ECONOMIC ANALYSIS: PROJECT LOAN

A. Introduction

1. The economic analysis was conducted for water and wastewater subprojects in six project cities in accordance with Asian Development Bank guidelines, including *Guidelines for the Economic Analysis of the Projects* and *Guidelines for the Economic Analysis of Water Supply Projects*.

2. **Sector development program.** The sector development program (SDP) complements past and ongoing efforts of the Government of Rajasthan to improve water supply and wastewater services to state residents. The SDP comprises (i) a program, financed by a policy-based loan, to support policy reforms, including institutional development and governance improvement in the urban sector; and (ii) a project, financed by a project loan, to invest in the water distribution network in five project cities and wastewater systems in the six project cities.

3. **Economic risks.** Economic risks include uncertainty in introducing and enforcing volumetric water tariffs. The SDP initiative to combine reforms with investments will likely incentivize the project cities to rationalize water tariffs. As the wastewater subprojects will not recover operation and maintenance (O&M) costs in the first few years, the project cities will need to mobilize other sources, i.e., local taxes and transfers from the state.

B. Economic Analysis

4. **Demand and rationale**. Water supply services for the six project cities are inadequate in terms of the service coverage and service hours. Average service coverage is 57%–86% and the average service provision for most areas is less than 2 hours/day. With the project, supply will increase to 135 liters per capita per day (lpcd), with 24-hour supply and 90% service coverage. On average, 40%–97% of the population relies on septic tanks; many resort to open defecation. Wastewater is discharged directly into open drainage, polluting water courses and underground aquifers. With the project, 72% of population will have access to a sewerage system and the wastewater will be collected through the piped system, centrally treated, and discharged meeting national discharge requirements.

5. **Least-cost analysis**: Alternative designs were assessed for cost-effectiveness, O&M capacity of the project cities, and safety to beneficiaries. The project design incorporates (i) service coverage of 90% of the population; (ii) an optimum network with least-cost options including size and material for pipes; (iii) rehabilitation of the existing system; (iv) selection of optimum locations and technologies for treatment plants; and (v) locally available and least-cost, but internationally accepted materials and equipment for construction and maintenance.

6. **Affordability analysis**. The affordability analysis uses the average household income[1] of the project cities to arrive at a tariff structure that (i) reflects the road map for rationalization of the tariff;[2] (ii) includes a breakeven tariff to cover the full O&M costs, and (iii) covers full cost recovery of the subprojects. The proposed monthly household tariff to cover 50% of O&M by FY2019[3] for both services is in the range of Rs131–Rs388. The surveys found that households in the project cities are willing to pay a total of Rs200 per month, on average, for water supply

[1] The average monthly household income in the project towns is about Rs15,000 per month (Baseline survey, 2013).
[2] As per policy matrix agreed between the Asian Development Bank and the Government of Rajasthan.
[3] Proposed water and wastewater tariffs are given in the Financial Analysis (accessible from the list of linked documents in Appendix 2).

and wastewater. Thus, except for Jhunjhunu and Tonk, the proposed tariffs are within the willingness-to-pay limits. However, government support would be required to cover the full O&M costs. At present, on average, households pay less than 1% of their income for municipal services. The proposed tariff to cover 50% of O&M is about 0.9%–2.6% of the average urban household income, which indicates that the proposed tariff is generally within the acceptable limit of 5% for urban services.

7. **Water demand.** Water demand is derived from data on the current population within the planned service area, population growth, current and future domestic water consumption, and a provision for nondomestic water consumption. The population in the five project cities[4] is estimated at around 1.2 million in 2011, and is projected to increase to 1.6 million by 2046. With the project, the proportion of the population to be served by the water supply network is projected to increase from 67% in 2014 to 90% in 2019.[5] Water demand is based on the population forecast: the percentage of population served, assumed supply rate of water, price, disposable household income, and accessibility of water supply. Based on an earlier survey, access to water supply services is limited in project towns due to high nonrevenue water (NRW) in the range of 36%–76%. At project completion, the average supply rate in each project area is expected to increase by 45–113 lpcd as a result of reducing NRW.[6]

8. The following assumptions are adopted for the economic analysis:
   (i) The analysis is based on domestic numeraire in April 2014 constant prices.
   (ii) Population growth in each town is projected based on historical trends.
   (iii) Subprojects are analyzed over 25 years including 4 years of project implementation.
   (iv) The first year of the full benefit of the project is 2019.
   (v) The economic costs include base costs ($327.4 million, all local costs), physical contingency and excluded price contingency, financing charges, taxes, and duties. The shadow wage factor of 0.79 and the shadow exchange factor of 1.03 were applied to convert financial values to economic values.
   (vi) The O&M cost estimates are based on the observed annual O&M costs of the concerned public health engineering department city division;
   (vii) The nonincremental economic benefits from the water supply subprojects include (a) time saved procuring water, (b) household expenditure saved procuring bottled water, (c) NRW reduced, and (d) health benefits associated with saved household medical expenditures and reduced productivity loss due to waterborne diseases during sick days. Incremental benefits are not considered as the project envisages supplying only the minimum required 135 lpcd in project cities.
   (viii) The economic benefits from the wastewater subprojects include (a) saving in medical expenditures and reduced productivity loss due to waterborne diseases; (b) saved household expenditure on purchase, installation, and maintenance of septic tanks; and (c) sale of treated sewage.

