ECONOMIC ANALYSIS

A. Introduction

1. Annual economic growth in the state of Jharkhand averaged 7.5% during fiscal year (FY) 2016–2020, compared to a national growth rate of 6.3%.[1] Jharkhand is less urbanized (24.1%) than the national average (31.2%) according to the 2011 Census of India, and its rate of urbanization is projected to catch up with other Indian states after 2030. Water supply services in Jharkhand are below national service level standards because of intermittent and unsafe water supply.[2] The weak financial resources and human resource capacity constraints of urban local bodies (ULBs) in Jharkhand have led to low coverage, poor asset maintenance, and deterioration. The Jharkhand Urban Water Supply Improvement Project aims to improve access to water supply services in four ULBs of Jharkhand (Hussainabad, Jhumri Tiliaiya, Medininagar, and Ranchi), which is in line with the Jharkhand Vision and Action Plan 2021 (2017).[3]

B. Rationale

2. **Rationale for the government intervention.** The rationale is sound as the project will focus on urban basic services, where (i) there is a natural monopoly and (ii) the services provided are public goods managed by the government. The lower tariffs for cost recovery and large up-front investment costs have not attracted private investment to urban infrastructure in Jharkhand, which justifies the government investment in the project.

3. **Government capacity and associated policy.** The Government of Jharkhand (GOJ) has implemented various projects financed by Asian Development Bank (ADB) and other external agencies.[4] Further, the project management unit for the project has already been established within Jharkhand Urban Infrastructure Development Company (JUIDCO). The GOJ's major sector policy include the Jharkhand State Water Policy (2011).[5]

C. Demand Analysis

4. The average piped water supply is only 34 liters per capita per day (lpcd) in Hussainabad with 20% coverage, 11 lpcd in Jhumri Tiliaiya with 13% coverage, 10 lpcd in Medininagar with 13% coverage, and 28 lpcd in Ranchi with 46% coverage, all much less than the recommended minimum required 135 lpcd with 100% coverage.[6] Further, high dependence on groundwater (which is depleting at a faster rate) as a major source of water supply, and the outdated distribution network have caused a high percentage of unaccounted water in the project ULBs. This inadequate piped water supply has resulted in more dependence on water

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[1] Reserve Bank of India. 2020. *Handbook of Statistics on Indian States, 2019–2020*. Mumbai.

[2] On average, the coverage of piped water supply is below 25%, the quantum of water supplied is 56 liters per capita per day, the daily water supply is 3.7 hours, and the estimated nonrevenue water is 45%.

[3] Government of Jharkhand. 2017. *Jharkhand Vision and Action Plan 2021*. Ranchi.

[4] These include (i) the ADB-funded Jharkhand State Road Project (2009), Second Jharkhand State Road Project (2015), and Second Rural Connectivity Investment Program (2018); (ii) the World Bank-funded Jharkhand Municipal Development Project (2018) and Jharkhand Power System Improvement Project (2018); and (iii) the Japan International Cooperation Agency-funded Jharkhand Horticulture Intensification by Micro Drip Irrigation Project (2018).

[5] Government of Jharkhand, Water Resources Department. 2011. *Jharkhand State Water Policy, 2011*. Ranchi.

[6] Government of India, Ministry of Urban Development. 2014. *Water Supply and Sanitation Adaptation and Mitigation Measures Guidelines*. Delhi. It suggests 135 lpcd as a benchmark for water supply in ULBs.

from other unhygienic sources with higher costs.[7] Because of the above, inadequate water supply services pose a major health risk and are a major challenge in Jharkhand.[8] All these existing water supply related issues and the increasing population of ULBs have led to a strong demand for improved and sustainable surface water supply services, which will be met by the project.[9] About 115,000 households (comprising 0.7 million people) in the four ULBs are expected to benefit from the project by 2025.

D. Alternative Analysis

5. Alternative designs were assessed for cost-effectiveness in the detailed project reports prepared for the subprojects.[10] A least-cost analysis mainly considered the following options: (i) selection of intake and water treatment plant locations, (ii) alignment of the pipeline from the source to water treatment, (iii) water treatment technology, (iv) selection of pipe material, and (v) district metered area-based distribution network. The selection of these options was considered along with other considerations, including economic, environmental, and social safeguard issues; availability of materials; and ruling specifications. All the subprojects were found to be the most economical option for meeting demand in terms of scale, technology, and timing.

