Korea

Imha Multipurpose Dam Project

Report Date: September 2002
Field Survey: July 2001

1. Project Profile and Japan's ODA Loan

Site Map: Outskirt of Andong City, Korea

Site Photo: Imha Multipurpose Dam

1.1 Background

In the Republic of Korea, the Government made it a policy in the successive five-Year Development Plans[1] to construct multi-purpose dams to cope with increasing demands for water, i.e., for various consumptive uses and for hydro- electric generation as an alternative source of energy to the oil as well as the source of power generation in the peak demand hours. Also in perspective were ever increasing threats to lives and assets in riparian areas by floodwater. Background realities were developing industries, population increases, and the improving living standards. Recognizing those challenges, an especially high priority was being given to the earlier completion of Imha dam because the Nakdong-Gang river basin comprises of such cities as Teguh, Pusan, Andong, and Gumi, all of which were short of water supply because in those cities, demands increased rapidly due to industrial development, population increases, improvements in the living standards, etc. The priority was also due to the deterioration of the living environment in the downstream areas where water pollution was aggravated and noted problematic in low flow seasons because the river discharges were too low to maintain the cleansing function of the river.

1.2 Objectives

The Project was to supply municipal and industrial water, environmental water, and irrigation water, to control floods, and to generate electricity by hydraulic power, by constructing a multi-purpose dam in a tributary of the Nakdong-Gang, the second largest river in the Republic of Korea.

1.3 Project Scope

Japan's ODA loan finances all the foreign currency cost and a part of the local currency costJapan's ODA loan. Specific components financed by Japan's ODA loan are namely, metal works such as gates, generators and their appurtenant machines and equipment, flood warning systems, and consulting services, related to construction of the Rockfill Multipurpose Dam (length 73m, width 525m), electric power plant (25MW x 2units), and power transmission line. Also financed is a part of civil works that are

[1] The Imha dam was listed in the Fifth Five Year Plan (1982-1986) as one of the five (5) projects for planning. Out of those five, the Imha dam was the only project that was brought to implementation within the period of the Fifth Five Year Plan (1982-1986) and preparatory civil works were undertaken. In the Sixth Five Year Plan (1987-1991), the construction of the Imha dam was to be completed within the plan period.

contracted out with the local currency.

1.4 Borrower/Executing Agency

The Government of the Republic of Korea / Ministry of Construction

1.5 Outline of Loan Agreement

Loan Amount/ Loan Disbursed Amount	6,975million yen/4,565million yen
Exchange of Notes/ Loan Agreement	March 1987/ August 1987
Terms and Conditions Interest Rate Repayment Period (Grace Period) Procurement	 4.25 % p.a. (3.25% for Consulting Services) 25 years (7 years) General untied (Partial Untied for Consulting Services)
Final Disbursement Date	August 1993

2. Results and Evaluation

2.1 Relevance

At the time of planning, the Government of the Republic of Korea was advancing the construction of several multi-purpose dams in the successive Five Year Economic and Social Development Plans (in the 5th Five Year Plan: 1982 – 1986 and in the 6th Five Year Plan: 1987 –1991). These plans were designed so as to cope with such challenges as increases in the demands for water in various uses, which are due to industrial development, population increases, improvements in the standards of living, etc., increasing potential amounts of damage to be caused by floods, or needs to increase electricity generation with hydropower in view of the policy to develop alternative energy sources to oil, particularly as a source of electricity supply in the peak demand hours. Table 1 shows the trends of water demands in the Nakdong-Gang river basin. Increases are notable in the 1990's in the demands for municipal water and industrial water. In addition, as can be seen in Table 2, the national total of the electricity demands in the peak hours is increasing remarkably. Consequently, the Project fits well into the contexts of the needs for the national economic and social development, and has relevance having played a large part in realizing a stable supply of water for various purposes.

