Islamic Republic of Pakistan

Ex-Post Evaluation of Japanese ODA Loan Project:
Ghazi Barotha Hydropower Project (I) (II)

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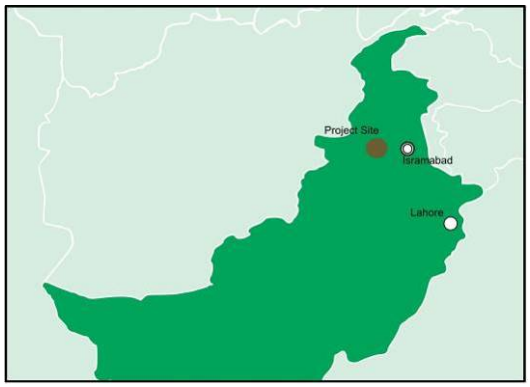
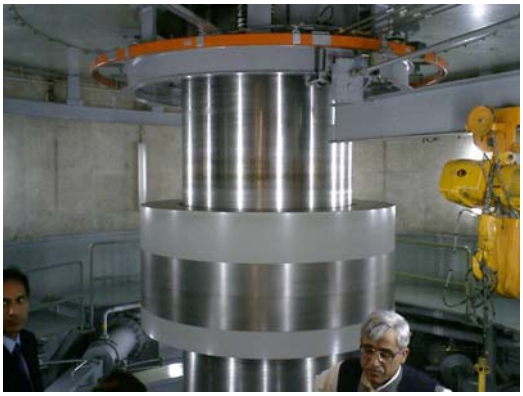
Pegasus Engineering Corporation
Field Survey: November, 2008

1. Project Description and Outline of the ODA Loan Assistance



Location of the Project



Shaft to Connect Generator and Turbine, Constructed by the Project

1.1. Project Objective

The power supply shortage is a serious issue and it has impeded the industrial and economic growth of the Islamic Republic of Pakistan, or Pakistan. The high growth rate in electricity demand is projected to continue yearly, and promoting the development of electric power resources to meet this rapidly growing demand is a major issue. Domestic resources in petroleum, natural gas, and other fossil fuels are limited and hydropower development is anticipated to increase supply and control imported fuel; it is an important strategy of the nation as indicated in Five-year Plans.

Public sector of the power in Pakistan was mainly managed by two major national power organizations namely, the Water and Power Development Authority (WAPDA) and the Karachi Electricity Corporation (KESC) until WAPDA was reorganized in 1998. WAPDA was established as 100% owned by the government, that was responsible for supplying power within the country (service area other than KESC), and KESC's service area is

limited to Karachi City and its suburbs.

This project was co-financed by JICA, the World Bank, the Asian Development Bank and others.

1.2. Objectives

The objective of this project is to meet WAPDA's constant power shortage and the increase in future power demand, by constructing a barrage at about 7km downstream of the Tarbela Dam, located in the upstream region of the Indus River in northern Pakistan, a 52km-long power channel, and a hydroelectric power station (facility capacity: 290MW x 5), downstream of the channel; thereby contribute to the development of the country's economy and industrial activities.

1.3 Borrower/ Executing agency

President of the Islamic Republic of Pakistan

/ Water and Power Development Authority (WAPDA)

1.4 Outline of the Loan Agreement (L/A)

Approved Amount/ Disbursed Amount	20 billion yen (I) 14,902 million yen (II) / 19,951 million yen (I) 11,474 million yen (II)
Exchange of Notes Date/ Loan Agreement Signing Date	Jan. 1996/ Mar. 1996 (I) Aug. 1996/ Mar.1997 (II)
Terms and Conditions	Interest Rate: 2.3% Repayment Period: 30 years (Grace Period: 10 years) Conditions for Procurement: General untied
Final Disbursement Date	Jan. 2003 (I) , May 2006 (II)
Main Contractor (Over 1 billion yen)	Contractors for the components of ODA Dongfang Electric Corporation of China (China), VOITH Hydro Kraftwerkstechnik GmbH. & Co.(Germany), Toshiba (Japan) / Mitsui & Co. (Japan) Contractors for the components by other donors Ghazi Barotha Contractors (GBC) (Impregilo(Italy), ED. Zublin AG. (Germany), Nazir & Co (Pvt) Ltd.((Pakistan), Saadullah Khan & Brothers (SKB) (Pakistan) (JV))
Main Consultant (Over 100 million yen)	Pakistan Hydro Consultants(PHC) (National Engineering Services Pakistan (Pvt) Ltd.(NESPAK) (Pakistan), Associated Consulting Engineers (Pvt) Ltd. (Pakistan), Binnie & Partners

	(Overseas) Ltd.(U.K), Harza Engineering Company International (U.S), Ewbank Preece Ltd. (U.K) (JV))
Feasibility Studies, etc.	Jul., 1992 F/S prepared (by Pakistan Hydro Consultant (JV); conducted by technical assistance of the World Bank)

2. Evaluation Outcome (Overall rating: A)

2.1. Relevance (Rating: a)

2.1.1. Relevance at Appraisal

The capacity of the power generating facilities in Pakistan was 11,349 MW in 1994; the Eighth Five-year Plan (1993 to 1998) indicated the necessity of an increased capacity of about 4,500 MW (16,286 MW in 1997 to 1998) with maintaining a balance between hydraulic and thermal power. The power shortage was acute reaching 1,800 MW (1994) during peak hours, and a planned power outage of two to four hours in the urban area and six to eight hours in rural areas was implemented. The annual average rate of increase in electricity demand was projected at 8.8% the Eighth Five-year Plan; and to cope with this power supply-demand gap, short-term thermal power generation by the private sector was pursued. However, for the long term, policies promoting power generation that used the domestic resources of coal and coal fired thermal power were enacted.

