ECONOMIC ANALYSIS

A. Introduction

1. Among the states of India, West Bengal is the sixth largest economy. Its gross state domestic product expanded at a compound annual growth rate of 10.6% from fiscal year (FY) 2005 (ended 31 March) to FY2016 and was $140.5 billion in FY2016.[1] West Bengal is in eastern India and borders five other states of India (Assam, Bihar, Jharkhand, Odisha, and Sikkim) as well as Bangladesh, Bhutan, and Nepal. This location advantage has made it a traditional market for eastern and northeastern India, Bhutan, and Nepal. The state is also a strategic entry point for markets in Southeast Asia.

2. Due to excessive use and contamination of groundwater, the quality of drinking water in rural areas of the state has deteriorated significantly.[2] West Bengal is the most arsenic-affected state and ranks among the top five states in terms of fluoride contamination in India.[3] The Government of India has requested financing from the Asian Development Bank (ADB) for the proposed West Bengal Drinking Water Sector Improvement Project to ensure drinking water security in selected areas of West Bengal affected by arsenic, fluoride, and salinity. The project aims to provide safe, sustainable, and inclusive drinking water to about 1.65 million people in Bankura (fluoride affected), North 24 Parganas (arsenic affected), and Purba Medinipur (salinity affected) districts, with the following outputs: (i) climate-resilient drinking water infrastructure constructed; and (ii) institutions and capacity of stakeholders for drinking water service delivery strengthened.[4] The Public Health Engineering Department (PHED) of the Government of West Bengal (GOWB) will be the executing and implementing agency for the project. Of the 66 *gram panchayats* (governing bodies working at the village level) covered under the project, three—Chaltaberia, Kashbalanda, and Sonapukur Sankarpur—were selected to serve as samples for the economic analysis.

B. Project Rationale

3. **Rationale for government intervention.** The government intervention under the project focuses on basic water supply services where (i) there is a natural monopoly in the sector; and (ii) the services provided are public goods managed by the government. This intervention will enable sector reforms and the provision of basic water supply services to promote growth and improve living conditions in the project *gram panchayats*.

4. **Associated government policies.** State and central government policies underlining the need for the project include the following: (i) Vision 2020 (footnote 2); which aims to provide safe, sustainable, and adequate water supply; and (ii) the National Sub-Mission for Arsenic and Fluoride Removal.[5]

5. **Government capacity.** The GOWB has sufficient experience in implementing externally funded projects, including the completed and ongoing urban projects for Kolkata Municipal

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[1] Government of West Bengal. Department of Planning, Statistics and Programme Monitoring. Data valid as of 1 September 2017.

[2] Government of West Bengal, Public Health Engineering Department. 2011. *Vision 2020: To provide Safe, Sustainable, and Adequate Water Supply to All Humans and Livestock in West Bengal by 2020*. Kolkata.

[3] S. Chaudhuri and M. Roy. 2016. Overview of Rural Water Supply Sector in West Bengal, India: Challenges and Concerns. *International Journal of Innovative Research in Science, Engineering and Technology.* 5 (6). pp. 9768–9777.

[4] One neighboring block in South 24 Parganas district (arsenic affected) is also included in the project.

[5] Government of India, Ministry of Drinking Water and Sanitation. 2016. *National Sub-Mission Guidelines to Provide Safe Drinking Water to Arsenic and Fluoride Affected Habitations in Rural India on Mission Mode.* New Delhi.

Corporation funded by ADB.[6] Apart from ADB-funded projects, the GOWB has completed road, transportation, and forest projects funded by the World Bank and JICA. The PHED has also implemented large-scale water supply projects funded by the GOWB and government of India.

6. The GOWB has already created a project management unit and three project implementation units under the PHED to manage project implementation, engage design consultants, and tender bulk supply and distribution network packages for one of the three project districts. This underlines the capacity of the GOWB and PHED to manage the project.

