Pakistan

Korangi Wastewater Management Project

I. Background of the Project

Pakistan's population has been growing at an annual rate of 3 percent with the growth rate in Karachi, a megacity with a population of 12 million, at an even higher rate of 5 percent. The national life expectancy at birth is only 58 years, and a large percentage of deaths, especially of children, are caused by transmission of waterborne diseases.

It is estimated that only 55 percent of urban residents have access to adequate sanitation. Most of the country's urban water supply and sewerage works were installed—or last upgraded—more than 20 years ago. They are operating above design capacity, in generally poor condition, and many have reached the end of their serviceable life.

As with most cities, persons living in low-income areas typically receive inadequate sanitation services. Most sewage is discharged untreated directly to waterways, thereby damaging the environment and posing health risks to the public. Storm water drains are often in the form of open drains interconnected with sanitary sewers, and these drains are often clogged with solid wastes. During heavy rains noxious mixtures of rainwater runoff, municipal sewage, and industrial effluent overflow into streets in many areas thereby contaminating homes, shops, and factories. Areas with flat topography and poor natural drainage, such as Karachi, are most severely affected by these sewerage and drainage inadequacies. Shallow groundwater, frequently used as the major source of drinking water for low-income communities, becomes a means of disease transmission as shallow aquifers are contaminated by sewage.

The Government has recognized that inadequate access to safe drinking water and sanitation facilities constrains economic and social development, particularly in urban areas. Thus, it has allocated substantial budgetary provisions to improve the basic social services of education, health,

population welfare, water supply and sanitation. The Government is also adopting policies to overcome many urban water and sanitation financial problems. Steps are being taken to: (i) encourage water supply metering in new schemes, (ii) increase the magnitude and progressiveness of user fees to recover costs in metropolitan cities, (iii) provide loans to municipalities at concessional interest rates with relatively long payback periods, (iv) pass on external loans to local water and sanitation utilities on concessional terms, (v) match service provisions with affordability and users' willingness to pay, and (vi) gradually eliminate provincial subsidies to municipal governments for operational expenses.

ADB has historically played a major role in providing assistance for water supply, sanitation and urban development in Pakistan, and ADB's operational strategy—as well as the medium-term program for Pakistan—envisions continued support to the sector. Since 1976, the ADB has provided direct financial assistance of $340 million for six projects in the sector.[14]

II. Project Details

The Project covers 14,000 hectares of densely populated, predominantly industrial areas southeast of Karachi. The area consists of the two townships of Korangi and Landhi, covering one-fifth of Karachi's land area (see Map). The two townships have 1.3 million permanent residents, 200,000 transient residents and factory workers, and nearly 5,000 industrial facilities.

The objectives of the Project are to: (i) improve the urban environment and public health in the Korangi and Landhi townships; (ii) upgrade the quality of the aquatic environment of the Malir River and Girzhi Creek; (iii) improve public awareness of hygiene practices to reduce disease incidence; (iv) phase-out raw industrial wastewater for irrigating edible food

[14] *Two projects—amounting to $140 million—have targeted urban development and sewerage in Karachi. The rest are ongoing in the sector (Loan Nos. 1001-PAK/ 1002-PAK: Karachi Sewerage Project, for $85 million, approved on 14 December 1989; Loan No. 1004-PAK: Second Urban Development Project, for $66 million, approved on 19 December 1989; and Loan No. 1260-PAK:Urban Water Supply and Sanitation Project, for $72 million, approved on 4 November 1993).*

Map
Pakistan Korangi Wastewater Management Project

crops in Korangi; (v) strengthen the Karachi Water and Sewerage Board (KWSB)-community partnership to provide household sewer connections, using housing block committees and NGOs; (vi) strengthen the capacity of KWSB to construct, operate, and maintain sewerage networks and sewage treatment plants; (vii) enhance revenue collection to achieve full cost recovery; (viii) facilitate private sector participation in KWSB's operations; and (ix) plan for Karachi's wastewater investment needs to the year 2020.