The Eighth Five-year plan indicated to secure plant capacity that would achieve a peak power surplus to a certain extent by FY1997/1998. For this purpose, the overall nationwide power plant capacity would be increased by 4,500MW from 11,729MW in FY1993/1994 to meet an increase of 1.4 times or 16,286MW by FY1997/1998 (of which the WAPDA facility capacity was 11,422MW). Specifically, about 2,000MW (including 1,450MW supplied by the Ghazi Barotha power plant) by WAPDA/KESC and an increased power plant capacity of about 2,500MW by private Independent Power Producers (IPPs) would be required. In this plan, with the progress of private sector, increase of the power plant capacity by the public sector was expected, provided the main investment programs of the public sector are re-examined.

2.1.2. Relevance at Ex-Post Evaluation

Potential hydraulic power generation capability was 46,000MW as of 2007, however, the current power capacity in use is only 6,499MW. Of the total national electricity output of 97,094GWh, it has maintained at 31,942GWh.

According to “the Medium-term Development Framework 2005-2010,” a power supply shortage is still projected to continue. In view of the GDP growth rate of 5.8%, a peak-hour demand amounting to 21,500MW in 2010 is projected. Impeding factors that are of concern are the delay in hydropower development, reduced winter output of hydropower, gas supply restrictions, deterioration of thermal power capacity, and frequent repairs. Despite the share of hydropower that is more than 30 percent of the total energy

composition, there is a 6,499MW generating capacity in summer, however, it is visibly decreased to 1,872 MW.

The government has continuously strengthened power generation plants, and the volume of required power supply of 67,480GWh in 2007 may be increased to 103,500GHw in 2010 by reinforcing power plant facilities of 7,100MW during the period of 2005 to 2010. In addition, a bilateral agreement was signed with Iran to import 1,000MW in April 2007.

Ghazi Barotha project was important for providing an inexpensive power supply and for mitigating the power supply-demand gap. From this perspective, this project has been highly relevant with the country's national policies and development needs at the times of both appraisal and ex-post evaluation, therefore its relevance is high.

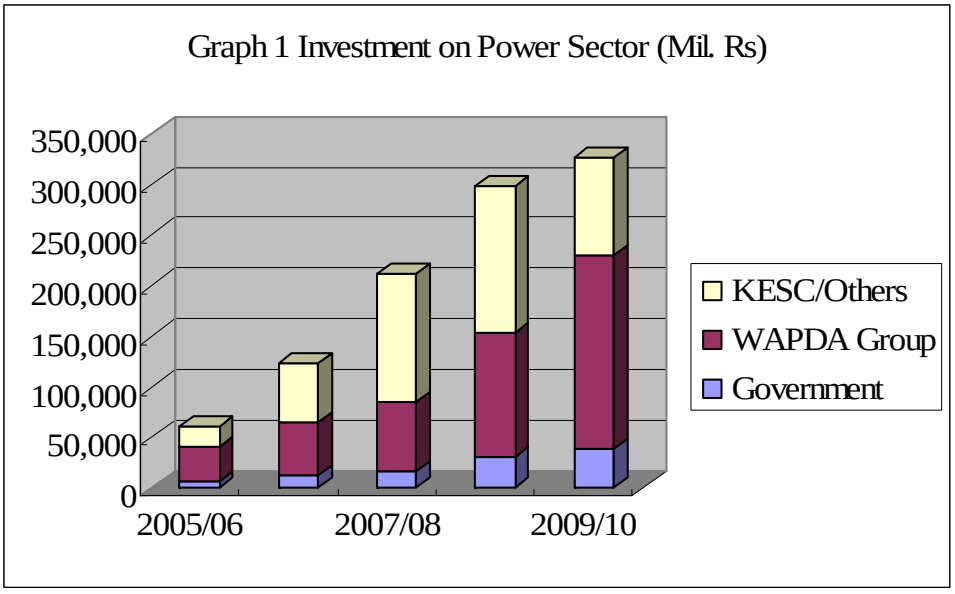


Table 1 Investment on Power Sector (Mil. Rs)					
Actual / Plan	Actual				Plan
Fiscal year	2005/06	2006/07	2007/08	2008/09	2009/10
Total	61,159	122,689	212,554	299,482	326,386
Government	6,178	13,634	16,440	31,300	39,973
WAPDA	35,587	52,655	68,014	122,390	190,552
KESC/Others	19,394	56,400	128,100	145,792	95,861

MTDF2005-10, Planning Commission

Power facility

Diversion barrage

2.2. Efficiency (Rating: b)

2.2.1. Project Outputs

The construction of Ghazi Barotha Power Plant was planned in the northwestern region of Pakistan—located downstream of already existing Tarbela power plant. The plant avails the hydrological drop with the discharged water level between Tarbela power plant and the intersecting point of the Indus and Haro rivers. The incline at this point is 63km horizontally and 76m vertically.

The project is composed of (1) intake barrage located 7km downstream Tarbela Dam, (2) a 52km power channel with 1,600m^3/second capacity, and (3) part of the power plant structure. At this plant, a 1,450MW generator was installed, capable of producing the projected annual average power generation of 6,600 million kWh.

The Japanese ODA loan component of this project is part of the foreign currency cost for the civil engineering works and the power plant equipment (three turbines and five generators).

Minor modifications were implemented due to the bedrock, soft ground, and other geological conditions during the construction works, as well as a review of the transmission network according to the regional power supply and demand conditions that did not substantially affect the actual performance of the project. The reasons for the modifications were reasonable, and problems were not seen during the modification process.

