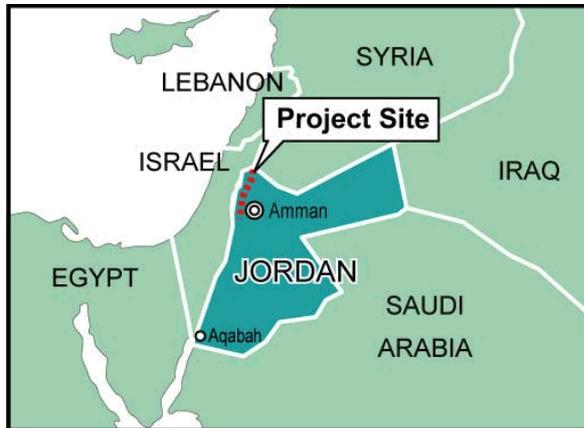


1. Project Profile and Japan's ODA Loan



Site Map: Pipeline in North Ghor Area



Site Photo: No.2 Pumping Station

1.1 Background

The agricultural sector in Jordan occupied 7 per cent of the GDP and 10 per cent of the total working population. For Jordan—a country poor in resources—its role has been significant. However, since most of the land is affected by dry weather and is desert, it was a critical task to make effective use of water resources, to increase crops by seven per cent in irrigated areas (38,000 ha: occupying only six per cent of arable area (528,000 ha) in total), and to newly irrigate non-irrigated areas.

The Third Economic and Social Development Plan (1986–1990) also advocated (1) multi-purpose use of water resources and (2) effective use of irrigation water. This project was to be implemented in order to make effective use of limited water resources for the stabilization and improvement of agricultural production.

1.2 Objectives

Through improving the existing surface irrigation in already irrigated areas and by newly establishing irrigation systems in non-irrigated areas, this project aims at saving irrigation water, increasing agricultural production, and thereby effectively using water resources in the North Ghor area located between the Yarmouk River and the Rajib River, east of the Jordan River.

1.3 Project Scope

The major project scope is shown below:

- (1) Changes in the water channel system (from an open water line system to a pipe line system) from main water lines to end farm fields in the already irrigated area of North Ghor (7,200 ha).
- (2) Construction of pipeline water distribution facilities in non-cultivated areas (900 ha) surrounding the already irrigated area.
- (3) Adoption of new irrigation types (mainly drip irrigation) in the end farm fields in the above (1) and (2).
- (4) The ODA loan covered above (1) and (2). Concretely, 10 pumping stations, 276 km of pipelines, and 79 km of farm roads were constructed.

The ODA loan covered 80 per cent of the total project costs, to which was added the partial local currency. In concrete terms, funds were allocated to arrange the equipment, materials and services necessary to undertake the civil works referred to in (1) and (2), as well as to arrange consulting services.

As regards the third project scope, it was planned that farmers in the project area would borrow funds from the Agricultural Credit Corporation (ACC) to construct the irrigation facilities necessary for end farm fields (such as the procurement of drip irrigation equipment).

1.4 Borrower / Executing Agency

Hashemite Kingdom of Jordan / Ministry of Water and Irrigation • Jordan Valley Authority (JVA)

1.5 Outline of Loan Agreement

Loan Amount	4,080 million yen
Loan Disbursed Amount	4,080 million yen
Date of Exchange of Notes	September, 1988
Date of Loan Agreement	January, 1989
Teams and Conditions	
Interest Rate	2.9 %
Repayment Period (Grace Period)	30 years (10 years)
Procurement	LDC untied
Final Disbursement Date	April, 1997

2. Results and Evaluation

2.1 Relevance

The objectives of this project were the effective use of water resources by saving irrigation water and the increase in agricultural products. The 'Water Strategy' formulated in April 1997 by the Government of Jordan continuously identifies the major task as being the control and effective use of limited water resources. It also set a higher efficiency at the stages of water carriage, distribution and use as one of the objectives. Under co-operation with the governments of Germany and France, the Jordan Valley Authority (JVA) and the Ministry of Water and Irrigation, which were the implementing agencies of this project, also introduced in 1999 a water resource management system, which used the GIS. They have been managing water supply including the collection of data concerning Jordan's water sources, monitoring and irrigation water. They emphasize the effective use of water resources and thus the relevance of this project is still valid.

