

Annex F
Construction Plan

ANNEX F CONSTRUCTION PLAN

Table of Contents

F1. INTRODUCTION.....	F - 1
F2. CONSTRUCTION PLAN	F - 1
F2.1. Construction Plan	F - 1
F2.2. Basic Assumption of Construction Plan.....	F - 1
F2.2.1. Operation Days.....	F - 1
F2.2.2. Concrete.....	F - 2
F2.2.3. Floating Bulkhead Gate and Cofferdam.....	F - 2
F2.3. Construction Procedure and Method.....	F - 2
F2.3.1. General.....	F - 2
F2.3.2. Rehabilitation of Gates Structure.....	F - 3
F2.3.3. Rehabilitation of Hydraulic Structure.....	F - 5
F2.3.4. Foundation of Taunsa Barrage	F - 7
F2.3.5. Other Works	F - 7

List of Figures

Fig. F.1	Schedule for Construction Work.....	F - 9
Fig. F.2	Execution Schedule for Rehabilitating a Weir Gate.....	F - 10
Fig. F.3	Execution Schedule for Rehabilitating a Under-Sluice Gate.....	F - 10
Fig. F.4	Execution Schedule for Civil Work.....	F - 11

F1. INTRODUCTION

This ANNEX F presents the results of field and home studies of the construction plan for the Project based on the results discussed in ANNEX A and B. The Project consists of the following components; rehabilitation of gates using floating bulkhead gate, repair of Taunsa Barrage hydraulic structure, expansion of guide wall, measures against sediments in D.G. Khan canal, and repair of canal structures.

F2. CONSTRUCTION PLAN

F2.1. Construction Plan

The rehabilitation of gate structure shall be executed prior to other works, and the rehabilitation work of hydraulic structure shall be conducted afterward. The construction period is planned to be nine (9) years. The work of gate structure shall be executed using floating bulkhead gates that will make working site dry. The work of hydraulic structure is basically planned to be conducted after the job site is dried with cofferdam constructing round there.

F2.2. Basic Assumption of Construction Plan

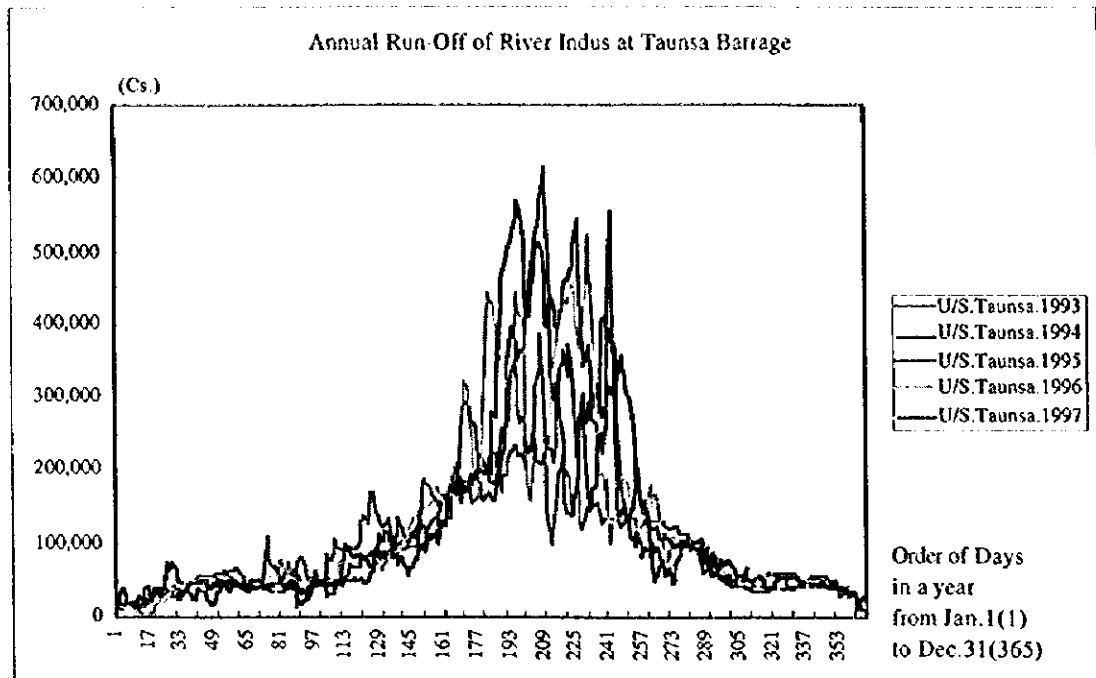
F2.2.1. Operation Days

The rehabilitation works are mostly affected by flood discharge. In rehabilitation of gate structure, the floating bulkhead gates should be used to lower water depth around the site. The work of gate structure, therefore, should not be executed during flood season, June, July, and August. The work of hydraulic structure should be conducted when the discharge of the Indus River at the Taunsa Barrage is less than 100,000 cusec. Therefore, the work of hydraulic structure is planned between October and April.

Operation days per week are assumed to be six (6) days.

During the rehabilitation work of the gate, the traffic on the road bridge will to be restricted to certain hours, such as;

First time	8: 00	to	9: 45
Second time	10: 00	to	12: 00
Third time	13: 00	to	14: 45
Forth time	15: 00	to	17: 00



Annual Run-off of River Indus at Taunsa Barrage

F2.2.2. Concrete

Concrete used for skin concrete and friction blocks should be bearing against wear. Concrete aggregate, therefore, should have large abrasion resistance. Standard mix proportions of the concrete should be rich concrete. Compressive strength of the concrete is 23.52 N/mm² (=3,413 psi).

F2.2.3. Floating Bulkhead Gate and Cofferdam

The rehabilitation work of the gate and hydraulic structure shall be planned to executed under dry condition. Therefore, floating bulkhead gates shall be intended for use in repair of gates. Six (6) floating bulkhead gates shall be prepared before starting the rehabilitation work of the gates. In execution of the repair of the hydraulic structure, cofferdams should be placed to surround 13 bays as a job site. The cofferdam (4m x 6m x 4m) shall be planned to be constructed with steal cage and sandbags.

F2.3. Construction Procedure and Method

F2.3.1. General

Rehabilitation work Procedure is that the work of gate structure shall be accomplished, after

which the work of hydraulic structure should be executed, as shown in Fig. F.1.

F2.3.2. Rehabilitation of Gates Structure

Rehabilitation works and quantity of gate structure are as follows.

Gates at Taunsa Barrage.

(ton)

Item	Undersluice gates (11 gates)		Weir gates (53 gates)		Upstream lock gate (1 gate)		Downstream lock gate (1 gate)	
	Unit Weight	Total	Unit weight	Total	Unit weight	Total	Unit weight	Total
Repair track plate and rocker assembly	4.148	45.628	3.561	188.733	4.148	4.148	-	-
Replace gate leaf	45.986	505.846	-	-	14.978	14.978	-	-
Install rubber seal and change seal beams of the water tight part	1.609	17.699	1.599	84.747	0.601	0.601	-	-
Renew gate hoist	4.317	47.487	1.516	80.348	1.516	1.516	1.516	1.516
Electrify gate hoist	1.286	14.146	1.286	68.158	1.286	1.286	1.286	1.286
Improve deck on superstructure	1.431	15.741	1.431	75.843	0.610	0.610	1.779	1.779
Install inspection passage	2.000	22.000	2.000	106.000	1.509	1.509	1.509	1.509
Repaint superstructure	(375.44)	(4,129.84)	(332.18)	(17,605.54)	(290.62)	(290.62)	(909.08)	(909.08)
Preparatory work for using bulkhead	3.746	41.206	2.206	119.780	-	-	-	-

Gates of Head Regulator

(ton)

Item	Gates of T.P. Link C (7 gates)		Gates of D.G. Khan C (7 gates)		Gate of Muzff. C (5 gates)	
	Unit weight	Total	Unit weight	Total	Unit weight	Total
Replace gate leaf	8.2000	57.400	-	-	-	-
Improve deck on super structure	0.498	3.486	0.498	3.486	0.498	2.490
Install inspection passage	1.273	8.911	1.273	9.911	1.273	6.365
Repaint superstructure	-	200.000	-	200.000	-	-

Floating Bulkhead Gates

(ton)

Item	Unit weight	Total	
Fabricate Bulkhead gate	110.559	663.359	One bulkhead shall be separate six pieces. Most heavy piece is 30 ton
Jetty and stockyard	100.000	600.000	Carrier, Incline, etc.

The general procedure of the gate rehabilitation is as follows.

- 1) To assemble floating bulkhead gates.
- 2) To rehabilitate undersluice gates and 16 weir gates at the right side.
- 3) To rehabilitate undersluice gates at the left side.
- 4) To rehabilitate weir gates from the left side to the right side.

The floating bulkhead gates shall be set on upstream point of the existing piers. Elevation of a top of the bulkhead gate shall be the same as a top of the existing gates. Guiderail and bearing plate for the bulkhead gate shall be fixed to the piers in order to disperse hydrostatic pressure load to the pier. Guiderail and bearing plate, which are for the setting bulkhead near the gates such as Bay 1, Bay 9, Bay 61, Bay 62, Bay 65 of streamside and guide bank shall be put on the wall with chemical anchor. Bearing pressure girder of the bulkhead shall be possible to replace girder for central pier into girder for streamside and guide wall with flange type joint. Water stop plate shall be formed at gate side with rotating hinge, flat rubber seal that pressed on the wall. In stopping water on crest, flat rubber seal shall be installed on lip of leaf, and then floating bulkhead gate shall be pressed well to crest by weight of itself to be watertight. The bulkhead gate shall sink in and shall float on water by controlling volume of water in its six tanks.

In execution of rehabilitation work of the undersluice gates, the existing leaf shall be removed, then new gate leaf shall be placed with floating crane on upstream pond. Counter weight is hugged temporarily over the gate in execution. Small members should be rehabilitated with truck crane on the bridge.

In execution of rehabilitation work of the weir gate, the existing gates will temporarily be reeled up and hung from the highest place, and then side girder shall be replaced with truck crane on the bridge. Then gates shall be moved down and those bottom girder shall be replaced continuously at lower position.

In execution of rehabilitation work of the lock gate, the gate girder shall be renewed during the closure period. Side girder of the upstream lock gate shall be replaced with truck crane on the bridge with downstream lock gate shut. Bottom girder shall be changed on hanging scaffolding.

Operating days for the rehabilitation work of an undersluice gate and a weir gate are estimated at 71 days and 50 days respectively as shown in Fig. F.2 and Fig. F.3.

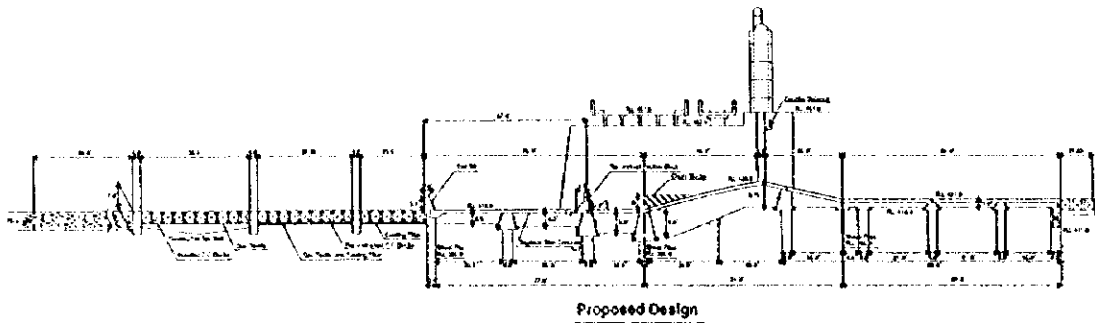
F2.3.3. Rehabilitation of Hydraulic Structure

Rehabilitation works of hydraulic structure are as follows.

Working	Number of place required repairing	Qty per unit	Total (m ³)	Remarks
Repair skin concrete			10,400	Removal and reconstruction
Trapezoidal block chute blocks and end sill			3,454	Blocks are fixed mass concrete
Protect Existing C.C blocks	14,160 blocks	1.73	24,470	Spread geo-textile filter under the blocks
Install C.C blocks	8,220 blocks	1.73	14,220	Spread geo-textile filter under the blocks
Toe wall to protect C.C blocks from wash out	-	-	5,760	
Launching apron			19,600	
Repair flared out wall				
Earth work	-	8,880	17,760	Both side bank
Concrete work		600	1,200	ditto

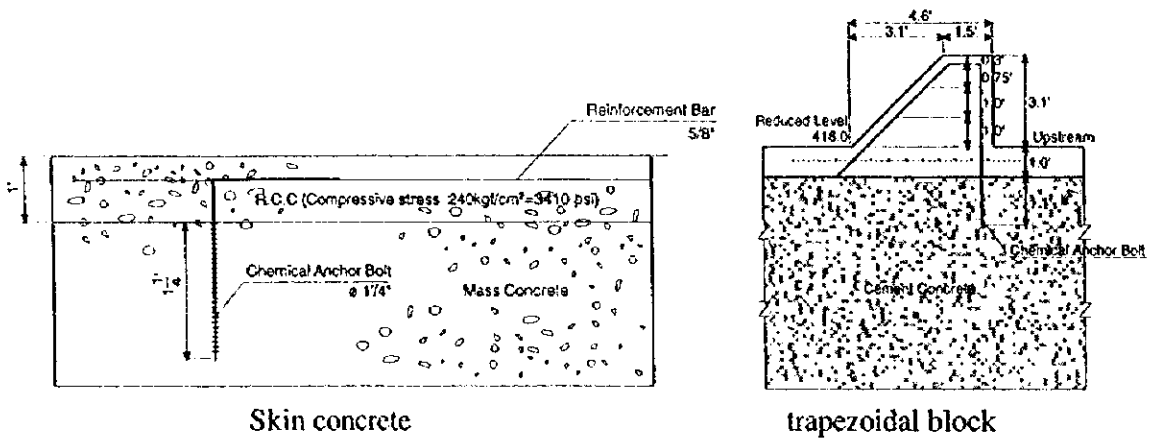
Civil work of hydraulic structure rehabilitation shall be executed from the gates that are watertightened after the gate rehabilitation work. To start with, cofferdam shall be constructed in downstream by unit of 13 gate leaves. Steel cage (4m x 6m x 4m) shall be set on riverbed by the floating crane and sandbags shall be put in the cage.

Rehabilitation of hydraulic structure shall be started under dry condition after cofferdam is completed. Procedure of execution is as follows; 1) to remove existing skin concrete and friction blocks, spreading geo-textile on concrete joints, assemble bars, trapezoidal and chute blocks, end sill, and skin concrete, 2) to remove existing C.C. blocks, spreading geo-textile, reconstructing C.C blocks, and 3) to remove a part of existing launching apron, constructing new C.C. Blocks. After these works are completed, cofferdam shall be removed. Finally launching apron shall be constructed. All these jobs shall be executed during October to April as shown in Fig.F.3.

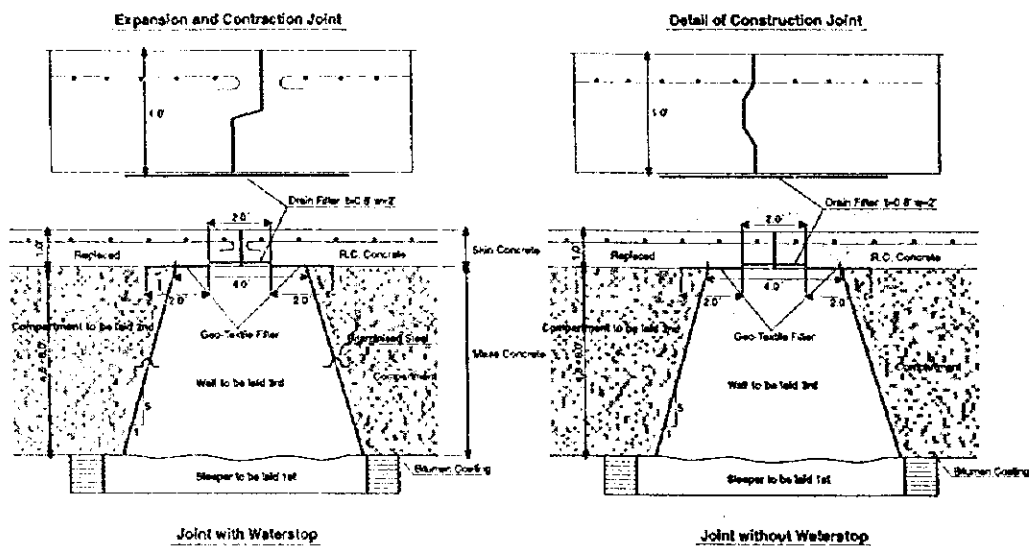


Cross section of proposed design for downstream

Skin concrete, trapezoidal and shut blocks and end sill should be fixed to mass concrete with chemical anchors.



Skin concrete and trapezoidal block fixed to mass concrete



Geo-textile spreaded over concrete joint

Flared out wall shall be improved during rehabilitation of bay under the wall. Executing procedure is as follows; 1) to remove existing concrete blocks that are composing wall, 2) to construct buttressed-retaining wall, 3) to spread geo-textile, and 4) to backfill by vibration roller. A lower part of wall shall be completed by May.

Pressure pipe shall be installed at 13 piers, i.e 20% to all piers. Twelve (12) pressure pipes shall be positioned per one pier. This pipe shall be managed by remote control at boot on superstructure.

F2.3.4. Foundation of Taunsa Barrage

1) Grouting

Grouting shall be conducted to strengthen the foundation of the Taunsa Barrage when existing concrete will be removed. If inflow water will be conformed, 10 holes ($\phi=45\text{mm}$) per one leaf shall be grouted. Grouting shall be down 10 holes per one downstream bay. Diameter of grout hole shall be 45 mm. Quantity of used cement shall be estimated 400 kg a hole. The number of grouting is 640 holes.

F2.3.5. Other Works

(1) Measures against sediment in D. G Khan canal

D.G. Khan canal has much sediment that results to reduce flow capacity of the canal. Area of much sediment is between RD. 000, which is directly beneath the head regulator gates, and RD. 40,000. The distance is 12.192 km. This sediment shall be dredged to depth of the planed canal limited in the width of the tentative canal (180 feet; 54.86 m). The dredged volume is estimated at 1,270,000 m³. Dredging work is planned to be executed with bulldozer during the closure period.

Right guide wall extended shall be composed of steel seat pile, sand filling between bottom and top concrete. This wall shall be extended 100 feet to upstream. This works shall be executed during closure period. Steel seat pile shall be installed with vibro-pile hammer.

(2) Repair work in Canals

Repair work shall be conducted on the outlets of D.G. Khan canal located at RD. 88,500 and Muzaffargah canal located at RD. 246,000. Quantity of the repair work in each canal is shown below:

Item	Escape in D.G. Khan C		Escape in Muzff C	
	ton / Gate	Total	ton / Gate	Total
Repair truck plate and rocker assembly	0.50	3.50		
Replace gate leaf	2.10	14.70	-	-
Install rubber seal and change seal beam at water tight portion	0.10	0.70		
Renew device of open and shut	0.22	1.54	-	-
Improve deck on super structure	1.20	8.40		
Civil work	(m ³)	(m ³)	(m ³)	(m ³)
Dredge sediments	-	2,000	-	2,500
Slope pitching	-	150	-	700

(3) Jetty and Stockyard

Jetty and Stockyard which has about one (1) hecor space where the bulkhead and materials for gate works can be placed temporally and adjusting work can be done should be prepared before the permanent work starts. The stockyard shall be placed being reclaimed inside the guide bund of the left bank of the Taunsa Barrage, where works on the water are possible and would not influence hydraulically the Taunsa Barrage jetty's water system. For temporary stockyard for civil work, parks of the both riversides shall be used and idle space inside the right bank of the Barrage shall be used, if necessary.