7. **Least-cost analysis.** The subprojects proposed under the project have been carefully prepared for cost-effectiveness after comparing them with alternative solutions and are based on a comprehensive district-wide drinking water quality action plan prepared by the PHED with support from ADB's project preparatory team. The alternative solutions considered included locations of ground-level service reservoirs, a hydraulic modeling-based distribution system, sizing and number of connections per district metering area, and selection of pipe material. Based on the comparison, the subprojects under the proposed project were found to be the most economical option for meeting demand in terms of scale, materials, technology, and timing.

8. **Demand analysis.** As of October 2017, there were no household connections for water supply in rural areas of the state. The present average water consumption in the project areas is 44.3 liters per capita per day (lpcd),[7] and the water is supplied mainly from dug wells and hand pumps. This supply is insufficient to meet the increasing demands for drinking, cooking, and other household needs, and is less than the currently recommended supply requirement of 70 lpcd.

9. **Affordability of proposed water user charges.** An affordability and willingness-to-pay survey (footnote 7) was conducted in the sample *gram panchayats*. The proposed monthly water user charge under the agreed asset management and service delivery framework for the project in 2021 is estimated to be 0.3%–0.5% of the average monthly household income, as shown in Table 1.[8] This demonstrates that the cost of water user charges for all income categories in the project *gram panchayats* is affordable, considering the generally accepted level of 5.0% of monthly household income in India.[9] The affordability and willingness-to-pay survey showed that 78% of respondents agreed to pay more than ₹91 per month, 12% agreed to pay from ₹61 to ₹90, 8.0% agreed to pay from ₹41 to ₹60, and 2.0% did not respond. Therefore, the proposed water user charge of ₹75 is within the range that consumers are willing to pay since 90% of the respondents are willing to pay above the range of ₹61–₹90 per month.

Table 1: Water Charges, Usage, and Average Household Income

Item	Proposed (2021)[a]
Average household monthly consumption (kiloliter)[b]	9.6
Water supply rate (₹/kiloliter)	7.8
Water supply monthly bill (₹/household)	75.0
Average monthly household income: low-income group[c] (₹)	13,800
Water bill as a share of monthly income: low-income group (%)	**0.5**
Average monthly household income: all categories[c] (₹)	23,000
Water bill as a share of monthly income: all categories (%)	**0.3**

[a] Operations in the three sample *gram panchayats* (governing bodies working at the village level) will start in 2021.

[6] ADB. 2013. *Report and Recommendation of the President to the Board of Directors: Proposed Multitranche Financing Facility to India for the Kolkata Environmental Infrastructure Improvement Program*. Manila. https://www.adb.org/projects/42266-013/main#project-documents.

[7] Based on the affordability and willingness-to-pay survey conducted in July 2017 by ADB project preparatory consultants in the sample *gram panchayats*.

[8] 2021 will be the first year of operations in the sample *gram panchayats* under the project.

[9] World Bank, Water and Sanitation Program. 2011. *Cost Recovery in Urban Water Services: Select Experiences in Indian Cities*. Washington, DC.

[b] Average household consumption of 9.6 kiloliters = 4.6 persons per household x 70 liters per capita per day x 30 days/1,000.
[c] Based on the findings of the affordability and willingness-to-pay survey conducted in July 2017 by Asian Development Bank project preparatory consultants.
Source: Asian Development Bank estimates.

10. **Financial sustainability.** A major risk is the lack of sufficient funding for operation and maintenance (O&M). Delays or non-implementation of the proposed water user charges and regular revisions may affect the financial sustainability of the assets created and services established under the project. The GOWB has committed to the allocation of sufficient funding for O&M as a loan covenant.