Plan	Actual Performance
Barrage: Planned Flood Adjustment Capacity: 18,700 m^3/s Maximum Flood Adjustment Capacity: 46,200 m^3/s	Barrage: (as planned)
Power Channel (1) Flow volume: 1,600 m^3/sec capacity (Dry season(Oct. to April): minimum300 m^3/sec) (2) Length: 52,027m (3) Slope: 1:9,600 (4) Maximum Depth: 9m (5) Bed Width: 58.4m (6) Flow Velocity : 2.33m/s (7) 33 bridges, 20 road bridges, 11 crossing bridges, 1 railway bridge, 1 gas pipeline	Power Channel (in general, as planned), despite (7) 33 bridges, 19 road bridges, 12 crossing bridges, 1 railway bridge, 1 gas pipeline
Power Plant (Annual average generation capacity: 6,600GWh) (1) Head pond located at the end of the power channel, (2) Self priming siphon spillway (capacity 1,600 m^3/sec) with energy dissipation in a stilling basin and a baffle chute, (3) Two head ponds, forebay and round gate, (4) Power Intake structure with fixed wheel gates and stop logs, (5) Five penstocks each with a 10.6m diameter, (6) Five generating units of 290MW each (total generating capacity: 1,450MW) and attached structure, (7) Tailrace channel located at intersecting point of Haro rivers.	Power Plant (as planned)
Power Transmission Line: Three routes, each 500kV design (1) New single line to Peshawar, (2) 4 transmission lines to the power plant, dividing the existing 2 lines.	Power Transmission Line(as planned)

2.2.2. Project Period

The period for the construction works including procurement is as follows.

(Plan)

Barrage and channel:

Jan. 1994 to Feb. 2000 (74 months)

Power plant (Japanese ODA loan component):

Jan. 1994 to Dec. 2001 (84 months)

(Actual Performance)

Barrage and channel:

Jan. 1994 to Dec. 2003 (120 months)

Power plant (Japanese ODA loan component):

Jan. 1994 to Sep. 2004 (129 months)

Start of commercial operations:

Jun. 5, 2005

The construction period was 62% delay against the overall plan and 54% to the power plant by the Japanese ODA loan in particular. The delay was mainly due to claims in the total amount of 18,900 million rupees filed in an international arbitration case over operation man-hours by the Italian contractor, Impregilo, the JV representative in charge of constructing the power channel. Based on negotiations with a panel of experts and dispute committee organized by WAPDA, the dispute ended in an amicable settlement. However, the delay in constructing the water channel for the upper portion of the facility critically impacted the operations of the entire plant.

In addition, the period of completion for the channel was extended by 11.5 months. The War in Afghanistan after the 9.11 terrorist attacks in the U.S. was one of the reasons for extending the period of the construction works, as the contractor for barrage and power channel temporarily became absent from the project, for instance. As well, involuntary resettlement in conjunction with land acquisition also caused the delay.

2.2.3. Project Costs

Details of the project costs and a comparison of the plan components with the actual performance that was achieved are given in Table 2.

Table 2 Project Cost Details

Unit: million dollars

Project costs	Plan			Actual			Increase or decrease (%)
	Foreign currency	Local currency	Total amount	Foreign currency	Local currency	Total amount	
Preparation	0.66	29.26	29.92	0.00	25.75	25.75	-13.9%
Land acquisition	0.23	88.56	88.79	0.00	113.91	113.91	28.3%
Civil works	814.04	362.68	1,176.72	759.54	339.51	1,099.05	-6.6%
Barrage	178.24	94.58	272.82	188.74	79.30	268.04	-1.8%
Power channel	370.92	154.41	525.33	294.56	176.53	471.09	-10.3%
Power plant construction	264.88	113.69	378.57	276.25	83.68	359.92	-4.9%
Equipment/Apparatus supply	347.77	86.82	434.59	210.32	20.63	230.95	-46.9%
Consultant and administrative costs	27.90	58.80	86.70	20.14	102.40	122.54	41.3%
Price escalation	80.47	35.84	116.31	71.02	25.95	96.97	-16.6%
Physical contingency[1]	127.71	60.11	187.82	111.21	145.22	256.44	N/A
Tax	0.00	31.10	31.10	0.00	37.98	37.98	22.1%
Interest during Construction	350.00	79.04	429.04	21.09	333.17	354.26	-17.4%
Total	1,748.78	832.22	2,581.00	1,193.33	1,144.52	2,337.85	-9.4%

Source: Appraisal Report, Reply of WAPDA to Questionnaire

The share of the Japanese ODA loan to the total amount of the participation loan for this project is 25.8% as indicated in Table 3.

Table 3 Breakdown of the Participation

(unit: million dollars)

Organization	World Bank	Asian Development Bank	Germany KfW	European Investment Bank	Islamic Development Bank	JICA	Total
Amount	350	300	103.8	35	35	286.2	1,110
Percentage share	31.5%	27.0%	9.4%	3.2%	3.2%	25.8%	100%

Source: Project Completion Report, WAPDA

There was an overall decrease of about 9.4% in total project costs with regard to the project plan. The increase or decrease of each project cost item and the underlying

[1] Physical contingency is allocated for the payment for the increased volume of quantity in the BoQ (Bill of Quantity) contract. This item is extracted from the actual construction cost to compare with the original allocation.

reasons are as follows.

