ECONOMIC ANALYSIS

A. Introduction

1. Economic growth in the state of Himachal Pradesh averaged 7.2% during 2016–2020, exceeding the national growth rate of 6.3%.[1] Most (90%) of state's population lives in rural areas, and the rural population grew during 2001–2011, at a rate of 1.2% per year. The concentration of the population in rural areas has given rise to unmanaged basic infrastructure, resulting in environmental degradation and an increase in rural poverty. The proposed project aims to improve rural basic infrastructure in the state using a sector loan. The project will help improve access to water supply services in four zones comprising 11 network districts. In addition, a pilot inclusive sanitation component consisting of fecal sludge management (FSM) is proposed. Considering the design work is ongoing and given that the pilot funding amount is $2.5 million, the assessment is strictly qualitative. The economic analysis considered three sample subprojects (Mandi Zone-01, Mandi Zone-02 Mandi, and Shimla Zone-03), which were selected given the size and geographic distribution.

B. Rationale

2. **Rationale for the government intervention.** The rationale for government involvement is sound, as the project will focus on providing water supply in rural areas, where (i) there is a natural monopoly, and (ii) the services are public goods managed by the government. The lower water tariff, which does not enable cost recovery, and large up-front investment costs have not attracted private investment to rural infrastructure, justifying the government's involvement.

3. **Government capacity and associated policy.** The Government of Himachal Pradesh (GOHP) has implemented various projects financed by the Asian Development Bank (ADB) and other external agencies.[2] A project management unit to oversee the monitoring of this project has been established at Jal Shakti Vibhag (JSV), which is the executing and implementing agency. GOHP is guided by its (i) Water Policy,[3] (ii) Vision 2030,[4] and (iii) Jal Jeevan Mission.[5]

C. Demand Analysis

4. The current piped water supply averages only 30 liters per capita per day (lpcd) in project villages with 80% coverage of households, which is much less than the recommended minimum required 70 lpcd with 95% coverage.[6] There is high dependence on groundwater, which is rapidly being depleted. The current and outdated distribution network has caused a high percentage of nonrevenue water, contributing to the inadequate water supply in the project villages. This inadequate piped water supply has increased dependence on higher-cost water from unhygienic sources.[7] As a result, the current water supply service poses a major health risk and is considered

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

[2] ADB. 2017. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to India for the Himachal Pradesh Skills Development Project.* Manila; and ADB. 2010. *Report and Recommendation of the President to the Board of Directors to India for the Infrastructure Development Investment Transformation Program.* Manila.

[3] GOHP, Department of Irrigation and Public Health. 2013. Himachal Pradesh State Water Policy 2013. *Notification No. IPH-B(F)1-3/2013 (November 18).* Shimla.

[4] GOHP, Department of Planning. 2017. *Drishti Himachal Pradesh 2030: Sustainable Development Goals*. Shimla.

[5] Jal Jeevan Mission. Its vision states: "Every rural household shall have assured drinking water supply".

[6] Central Public Health and Environmental Engineering Organisation, Ministry of Urban Development. 1999. *Manual on Water Supply and Treatment*. Delhi.

[7] Other sources of water include (i) bore wells by individual households and village panchayats, (ii) open wells, (iii) tanker water by private operators and rural local bodies, and (iv) bottled water.

one of the state's main challenges.[8] Accessing an additional 35 lpcd of water on average from non-piped sources to supplement the existing piped water supply of 30 lpcd results in an average of 0.8 hours of water collection time for household members. These issues coupled with the increasing rural population has led to the demand for an improved and sustainable surface water supply.[9] It is expected that around 80,000 households (or about 370,000 people) will benefit from the project by 2027.

D. Alternative Analysis

5. The detailed project reports assessed alternative designs for cost-effectiveness. During project design, the optimization approach with least-cost analysis was considered mainly in in selection of: (i) water supply grids by integrating various small water supply schemes in the sub-divisions; (ii) intake source, grid alignment, and water treatment plant locations; (iii) water treatment technology to suit rural water supply schemes with slow-sand filter technology requiring minimum operation and maintenance (O&M); (iv) gravity based distribution system; (v) pipe material; and (vi) zoning in the distribution system to ensure equalization of water supply in the area. Other considerations included economic, environmental, and social safeguard issues, availability of materials, and ruling specifications during the project designs.[10] In accordance with the finalized designs in the revised detailed project reports, all subprojects were found to be the optimum option—in terms of scale, technology, and timing at least cost—for meeting demand.