Fig. F.1 Schedule for construction work

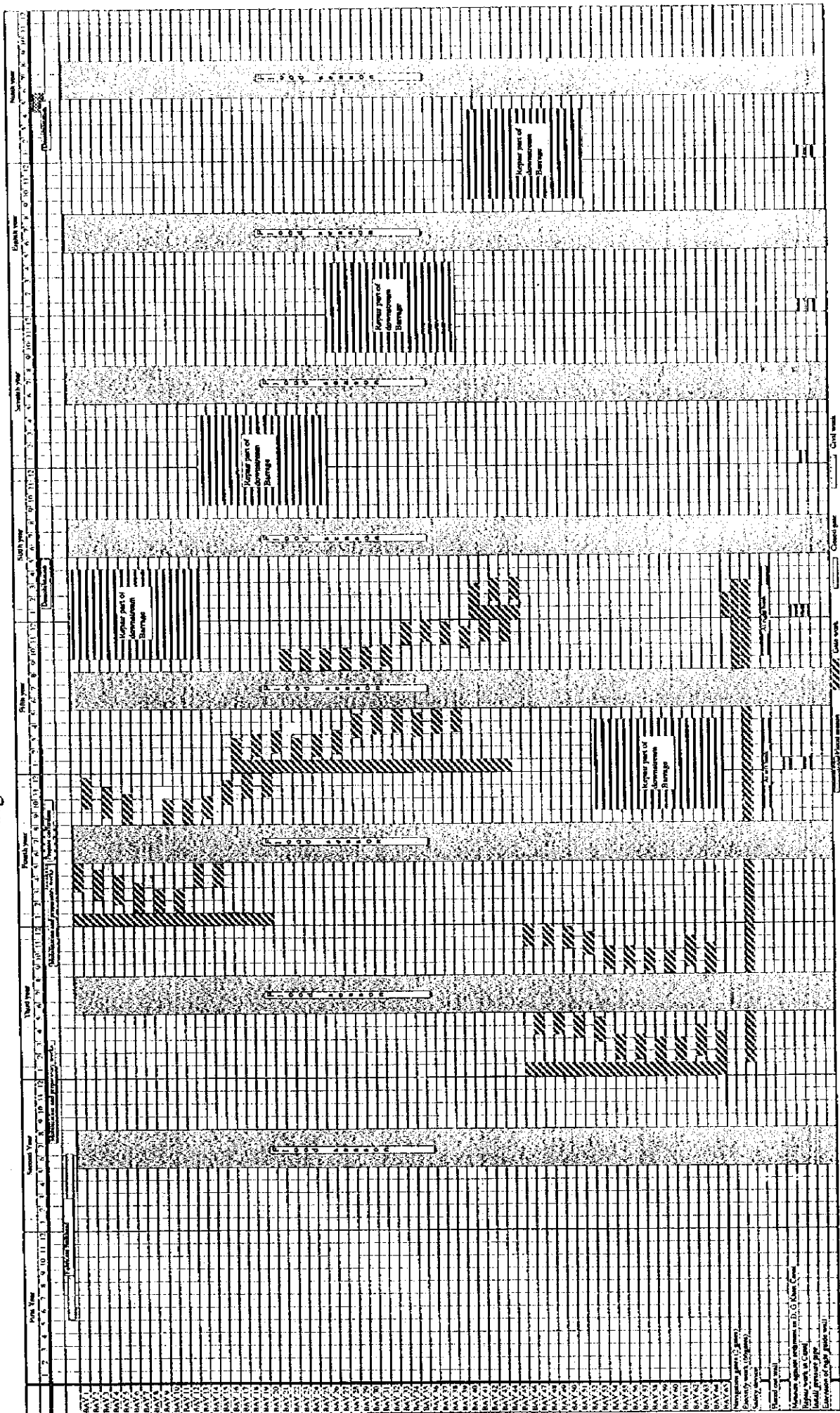


Fig. F.2 Execution Schedule for Rehabilitating a Weir gate

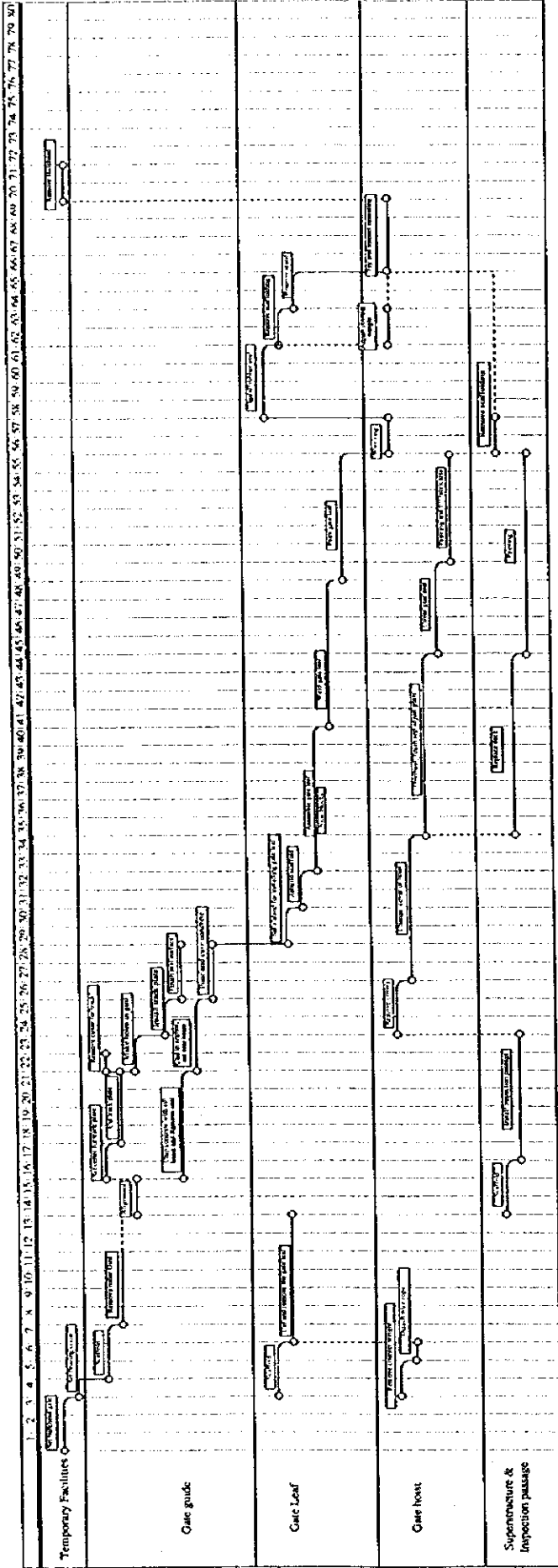


Fig. F.3 Execution Schedule for Rehabilitating a Under-Sluice gate

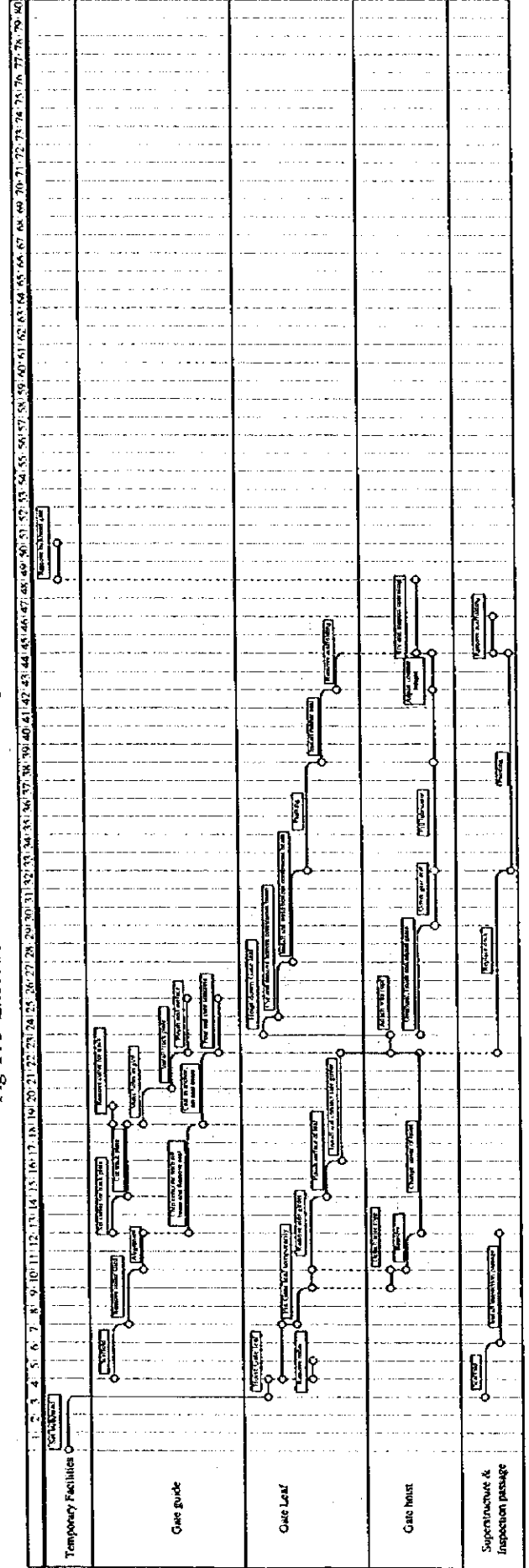
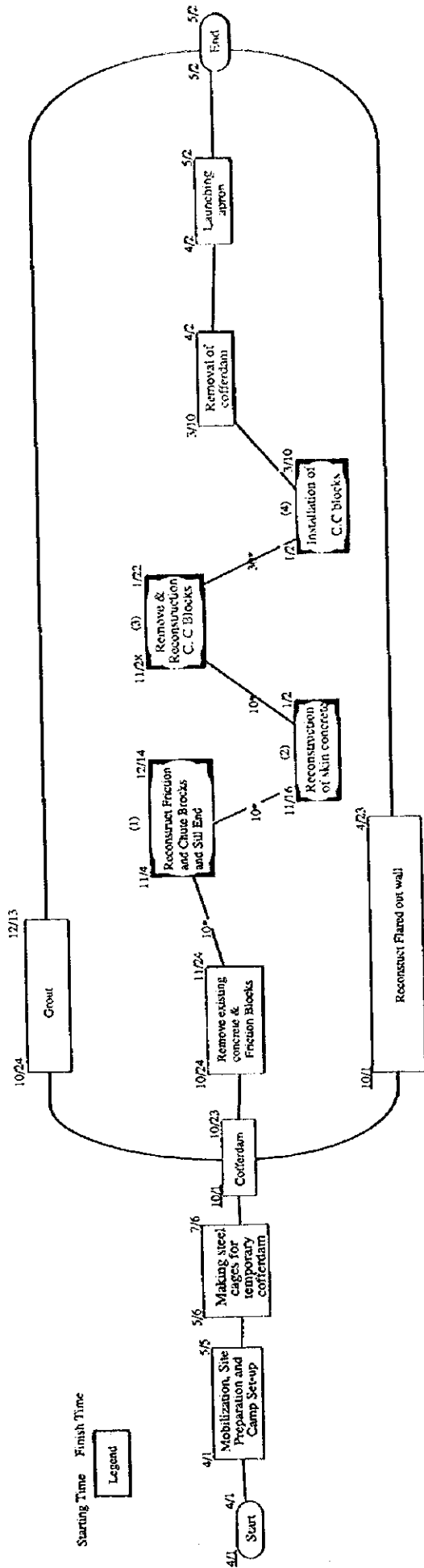
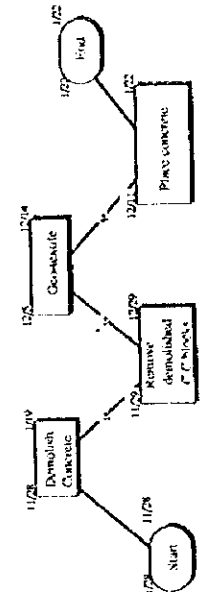


Fig F.4 Execution Schedule for Civil work

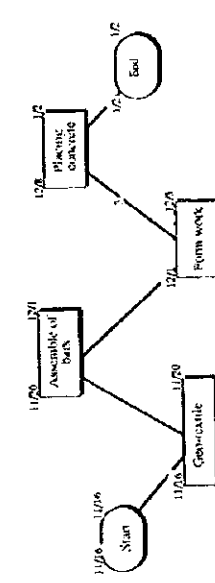


Starting Time Finish Time
Legend

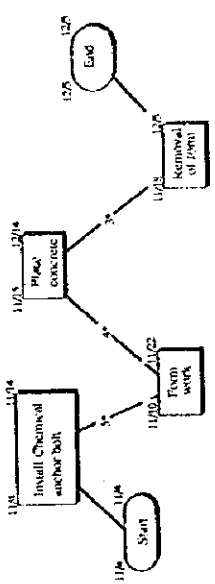
(5) Remove & Reconstruction C. C Block



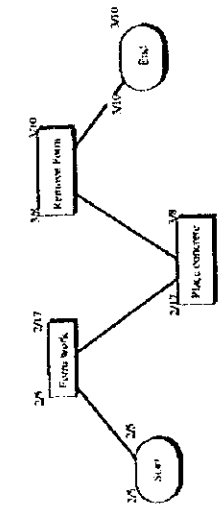
(2) Reconstruction of skin concrete



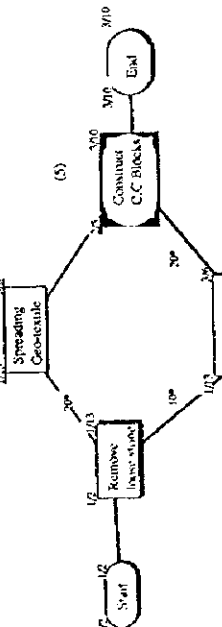
(1) Reconstruct Friction and Chute blocks and Sill End



(5) Construction of C. C. Blocks



(4) Installation of C. C. blocks



Annex G
Cost Estimates

ANNEX G COST ESTIMATE

Table of Contents

G1. GENERAL.....	G - 1
G2. ESTIMATE OF THE PROJECT COST.....	G - 1
G3. BREAKDOWN OF THE PROJECT COST.....	G - 2
G4. ANNUAL DISBURSEMENT SCHEDULE.....	G - 2
G5. EXECUTION RATE ANALYSIS.....	G - 2
G6. REPLACEMENT COST.....	G - 2
G7. ANNUAL OPERATION AND MAINTENANCE COST.....	G - 3

List of Tables

Table G.1	List of Major Material and Taxation.....	G - 4
Table G.2	Capital Project Cost.....	G - 5
Table G.3	Breakdown of Rehabilitation of Gate.....	G - 6
Table G.4	Breakdown of Procedure of floating Bulkhead Gate.....	G - 8
Table G.5	Breakdown of Repair Hydraulic Structure.....	G - 9
Table G.6	Breakdown of other works	G - 11
Table G.7	List of Procure Equipment	G - 12
Table G.8	Disbursement Schedule.....	G - 13
Table G.9	Unit price of Labour	G - 14
Table G.10	Unit Cost of Material	G - 15
Table G.11	Price of Depreciation, Rent of plant and tools	G - 16
Table G.12	Operation cost	G - 17
Table G.13	Schedule of Excursion Rate.....	G - 18

G1. GENERAL

The project cost is estimated under the following condition

- The project cost consists of construction cost, engineering cost, implementation cost and contingency
- The Construction works would be executed by full contract basis through international competitive bidding. The construction plant and equipment required for construction works shall be provided by the contractors. Therefore, depreciation costs of plants and equipment are included in the estimated construction cost.
- The exchange rate used in the cost estimate is shown as follows.
US\$1.0 = Rs. 44.00 = Yen 132.00 as exchange rate on Jun. 1998.
- Taxes on the construction materials to be imported from abroad are included in the cost estimate and listed up in Table G.1 based on Pakistan Customs Tariff.
- The construction cost integrated by unit costs is divided into both foreign and local currency portions. Local currency portion is estimated on the basis of the current price as on January, 1998 and of the data collected from markets around the project area. Foreign currency portion is estimated based on the CIF prices at Karachi.
- The physical contingency estimated at 10 % of the direct construction cost is included in the rehabilitation cost of both foreign and local currency portions.

G2. ESTIMATE OF THE PROJECT COST

Based on the condition and assumption mentioned above, The construction cost for the project is summarized below. Details of each item are shown in Table G.2

Cost component	Local Currency (1,000Rs)	Foreign Currency (1,000 Rs)	Total (1,000 Rs)
1. Direct construction cost	1,108,601	855,375	1,963,976
2. Indirect Construction Cost	114,349	180,248	294,596
3. Duty and Taxes	155,424	0	155,424
4. Physical Contingency	110,860	85,538	196,398
Base Construction cost	1,489,234	1,121,161	2,610,395
5. Price Contingency	1,635,026	348,785	1,983,811
6. Interest and Service Charge	44,677	33,635	78,312
Grand Total Cost	3,168,937	1,503,581	4,672,518

G3. BREAKDOWN OF THE PROJECT COST

(1) Direction construction Cost

Direction Cost was estimated component by component on the basis of unit costs which were obtained through necessary analysis. Cost break down for component such as Rehabilitation of Gate, Floating Bulkhead Gate, Repair Hydraulic Structure, Others works are described in Table G.3, G.4, G.5 and G.6, respectively. List of Procure Equipment proposed is shown in Table G.7.

(2) Consultancy Service and Implementation Cost

Cost of Consultancy Service and Implementation forming Indirect Construction Cost are assumed to be 10 % and 5 % of direct construction respectively.

(3) Cost of Preliminary and General Items

Cost of Preliminary and General Items is included 7 % of direct construction cost.

G4. ANNUAL DISBURSEMENT SCHEDULE

The annual disbursement schedule for the project is worked out as shown in Table G.8 based on the project implementation schedule.

G5. EXECUTION RATE ANALYSIS

Construction cost was calculated by use of detailed unit cost. Each unit cost is composed of the basic unit cost and working rate of labor and / or construction machinery. Basic costs of labor and materials surveyed and those classifications of local and foreign portion are shown in Table G.9, G.10 respectively. Depreciation and rent of Construction Plant is shown in Table G.10. Unit cost was calculated by each, according proposed work items that were designed by construction method. Analyzed execution rate is summarized in Table G.13.

G6. REPLACEMENT COST

Some of the facilities installed or constructed in the Project have some shorter useful life than the Project life and will require replacement at a certain time within the project useful life. The

replacement costs and the useful lives of these facilities are listed below.

Facility and parts to be replaced	Replacement period (year)	Qty	Replaced cost (Rs)
Rubber seal	10	Rubber seal attached all gates	8,700,000
Panel board	20	Gates of Taunsa Barrage	21,750,000
Lighting facility	10	L. S	1,200,000
Maintenance Plant	10		1,400,000

G7. ANNUAL OPERATION AND MAINTENANCE COST

Annual operation cost and maintenance cost comprise of the salaries for administrative and technical staff, the materials and costs for repair gate and hydraulic structure, renovation river, and monitoring, etc. Cost is shown below.

O&M working	O&M cost (Rs)	Remarks
Gate operation	950,000	It should operated by ten person
Gate painting	800,000	
Repair plant	4,000,000	
Repair Irrigation facility	400,000	
River improvement		
Monitoring	1,610,000	
Band Maintenance, dredging	6,000,000	
General cost	760,000	
General affairs cost	8,000,000	
Electrical charge	400,000	including Consumable cost
Others	390,000	
Total	28,810,000	

Table G.1 List of Major Material and Taxation

(Unit : Pakistan Rs.)

No.	Material	Specification	Tax Ratio	CIF Price (1,000Rs)	Qty of material required	Amount of Tax and Duty (1,000Rs)
1.	Geo-textaile		40%	0.64 / m2	34,300 m2	8,780
2.	Geo-textaile		40%	0.27 / m2	34,300 m2	3,700
3.	Steel for Gates		70%	134 / ton	1,443 ton	135,353
4.	Paint for rehabilitation of Superstructure		70%	0.36 / ton	26,735ton	6,737
Total						<u>145,540</u>

Note: CIF Karach price is estimated as same as domestic Price in Japan. US\$=1.00=Rs. 44.00=Yen132.00

Table G. 2 Capital Project Cost

Project Cost Component	Unit	Local Currency (Rs. 1000)	Foreign Currency (Rs. 1000)	Total (Rs. 1000)
I. Direct Construction Cost				
1 Rehabilitate gate at Taunsa barrage				
(1) Weir gates	53 gate	227,794	274,593	502,387
(2) Under sluice gates	11 gate	87,901	118,701	206,602
(3) Upstream lock gate	1 gate	4,051	5,129	9,180
(4) Downstream lock gate	1 gate	1,837	2,369	4,206
(5) D. G khan & Muzaffargarh canal regulator gate	12 gate	9,468	14,604	24,072
(6) T.P.A@Link regulator gate	7 gate	7,560	10,864	18,424
Sub-total		<u>338,611</u>	<u>426,260</u>	<u>764,871</u>
2 Flouting Bulkhead				
Fabricate and transportation	6 Gate	70,693	86,154	156,847
Construct jetty and stockyard	1 Place	60,013	51,399	111,412
Sub-total		<u>130,706</u>	<u>137,553</u>	<u>268,259</u>
3 Repair Taunsa Barrage				
(1) Remedial skin concrete	10400 m3	61,492	16,521	78,013
(2) Reconstruct friction block	1728 block	21,478	6,367	27,845
(3) Reconstruct C. C. concrete	block	160,266	30,555	190,821
(4) Expand C.C. concrete	block	60,533	17,737	78,271
(5) Construct toe wall	m	23,422	1,141	24,563
(6) Expand loose stone	m2	30,184	431	30,615
(7) Reconstruct flared out wall at left bank	1 wall	7,445	1,834	9,279
(8) Reconstruct flared out wall at right bank	1 wall	7,445	1,834	9,279
(9) Grouting	640 hole	3,346	11	3,357
Sub-total		<u>375,612</u>	<u>76,431</u>	<u>452,043</u>
4 Expand Right guide wall				
Sub-total	1 Place	5,191	5,788	10,979
		<u>5,191</u>	<u>5,788</u>	<u>10,979</u>
5 Measure against sedimentation in D. G khan canal				
Dredge D. G khan canal	1,270,000 m3	33,666	1,204	34,870
Sub-total		<u>33,666</u>	<u>1,204</u>	<u>34,870</u>
6 Repair work on canal				
a) Escape gate at D. G khan canal		3,055	2,514	5,569
Rehabilitate gate	7 Gate	2,821	2,510	5,331
Dredging	2000 m3	11	1	12
Repair slope protection	150 m3	222	3	226
b) Escape gate at Muzaffargarh canal		1,038	13	1,051
Repair slope protection	700 m3	1,038	13	1,051
Sub-total		<u>4,093</u>	<u>2,527</u>	<u>6,620</u>
7 Install pressure pipe				
	1 L.S	3,670	21,580	25,250
8 Procure material & equipment				
	1 L.S	142	1,423	1,565
9 Temporary work				
1 Cofferdam made by steel cage and jutting bags	5 time	80,000	10,500	90,500
2 Cofferdam made bay cofferdam	11 place	8,250	2,750	11,000
Sub-total		<u>88,250</u>	<u>13,250</u>	<u>101,500</u>
10 Site expence				
		<u>56,133</u>	<u>113,400</u>	<u>169,533</u>
11 Preliminary and General Items (7% to total of I to 9)				
	L.S	72,526	55,959	128,485
Sub-total (I)		<u>1,108,601</u>	<u>855,375</u>	<u>1,963,976</u>
II Indirect Construction Cost				
a) Consultancy Service (10% to D. Cost)	L.S	58,919	137,479	196,398
c) Implementation Cost (5% to D. Cost)		55,430	42,769	98,199
Sub-total		<u>114,349</u>	<u>180,248</u>	<u>294,597</u>
III. Duty and Taxes				
		<u>155,424</u>	<u>0</u>	<u>155,424</u>
IV. Physical Contingency				
	10 %	<u>110,860</u>	<u>85,538</u>	<u>196,398</u>
Total Base Construction Cost				
		<u>1,489,234</u>	<u>1,121,161</u>	<u>2,610,395</u>
V. Price Contingency *1				
		<u>1,635,026</u>	<u>348,785</u>	<u>1,983,811</u>
VI. Interest and Service Charge				
a) Interest During Construction Period (No interest for GOP is period)				
b) Bank Service Charge (3%)	3 %	44,677	33,635	78,312
GRAND TOTAL COST		<u>3,168,937</u>	<u>1,503,581</u>	<u>4,672,518</u>

Note :- *1

Price contingences have been derived using following inflation rates :-

	1990	1991	1992	1993	1994	1995	Average (%)
Local	12.7	10.58	9.83	11.27	13.02	10.84 (%)	11.37 %/year
Foreign	7.2	4.4	4.4	4.4	4.4	4 (%)	4.40 %/year

Table G.3 Breakdown of Rehabilitation of Gate (1/2)

Description	Weight per Gate (ton)	Unit Cost		Qty of Gate (gates)	Unit: Pakistan Rs. Rehabilitation Cost		
		L. C	F. C		L. C	F. C	Total
(1) Weir Gate							
1 Repair truck plate and Rocker Assembly	3.561	1,061	1,312	53	56,233	69,536	125,769
2 Replace Gate leaf							
3 Install rubber seal and change seal beam at water tight portion	1.599	1,113	1,167	53	58,989	61,851	120,840
4 Renew Gate hoist	1.516	465	421	53	24,645	22,313	46,958
5 Electrify Gate hoist	1.286	498	872	53	26,394	46,216	72,610
6 Improve deck on super structure	1.431	318	271	53	16,854	14,363	31,217
7 Install inspection passage	2	266	377	53	14,098	19,981	34,079
8 Repaint Superstructure		102	165	53	5,406	8,745	14,151
9 Preparatory work for using Bulkhead	2.26	475	596	53	25,175	31,588	56,763
Sub-total					227,794	274,593	502,387
(2) Under sluice gates							
1 Repair truck plate and Rocker Assembly	4.15	1,352	1,528	11	14,872	16,808	31,680
2 Replace Gate leaf	45.99	2,741	4,063	11	30,151	44,693	74,844
3 Install rubber seal and change seal beam at water tight portion	1.61	1,120	1,174	11	12,320	12,914	25,234
4 Renew Gate hoist	4.32	793	1,331	11	8,723	14,641	23,364
5 Electrify Gate hoist	1.29	498	872	11	5,478	9,592	15,070
6 Improve deck on super structure	1.43	318	272	11	3,498	2,992	6,490
7 Install inspection passage	2.00	266	377	11	2,926	4,147	7,073
8 Repaint Superstructure		115	186	11	1,265	2,046	3,311
9 Preparatory work for using Bulkhead	3.75	788	988	11	8,668	10,868	19,536
Sub-total					87,901	118,701	206,602
(3) Upstream lock gate							
1 Repair truck plate and Rocker Assembly	4.15	1,352	1,528	1	1,352	1,528	2,880
2 Replace Gate leaf	14.98	892	1,324	1	892	1,324	2,216
3 Install rubber seal and change seal beam at water tight portion	0.60	419	439	1	419	439	858
4 Renew Gate hoist	1.52	465	422	1	465	422	887
5 Electrify Gate hoist	1.29	498	872	1	498	872	1,370
6 Improve deck on super structure	0.61	135	116	1	135	116	251
7 Install inspection passage	1.51	201	284	1	201	284	485
8 Repaint Superstructure		89	144	1	89	144	233
Sub-total					4,051	5,129	9,180

Table G.3

Breakdown of Rehabilitation
of Gate (2/2)

Description	Weight per Gate (ton)	Unit Cost		Qty of Gate (gates)	Rehabilitation Cost		
		L. C	F. C		L. C	F. C	Total
(4) Downstream lock gate							
1 Repair truck plate and Rocker Assembly	-	-	-	1	-	-	-
2 Replace Gate leaf	-	-	-	1	-	-	-
3 Install rubber seal and change seal beam at water tight portion	-	-	-	1	-	-	-
4 Renew Gate hoist	1.516	465	422	1	465	422	887
5 Electrify Gate hoist	1.286	498	872	1	498	872	1,370
6 Improve hoist deck	1.431	395	337	1	395	337	732
7 Install inspection passage	2	201	284	1	201	284	485
8 Repaint Superstructure		278	454	1	278	454	732
Sub-total					1,837	2,369	4,206
(5) Breakdown of Rehabilitation cost for Regulator gates in D.G Khan & Muzaffargarh							
1 Repair truck plate and Rocker Assembly	-	-	-	-	-	-	-
2 Replace Gate leaf	-	-	-	-	-	-	-
3 Install rubber seal and change seal beam at water tight portion	-	-	-	-	-	-	-
4 Renew Gate hoist	-	-	-	-	-	-	-
5 Electrify Gate hoist	1.16	449	784	12	5,388	9,408	14,796
6 Improve deck on super structure	0.50	110	94	12	1,320	1,128	2,448
7 Install inspection passage	1.27	169	240	12	2,028	2,880	4,908
8 Repaint Superstructure		61	99	12	732	1,188	1,920
Sub-total					9,468	14,604	24,072
(6) Breakdown of Rehabilitation cost for Regulator gates in T. P link canal							
1 Repair truck plate and Rocker Assembly	-	-	-	-	-	-	-
2 Replace Gate leaf	8.2	489	724	7	3,423	5,068	8,491
3 Install rubber seal and change seal beam at water tight portion	-	-	-	-	-	-	-
4 Renew Gate hoist	-	-	-	-	-	-	-
5 Electrify Gate hoist	0.643	249	432	7	1,743	3,024	4,767
6 Improve hoist deck	0.498	110	94	7	770	658	1,428
7 Install inspection passage	1.273	169	204	7	1,183	1,428	2,611
8 Repaint Superstructure		63	98	7	441	686	1,127
Sub-total					7,560	10,864	18,424
GRAND TOTAL					338,611	426,260	764,871

Table G.4 Breakdown of Procure of Floating Bulkhead Gate

Description	Unit	Unit Price		Work Volume	Rehabilitation Price		Total(*1000)	
		L. C	F. C		L. C(*1000)	F. C(*1000)		
1 Fabricate and Transportation	110 ton per gate	gate	11,782,000	14,359,000	6	70,692	86,155	156,847
Sub-total						70,692	86,155	156,847
2 Jetty and Stockyard								
Site preparation								
Excavation/Loading	m3	17.30	0.70	58,000	1,003	40	1,043	
Grading by Bulldozer	m3	16.29	0.60	58,000	944	34	978	
Compaction	m3	61.06	7.70	58,000	3,541	446	3,987	
Mixing concrete(f=240) by portable mixer	m3	3,071.29	174.40	2,200	6,756	383	7,139	
Placing conc. by man power	m3	335.50	0.00	2,200	738	0	737	
Curing	m3	17.60	0.00	2,200	38	0	37	
Formwork	m2	298.70	12.20	176	52	2	54	
Reinforcement bars	ton	19,350.50	7,725.00	600	11,610	4,635	16,245	
Stone pitching	m3	1,483.30	22.00	2,500	3,708	55	3,763	
Steel material	ton	316,230.00	458,060.00	100	31,623	45,806	77,429	
Sub total					60,013	51,401	111,412	
GRAND TOTAL						130,705	137,556	268,259

Table G.5 Breakdown of Repair Hydraulic Structure (1/2)

Unit : Pakistan Rs.