2.2 Efficiency

2.2.1 Project Scope

Modification of project scope from the initial plan is seen in (1) the decrease in the number of farm turnout assemblies (FTA) from 2,114 to 1,928, (2) extension of the total length of farm roads from 76 km (new roads 55 km and rehabilitation roads 21 km) to 205 km (new roads 10 km and rehabilitation road 195 km), and (3) the addition of a replacement of 14 km length of an irrigation pipe in the Northeast Ghor area. As regards other parts of the project scope, there was no significant modification.

2.2.2 Implementation Schedule

Project completion on the initial plan was expected in December 1993. The project actually completed with a 51-month delay in February 1998. The major reasons for delay were (1) considerably prolonged

tender and contract procedures due to the affect of Gulf War in 1991 (45 months compared with seven months on the plan), and (2) a longer maintenance period (29 months compared with 12 months on the plan). The reason for the extension of the maintenance period was that it took 17 months to carry out the maintenance of components for the irrigation pipelines newly added to the project in the Northeast Ghor area, besides the 12 months initially planned.

2.2.3 Project Cost

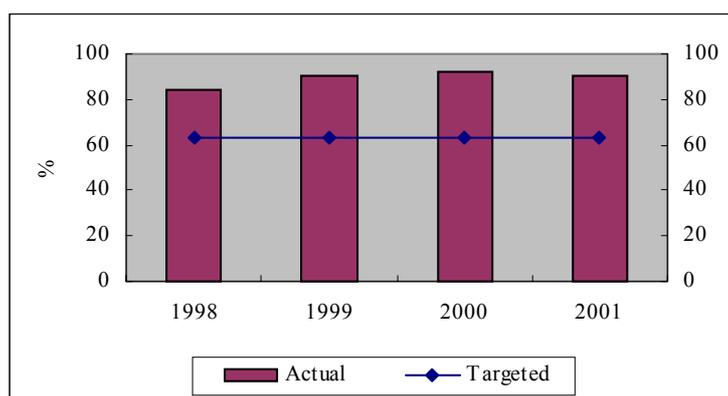
The initial plan estimated a 5,101 million yen for the total project cost (foreign currency 3,420 million yen and local currency 1,681 million yen), of which 4,080 million yen was supposed to be covered by the ODA loan). But on an actual basis, the total project cost was 5,375 million yen (foreign currency 3,601 million yen and local currency 1,774 million yen), of which 4,080 million yen was covered by the ODA loan. The main causes of cost overrun in the total project cost were the extension construction of farm roads, and irrigation pipeline replacement in the Northeast Ghor area, which was newly added to project scope.

2.3 Effectiveness

①Improvement of the Water Use Ratio

This project was expected to shift the water channel type from the conventional surface irrigation type—which degraded water distribution efficiency through leaks from cracks on the aging channels—to a pipeline irrigation system, which would improve the efficiency of water conveyance and distribution, and save water duty. The changes in efficiency of water use after project completion in 1998 were about 90 per cent—exceeding the target of 63.4 per cent. Hence there can be seen a remarkable improvement. Service water in this project is conveyed from main water channels (the King Abdullah Canal) to pumping stations, carrier pipes, distribution pipes, headgate units, Farm Turnout Assemblies (FTA) and farm fields. Water use efficiency here refers to the water conveyance and distribution efficiency from pumping stations to farm fields.

Figure 1: Improvement of Water Use Ratio in Project Area



Source: JVA.

②Irrigated Area

Changes in irrigated areas after project completion were under the planned targets of 8,100 ha in all years from 1998 to 2001. This is largely because there was not enough water supplies for irrigation due to the curb in the water supply volume. Table 2 illustrates that neither the pumping volume on an annual average (pump stations) nor the water conveyance volume on an annual average (pipelines) reached estimated volumes. According to JVA, the actual irrigation water supply to end farm fields

was 30 per cent of the necessary volume in 1999 and 50 per cent in 2000 and 2001. Thus, vegetable farming was restricted in the dry season.

Table 1: Irrigated Area in the Project Area

(unit: ha)

	1998 (Completion Year)	1999 (Second Year)	2000 (Third Year)	2001 (Fourth Year)
Irrigated area (planned)	8,100	8,100	8,100	8,100
Actual irrigated area				
(a) rainy season	6,470	5,847	6,035	5,882
(b) dry season	1,941	1,754	1,810	1,764

Source: JVA.