The Project has five parts: four comprise civil works and the fifth comprises consulting services. It is envisioned that the Project will solve the most severe environmental problems of Korangi and Landhi. Untreated industrial effluent has caused long-term health hazards due to toxic chemicals that enter the food chains of fish and vegetable cash crops, many of which accumulate over several years. Project facilities will improve aquatic and terrestrial environments, improving the livelihood of fishers and reducing the risk of contracting waterborne diseases for residents. An environmental assessment of the Project is shown in Appendix 4.

The total cost of the Project was estimated at $101 million equivalent covering $36.6 million in foreign exchange. ADB financed 69 percent of total project cost amounting to $70 million. The loan will have a repayment period of 35 years including a grace period of 10 years.

III. Analytical Methods

The Project's economic analysis consists of: (i) evaluation of technically feasible alternatives, confirming that the chosen alternative represents the least-cost solution in economic terms; (ii) estimation of the incremental economic costs; (iii) identification and valuation of the major economic benefits; (iv) a cost-benefit analysis; and (v) a sensitivity analysis.

The Project's provision of a 5.8 km trunk sewer, 120 km of lateral and lane sewers, and a biological sewage treatment plant will: (i) yield cost savings for residential, commercial and industrial wastewater generators, which will no longer require on-site treatment systems; (ii) reduce productivity losses due to industrial wastewater-related diseases, and reduce medi-

cal costs; (iii) minimize the need for heavy industrial/commercial polluters to relocate due to government and public pressure and environmental laws; and (iv) increase the value of properties served by the Project and properties close to the waterways. The economic benefits of the Project, including major environmental impacts, were valued using three broad categories: (i) human welfare, (ii) human health, and (iii) environmental values.

The economic cost of components includes base cost and physical contingencies, but is net of taxes, duties and transfer payments. The economic life of the civil works components is assumed to be 30 years after construction and 10 years for electrical and mechanical components. The economic analysis has been conducted at border prices. A conversion factor of 0.9 has been applied to all non-tradable inputs that are generally represented by the civil works. No market distortion has been assumed for skilled labor, while for unskilled labor a conversion factor of 0.64 was used. A shadow wage rate of 64 percent of the market wage rate for unskilled labor in the project area is justified because of prevailing underemployment or unemployment in Karachi. Operations and maintenance costs after project completion are computed by analysis of staffing, energy and repair costs, and increased by one-half percent every five years, with labor costs adjusted by the shadow wage rate. In view of the relatively competitive land market, the opportunity cost of land for the sewage treatment plant is estimated through a market price of Pakistan rupees(PRs)3.0 million per hectare. The economic land cost is included as a single payment in the first year of the Project. A residual value, estimated to remain constant relative to an anticipated real growth rate in gross domestic product of 3.8 percent per annum for the country, has been included at the end of the project life.

IV. Economic Valuation of Environmental Impacts

A. Cost of Illness and Lost Productivity

In the following section, monetary values (or proxies for values) for the health impacts are presented to obtain benefits due to improved

sanitation resulting from containment and treatment of raw sewage. Baseline estimates of disease incidence and medical treatment costs for the project area were provided by ADB-financed domestic consultants. Estimates of an individual's willingness-to-pay (WTP) to avoid adverse health impacts represent one measure of the total value of improvements in human health. However, if good health status is regarded as a "right" then it is more correct to assess the total willingness-to-accept compensation (WTA) to continue to suffer from the deleterious effects on human health. However, limited data are available on valuing morbidity-relevant WTP or WTA for the applicable cases and thus cost-of-illness (COI) estimates were used to value changes in disease morbidity. The COI approach provides a lower-bound estimate of the value of avoiding an adverse health effect; it reflects the out-of-pocket costs of being sick, not the value of remaining in good health. COI underestimates an individual's WTP to avoid adverse health impacts (and an individual's WTA to tolerate poor health), and this should be noted in the valuation. It was estimated, based on surveys, that the COI due to waterborne diseases was PRs200 per person per year. Of the 1.5 million residents within the Project area, it is estimated that approximately 100,000 individuals are affected by waterborne diseases in any given year. Based on surveys, it was also estimated that the COI due to ingestion of contaminated vegetables, milk, and meat is PRs500 per person per year. It was also estimated that 50,000 individuals annually ingest food products contaminated by sewage.