Table 1: Trends in the population and water demands in the Nakdong-Gang river basin

(Unit: Population in ,000., Demands in Million m^3/year)

	'91	'94	'98	2001	2006	2011
Population	12,774	12,990	13,255	13,306	13,547	13,717
Demands	8,872	8,569	9,486	9,803	10,115	10,880
- Municipal water	847	1,816	2,039	2,035	2,066	2,310
- Industrial water	263	752	1,416	1,613	1,744	1,870
- Irrigation	3,326	4,468	4,353	4,370	4,394	4,473
- Environmental	4,436	1,533	1,678	1,785	1,911	2,227

Sources: 1. Data of 1991: Korea Water Resources Corporation, "Status Survey on the Water Uses in the Nakdong-Gang River Basin," Statistical Appendix, December 1993.

2. Data of 1994: Water Resources Long-term Comprehensive Plan (1997-2011), 1996.

3. Data from 1998 onward: Water Resources Long-term Comprehensive Plan (2001-2020), 2001.

Table 2: National Annual Peak Electricity Demands and the Date of Occurrence

Year	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
Demand (MW)	9,915	11,039	13,658	15,058	17,752	19,124	20,438	22,112	26,696	29,878	32,282	35,851	32,996	37,293	41,007
Date	8.19	7.20	8.10	8.10	8.13	8.20	7.28	12.16	7.22	8.18	8.13	8.20	9.10	8.17	8.18

Source: Korea Power Corporation, "Management Statistics"; Korea Water Resources Corporation, "Power Operation Statistics 2000."

The Imha dam constructed by the Project has started to deliver services in 1992; thus, it has contributed to, and supports even now, the economic development in the Nakdong-Gang river basin, through the provision of electricity without causing public nuisances and the stable supply of water for various uses. That is the generally accepted notion of the multi-purpose dams and it continues to be recognized that water resources development is indispensable for economic and social development. On the other hand, issues regarding the operation and maintenance of dams and the management of water resources have got more attentions these years, and the focus is now on the efficient utilization of dams and other water related infrastructure as well as water resources development. There are already 11 completed multi-purpose dams in the Republic of Korea, including two that were undertaken later than the Imha dam. In addition, three more are under construction at a point in time of June 2001. Therefore, such an expansion of the priority area of water policy is justifiable because the priority policy expansion aims at more efficient delivery of available quantity of water, which is measured as flow, by making better use of (but not necessarily by making addition to) the stock of the infrastructure such as multi-purpose dams.

2.2 Efficiency

The Ministry of Construction, which is the Executing Agency, lets Korea Industrial Complex and Water Resources Development Corporation (it was renamed "Korea Water Resources Corporation (KOWACO)" in July 1988) to take over the construction of the Imha dam. At the time of execution of the Loan Agreement, the diversion tunnel was already under construction. At that time, the main dam, the spillway and other major civil works were to be undertaken successively thereafter, and all the construction was scheduled to be completed by the beginning of 1992. However, when it came to actual implementation, all the project construction components were undertaken at the same time in 1987, and as a result, the dam was completed at the end of 1991, a month earlier than the scheduled time of completion. While both the implementation period and the scope of the Project were largely in line with those originally planned, the local currency cost increased by more than 50%. The increase was due to double-fold increases in the cost of compensation that included the cost of right of way and that accounted for more than 50 % of the local currency cost. Such double-fold increases in compensation were induced by the high-speed growth of the Korean economy and by the raised awareness of the rights among the citizens affected by the Project. The construction itself was all completed within the scheduled implementation period within the planned estimates of the project cost that was inclusive of those for consulting services and the project administration; therefore, it could be evaluated that the project implementation was efficient.

2.3 Effectiveness

(2.3.1) Water supply

The Project was planned to supply water annually, in 269 million m^3 for municipal & industrial purposes, in 215 million m^3 for the environment, and in 13 million m^3 for irrigation. Planned figures and the actual figures of supply after the completion are shown in Table 3.