Table 2: Pumping Volume (Pump Stations) and Water Conveyance Volume (Pipelines) of Irrigation Facilities in Project Area

	Planned	1998 (Completion Year)	1999 (Second Year)	2000 (Third Year)	2001 (Fourth Year)
Pump Stations					
a. Average Pumping Volume (m ³ /hour)	11, 038	8,605 (80%)	3,983 (36%)	3,412 (31%)	n.a.
b. Average Pumping Volume (m ³ /year)	78,698,088	28,891,436 (37%)	28,398,736 (36%)	24,324,055 (31%)	n.a.
Pipelines					
a. Average Water Conveyance Volume (m ³ /hour)	6,070	6,809 (112%)	2,673 (44%)	1,532 (25%)	n.a.
b. Average Water Conveyance Volume (m ³ /Year)	43,276,248	16,833,678 (39%)	19,060,360 (44%)	10,923,447 (25%)	n.a.

Source: JVA.

Note: Data in parentheses refers to achievement ratio to the planned.

③ Agricultural Output

This project was expected to increase agricultural production in the project area, as well as to improve water efficiency. Comparing the planned and actual agricultural output of major crops at appraisal, despite sluggish growth in the irrigated area and a shortage of irrigation water, the planned target was mostly achieved. Although production varies according to the agricultural product, the production of three crops such as citrus and bananas drastically increased, and this pushed up total production quantity. As a result, total production achieved a production volume very close to that of the plan. In addition, though there was no contribution to the increase in production output, the productivity of several agricultural products such as tomatoes, eggplants, cucumbers, green beans and citrus outstandingly improved. This would be because farmers introduced modern irrigation farming methods such as water-saving drip irrigation, while also thinking about cropping type, scale and timing as well as fertilizer utilization to respond to the hard environment lacking water.

Table 3: Production of Major Crops in the Project Area

(unit: 1,000 tons)

Agricultural Products	Planned		1998 (Completion Year)	1999 (Second Year)	2000 (Third Year)	2001 (Fourth Year)	98-01 Average Productivity (ton/ha)
	Outputs	Productivity (ton/ha)					
Tomatoes	66,672	44.0	45,595	45,830	45,602	36,853	69.0
Eggplants	17,390	37.5	4,775	6,526	3,896	7,640	69.2

Cucumbers	11,268	47.5	11,788	10,373	9,244	11,400	86.23
Peppers	7,824	26.3	5,102	3,533	3,204	4,808	22.84
Squash	23,659	22.5	2,841	7,920	924	1,144	17.6
Potatoes	16,329	30.0	11,910	11,487	9,324	8,655	30.0
Cauliflowers/Cabbages	5,139	32.0	2,673	9,587	938	1,561	34.1/25.0
Green beans	2,680	12.5	2,640	2,065	2,873	2,835	25.0
Broad beans	5,844	15.0	-	-	-	-	-
Onions/Garlic	1,466	25.0	8,190	661	1,085	596	18.0
Mulokhia	986	20.0	-	-	-	-	-
Melons	3,406	25.0	-	-	27	66	26.5
Spinach/Lettuces	3,710	20.0	894	620	590	662	20.0
Alfalfa	-	-	2,188	248	810	1,038	22.96
Other vegetables	235	15.0	3,455	4,230	3,179	3,336	7.7
Vegetables (Sub-total)	166,608		102,051	103,080	81,696	80,594	
Citruses	53,461	35.0	126,311	122,399	139,165	119,250	43.6
Bananas	861	28.0	3,523	3,679	3,252	3,731	27.3
Other fruit trees	690	24.0	2,783	3,063	3,481	389	19.5
Tree Crops (Sub-total)	55,012		132,617	129,141	145,898	123,370	
Wheat/Barley	2,218	5.0	2,473	1,481	1,459	2,259	3.0/2.5
Other field crops	-		140	178	204	155	11.5
Crops (Sub-total)	2,218		2,613	1,659	1,663	2,414	
Total Production (Total)	223,838		237,281	233,880	229,257	206,378	

Source: JVA and JBIC.

Note: Date of planned was from prospect on F/S used in screening.

④ Other Effect and Operation Indices

As far as other effect and operation indices are concerned, further improvements are expected since the collection ratio of irrigation water bills from users in the project area is about 80 per cent. In addition, the average water conveyance loss through irrigation pipes was improving between 1999 and 2000. JVA aims at further reduction of water conveyance loss.

