

ANNEX K. PROJECT ECONOMY



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CHAPTER I. ECONOMIC INDEXES IN PAKISTAN

TABLE K-1. BALANCE OF TRADE, PAKISTAN

(Unit: million Rs)

Year	Imports *1	Exports *2	Balance
1975-76	20,465	11,253	- 9,212
1976-77	23,012	11,294	-11,718
1977-78	27,815	12,980	-14,835
1978-79	36,388	16,925	-19,463
1979-80	46,929	23,410	-23,519
1981-81	53,544	29,280	-24,264
1981-82	59,482	26,270	-33,212
1982-83	68,151	34,442	-33,709
1983-84	76,707	37,339	-39,368
1984-85	89,778	37,979	-51,799
1985-86	90,946	49,592	-41,354

Note : \*1 --- expressed in C.I.F. prices.

\*2 --- expressed in F.O.B. prices.

Source: "Foreign Trade Statistics of Pakistan"  
 Statistics Division, Government of Pakistan.



TABLE K-2. FEDERAL AND PROVINCIAL GOVERNMENTS SUBSIDIES

Items	(Unit: million Rs.)					
	1981-82	1982-83	1983-84	1984-85	1985-86 (Actual)	1986-87 (Budget)
Wheat and Sugar	1,303	1,159	1,282	2,888	3,919	4,064
Federal	( 190)	( 141)	( 110)	(1,371)	(1,921)	(1,452)
Provincial	(1,113)	(1,018)	(1,172)	(1,517)	(1,998)	(2,612)
Edible Oils	1	-	1,485	2,250	-	-
Fertilizer	1,794	1,948	1,466	1,501	2,408	1,842
Federal	(1,794)	(1,948)	(1,466)	(1,501)	(2,408)	(1,842)
Provincial	-	-	-	-	-	-
Plant protection, pesticides and Equipment	-	-	-	-	-	-
Tubewells	24	24	-	-	16	18
Export Subsidies	1,153	1,380	1,694	-	1,836	2,208
Petroleum Products <sup>1/</sup>	-	-	-	-	-	-
Others <sup>2/</sup>	28	267	207	222	103	1,321
<u>Total</u>	<u>4,333</u>	<u>4,779</u>	<u>6,134</u>	<u>6,861</u>	<u>8,282</u>	<u>9,453</u>
% of Current Expenditure	9.34	8.00	8.35	8.05	8.47	8.63
% of GDP	1.34	1.31	1.46	1.43	1.54	1.59

Note : <sup>1/</sup> --- Includes only direct subsidies and excludes refund of surcharges on petroleum products.  
<sup>2/</sup> --- Includes losses of Cotton Export Corporation of Rs 575 million in 1979-80 and Rs 2,208 million in 1986-87.

Source: "Economic Survey of Pakistan, 1986-87", Ministry of Finance, Govt. of Pakistan.

TABLE K-3. IMPORT AND EXPORT OF AGRICULTURAL PRODUCTS

(Unit: million Rs)

Commodity	1980-81	1981-82	1982-83	1983-84	1984-85
<b>A. Import</b>					
1. Total of Imports	53,544	59,482	68,151	76,707	89,778
2. Total of Agricultural Products (Total imports = 100)	3,461 (6.5%)	3,948 (6.6%)	4,491 (6.6%)	5,317 (6.9%)	7,960 (8.9%)
3. Selected Main Agricultural Products					
- Live Animals	23	17	23	35	52
- Milk and Cream	332	346	573	451	462
- Butter	60	45	8	190	57
- Wheat	633	800	873	858	2,750
- Fruit (Fresh & Nuts)	238	532	346	264	323
- Dried Fruit	159	55	26	31	26
- Vegetable Fresh Frozen	193	736	567	423	240
- Sugar & Honey	485	22	30	23	36
- Tea and Male	1,183	1,191	1,676	2,567	3,507
- Spices	123	173	147	176	172
<b>B. Export</b>					
1. Total of Exports	29,280	26,270	34,442	37,339	37,979
2. Total of Agricultural Products (Total export = 100)	2,738 (9.4%)	6,001 (22.8%)	6,238 (18.1%)	8,769 (23.5%)	6,187 (16.3%)
3. Selected Main Agricultural Products					
- Live Animals	10	3	44	83	180
- Fish	568	55	63	159	218
- Wheat	-	0	268	494	134
- Rice	5,602	4,128	3,683	5,688	3,340
- Barley Unmilled	84	108	57	80	8
- Fruit (Fresh and Nuts)	133	247	413	397	462
- Vegetable	148	130	235	243	172
- Sugar and Honey	348	289	282	439	369
- Spices	98	147	168	157	182
- Feeding Stuff for Animals	134	79	100	104	45