Description	Unit	Unit Cost		Work Volume	Rehabilitation Cost		
		L. C	F. C		L. C>(*1000)	F. C (*1000)	Total (*1000)
(1) Remedial skin concrete							
Remove of concrete	m3	1,904.0	0.0	10,400	19,803	0	19,803
Mixing concrete (f=240kgf)	m3	3,071.3	173.4	10,400	31,942	1,804	33,746
Concrete Placement by bucket	m3	331.1	0.9	10,400	3,444	10	3,454
Reinforcement	ton	19,350.5	7,725.0	104	2,013	803	2,816
Formwork	m2	298.4	12.2	5,096	1,521	62	1,583
Chemical Anchor bolt	bolt	242.0	1,210.0	11,440	2,769	13,842	16,611
Sub-Total					61,492	16,521	78,013
(2) Reconstruct friction block							
Trapezoidal				832			
Mixing concrete (f=240kgf)	m3	3,071.3	173.4	1,656	5,085	287	5,372
Concrete Placement by bucket	m3	331.1	0.9	1,656	548	1	549
Reinforcement	ton	19,350.5	7,725.0	83	1,609	642	2,251
Formwork	m2	298.4	12.2	3,328	993	40	1,033
Chemical Anchor bolt	bolt	242.0	1,210.0	1,664	402	2,013	2,415
Cubical Block				896			
Mixing concrete (f=240kgf)	m3	3,071.3	173.4	2,509	7,705	435	8,140
Concrete Placement by bucket	m3	331.1	0.9	2,509	831	2	833
Reinforcement	ton	19,350.5	7,725.0	90	1,734	692	2,426
Formwork	m2	298.4	12.2	7,168	2,139	87	2,226
Chemical Anchor bolt	bolt	242.0	1,210.0	1,792	433	2,168	2,601
Sub-total					21,478	6,367	27,846
(3) Reconstruct C. C block	block			14,160			
Mixing concrete (f=240kgf)	m3	3,071.3	173.4	24,922	76,542	4,321	80,863
Concrete Placement by man power	m3	335.5	0.0	24,922	8,361	0	8,361
Geo-Textile filter (6mm)	m2	1.5	691.2	21,806	33	15,073	15,105
Geo-textile filter (0.5mm)	m2	1.5	291.6	21,806	33	6,359	6,392
Remove of Concrete	m3	1,904.3	0.0	24,922	47,458	0	47,458
Miscellaneous Expenses	20 %				27,839	4,802	32,641
Sub-total					160,266	30,555	190,821
(4) Expand C. C block							
Trapezoidal	block			8,220			
Mixing concrete (f=240kgf)	m3	3,071.3	173.4	14,796	45,443	2,566	48,009
Concrete Placement by man power	m3	335.5	0.0	14,796	4,964	0	4,964
Geo-Textile filter (6mm)	m2	1.5	691.2	12,412	19	8,579	8,599
Geo-textile filter (0.5mm)	m2	1.5	291.6	12,412	19	3,619	3,638
Miscellaneous Expenses	20 %				10,089	2,973	13,062
Sub-total		3,409.8	1,156.2		60,533	17,737	78,271
(5) Construct Toe wall							
Mixing concrete (f=180kgf)	m3	2,537.8	144.7	5,760	14,618	833	15,452
Concrete Placement by man power	m3	335.5	0.9	5,760	1,932	5	1,938
Formwork	m2	298.7	12.2	9,600	2,868	117	2,985
Curing	m3	17.6	0.0	5,760	101	0	101
Miscellaneous Expenses	20 %				3,903	184	4,087
Sub-Total					23,422	1,140	24,563

Table G.5 Breakdown of Repair Hydraulic Structure (2/2)

Description	Unit	Unit Cost		Work Volume	Rehabilitation Cost		
		L. C	F. C		Unit : Pakistan Rs.		
		L. C (*1000)	F. C (*1000)		Total (*1000)		
(6) Expand loose stone							
loose stone	m3	1,540.0	22.0	19,600	30,184	431	30,615
Sub-Total					30,184	431	30,615
(7) Reconstruct Flared out wall at left Bank							
Concrete work							
Mixing concrete (f=240kgf)	m3	3,071.3	173.4	600	1,843	104	1,947
Concrete Placement by man power	m3	335.5	0.0	600	201	0	201
Formwork	m2	298.7	12.2	1,600	478	20	497
Curing	m3	17.6	0.0	600	11	0	11
Reinforcement	ton	19,350.5	7,725.0	120	2,322	927	3,249
Miscellaneous Expenses	35 %				1,680	394	2,074
Earth work							
Remove existing block	block	417.8	47.6	483	202	23	225
Excavation	m3	26.2	1	8,880	233	9	242
Grading by Bulldozer 15ton	m3	16.3	0.6	8,880	145	5	150
Compaction by Vibration roller	m3	37.2	6.5	8,880	330	58	388
Geo-Textile filter (6mm)	m2	1.5	691.2	300	0	207	208
Geo-textile filter (0.5mm)	m2	1.5	291.6	300	0	87	88
Sub-total					7,445	1,834	9,279
(8) Reconstruct Flared out wall at Right Bank							
Concrete work							
Mixing concrete (f=240kgf)	m3	3,071.3	173.4	600	1,843	104	1,947
Concrete Placement by man power	m3	335.5	0.0	600	201	0	201
Formwork	m2	298.7	12.2	1,600	478	20	497
Curing	m3	17.6	0.0	600	11	0	11
Reinforcement	ton	19,350.5	7,725.0	120	2,322	927	3,249
Miscellaneous Expenses	35 %				1,680	394	2,074
Earth work							
Remove existing block	block	417.8	47.6	483	202	23	225
Excavation	m3	26.2	1	8,880	233	9	242
Grading by Bulldozer 15ton	m3	16.3	0.6	8,880	145	5	150
Compaction by Vibration roller	m3	37.2	6.5	8,880	330	58	388
Geo-Textile filter (6mm)	m2	1.5	691.2	300	0	207	208
Geo-textile filter (0.5mm)	m2	1.5	291.6	300	0	87	88
Sub-total					7,445	1,834	9,279
(9) Grouting							
Sub-Total	hole	5,228.0	18.0	640	3,346	11	3,357
					3,346	11	3,357
GRAND TOTAL					375,611	76,430	452,045

Table G.6 Breakdown of Other Works

Unit : Pakistan Rs.

Description	Unit	Unit Price (Rs.)		Work Volume	Rehabilitation Price		
		L. C	F. C		L. C(*1000)	F. C(*1000)	Total(*1000)
(1) Expand Right GuideWall							
Remove Existing Lounchig Apron	m3	33.62	1.23	95	3	0	3
Remove Existing CCBlocks	m3	1,904.27	0.00	36	68	0	68
Steel Seat Pile(III)	m2	41.79	4,916.02	1,156	48	5,681	5,729
Concrete (f=180)	m3	2,867.65	146.81	83	238	12	250
Concrete(f=210)	m3	3,260.80	166.59	156	508	25	533
Fill sand	m3	45.15	16.55	504	22	8	30
Replacing Lounching Stone	m3	1,540.00	22.00	2,795	4,304	61	4,365
Sub-Total					5,191	5,787	10,978
(2) Measure against sedimentation in D. G. Khan Canal							
Dredge	m3	26.5	0.9	1,270,000	33,666	1,204	34,870
Sub-Total					33,666	1,204	34,870
(3) Repair work in canal							
a)Rehabilitate Escape gate in D. G Khan canal					2,821	2,510	5,331
-Repair truck plate and Rocker Assembly	ton	325,940	368,370	3.5	1	1	2
-Replace Gate leaf	ton	596,208	883,296	14.7	9	13	22
-Install robber seal and change seal beam at water tight portion	ton	698,171	730,449	0.7	489	511	1,000
-Renew Gate hoist	ton	292,125	262,250	1.5	450	404	854
-Improve deck on super structure	ton	222,811	188,164	8.4	1,873	1,581	3,453
Earth work					233	4	237
-Dredging	m3	5.5	0.5	2,000	11	1	12
-Slop Protection	m3	1,480.0	20.0	150	222	3	225
b)Rehabilitate Escape gate in Muzaffargarh canal					1,038	13	1,051
Slop Protection	m3	1,480.0	20.0	700	1,038	13	1,051
Sub-total					4,093	2,527	6,620
(4) Install pressure pipe							
Sub-total	L. S				3,670	21,580	25,250
					3,670	21,580	25,250
(5) Temporary work							
a) Cofferdam made by steel cage and jute bags	time	16,000,000	2,100,000	5	80,000	10,500	90,500
b) Cofferdam made Jute bags	Place	750,000	250,000	11	8,250	2,750	11,000
Sub-total					88,250	13,250	101,500
GRAND TOTAL COST					134,870	44,348	179,218

Table G.7 List of Procure Equipment

Name of Equipment	Unit	Unit Price(1000Rs)		nos	Total(1000Rs)		
		L. C	F. C		L. C	F. C	Total
(1) Water recorder with floating system	unit		150	7		1,050	1,050
(2) Rain recorder tipping bucket system	unit		100	1		100	100
(3) Surveying Instrument	unit		330	1		330	330
(3) Current meter							
a) For high velocity	unit		110	1		110	110
b) for low/middle velocity	unit		110	2		220	220
(5) Sampler of bed material							
a) For sampling bed load	unit		130	1		130	130
b) For sampling suspended load	unit		130	1		130	130
(6) Apparatus for analyzing grain-size of sand and silt	unit		650	1		650	650
(7) Boat (23feet)	unit		130	1		130	130
(8) Handie-Tolkie	set		170	2		340	340
(9) Computer	set		330	3		990	990
(10) Truck: Capacity load 2ton With long body	Unit		2,735	2		5,470	5,470
(11) Wheel loader Bucket capacity : 1.5 m3 to 2.0 m3	unit		3,000	2		6,000	6,000
Total						15,650	15,650

Table G.8 Disbursement Schedule

(Use Figures B1 of FORM 2)

Project Cost Components	1st		2nd		3rd		4th		5th		6th		7th		8th		9th		10th		11th	
	Unutilized	Local	Unutilized	Local	Unutilized	Local	Unutilized	Local	Unutilized	Local	Unutilized	Local	Unutilized	Local	Unutilized	Local	Unutilized	Local	Unutilized	Local	Unutilized	Local
1. Direct Construction Cost																						
1.1. Rehabilitation of T. J. ...	2,010	4,774	2,606	2,404	1,910	10,998	2,804	1,910	10,998	2,804	1,910	10,998	2,804	1,910	10,998	2,804	1,910	10,998	2,804	1,910	10,998	2,804
2. Planning (Subtotal)	1,993	3,666	3,186	3,293	3,466	3,186	3,466	3,186	3,466	3,186	3,466	3,186	3,466	3,186	3,466	3,186	3,466	3,186	3,466	3,186	3,466	3,186
3. Major Items (Subtotal)	8,463	8,270	21,264	6,997	5,506	15,486	4,997	5,506	15,486	4,997	5,506	15,486	4,997	5,506	15,486	4,997	5,506	15,486	4,997	5,506	15,486	4,997
4. Contingency (Subtotal)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5. Measure against inflationation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6. Major work to cover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7. Local purchase job	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8. Provision against inflation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9. Temporary work	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10. Site Expanses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11. Preliminary and General Item	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub-total	12,466	16,714	35,334	13,677	10,972	30,078	10,972	10,972	30,078	10,972	10,972	30,078	10,972	10,972	30,078	10,972	10,972	30,078	10,972	10,972	30,078	10,972
12. Unallocated Contingency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13. Physical Contingency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Base	12,466	16,714	35,334	13,677	10,972	30,078	10,972	10,972	30,078	10,972	10,972	30,078	10,972	10,972	30,078	10,972	10,972	30,078	10,972	10,972	30,078	10,972
Contingency Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14. Price Contingency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15. Bank Service Charge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Project Cost	12,466	16,714	35,334	13,677	10,972	30,078	10,972	10,972	30,078	10,972	10,972	30,078	10,972	10,972	30,078	10,972	10,972	30,078	10,972	10,972	30,078	10,972

Price Contingency have been derived using following inflation rates:

Year	1986	1991	1992	1993	1994	1995
Local	12.7	10.8	9.3	11.27	13.02	10.84
Foreign	7.2	6.6	6.6	6.6	6.6	6.6

Table G.9 Unit Cost of Labour

No.	Code	Unit	Cost (Rs.)	Component		Unit cost	
				Local (%)	Foreign (%)	Local (Rs.)	Foreign (Rs.)
MP-01	Foreman on gate's work	man-day	450	0	100	0	450
MP-02	Foreman on civil	man-day	400	0	100	0	400
MP-03	Un-skilled worker	man-day	150	0	100	0	150
MP-04	Bar bender	man-day	300	0	100	0	300
MP-05	Welder, X-ray	man-day	500	0	100	0	500
MP-06	Welder	man-day	400	0	100	0	400
MP-07	Slinger	man-day	300	0	100	0	300
MP-08	Blacksmith	man-day	550	0	100	0	550
MP-09	Mechanician	man-day	600	0	100	0	600
MP-10	Rebar worker	man-day	300	0	100	0	300
MP-11	Scaffolder	man-day	300	0	100	0	300
MP-12	Painter	man-day	300	0	100	0	300
MP-13	Electrician	man-day	300	0	100	0	300
MP-14	Timberman	man-day	300	0	100	0	300
MP-15	Concrete worker	man-day	250	0	100	0	250
MP-16	Inspector for X-ray inspection	man-day	600	0	100	0	600
MP-17	Inspector for color	man-day	650	0	100	0	650
MP-18	Diver	man-day	1,000	0	100	0	1,000
MP-19	Sailor (Boat man)	man-day	400	0	100	0	400
MP-20	Operate	man-day	500	0	100	0	500
MP-21	Dump truck driver	man-day	400	0	100	0	400
MP-22	Common driver	man-day	300	0	100	0	300
MP-23	Smith	man-day	400	0	100	0	400
MP-25	Tractor driver	man-day	400	0	100	0	400
MP-30	Engineer(15year) for gate work	man-month	90,000	0	100	0	90,000
MP-31	Engineer(15year) for civil work	man-month	90,000	0	100	0	90,000
MP-32	Foreign Engineer(30year) for Gate work	man-month	660,000	100	0	660,000	0
MP-33	Foreign Engineer(20year) for Gate work	man-month	500,000	100	0	500,000	0
MP-34	Foreign Engineer(30year) for Civil work	man-month	660,000	100	0	660,000	0
MP-35	Foreign Engineer(20year) for Civil work	man-month	500,000	100	0	500,000	0

Table G.10 Unit Cost of Material

Unit: Pakistan Rs.

Item	Code	Unit	Unit Cost			Remarks
			Local Cost	Foreign Cost	Total Cost	
CP-01	Portland cement 50kg per bag	kg	4.00	0.20	4.20	
CP-02	Sand	normal	m3	214.75	15.25	230.00
CP-03	Sand	coarse	m3	214.75	15.25	230.00
CP-04	Aggregate / Gravel		m3	465.00	45.00	510.00
CP-05	Rock	for loose stone	m3	1,100.00	22.00	1,122.00
CP-06	Fine clay		m3	59.70	15.30	75.00
CP-07	Gachi		m3	119.70	15.30	135.00
CP-08	Plywood, 5mm	4'8'	pie	500.00	0.00	500.00
CP-09	Plywood	4'8'	pie	800.00	0.00	800.00
CP-10	Timber	1"*12"	m3	25,000.00	0.00	25,000.00
CP-11	Timber	4"*4"	m3	25,000.00	0.00	25,000.00
CP-12	Reinforced iron bar		ton	17,500.00	7,500.00	25,000.00
CP-13	Gasoline		lit	5.70	19.20	24.90
CP-14	Diesel		lit	3.00	6.90	9.90
CP-15	Engine oil for construction equipment		kg	56.00	24.00	80.00
CP-16	Lubrication grease		kg	123.50	52.90	176.40
CP-17	Bitumen		kg	15.80	6.80	22.60
CP-18	Jute bag		lit	21.00	9.00	30.00
CP-19	Welding Rod		kg	52.50	22.50	75.00
CP-20	Weep-holes		kg	800.00	0.00	800.00
CP-21	Water stop(Rubber belt)	200*6mm	m	415.00	0.00	415.00
CP-22	Geo-Textile (0.5mm)	0.5mm	m2	0.00	270.00	270.00
CP-23	Geo-Textile (6.0mm)		m2	0.00	640.00	640.00
CP-24	Steel sheet pile		ton	0.00	27,300.00	27,300.00
CP-25	Steel material		ton	17,500.00	7,500.00	25,000.00
CP-26	Jig		kg	56.00	24.00	80.00
CP-27	Cradle		ton	28,000.00	12,000.00	40,000.00
CP-28	Paint for gate		kg	140.00	60.00	200.00

Table G.11 Price of Depreciation, Rent of Plant and Tools

Unit: Pakistan Rs.

Plant	Specification	Unit	Unit Price			Remarks	
			Local c	Foreign c	Total		
EP-01	Truck crane mechanical system,80ton capacity	month	600,000	0	600,000		
EP-02	Truck crane hydraulic system,45ton capacity	month	500,000	0	500,000		
EP-03	Truck crane hydraulic system,20ton capacity	month	300,000	0	300,000		
EP-04	Truck	4ton	month	35,000	0	35,000	
EP-05	Truck	10ton	month	60,000	0	60,000	
EP-06	Truck	30ton	month	150,000	0	150,000	
EP-07	Pontoon for crane	15m*16m	month	300,000	0	300,000	
EP-08	Barge	10m*16m	month	200,000	0	200,000	
EP-09	Tugboat	200ps	month	75,000	0	75,000	
EP-10	Launch	25ps	month	25,000	0	25,000	
EP-11	Working boat	50ps	month	35,000	0	35,000	
EP-12	Air compressor engine system	50ps	month	60,000	0	60,000	
EP-13	Generator	125kva	month	100,000	0	100,000	
EP-14	Welding machine with output 500AAC		month	12,000	0	12,000	
EP-15	Welding machine with output 600ADC		month	14,000	0	14,000	
EP-16	Air compressor	30PS	month	30,000	0	30,000	
EP-17	Welding machine engine system with output 250A		month	20,000	0	20,000	
EP-18	Cutting machine for trackplate		month	15,000	0	15,000	
EP-19	Core cutter, 60mm in diameter		month	10,000	0	10,000	
EP-20	Submersible sand pump		month	0	10,000	10,000	
EP-21	Truck crane hydraulic system with 20 ton		month	300,000	0	300,000	
EP-22	Bulldozer Tractor	11ton 160ps	day	11,200	0	11,200	
EP-23	Bulldozer Tractor	21ton 210ps	day	11,200	0	11,200	
EP-24	Bulldozer Tractor	27ton 290ps	day	15,000	0	15,000	
EP-25	Excavator (backhoe)	0.7m3	day	8,800	0	8,800	
EP-26	Dredger	1.2m3	day	48,600	0	48,600	
EP-27	Clamshell	0.6m3	day	48,600	0	48,600	
EP-28	Wheel loader	1.2m3	day	5,000	0	5,000	
EP-29	Dump truck	11ton	day	4,000	0	4,000	
EP-30	Dump truck	20 ton	day	4,500	0	4,500	
EP-31	Wheel loder		day	2,000	0	2,000	
EP-32	Tire roller		day	2,500	0	2,500	
EP-33	Tire Roller		day	2,500	0	2,500	
EP-34	Tamping roller		day	1,500	0	1,500	
EP-35	tamper		day	1,500	0	1,500	
EP-36	Vibration roller	11t to 12t	day	2,500	0	2,500	
EP-38	Vibration roller (0.8-1.1t)		day	2,500	0	2,500	
EP-39	Jeep, 4 wheel drive		day	4,500	0	4,500	
EP-40	Truck w/2t crane		day	5,000	0	5,000	
EP-41	Tractor w/1t crane		day	1,500	0	1,500	
EP-42	Concrete mixer, 1bag	0.16m3	day	500	0	500	
EP-43	Concrete mixer, 3bag	0.48m3	day	700	0	700	
EP-44	Generator	10KVA	day	500	0	500	
EP-45	Generator	35KVA	day	1,000	0	1,000	
EP-46	Generator 60kVA		day	1,000	0	1,000	
EP-47	Compressor, portable type	3.5kg	day	1,000	0	1,000	
EP-48	Concrete Breaker (20kg)		day	76	0	76	
EP-49	Truck mixer		hr	0	860	860	
EP-50	Concrete Plant (45 m3/sec, 0.75m3*1)		hr	0	2,650	2,650	
EP-51	Crawler crane 50t		day	10,000	0	10,000	
EP-52	Crawler crane 80t		day	16,700	0	16,700	
EP-53	Truck crane hydraulic system with 10 ton		day	5,000	0	5,000	
EP-54	Concrete vibrator 23A*32mm 0.53kw		day	0	106	106	
EP-55	Generator 200KVA		day	2,600	0	2,600	

Table G.12 Operation Cost

Code No	Plant	Qty	Unit	Operation Cost			Remarks
				Local C	Foreign C	total	
EQ-01	Backhoe 0.7Çç3	1	hr	1,366.98	55.21	1,422.18	
EQ-02	Bulldozer 15t	1	hr	1,680.97	61.29	1,742.27	
EQ-03	Bulldozer 21t	1	hr	1,756.82	89.98	1,846.80	
EQ-04	Dump truck (10t)	1	hr	677.08	42.21	719.29	
EQ-05	Vibration roller (0.8 to 1.1t)	1	hr	385.92	3.66	389.58	
EQ-06	Tamper (60-100kg)	1	day	1,741.93	27.29	1,769.22	
EQ-07	Tractor	1	hr	363.04	14.36	377.40	
EQ-08	Generator 35KVA	1	day	1,272.45	1,118.45	1,390.90	
EQ-09	Generator 60kVA	1	day	1,486.92	211.71	1,698.63	
EQ-10	Generator 200KVA	1	day	4,788.17	725.29	5,513.46	
EQ-11	Concrete vibrator 23 to 32mm 0.53kw	1	day	77.16	139.55	216.71	
EQ-12	Light truck (Diesel engine)	1	day	619.42	73.66	693.08	
EQ-13	Electric Vibro pile driver (60KW)	1	day	21,284.14	12,046.80	33,330.94	
EQ-14	Truck crane mechanical system with 80 ton	1	hr	2,739.27	43.16	2,782.44	
EQ-15	Truck crane hydraulic system with 45 ton	1	hr	2,401.02	70.01	2,471.03	
EQ-16	Truck crane hydraulic system with 20 ton	1	day	1,105.71	50.31	1,156.01	
EQ-17	Truck crane hydraulic system with 10 ton	1	hr	880.71	50.31	931.01	
EQ-18	Truck crane hydraulic system with 20 ton	1	hr	1,505.71	50.31	1,556.01	
EQ-19	Truck crane hydraulic system with 10 ton	1	hr	880.71	50.31	931.01	
EQ-20	Crawler crane 80t	1	day	2,355.71	50.31	2,406.01	
EQ-21	Crawler crane 50t	1	day	1,531.09	61.34	1,592.43	
EQ-22	Electric welding machine, 250A	1	day	493.61	40.70	534.30	
EQ-23	Submersible sand pump, 80mm, 20m	1	day	0.00	270.00	270.00	
EQ-24	Submersible sand pump, 100mm, 75m	1	day	0.00	335.00	335.00	
EQ-25	Grab bucket dragger	1	day	49,677.82	274.05	49,951.87	
EQ-26	Portable concrete mixer 0.48m ³ (3.0m ³ /hr)	1	hr	92.81	2.31	95.12	
EQ-27	Concrete plant (45m ³ /sec, 0.75m ³ *1)	1	hr	0.00	2,651.00	2,651.00	
EQ-28	Truck mixer (4.5m ³)	1	hr	162.45	900.19	1,062.64	
EQ-29	Concrete pump car (90-110m ³ /sec)	1	hr	226.28	542.73	769.01	
EQ-30	Vibration roller (11 to 12 ton)	1	hr	2,137.18	379.21	2,516.39	
EQ-31	Concrete Breaker (20kg)	1	hr	91.20	0.00	91.20	
EQ-32	Compressor (portable type, 3.5kg)	1	hr	1,200.00	0.00	1,200.00	
EQ-33	Boring machinery	1	day	18,700.00	0.00	18,700.00	

Table G.13 Schedule of Rates

Unit: Pakistan Rs.