E. Cost–Benefit Analysis

6. An economic analysis assessed the economic viability of all subprojects by their economic internal rates of return and their economic net present values according to ADB's guidelines.[11]

7. **Economic costs.** The following assumptions were made for the economic analysis:
   (i) all costs were expressed in 2021 constant prices and converted at the exchange rate of $1 = ₹73.2 as of 12 June 2021;
   (ii) projections covered June 2021 to May 2045, including 4 years of construction (June 2021–May 2025),[12] and assets created were assumed to have a 20-year lifespan for operation and maintenance (O&M) upon completion (June 2025–May 2045);
   (iii) all costs, including capital and O&M expenditures, were valued using the domestic price numeraire; tradable inputs and unskilled labor costs were further adjusted by the shadow exchange rate factor of 1.02 (Table 1) and the shadow wage rate factor (SWRF) of 0.84;[13] and

[7] Other sources of water include (i) bore wells by individual households and ULBs, (ii) open wells, (iii) tanker water by private operators and ULBs, and (iv) bottled water. Households in the project ULBs obtained an average of 70 lpcd of water from non-piped sources and spent an average of 0.8 hour per day in collecting water in 2018 (Source: Baseline Socio-Economic Survey, 2018).

[8] In 2018, around 25% of households in project ULBs were found affected by waterborne diseases, spending about Rs35,000 per annum for medical expenditure with an average of 11.8 working days lost. (Source: Baseline Socio-Economic Survey, 2018).

[9] More than 95% of households in the project ULBs would avail the improved piped water supply provided by the project (Source: Baseline Socio-Economic Survey, 2018).

[10] The subprojects include: (i) Hussainabad water supply, (ii) Jhumri Telaiya water supply, (iii) Medininagar water supply, (iv) Ranchi intake works, and (v) Ranchi water supply.

[11] ADB. 2017. *Guidelines for the Economic Analysis of Projects*. Manila.

[12] Out of the implementation period (June 2021–May 2028), the construction will be completed in May 2025 and the remaining 3 years will be for O&M of created assets by the contractors.

[13] The SWRF was estimated at 0.84 by dividing $3.14 per day (the unskilled labor cost using the practiced labor wage rate paid by contractors) by $3.75 per day (the minimum wage for unskilled labor in 2020, as suggested by the GOJ).

(iv) the economic opportunity cost of capital was assumed to be at 9% in real terms.

Table 1: Shadow Exchange Rate Factor

Item	2015	2016	2017	2018	2019	2020	Average
Exports ($ billion)	295.62	255.43	284.00	286.08	327.70	303.87	292.56
Imports ($ billion)	426.66	370.61	395.82	438.81	510.42	459.69	434.91
Customs duties ($ billion)	19.95	19.17	20.79	11.49	10.68	10.79	15.30
Standard conversion factor	0.97	0.97	0.97	0.98	0.99	0.99	0.98
Shadow exchange rate factor[a]	1.03	1.03	1.03	1.02	1.01	1.01	1.02

[a] Shadow exchange rate factor = 1 + customs duties/(exports + imports).
Sources: Reserve Bank of India. 2020. *Handbook of Statistics on Indian Economy 2019–2020*. Delhi; and Government of India, Ministry of Finance. 2019. *Receipt Budget 2016–2017 to 2018–2019*. Delhi.

8. By excluding 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 1.02. In the case of local costs, the component of unskilled labor (30%) was further segregated and converted to economic costs using the SWRF of 0.84. By adding all economic costs by component estimated separately (foreign, unskilled labor, and remaining local costs), the economic costs were derived for each subproject, translating into 77.1% of the financial project costs (Table 2).

Table 2: Details of Project Costs
($ million)

	Capital Costs		O&M Costs			
Project ULB	Project Cost[a]	Economic Cost[b]	Project Cost	Economic Cost[b]	Implementation	O&M
Hussainabad	5.6	4.3	1.6	1.2		
Jhumri Tilaiya	18.6	14.3	7.8	6.0	June 2021	June 2025 –
Medininagar	20.8	16.0	11.0	8.4	– May 2025	May 2045
Ranchi	110.8	85.4	28.7	22.1		
Total	**155.8**	**120.1**	**49.0**	**37.8**		

O&M = operation and maintenance.
[a] Construction cost ($155.8 million), which excludes initial 3-year O&M costs ($4.2 million) post-construction.
[b] Excludes taxes and duties, price contingencies, and financial charges.
Source: Asian Development Bank estimates.

