Asian Development Bank

Punjab Intermediate Cities Improvement Investment Program (PICIIP)

Sahiwal and Sialkot Economic Analysis

Project Preparatory Technical Assistance (PPTA

1 Economic Analysis

1.1 Economic Analysis Methodology

The economic analysis of the investments under the proposed projects were undertaken in accordance with the principles and procedures set out by the ADB guidelines. The analysis period covered 10 years from the scheduled start of project implementation in 2016. Costs and benefits were forecasted according to July 2016 prices. An exchange rate of $1 = PKR104.25 was used for converting foreign exchange costs to the local currency equivalent. All costs were valued using the domestic price numeraire. The analysis derived the economic costs from its financial estimates of investment and operating costs, adjusted for transfer payments and other market distortions. The real costs were converted to border parity prices using a conversion factor of 0.9. The economic capital costs are based on the financial capital costs used in the investment plan excluding all price contingencies, interest costs, taxes, and duties.

1.2 Economic Cost Benefit Analysis

Adaptation is costly, and could be expensive sometimes for the engineering based ‘hard’ options. Hence, the implementation of an adaptation option must be economically justified. However, conducting an economic evaluation of adaptation options is often difficult because of the uncertainty in future climate change and the lack of data to support such an exercise.

A major decision-supporting tool commonly used for economic evaluation of projects is cost-benefit analysis (CBA). CBA is used to organize, appraise and present the economic costs and benefits, and inherent tradeoffs of projects taken by public sector authorities like local, regional and central governments and international donor institutions to increase public welfare. In a standard economic project appraisal, benefits and costs are discounted over time in the calculation of the net present value (NPV), benefit/cost (B/C) ratio or internal rate of return (IRR). One important issue is the selection of the discount rate, for which values of 0-20% exist in literature and often 12% is used in project practice, following the ADB guideline. Another issue is the selection of the lifetime of a project: the longer a project can be assumed to be in existence, the higher the benefits will be, assuming that the project is still delivering benefits; and assuming that costs of its maintenance and replacement do not overtake benefits.

1.2.1. Benefits of water supply

Current coverage of municipal water supply is 30% of the population. Further, 30% of the Sialkot/Sahiwal population is suffering from water related diseases. This leads to 107,938 persons (1,199,310x30%x30%) suffering from water related diseases, which are using municipality water. An average monthly medical expenditure of Rs. 800 is incurred by a household in a project area.

The findings show that the people of Sialkot/Sahiwal would be able to save Rs 2000 per person on annual basis because of reduced incidence of water-borne diseases after the project ensures better and adequate drinking water. Thus, a conservative estimate is made by including the tangible benefits.

The proposed investments would lead to a reduction in annual health cost of Rs. 381.0 Million (2000 x 107,938 x 12 / 6.8). Annual economic benefit of Rs. 381.0 Million or equivalent US$ 3.65 Million would therefore arise. However, 50% of this economic benefit amounting to Rs. 190.47 Million or US$ 1.8 Million is attributed to water related projects, and 50% is attributed to waste water & drainage related projects.

1.2.2. Benefits of Health & Hygiene

Knowledge of the health benefits of the four interventions is important not only for a cost-effectiveness analysis, but also for a cost-benefit analysis as some important economic benefits depend on estimates of health effects. Over recent decades, compelling evidence has been gathered that significant and beneficial health impacts are associated with improving safe drinking water, wastewater, solid waste disposal and sanitation facilities. The routes of pathogens to affect health via the medium of water are many and diverse. Five different routes of infection for water-related diseases are distinguished: water-borne diseases (e.g. cholera, typhoid), water-washed diseases (e.g. trachoma), water-based diseases (e.g. schistosomiasis), water-related vector-borne diseases (e.g. malaria, filariasis and dengue), and water-dispersed infections (e.g. legionellosis). While a full analysis of improved safe drinking water, wastewater, solid waste disposal and sanitation services would consider pathogens passed via all these routes, the present study focuses on water-borne and water-washed diseases. This is partly because, at the household level, it is the transmission of these diseases that is most closely associated with poor water supply, poor sanitation and poor hygiene. Moreover, water-borne and water-washed diseases are responsible for the greatest proportion of the direct-effect water and sanitation-related disease burden.