Source: "Economic Survey of Pakistan, 1986-87" Ministry of Finance Govt. of Pakistan.

TABLE K-4. CONSUMER AND WHOLESALE PRICE INDEX  
(1975-76 = 100)

Year	GDP Deflator	CONSUMER PRICE INDEX					WHOLESALE PRICE INDEX					
		General	Food Beverages & Tobacco	Apparel Textiles & Foot- wears	Housing & House- hold Op- erations	Misce- llaneous	General	Food	Raw Materi- als	Fuel Lighting & Lubri- cants	Manufac- tures	Building Materi- als
1976-77	320.70	111.77	112.15	117.84	109.94	109.49	111.92	113.76	108.17	105.05	112.44	114.94
1977-78	349.91	120.48	120.92	126.82	117.75	118.95	120.81	124.41	118.44	106.77	119.89	126.25
1978-79	361.44	128.47	128.28	133.50	125.68	129.64	128.85	126.33	139.02	124.38	126.67	151.66
1979-80	406.08	142.23	139.19	145.79	139.42	153.00	144.73	137.15	142.57	176.25	139.91	197.52
1980-81	448.75	159.81	157.40	156.65	156.54	172.57	163.69	155.02	152.47	231.98	154.04	204.73
1981-82	490.81	175.79	178.74	168.39	165.95	182.21	176.16	175.55	157.66	243.64	159.11	201.41
1982-83	519.14	183.67	182.27	189.45	172.19	198.34	182.27	178.66	158.99	262.23	169.08	200.48
1983-84	568.16	199.03	197.96	212.73	179.59	217.88	201.38	191.22	199.66	278.40	190.80	216.50
1984-85	602.64	213.87	212.18	239.47	189.70	233.75	208.92	205.23	181.88	298.13	194.16	228.98
1985-86	632.72	224.21	217.53	256.44	198.64	258.31	217.38	214.07	181.15	329.72	197.98	240.08

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Source: "Economic Survey of Pakistan, 1986-87" Ministry of Finance, Govt. of Pakistan.

TABLE K-5. WHOLESALE PRICE INDEX OF AGRICULTURAL PRODUCTS  
(1975-76 = 100)

Year	Wheat	Rice	Gram (White)	Sugar	Vegetable Ghee	Meat	Vegeta- bles	Milk
1976-77	106.87	115.32	104.83	100.00	99.92	111.56	145.24	117.33
1977-78	116.80	134.73	171.82	100.00	100.00	120.98	141.96	120.50
1978-79	129.77	113.37	146.96	100.00	100.89	125.12	147.56	117.05
1979-80	130.85	122.75	160.98	107.99	110.43	138.83	143.61	125.76
1980-81	135.14	152.41	365.12	140.15	110.43	162.78	171.76	129.96
1981-82	157.75	170.19	511.92	163.63	110.43	173.35	218.48	148.09
1982-83	164.39	172.97	444.99	163.63	110.43	187.09	153.81	168.30
1983-84	173.36	178.55	341.19	180.41	126.44	198.03	244.68	182.74
1984-85	189.82	183.58	366.68	181.94	138.01	212.03	235.40	204.93
1985-86	201.07	200.73	388.95	197.56	136.13	220.46	167.51	209.02

Source: "Economic Survey of Pakistan, 1986-87" Ministry of Finance, Govt. of Pakistan.