E. Cost-benefit Analysis

6. An economic analysis assessed the economic viability of three subprojects (Mandi Zone-01, Mandi Zone-02 Mandi, and Shimla Zone-03) by their economic internal rates of return and their economic net present values in accordance with 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 of $1.00 = ₹76.42; (ii) projections covered from 2021 to 2046, including 5 years of construction (2022–2026),[12] and assets created were assumed to have a 20-year lifespan upon completion for operation (2027–2046); (iii) all costs, including capital and operation and maintenance expenditures, were valued using the domestic price numeraire;[13] (iv) 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 0.93;[14] and (v) the economic opportunity cost of capital was assumed to be at 9% in real terms.

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[8] The 2021 Baseline Socioeconomic Survey (2021 BSS) and focus group discussions found that about 10% of households in the project villages were affected by waterborne diseases, with about ₹1,600 in monthly medical expenditures, and an average of 10 working days lost. Source: JSV. 2021 BSS. Shimla.

[9] The 2021 BSS indicated that more than 95% of project households will access the improved piped water supply provided by the project.

[10] The detailed project reports for the subprojects have considered all technical options, cost alternatives, safeguard issues, material availability, and design specification requirements in preparing the final designs and costs.

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

[12] A 5-year of O&M contract covers asset O&M. The project will finance the first year of O&M and JSV will fund the remaining years through budgetary allocations from the government.

[13] All costs and benefits were estimated in domestic price numeraire for the analysis. However, all results were converted into United States dollars using the exchange rate of $1.00 = ₹76.42 for reporting purposes.

[14] The SWRF of 0.93 was estimated by dividing the unskilled labor cost of $3.3 per day (using the practiced labor wage rate paid by contractors to unskilled laborers) into the shadow wage rate (estimated based on GOHP's suggested minimum wage for unskilled labor in 2021) of $3.5 per day. To calculate the shadow wage rate, 20% under-employment with 50% of minimum wage was used.

Table 1: Shadow Exchange Rate Factor

Details	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
Conversion Factor	0.97	0.97	0.97	0.98	0.99	0.99	0.98
Shadow Exchange Rate Factor	**1.03**	**1.03**	**1.03**	**1.02**	**1.01**	**1.01**	**1.02**

Note: Shadow Exchange Rate Factor = 1+ (Customs duties) / (Exports + Imports).
Sources: (i) Reserve Bank of India. 2020. *Handbook of Statistics on Indian Economy 2019–2020*. Delhi; and (ii) Government of India, Ministry of Finance. 2019. *Receipt Budget 2016–2017 to 2018–2019*. Delhi.

8. Financial charges, price contingencies, and taxes and duties, were excluded while investment costs and physical contingencies were considered in estimating 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 unskilled labor component (30%) was further segregated and converted to economic costs using the SWRF of 0.93. By adding all economic costs estimated separately (foreign, unskilled labor, and remaining local costs) by component, the economic costs for the subprojects were derived, these equal 78.7% of the financial project costs (Table 2).

Table 2: Details of Project Costs ($ million)

Subproject	Capital Costs		O&M Costs		Implementation	Operation
	Project Costs[a]	Economic Cost[b]	Project Costs	Economic Cost[a]		
Mandi Zone-01	15.1	11.9	20.1	15.8	2022–2026	2027–2046
Mandi Zone-02	11.3	8.9	19.0	15.0		
Shimla Zone-03	10.2	8.0	13.5	10.7		

O&M = operation and maintenance.
[a] The sanitation component cost of $2.5 million is excluded for this analysis.
[b] Excludes taxes and duties, price contingencies, and financial charges.
Source: Asian Development Bank.

9. **Project benefits.** The project will include the construction of groundwater wells, surface water intake facilities, water treatment plants, storage tanks, overhead and ground-level reservoirs, pumping stations, bulk water supply, and distribution pipelines, and household service connections. These will be installed across 187 water supply schemes, and are designed to provide project beneficiaries with 70 lpcd; the project will benefit 0.37 million people with 95% coverage in 2027.[15] The current average per capita piped water supply is 30 lpcd and the average total water consumption is 65 lpcd in the project area.[16] The difference between the existing water supply and the present water consumption is considered a non-incremental benefit, and the water supply beyond the existing consumption up to the target (70 lpcd) is treated as an incremental benefit. Quantifiable non-incremental benefits considered for the analysis include: (i) savings in resource cost for replaced water from other sources, (ii) savings in water collection time, and (iii) savings in earnings loss during sick days due to waterborne disease. The willingness to pay based on the average unit rate is considered as incremental benefits (Table 3). Qualitative benefits for the proposed sanitation component through FSM include reduced health risk with reduction in household medical expenditure, increased labor productivity, and a cleaner environment.