To determine the COI, the cost of lost work time was used as a proxy for value. This is assumed to be equal to the per capita gross provincial product, which includes returns to all factors of production (not just labor), and thus may overstate the value of lost work time. A figure of PRs100 per person per day, or a total of PRs10 million per year, represents the value of lost work time due to illness. Each incident was estimated to result in only one lost day of work. Table 1 shows the yearly aggregated estimate under the item health benefits.

B. Industrial Relocation and Increase in Property Value

It was estimated that without the Project approximately 10 percent of the 5,000 industries in the project area would relocate due to the extent of the pollution. The 10 percent would typically be composed of medium-size industries such as textiles and pharmaceutical firms. The larger firms would be able to shoulder the cost of on-site treatment, while many smaller firms would be forced to close down. The relocation cost per industry amounts to an estimated PRs8 million, which is spread equally over three years.

The benefits of improved wastewater disposal and treatment, and the consequent improvement in the environment, may also be reflected in the amount people are willing to pay for property either in terms of rent or the purchase price of a house. Conservative estimates have been used for the increase in land value likely to take place as a result of the Project. The total developed area of the project site is around 6,960 ha, with about 55 percent being residential. An average land value of PRs3 million per ha was adopted for residential property and other developed land based on estimates provided by the Karachi Development Authority. It is estimated that improved wastewater collection will increase total land values by 10 percent to PRs1,150 million, with the benefits being spread over five years for about PRs230 million per year.

The base case economic internal rate of return (EIRR) was calculated at 22.4 percent. In terms of contribution to the level of benefits, health savings accounted for 14 percent of total benefits; increases in land value accounted for 7 percent; and industry relocation savings accounted for 12 percent. Thus, the valued environmental benefits account for over one third of total benefits.

The estimated EIRR is conservative since a large amount of environmental benefits and other social improvements related to the Project were not quantified. Among the potential benefits that were not counted are: (i) improvements in water quality used for industrial, agricultural, and aquacultural purposes; (ii) reduced corrosion in the sewage treatment plant and culverts/pipes, and benefits from the use of waterways for trade and

Table 1: Integrated Economic and Environmental Analysis *(PRs million)*

	Economic Cost				
Year	Capital Cost	Operating Cost	Total	Health Benefit	Property Value Increase
1998	*590.7*		*590.7*		
1999	*207.0*		*207.0*		
2000	*661.5*		*661.5*		
2001	*800.2*	*10.7*	*810.8*		
2002	*552.1*	*18.7*	*570.8*		
2003	*529.5*	*26.6*	*556.2*	*55.5*	*229.6*
2004	*428.1*	*26.6*	*454.7*	*58.3*	*234.1*
2005		*26.6*	*26.6*	*61.2*	*238.8*
2006		*26.6*	*26.6*	*64.2*	*243.6*
2007		*26.6*	*26.6*	*67.5*	*248.5*
2008		*28.7*	*28.7*	*70.8*	
2009		*28.7*	*28.7*	*74.4*	
2010		*28.7*	*28.7*	*78.1*	
2011		*28.7*	*28.7*	*82.0*	
2012		*28.7*	*28.7*	*86.1*	
2013		*30.7*	*30.7*	*90.4*	
2014		*30.7*	*30.7*	*94.9*	
2015	*80.7*	*30.7*	*111.4*	*99.7*	
2016		*30.7*	*30.7*	*104.6*	
2017		*30.7*	*30.7*	*109.9*	
2018		*30.7*	*30.7*	*115.4*	
2019		*30.7*	*30.7*	*121.1*	
2020		*30.7*	*30.7*	*127.2*	
2021		*30.7*	*30.7*	*133.6*	
2022		*30.7*	*30.7*	*140.2*	
2023		*32.7*	*32.7*	*147.2*	
2024		*32.7*	*32.7*	*154.6*	
2025		*32.7*	*32.7*	*162.3*	
2026		*32.7*	*32.7*	*170.5*	
2027	*(1,708.0)*[a]	*32.7*	*(1,675.6)*	*179.0*	

[a] *Negative residual value of land*

HH = household

Increases in rental value rather than increases in land value are now used in economic analysis of ADB projects. Economic internal rate of return (EIRR) was calculated at 22.4 percent.