Land acquisition (increase): Land acquisition for barrage construction increased as well as compensation cost,

Public works (decrease): The successful bid for the power plant construction was low,

Equipment supply (decrease): The successful bid for equipment supply was low,

Consultant fee (increase): Consultants' fee revised accompanied by the increase of M/M due to the extension of construction work,

Tax (increase): Increase in taxes, such as customs duty.

As mentioned above, the output for this project was as planned with minor modifications. Although the project cost was lower than planned, the project period was much longer than planned (by 62%); therefore efficiency of the project is fair. Delays related to the barrage and channel construction affected commencement for commercial operations of the power plant financed by the Japanese ODA loan.

2.3. Effectiveness (Rating: a)

2.3.1. Mitigation of Insufficient Power Supply

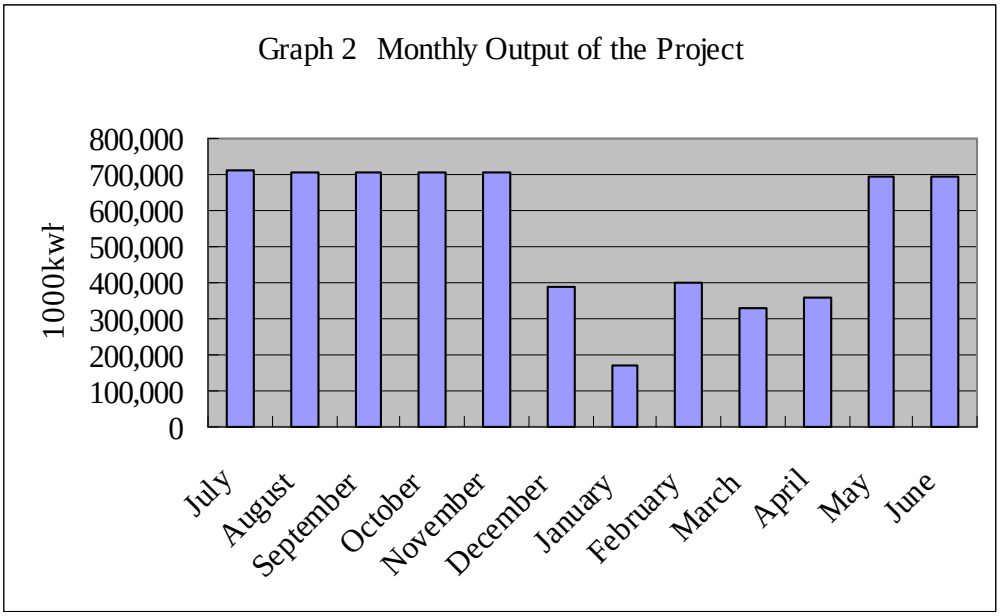
Each operation and effect indicator value after construction, aimed at alleviating power supply shortage, has shown standard operating conditions. The annual facility usage ratio is comparatively low because only three to four turbines out of five turbines were in operation during the drought season (October to April). This was anticipated in the project.

Table 4 Operation Effect Indicator and Actual Performance Value

Operation and Effect Indicator	Plan	2005/06	2006/07	2007/08	2007-08/ plan ratios
Unplanned outage for the year (hours)	-	64	50	46	-
Annual planned outage (hours)	-	3,676	3,243	2,793	-
Facility usage ratio (%)	52	52	53	54	104%
Annual hours of operation (hours)	22,775	25,448	25,544	26,306	116%
Hydropower usage rate (%)	100	100	101	104	104%
Annual total volume of inflow (m^3)	32,800	37,444	38,689	40,593	124%
Power transmission end electric energy (GWh/year)	6,600	6,614	6,673	6,855	104%
Maximum output (MW)	1,450	1,450	1,450	1,450	100%

Source: Reply of WAPDA to Questionnaire

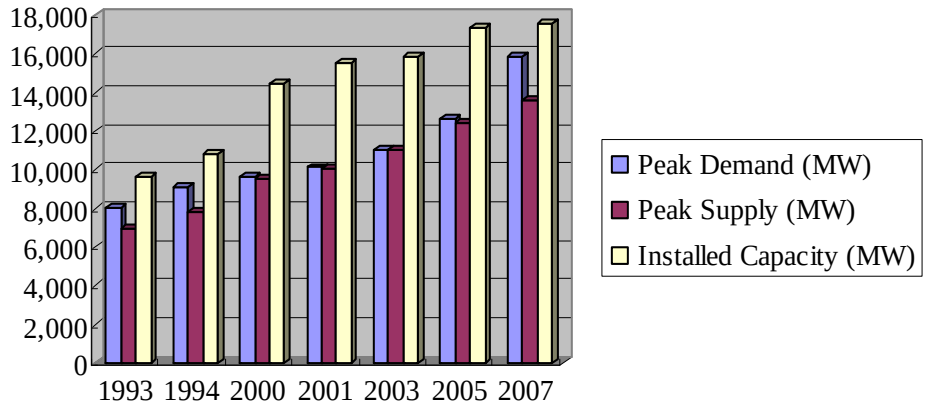
Graph 2 Monthly Output of the Project



Source: Reply of WAPDA to Questionnaire

The WAPDA power generation capacity increased after the completion of the project, however, the peak-hour supply capacity remains at 86% (2007) and there continues to be a shortage. This is because an additional large power plant has not been constructed since Ghazi Barotha and plant capacity has not increased. In contrast, as of 2005, the growth in demand has been marked; and this is attributed by the economic growth identified in the GDP transition.