9. Table 1 shows the financial and economic costs of the subprojects for water and wastewater.

[4] Of the six project cities, Bhilwara does not have a water supply component.
[5] Most cities in Rajasthan have intermittent water supply and high NRW.
[6] Water is supplied in most of cities for 1–3 hours every 24–72 hours. The household size ranges from 4.8 (Sri Ganganagar) to 5.9 (Jhunjhunu) in the project towns.

Table 1: Subproject Costs

City	Water Supply ($ million) Financial Cost	Water Supply ($ million) Economic Cost	Wastewater ($ million) Financial Cost	Wastewater ($ million) Economic Cost
Tonk	24.78	22.92	30.60	26.77
Pali	27.35	25.12	48.48	42.17
Sri Ganganagar	28.27	25.97	58.49	51.18
Jhunjhunu	15.97	14.67	25.59	22.08
Hanumangarh	14.85	13.64	21.27	17.51
Bhilwara			60.60	53.52
Total	**111.23**	**102.32**	**245.03**	**213.24**

Notes: 1. Financial and economic costs include the cost of ongoing projects.
2. $1 = Rs60.
Source: Asian Development Bank estimates.

10. Four major economic benefits were quantified: time saved procuring water, resource cost benefit, benefits from reduced NRW, and savings in health care expenditure.

11. **Time saved in procuring water.** The households save time due to continuous water availability within the household compared with time spent obtaining water from other sources prior to the project. The 2013 baseline surveys in project towns estimate the time savings per household per year to be in the range of 21–53 days (about $0.79 million–$2.0 million) by 2019. Table 2 shows economic value of time saved in the subproject cities.

Table 2: Economic Benefits from Time Saved in Collecting Water

	Number of House-holds	Price of Labor/ Annum (Rs)	Time Savings/ Household/Year[a] (working days)	Shadow Price/ Laborer/Day[b] ($)	Economic Value ($ million per year by 2019)
Pali	47,800	8,899	30.9		1.71
Tonk	34,340	8,899	53.1		1.96
Sri Ganganagar	49,400	8,899	30.9	1.24	2.00
Jhunjhunu	19,190	8,899	49.7		1.25
Hanumangarh	31,726	8,899	20.6		0.79

[a] Based on socioeconomic survey reports of towns, 2013.
[b] Based on 50% of casual urban unskilled laborers.
Source: Asian Development Bank estimates.

12. **Resource cost benefit.** With the increase in per capita supply, water will no longer be needed from other sources including water purchased from vendors. The resource cost benefit from water sales is calculated by using the difference in the water tariff to be paid after the project and the cost of replaced water paid through water vendors.[7]

13. **Benefits from reducing NRW.** The subprojects will help reduce the high physical loss of water, currently about 36%–76%, to 15% through system rehabilitation. This will directly result in increased per capita water supply in 2019 when project implementation is complete with services commissioned.

14. **Savings in health care expenditure.** Improved piped water will help reduce the incidence of waterborne diseases, which cause high health expenditure and loss in income during sick days. Based on national data and similar studies, about 7% of household income is

[7] About 5% of total water demand for drinking is met by water bottles at Rs1,500/kiloliter and about 7% of water for other purposes is from tankers at Rs150/kilolitre, all purchased from vendors in the project towns.

assumed to be spent on health expenditure. About 12% of health expenditure is due to waterborne and sanitation-related health expenditure, and 45% of that expenditure is due to lack of adequate water supply. An average of 12 working days are lost annually due to sanitation-related sickness resulting in a loss of Rs1,440 for a slum household and Rs3,377 for a nonslum household. In addition to the quantifiable benefits, the project will generate nonquantifiable benefits, including the economic benefit of impacts of improved school attendance and educational performance, and reduction in unpaid labor required to care for the sick.