Table3: Water Supply Plan and Actual Delivery

(Unit: Million m^3/year)

		1992 Completion)	1993 (2nd year)	1994 (3rd year)	1995 (4th year)	1996 (5th year)	1997 (6th year)	1998 (7th year)	1999 (8th year)	2000 (9th year)
Municipal & Industrial water	Plan	269	269	269	269	269	269	269	269	269
	Actual		3	65	145	159	181	133	151	97
Environmental water	Plan	215	215	215	215	215	215	215	215	215
	Actual	215	215	215	215	215	215	215	215	215
Irrigation	Plan	13	13	13	13	13	13	13	13	13
	Actual	13	13	13	13	13	13	13	13	13

Source: Korea Water Resources Corporation

The Imha dam and reservoir started to supply just in the planned quantities, environmental water and irrigation water in the first year of service after the completion and continued to do so since then[2]. On the other hand, the actual figures of municipal and industrial water supply stayed at the level about two thirds of the planned figures. The gaps between the planned and the actual figures are, according to KOWACO, due to such facts as (1) water is supplied as a result of conjunctive operation of major water resources works in the Nakudon-Gang river basin, i.e., three multi-purpose dams, namely Andon, Nangang and Saccheon, and the Barrage at the river-mouth, and (2) the target years set in the supply plans of the individual municipal and industrial water users have not yet arrived. At the time of the project planning, it was estimated that the quantity of the total water demands would exceed the total supply capacities by 2001 both in the whole Nakdong-Gang river basin and in the sub-area where the Imha dam had direct effects (the basin area upstream of the Koreh Bridge located about 12 km west to the city of Taeguh), even if the Imha dam together with other water resource works that were under construction, such as the Saccheon dam and the Nakdon-Gang River-Mouth Barrage, should come into operation[3]. The major contributing factor of this estimation was the continual and substantial increase in demands for municipal and industrial water and the water for the environment. The actual demands for municipal and industrial water, however, lie far below the estimation. Having said that, it should be noted that the water demands in the Nakdong-Gang river basin have increased and that the Imha dam has met such increase in the demands. In addition, as will be examined in (2.3.3), the rates of inflow into the reservoir is problematic, which will require a more detailed deliberation, before the judgment is made on if the Imha dam and its reservoir have an excessive capacity to meet demands.

(2.3.2) Flood control

After completion of the dam construction, the flood control was implemented three times in 1993, 1998 and 1999, utilizing the reservoir flood control capacity (part of the reservoir capacity allocated for flood control). The flood control operations were planned to regulate 80 million m^3 of floodwater annually by making use of the flood control reservoir capacity of 47 million m^3. The actual quantities of floodwater controlled by the Imha damin 1993, 1998 and 1999 were 28.4, 35.5 and 63.4 million m^3 respectively.

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2 The annual quantity of release from the Imha dam for the environmental purposes is provided for in the relevant Law. Accordingly, KOWACO replied that the required quantity of water had been released from the dam. On the other hand, the Imha dam administration Office at the dam site does not keep record on the release of water for irrigation purpose; the figures listed in the Table 3 in the row for actual are just estimates provided by KOWACO. The discharges should vary as demands vary in accordance with the changes in rainfall year by year, but those variances should not have much impact on the quantity of the total releases of water supply from the Imha dam because the percentage share of irrigation water in the total quantity of water supply is relatively small.

3 According to the data at the time of December 1985 provided by the Ministry of Construction, and those were referred to in a JBIC file.

Floods occurred, of course, in other years but the water levels in the reservoir did not come up to the highest level even though most of the flood inflows were cut and impounded in the reservoir by the Imha dam. Accordingly, the percentage ratios of flood control in other years than 1993, 1998 and 1999 are comparatively high (more than 90 %) and it is understandable that the floodwater inflows were intercepted by the Imha dam and subsequently utilized for economic purposes. Just for reference, in the flood control plan, the peak flood inflow rate of 4,600 m^3/s was to be cut down to 2,455 m^3/s with the use of the reservoir flood control capacity. Table 4 shows the figures of this ratio resulted from actual flood control operations.