9. **Project benefits.** The construction of an intake facility, a transmission main, water treatment plants, a distribution network, and household connections will be included in the project, designed to provide 135 lpcd, benefiting about 115,000 households (comprising 0.7 million people) in the project ULBs in June 2025.[14] The current total water consumption is 103 lpcd in Hussainabad, 84 lpcd in Jhumri Tilaiya, 79 lpcd in Medininagar, and 87 lpcd in Ranchi. The difference between the existing piped water supply and the current water consumption is considered a non-incremental benefit, and the water supply beyond the existing consumption up to the target (135 lpcd) is treated as an incremental benefit. The quantifiable non-incremental benefits considered for the analysis include (i) savings in resource costs for replaced water from other sources, (ii) savings in water collection time, and (iii) savings in earning loss during sick days because of waterborne disease. The willingness to pay based on average unit rate was adopted as an incremental benefit (Table 3). The non-incremental benefits were projected to account for 93%–96% of total benefits, while the remaining 4%–7% would be incremental benefits.

[14] Through the project, piped water will be supplied mainly to the households that are not currently connected to piped water supply systems (2020 baseline: 0-kilometer distribution network and 0 households connected to piped water supply).

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

Category	Unit Rate	Total Benefits (Net Present Value) Hussainabad	Jhumri Tiliaiya	Medininagar	Ranchi
A. Non-incremental benefits					
1. Savings in replaced water from other sources	$78.3/household/year[a]	4.2	12.4	12.2	38.3
2. Savings in water collection time	$52.0/household/year[b]	2.8	8.2	8.1	25.4
3. Savings in earning loss during sick days	$23.4/household/year[c]	1.3	3.7	3.6	11.4
B. Incremental benefits					
1. Average unit cost for incremental benefit	$0.1/kiloliter[d]	0.3	1.5	1.8	4.2

[a] Replaced water breakdown: 3.1 kl via open well at ₹8.5/kl, 129.2 kl via bore well at ₹12.8/kl, 2.1 kl via bottled water at ₹1,929.4/kl, and 1.1 kl via tanker water at ₹77.0/kl. Costs of replaced water are ₹5,731.3/household/year.
[b] 0.83 hours (average daily household water collection time) x 80% of time saved x 365 days x ₹15.6 (time value for unskilled labor) = ₹3,806.9/household/year.
[c] ₹578.8 (average daily household income) x 11.8 days (average annual working days lost) = ₹6,842.6 (average annual household earning loss during sick days); 25% of loss (₹1,710.6 or $23.4) is assigned to water supply (H. Waddington et al. 2009. *Water, Sanitation and Hygiene Interventions to Combat Childhood Diarrhoea in Developing Countries*. Washington, DC: International Initiative for Impact Evaluation).
[d] Results of the willingness to pay survey (₹6.8/kl or $0.1/kl) carried out in 2018 in the project urban local bodies were used for the incremental water unit rate.
Source: Government of Jharkhand. 2018. *Baseline Socio-Economic Survey, 2018*. Ranchi; and Asian Development Bank estimates.

10. **Results of cost–benefit analysis.** The results of the cost–benefit analysis show that all subprojects are economically viable, with a combined economic internal rate of return of 13.3% (Hussainabad: 22.2%, Jhumri Telaiya: 20.1%, Medininagar: 18.0%, and Ranchi: 10.4%), higher than the economic opportunity cost of capital, estimated at 9.0% (Table 4).[15]

Table 4: Combined Cost and Benefit Streams
($ million)[a]

	Costs			Benefits					
				Non-Incremental					
Year	Construction	O&M	Total	Savings in other Sources	Savings in Water Collection Time	Savings in Earning Loss	Incremental	Total	Net Benefits
2021	14.3	0	14.3	0	0	0	0	-	(14.3)
2022	21.4	0	21.4	0	0	0	0	-	(21.4)
2023	23.3	0	23.3	0	0	0	0	-	(23.3)
2024	29.8	0	29.8	0	0	0	0	-	(29.8)
2025	31.3	1.0	32.3	5.5	3.6	1.6	1.0	11.8	(20.5)
2026	-	1.6	1.6	9.6	6.4	2.9	1.1	19.9	18.3
2027	-	1.7	1.7	9.8	6.5	2.9	1.1	20.3	18.6
2028	-	1.7	1.7	9.9	6.6	3.0	1.1	20.6	18.9
2029	-	1.7	1.7	10.1	6.7	3.0	1.1	21.0	19.3
2030	-	1.8	1.8	10.3	6.8	3.1	1.2	21.4	19.6
2031	-	1.8	1.8	10.5	7.0	3.1	1.2	21.8	20.0
2032	-	1.9	1.9	10.7	7.1	3.2	1.2	22.2	20.3
2033	-	1.9	1.9	10.9	7.2	3.2	1.2	22.6	20.7
2034	-	1.9	1.9	11.1	7.4	3.3	1.2	23.0	21.1
2035	-	1.9	1.9	11.3	7.5	3.4	1.3	23.4	21.5
2036	-	1.9	1.9	11.5	7.7	3.4	1.3	23.9	22.0
2037	-	1.9	1.9	11.8	7.8	3.5	1.3	24.4	22.5
2038	-	2.0	2.0	12.0	8.0	3.6	1.3	24.9	23.0
2039	-	2.0	2.0	12.3	8.2	3.7	1.4	25.5	23.5

[15] Cost and benefit streams of each project ULB are included in the Detailed Economic Analysis (accessible from the list of linked documents in Appendix 2 of the report and recommendation of the President).