Figure 3 Power Supply/Demand of WAPDA Operational Area



Source: Electricity Marketing Data, Jan.2008, WAPDA

Table 5 WAPDA Power Supply and Demand

Item/Fiscal Year	1993	1994	2000	2001	2003	2005	2007
Power generation equipment capacity (MW)	9,681	10,853	14,444	15,534	15,819	17,395	17,526
Hydraulic power (MW)	4,725	4,825	4,825	5,039	5,039	6,493	6,474
Thermal power (MW)	4,956	6,028	9,619	10,170	10,455	10,577	10,725
Nuclear power (MW)	-	-	0	325	325	325	325
Peak capacity (MW)[2]	6,950	7,793	9,556	10,033	11,000	12,385	13,645
Peak demand (MW)[3]	8,067	9,067	9,609	10,128	11,044	12,595	15,838
Volume of supply (GWh)	32,131	35,032	40,910	43,384	47,421	55,278	67,480
Net power energy demand (GWh)	34,731	44,456	68,853	72.919	76,985	81,051	85,117

Source: Electricity Marketing Data, Jan.2008, WAPDA

2 The supply volume per hour at the maximum in each year is called “annual peak supply.”
3 The demand volume per hour at the maximum in each year is called “annual peak demand.”

2.3.2. Internal Rate of Return Index (IRR)

Estimated value and actual economic and financial index of internal rate of return (IRR)[4] of this project are nearly comparable. The calculation demonstrates that financial and economic profitability is secured.

Plan	Actual
FIRR:14.62% Cost : (1) Initial investment (project costs of this project) (2) Equipment replacement cost (30 years later) (3) Management operational costs Benefit: Electricity-sales-to-utilities income (1.62 Rs/kWh = 6.5 Cents/kWh) Project life (after the start of operations): 60 years	FIRR:13.88%[5] Cost : (1) Initial investment (project costs of this project) (2) Equipment replacement cost (30 years later) (3) Management operational costs Benefit : Electricity-sales-to-utilities income (3.93 Rs/kWh = 6.5 Cents/kWh) Project life (after the start of operations): 60 years
EIRR:22.30 % Cost : (1) Initial investment (project costs of this project) (2) Equipment replacement cost (30 years later) (3) Management operational costs (4) Transmission line construction costs Benefit : (1) Electricity sales to utilities(an income) (2) Consumer surplus (JICA does not usually include) (3) Land value (Alternative irrigation use is assumed as a substitute land in the case of land acquisition, increasing the value of the land acquired) Project life (after the start of operations): 60 years	EIRR:22.19 % Cost : (1) Initial investment (project costs of this project) (2) Equipment replacement cost (30 years later) (3) Management operational costs (4) Transmission line construction costs Benefit : Substitution of thermal power generation (due to the participation loan, the conditions were unified based on discussions with other donors) Project life (after the start of operations): 60 years

[4] The index is calculated in Pakistani Rupees (Rs).

[5] Main reasons for lower value than the original are extended construction period and the increase of project cost calculated in Rs, although the project revenue in Rs was increased.

2.3.3. Qualitative Effect

The stability (43% of the respondents of the social survey) of electric power, increase in radio use (39% ditto) and others were responded by the interview from the implementing agency and social surveys (subjects: involuntary resettled persons, 75 respondents). The positive changes by the project include the mitigation of constant power shortages and the additional supply to increased power demand in the WAPDA operation area. This can verify the achievement of the project's objectives.

Based on the above, this project has largely achieved its objectives, therefore its effectiveness is high.

2.4. Impact

2.4.1. Impacts on Beneficiaries (the Economy and Industrial Activities of Pakistan)

As shown in Table 6, the constant economic growth can be observed in terms of the development of the economy and the industrial activity of the country in the large-scale industrial sector, even though their growth rate may vary each fiscal year. This can suggest that the large-scale industry has been developed through a reinforced power supply including this project and the project partially affected an overall positive impact on the economy and the industrial activity of the country.

Table 6 Economic Growth Rate (%)

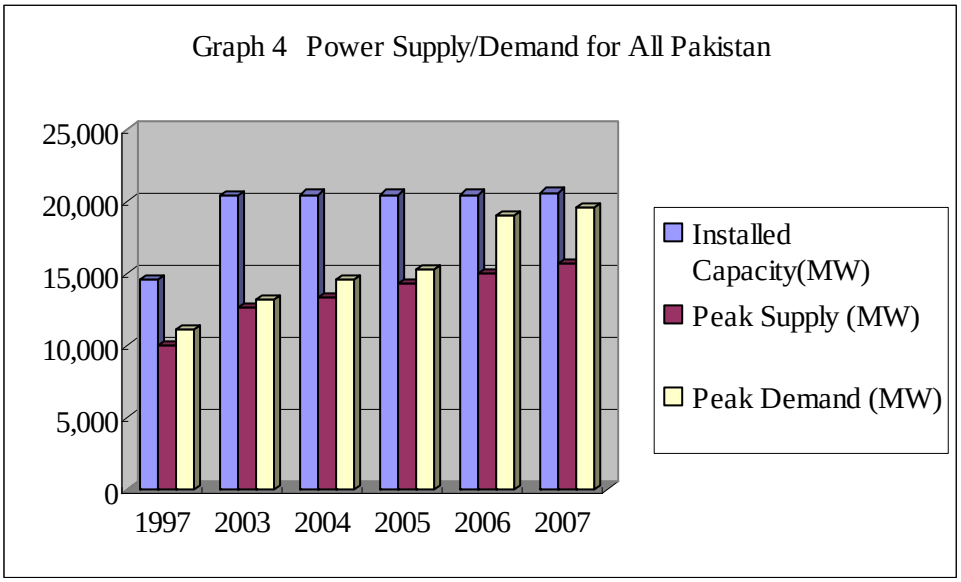
	average (2001 -05)	2004	2005	2006	2007
GDP	5.7	9.0	5.8	6.8	4.1
Agriculture	3.5	6.5	6.3	4.1	1.1
Grain	5.9	17.7	-3.9	7.7	-6.4
Stock raising	2.8	2.3	15.8	2.8	4.2
Industry	9.5	15.5	8.7	8.3	4.8
Large-scale industry	11.1	19.9	8.3	8.7	4.0
Service	6.0	6.6	9.9	7.9	10.0

Source: Federal Bureau of Statistics (2008-09),
Ministry of Finance

During FY2003 to FY2007, an additional large power plant was not constructed; hence, the plant capacity has not increased. Also, the inadequate periodical replacement on depreciated power plants resulted in further deterioration. The peak-hour supply capacity of the entire country still remains insufficient.