Table 4: Peak Flood Inflow and Ratio of Control

Year		1992 (Completion)	1993 (2ns year)	1994 (3rd year)	1995 (4th year)	1996 (5th year)	1997 (6th year)	1998 (7th year)	1999 (8th year)	2000 (9th year)
Flood Control	Peak Flood Inflow (m^3/s)	682.8	3,909.0	308.3	499.0	1,206.0	1,930.0	3,488.8	2,553.3	1,444.4
	Maxim Discharge (m^3/s)	0 1)	2,053.0	20.0	3.4	104.7	102.6	509.8	1,713.0	119.1
	Ratio of Control 2) (%)	100	47.5	93.5	99.3	91.3	94.6	85.4	32.9	91.7

Source: Korea Water Resources Corporation

Note: 1) During the period of water impoundment after the completion of the construction

2) Ratio of Control = 〔(Peak Flood Inflow - Maxim Discharge) / Peak Flood Inflow〕 * 100

The construction of the Imha dam was completed in 1991as the fourth multi-purpose dam built in the Nakdong-Gang river basin. Table 5 shows the comparison of the damages caused by floods in the Nakdong-Gang river basin before 1991 (1991inclusive) and those after 1992 (1992 inclusive). It is observable that the average number of death per year decreased by more than 60% from 43 before 1991 to 16 after 1992, and that the total amount of actual flood damage per year after adjustment with GNP deflators decreased by more than 55% from 148.5 billion Won to 80.8 billion won. All the differences in the flood damage before and after the Imha dam cannot be attributed solely to the flood control operations that are made possible by the construction of the multi-purpose dams, because there are differences in the depth of rainfalls year by year as well as changes in the flood protection facilities and other related flood mitigation measures before and after. There supposed to be, nonetheless, a substantial contribution by the Imha dam as there assessed to be significant reduction in the flood damages after 1992 in comparison with the damages before the completion of the dam.

Table 5: Actual Flood Damage in the Nakdong-Gang River Basin

(Flood Damage in Million Won)

Year	Death (Person)	Inuandated (Person)	Inuandated (Ha)	Actual Flood Damage						Total (After Adjustment	GNP Deflator
				Buildings	Ships	Farm Land	Public Facilities	Others	Total		
1986	34	11627	18934	270	165	63159	5751	3199	72544	142243	51.0
1987	127	27043	52078	2186	1294	52577	96647	14162	166867	309586	53.9
1988	9	1771	4846	118	-	3965	23093	165	27342	47141	58.0
1989	40	17353	25175	1288	9	64444	48092	38716	152549	248856	61.3
1990	20	7004	7480	511	-	1320	24436	17932	44201	65097	67.9
1991	29	9225	21838	391	130	2500	49928	5672	58622	77955	75.2
1992	2	6	130	8	243	272	533	60	1117	1379	81.0
1993	1	1974	11036	105	711	909	27532	631	29888	34473	86.7
1994	8	2459	1735	44	388	2362	11213	12882	26891	28822	93.3
1995	20	1371	5177	783	263	3126	35339	25503	65016	65016	100.0
1996	4	9	17538	37	-	16	1525	557	2136	2056	103.9
1997	3	2497	6221	51	12	639	12379	3490	16573	15460	107.2
1998	71	6092	20066	2202	2	31059	360236	27088	420589	373525	112.6
1999	19	1118	8867	1515	5	1699	124891	10925	139037	125485	110.8

Source: Ministry of Local Government, "Disaster Yearbook," (Death includes those whose whereabouts are unknown)

Note: 1. 'Actual Flood Damage' is in the current price, and incudes all those in the Nakdong-Gang river basin.
2. GNP Deflators are taken from IMF IFS Yearbook.