Code No	Item	Qty	Unit	Unit price			Remarks
				Local C	Foreign C	Total	
CU-01	Excavation/Loading (in ordinary stiff soil)	0.7m3	1 m3	16.39	1.61	18.00	
CU-02	Excavation (Stiff Sand / sandy soil)		1 m3	24.93	2.19	27.12	
CU-03	Soil lead upto 5.0km		1 m3	81.65	12.74	99.94	
CU-04	Grading by Bulldozer tractor		1 m3	15.52	1.37	16.88	
CU-05	Compaction		1 m3	11.91	1.05	12.96	
CU-06	Compaction		1 m3	23.81	1.21	25.02	
CU-07	Grading and Compaction		1 m3	28.03	2.41	30.44	
CU-08	Compaction (11 to 12 ton)		1 m3	28.76	14.94	43.70	
CU-09	Loose stone		1 m3	1,540.00	22.00	1,562.00	
CU-10	Geo-Textile filter (6mm)		1 m2	1.50	691.20	692.70	
CU-11	Geo-Textile filter (0.5mm)		1 m2	1.50	291.60	293.10	
CU-12	Steel sheet pile		1 m2	41.79	4,916.02	4,957.81	
CU-13	Mixing Concrete (f=240) by plant (45m3/sec, 0.75m3*1)		1 m2	2,957.22	183.07	3,140.29	
CU-14	Mixing Concrete (f=210) by plant (45m3/sec, 0.75m3*1)		1 m3	2,798.95	175.02	2,973.97	
CU-15	Mixing Concrete (f=180) by plant (45m3/sec, 0.75m3*1)		1 m3	2,646.74	167.51	2,814.25	
CU-16	Mixing mortar by plant		1 m3	3,171.88	174.06	3,345.95	
CU-17	Mixing conc. (f=240) by portable mixer 0.48m3(3.0m3/hr)		1 m3	3,071.30	173.44	3,244.74	
CU-18	Mixing conc. (f=210) by portable mixer 0.48m3(3.0m3/hr)		1 m3	2,925.30	166.59	3,091.89	
CU-19	Mixing conc. (f=180) by portable mixer 0.48m3(3.0m3/hr)		1 m3	2,537.78	144.69	2,682.47	
CU-20	Mixing mortar by portable mixer 0.48m3(3.0m3/hr)		1 m3	3,298.24	165.62	3,463.86	
CU-21	Placing conc. by man power		1 m3	335.50	0.00	335.50	
CU-22	Curing		1 m3	17.62	0.00	17.62	
CU-23	Reinforcement		1 ton	19,350.50	7,725.00	27,075.50	
CU-24	Formwork		1 m2	298.66	12.17	310.83	
CU-25	Formwork for sleeper		1 m2	144.00	0.00	144.00	
CU-26	Stone pitching		1 m2	1,483.33	22.00	1,505.33	
CU-27	Demolition of concrete		1 m3	1,462.27	0.00	1,462.27	
CU-28	Remove of concrete		1 m3	442.00	0.00	442.00	
CU-29	Concrete Placement by bucket		1 m3	329.87	2.12	331.99	
CU-30	Supplying and filling jute bags 0.072m3, with sand earth , sewing and stacking in dry		1 m3	431.44	125.10	556.54	
CU-31	Fabricate cage used cofferdam		1 cage	101,098.33	44,974.05	146,072.38	

Annex H
Project Evaluation

ANNEX II PROJECT EVALUATION

Table of Contents

H.1	INTRODUCTION	H - 1
H.2	ECONOMIC EVALUATION	H - 1
H.2.1	Basic Assumption	H - 1
H.2.2	Economic Cost	H - 2
H.2.3	Economic Benefit	H - 3
H.2.4	Economic Evaluation	H - 7
H.2.5	Sensitivity Analysis	H - 8
H.3	FINANCIAL ANALYSIS	H - 8
H.4	SOCIAL IMPACTS OF THE PROJECT	H - 12
H.5	ENVIRONMENTAL CONSIDERATION	H - 13

List of Tables

Table H.1	Economic Project Cost	H -14
Table H.2	Annual O&M Cost and Replacement Cost	H -18
Table H.3	Price Structure of Major Agricultural Outputs and Inputs	H -19
Table H.4	Financial and Economic Farm Gate Prices of Agricultural Outputs and Inputs	H -22
Table H.5	Net Return of Crops Per Acre	H -23
Table H.6	Crop Production Value under With and Without Project Condition	H -25
Table H.7	Cash Flow and Economic Evaluation of the Project	H -26
Table H.8	Sensitivity Analysis	H -27

H.1 INTRODUCTION

The objective of the Taunsa Barrage Irrigation System Rehabilitation Project is to recover or secure the irrigation service originated by the long-served Taunsa barrage by means of rehabilitation and/or remodeling of the existing barrage.

The main project components derived from the comparative studies are; 1) restoration of the gate structures, 2) rehabilitation of the hydraulic structure, 3) strengthening of foundation, 4) improvement of sediment control, 5) rehabilitation of canal facilities, 6) O&M equipment, and 7) temporary works. Some works aim enlonging their useful life or reducing O&M cost in the course of the rehabilitation project.

The objective of the Project is to keep the present irrigation service in the command area continuously and certainly. If the Project will not be implemented, the diversion function of the barrage will be reduced

H.2 ECONOMIC EVALUATION

H.2.1 Basic Assumption

The basic assumption for the economic evaluation of the Project are summarized as follows.

- The economic useful value of the Project is 50 years.
- All prices are expressed at January 1998 prices in Pakistan rupee.
- The currency exchange rate is at US\$ 1.00 = Rs. 44.00 = Yen 132.00 as of January, 1998.
- The transfer cost elements such as tax, duty, subsidy and interest are excluded for the estimation of the economic values.
- The standard conversion factor (SCF) of 0.87 is applied to domestic cost elements for the estimation of the economic values.

Derivation of Standard Conversion Factor

Year	(Rs. million)				
	1991/92	1992/93	1993/94	1994/95	1995/96
Total Imports (CIF)	229,889	258,643	258,250	320,892	397,575
Total Exports (FOB)	171,728	177,028	205,449	251,173	294,741
Taxes on Imports	57,121	62,360	63,370	76,522	87,708
Sales Taxes on Imports	9,969	11,057	15,304	21,800	24,900
Subsidies on Imports	7,324	4,641	4,608	3,313	11,150
Taxes on Exports	4,700	865	870	1,130	1,200
Standard Conversion Factor	0.88	0.87	0.86	0.86	0.87
Average SCF (1990/91-1994/95)					0.87

Note 1: Formula of Standard Conversion Factor (SCF) is:

$$SCF = (M + X) / (M + T_m) + (X - T_x)$$

Where,

M = CIF value of imports at current prices

X = FOB value of exports at current prices

T_m = Net value of taxes on imports at current prices

T_x = Net value of taxes on exports at current prices

- The unskilled labor cost is converted to the economic value applying the conversion factor of 0.75.
- The foreign currency portion of the cost is the same as the financial price.
- The economic prices of the tradable agricultural commodities are estimated on the basis of IBRD projection of world market prices terms.

H.2.2 Economic Cost

The economic costs of the Project are estimated for the economic evaluation, applying the basic assumption mentioned above. The costs for the construction components are divided into the following categories, then applied the conversion factors.

Conversion Factors by Category of Construction Component

Category	Conversion Factor	Remarks
I Foreign Cost	1.00	Shadow exchange rate = 1.00
II Local Cost		
II-1 Transfer Payment	0.00	10 % of the local cost
II-2 Unskilled Labor Cost	0.75	
II-3 Other Local Costs	0.87	Standard conversion factor

Source: JICA Study Team

The economic construction cost is consequently estimated at Rs. 2,150.5 million, as shown in the following table. The O&M cost and replacement cost are also converted into economic cost by using the conversion factors.

Summary of Financial and Economic Costs of the Project

(Unit: Rs. million)

Item	Financial Cost	Economic Cost
I Construction Cost	2,455.0	2,150.5
1) Direct Cost	1,964.0	1,711.3
2) Engineering/Administration	294.6	258.0
3) Physical Contingency	196.4	171.1
II Annual O&M Cost*	-3.2	-2.8
III Replacement Cost		
Rubber parts (every 10 years)	8.7	7.6
Electric facilities (every 20 years)	21.8	18.9
Light, etc. (every 10 years)	1.2	1.0
O&M equipment (every 10 years)	1.4	1.2

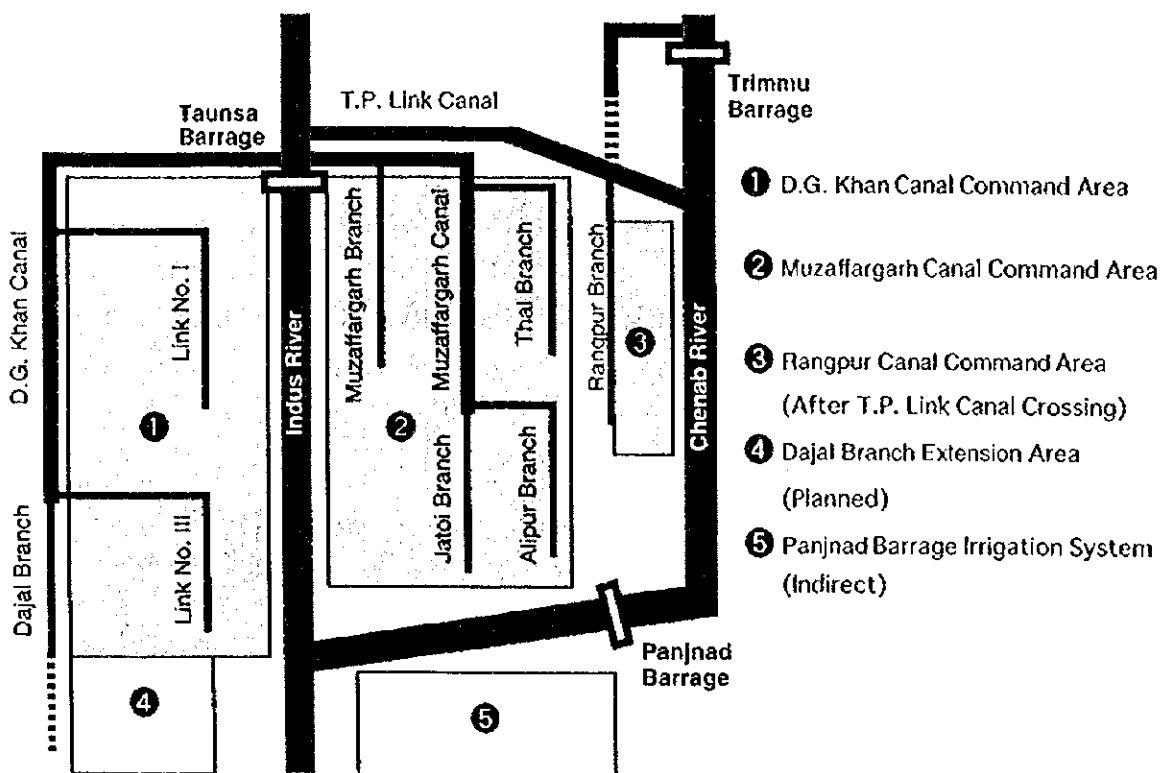
Note: * The difference of the O&M cost between under With and Without Project conditions, Rs. 28.81 million and Rs. 32.00 million.

Source: JICA Study Team

H.2.3 Economic Benefit

(1) Beneficial Area

The general layout of the irrigation system is shown in the following figure. The gross canal command area (GCA) of Muzaffargarh is about 391,000 ha between the Indus and Chenab rivers. The GCA of D.G. Khan canal system is 401,000 ha lying on the right bank of the Indus river. The westward of D.G. Khan canal is a hill torrent area. The extension of Dajal branch canal is planned at the lower portion of the area. Besides, T.P. link canal carries water from the Indus to Chenab river, then eventually irrigates Panjnad barrage command area. In addition, the lower part of Rangpur canal area is directly irrigated by T.P. link canal in these years because of the collapse of the middle reach of Rangpur canal by a heavy flood in 1992.



General Layout of Taunsa Barrage Irrigation System

Canal-wise Gross and Culturable Command Area (1996-97)

Canal	Gross Canal Command Area	Culturable Command Area
1 D.G. Khan Canal	405,000	385,000
2 Muzaffargarh Canal	367,000	314,000
3 Rangpur Canal	51,000	48,000
Total	833,000	747,000
4 Dajal Branch Extension	132,000	126,000
5 Panjnad System	615,000	549,000

Source: Canal Divisions of IPD Punjab (for 1, 2 & 3)
 Punjab Irrigation Directory (for 4)
 Punjab Development Statistics 1995 (for 5)

The direct beneficial areas of the Project are the command areas of the D.G. Khan canal, Muzaffargarh canal. The total area amounts to 833,000 ha in GCA or 747,000 ha in CCA. The benefit born in the area is evaluated by the difference of the agricultural production between with- and without-project condition.

The command area of the Panjnad irrigation system is counted for the indirect beneficial area of the Project. The benefit is simply measured by the discharge of the T.P. link canal and the expected unit water value.

(3) Agricultural Output under With and Without Project Condition

The benefit born in the area is evaluated by the difference of the agricultural production between With and Without Project condition.

Unit Net Return of Main Crops in Economic Prices

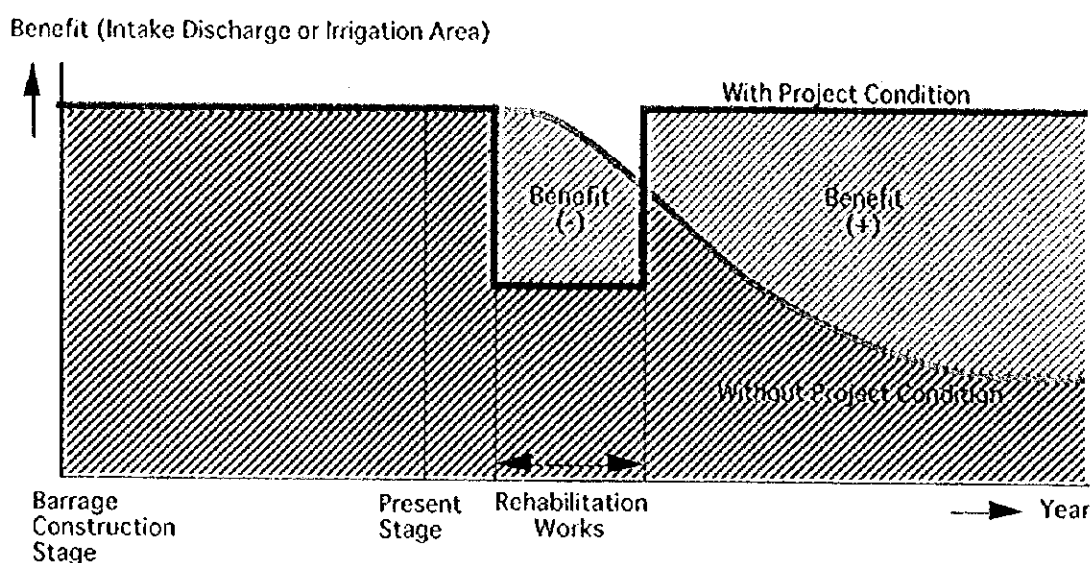
(Unit: Rs./acre)

Crop	Gross Return	Production Cost	Net Return
Cotton (Irrigated)	23,509	5,623	17,886
Rice (Irrigated)	2,253	2,190	64
Kharif Fodder (Irrigated)	4,118	1,518	2,600
Kharif Fodder (Un-Irrigated)	2,882	1,405	1,477
Wheat (Irrigated)	8,686	3,683	5,002
Wheat (Un-Irrigated)	4,570	3,683	887
Oilseeds (Irrigated)	4,916	1,825	3,091
Oilseeds (Un-Irrigated)	2,624	1,882	743
Rabi Fodder (Irrigated)	5,982	2,887	3,095
Rabi Fodder (Un-Irrigated)	4,187	2,660	1,527
Sugarcane (Irrigated)	40,425	28,648	11,779
Orchard (Irrigated)	28,298	26,797	1,500

Notes:

Source: JICA Study Team

The cropping pattern in the area is assumed to be continued in case of With Project condition. Under Without Project condition, the intake discharge as well as irrigated area will diminish due to failure of weir gate operation. On the abandoned farm land some rainfed cultivation of crops except rice, cotton and sugarcane. During the construction works, the irrigated area will be decreased at 50 % both in Kharif and Rabi season.



Concept of Sequential Benefit by Irrigation

Benefit of the Project in Economic Prices

Crop	Unit Return (Rs./acre)	With Project		Without Project	
		Area ('000 acre)	Return (Rs. million)	Area ('000 acre)	Return (Rs. million)
Cotton (Irrigated)	17,886	646	11,574	148	2,656
Rice (Irrigated)	64	85	5	20	1
Kharif Fodder (Irrigated)	2,600	218	568	50	131
Kharif Fodder (Un-Irrigated)	1,477	0	0	749	1,106
Wheat (Irrigated)	5,002	623	3,118	0	0
Wheat (Un-Irrigated)	887	0	0	623	553
Oilseeds (Irrigated)	3,091	23	70	0	0
Oilseeds (Un-Irrigated)	743	0	0	23	17
Rabi Fodder (Irrigated)	3,095	130	401	0	0
Rabi Fodder (Un-Irrigated)	1,527	0	0	130	198
Sugarcane (Irrigated)	4,934	23	115	5	26
Orchard (Irrigated)	11,779	129	1,517	30	349
Orchard (Un-Irrigated)	1,500	0	0	99	149
Total		1,877	17,341	1,877	5,186
Increment				0	12,156

Notes: The figures under Without Project condition shows the lowest intake situation (23 % of original discharge).

Source: JICA Study Team

H.2.4 Economic Evaluation

The indicators of Net Present Value (NPV), Benefit Cost Ratio (B/C) and Economic Internal Rate of Return (EIRR) is calculated assuming a discount rate as 12 %. The cash flow of the Project is shown in the following table.

Cash Flow of the Project

(Rs. million)

Year	Cost			Benefit			B-C		
	Const.	O&M Replace.	Total	With	Without	W-WO			
1	2000	44		44	17,341	17,341	0	-44	
2	2001	22		22	13,550	13,550	0	-22	
3	2002	99		99	13,550	13,550	0	-99	
4	2003	306		306	11,732	11,732	0	-306	
5	2004	278		278	11,004	11,004	0	-278	
6	2005	324		324	9,869	11,004	-1,135	-1,459	
7	2006	413		413	9,869	9,792	77	-336	
8	2007	239		239	9,869	9,792	77	-162	
9	2008	149		149	9,869	8,095	1,774	1,625	
10	2009	155		155	9,869	8,095	1,774	1,620	
11	2010	121		121	9,869	8,095	1,774	1,653	
12	2011		-3	-3	17,341	7,731	9,610	9,613	
13	2012		-3	-3	17,341	7,731	9,610	9,613	
14	2013		-3	-3	17,341	7,489	9,852	9,855	
15	2014		-3	-3	17,341	6,155	11,186	11,189	
16	2015		-3	-3	17,341	5,913	11,428	11,431	
17	2016		-3	-3	17,341	5,792	11,550	11,552	
18	2017		-3	9	6	17,341	5,792	11,550	11,544
19-20	2018		-3	-3	17,341	5,671	11,671	11,674	
21	2020		-3	1	-2	17,341	5,671	11,671	11,672
22-24	2021		-3	-3	17,341	5,549	11,792	11,795	
25-27	2024		-3	-3	17,341	5,428	11,913	11,916	
28	2027		-3	28	25	17,341	5,428	11,913	11,888
29-30	2028		-3	-3	17,341	5,343	11,998	12,001	
31	2030		-3	1	-2	17,341	5,343	11,998	12,000
32-37	2031		-3	-3	17,341	5,343	11,998	12,001	
38	2037		-3	9	6	17,341	5,343	11,998	11,992
39-40	2038		-3	-3	17,341	5,186	12,156	12,158	
41	2040		-3	1	-2	17,341	5,186	12,156	12,157
42-47	2041		-3	-3	17,341	5,186	12,156	12,158	
48	2047		-3	28	25	17,341	5,186	12,156	12,131
49-50	2048		-3	-3	17,341	5,186	12,156	12,158	
51	2050		-3	1	-2	17,341	5,186	12,156	12,157
52-57	2051		-3	-3	17,341	5,186	12,156	12,158	
58	2057		-3	9	6	17,341	5,186	12,156	12,150
59-61	2058		-3	-3	17,341	5,186	12,156	12,158	

Source: JICA Study Team

The cash flow table provides the economic indicators of NPV as Rs. 26,681 million, B/C as 26.1, and EIRR as 50.2 %. As the annual benefit derived from irrigated agriculture is significantly large compared with the Project cost, these economic indicators are extremely high. As a conclusion, the Taunsa barrage irrigation system rehabilitation project is judged as an economically feasible project.