Benefit				
Industrial Relocation Savings	Construction/ Maintenance for HH Treatment	Savings from Industrial On-site Treatment	Total	Total Net Benefit
				(590.7)
				(207.0)
				(661.5)
				(810.8)
732.5			*732.5*	*161.8*
732.5	*226.0*	*291.4*	*1,535.0*	*978.8*
732.5	*228.3*	*277.7*	*1,530.9*	*1,076.2*
	230.6	*275.5*	*806.1*	*779.4*
	232.9	*273.0*	*813.7*	*787.1*
	235.2	*270.1*	*821.2*	*794.6*
	237.6	*266.7*	*575.1*	*546.5*
	237.9	*263.5*	*575.8*	*547.1*
	242.3	*259.4*	*579.8*	*551.1*
	244.7	*255.1*	*581.8*	*553.2*
	247.2	*249.8*	*583.1*	*554.4*
	249.7	*244.3*	*584.3*	*553.7*
	252.2	*237.4*	*584.5*	*553.8*
	254.7	*230.2*	*584.5*	*473.2*
	257.2	*221.3*	*583.1*	*552.5*
	259.8	*211.9*	*581.6*	*551.0*
	262.4	*200.4*	*578.1*	*547.5*
	265.0	*188.2*	*574.4*	*543.7*
	267.7	*188.2*	*583.1*	*552.4*
	270.4	*188.2*	*592.1*	*561.5*
	273.1	*188.2*	*601.5*	*570.8*
	275.8	*188.2*	*611.2*	*578.5*
	278.5	*188.2*	*621.4*	*588.7*
	281.3	*188.2*	*631.9*	*599.2*
	284.1	*188.2*	*642.8*	*610.1*
	287.0	*188.2*	*654.2*	*2,329.7*

transport; (iii) sales of wastewater sludge as fertilizer or filling material; (iv) reduction of pollution loads (heavy metals) in the coastal zone; (v) increased productivity of fisheries; (vi) improvements in the aesthetic quality of the waterways; and (vii) provision of safe irrigation water for some 300 irrigators using toxic industrial wastewater. Furthermore, no attempt was made to value the improvement in the biological environment. Though these benefits were unquantified, it is clear through the inclusion of several environmental impacts in the valuation process that the Project will clearly benefit the environment.

V. Notable Aspects

The novel aspect of this Project is that it is primarily concerned with urban environmental issues; once again it shows that environmental problems are not confined to rural areas where "nature" predominates. In this project, the ADB will assist the Government of Pakistan to address serious problems of urban water supply availability and pricing. These efforts will improve public health, enhance the aquatic environment in Pakistan's major urban area, enhance public awareness of hygiene, improve KWSB, and facilitate private-sector activities in this general area of water management.

It is interesting to note that the most important environmental benefits are not esoteric issues but are closer to basic needs such as health and clean water. Project benefits accrue because of cost savings for residential, commercial, and industrial users. In addition, benefits will arise because of lower incidence of illness and because of enhanced property values. Avoided costs of illness provide one means to estimate project benefits. Taken together, environmental benefits account for approximately one third of total project benefits. Again, it illustrates the valuable role that development projects can make to improve environmental quality.

Revenue-generating public institutions continue to face problems of cost recovery. Water supply, wastewater management, and irrigation management agencies are some examples of such institutions. Properly conducted WTP and ability-to-pay studies can clearly demonstrate the existence of potential cost recovery for these institutions. Under the Project,

the Government agreed to review key issues such as existing water standards, agency autonomy, and efficient pricing for wastewater treatment. The review of such issues will be aided by the figures generated from the economic valuation of environmental impacts.