Table 4: Indicators of Other Effects and Operations

	(unit: %)			
	1998 (Completion Year)	1999 (Second Year)	2000 (Third Year)	2001 (Fourth Year)
Collection Ratio of Irrigation Water Bills	77%	78%	79%	79%
Average Water Conveyance Loss (pipelines)	1.0%	10%	8%	n.a.

Source: JVA.

⑤ Interview Survey with Beneficiaries of this Project

This survey, as part of the contribution survey of this project, arranged interview surveys with 100 beneficiary farmers. The interview survey was implemented by randomly selecting 100 farmers from a list of irrigation water users in the project area, and asking prepared questions with an individual interview style. Following is a summary of the survey.

As regards the general effects of this project, it succeeded in acquiring a high level of evaluation—90 out of 100 farmers answered that they felt the effects were 'satisfactory' or more (32 farmers answered 'very satisfactory', and 58 'satisfactory'). Recognized as project effects were the reduction of labor cost and hours, the improvement of agricultural technology, and the stability in supply of irrigation water. The qualitative and quantitative improvement of agricultural output and the diversification of agricultural crops were also cited.

Figure 2: Evaluation of 100 Beneficiary Farmers to the Project

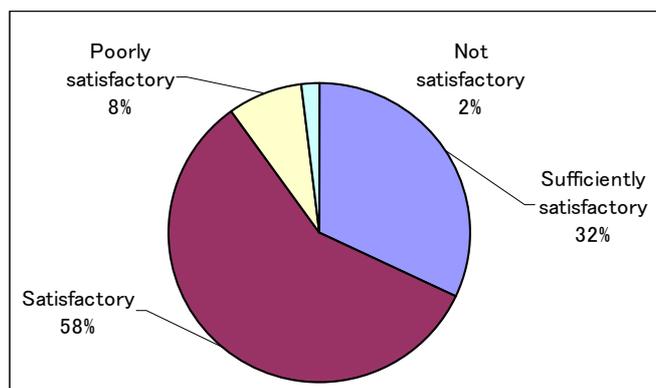
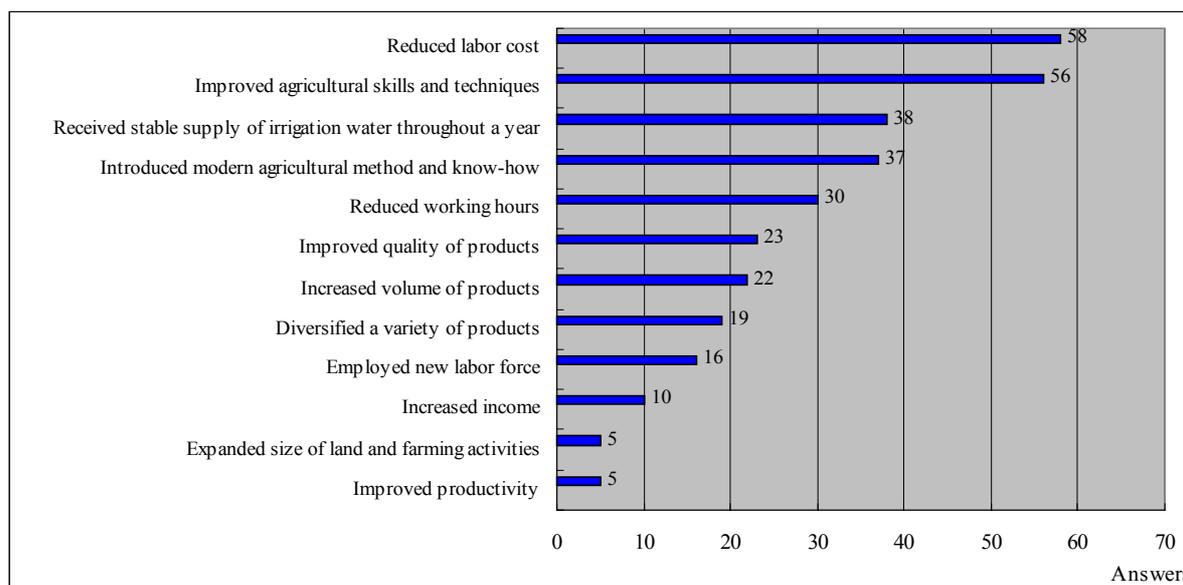


Figure 3: Project Effects Recognized by 100 Beneficiary Farmers (Multiple Answers)