Without the project, the output supply capacity 1,450MW and annual average supply volume 6,600GWh—corresponding to about ten percent of WAPDA supply volume

(FY2007) —would continue to create a shortage gap that may have affected the national economy seriously.



Source: Electricity Marketing Data, Jan. 2008, WAPDA

Table 7 National Power Supply and Demand

Items / Fiscal year	1997	2003	2004	2005	2006	2007
Power generation equipment capacity (MW)	14,618	20,360	20,456	20,495	20,495	20,626
Hydraulic power (MW)	4,825	6,464	6,464	6,499	6,499	6,499
Thermal power (MW)	9,656	13,434	13,530	13,534	13,534	13,665
Peak capacity (MW)	10,034	12,632	13,333	14,296	14,989	15,685
Peak demand (MW)	11,145	13,151	14,582	15,289	18,987	19,615
Volume of supply (GWh)	60,109	83,607	88,379	96,478	96,478	97,094

Source: Electricity Marketing Data, Jan. 2008, WAPDA

2.4.2. Impacts on Beneficiaries (the Local Community)

WAPDA established Public Information Center (PIC) to achieve the project's transparency and accountability. As well, through comprehensive regional development in cooperation with NGO, Ghazi Barotha Taraqiati Idara (GBTI), WAPDA supported local communities in raising their incomes such as provision of vocational training and promoting employment opportunities. The average income of resettled residents went up by 6.8% or Rs15, 579 (1994) to Rs16, 645 (2004) due to policies such as preferential

hiring measures. However, inflation and savings should be taken into consideration in this increase.

As part of the evaluation procedures, project affected people (PAP) survey was conducted in the project affected area. The survey randomly selected 75 households—each of 25 households from the three villages Essa, Feroz Banda, and Barotha. The results are shown in the table 8.

Table 8 Project Affected People (PAP) Survey

Survey item	Questionnaire	Response
Average household monthly income	Average monthly household income before/ after the project	Rs5,000 (before project) -> Rs10,000 (after project)
Occupation	Present occupation of the head of household	Agriculture (24%), a day laborer (27%), services (14%), self-employed (13%)
Land ownership	The land ownership in a settlement	Owned land (37%), leased land (31%), without any land (32%)
Project relevance	Are you satisfied with the living environment in the settlement?	Yes: 58 % No: 42% (access to medical facility and schools is inadequate)
Direct benefit	Multiple choice	Voltage stability (43%), increased hours of radio use (39%), Increased hours of electrical appliance use (7%)
Indirect benefit	Multiple choice	Education 31%, contribution to regional economy 29%, reduction in firewood 21%, hygiene improvement 17%
Electricity bill	Average monthly bill per household	Rs200 (before project) ->Rs1,000 (after project)
Problems in everyday life	Multiple choice	Drinking water (19%), drainage (17%), shopping (14%), means of transportation (11%)

Source: Project Affected People (PAP) Survey Report at Evaluation

In Table 8, the increase in household income, stability in power supply, and improvement in living standards indicate positive impact on the local residents.

2.4.3. Impact on the Natural Environment

WAPDA prepared Environmental Impact Assessment (EIA) Report to obtain

permission on the project by the competent authorities in October, 1994, although it was later than what was originally planned. WAPDA as well launched the Environmental Cell, or WAPDA Environmental Cell (WEC), separately operated and functioning as monitoring the impact of the project. In addition, Independent Environmental and Resettlement Review Panel (ERRP) and the Environmental Cell conducted monitoring during the implementation phase of the project.

As the osmosis water from the relevant reservoir of the facility flows into the Indus River through groundwater running down at an incline, and negative impact to the neighboring small-scale irrigation system has not been reported. It should also be noted that with the spoil material, banks along both sides of the power channel have been developed as agricultural land, so that they function to mitigate major adverse environmental effect.

No natural swampland can be seen in the project area, nor the power channel passing through forests or natural habitats.

2.4.4. Land Acquisition and Resettlement

WAPDA has been holding Scoping Sessions since 1990 to disseminate and share information with residents in the project area about the project's implementation and resettlement and compensation policies. PIC created frequent meetings with the residents. WEC established within WAPDA carried out the environmental and social concerns of the project including the land acquisition procedure, compensation, resettlement, prioritized procurement of local labor, bank protection, and others.

In the beginning, 3,460ha was scheduled to be acquired from the private sector based on the Resettlement Plan prepared by WAPDA in September, 1994, however, due to design changes of the channel, measurement mistakes on land acquisition, complaints by the residents, and others, slight changes were made and the actual amount of land acquired was 4,442ha. Resettlement was actually delayed due to the difficult interactions with the local people to fill the gap between the original book value of the land and the prevailing market price, which was settled properly according to market price. The households that finally moved increased by 26 to become 136 households, and the number of the resettled households increased from 179 to 200. Number of households resettled in the new villages prepared at the three sites was 29 households in Essa village, 74 households in Barotha village, and 27 in Feroze Banda village. Utilities such as water and sewage, roads, electric power, schools, clinics, mosques, cemetery, playground, and others infrastructure, were constructed in the resettled village. Moreover, in order to support their living standards, comprehensive regional development programs including vocational training centers in cooperation with NGO (GBTI) were made functional.