NPV, B/C and EIRR of the Project

Indicator	Result
1 Net Present Value (NPV, 12 % discount rate)	Rs. 26,681 million
2 Benefit Cost Ratio (B/C, 12 % discount rate)	26.1
3 Economic Internal Rate of Return (EIRR)	50.2 %

Source: JICA Study Team

II.2.5 Sensitivity Analysis

The sensitivity analysis of the Project was done for expectation of some risky conditions. Three cases is assumed in this analysis; 1) 20 % increase in the initial investment, 2) 20 % decrease in agricultural benefit, and 3) 1 year delay in the project implementation. The EIRR under the any cases is estimated as high as 47 %, as shown in the following table.

Sensitivity Analysis of the Project

Case	NPV Rs. million	B/C	EIRR %
1 20 % increase in initial investment	26,468	21.8	47.8
2 20 % decrease in agricultural benefit	21,133	20.9	47.2
3 1-year delay in project implementation	22,110	24.3	46.9

Source: JICA Study Team

H.3 FINANCIAL ANALYSIS

(1) Present Worth of the Barrage

The Taunsa barrage, the key facility of the irrigation system, serves other non-irrigation functions, such as 1) non-irrigation water use, 2) road transportation across the Indus river, 3) railway transportation, 4) oil pipeline from Karachi port to upcountry, and 5) telephone line crossing.

The irrigation water fee assessed in the D.G. Khan, Muzaffargarh and the lower Rangpur canal command areas is estimated at about Rs. 85.0 million a year, based on the unit rates and cropped area.

For the non-irrigation use of the canal water, the IPD also charges at fixed rates by purpose. The non-irrigation income of D.G. Khan canal division is at least Rs. 1.5 million in the year of 1996-97. As there are 4 canal divisions in the area, the annual income on the non-irrigation is estimated at minimum Rs. 6.0 million.

The traffic charge on the vehicles crossing the barrage is collected by the IPD. Actually the IPD sublet the collecting job to a contractor at Rs. 4.0 million every year. The unit rate on the vehicles is Rs. 100 for long and heavy vehicles, Rs. 15 for buses and trucks, Rs. 5 for mini buses and wagons, and Rs. 3 for cars, jeeps and tractors. As a result of the traffic volume survey conducted by the JICA Study Team, the annual traffic income amounts to nearly Rs. 10.0 million.

The total income of the Taunsa barrage is estimated at more than 100 million in a year, excluding the values on the railway, oil pipeline and telephone line on the barrage.

Preliminary Estimate of Annual Worth of Taunsa Barrage

(Rs. '000)

Description	Worth Estimate	Remarks
Irrigation Water Use 1/	85,000	IPD; Unit rate and cultivated area by cropping
Non-Irrigation Water Use	6,000	IPD; Unit rate and water consumption
Road Transportation	10,000	IPD; Unit rate and traffic volume surveyed by the JICA Study Team
Railway Transportation		
Oil Pipeline Crossing		
Telephone Line Crossing		

Notes: 1/; D.G. Khan canal, Muzaffargarh canal and the lower Rangpur canal irrigated area.

Source: Irrigation and Power Department of the Punjab

Non-Irrigation Income of D.G. Khan Canal Division

Description	Annual Water Consumption (cft)	Rate for 10,000 cft (Rs.)	Annual Income (Rs.)
Pakistan Railways	29,376,000	65.00	190,944
Pakistan Atomic Energy Commission	29,376,000	65.00	190,944
Punjab Public Health Eng. Dept. (Drinking Water)	34,559,878	22.88	79,073
Al Gazi Tractors (Drinking Water)	5,244,755	22.88	12,000
D.G. Khan Cement	165,668,000	65.00	1,050,192
Total			1,523,153

Source: Irrigation and Power Department of the Punjab

(2) O&M Cost on Irrigation and Power Department

The budget of the IPD consists of "Annual Development Program (ADP)" and "Maintenance and Repair (M&R)" budget. The ADP budget is used for the project implementation. For example, D.G. Khan construction division of the IPD requested about Rs. 2 billion of ADP for the works under the National Drainage Programme. The M&R budget consists of M&R-works

for direct construction costs and M&R-establishment for the administration costs and wages and salary. The annual M&R-works budget of Taunsa barrage division is about Rs. 17.1 million. Of which, the cost on maintenance and repair works of the barrage is approved as Rs. 6.8 million and that on embankment of spurs and banks is as Rs. 5.3 million for 1997-98. The M&R-works budgets of D.G. Khan, Rajanpur, Kot Addu and Muzaffargarh canal divisions range from Rs. 12 million to Rs. 22 million. The M&R-establishment for the Taunsa barrage division was Rs. 15.0 million in 1996-97 mostly spent for wages/salary and many kinds of allowances.

The estimated O&M cost under with-project condition is Rs. 28.81 million., while the present O&M budget of the Taunsa barrage division of the IPD is about Rs. 32.1 million a year including M&R-works and M&R-establishment. If the O&M budget is provided certainly and timely, the IPD can maintain the barrage properly.

(3) Irrigation Water Fee on Farmers

The canal water fee is fixed by the Irrigation and Power Department at the subsidized rates, which are much lower than the private tubewell water. The latest units rate of the canal water are shown in the following table.

Irrigation Water Fee on D.G. Khan, Muzaffargarh and Rangpur Canal Area
(Rs./acre)

Crops	Per	Rate
Sugarcane on Kharif Channel	Crop	84.85
Sanctioned Gardens & Orchard	Half Year	104.81
Gardens & Orchard	Half Year	81.53
Vegetable except Turnip	Crop	81.53
Tobacco	Crop	69.88
Rice	Crop	66.51
Water Nut & Lotus Product	Crop	66.51
Cotton	Crop	69.88
Fibers other than Cotton	Crop	58.24
Poppy, Drugs, Dyes, Spices, Chilies & Melons	Crop	58.24
Oilseeds (except Rabi oilseeds on Kharif channels)	Crop	48.25
Forest Plantation	Half Year	46.59
Maize	Crop	34.93
Unspecified crops	Crop	44.93
Gardens & Orchards on Kharif Channels during Rabi	Half Year	33.28
Vegetables on Kharif channels during Rabi	Crop	33.28
Jowar, Chinna & all fodder crops including Tunip	Crop	28.29
Grass which has received two or more watering	Half Year	28.29
Bajra, Gram, Monsoor & Pulses	Crop	33.28
All Rabi crops on Kharif channels excluding gardens, orchards & vegetables	Crop	23.29
Watering for ploughing not followed by a crop in the succeeding harvest	Half Year	11.65

Notes: Rangpur canal area is only the lower area from the T.P. link canal crossing point.
Effected from Kharif season of 1996.

Source: Irrigation and Power Department of the Punjab

This Project will not force the farmers to pay for the cost. The farmers will pay their regular irrigation water fee to the IPD, if not transformed. The annual farm income under the standard cropping pattern and practices is estimated at Rs. 7,528 /acre in financial terms, while the water fee is only Rs. 53 /acre or 0.7 % of the farm income. Under Without Project condition, the farm income may decrease at Rs. 5,672 /acre and the water fee become Rs. 33 /acre due to change in cropping pattern. The present canal water fee is very little compared with the return.

Farm Income and Irrigation Water Fee

		(Unit: Rs./acre)	
Condition	Farm Income	Water Fee	
1 With Project condition	7,518	53 (0.7%)	
2 Without Project condition	5,672	33 (0.6%)	
3 Increment	1,846		

Note: All figures are expressed in market prices.

Source: JICA Study Team

When the PIDA is established, water fee could increase and reliability of water supply could go up. From the viewpoint of the beneficial farmers, the advantage of the expected irrigation practice seems to be much stronger than the disadvantage of the increased water fee.

H.4 SOCIAL IMPACTS OF THE PROJECT

(1) Panjnad Barrage Irrigation System

The main function of the T.P. link canal is a supplemental water supply to the Panjnad barrage located at the tail of the Chenab river or on the Panjnad river. Panjnad and Abbasia canals originated from the Panjnad barrage irrigate 615,000 ha of GCA. After rehabilitation of the Taunsa barrage, therefore, the preferable diversion from the Indus and more stable irrigation in the Panjnad barrage irrigation system area is expected.

(2) Mitigation of Flood Damage

The flood damage occurs frequently in these years because some degraded weir gates can not open during the high water season. The flood damage is anticipated to become more frequently and significantly if the rehabilitation is not carried out. As this rehabilitation project will make the gate operation more certain even in a flood season, the magnitude of the flood damage around the barrage will be mitigated considerably.

(3) Improvement of Farm Economic Condition by Stable Water Supply

The stable water supply accompanied by the proper gate operation is expected to contribute to improvement of farmers' economic condition. The most farmers use tubewells together with canal for the purpose of supplemental water supply when they can not get expected amount of canal water on their farms even in Kharif season. If the Taunsa barrage irrigation system can be operated more certainly, the pump operation time can be minimized. Thus, the pump operation cost or payment to water market can be saved.

(4) Dajal Branch Canal Extension Plan

The Dajal branch extension plan to irrigate 132,000 ha of GCA at the tail of D.G. Khan canal command area is still pending. The long-history plan since the Taunsa barrage construction period is difficult to be implemented soon because of the water right of the Indus. However, the plan is possible to run when some desirable allocation of water is arranged. To keep the Taunsa barrage in good condition secures the possibility of the future project implementation.

(5) Assurance of Non-Irrigation Functions

The Taunsa barrage serves several non-irrigation functions, such as non-irrigation water use, road transportation, railway transportation, oil pipeline, and telephone line crossing. Such associate functions will be automatically assured by means of the implementation of the Taunsa barrage rehabilitation project.

H.5 ENVIRONMENTAL CONSIDERATION

Since the proposed rehabilitation work of the Taunsa barrage is the preventive measure for the existing irrigation system and it does not include the expansion of the irrigation area, the impact of this rehabilitation on the environment of the Study area is expected to be minimal. However, the impact on the wildlife sanctuary during the construction should be taken into account in order to avoid any negative effects on the precious inhabitants. Among the conceivable impacts during the construction period, the most important point is to avoid any water pollution not to give any detrimental impact on the water life around the barrage and in the lower stream including Indus dolphin, water birds and fisheries.

Table H. 1 Economic Project Cost

	Financial Cost in Ra.'000											
	Overall			1st Year			2nd Year			Foreign Cost		
	Total Cost	Transfer	Unskilled	Total Cost	Transfer	Unskilled	Total Cost	Transfer	Unskilled		Others	
Total Rehabilitation Cost	2,454,963	87,817	455,635	48,207	822	8,603	31,384	24,639	536	4,397	4,820	14,886
A Direct Cost	1,963,969	74,217	366,420	0	0	0	0	0	0	0	0	0
A1 Rehabilitation Works on Gates	764,871	18,825	169,429	0	0	0	0	0	0	0	0	0
A2 Bulkhead	268,260	5,096	79,743	0	0	0	0	0	0	0	0	0
A3 Rehabilitation Works on Barrage	482,041	29,135	84,260	0	0	0	0	0	0	0	0	0
A4 Expand Right Guide Wall	10,978	104	4,152	0	0	0	0	0	0	0	0	0
A5 Sediment Control, DGK Canal	34,870	3,334	328	0	0	0	0	0	0	0	0	0
A6 Rehabilitation Works on DGK Escape	6,620	195	2,140	0	0	0	0	0	0	0	0	0
A7 Installation of Pressure Pipe	25,248	300	666	0	0	0	0	0	0	0	0	0
A8 Equipment	1,565	14	0	0	0	0	0	0	0	0	0	0
A9 Temporary Works	101,498	7,151	16,743	0	0	0	0	0	0	0	0	0
A10 Site Expense	169,533	5,103	5,103	0	0	0	0	0	0	0	0	0
A11 Preliminary & General Items	128,485	4,960	22,928	0	0	0	0	0	0	0	0	0
B Indirect Cost	294,597	6,178	55,602	48,207	922	9,603	31,384	24,639	536	4,397	4,820	14,886
B1 Consultancy Service	196,400	2,387	35,050	39,280	477	7,010	27,496	15,712	191	2,804	7,719	10,998
B2 Administration Cost	98,197	3,791	17,523	8,927	345	1,593	3,101	8,927	345	1,593	3,101	3,888
C Physical Contingency	196,397	7,422	36,642	0	0	0	0	0	0	0	0	0
Economic Cost in Ra.'000	2,150,492	74,000	361,725	44,273	0	6,452	31,384	22,377	0	3,238	4,194	14,886
Total Rehabilitation Cost	1,711,313	0	274,815	0	0	0	0	0	0	0	0	0
A1 Rehabilitation Works on Gates	686,431	0	112,768	0	0	0	0	0	0	0	0	0
A2 Bulkhead	237,265	0	59,807	0	0	0	0	0	0	0	0	0
A3 Rehabilitation Works on Barrage	367,753	0	63,195	0	0	0	0	0	0	0	0	0
A4 Expand Right Guide Wall	9,715	0	3,114	0	0	0	0	0	0	0	0	0
A5 Sediment Control, DGK Canal	27,554	0	246	0	0	0	0	0	0	0	0	0
A6 Rehabilitation Works on DGK Escape	5,661	0	1,695	0	0	0	0	0	0	0	0	0
A7 Installation of Pressure Pipe	24,431	0	500	0	0	0	0	0	0	0	0	0
A8 Equipment	1,534	0	0	0	0	0	0	0	0	0	0	0
A9 Temporary Works	81,796	0	12,557	0	0	0	0	0	0	0	0	0
A10 Site Expense	157,184	0	3,827	0	0	0	0	0	0	0	0	0
A11 Preliminary & General Items	111,990	0	17,196	0	0	0	0	0	0	0	0	0
B Indirect Cost	268,047	0	39,430	44,273	0	5,452	31,384	22,377	0	3,238	4,194	14,886
B1 Consultancy Service	182,457	0	26,288	36,492	0	5,258	27,496	14,597	0	2,103	7,496	10,998
B2 Administration Cost	85,591	0	13,142	7,781	0	1,195	2,698	7,781	0	1,195	2,698	3,888
C Physical Contingency	171,131	0	27,492	0	0	0	0	0	0	0	0	0

Table H. 1 Economic Project Cost

	Financial Cost in Rs. '000					
	3rd Year		4th Year		5th Year	
	Total Cost	Foreign Cost	Total Cost	Foreign Cost	Total Cost	Foreign Cost
Total Rehabilitation Cost	110,905	62,271	346,870	166,367	302,430	174,220
A Direct Cost	76,424	43,077	292,937	139,528	258,693	144,858
A1 Rehabilitation Works on Gates	0	0	0	0	0	0
A2 Bulkhead	76,424	43,077	189,896	94,476	226,793	126,059
A3 Rehabilitation Works on Barrage	0	0	0	0	0	0
A4 Expand Right Guide Wall	0	0	0	0	0	0
A5 Sediment Control, DGK Canal	0	0	0	0	0	0
A6 Rehabilitation Works on DGK Escape	0	0	0	0	0	0
A7 Installation of Pressure Pipe	0	0	0	0	0	0
A8 Equipment	0	0	313	285	0	0
A9 Temporary Works	0	0	0	0	4,000	270
A10 Site Expende	0	0	0	0	24,219	16,200
A11 Preliminary & General Items	0	0	102,788	44,767	3,671	1,599
B Indirect Cost	24,639	14,886	24,639	14,886	24,639	14,886
B1 Consultancy Service	15,712	10,998	15,712	10,998	15,712	10,998
B2 Administration Cost	8,927	3,888	8,927	3,888	8,927	3,888
C Physical Contingency	7,842	4,308	29,294	13,953	25,868	14,486
Economic Cost in Rs. '000	99,029	62,271	305,602	158,267	277,963	174,220
Total Rehabilitation Cost	99,029	62,271	305,602	158,267	277,963	174,220
A Direct Cost	69,683	43,077	257,481	139,528	232,350	144,858
A1 Rehabilitation Works on Gates	0	0	0	0	0	0
A2 Bulkhead	69,683	43,077	167,582	94,476	203,436	126,059
A3 Rehabilitation Works on Barrage	0	0	0	0	0	0
A4 Expand Right Guide Wall	0	0	0	0	0	0
A5 Sediment Control, DGK Canal	0	0	0	0	0	0
A6 Rehabilitation Works on DGK Escape	0	0	0	0	0	0
A7 Installation of Pressure Pipe	0	0	307	285	0	0
A8 Equipment	0	0	0	0	0	0
A9 Temporary Works	0	0	0	0	3,260	235
A10 Site Expende	0	0	0	0	22,455	16,200
A11 Preliminary & General Items	0	0	69,592	44,767	3,200	1,599
B Indirect Cost	22,377	14,886	22,377	14,886	22,377	14,886
B1 Consultancy Service	14,597	10,998	14,597	10,998	14,597	10,998
B2 Administration Cost	7,781	3,888	7,781	3,888	7,781	3,888
C Physical Contingency	6,969	4,308	25,748	13,953	23,235	14,486

Table H. 1 Economic Project Cost

	6th Year				7th Year				8th Year			
	Local Cost		Foreign Cost		Local Cost		Foreign Cost		Local Cost		Foreign Cost	
	Transfer	Unskilled	Others	Total	Transfer	Unskilled	Others	Total	Transfer	Unskilled	Others	Total
Total Rehabilitation Cost	365,323	69,377	100,878	435,580	19,623	77,826	176,606	200,961	11,828	64,437	106,448	113,305
A Direct Cost:	309,713	9,703	67,325	386,741	17,352	66,754	156,163	169,159	10,265	36,400	92,389	89,472
A1 Rehabilitation Works on Gates	2,678	5,054	44,078	51,730	6,093	46,526	54,833	129,523	2,144	14,360	19,300	48,513
A2 Bulkhead	0	0	0	0	0	0	0	0	0	0	0	0
A3 Rehabilitation Works on Barrage	38,746	2,497	7,222	48,465	5,827	16,852	52,443	15,286	5,827	16,852	52,443	15,286
A4 Expand Right Guide Wall	0	0	0	0	0	0	0	0	0	0	0	0
A5 Sediment Control, DGK Canal	0	0	0	0	3,334	328	30,004	1,204	0	0	0	0
A6 Rehabilitation Works on DGK Escape	0	0	0	0	0	0	0	0	195	2,140	1,758	2,527
A7 Installation of Pressure Pipe	4,208	50	111	4,369	50	111	450	3,597	50	111	450	3,597
A8 Equipment	0	0	0	0	0	0	0	0	0	0	0	0
A9 Temporary Works	22,083	1,231	6,278	29,592	1,178	1,553	10,602	1,750	1,178	1,553	10,602	1,750
A10 Site Expense	24,219	729	6,561	31,509	729	729	6,561	16,200	729	729	6,561	16,200
A11 Preliminary & General Items	3,671	142	655	4,468	142	655	1,275	1,599	142	655	1,275	1,599
B Indirect Cost	24,639	4,397	4,820	33,856	536	4,397	4,820	14,886	536	4,397	4,820	14,886
B1 Consultancy Service	15,712	191	2,804	18,707	191	2,804	1,719	10,998	191	2,804	1,719	10,998
B2 Administration Cost	8,927	345	3,101	12,373	345	1,593	3,101	3,888	345	1,593	3,101	3,888
C Physical Contingency	30,971	970	8,733	40,674	1,735	6,675	15,617	16,916	1,927	3,640	9,259	9,947
Economic Cost in Rs. '000	320,656	82,033	112,784	515,473	20,113	89,874	235,203	242,995	13,751	74,777	126,668	133,338
Total Rehabilitation Cost	320,656	82,033	112,784	515,473	20,113	89,874	235,203	242,995	13,751	74,777	126,668	133,338
A Direct Cost:	273,890	44,305	75,973	394,168	12,123	50,066	135,067	169,159	0	27,300	80,378	89,472
A1 Rehabilitation Works on Gates	194,799	33,059	39,575	267,433	6,093	34,895	47,705	129,523	0	10,770	16,791	48,513
A2 Bulkhead	0	0	0	0	0	0	0	0	0	0	0	0
A3 Rehabilitation Works on Barrage	31,521	0	19,554	51,075	0	12,639	45,825	15,286	0	12,639	45,825	15,286
A4 Expand Right Guide Wall	0	0	0	0	0	0	0	0	0	0	0	0
A5 Sediment Control, DGK Canal	0	0	0	0	0	246	26,104	1,204	0	0	0	0
A6 Rehabilitation Works on DGK Escape	0	0	0	0	0	0	0	0	0	1,602	1,529	2,527
A7 Installation of Pressure Pipe	4,072	83	392	4,547	0	83	392	3,597	0	83	392	3,597
A8 Equipment	0	0	0	0	0	0	0	0	0	0	0	0
A9 Temporary Works	17,843	4,709	9,635	32,187	0	1,165	9,224	1,750	0	1,165	9,224	1,750
A10 Site Expense	22,455	547	5,708	28,710	0	547	5,708	16,200	0	547	5,708	16,200
A11 Preliminary & General Items	3,200	491	1,110	4,801	0	491	1,110	1,599	0	491	1,110	1,599
B Indirect Cost	22,377	3,298	4,194	30,869	0	3,298	4,194	14,886	0	3,298	4,194	14,886
B1 Consultancy Service	14,597	2,103	1,496	18,196	0	2,103	1,496	10,998	0	2,103	1,496	10,998
B2 Administration Cost	7,781	0	2,698	10,479	0	1,195	2,698	3,888	0	1,195	2,698	3,888
C Physical Contingency	27,389	4,430	7,597	39,416	0	5,007	13,587	16,916	0	2,730	8,058	9,947