By contrast, it also turned out that the conditions of irrigation facility utilization and its maintenance had problems. Many farmers complained about the current supply shortage of irrigation water and the timing of the irrigation water supply schedule. These were factors that shrank the size of crops. As for factors affecting the irrigation water supply shortage, some answers pointed out human-induced factors, such as the poor operation and maintenance capacity of JVA and stealing of water¹ by some farmers. As regards the irrigation water tariff, almost all interviewees had already fulfilled their

¹ Often water stealing would be primarily because of water shortage. But design change of pipe pressure from 6 litre/second to 9 litre/second would also be one of the factors. In the case of little supply, hydraulic pressure decreases. Particularly in the part of gravity pipe, vertical interval may create low and high water pressure. Water stealing was often seen in zones which were led to gravity pipe below low pumping zone.

payment duty. They therefore sufficiently understood the benefit principle. Meanwhile, however, they perceived that they did not receive due services in compensation for the price.

Figure 4: Maintenance Capacity of Irrigation System Implementing Agencies

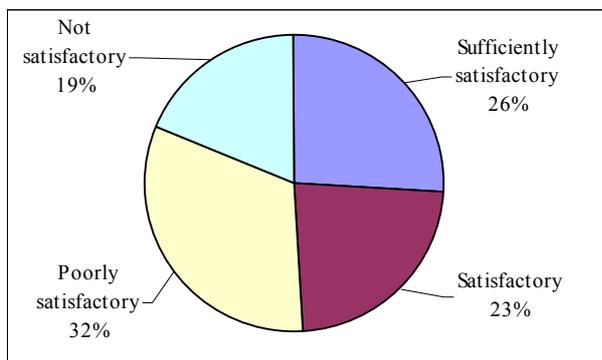
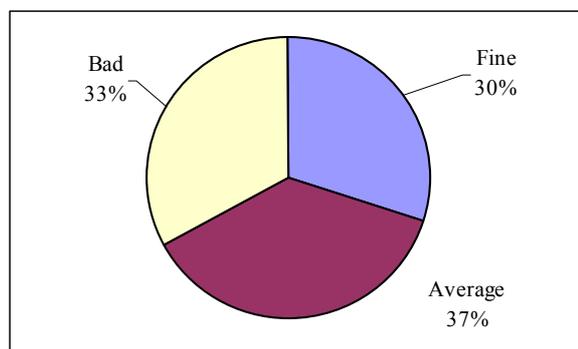


Figure 5: Status of Irrigation Facilities in Farm Fields



In this project, it was expected that farmers would borrow funds from the Agricultural Credit Cooperation (ACC) to install necessary irrigation facilities in farm fields. But those who actually borrowed and invested in the installation of irrigation facilities occupied only nine per cent of the total. High interest rates and complicated lending procedures were indicated as reasons for the difficulty in using the lending mechanism of the Agricultural Credit Cooperation,.

In general, positive effects of this project were widely perceived by beneficiaries. But there is room for further improvement in the current maintenance conditions of the irrigation system, the supply services for irrigation water, and the agricultural support system, which utilized public funds.

⑥Recalculation of the Economic Internal Return Rate (EIRR)

At appraisal, the economic internal return rate (EIRR) of this project was estimated at 19.9 per cent. In recalculating the EIRR in the current assessment, it was 20.1 per cent. Preconditions for recalculation are as following.

(Preconditions)

- Project life: 25 years including the project implementation period.
- Benefits: increased income through increased crops (already irrigated fields), and income through harvested crops (newly irrigated fields).
- Costs: total project cost, maintenance cost, construction costs of irrigation facilities in end farm fields (borne by farmers).

2.4 Impact

①Decrease in Labor Cost

As efficient irrigation types such as the drip irrigation type are being introduced in the project area, more labor is saved than when the conventional surface irrigation type is used, leading to labor cost reduction. In addition, the use of chemical fertilizer based on irrigation also contributed to labor cost reduction. A similar impact was also recognized the interview survey with farmers, mentioned previously.

②Improvement of Agricultural Technology

By shifting from the conventional surface irrigation type to the pipeline irrigation type, new irrigation technologies such as drip irrigation and mini-sprinklers at end farm fields were introduced. As a result, agricultural technologies were improved. This contributed to a remarkable improvement in the productivity of several agricultural crops. The results of the interview survey with farmers also confirmed this.