Support for generating income was offered, and it has now become a continuous process. The construction generated approximately 10,000 jobs, and efforts were particularly made to maximize the number of employment opportunities to the affected community. Moreover, in order to avoid the socio-economic disruptions, 33 bridges, a track bridge, 12 pedestrian bridges, and 45 drainage channel bridges (with a sidewalk) have been constructed over a 52km long power channel.

Based on the WAPDA Resettlement Plan formulated by the WAPDA with World Bank guidelines, adequate compensation was paid for the acquired land at the market price. However, according to NGO interview surveys, about 200 to 300 cases still remain unresolved. Around ten percent of them involve involuntary resettled persons. The resettled households due to the power plant construction by Japanese ODA loan were limited to 29 households in Barotha village, and all compensation is fully completed.

Table 9 indicates compensation conditions collected through a social survey on three resettlement sites (a total of 75 samplings with 25 households). The results suggest that not all involuntary resettled residents are satisfied. However, support has not been limited to building village infrastructure; it continues even now to improve the lives of the residents. It is expected that eventually their dissatisfactions may be resolved.

Table 9 Status of Compensation (number of respondents)

Settlements	Phase of compensation received			Compensation by kind		Satisfied	
	Initial	Construction	Not-received	Land	Cash	Yes	No
Barotha	20	3	1	13	17	18	7
Feroze Banda	21	3	1	20	13	18	7
Essa	16	1	6	15	11	13	4
Total	57	7	8	48	41	49(73%)	18

Source: Project Affected People (PAP) Survey Report at Evaluation

Intake water channel

Activity of NGO (GBTI)

2.5. Sustainability (Rating: a)

2.5.1. Executing agency

2.5.1.1. Structural Aspects of Operation and Maintenance

WAPDA, being responsible for the maintenance and operation of the constructed facilities, was divided into the three divisions of power , transmission, and power distribution in 1998. At present, there exist four power generating companies, a power transmission company, and 9 power distribution companies. The functions of the WAPDA are only to construct hydraulic power plants, their operation, maintenance, and purchasing electricity from IPPs. . Pakistan Electric Power Company (PEPCO) was founded simultaneously during the reorganization to regulate these power companies. Each company is strengthening its organization with the intention to privatize. The three power generation/distribution companies have already decided to privatize and their investment activities are supported by a privatization committee. However, despite its ongoing announcement about privatization for the past ten years, in actuality, the effort has foundered and no progress has been made.

WAPDA is comprised of Power Wing and Water Wing. For this project, the Power Wing operates the power plant, and the Water Wing manages the channel operation. General Manager (co-serving with Tarbela Dam) and two Chief Engineers function vital roles. Table 10 indicates the transaction of those staff engaged for the operation and maintenance of this project.

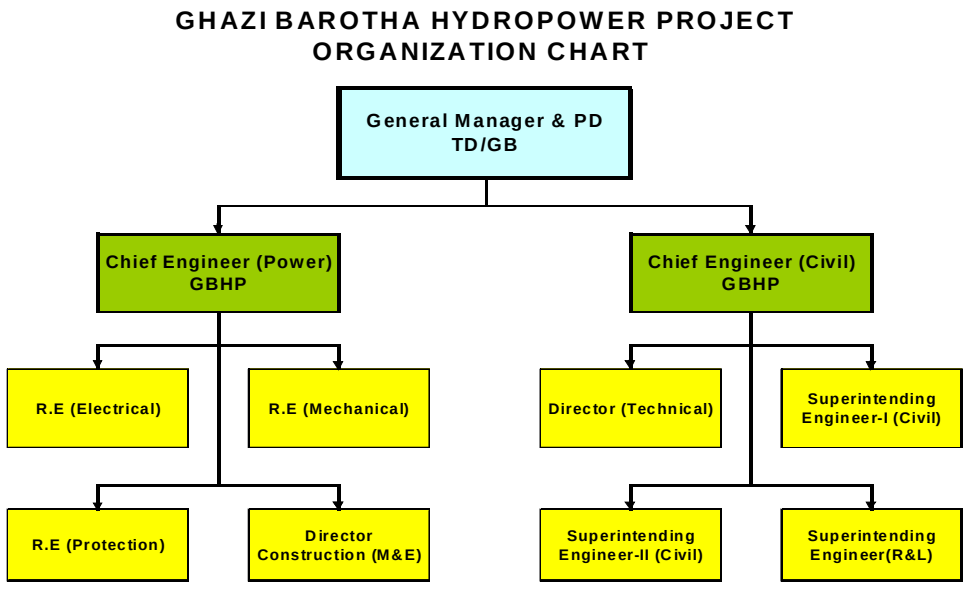
Table 10 Operation and Maintenance Staff

(Unit: person)

Fiscal Year	2001	2002	2003	2004	2005	2006	2007
Total	509	452	405	487	545	548	568
Engineer	188	164	143	153	159	158	177
Administration	321	288	262	334	386	390	391

Source: Reply of WAPDA to Questionnaire

Fig. 5 Operation and maintenance organization of Ghazi Barotha facility



Source: Reply of WAPDA to Questionnaire

2.5.1.2. Technical Aspects of Operation and Maintenance

Water and Power Wings of WAPDA has experience in the operation and maintenance of the Tarbela Dam construction project. The authority has updated its manual and training institute. It can be said that WAPDA is competent enough to impart the scheduled training courses on its own and can transfer technical capabilities to the staff of the project. Yet, during the ex-post evaluation process, WAPDA officials made a request for higher level training in Japan especially in generator control.

