.8
ENPV								10.9
EIRR								11.9%

( ) = negative, DALY = disability-adjusted life years, EIRR = economic internal rate of return, ENPV = economic net present value.

Source: Asian Development Bank estimates.