1.2.3. Non-health benefits

There are many and diverse potential benefits associated with improved drinking water, Solid waste, sewerage, drainage and sanitation, ranging from the easily identifiable and quantifiable to the intangible and difficult to measure benefits including both (a) reductions in costs and (b) additional benefits resulting from the interventions, over and above those that occur under current conditions. Some of these benefits – the direct benefits related to the health intervention - are used for calculating the cost-effectiveness ratio (CER) in terms of cost per Disability Adjusted Life Year (DALY) avoided All these benefits, on the other hand, can be used in calculating the cost-benefit ratio (CBR), which is a broader measure of economic efficiency Limited by measurement problems, the aim of this analysis is not to include all the benefits, but to capture the most tangible and measurable ones, and identify who the beneficiaries are. This approach was adopted not only because of the difficulties of measuring some types of economic benefit due to environmental changes, but also because the selected benefits were those most likely to occur in all settings.

1.2.4. Benefits of Soild Waste, Sewerage, Drainage & Sanitation

The proposed study will benefit existing population with additional projection for the future needs. The main benefit is the economic value of the time and improvements to health for people diverted to activities that will contribute to the socio-economic well-being of the household. The experience from the communities also suggests that the resultant time saving significantly reduces the stress on population.

The economic analysis is based on the traditional approach. The main benefits that have been quantified are value of time and health saved in construction of latrines.

Table 1: Economic Benefits arising from Solid Waste, Sewerage, Drainage & Sanitation improvements

BENEFICARY	Direct economic benefits of avoiding diarrheal disease	Indirect economic benefits related to health improvement	Non-health benefits related to water and sanitation improvement
Health sector	Less expenditure on treatment of diarrhoeal disease	Value of less health workers falling sick with diarrheal	More efficiently managed water resources and effects on vector bionomics
Patients	Less expenditure on treatment of diarrheal disease and related costs Less expenditure on transport in seeking treatment Less time lost due to treatment seeking	Value of avoided days lost at work or at school Value of avoided time lost of parent/carer of sick children Value of loss of death avoided	More efficiently managed water resources and effects on vector bionomics

Consumers			Time savings related to water collection or accessing sanitary facilities; Labor-saving devices in households; Switch away from more expensive water sources; Property value rise; Leisure activities and non-use value
Agricultural sector	Less expenditure on treatment of employees with diarrheal disease	Less impact on productivity of ill-health of workers	Benefits to agriculture of improved water supply, more efficient management of water resources-time saving

Average length of stay was assumed to equal 4 days (range 2 to 5). In the base case 8% of cases were assumed to be hospitalized (data source by WHO) with a range of 5% to 10% of patients hospitalized. The rest were assumed to be ambulatory. For the sensitivity analysis the base case unit costs were multiplied by 0.75 and 1.25 for the low and high treatment cost saving, respectively. The unit costs included the full cost varying between Rs.100 and Rs.300 per case of diarrhea treated.

Direct costs of a non-health care nature are mainly those incurred by the patient, and are usually related to one or more visits to the health facility, such as transport costs, other expenses associated with a visits (e.g. food and drinks) and opportunity costs (e.g. time that could have been spent more productively). The most tangible patient cost included in the analysis refers to transport, although there is a lack of data on average transport costs. In the base case it was assumed that 50% of patients use some form of transport at Rs.150 per return journey, excluding other direct costs associated with the journey. This gives an average of Rs. 300 per patient visit per visit. Other costs associated with a visit to the health facility were also assumed, such as the costs of food and drinks, and added to transport costs, Rs.300 per outpatient visit and Rs.100 per inpatient admission. Time costs avoided as a result of treatment seeking are assumed to be included in the benefits related to health improvement, and are therefore not included here.

Table 2: Calculation Methodology, data sources and values for economic benefits

Benefits by sector	Variable	Data source	Data Values (+ range)
1. Health sector			
More efficiently managed water resources and effects on vector bionomics	Unit cost per treatment	Expert opinion	Rs. 100+300 (cost per visit) Rs.300+500 (cost per day
	Number of cases	Expert opinion	216465
	Visits or days per case	Expert opinion	3 visits
	Hospitalization rate	WHO data	8.2% of cases hospitalized
2. Patients			
More efficiently managed water resources and effects on vector bionomics	Transport cost per visit	Assumption	Rs. 150 per visit
	% patient use transport	Assumption	50% of patient use treatment
	Non-health care patient costs	Assumption	Rs.100 ambulatory Rs. 150 hospitalization
	Number of cases	WHO data	91.8% of cases ambulatory 8.2% of cases hospitalized
	Visits or days per case	Expert opinion	4 days
	Hospitalization rate	WHO data	8.2%
Income gained, due to days lost from work avoided	Days off work/ episode	Expert opinion	3 days
	Number of people of working age	Population Data	20-35 Years old
	Opportunity cost of time	World bank criteria	37.5 per hr
Days of school absenteeism avoided	Absent days/ episode	Population data	3 days
	Number of school of age children	Population data	5-15 years old
	Opportunity cost of time	World bank criteria	50% of minimum wage rate
	Days sick	Expert opinion	5