2.5.1.3. Financial Aspects of Operation and Maintenance

Due to the restructuring process, WAPDA was divided and was given sole responsibility for hydropower power generation, and other power generation is managed by Generation Companies (GENCOs) with separate transmission and distribution companies. Thus, an accurate comparison with conditions during the time of appraisal could not be conducted during the ex-post evaluation. However, the financial situation in 2007 shows sound numerical values in profitability (the net profit ratio of the hydropower section/net fixed asset: 21.1%), financial health (own capital ratio/ (liability + capital): 62.1%), cash flow (own capital ratio/ investment: 41.9%), and debt ratio (debt ratio=own capital/liability: 1.6). It has adequate capital to appropriately perform operation and maintenance. Administrative and maintenance costs of this project have been adequately secured as shown in the following table.

Table 11 Administrative and Maintenance Costs (1,000 rupees)

Item	2006/07	2007/08
Annual operational expenditure of WAPDA (A)	147,424,189	178,994,445
WAPDA administrative and maintenance cost (B)	13,001,501	13,521,849
Ratio against the expenditure (= B/A)	8.8%	7.6%
OM cost for this project (actual)	500,000	500,000
OM cost for this project (plan)	488,000	488,000

Source: WAPDA Financial Statement,
Reply of WAPDA to Questionnaire

Withdrawal of subsidy as agreed under the IMF stand-by credit conditions shall reduce the fiscal deficit to a sustainable level. An electricity rate increase to secure a sustainable operation and maintenance is expected, however, the safety net for the poor also needs to be considered; and this has become a serious political issue.

2.5.2. Current Status of Operation and Maintenance

Although operation and maintenance underwent changes due to structural reform, the facility and constructed under the project is operating appropriately based on direct observations in a field survey on the operation and maintenance conditions and organization of the facility.

In conclusion, no major problems have been observed in the capacity of the executing agency nor its operation and maintenance system, therefore sustainability of the project is high.

3. Conclusion, Lessons Learned and Recommendations

3.1. Conclusion

In light of the above, this project is evaluated to be highly satisfactory. As for the scope funded by the Japanese ODA loan, the commissioning of the power plant in the last process suffered the delay of barrage and water channel construction. However, construction costs decreased in comparison to the estimate, the operation and effect indicators and impact of installed plants were as planned, and their operation and maintenance condition is also appropriate. The generators installed form the main components of this project, and they affect the evaluation of the entire project. Thus, future sustainability of the project is expected.

3.2. Lessons Learned

None

3.3. Recommendations

- Executing agency

Current cases under dispute with PAP concerning compensation for resettled residents need be resolved immediately although it is outside of the scope of Japanese ODA loan's terms and conditions.

Comparison of the Original and Actual Scope

Items	Planed	Actual
(1) Project Outputs	The Japanese loan covers a part of the foreign currency cost for equipment (three turbines, five generators) and the public works.	
	Barrage: Planned Flood Adjustment Capacity: 18,700 m^3/s Maximum Flood Adjustment Capacity: 46,200 m^3/s	Barrage: (as planned)
	Power channel (1) Flow volume: 1,600 ㎥/sec capacity (Dry season(Oct. to April): minimum 300 ㎥/sec) (2) Length: 52,027m (3) Slope: 1:9,600 (4) Maximum Depth: 9m (5) Bed Width: 58.4m (6) Flow Velocity : 2.33m/s (7) 33 bridges, 20 road bridges: 20, 11 crossing bridges, 1 railway bridge, 1 gas pipeline	Power channel (in general, as planned), despite (7) 33 bridges, 19 road bridges, 12 crossing bridges, 1 railway bridge, 1 gas pipeline
	Power Plant (Annual Average Generation Capacity: 6,600GWh) (1) Head pond located at the end of the Power channel (2) Self priming siphon spillway (capacity 1,600 m^3/sec) with energy dissipation in a stilling basin and a baffle chute. (3) Two Head ponds, fore bay and round gate (4) Power Intake structure with fixed wheel gates and stop logs. (5) Five penstocks each with a 10.6m diameter (6) Five generating units of 290MW each (Total generating capacity: 1,450MW) and attached structure	Power Plant: (as planned)

	(7) Tailrace Channel located at intersecting point of Haro rivers Power Transmission Line: Three routes, each 500kV design (1) New single line to Peshawar (2) 4 transmission lines to the power plant, dividing the existing 2 lines	Power Transmission Line: (as planned)
(2) Project Period	Barrage and channel: Jan. 1994 to Feb. 2000 (74 months) Power plant (Japanese loan component): Jan. 1994 to Dec. 2001 (84 months) Start of commercial operations: Oct. 2000	Barrage and channel: Jan. 1994 to Dec. 2003 (120 months) Power plant (Japanese loan component): Jan. 1994 to Sep., 2004 (129 months) Start of commercial operations: Jun. 2005
(3)Costs		
Foreign currency	171,905 million yen	117,304 million yen
Local currency	85,552 million yen (US$ 832,220,000)	112,506 million yen (US$ 1,144,520,000)
Total	257,457 million yen	229,810 million yen
Japanese ODA loan portion	34,902 million yen	31,425 million yen
Exchange rate	1US$=102.8 yen (As of Sept., 1995)	1US$=118.00 yen (Average between Mar.1996 and may 2006)