[15] Beneficiary population will grow at 1.8% annually.
[16] Existing water supply is designed for 30 lpcd and its network system is in poor condition with high nonrevenue water. The per capita water supply at consumer end was finalized based on the discussion with JSV.

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

Category	Unit Rate	Benefits (Net Present Value)		
		Mandi Zone-01	Mandi Zone-02	Shimla Zone-03
A. Non-incremental benefits				
1. Savings in replaced water from other sources	$149.2/HH/year[a]	7.6	7.2	5.0
2. Savings water collection time	$136.3/HH/year[b]	6.9	6.6	4.6
3. Savings in earning loss during sick days	$37.5/HH/year[c]	1.9	1.8	1.3
B. Incremental benefits				
4. Average unit cost for incremental benefit	$0.1/kl[d]	0.03	0.03	0.02

₹ = Indian rupee, $1.00 = ₹76.42, HH = household, kl = kiloliter.

[a] Annual replaced water breakdown: 12.0 kl (20%) via open well at ₹14.2 per kl, 45.0 kl (75%) via borewell at ₹152.9 per kl, 2.4 kl (4%) via bottled water at ₹1,750 per kl, and 0.6 kl (1%) via tanker water at ₹250 per kl. Cost of replaced water is ₹11,408 per HH per year ($149.2 per HH per year). Sources: 2021 BSS; focus group discussions; ADB. 2019. India: Tamil Nadu Urban Flagship Investment Program (Tranche 2) for unit rates (assumed through a revealed preference approach, with suitable updates to 2021); and (iii) Jal Shakti Vibhag officials.

[b] 0.75 hours (average daily water collection time) x 85% of time saved x 365 days x ₹44.79 (time value during non-working hours = ₹716.6 daily wage x 50% for non-working hours/8 working hours) = ₹10.421.39/HH ($136.3/HH/year). Sources: (i) 2021 BSS, and (ii) focus group discussions.

[c] ₹1,147 (average household daily income) x 10 days (average working days lost/year) = ₹11,470 (estimated average household annual earnings losses during sick days from waterborne diseases); 25% of loss (₹2,866 or $37.5) is assigned to the water supply. Sources: 2021 BSS; and International Initiative for Impact Evaluation (3ie). 2009. Water, Sanitation and Hygiene Interventions to Combat Childhood Diarrhea in Developing Countries. Delhi.

[d] Results of the willingness to pay survey carried out in 2021 in the project villages: ₹5.07/kl ($0.1/kl) for the incremental water unit rate (i.e., ₹50/month water tariff/monthly household water consumption (9.87 kl) = ₹5.07/kl). Sources: 2021 BSS, and existing water tariff structure.

Source: Asian Development Bank.

10. **Results of cost-benefit analysis.** The three sample subprojects are economically viable, with the economic internal rate of return in the range of 10.8% (Shimla Zone-03) to 16.3% (Mandi Zone-02), higher than the economic opportunity cost of capital, estimated at 9.0% (Table 4). The project's economic viability increases further if unquantifiable benefits such as environmental improvements are included in the analysis. In the combined project benefit estimation most benefits (99.8%, in terms of total benefits and the net present value terms) were from non-incremental benefits, leaving only 0.2% from incremental benefits.

Table 4: Costs and Benefits Streams ($ million)

Year	Mandi Zone-01				Mandi Zone-02				Shimla Zone-03			
	Const. Cost	O&M Cost	Total benefits	Net benefits	Const. Cost	O&M Cost	Total benefits	Net benefits	Const. Cost	O&M Cost	Total benefits	Net benefits
2022	1.9	0.0	0.0	(1.9)	1.5	0.0	0.0	(1.5)	1.3	0.0	0.0	(1.3)
2023	3.1	0.0	0.0	(3.1)	2.3	0.0	0.0	(2.3)	2.1	0.0	0.0	(2.1)
2024	3.0	0.0	0.0	(3.0)	2.3	0.0	0.0	(2.3)	2.0	0.0	0.0	(2.0)
2025	1.9	0.0	0.0	(1.9)	1.4	0.0	0.0	(1.4)	1.3	0.0	0.0	(1.3)
2026	1.1	0.0	0.0	(1.1)	0.8	0.0	0.0	(0.8)	0.7	0.0	0.0	(0.7)
2027	0.8	0.0	2.8	2.0	0.6	0.0	2.7	2.1	0.5	0.0	1.9	1.3
2032	0.0	0.9	3.0	2.1	0.0	0.9	2.8	2.0	0.0	0.9	2.0	1.1
2037	0.0	0.9	3.1	2.2	0.0	0.9	3.0	2.1	0.0	0.9	2.0	1.1
2042	0.0	0.9	3.3	2.3	0.0	0.9	3.1	2.2	0.0	0.9	2.2	1.2
2046	0.0	0.4	3.4	3.0	0.0	0.4	3.2	2.8	0.0	0.4	2.2	1.8
Total	**11.9**	**16.2**	**62.3**	**34.2**	**8.9**	**16.2**	**58.8**	**33.7**	**8.0**	**16.2**	**40.9**	**16.6**
ENPV	**8.5**	**4.1**	**16.5**	**3.9**	**6.3**	**4.1**	**15.6**	**5.1**	**5.7**	**4.1**	**10.8**	**1.0**
EIRR				**13.4%**				**16.3%**				**10.8%**