(2.3.3) Electricity generation

The electricity generation of the Project is designed to meet increasing demands in peak hours. The actual generation records are shown in Table 6. The actual electricity generated by the Project measured at the transmission terminal are substantially lower than the planned figure of generation in most of the years, while national annual peak electricity demands increase year by year (Table 2). In the project plan, the rate of inflow at the dam site was estimated to be the mean of inflow rates over a period from 1963 to 1983, i.e., 24.1 m^3/s; the actual inflow rates are observed to be 20.9 m^3/s, on average in the years since 1993. This reduction in the rate of inflow is viewed by some as a contributing factor to the less than design performance in the electricity generation.

Table 6: Electricity Generation

(Unit: GWH/year、%、GWH/year、Million Won)

		1992 (Completion)	1993 (2nd year)	1994 (3rd year)	1995 (4th year)	1996 (5th year)	1997 (6th year)	1998 (7th year)	1999 (8th year)	2000 (9th year)
Electricity at the transmission terminal	Plan	96.7	96.7	96.7	96.7	96.7	96.7	96.7	96.7	96.7
	Actual	5.3	116.3	34.0	17.7	38.5	53.3	123.0	82.5	68.6
Availability factor[1)]		3.3	30.5	12.1	6.7	12.8	14.0	35.1	22.9	18.7
Electricity Sold	Sales revenue	237	6,978	2,134	1,131	2,495	4,307	10,145	6,810	5,402

Source: Korea Water Resources Corporation

Note: 1) Availability Factor = hours of operation in a certain period of time (hr) / hours in the total calendar days in the same period of time (hr)

It should be noted, however, that the reverse regulation pond was designed in the project plan to impound discharges for the electricity generation and then release the water for such purposes as municipal, industrial, environment, etc. Take 1995 for instance. If it is assumed that (1) the reverse regulation had worked as designed; (2) all the discharges for the electricity generation had resulted in the water release to meet the water demands; and (3) water had been released as shown in Table 3, then, the electricity generation in 1995 should have exceeded the planned generation by about 40%[4]. The relatively poor performance of the electricity generation is supposed to reflect the particular situations of the purchaser[5] side or other relevant factors at the Imha dam power plant side.

(2.3.4) Internal Rate of Return

The economic rate of return (EIRR) of the Project was calculated at the time of appraisal to be 8.0 %, while the rate was recalculated to be 2.8 % if the actual figures of project costs and the operation and maintenance expenditures are taken into consideration. Two major causes for this reduction are (1) increases in the expenditures for compensation that accounted for 40 plus percent of the total project cost; and (2) increases in the actual expenditures for the operation and maintenance. The assumptions of the calculations are as follows:

Project life: 50 years, but machinery and equipment for electricity generation is to be replaced in every 25 years.

Benefits:

A) From electricity generation: construction cost for the alternative power plant and expenditures for operation and maintenance;
B) From municipal and industrial water supply: construction costs of the alternative dams and expenditures for operation and maintenance;
C) From irrigation: increases in the amounts of farm incomes;
D) From flood control: decreases in the flood damages and increases in the effective uses of lands

Costs: project costs and expenditures for operation and maintenance (actual cost)

2.4 Impact

(2. 4.1) Developments in the regional economy

In the upstream basin of the Nakdon-Gang river, or Kyong San Pok Do, several multi-purpose dams, including the Imha dam, were constructed successively and they together supposedly brought about impacts on the regional industries and economy. Figure 1 shows shares of Kyong San Pok Do in the nation in terms of several economic indicators. In Figure 1, Agriculture represents the sum of total production of rice from both paddy fields and upland fields and it is observed to show downward trends. On the other hand, the total amount of shipped industrial outputs (the sum of those of all the individual manufacturing sub-sectors) has increased its shares greatly in the late 1990's. Nonetheless, the shares of the regional income, which represent the results of all the transactions in all the industries, are showing declining trends over this 15 year period up to 1998. The shares of the population likewise are declining and stay consistently below those of the regional income in every year form 1992 to 1999. In other words, Kyong San Pok Do has successfully sustained the levels of per capita regional income that are high in comparison to the corresponding figures of the per capita national income throughout the 1990's without exception.