C. Economic Analyses of Sample *Gram Panchayats*

11. The economic analysis assessed the economic viability of the three sample *gram panchayats* in terms of economic internal rate of return and economic net present value in accordance with ADB guidelines, including the *Guidelines for the Economic Analysis of Water Supply Projects* and the *Guidelines for the Economic Analysis of Projects*.[10]

12. **Economic costs.** The following assumptions were made for the economic cost estimates of the three sample *gram panchayats*:

(i) All costs are based on 2017 constant prices and converted at $1 = ₹65;
(ii) The 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);
(iii) All costs, including capital works and O&M, are valued using the domestic price numeraire; tradable inputs are adjusted by the shadow exchange rate factor of 1.03,[11] and unskilled labor is adjusted by a conversion factor of 0.79 of the market wage rate to estimate the shadow wage rate;[12]
(iv) The raw water to be abstracted from rivers is not considered, as it mostly flows into the ocean;
(v) The projections cover July 2018 to June 2041, including 3 years of construction, and a 20-year life span for assets created upon completion of subprojects in the three sample *gram panchayats*; and
(vi) The O&M period of 20 years consists of 3 years under design build operate packages of the project and 17 years of O&M by the *gram panchayats*.

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

[11] **Shadow Exchange Rate Factor**

Item	FY2016	FY2015	FY2014	FY2013	FY2012	Average
Exports ($ billion)	263.76	291.76	293.08	251.43	225.53	265.11
Imports ($ billion)	382.45	421.09	417.76	410.64	360.84	398.56
Customs duties ($ billion)	21.62	19.61	19.69	18.62	17.83	19.47
Standard conversion factor	0.968	0.973	0.973	0.973	0.970	0.97
Shadow exchange rate factor	1.03	1.03	1.03	1.03	1.03	1.03

FY = fiscal year.
Source: Reserve Bank of India. 2016. *Handbook of Statistics on Indian Economy, 2015–16.* Mumbai.

[12] The shadow wage factor of 0.79 was estimated by dividing $2.73 per day (the minimum wage of West Bengal) by $3.47 per day (the unskilled labor cost, using the labor wage rate paid by contractors to unskilled laborers).

Table 2: Project Costs for Sample *Gram Panchayats*[a]

($ million)

	Capital Costs		O&M Cost		Project Period	
Gram Panchayat	**Project Costs**	**Economic Cost[b]**	**Project Costs**	**Economic Cost**	**Implementation**	**Operation**
Sonapukur Sankarpur	3.1	2.3	3.0	2.3	July 2018–June 2021	July 2021–June 2041
Kashbalanda	3.3	2.5	3.2	2.4		
Chaltaberia	4.4	3.3	4.2	3.2		

O&M = operation and maintenance.
[a] *Gram panchayats* are governing bodies working at the village level.
[b] Excludes taxes and duties, price contingencies, and financing charges.
Source: Asian Development Bank estimates.

13. **Project benefits.** There is currently no piped household water supply in the sample *gram panchayats* and inhabitants consume groundwater using individual hand pumps, spot sources, and ponds. The groundwater levels are fast depleting and available water is contaminated with iron and arsenic and not fit for consumption. The beneficiaries in the sample *gram panchayats* will be around 100,000 persons (21,957 households) in 2021 with an average piped water supply of 70 lpcd.[13] The proposed numbers of household connections under the project for each of the three sample *gram panchayats* are as follows: Sonapukur Sankarpur (6,189), Kashbalanda (6,562), and Chaltaberia (9,206). Individual metered connections would be provided free of charge to project households.[14] The water treatment plant and pipelines are designed to cover water supply for 20 years of operation from July 2021 to June 2041. The present average per capita consumption of 44.3 lpcd is considered a non-incremental benefit since there is no piped water supply in the sample project *gram panchayats* (footnote 7). The non-incremental water is sourced from other sources, and this will be replaced by piped water supply when operations commence in 2021. The water supply beyond the existing consumption of 44.3 lpcd up to the target of 70 lpcd is treated as an incremental benefit.