15. Based on the assumptions, the economic internal rate of return (EIRR) was calculated and then compared with the economic opportunity cost of capital (EOCC) estimated at 12%. Detailed benefit cost analysis of the aggregate of water supply subprojects indicates an aggregate EIRR of 19.29%. Similar analysis for wastewater subprojects indicates an aggregate EIRR of 18.04%. The EIRRs of the five water supply subprojects range from 17.3% to 21.7 % and six wastewater subprojects range from 15.8% to 25.2%, higher than the EOCC of 12%. The results of the sensitivity analysis are satisfactory against downside risk, including a 20% increase in capital expenditure, a 20% increase in operating cost, a 20% decrease in benefits, and 1-year delay in project completion. The EIRRs are summarized in Table 3. The EIRRs are most sensitive to reduction in beneficiaries. All six project cities have experienced population growth above the national population growth rate. The rapid urbanization in the state will ensure sufficient demand for improved water supply and sanitation services. A summary of the current and postproject beneficiaries, connections, and water user charges is in Table 4.

Table 3: EIRR and Sensitivity Analysis (%)

Item		Tonk	Pali	Sri Ganga-nagar	Jhun-jhunu	Hanu-mangarh	Bhil-wara
Water Supply Subprojects							
Base Case	**EIRR**	**17.6**	**19.1**	**21.7**	**17.3**	**20.5**	NA
Capital (+20%)	EIRR	14.9	16.3	18.7	14.6	17.5	NA
	SV	49.0	64.0	91.0	46.0	77.0	NA
O&M (+20%)	EIRR	16.9	18.5	21.2	16.7	19.8	NA
	SV	163.0	235.0	346.0	159.0	240.0	NA
Revenue (–20%)	EIRR	13.6	15.1	17.5	13.4	16.2	NA
	SV	27.0	33.0	42.0	26.0	36.0	NA
One-year delay	EIRR	17.4	19.0	21.6	17.2	20.4	NA
Wastewater Subprojects							
Base Case	**EIRR**	**15.8**	**16.6**	**17.9**	**25.2**	**16.3**	**20.3**
Capital (+20%)	EIRR	13.0	13.7	14.9	21.2	13.3	17.1
	SV	29.0	35.0	43.0	65.0	30.0	67.0
O&M (+20%)	EIRR	15.7	16.5	17.8	25.1	16.2	20.2
	SV	480.0	630.0	1,010.0	981.0	657.0	1,190.0
Revenue (–20%)	EIRR	12.3	12.9	14.1	20.2	12.6	16.2
	SV	21.0	24.0	29.0	38.0	22.0	38.0
One-year delay	EIRR	15.7	16.5	17.8	25.2	16.2	20.2

EIRR = economic internal rate of return, O&M = operation and maintenance, SV = switching value.
Source: Asian Development Bank estimates.

Table 4: Summary of Subprojects

	Beneficiaries				Connections (No.)		User Charge (Rs)		Average Water Supply (lpcd)	
Subprojects	**2014**	**Coverage**	**2019**	**Coverage**	**2014**	**2019**	**2014**	**2019**	**2014**	**2019**
Water Supply										
Tonk	94,998	55%	168,105	90%	16,700	29,492	1.56-4.00/kl	8.61/kl	72	135
Pali	165,680	69%	237,168	90%	33,701	44,749	1.56-4.00/kl	5.59/kl	90	135
Sri Ganganagar	170,755	68%	250,038	90%	38,752	52,091	1.56-4.00/kl	4.00/kl	88	135
Jhunjhunu	113,814	92%	120580	92%	19236	20670	1.56-4.00/kl	12.20/kl	22	135
Hanumangarh	140,863	89%	154830	90%	27675	30966	1.56-4.00/kl	6.75/kl	49	135
Total	**686,110**	**67%**	**930,721**	**90%**	**136,064**	**177,968**				
Wastewater										
Tonk	0		134,484		0	23,594	0	65/mth		
Pali	0		189,734		0	35,799	0	39/mth		
Sri Ganganagar	0		200,031		0	41,673	0	53/mth		
Jhunjhunu	0		96,464		0	16350	0	96/mth		
Hanumangarh	0		123,864		0	24773	0	52/mth		
Bhilwara	0		298,982		0	61699	0	119/mth		
Total			**1,043,559**			**203,888**				

kl = kiloliter, lpcd = liters per capita per day, mth = month, No. = number.

Assumptions and notes:

1. Current user charge (2014) represents the present tariff rate levied by Public Health Engineering Department.
2. Proposed water tariff assumes that volumetric tariff rates will apply to the six project cities.
3. Town-specific proposed tariff will apply from 2019 with the objective of recovering at least 50% of O&M, as agreed by the Rajasthan government. This tariff is assumed to increase by 25% every 5 years.
4. Per capita water supply (lpcd) is calculated as supply after loss divided by number of connected population through flow-measurement study in project towns.

Source: Asian Development Bank estimates.