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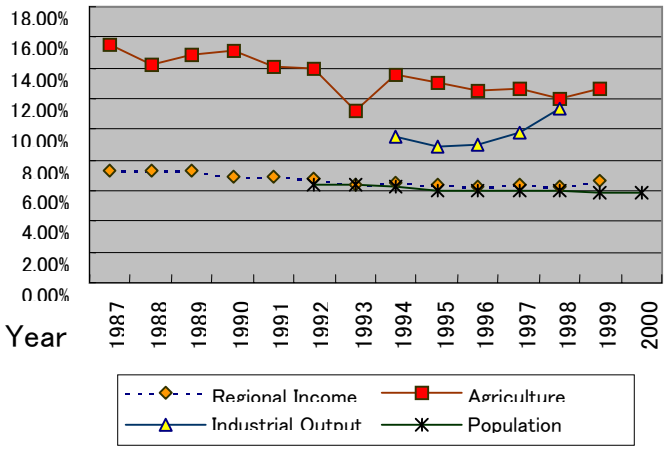
4 Given the maximum rate of discharge for the rated electricity generation is 122 m^3/s, the plant with the 50 MW rated capacity needs 849 million m^3 of water to generate the planned annual target of 96.7 x 10^6kwh. On the other hand, the actual total releases in 1995 for water supply (excluding those for irrigation purposes) amounted to 360 million m^3, or 42 % of needed discharge of 849 million m^3.

5 The purchaser: Korea Power corporation (KEPCO), the Seller: KOWACO

Figure 1: Kyoung San Pok Do in the Nation



(2.4.2) Resettlement of the residents

The number of the households that were resettled because of the implementation of the Project amounted to 1793 as against the estimated number of 1740 at the time of planning. Out of that actual number, 348 moved to and resettled in the five (5) housing complexes such as Joongpyung, Soogok, Maryoung or Naksa, which were developed in the areas adjacent to the reservoir for the purpose of accepting the re-settlers. All the others moved out of Kyong San Pok Do or Nakdong city or moved to neighboring areas within the city. The re-settlers chose the places of their resettlement with their own free will.

The actual expenditures for compensation doubled to 202,732 million Won (right of way: 136,260 million Won, construction cost of rerouted roads: 66,472 million Won) from the estimated expenditures of 97,204 million Won at the time of planning (right of way: 59,741 million Won, construction cost of rerouted roads: 32,243 million Won, relocating cost of houses: 5,220 million Won). Rapid increases in the land prices and the raised awareness of the rights among the concerned citizens were contributing factors to the increses. The awareness was raised, however, concerning the conditions for compensation only, and no movements opposing to the dam construction itself were launched.

In addition, for those of the re-settlers who moved to and resettled in the housing complexes for accepting the re-settlers, follow-up measures such as living environment improvement in the housing areas or furnishing facilities for increasing incomes of the re-settlers are successively taken according to the provisions of the relevant laws. For the re-settlers concerning the Imha dam, 272 million Won was outlaid from 1990 to 1994 according to “Law concerning the supports for areas adjacent to power plants.” Over the period from 1995 to 1999, 10,006 million Won, and in fiscal year 2000, 565 million Won (just for fiscal year 2000), were expended based on “Designated multi-purpose dams act” and “Law concerning supports for dam construction and adjacent areas” respectively. The expenditure of 670 million Won is budgeted for fiscal year 2001.

(2.4.3) Impact on the environment

The Project created the reservoir by damming-up the inflow of water and that brought about the changes in the varieties of fish. In those days without the dam, prevailing species of the fish were those that had habitat in rapid waters while after the construction, those species of impounded water such as perch well adapted to the changes in the environment. In addition, fingering and inseminated eggs of other species of fish are released to the river every year in order to diversify the varieties of the fish and protect them.