③Impacts on the Environment

JVA do not undertake particular monitoring activities. According to them, no critical environmental impacts were found.

2.5 Sustainability

The implementing agency of the project is the Jordan Valley Authority (JVA)• the Ministry of Water and Irrigation. The maintenance of irrigation facilities constructed by this project is carried out by the O & M Directorate Northern Region and the O & M Directorate Middle Region. The number of staff in the O & M Directorate Northern Region is in total 272 (177 engineers and 95 desk workers). Among these, 95 engineers are directly involved in the maintenance of this project. The number of staff in the O & M Directorate Middle Region is in total 201 (157 engineers and 44 desk workers). Among these, 15 engineers are in charge of project maintenance for this project.

Major maintenance activities can be classified into preventive maintenance and regular maintenance. As regards preventive maintenance, regular sand removal from intake and pumping stations, pipe cleaning and intake bulb replacement can be cited. As regards regular maintenance, the checking, repair and replacement of the Farm Turnout Assemblies (FTA) as well as the repair of irrigation pipe are regularly implemented. Farm roads were not repaired because this had not been necessary since the project had been completed.

As far as spare parts are concerned, 80 per cent of the parts which were procured in the implementation of the project have already been consumed. And since the JVA's budgetary steps to procure spare parts have been insufficient, spare parts for major equipment such as pumping motors have become scarce. As regards unavailable spare parts, alternative parts which can be obtained domestically are used on site through fine adjustment of the product design. Nonetheless, it is a concern that the shortage of spare parts will in future cause serious obstacles. The headquarters of JVA are considering prioritized budgetary steps for spare part procurement, which should have a higher priority.

The result of the sample interview survey with beneficiary farmers revealed that there still remains large room for: the effective use of irrigation facilities by the improvement of water supply plans and management ability; the further reinforcement of facility maintenance systems; and the strengthened crackdown of illegal activities such as stealing water. The JVA, while it continues to crack down on illegal activities, is considering the reinforcement of maintenance systems by participatory maintenance. In relation to this, the JVA is also implementing a pilot project in the area next to this project area with the co-operation of the French government in order to maintain irrigation facility networks with the participation of farmers. Its effective utilization is expected.

Comparison of Original Plan and Actual Scope

Item	Plan	Actual
①Project Scope		
1. Civil Works		
a) Pumping Stations		
- Pumping Stations	10 stations	Same as plan
- Pumping Units	29 units	Same as plan
b) Irrigation Network Construction		
- Carrier Pipe	14 km	11 km
- Distribution Pipe	31 km	33 km
- Headgate Unit M/P	232 km	222 km
- Farm Turnout	2,114 assemblies	1,928 assemblies
c) Farm Roads		
- New Roads	55 km	10 km
- Rehabilitation Roads	21 km	195 km
d) Existing Pipe Rehabilitation	-	Replacement of irrigation pipes (14 km)
2. Consulting Services	Total: 211 M/M	Total: 604 M/M
②Construction Period		
1. Civil Works		
a) Tender and Contract	June, 1988~December, 1988 (7 months)	March, 1989~November, 1992 (45 months)
b) Preparatory Construction	January, 1989~March, 1989 (3 months)	December, 1992~January, 1993 (2 months)
c) Intake and Pump Stations	February, 1989~March, 1992 (38 months)	November, 1993~December, 1995 (26 months)
d) Pipelines	March, 1989~June, 1992 (40 months)	August, 1993~February, 1997 (43 months)
e) Farm Roads	January, 1991~December, 1992 (24 months)	June, 1994~June, 1996 (26 months)
f) Maintenance	January, 1993~December, 1993 (12 months)	October, 1995~February, 1998 (29 months)
2. Consulting Services		
a) Tender and Contract	July, 1988~September, 1988 (3 months)	March, 1989~January, 1992 (35 months)
b) Consulting Services	October, 1988~December, 1993 (63 months)	January, 1993~March, 1997 (45 months)
3. Overall Construction Period	June, 1988~December, 1993 (67 months)	March, 1989~February, 1998 (108 months)
③Project Costs		
Foreign Currency	3,420 million yen	3,601 million yen
Local Currency	1,681 million yen	1,774 million yen
Total	5,101 million yen	5,375 million yen
Out of which JBIC Yen loan portion	4,080 million yen	4,080 million yen
Exchange Rate	1 JD = 373 yen (January, 1988)	1 JD = 180 yen (1993)