( ) = negative, Constr. = construction, EIRR = economic internal rate of return, ENPV = economic net present value, O&M = operation and maintenance, $1.00 = ₹76.42.

Note: Completion planned by 2026, with 20-year operations from 2027 to 2046. O&M is included in the project cost for 2027.

Source: Asian Development Bank.

F. Sensitivity Analysis

11. A sensitivity analysis was conducted for the subprojects to assess the effect of adverse changes in key variables, including (i) a 20% capital cost overrun, (ii) a 20% overrun in O&M costs, (iii) a 20% decline in estimated benefits, (iv) a 1-year implementation delay, (v) the downside risks combined, and (vi) changes in the benefit composition (80% non-incremental and 20% incremental). The results are satisfactory, except for cost increase and benefits decrease for Shimla Zone-03 subproject, and the combined worst scenario for all three sample subprojects (Table 5). Sensitivity analysis indicates that the EIRR is more sensitive to benefit decreases and capital cost increases. Hence, with ADB implementation support, appropriate project monitoring measures to control cost overruns and increase the number project beneficiaries (such as providing connection subsidies to low-income households) need to be ensured.

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

Details	Mandi Zone-01			Mandi Zone-02			Shimla Zone-03		
	EIRR	NPV	SV	EIRR	NPV	SV	EIRR	NPV	SV
i. Base case	13.4%	3.9		16.3%	5.1		10.8%	1.0	
ii. Construction cost (+20%)	11.2%	2.2	46%	13.9%	3.9	81%	8.8%	(0.2)	17%
iii. O&M cost (+20%)	12.6%	3.1	95%	15.4%	4.3	125%	9.3%	0.2	24%
iv. Benefit (-20%)	9.7%	0.6	24%	12.2%	2.0	33%	6.5%	(1.2)	9%
v. 1-year delay of operation	13.2%	3.3		16.2%	4.4		10.6%	0.7	
vi. Combined (ii) to (v)	6.4%	(2.0)		8.5%	(0.3)		2.0%	(3.0)	
vii. Change in benefit composition[a]	10.6%	1.3		13.1%	2.6		7.5%	(0.7)	

( ) = negative, EIRR = economic internal rate of return, NPV = net present value, O&M = operation and maintenance, SV = switching value, $1.00 = ₹76.42.

[a] Benefit composition is non-incremental 80%, and incremental 20%.

Source: Asian Development Bank.

G. Distribution Analysis

12. The project will provide new water connections covering at least 90% of the vulnerable population including those living below the poverty line. The proportion of project net benefits accruing to the poor was calculated. To distribute net economic benefits, stakeholders were grouped into household, unskilled labor, city, and government. The state rural poverty level was used to estimate the share of household and *gram panchayat* net benefits accruing to the poor, while the state combined poverty rate was used to estimate GOHP's share of net benefits to the poor, and all unskilled labor benefits were assigned to the poor to estimate the poverty impact ratios at 32.3% (Mandi Zone-02), 34.9% (Mandi Zone-01), and 38.2% (Shimla Zone-03). The three sample subprojects are expected to benefit the poor.

H. Sustainability Analysis

13. The project's financial sustainability is an identified risk, as the required tariff revisions may be delayed during operations. The financial analysis indicates that the project would need GOHP's continued support to fund subproject O&M expenditures. GOHP and JSV are committed to taking the following mitigation measures: (i) periodic revisions of water tariffs as indicated in the policy, (ii) improved collection efficiency, and (iii) continued GOHP support. The 5-year O&M contract and other reforms built into the project will help JSV improve their financial efficiency and sustainability.