The degradation of the water quality of reservoir is, in general, due to inflow of household and livestock effluents that carry pollutants (substance with nitrogen and that with phosphate) from sources upstream of the dam. In order to preserve the water quality of the reservoir created by the Imha dam, water plants are grown in two locations within the catchment area of the reservoir to absorb pollutants, and 20 persons are entrusted for monitoring illegal dumping of pollutants into the river and the reservior.

Additionally, KOWACO responded that there observed changes in the microclimate of the surrounding area of the reservoir such as increases in the number of days with fog occurrence, due to the emergence of the reservoir with the impounding area of 26.4 km^2.

2.5 Sustainability

(2.5.1) Operation and Maintenance

KOWACO is a special judiciary person established by the law; the law provides for more than 50 % of the share of the corporation (79.8 % at the end of year 2000) be owned by the Government. The total assets at the end of year 2000 amounts to 9 trillion Won (about US$7.2 billion). More than 51 % of the total assets are the utilization rights, which are contributed in kind by the Government and the local autonomies, of the dams and the water infrastructure such as regional water supply systems, all of which are operated and maintained by KOWACO. In the latest two accounting years, the public utilities operations, which consist of electric power generation and water supply, earned more than 50 % of the total revenues of KOWACO[6]. KOWACO has four departments of operations and 23 divisions and rooms, and more than 3000 employees.

The Imha dam was contributed in kind to KOWACO, after the completion by the Government as was envisaged in the original plan. At the time of planning, Dam Administration Division, Power Generation Operations Department, was to take charge of the operation and maintenance of the dam. Due to the organizational changes thereafter, Imha Dam Administration Office, which is under the supervision of Dam Operations Department, KOWACO, is currently in charge of the operation and maintenance. The operation and maintenance of multi-purpose dam are comprised mainly of general administration, power generation, dam operation, maintenance and repair of works, machines and equipment. Expertise that is deemed necessary to carry out such areas of operations includes public administration, civil engineering, electrical engineering, electronics and communications, computer science, hydrology & meteorology, etc. In addition, employees with professional knowledge in respective fields of expertise should be deployed with a proper mix and structure. Imha Dam Administration Office is staffed presently with 40 employees including the director; the expertise of those staff members covers such areas as civil engineering, electrical engineering, mechanical engineering, communication engineering, and environment. Back-supporting Imha Dam Administration Office, the staff members of Dam Administration Division, KOWACO Headquarters, number 48 in all, all of whom having bachelor's degree or equivalent certificates (some have even doctorates) and specializing in civil engineering, communication engineering, environment, etc, are engaged in the operation, maintenance and management of the dams. Further more, KOWACO makes efforts to upgrade the technical capabilities of its employees in charge of operation and maintenance by letting them visit overseas agencies of the same sort with advanced technologies and participate in the training abroad. In view of such current state of operation and maintenance and the track records of the past 9 years, no particular institutional and technical problems can be identified with respect to the operation and maintenance of the Imha dam.

(2.5.2) About the future of the Project

The public utilities operations of KOWACO, when taken in their totality, recorded profits having the ratio of the revenues to the costs (operating expenditures excluding sales and administration costs) as 1 to 0.7. The Figure 2 shows the actual figures of revenues and expenditures of the Imha dam. During the four-year period from 1994 to 1997 when the electricity generation was low, the operating income recorded in each year a negative figure. The total cost shown here did not include the depreciation; and the operating income after depreciation became negative in every year if the total cost were re-calculated taking into consideration the depreciation based on the total construction cost of the Project.

KOWACO is of the view in this respect that the balance between the revenues and the costs will improve hereafter because KOWACO will be able to raise continually the water fees as the Government makes efforts to materialize realistic levels of water fees recognizing the importance of securing the water resources and shifting away from the traditional policy of suppressing fees of water supply operations in order to control the inflation.