Productive parent days lost avoided, due to less child illness	Number of babies	Population data	
	Opportunity cost of time	World bank data	37.11 per hr
Value of less of life avoided (life expectancy discounting future years at 3%)	Discounted productive years lost (0-4) years	WASH study 16	16.2 years (9.5-29.1)
	Discounted productive years lost (5+14 years)	WASH study 16	21.9 years (15.2-33.8)
	Discounted productive years lost (15+ year)	WASH study 16	19.0 years (16.3-22.7)
	Opportunity cost per year of life lost	World bank criteria	300 per day
3. Consumers			
Convenience time savings	Water collection time saved per household per day for better external access	Expert opinion	0.5 hours
	Water collection time saved per household per day for piped water	Expert opinion	1.5 hours
	Sanitation access time saved per person	Expert opinion	6 people
	Average household size	Population data	8 people
	Opportunity cost of time	World bank criteria	300 Rs per day

Source: WHO DATA

The analysis generated a huge quantity of data. Selected results are presented for the four interventions and include the number of people receiving water and sanitation improvements from each intervention, the number of cases of diarrhea prevented per year, the intervention costs, the potential benefits resulting from the intervention, and finally the cost-benefits ratios.

The above economic benefit of saved lives is calculated for 30% of the population connected to municipal water supply system. Since wastewater and drainage projects are also likely to affect other people. It is estimated that out of the remaining 70%, another 30% would also get direct benefit of improved wastewater & drainage services in the city. This means 40% additional under-5 lives would also be saved due to better wastewater & drainage services. It would result, therefore, into annual economic benefit of (381.0/30%*40%) Rs. 508 Million or US$ 4.87 million due to wastewater & drainage projects

The economic rationale behind the investment in the provision of water supply and sanitation is in line with the poverty reduction objectives of the Government and ADB. The communities that have poor access to drinking water are mostly poor and do not have the capacity to invest in the infrastructure. Moreover, most of them are in small settlements with the water source at considerable distance, requiring a large investment, beyond their capacity. Substantial effort and time is also required to fetch and carry clean water.

1.2.5 Transportation Benefits

Basic parameters required for valuing travel time for Motorcycle, Car, Wagon, Coaster and Bus, value of travel time under without and with project conditions have been calculated by dividing value of time per hour.

Annual value of travel time is a function of value of travel time per km. Based on these parameters worked out earlier,

1.2.6 Sensitivity Analysis and Switching Values

A sensitivity analysis for an increase in capital costs, increase in operational costs and reduction in benefits is undertaken with the results provided in the following tables 4:

1.3 ECONOMIC NET PRESENT VALUE (ENPV) AND BENEFIT COST RATIO (BCR)

Economic measures like Economic Net Present Value (ENPV), Benefit Cost Ratio (BCR) and Internal Economic Rate of Return (IERR) have been calculated to examine the economic feasibility of implementation the project. The streams of project benefits and costs have been discounted at 12 percent rates of interest and results are summarized in the following table.

Table 3: Overall Sensitivity analysis of Project

Assumption	Overall EIRR
EIRR Base Model	**24.35**
Benefits delayed three years	18.03
Incremental Benefits reduced 20%	20.74
Development cost increased 20%	21.38
Benefits reduced 20% and development cost increased 20%	17.99
	Million PKR
Cost	23,378
Benefits	28,893
ENPV	5,515
B/C R	1.24

Table 4: City Sensitivity Analysis

Assumption	Sahiwal	Sialkot
EIRR Base Model	**16.46%**	**26.05%**
Benefits delayed three years	12.21%	19.91%
Incremental Benefits reduced 20%	13.42%	22.32%
Development cost increased 20%	14.03%	22.98%
Benefits reduced 20% and development cost increased 20%	10.78%	19.47%
	Million PKR	
Cost (M. Rs)	18,256	11,824
Benefits (M. Rs)	24,282	26,514
ENPV (M. Rs)	6,026	14,690
B/C R	1.33	2.24