Table H. 1 Economic Project Cost

	9th Year				10th Year				11th Year			
	Total Cost	Local Cost		Foreign Cost	Total Cost	Local Cost		Foreign Cost	Total Cost	Local Cost		Foreign Cost
		Transfer	Unskilled			Others	Transfer			Unskilled	Others	
Total Rehabilitation Cost	175,987	9,264	26,287	57,161	182,025	9,211	28,571	83,739	150,793	6,576	20,626	59,108
A Direct Cost	137,589	7,926	19,900	38,432	143,078	7,978	21,976	71,798	105,585	5,492	14,754	49,425
A1 Rehabilitation Works on Gates	0	0	0	0	0	0	0	0	0	0	0	0
A2 Bulkhead	0	0	0	0	0	0	0	0	0	0	0	0
A3 Rehabilitation Works on Barrage	90,408	5,827	16,852	15,286	90,408	5,827	16,852	15,286	51,663	3,330	9,630	29,967
A4 Expand Right Guide Wall	0	0	0	0	5,489	52	2,076	467	5,489	52	2,076	467
A5 Sediment Control, DGK Canal	0	0	0	0	0	0	0	0	0	0	0	0
A6 Rehabilitation Works on DGK Escape	4,208	50	111	3,597	4,208	50	111	3,597	4,208	50	111	450
A7 Installation of Pressure Pipe	0	0	0	0	0	0	0	0	1,252	11	0	103
A8 Equipment	0	0	0	0	0	0	0	0	1,553	10,602	1,750	10,602
A9 Temporary Works	15,083	1,178	1,553	10,602	15,083	1,178	1,553	10,602	15,083	1,178	1,553	10,602
A10 Site Expense	24,219	729	729	16,200	24,219	729	729	6,561	24,219	729	729	6,561
A11 Preliminary & General Items	3,671	142	655	1,599	3,671	142	655	1,275	3,671	142	655	1,275
B Indirect Cost	24,639	536	4,397	4,820	24,639	536	4,397	4,820	24,639	536	4,397	4,820
B1 Consultancy Service	15,712	191	2,804	1,719	15,712	191	2,804	1,719	15,712	191	2,804	1,719
B2 Administration Cost	8,927	345	1,593	3,101	8,927	345	1,593	3,101	8,927	345	1,593	3,101
C Physical Contingency	13,759	793	1,990	7,133	14,308	798	2,198	7,180	10,559	549	1,475	4,943
Economic Cost In Rs.'000	140,334	0	19,715	57,161	154,672	0	21,428	72,905	121,355	0	15,470	54,394
A Direct Cost	115,415	0	14,925	38,432	120,273	0	16,482	62,465	89,980	0	11,066	43,000
A1 Rehabilitation Works on Gates	0	0	0	0	0	0	0	0	0	0	0	0
A2 Bulkhead	0	0	0	0	0	0	0	0	0	0	0	0
A3 Rehabilitation Works on Barrage	73,550	0	12,639	15,286	73,550	0	12,639	15,286	42,030	0	7,223	26,072
A4 Expand Right Guide Wall	0	0	0	0	4,857	0	1,557	406	4,857	0	1,557	406
A5 Sediment Control, DGK Canal	0	0	0	0	0	0	0	0	0	0	0	0
A6 Rehabilitation Works on DGK Escape	0	0	0	0	0	0	0	0	0	0	0	0
A7 Installation of Pressure Pipe	4,072	0	83	3,597	4,072	0	83	392	4,072	0	83	392
A8 Equipment	0	0	0	0	0	0	0	0	1,227	0	0	89
A9 Temporary Works	12,138	0	1,165	9,224	12,138	0	1,165	9,224	12,138	0	1,165	9,224
A10 Site Expense	22,455	0	547	16,200	22,455	0	547	5,708	22,455	0	547	5,708
A11 Preliminary & General Items	3,200	0	491	1,599	3,200	0	491	1,110	3,200	0	491	1,110
B Indirect Cost	22,377	0	3,298	4,194	22,377	0	3,298	4,194	22,377	0	3,298	4,194
B1 Consultancy Service	14,597	0	2,103	1,496	14,597	0	2,103	1,496	14,597	0	2,103	1,496
B2 Administration Cost	7,781	0	1,195	2,698	7,781	0	1,195	2,698	7,781	0	1,195	2,698
C Physical Contingency	11,542	0	1,493	3,843	12,027	0	1,648	6,246	9,998	0	1,107	4,300

Table H.2 Annual O&M Cost and Replace Cost

(Unit: Rs.'000)

Item	Financial Cost				Economic Cost				
	Total Cost	Local Cost			Total Cost	Local Cost			Foreign Cost
		Transfer	Unskilled	Others		Transfer	Unskilled	Others	
Annual O&M Cost (Increment)	-3,190	0.039	0.184	0.352	-2,773				
A Without Project Condition	92,000	1,248	5,888	11,264	27,816	0	4,416	9,800	13,600
B With Project Condition	28,810	1,124	5,301	10,141	25,043	0	3,976	8,823	12,244
Replacement Cost									
A Rubber Parts (every 10 year)	8,700	339	1,601	3,062	7,563	0	1,201	2,664	3,698
B Electric Facilities (every 20 year)	21,750	848	4,002	7,656	18,907	0	3,002	6,661	9,244
C Lump, etc. (every 10 year)	1,200	47	221	422	1,043	0	166	367	510
D O&M Equipment (every 10 year)	1,400	55	258	493	1,217	0	193	429	595

Table H.3 Price Structure of Major Agricultural Outputs and Inputs (1/3)

(1) Wheat (Import Substitution)

Item	Operation	Unit	Price
1 Projected Price *1		US\$/ton	160
2 Adjustment for quality and marketing (-2%)	-	US\$/ton	3
3 Ocean freight and insurance	+	US\$/ton	35
4 CIF Karachi price	=	US\$/ton	192
		Rs./ton	8,439
		US\$1.00 = Rs.44.00	
5 Port charge, storage and other costs	+	Rs./ton	300
6 Transportation, Karachi to D.G. Khan	+	Rs./ton	700
7 Value of imported wheat at D.G. Khan	=	Rs./ton	9,439
8 Transport and handling cost (Threshing, flour procurement center)	-	Rs./ton	90
9 Farm gate price/threshing floor value	=	Rs./ton	9,349

(2) Cotton (Export Parity)

Item	Operation	Unit	Price
A Cotton Lint (Export Parity)			
1 Projected Price *1		US\$/ton	1,742
2 Adjustment for quality and marketing (-14%)	-	US\$/ton	244
3 Ocean freight and insurance	-	US\$/ton	60
4 CIF Karachi price	=	US\$/ton	1,438
		Rs./ton	63,277
		US\$1.00 = Rs.44.00	
5 Port charge, warehousing, Procurement and other costs	-	Rs./ton	1,350
6 Value of lint at ginnery	=	Rs./ton	61,927
7 Conversion to cotton seed (33%)	=	Rs./ton	20,436
9 Ginning cost	-	Rs./ton	1,500
10 Value of seed cotton at ginnery	=	Rs./ton	18,936
B Cotton Seed Oil (Import Substitution)			
1 Projected Price *1		US\$/ton	530
2 Adjustment for quality and marketing (-10%)	-	US\$/ton	53
3 Ocean freight and insurance	+	US\$/ton	36
4 CIF Karachi price	=	US\$/ton	513
		Rs./ton	22,572
		US\$1.00 = Rs.44.00	
5 Port charge, warehousing, Procurement and other costs	+	Rs./ton	200
6 Value of oil at oil mill	=	Rs./ton	22,772
7 Conversion to cotton seed (7%)	=	Rs./ton	1,594
9 Processing cost	-	Rs./ton	450
10 Value of seed cotton at oil mill	=	Rs./ton	1,144
C Oilcake (Import Substitution)			
1 Projected Price *1		US\$/ton	260
2 Adjustment for quality and marketing (-35%)	-	US\$/ton	91
3 Ocean freight and insurance	+	US\$/ton	36
4 CIF Karachi price	=	US\$/ton	205
		Rs./ton	9,020
		US\$1.00 = Rs.44.00	
5 Port charge, warehousing, Procurement and other costs	+	Rs./ton	200
6 Value of oilcake at oil mill	=	Rs./ton	9,220
7 Conversion to cotton seed (55%)	=	Rs./ton	5,071
9 Processing cost	-	Rs./ton	450
10 Value of seed cotton at oil mill	=	Rs./ton	4,621
D Cotton Seed as a whole			
1 Value of cotton seed as lint, oil and oilcake (A+B+C)		Rs./ton	24,701
2 Transport and handling cost, factory to farm gate	-	Rs./ton	165
3 Farm gate price of seed cotton	=	Rs./ton	24,536

Table H.3 Price Structure of Major Agricultural Outputs and Inputs (2/3)

(3) Paddy (Export Parity)

Item	Operation	Unit	Price
1 Projected Price *1		US\$/ton	330
2 Adjustment for quality and marketing (-38%)	-	US\$/ton	125
3 Ocean freight and insurance	-	US\$/ton	60
4 CIF Karachi price	=	US\$/ton	145
		US\$1.00 = Rs.44.00	
		Rs./ton	6,362
5 Handling and transportation between port and market	-	Rs./ton	700
6 Milling and transportation cost	-	Rs./ton	554
7 Ex-mill price	=	Rs./ton	5,108
8 Conversion to paddy (67%)	=	Rs./ton	3,423
9 Handling and transportation, mill to farm gate	-	Rs./ton	150
10 Farm gate price of paddy	=	Rs./ton	3,273

(4) Sugarcane (Import Substitution)

Item	Operation	Unit	Price
1 Projected Price *1		US\$/ton	245
2 Adjustment for quality and marketing (-0%)	-	US\$/ton	0
3 Ocean freight and insurance	+	US\$/ton	36
4 CIF Karachi price	=	US\$/ton	281
		US\$1.00 = Rs.44.00	
		Rs./ton	12,364
5 Wharfage, cleaning and other port costs	+	Rs./ton	548
6 Administration cost	+	Rs./ton	676
7 Storage losses	+	Rs./ton	65
8 Transport and handling cost, Karachi to sugar mill	+	Rs./ton	1,000
9 Ex-mill value of sugar	=	Rs./ton	14,653
10 Processing costs	-	Rs./ton	5,613
11 Conversion to cane (8.7%)	=	Rs./ton	786
12 Handling and transportation, mill to farm gate	-	Rs./ton	138
13 Farm gate price of sugarcane	=	Rs./ton	648

Table H.3 Price Structure of Major Agricultural Outputs and Inputs (3/3)

(5) Urea (Import Substitution)

Item	Operation	Unit	Price
1 Projected Price *1		US\$/ton	160
2 Ocean freight and insurance	+	US\$/ton	36
3 CIF Karachi price	=	US\$/ton	196
		US\$1.00 = Rs.44.00	8,624
4 Port charge, handling, warehousing, etc.	+	Rs./ton	200
5 Transport and handling cost, Karachi to dealer	+	Rs./ton	700
6 Marketing and dealers' cost	+	Rs./ton	190
7 Transport and handling cost, dealer to farmer	+	Rs./ton	70
8 Farm gate price	=	Rs./ton	9,784
(Nutrient: Nitrogen, 46%)	=	Rs./ton	21,270

(6) TSP (Import Substitution)

Item	Operation	Unit	Price
1 Projected Price *1		US\$/ton	172
2 Ocean freight and insurance	+	US\$/ton	36
3 CIF Karachi price	=	US\$/ton	208
		US\$1.00 = Rs.44.00	9,152
4 Port charge, handling, warehousing, etc.	+	Rs./ton	200
5 Transport and handling cost, Karachi to dealer	+	Rs./ton	700
6 Marketing and dealers' cost	+	Rs./ton	167
7 Transport and handling cost, dealer to farmer	+	Rs./ton	70
8 Farm gate price	=	Rs./ton	10,289
(Nutrient: Phosphorus, 46%)	=	Rs./ton	22,367

(7) Potassium Chloride (Import Substitution)

Item	Operation	Unit	Price
1 Projected Price *1		US\$/ton	117
2 Ocean freight and insurance	+	US\$/ton	36
3 CIF Karachi price	=	US\$/ton	153
		US\$1.00 = Rs.44.00	6,732
4 Port charge, handling, warehousing, etc.	+	Rs./ton	200
5 Transport and handling cost, Karachi to dealer	+	Rs./ton	700
6 Marketing and dealers' cost	+	Rs./ton	130
7 Transport and handling cost, dealer to farmer	+	Rs./ton	70
8 Farm gate price	=	Rs./ton	7,832
(Nutrient: Potassium, 60%)	=	Rs./ton	13,053

Note *1:

Wheat: US, No.1, Hard red winter, ordinary protein, export price delivered at the Gulf port

Cotton Lint: Outlook, A index, middling 1-3/32 inch, CIF Europe

Cotton Seed Oil: Soybean oil, Dutch, crude, FOB ex-mill

Oilcake of Cotton: Soybean meal, any origin, Argentine 15/46% extraction, CIF Rotterdam

Rice: 5% broken, WR, milled, government standard, FOB Bangkok

Sugarcane: World, International Sugar Agreement, Daily, FOB Greater caribbean ports

Urea: Bagged, Spot, FOB West Europe)

TSP: Bulk, Spot, FOB US Gulf

Potassium Chloride: Standard grade, Spot, FOB Vancouver

Source *1:

Commodity Markets and the Developing Countries, World Bank

Table H. 4 Financial and Economic Farm Gate Prices of Agricultural Outputs and Inputs

Item	Unit	Financial Price	Economic Price	Remarks
Outputs				
Crops				
Wheat	Rs./kg	4.30	9.35	International market
Rice (IRRI)	Rs./kg	5.27	3.27	International market
Oilseeds (Mustard)	Rs./kg	11.46	11.46	
Sugarcane	Rs./kg	0.90	0.65	International market
Cotton	Rs./kg	18.90	24.54	International market
Fruits (Mango)	Rs./kg	5.50	5.50	
Fodders (Sorghum)	Rs./kg	0.84	0.84	
Fodders (Berseem)	Rs./kg	0.57	0.57	
By-Products				
Wheat Straw	Rs./kg	0.40	0.40	
Rice Straw	Rs./kg	0.18	0.18	
Sugarcane	Rs./kg	0.41	0.41	
Cotton	Rs./kg	0.27	0.27	
Inputs				
Seed/Seedling				
Wheat	Rs./kg	5.29	5.29	
Rice	Rs./kg	6.17	6.17	
Oil Seeds (Mustard)	Rs./kg	13.58	13.58	
Sugarcane	Rs./kg	0.46	0.46	
Cotton	Rs./kg	17.43	17.43	
Fruits (Mango)	Rs./plant	45.00	45.00	
Fodders (Sorghum)	Rs./kg	12.60	12.60	
Fodders (Berseem)	Rs./kg	27.00	27.00	
Fertilizer				
N	Rs./kg	14.41	21.27	International market
P	Rs./kg	19.57	22.37	International market
K	Rs./kg	18.00	13.05	International market
Manure	Rs./40kg	2.72	2.72	
Agro-chemicals				
Insecticide	Rs./kg	44.00	44.00	
Pestiside	Rs./kg	350.00	350.00	
Labor				
Common labor	Rs./man-day	72.00	54.00	Conversion Rate=0.75
Machinery/Animal Power				
Land Preparation by Tractor	Rs./hour	75.00	65.25	Conversion Rate=0.87
Land Preparation by Bullocks	Rs./day	70.00	60.90	Conversion Rate=0.87
Interculture by Bullocks	Rs./day	70.00	60.90	Conversion Rate=0.87
Harvesting	Rs./mound	75.00	65.25	Conversion Rate=0.87

Table H.5 Net Return of Crops Per Acre

Net Return of Crops Per Acre - Economic Price

Items	Unit	Rice	Cotton	K. Fodder- Sorghum		Wheat		Oilseeds- Rice & Mustard		R. Fodder- Berseem		Sugar- cane	Orchard- Mango	Orchard- Mango	
		Irr.	Irr.	Irr.	Un-Irr.	Irr.	Un-Irr.	Irr.	Un-Irr.	Irr.	Un-Irr.	2yr avg	Irr.	Un-Irr.	
Gross Return	Rs	2,253	23,509	5,118	2,882	8,686	5,570	4,916	2,624	5,982	4,182	9,113	50,425	28,298	
Production Value	Rs	1,550	23,509	4,118	2,882	8,032	4,226	4,916	2,624	5,982	4,187	7,885			
Yield	Kg	474	958	4,902	3,431	859	452	429	229	10,495	7,346	12,130			
Unit price	Rs/kg	3.27	24.54	0.84	0.84	9.35	9.35	11.46	11.46	0.57	0.57	0.65			
By-Product	Rs		703			654	344					1,228			
Production Cost	Rs	2,190	5,623	1,518	1,405	3,683	3,683	1,825	1,882	2,887	2,660	4,178	28,646	26,797	
Ploughing, etc.	Rs	196	424	196	196	424	424	261	261	261	261	196			
Nos.	hr	3	7	3	3	7	7	4	4	4	4	3			
Unit cost	Rs/hr	65.25	65.25	65.25	65.25	65.25	65.25	65.25	65.25	65.25	65.25	65.25			
Seed	Rs	49	139	252	252	265	265	27	27	216	216	591			
Amount	kg	8	8	20	20	50	50	2	2	8	8	1,285			
Unit price	Rs/kg	6.17	17.43	12.60	12.60	5.29	5.29	13.58	13.58	27.00	27.00	0.46			
Fertilizer N	Rs	574	936	425	425	936	936	425	425	744	744	1,021			
Amount	kg	27	44	20	20	44	44	20	20	35	35	48			
Unit rate	Rs/kg	21.27	21.27	21.27	21.27	21.27	21.27	21.27	21.27	21.27	21.27	21.27			
Fertilizer P	Rs	157	515	0	0	492	492	268	268	0	0	336			
Amount	kg	7	23	0	0	22	22	12	12	0	0	15			
Unit rate	Rs/kg	22.37	22.37	22.37	22.37	22.37	22.37	22.37	22.37	22.37	22.37	22.37			
Fertilizer K	Rs	0	0	0	0	0	0	0	0	0	0	0			
Amount	kg	0	0	0	0	0	0	0	0	0	0	0			
Unit rate	Rs/kg	13.05	13.05	13.05	13.05	13.05	13.05	13.05	13.05	13.05	13.05	13.05			
Fertilizer FYM	Rs	16	103	33	33	95	95	0	0	340	340	238			
Amount	kg	240	1,520	480	480	1,400	1,400	0	0	5,000	5,000	3,500			
Unit rate	Rs/kg	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07			
Sprays	Rs	175	700	0	0	0	0	0	0	0	0	140			
Nos.	lit	2	4	0	0	0	0	0	0	0	0	1			
Area sprayed	%	25%	50%	0%	0%	0%	0%	0%	0%	0%	0%	40%			
Unit rate	Rs/lit	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00			
Hired Labor	Rs	594	1,674	0	0	756	756	189	216	0	0	648			
Amount	man-day	11	31	0	0	14	14	4	4	0	0	12			
Unit rate	Rs/md	54.00	54.00	54.00	54.00	54.00	54.00	54.00	54.00	54.00	54.00	54.00			
Family Labor	Rs	324	864	540	432	540	540	567	594	1,188	972	810			
Amount	man-day	6	16	10	8	10	10	11	11	22	18	15			
Unit rate	Rs/md	54.00	54.00	54.00	54.00	54.00	54.00	54.00	54.00	54.00	54.00	54.00			
Contingencies (@5%)	Rs	104	268	72	67	175	175	87	90	137	127	199			
Net Return	Rs	64	17,886	2,600	1,477	5,002	887	3,091	743	3,095	1,527	4,934	11,779	1,500	
With Project	Acre	85,208	645,602	218,447		0	623,262	0	22,662	0	129,591	0	23,322	128,750	0
	%	4.6%	35.0%	12.0%		0.0%	33.7%	0.0%	1.1%	0.0%	6.9%	0.0%	1.3%	7.0%	0.0%
	Rs/acre	3	6,252	312		0	1,688	0	35	0	215	0	62	821	0
	W_Fee	65.51	69.88	28.29			23.29		23.29		23.29		84.85	163.06	
	Rs/acre	3	24	3		0	8	0	0	0	2	0	1	11	0
(Average)	Rs/acre	102%	9,388	53.02											
Without Project	Acre	19,598	148,488	50,243	748,886		0	623,262	0	22,662	0	129,591	5,364	29,613	93,138
	%	1.1%	8.0%	2.7%	40.5%		0.0%	33.7%	0.0%	1.2%	0.0%	7.0%	0.3%	1.6%	5.4%
	Rs/acre	1	1,438	71	599		0	299	0	9	0	107	14	189	81
	W_Fee	65.51	69.88	28.29			23.29		23.29		23.29		84.85	163.06	
	Rs/acre	1	6	1	0		0	0	0	0	0	0	3	0	
(Average)	Rs/acre	102%	2,808	9.94											

Table H.5 Net Return of Crops Per Acre

(2/2)

Net Return of Crops Per Acre - Market Price

Items	Unit	Rice		Cotton		K. Fodder-Sorghum		Wheat		Oilseeds-Race & Mustard		R. Fodder-Berseem		Sugar-cane	Orchard-Manoo	Orchard-Manoo
		Irr.	Irr.	Irr.	Un-Irr.	Irr.	Un-Irr.	Irr.	Un-Irr.	Irr.	Un-Irr.	Irr.	Un-Irr.	Irr.	Irr.	Un-Irr.
		2yr avg. Average Average														
Gross Return	Rs	3,201	18,106	4,118	2,882	4,348	2,288	4,916	2,624	5,982	4,187	12,145	40,425	28,298		
Production Value	Rs	2,498	18,106	4,118	2,882	3,694	1,944	4,916	2,624	5,982	4,187	10,917				
Yield	Kg	474	958	4,902	3,431	659	452	429	229	10,495	7,346	12,130				
Unit price	Rs/kg	5.27	18.90	0.84	0.84	4.30	4.30	11.46	11.46	0.57	0.57	0.90				
By-Product	Rs	703				654	344						1,228			
Production Cost	Rs	1,873	4,308	819	819	2,738	2,200	1,067	1,095	1,396	1,396	2,905	22,965	21,120		
Ploughing, etc.	Rs	225	488	225	225	488	488	300	300	300	300	225				
Nos.	hr	3	7	3	3	7	7	4	4	4	4	3				
Unit cost	Rs/hr	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00				
Seed	Rs	49	139	252	252	265	265	27	27	216	216	591				
Amount	kg	8	8	20	20	50	50	2	2	8	8	1,285				
Unit price	Rs/kg	6.17	17.43	12.60	12.60	5.29	5.29	13.58	13.58	27.00	27.00	0.46				
Fertilizer N	Rs	389	595	271	271	595	298	271	271	474	474	649				
Amount	kg	27	44	20	20	44	22	20	20	35	35	48				
Unit rate	Rs/kg	14.41	13.53	13.53	13.53	13.53	13.53	13.53	13.53	13.53	13.53	13.53				
Fertilizer P	Rs	137	450	0	0	431	215	235	235	0	0	294				
Amount	kg	7	23	0	0	22	11	12	12	0	0	15				
Unit rate	Rs/kg	19.57	19.57	19.57	19.57	19.57	19.57	19.57	19.57	19.57	19.57	19.57				
Fertilizer K	Rs	0	0	0	0	0	0	0	0	0	0	0				
Amount	kg	0	0	0	0	0	0	0	0	0	0	0				
Unit rate	Rs/kg	13.05	13.05	13.05	13.05	13.05	13.05	13.05	13.05	13.05	13.05	13.05				
Fertilizer FYM	Rs	16	103	33	33	95	95	0	0	340	340	238				
Amount	kg	240	1,520	480	480	1,400	1,400	0	0	5,000	5,000	3,500				
Unit rate	Rs/kg	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07				
Sprays	Rs	175	700	0	0	0	0	0	0	0	0	140				
Nos.	lit	2	4	0	0	0	0	0	0	0	0	1				
Area sprayed	%	25%	50%	0%	0%	0%	0%	0%	0%	0%	0%	40%				
Unit rate	Rs/lit	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00				
Hired Labor	Rs	792	1,628	0	0	735	735	184	210	0	0	630				
Amount	man-day	11	31	0	0	14	14	4	4	0	0	12				
Unit rate	Rs/md	72.00	52.50	52.50	52.50	52.50	52.50	52.50	52.50	52.50	52.50	52.50				
Family Labor	Rs	0	0	0	0	0	0	0	0	0	0	0				
Amount	man-day	6	16	10	8	10	10	11	11	22	18	15				
Unit rate	Rs/md	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
Contingencies (@5%)	Rs	89	205	39	39	130	105	51	52	66	66	138				
Net Return	Rs	1,328	13,798	3,298	2,063	1,609	88	3,849	1,530	4,586	2,791	9,240	17,460	7,178		
With Project	Acre	85,208	645,602	218,447	0	623,262	0	22,662	0	129,591	0	23,322	128,750	0		
	%	4.6%	35.0%	12.0%	0.0%	33.7%	0.0%	1.1%	0.0%	6.9%	0.0%	1.3%	7.0%	0.0%		
	Rs/acre	61	4,823	396	0	543	0	44	0	318	0	117	1,217	0		
	W_Fee	65.51	69.88	28.29	0	23.29	0	23.29	0	23.29	0	84.85	163.06	0		
	Rs/acre	3	24	3	0	8	0	0	0	2	0	1	11	0		
(Average)	Rs/acre	102%	7,518	53.02												
Without Project	Acre	19,598	148,488	50,243	748,886	0	623,262	0	22,662	0	129,591	5,364	29,613	99,138		
	%	1.1%	8.0%	2.7%	40.5%	0.0%	33.7%	0.0%	1.2%	0.0%	7.0%	0.3%	1.6%	5.4%		
	Rs/acre	14	1,109	90	836	0	30	0	19	0	196	27	280	385		
	W_Fee	65.51	69.88	28.29	0	23.29	0	23.29	0	23.29	0	84.85	163.06	0		
	Rs/acre	1	6	1	0	0	0	0	0	0	0	0	3	0		
(Average)	Rs/acre	102%	2,986	9.94												

Table H.6 Crop Production Value under With and Without Project Condition

Crop	Irrigation Status	Unit Net Return (Rs./acre)	With Project		Without Project*	
			Cropped Area (acre)	Total Net Production (Rs. million)	Cropped Area (acre)	Total Net Production (Rs. million)
			100.0%		23.0%	
Rice	Total		85,208	5	19,598	1
	Irr.	64	85,208	5	19,598	1
	Un-Irr.		0	0	0	0
Cotton	Total		645,602	11,547	148,488	2,656
	Irr.	17,886	645,602	11,547	148,488	2,656
	Un-Irr.		0	0	0	0
Kharif Fodder	Total		218,447	568	799,129	1,237
	Irr.	2,600	218,447	568	50,243	131
	Un-Irr.	1,477	0	0	748,886	1,106
Wheat	Total		623,262	3,118	623,262	553
	Irr.	5,002	623,262	3,118	0	0
	Un-Irr.	887	0	0	623,262	553
Oilseeds	Total		22,662	70	22,662	17
	Irr.	3,091	22,662	70	0	0
	Un-Irr.	743	0	0	22,662	17
Rabi Fodder	Total		129,591	401	129,591	198
	Irr.	3,095	129,591	401	0	0
	Un-Irr.	1,527	0	0	129,591	198
Sugarcane	Total		23,322	115	5,364	26
	Irr.	4,934	23,322	115	5,364	26
	Un-Irr.		0	0	0	0
Orchard (Mango)	Total		128,750	1,517	128,750	498
	Irr.	11,779	128,750	1,517	29,613	349
	Un-Irr.	1,500	0	0	99,138	149
Total			1,876,844	17,341	1,876,844	5,186
With-Without						12,156

Note: "Without project condition" is set at lowest production year in future.