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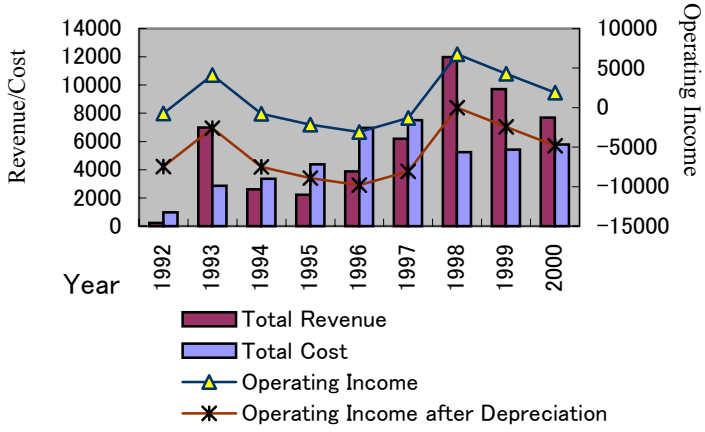
[6] Other sources of revenue are new cities and industrial complexes development operation: 30%; and dams and water supply systems construction operation (as this is an agent operation, revenues equal to expenditures): 10%.

It is true that the Project will continue to realize benefits without any difficulties, in water supply, flood control as well as electricity generation, given the present state of national economy, figures in the recent financial statements of KOWACO, and the organizational framework for the operation and maintenance of the Imha dam. But KOWACO might need to examine, in its right perspective, ways to recover the investment costs on a project by project basis including how and to what extent the Government should shoulder the burden of the operation and maintenance costs that are necessary for sustaining flood control functions and for realizing benefits through the supply of water for the environment, both of which have much bearing on the public welfare.

Figure 2: Operating Income of the Imha Dam



Source: KOWACO

Comparison of Original and Actual Scope

Item	Plan	Actual
①Project Scope		
DAM		
Type	Rock fill dam with central earth core	Same as left
Height	73.00m	Same as left
Crest length	515.00m	Same as left
Embankment volume	$2.99*10^6m^3$	$3.423*10^6m^3$
Gross storage capacity	$595*10^6m^3$	Same as left
Catchment area	$1,361km^2$	Same as left
Reservoir area	$26.1km^2$	$26.4km^2$
POWER HOUSE		
Installed capacity	50MW(25MW*2units)	Same as left
Transmission line	154kV, 15.00km	Same as left
CONSULTING SERVICE (TOR)	-bid evaluation	-Same as left
	-review the tender design and drawings	-Same as left
	-preparation of working drawings	-Same as left
	-assistance to MOC in engineering aspect,	-Same as left
	-preparation of operation plan and maintenance manual	-Same as left
	-arrangement for the training of MOC and IWACO staffs	-Same as left
	693m/m	-Same as left
②Implementation Schedule		
Diversion tunnel	～08/1988	～10/1987
Cofferdams	07/1988～04/1989	05/1987～10/1991
Main dam	09/1987～12//1991	09/1987～10/1991
Spillway	08/1987～08/1991	08/1987～12/1991
Waterway	12/1987～12/1991	05/1987～10/1990
Powerhouse	05/1988～08/1991	02/1987～04/1991
Saddle dam	07/1989～04/1991	11/1987～12/1989
Regulation dam	08/1988～01/1992	11/1987～12/1989
③Project Cost		
Foreign currency	5,094 million Yen	4,565 million Yen
Local currency	33,866 million Yen	42,130 million Yen
（Local currency in Won）	(192,056 million Won)	(304,384 million Won)
Total	38,960 million Yen	46,695 million Yen
ODA Loan Portion	6,975 million Yen	4,565 million Yen
Exchange Rate	567.10 won = 100.0 Yen (1986)	722.49 won = 100.0 Yen (December 1993)