Table 3: Economic Benefits

		Benefits ($ million)		
Category	**Unit Rate**	Sonapukur Sankarpur	Kashbalanda	Chaltaberia
A. Non-incremental benefits				
1. Savings in replaced water from other resources	$0.7/household/year[a]	0.1	0.1	0.1
2. Savings in water collection time	$0.3/kiloliter/day[b]	1.4	1.5	2.1
3. Savings in earning loss during sick days	$29.8/household/year[c]	1.8	1.9	2.6
B. Incremental benefits				
1. Unit rate based on the willingness to pay	$1.2/household[d]	0.8	0.9	1.2

[a] The annual household cost of replaced water is estimated at ₹46.0/household/year ($0.7/household/year). This is based on the following: 42.7% of consumed water from hand pumps at ₹8.8/household/year, 38.1% of consumed water from dug wells at ₹3.9/household/year, and 16.1% of consumed water from private vendors at ₹33.2/household/year.
[b] ₹4.2/day (average daily time value) / 0.2 kiloliters/day (average daily household water collection) = ₹20.5/kiloliters/day ($0.3/kiloliters/day).
[d] Average daily household income of ₹846.4 x 9 working days lost due to waterborne diseases x 25% apportioned for water supply component = ₹1,904.4/household/year ($29.8/household/year).
[e] The unit rate for incremental water is estimated at the willingness to pay of ₹75.0/household (₹1.2/household).
Sources: Government of West Bengal, Public Health Engineering Department. 2016. Detailed project reports. India; Vision Document and Overview of Rural Water Supply Sector in West Bengal. 2016. India; and World Bank. 2009. Water, Sanitation, and Hygiene Interventions to Combat Childhood Diarrhoea in Developing Countries. New Delhi.

[13] The expected populations of the three sample *gram panchayats* in 2021 are Sonapukur Sankarpur (28,242), Kashbalanda (30,185), and Chaltaberia (42,349).
[14] The project would install meters so the PHED and *gram panchayats* could monitor the flow of water and understand each household's pattern of consumption and usage.

14. **Economic feasibility results.** The economic analysis shows the schemes in the sample *gram panchayats* to be economically viable, with the calculated economic internal rate of return exceeding the economic opportunity cost of capital of 9%. The results of the sensitivity analysis were also satisfactory, except when all downside risks combined in all sample *gram panchayats* and when benefits decreased by 20% in Kashbalanda and Sonapukur Sankarpur (Table 4). However, the project is likely to be economically viable even in those cases because of unquantifiable benefits not reflected in the analysis, such as environmental improvements, reduced cost of health treatments, and increased property values.[15]

Table 4: Economic Internal Rate of Return and Sensitivity Analysis

	Overall			Sonapukur Sankarpur		
Scenario	**Economic Internal Rate of Return** (%)	**Economic Net Present Value** ($ million)	**Switching Value** (%)	**Economic Internal Rate of Return** (%)	**Economic Net Present Value** ($ million)	**Switching Value** (%)
Base case	13.5	2.2		13.0	0.5	
Construction costs +20%	10.8	1.0	37.2	10.3	0.2	32.7
O&M costs +20%	12.6	1.7	98.3	12.1	0.4	85.1
Benefits –20%	9.3	0.1	21.3	8.8	(0.0)	19.1
1-year delay	13.4	2.1		12.9	0.5	
Combined	5.9	(1.5)		5.4	(0.5)	
	Kashbalanda			**Chaltaberia**		
Scenario						
Base case	13.0	0.6		14.2	1.1	
Construction costs +20%	10.3	0.2	32.7	11.5	0.6	40.0
O&M costs +20%	12.1	0.5	85.1	13.5	0.9	84.1
Benefits –20%	8.8	(0.0)	19.1	10.0	0.2	23.8
1-year delay	12.9	0.6		14.1	0.9	
Combined	5.4	(0.5)		6.6	(0.4)	

( ) = negative, O&M = operation and maintenance.
Source: Asian Development Bank estimates.

D. Distribution Analysis

15. A distribution analysis enables calculation of the poverty impact ratio, i.e., the proportion of project net benefits accruing to the poor. The analysis showed that the poverty impact ratio is 25.1%. Considering that 22.5% of the urban population in West Bengal currently lives below the poverty line, the project is expected to benefit the poor considerably.

[15] Cost and Benefit Flow Streams of Sample *gram panchayats* (accessible from the list of linked documents in Appendix 2 of the report and recommendation of the President).