Source: JICA Study Team

Table H.7 Cash Flow and Economic Evaluation of the Project

(Unit: Rs million)

Year	Cost Const.	Cost O&M	Cost Replace.	Cost Total	Production With	Production Without	Benefit W:W0	B:C	
	2,150						IRR	50.2%	
	1.00						NPV (12%)	26,681	
							B/C (12%)	26.13	
1	2000	44		44	17,341	17,341	0	-44	
2	2001	22		22	13,550	13,550	0	-22	
3	2002	99		99	13,550	13,550	0	-99	
4	2003	306		306	11,732	11,732	0	-306	
5	2004	278		278	11,004	11,004	0	-278	
6	2005	324		324	9,869	11,004	-1,135	-1,459	
7	2006	413		413	9,869	9,792	77	-336	
8	2007	239		239	9,869	9,792	77	-162	
9	2008	149		149	9,869	8,095	1,774	1,625	
10	2009	155		155	9,869	8,095	1,774	1,620	
11	2010	121		121	9,869	8,095	1,774	1,653	
12	2011		-3	-3	17,341	7,731	9,610	9,613	
13	2012		-3	-3	17,341	7,731	9,610	9,613	
14	2013		-3	-3	17,341	7,489	9,852	9,855	
15	2014		-3	-3	17,341	6,155	11,186	11,189	
16	2015		-3	-3	17,341	5,913	11,428	11,431	
17	2016		-3	-3	17,341	5,792	11,550	11,552	
18	2017		-3	9	6	17,341	5,792	11,550	11,544
19	2018		-3	-3	17,341	5,671	11,671	11,674	
20	2019		-3	-3	17,341	5,671	11,671	11,674	
21	2020		-3	1	-2	17,341	5,671	11,671	11,672
22	2021		-3	-3	17,341	5,549	11,792	11,795	
23	2022		-3	-3	17,341	5,549	11,792	11,795	
24	2023		-3	-3	17,341	5,549	11,792	11,795	
25	2024		-3	-3	17,341	5,428	11,913	11,916	
26	2025		-3	-3	17,341	5,428	11,913	11,916	
27	2026		-3	-3	17,341	5,428	11,913	11,916	
28	2027		-3	28	25	17,341	5,428	11,913	11,888
29	2028		-3	-3	17,341	5,343	11,998	12,001	
30	2029		-3	-3	17,341	5,343	11,998	12,001	
31	2030		-3	1	-2	17,341	5,343	11,998	12,000
32	2031		-3	-3	17,341	5,343	11,998	12,001	
33	2032		-3	-3	17,341	5,343	11,998	12,001	
34	2033		-3	-3	17,341	5,343	11,998	12,001	
35	2034		-3	-3	17,341	5,343	11,998	12,001	
36	2035		-3	-3	17,341	5,343	11,998	12,001	
37	2036		-3	-3	17,341	5,343	11,998	12,001	
38	2037		-3	9	6	17,341	5,343	11,998	11,992
39	2038		-3	-3	17,341	5,186	12,158	12,158	
40	2039		-3	-3	17,341	5,186	12,158	12,158	
41	2040		-3	1	-2	17,341	5,186	12,158	12,157
42	2041		-3	-3	17,341	5,186	12,158	12,158	
43	2042		-3	-3	17,341	5,186	12,158	12,158	
44	2043		-3	-3	17,341	5,186	12,158	12,158	
45	2044		-3	-3	17,341	5,186	12,158	12,158	
46	2045		-3	-3	17,341	5,186	12,158	12,158	
47	2046		-3	-3	17,341	5,186	12,158	12,158	
48	2047		-3	28	25	17,341	5,186	12,158	12,131
49	2048		-3	-3	17,341	5,186	12,158	12,158	
50	2049		-3	-3	17,341	5,186	12,158	12,158	
51	2050		-3	1	-2	17,341	5,186	12,158	12,157
52	2051		-3	-3	17,341	5,186	12,158	12,158	
53	2052		-3	-3	17,341	5,186	12,158	12,158	
54	2053		-3	-3	17,341	5,186	12,158	12,158	
55	2054		-3	-3	17,341	5,186	12,158	12,158	
56	2055		-3	-3	17,341	5,186	12,158	12,158	
57	2056		-3	-3	17,341	5,186	12,158	12,158	
58	2057		-3	9	6	17,341	5,186	12,158	12,150
59	2058		-3	-3	17,341	5,186	12,158	12,158	
60	2059		-3	-3	17,341	5,186	12,158	12,158	
61	2060		-3	-3	17,341	5,186	12,158	12,158	

Table H.8 Sensitivity Analysis

(Unit: Rs.million)

Case 1: 20 % Increase In Construction Cost		Cost Const.	Cost O&M	Cost Replace.	Cost Total	Production With	Production Without	Benefit W-WO	B/C
		2,581						IRR	47.8%
		1.20						NPV (12%)	26,468
								B/C (12%)	21.76
1	2000	53			53	17,341	17,341	0	-53
2	2001	27			27	13,550	13,550	0	-27
3	2002	119			119	13,550	13,550	0	-119
4	2003	367			367	11,732	11,732	0	-367
5	2004	334			334	11,004	11,004	0	-334
6	2005	388			388	9,869	11,004	-1,135	-1,523
7	2006	496			496	9,869	9,792	77	-418
8	2007	287			287	9,869	9,792	77	-210
9	2008	179			179	9,869	8,095	1,774	1,595
10	2009	186			186	9,869	8,095	1,774	1,589
11	2010	146			146	9,869	8,095	1,774	1,629
12	2011		-3		-3	17,341	7,731	9,610	9,613
13	2012		-3		-3	17,341	7,731	9,610	9,613
14	2013		-3		-3	17,341	7,489	9,852	9,855
15	2014		-3		-3	17,341	6,155	11,186	11,189
16	2015		-3		-3	17,341	5,913	11,428	11,431
17	2016		-3		-3	17,341	5,792	11,550	11,552
18	2017		-3	9	6	17,341	5,792	11,650	11,544
19	2018		-3		-3	17,341	5,671	11,671	11,674
20	2019		-3		-3	17,341	5,671	11,671	11,674
21	2020		-3	1	-2	17,341	5,671	11,671	11,672
22	2021		-3		-3	17,341	5,549	11,792	11,795
23	2022		-3		-3	17,341	5,549	11,792	11,795
24	2023		-3		-3	17,341	5,549	11,792	11,795
25	2024		-3		-3	17,341	5,428	11,913	11,916
26	2025		-3		-3	17,341	5,428	11,913	11,916
27	2026		-3		-3	17,341	5,428	11,913	11,916
28	2027		-3	28	25	17,341	5,428	11,913	11,888
29	2028		-3		-3	17,341	5,343	11,998	12,001
30	2029		-3		-3	17,341	5,343	11,998	12,001
31	2030		-3	1	-2	17,341	5,343	11,998	12,000
32	2031		-3		-3	17,341	5,343	11,998	12,001
33	2032		-3		-3	17,341	5,343	11,998	12,001
34	2033		-3		-3	17,341	5,343	11,998	12,001
35	2034		-3		-3	17,341	5,343	11,998	12,001
36	2035		-3		-3	17,341	5,343	11,998	12,001
37	2036		-3		-3	17,341	5,343	11,998	12,001
38	2037		-3	9	6	17,341	5,343	11,998	11,992
39	2038		-3		-3	17,341	5,186	12,156	12,158
40	2039		-3		-3	17,341	5,186	12,156	12,158
41	2040		-3	1	-2	17,341	5,186	12,156	12,157
42	2041		-3		-3	17,341	5,186	12,156	12,158
43	2042		-3		-3	17,341	5,186	12,156	12,158
44	2043		-3		-3	17,341	5,186	12,156	12,158
45	2044		-3		-3	17,341	5,186	12,156	12,158
46	2045		-3		-3	17,341	5,186	12,156	12,158
47	2046		-3		-3	17,341	5,186	12,156	12,158
48	2047		-3	28	25	17,341	5,186	12,156	12,131
49	2048		-3		-3	17,341	5,186	12,156	12,158
50	2049		-3		-3	17,341	5,186	12,156	12,158
51	2050		-3	1	-2	17,341	5,186	12,156	12,157
52	2051		-3		-3	17,341	5,186	12,156	12,158
53	2052		-3		-3	17,341	5,186	12,156	12,158
54	2053		-3		-3	17,341	5,186	12,156	12,158
55	2054		-3		-3	17,341	5,186	12,156	12,158
56	2055		-3		-3	17,341	5,186	12,156	12,158
57	2056		-3		-3	17,341	5,186	12,156	12,158
58	2057		-3	9	6	17,341	5,186	12,156	12,150
59	2058		-3		-3	17,341	5,186	12,156	12,158
60	2059		-3		-3	17,341	5,186	12,156	12,158
61	2060		-3		-3	17,341	5,186	12,156	12,158

Table H.8 Sensitivity Analysis

Case 2: 20 % Decrease in Benefit

(Unit: Rs.million)

Year	Cost Const.	Cost O&M	Cost Replac.	Cost Total	Production With	Production Without	Benefit W-WO	B/C	
	2,150						IRR	47.2%	
	1.00						NPV (12%)	21,133	
							B/C (12%)	20.90	
1	2000	44		44	17,341	17,341	0	-44	
2	2001	22		22	13,550	13,550	0	-22	
3	2002	99		99	13,550	13,550	0	-99	
4	2003	306		306	11,732	11,732	0	-306	
5	2004	278		278	11,004	11,004	0	-278	
6	2005	324		324	9,669	11,004	-908	-1,232	
7	2006	413		413	9,669	9,792	62	-351	
8	2007	239		239	9,669	9,792	62	-177	
9	2008	149		149	9,669	8,095	1,420	1,270	
10	2009	155		155	9,669	8,095	1,420	1,265	
11	2010	121		121	9,669	8,095	1,420	1,298	
12	2011		-3	-3	17,341	7,731	7,688	7,691	
13	2012		-3	-3	17,341	7,731	7,688	7,691	
14	2013		-3	-3	17,341	7,489	7,882	7,885	
15	2014		-3	-3	17,341	6,155	8,949	8,951	
16	2015		-3	-3	17,341	5,913	9,143	9,145	
17	2016		-3	-3	17,341	5,792	9,240	9,242	
18	2017		-3	9	6	17,341	5,792	9,240	9,234
19	2018		-3	-3	17,341	5,671	9,337	9,339	
20	2019		-3	-3	17,341	5,671	9,337	9,339	
21	2020		-3	1	-2	17,341	5,671	9,337	9,338
22	2021		-3	-3	17,341	5,549	9,434	9,436	
23	2022		-3	-3	17,341	5,549	9,434	9,436	
24	2023		-3	-3	17,341	5,549	9,434	9,436	
25	2024		-3	-3	17,341	5,428	9,531	9,533	
26	2025		-3	-3	17,341	5,428	9,531	9,533	
27	2026		-3	-3	17,341	5,428	9,531	9,533	
28	2027		-3	28	25	17,341	5,428	9,531	9,506
29	2028		-3	-3	17,341	5,343	9,598	9,601	
30	2029		-3	-3	17,341	5,343	9,598	9,601	
31	2030		-3	1	-2	17,341	5,343	9,598	9,600
32	2031		-3	-3	17,341	5,343	9,598	9,601	
33	2032		-3	-3	17,341	5,343	9,598	9,601	
34	2033		-3	-3	17,341	5,343	9,598	9,601	
35	2034		-3	-3	17,341	5,343	9,598	9,601	
36	2035		-3	-3	17,341	5,343	9,598	9,601	
37	2036		-3	-3	17,341	5,343	9,598	9,601	
38	2037		-3	9	6	17,341	5,343	9,598	9,593
39	2038		-3	-3	17,341	5,186	9,725	9,727	
40	2039		-3	-3	17,341	5,186	9,725	9,727	
41	2040		-3	1	-2	17,341	5,186	9,725	9,726
42	2041		-3	-3	17,341	5,186	9,725	9,727	
43	2042		-3	-3	17,341	5,186	9,725	9,727	
44	2043		-3	-3	17,341	5,186	9,725	9,727	
45	2044		-3	-3	17,341	5,186	9,725	9,727	
46	2045		-3	-3	17,341	5,186	9,725	9,727	
47	2046		-3	-3	17,341	5,186	9,725	9,727	
48	2047		-3	28	25	17,341	5,186	9,725	9,700
49	2048		-3	-3	17,341	5,186	9,725	9,727	
50	2049		-3	-3	17,341	5,186	9,725	9,727	
51	2050		-3	1	-2	17,341	5,186	9,725	9,726
52	2051		-3	-3	17,341	5,186	9,725	9,727	
53	2052		-3	-3	17,341	5,186	9,725	9,727	
54	2053		-3	-3	17,341	5,186	9,725	9,727	
55	2054		-3	-3	17,341	5,186	9,725	9,727	
56	2055		-3	-3	17,341	5,186	9,725	9,727	
57	2056		-3	-3	17,341	5,186	9,725	9,727	
58	2057		-3	9	6	17,341	5,186	9,725	9,719
59	2058		-3	-3	17,341	5,186	9,725	9,727	
60	2059		-3	-3	17,341	5,186	9,725	9,727	
61	2060		-3	-3	17,341	5,186	9,725	9,727	

Table H.8 Sensitivity Analysis

(Unit: Rs million)

Case 3: 1 Year Delay in Implementation

Year	Cost Const.	Cost O&M	Cost Replace.	Cost Total	Production With	Production Without	Benefit W-WO	B-C	
	2,150						IRR	46.88%	
	1.00						NPV (12%)	22,110	
							B/C (12%)	24.32	
1	2000	0		0	17,341	17,341	0	0	
2	2001	44		44	13,550	13,550	0	-44	
3	2002	22		22	13,550	13,550	0	-22	
4	2003	99		99	11,732	11,732	0	-99	
5	2004	306		306	11,004	11,004	0	-306	
6	2005	278		278	9,669	11,004	0	-278	
7	2006	324		324	9,669	9,792	-1,135	-1,459	
8	2007	413		413	9,669	9,792	77	-336	
9	2008	239		239	9,669	8,095	77	-162	
10	2009	149		149	9,669	8,095	1,774	1,625	
11	2010	155		155	9,669	8,095	1,774	1,620	
12	2011	121		121	9,669	7,731	1,774	1,653	
13	2012		-3	-3	17,341	7,731	2,138	2,141	
14	2013		-3	-3	17,341	7,489	9,610	9,613	
15	2014		-3	-3	17,341	6,155	9,852	9,855	
16	2015		-3	-3	17,341	5,913	11,186	11,189	
17	2016		-3	-3	17,341	5,792	11,428	11,431	
18	2017		-3	-3	17,341	5,792	11,550	11,552	
19	2018		-3	9	6	17,341	5,671	11,550	11,544
20	2019		-3	-3	17,341	5,671	11,671	11,674	
21	2020		-3	-3	17,341	5,671	11,671	11,674	
22	2021		-3	1	-2	17,341	5,549	11,671	11,672
23	2022		-3	-3	17,341	5,549	11,792	11,795	
24	2023		-3	-3	17,341	5,549	11,792	11,795	
25	2024		-3	-3	17,341	5,428	11,792	11,795	
26	2025		-3	-3	17,341	5,428	11,913	11,916	
27	2026		-3	-3	17,341	5,428	11,913	11,916	
28	2027		-3	-3	17,341	5,428	11,913	11,916	
29	2028		-3	28	25	17,341	5,343	11,913	11,888
30	2029		-3	-3	17,341	5,343	11,998	12,001	
31	2030		-3	-3	17,341	5,343	11,998	12,001	
32	2031		-3	1	-2	17,341	5,343	11,998	12,000
33	2032		-3	-3	17,341	5,343	11,998	12,001	
34	2033		-3	-3	17,341	5,343	11,998	12,001	
35	2034		-3	-3	17,341	5,343	11,998	12,001	
36	2035		-3	-3	17,341	5,343	11,998	12,001	
37	2036		-3	-3	17,341	5,343	11,998	12,001	
38	2037		-3	-3	17,341	5,343	11,998	12,001	
39	2038		-3	9	6	17,341	5,186	11,998	11,992
40	2039		-3	-3	17,341	5,186	12,156	12,158	
41	2040		-3	-3	17,341	5,186	12,156	12,158	
42	2041		-3	1	-2	17,341	5,186	12,156	12,157
43	2042		-3	-3	17,341	5,186	12,156	12,158	
44	2043		-3	-3	17,341	5,186	12,156	12,158	
45	2044		-3	-3	17,341	5,186	12,156	12,158	
46	2045		-3	-3	17,341	5,186	12,156	12,158	
47	2046		-3	-3	17,341	5,186	12,156	12,158	
48	2047		-3	-3	17,341	5,186	12,156	12,158	
49	2048		-3	28	25	17,341	5,186	12,156	12,131
50	2049		-3	-3	17,341	5,186	12,156	12,158	
51	2050		-3	-3	17,341	5,186	12,156	12,158	
52	2051		-3	1	-2	17,341	5,186	12,156	12,157
53	2052		-3	-3	17,341	5,186	12,156	12,158	
54	2053		-3	-3	17,341	5,186	12,156	12,158	
55	2054		-3	-3	17,341	5,186	12,156	12,158	
56	2055		-3	-3	17,341	5,186	12,156	12,158	
57	2056		-3	-3	17,341	5,186	12,156	12,158	
58	2057		-3	-3	17,341	5,186	12,156	12,158	
59	2058		-3	9	6	17,341	5,186	12,156	12,150
60	2059		-3	-3	17,341	5,186	12,156	12,158	
61	2060		-3	-3	17,341	5,186	12,156	12,158	
62	2061		-3	-3	17,342	5,187	12,156	12,158	

Annex I
Environment

ANNEX I ENVIRONMENT

Table of Contents

I.1	ENVIRONMENTAL INSTITUTIONS AND ENVIRONMENTAL PROTECTION	I- 1
I.1.1	Environmental Institutions	I- 1
I.1.2	Achievements of Environmental Protection Department	I- 1
I.1.3	Environmental Impact Assessment	I- 2
I.2	INITIAL ENVIRONMENTAL EXAMINATION	I- 2
I.2.1	Outline of the Project	I- 2
I.2.2	Examination of the Local Environment	I- 3
I.2.2.1	Land Use	I- 3
I.2.2.2	Salinity and Waterlogging	I- 3
I.2.2.3	Wildlife	I- 4
I.2.2.4	Public Health	I- 5
I.2.2.5	Forestry	I- 6
I.2.2.6	Fishery	I- 6
I.2.3	Examination of the Adverse Effect on the Environment	I- 7
I.2.3.1	Negative Impact during Construction	I- 7
I.2.3.2	Mitigation Measures	I- 7
I.2.4	Necessity of the Environmental Impact Assessment	I- 8

List of Tables

Table I.1	Structure of Health Control Facilities	I - 9
Table I.2	Out Patient Morbidity Pattern in the Study Area (1996)	I - 10
Table I.3	Forest Type And Areas in D.G. Khan Circle	I - 10
Table I.4	Production of Timber and Firewood in D.G. Khan Circle	I - 10

List of Figures

Fig. I.1	Environmental Impact Assessment System	I - 11
Fig. I.2	Year Wise Change of Waterlogging Area in SCARP-III	I - 12
Fig. I.3	Location Map of Taunsa Wildlife Sanctuary	I - 13

I.1 ENVIRONMENTAL INSTITUTIONS AND ENVIRONMENTAL PROTECTION

I.1.1 Environmental Institutions

Environment and Urban Affairs Division started its function on the environmental protection under the Federal Ministry of Housing and Works in 1974. This organization was then strengthened under the coordination with Environmental Pollution Control Organization and Public Health Engineering Department. In 1983, Pakistan Environmental Protection Ordinance was declared and Pakistan Environmental Protection Agency and Pakistan Environmental Protection Council were established in 1984. Environmental Protection Department Punjab was established in 1987 and started its functions as an attached department which has now grown to an independent Ministry of Environment.

I.1.2 Achievements of Environmental Protection Department

EPDP performs a wide range of activities aiming at the pollution control and the environmental protection. The main activities are as follows;

- Education and awareness activity
- Pollution load assessment activity
- Solid waste disposal activity
- Air monitoring and surveillance activity
- Environmental impact assessment

EPD office in D.G. Khan was established on 1996 with the full responsibility for the environmental protection in D.G. Khan division. This office is not fully functioned yet, the inspection activities on air and water pollution have just commenced. Especially, power was poured into the management of the noise pollution with the horn etc. of the vehicles. It is a big causing of air pollution as for smoke from the brick factory, the sugar mill and the cotton ginning factory in addition to the exhaust from the vehicles. The case where the old tire is mixed with the fuel causes a lot of generation of a poisonous gas. Moreover, the water pollution of the irrigation canal with an industrial waste water is worried about. The management of such air and water pollution will be an important subject in the future.

I.1.3 Environmental Impact Assessment

The Asian Development Bank offered an assistance to the government of Pakistan in 1986 for formulating the guideline of the environmental impact assessment. This guideline is formulated to be an index of the environmental planning and management for 3 different fields which are agriculture/village development, infrastructure and mining/manufacturing industry. A wide range of projects such as agriculture, livestock, forestry, fishery, crop production, marketing, irrigation and coastal development etc. are targeted in the field of agriculture/village development. However, this guideline does not function actually enough and not well established as a system for the environmental impact assessment.

Under these circumstances, the environmental impact assessment system have been reviewed recently at the state government level and the new system has already been established on December 1997. In this new EIA system, the public exhibition and comment is strongly emphasized (Fig. I.1).

According to this new system, 5 copies of IEE report should be submitted to the Environmental Protection Department, Punjab (EPDP) upon decision of the execution of the rehabilitation work. IEE report should include (i) the outline of the project, (ii) the examination of the local environment, (iii) the examination of the adverse effect on the environment, and (iv) the conceivable mitigation measures if any. It was further recommended by EPDP to inform the outline of the project to Wildlife Department, Fisheries Department and other concerned authorities upon commencement of the project.

I.2 INITIAL ENVIRONMENTAL EXAMINATION

Initial Environmental Examination is the outline investigations executed when the judgment is needed whether the environmental impact assessment is necessary in the development project. The main elements of IEE are the outline of the project, the examination of the local environment, the examination of the adverse effect on the environment, and the judgment whether the environmental impact assessment is necessary or not.