2040	-	2.0	2.0	12.5	8.3	3.7	1.4	26.0	24.0
2041	-	2.0	2.0	12.5	8.3	3.7	1.4	26.0	24.0
2042	-	2.0	2.0	12.5	8.3	3.7	1.4	26.0	24.0
2043	-	2.1	2.1	12.5	8.3	3.7	1.4	26.0	23.9
2044	-	2.1	2.1	12.5	8.3	3.7	1.4	26.0	23.9
2045	-	0.9	0.9	5.2	3.5	1.6	0.6	10.8	10.0
Total	**120.1**	**37.8**	**157.9**	**225.1**	**149.5**	**67.2**	**25.7**	**467.4**	**309.5**
NPV	**90.6**	**11.4**	**102.0**	**67.1**	**44.6**	**20.0**	**7.8**	**139.5**	**37.5**
EIRR									**13.3%**

( ) = negative, EIRR = economic internal rate of return, NPV = net present value, O&M = operation and maintenance.
[a] Numbers may not sum precisely because of rounding.
Source: Asian Development Bank estimates.

F. Sensitivity Analysis

11. A sensitivity analysis was conducted to assess the effects of adverse changes in key variables, including (i) a capital cost overrun of 20%, (ii) an O&M cost overrun of 20%, (iii) a decline in estimated benefits of 20%, (iv) a 1-year delay in implementation, (v) all downside risks combined, and (vi) a change in benefit composition to non-incremental at 80% and incremental at 20%. The sensitivity analysis revealed that the results are satisfactory except for (i) all downside risks combined for the overall project and (ii) a capital cost overrun of 20%, a decline in benefits of 20%, and all downside risks combined for the subproject in Ranchi (Table 5). 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.

12. To support the project's economic viability, the project will prepare a sustainable asset management strategy for efficient O&M, and conduct awareness campaigns to promote full utilization of piped water supplied under the project.

Table 5: Economic Internal Rate of Return and Sensitivity Analysis

(NPV in $million)

	Combined			Hussainabad			Jhumri Tiliaiya			Medininagar			Ranchi		
Variable	**EIRR (%)**	**NPV**	**SV (%)**	**EIRR (%)**	**NPV**	**SV (%)**	**EIRR (%)**	**NPV**	**SV (%)**	**EIRR (%)**	**NPV**	**SV (%)**	**EIRR (%)**	**NPV**	**SV (%)**
Base case	13.3	37.5		22.2	4.9		20.1	13.2		18.0	11.2		10.4	8.2	
Capital cost (+20%)	11.0	19.4	41	19.1	4.3	151	17.2	11.1	123	15.2	8.7	92	8.3	(4.7)	13
O&M cost (+20%)	13.1	35.2	330	22.0	4.9	1,396	19.8	12.9	728	17.7	10.7	450	10.2	6.8	122
Benefits (–20%)	10.2	9.6	27	18.2	3.2	58	16.3	8.1	51	14.2	6.0	43	7.6	(7.7)	10
1-year delay	13.2	33.3		22.1	4.5		20.0	11.9		18.0	10.1		10.3	6.9	
Combination	7.7	(10.7)		15.3	2.2		13.3	4.9		11.3	2.7		5.3	(20.6)	
Change in benefit composition[a]	13.2	36.1		21.8	4.7		20.1	13.1		18.0	11.1		10.6	9.0	

( ) = negative, EIRR = economic internal rate of return, NPV = net present value, O&M = operation and maintenance, SV = switching value.
[a] Benefit composition is changed to non-incremental at 80% and incremental at 20%.
Source: Asian Development Bank estimates.

G. Distribution Analysis

The proportion of project net benefits accruing to the poor was calculated. The poverty impact ratios were estimated at 26.1% for Hussainabad, 26.3% for Jhumri Tiliaiya, 26.5% for Medininagar, and 27.5% for Ranchi. With 24.8% of the urban population in Jharkhand living below the poverty line, the subprojects are expected to benefit the poor considerably.[16]

[16] Government of India, Planning Commission. 2012. *Press Note on Poverty Estimate 2011–2012*. Delhi.