I.2.1 Outline of the Project

Taunsa Barrage was constructed on the Indus river in 1959. Through 40 years operation, the barrage has been deteriorated causing much leakage water through damaged gates, non-reliable gate control against flood, and lowering intake capacity compared with the original design

capacity. The main objectives of this project is, therefore, to conduct a feasibility study on Taunsa Barrage Irrigation System Rehabilitation basically aiming at a renovation of the main body of the barrage and other improvement necessary for the proper operation and management. The agriculture and irrigation plan and the operation and maintenance system of the canal network should also be examined in the study when it is necessary.

I.2.2 Examination of the Local Environment

I.2.2.1 Land Use

As already mentioned in the section of soil and land use in agriculture of the command area, the flood of hill torrents from Sulaiman mountain in the right bank and the sand dune encroachment in the left bank are the major constraints of the agricultural development in the Study area. In order to prevent the destruction of canal network due to the flood, a concrete structure is constructed in an important part. Moreover, the watershed management project is conducted to harvest as much amount of run-off water as possible on the upstream of the hill torrents. The afforestation activity for the dune fixation is executed and the part which has already been fixed begins to be used for agriculture in the dune area on the left bank.

I.2.2.2 Salinity and Waterlogging

Waterlogging and soil salinization are also the major constraints of the agricultural development in the Study area. SCARP (Salinity Control and Reclamation Project) has begun in 1960's and various studies and activities has already been carried out to solve this problem by drawing up underground water using tubewells (Fig. I.2). The activity of SCARP-III was commenced in 1973 and various works are executed especially on the left bank of the Study area. The total waterlogged area of about 55,000 ha at the beginning of the project has decreased up to 15,000 ha in 1978 through the installation of tubewells (1,800 numbers) and also the construction of drainage canal (250 km in total length). Most of the salt affected area extending over 130,000 ha was improved and rising tendency of the underground water table was settled down to some extent. With the passage of years afterwards, however, the waterlogged area increases gradually again and turns back to 54,000 ha in the year 1996. The main conceivable causes are the increase of water allowance per unit area, the decline of tubewell capacity, the inflow of flood into the irrigated area and so on. Since the strategy of the problem solving has already been clarified, the future practical planning including the

establishment of the integrated regional irrigation schedule and the management program of tubewell will become an important subject from now on.

I.2.2.3 Wildlife

The Taunsa Wildlife Sanctuary was declared as a wildlife sanctuary in 1972 and re-noticed in April 1983 and was also declared as Ramsar Site on 1996. The sanctuary lies on the state land behind the Taunsa Barrage on the Indus river near the town of Taunsa, 20 km northwest of Kot Addu with the total area of 6,567 ha as shown in Fig. I.3. Followings are the detailed information about the sanctuary.

Climate

Conditions are dry subtropical, with an annual rainfall of 200 - 450 mm. Mean minimum temperature in January is 4.5 - 5.5 °C, and mean maximum in June is 42 - 45 °C.

Vegetation

The aquatic vegetation of various kinds are growing in the seepage lagoons and much of the land adjacent to the reservoir is cultivated, mainly for cotton, sugarcane, wheat and fodder crops. Riverine forest along the Indus is dominated by Shisham (*Dalbergia sissoo*) and Ubhan (*Populus euphratica*) in association with *Tamarix dioica*.

Indus dolphin

Indus Dolphin (*Platanista minor*) is listed as endangered species in the IUCN (International Union for Conservation of Nature) Red Data Book since 1976. This species is on Appendix 1 of the CITES (Convention on International Trade of Endangered Species) and it was added to the U.S. Department of Commerce endangered species list in 1989. It is protected under the Wildlife Act of Sindh (1972), Punjab (1974) and NWFP (1975). The local name of Indus dolphin is "Bulhn". The maximum size of the dolphin is 200 kg in weight and 5.5 feet in length. The female normally gives birth to a single calf after a gestation period of eight to nine months. Births may occur at any time of the year but mostly from October to March. Between Chashma and Gudu Barrage, 99 dolphins were observed by the census survey in 1996 while 275 dolphins were observed in 1997. The number of dolphin between Chashma and Taunsa is expected more or less 50 and therefore more number can be expected between Taunsa and Guddu. Dolphins living between any two barrages are permanently isolated from other subpopulations under the inherent risk associated with low population size such as stochastic effects of environmental flux, demographic structure and genetic problems. In

order to improve such situation, a project is proposed for the research of ecological corridor for the dolphin under the cooperation with Sea Mammals Research Unit, Cambridge University, UK. A group of this cooperation project will visit the sanctuary in the spring season of this year. The future coordination between this project and the barrage rehabilitation work might be needed for the smooth implementation of both activities.

Other mammals

Other mammals include hog deer, smooth-coated otter, jackal, jungle cat, wild bore and black-naped hare. Among those mammals, hog deer is another precious mammal which can be found in the riverine forest distributed along the river side.

Water birds

The wetland is a very important wintering area for waterfowl, notably Anatidae, a breeding area for several species, particularly lesser whistling duck and staging area for cranes and shorebirds. It is also most important wintering area in Pakistan for bar-headed goose.

Fishes

Approximately over 60 different species of fish including carp fishery and catfishes are found in the sanctuary. The pond created by barrage is an excellent breeding ground for these fishes.

I.2.2.4 Public Health

In order to investigate the public health condition in the Study area, the data on public health organization and out patient morbidity pattern was collected focusing on the water borne diseases which might be affected by the irrigation activity. As for the organization of the health department, facilities which have the function for each level of district, teshil, markaz and union are arranged respectively (Table I.1). According to the morbidity pattern of the Study area (Table I.2), the major diseases were respiratory diseases, fever and diarrhoeal diseases. The high percentage of the respiratory diseases can be attributed to the heavy air pollution pointed out by the EPD. Concerning the water borne diseases, it is thought that diarrhoea is mainly caused in the polluted drinking water. Moreover, malaria and typhoid fever was ranked within the major diseases. The other water borne diseases such as schistosomiasis (bilharziosis) and leishmaniasis were not significant in the Study area.

1.2.2.5 Forestry

A large amount of forest resource is used in the region as a necessary fuel supply source for the local population and also for the small and medium scale industry such as the brick factories and as a material for many other purposes. The conservation of the existing forest and the forestry activities are taking an important role to produce and supply such wood resources. The forest department classifies the forests in the Study area into 5 types (Table I.3) which are (i) irrigated plantation, (ii) riverine forest, (iii) range land plantation, (iv) canal side plantation and (v) road side plantation. Although the range land plantation accounts for 50 % or more area-wise, these are mainly distributed in Sulaiman mountain area and shrubs are planted aiming at the soil conservation and livestock raising. The forests of the other four types are widely distributed within the Study area. These forests provide the wood resources for the local population and the annual average amount utilized are the timber of 7,000 cu.m and the fuel wood of 30,000 cu.m (Table I.4). The main activities of the forest department thus consists of management of forests, marketing of forests products, maintenance of existing plantations and promotion of tree plantation on farm lands.

1.2.2.6 Fishery

Approximately over 60 different species of fish including carp fishery and catfishes are found in the Study area. By such abundant fishery resources, the total production of fish in D.G. Khan division during the last year was equivalent to Rs. 10 million dealt through auctions. The pond area of the Indus river within the Study area is of immense ecological importance for sustainable development of natural fishery. Especially, the pond created by barrage is an excellent breeding ground for these fishes. The existing barrage structure provides two fish ladders which facilitates the fish migration in the river. The main activities of the fisheries department are (i) control of illegal fisheries and (ii) hatcheries operation for fish breeding. It was suggested by the fisheries department that a sudden opening of gates in the past has damaged the downstream fishery. It is proposed that the release of water flow at barrage be slow, gentle and gradual to ensure that the aquatic life downstream is not affected by the sudden flooding. It was also mentioned that the full involvement of the fisheries department in deciding day to day operations of the barrage will be highly appreciated.

1.2.3 Examination of the Adverse Effect on the Environment

1.2.3.1 Negative Impact during Construction

Since the proposed rehabilitation work of the Taunsa barrage is the preventive measure for the existing irrigation system, the impact of this rehabilitation on the environment of the Study area is expected to be minimal. However, the impact on the wildlife sanctuary during the construction should be taken into account in order to avoid any negative effects on the precious inhabitants. Among the conceivable impacts during the construction period, the most important point is to avoid any water pollution not to give any detrimental impact on the water life around the barrage and in the lower stream including Indus dolphin, water birds and fisheries.

Since the current feasibility study includes the operation plan of the barrage along with the construction plan, the effect of the barrage operation on the environment should also be considered. The operation practice of the barrage should therefore be determined by taking the opinions of fisheries and/or wildlife related staff into consideration in order to preserve the favorable condition of the habitat.

1.2.3.2 Mitigation Measures

The following mitigation measures can be conceivable during the construction period and also for the future operation.

- Awareness of the ecological importance of the area by the construction staff,
- Maintenance of the cleanliness of the working site and the worker's living quarter with special attention to the drainage,
- Appropriate handling of any chemicals including fuel, lubricant and paint in order not to pollute river water,
- Prevention of inflow of any pollutant into river water,
- Active involvement to the research project of ecological corridor for Indus dolphin,
- Establishment of the barrage operation manual under the mutual cooperation with Wildlife Department, Fisheries Department and other concerned authorities,

1.2.4 Necessity of the Environmental Impact Assessment

Based on the present natural and socio-environmental circumstances of the Study area, it is expected that the environmental impact assessment is not necessary because the influence of this rehabilitation work on the environment is extremely negligible. However, a lot of environmental problems are prevailing in the Study area as mentioned above. The establishment of an appropriate environmental conservation measures is therefore required for the future sustainable development of the area and also for promoting this rehabilitation project more effectively.

Table I.1 Structure of Health Control Facilities

	(District level) District Head Quarter Hospital (DHQ)	(Tasil Level) Tasil Head Quarter Hospital (THQ)	(Markaz level) Rural Health Center (RHC)	(Union level) Basic Health Unit (BHU)
Number of Facilities in each District				
D.G. Khan	1	1	9	52
Rajanpur	1	2	6	31
Muzaffargarh	1	2	13	76
Number of Staff in each Facility				
Medical Superintendent	1	1		
Specialist	15	3		
Medical Officer	15	5	2	1
Woman Medical Officer	6	2	1	1
Paramedical Staff	+			
Surgeon		1		
Pediatrician		1		
Medical Technician			1	1
Other Additional Facilities				
Emergency Facility	+	+	+	+
Dispensary	+	+	+	+
Laboratory	+	+	+	
X-ray Facility	+	+	+	
Operation Facility	+	+	+	

Note: "+" means existing in different numbers and grades

Source: Health Department

Table I.2 Out Patient Morbidity Pattern in the Study Area (1996)

Top Ranking Diseases	Total			D.G. Khan			Rajanpur			Muzaffargarh		
	Rank	Cases	(%)	Rank	Cases	(%)	Rank	Cases	(%)	Rank	Cases	(%)
Total		724,423	100.0		273,277	100.0		168,912	100.0		282,234	100.0
Respiratory Diseases	1	220,977	30.5	1	81,341	29.8	1	63,831	37.8	1	75,805	26.9
Unknown Fever	2	150,117	20.7	2	47,185	17.3	2	44,527	26.4	2	58,405	20.7
Diarrhoeal Diseases	3	107,713	14.9	3	44,826	16.4	3	18,693	11.1	3	44,194	15.7
Eye Infections	4	48,126	6.6	4	22,922	8.4	4	11,202	6.6	6	14,002	5.0
Skin Diseases	5	39,408	5.4	5	15,419	5.6	6	5,727	3.4	4	18,262	6.5
Ear Infections	6	35,546	4.9	6	14,042	5.1	5	7,505	4.4	7	13,999	5.0
Malaria	7	28,981	4.0	7	12,073	4.4	9	2,824	1.7	5	14,084	5.0
Intestinal Diseases	8	20,051	2.8	9	7,885	2.9	7	4,110	2.4	9	8,056	2.9
Stomach Diseases	9	18,500	2.6	11	5,254	1.9	11	1,749	1.0	8	11,497	4.1
Nose Infections	10	18,318	2.5	8	8,179	3.0	8	3,512	2.1	11	6,627	2.3
Typhoid fever	11	13,092	1.8	12	4,222	1.5	13	1,029	0.6	10	7,841	2.8
Pneumonia	12	12,630	1.7	10	6,366	2.3	12	1,521	0.9	12	4,743	1.7
Lung Tuberculosis	13	10,964	1.5	13	3,563	1.3	10	2,682	1.6	13	4,719	1.7

Source: Health Department

Table I.3 Forest Type and Areas in D.G.Khan Circle

Type of Forest	(Unit: acres)			
	D.G.Khan	Rajanpur	Muzaffargarh	Total
Irrigated Plantation	2,937	16,829	35,226	54,992
Riparian Forest	20,749	9,446	33,621	63,816
Range Land Plantation	104,000	3,100	30,334	137,434
Road-side Plantation	147	158	219	524
Canal-side Plantation	423	705	1,250	2,378

Note: 1 acre = 1 avenue Km for road-side and canal-side plantation

Source: Forestry in D.G.Khan (Punjab Forestry Department)

Table I.4 Production of Timber and Firewood in D.G.Khan Circle

Year	(Unit: Cubic meter)	
	Timber	Firewood
1991-1992	5,947	22,090
1992-1993	8,298	29,396
1993-1994	4,106	22,288
1994-1995	9,091	47,181
1995-1996	6,570	26,904
Average	6,802	29,572

Source: Forestry in D.G.Khan (Punjab Forestry Department)

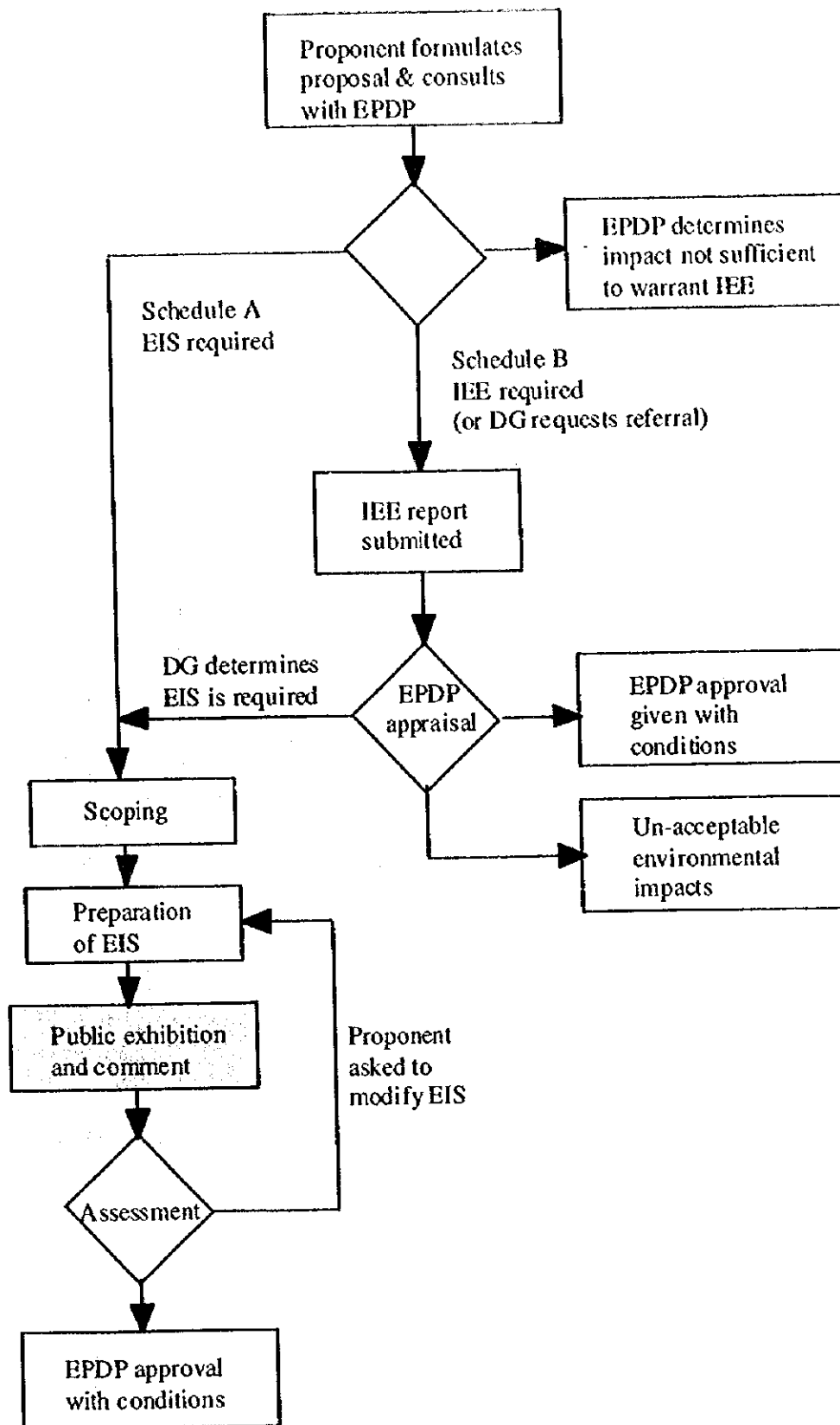


Fig. I.1 Environmental Impact Assessment System

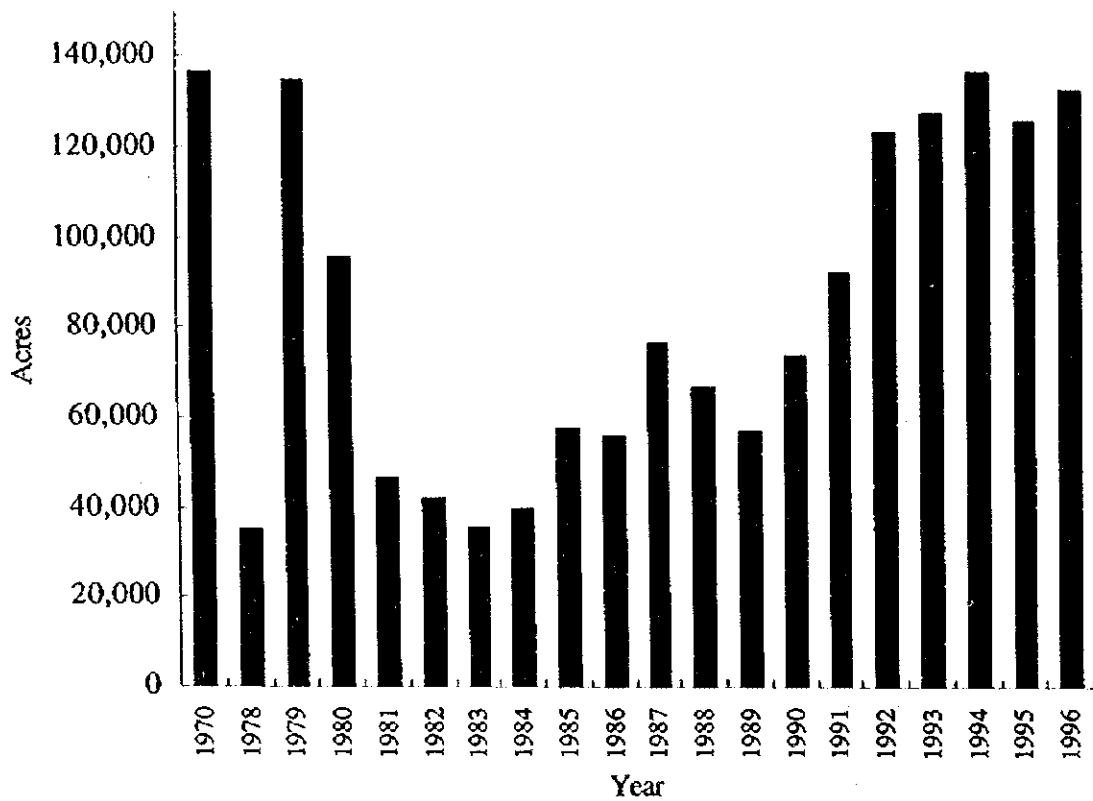


Fig. I.2 Year Wise Change of Waterlogged Area in SCARP-III

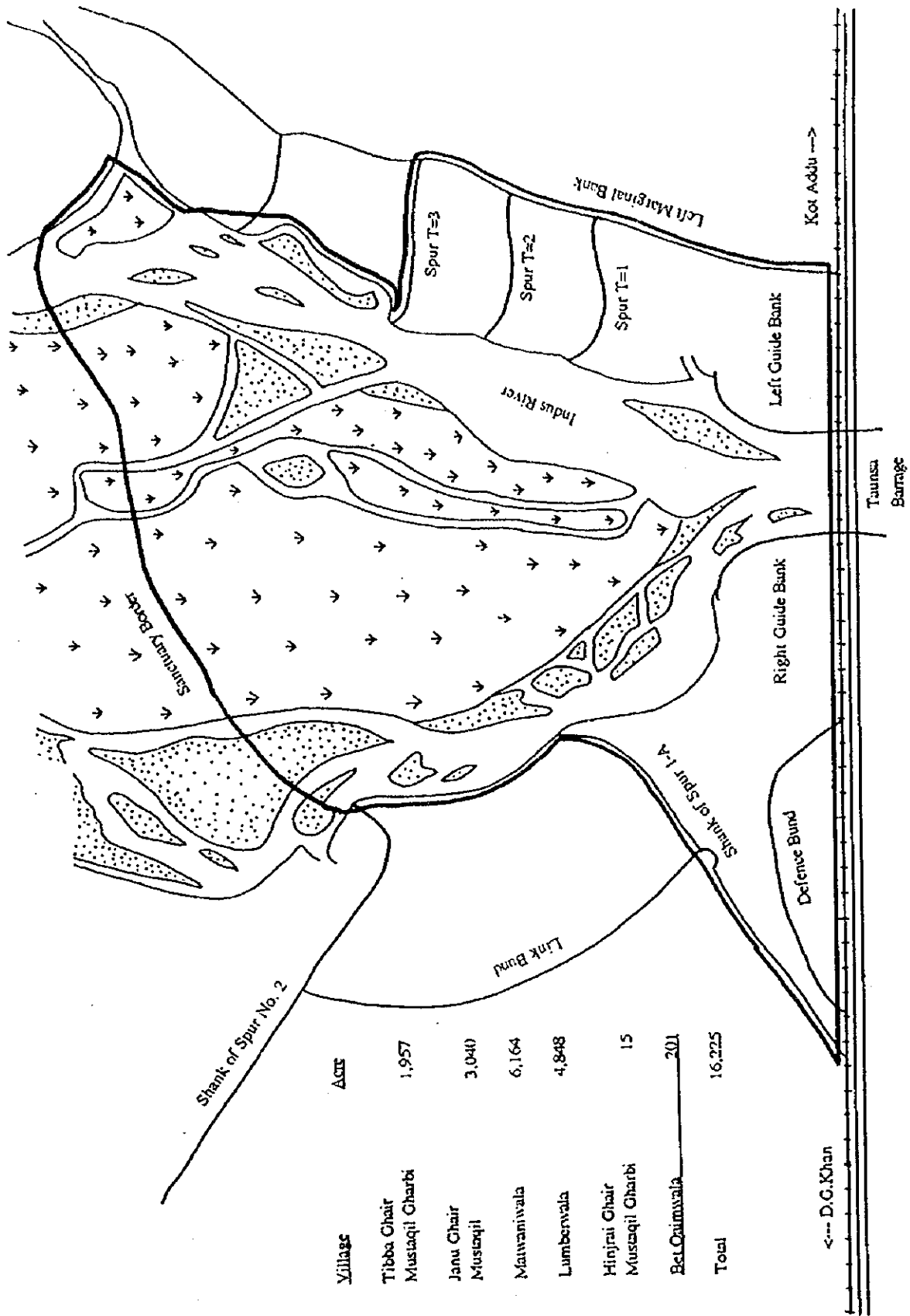


Fig. 1.3 Location Map of Taunsa Wildlife Sanctuary

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