TABLE K-6. AVERAGE WHOLESALE PRICES OF SELECTED AGRICULTURAL PRODUCTS  
- AVERAGE OF PAKISTAN -

(Unit: Rs/unit)

Year	Wheat F.A.Q. (40kg)	Rice Basmati F.A.Q. (40kg)	Maize F.A.Q. (40kg)	Gram Whole F.A.Q. (40kg)	Beef (40kg)	Mutton (40kg)	Milk (40kg)	Eggs ('000 Nos.)	Potatoes White (40kg)	Onion (40kg)
1975-76	43.69	126.90	49.05	52.42	227.87	457.14	92.08	405.63	44.95	48.29
1976-77	42.20	139.72	46.98	55.00	250.74	514.94	107.21	451.15	65.68	64.80
1977-78	50.44	162.20	53.26	89.96	268.67	569.72	109.33	481.63	59.51	56.76
1978-79	55.13	145.60	65.40	77.08	271.32	608.59	106.56	496.95	61.43	54.15
1979-80	57.27	155.38	62.08	84.35	304.12	665.21	115.86	515.47	54.08	79.29
1980-81	58.68	201.95	62.27	191.17	354.65	789.17	120.50	581.81	79.43	52.07
1981-82	68.75	226.64	85.98	268.11	378.13	834.95	135.62	618.30	89.25	88.13
1982-83	71.79	228.18	88.63	232.89	413.19	888.18	152.92	701.17	50.30	57.06
1983-84	75.50	233.36	83.96	178.92	437.08	938.98	167.56	774.96	91.33	115.42
1984-85	83.69	235.20	93.48	191.75	473.47	987.30	187.98	752.31	100.29	86.89
1985-86	86.75	269.92	96.28	203.95	483.09	1,058.78	190.71	823.92	77.55	53.59

Source: "Economic Survey of Pakistan, 1986-87" Ministry of Finance, Govt. of Pakistan.

TABLE K-7. ESTIMATION OF STANDARD CONVERSION FACTOR (SCF) FOR PAKISTAN

(unit: Million Rs.)

Items	FY 81 - 82	FY 82 - 83	FY 83 - 84	FY 84 - 85	FY 85 - 86	5 Years Average
(1) Total Import Value (CIF)	59,482	68,151	76,707	89,778	90,946	77,013
(2) Total Import Duties	13,569	17,295	20,901	22,882	24,334	19,796
(3) Total Export Value (FOB)	26,270	34,442	37,339	37,978	49,592	37,124
(4) Total Export Duties	393	400	458	489	990	546
(5) Export Subsidy	1,153	1,380	1,694	-	1,836	1,213
(6) = (1) + (3)	85,752	102,593	114,046	127,757	140,538	114,137
(7) = (1) + (2) + (3) - (4) + (5)	100,081	120,868	136,183	150,150	165,718	134,600
(8) SCF = (6)/(7)						0.85

Source: "Economic Survey, 1986 - 87" Economic Adviser's Wing, Ministry of Finance.

## CHAPTER II. PROJECT COST

TABLE K-8. FINANCIAL AND ECONOMIC PROJECT COST

Items	(Unit: million Rs)				
	Foreign Currency	Local Currency		Total Cost	
		Financial	Economic	Fi.	Eco.
1. Civil Works					
1-1. Pre-Engineering	7.3	0.0	0.0	7.3	7.3
1-2. Dam Works	277.2	128.7	109.4	405.9	386.6
1-3. Canal Works	82.7	66.3	56.4	149.0	139.1
1-4. Road Works	5.4	2.5	2.1	7.9	7.5
1-5. Project Facilities	1.4	4.3	3.7	5.7	5.1
<u>Sub Total</u>	<u>374.0</u>	<u>201.8</u>	<u>171.6</u>	<u>575.8</u>	<u>545.6</u>
2. On-Farm Development	27.1	25.1	21.3	52.2	48.4
3. Agricultural Supporting Facilities	16.7	3.3	2.8	20.0	19.5
4. Land Acquisition and Compensation	3.4	110.5	-	113.9	3.4
5. O & M Equipment	12.3	0.5	0.4	12.8	12.7
6. Project Administration	4.2	5.3	4.5	9.5	8.7
7. Consulting Services	60.0	23.8	20.2	83.8	80.2
<u>Total</u>	<u>497.7</u>	<u>370.3</u>	<u>220.8</u>	<u>868.0</u>	<u>718.5</u>
8. Contingency	49.8	37.0	31.5	86.8	81.3
<u>Total</u>	<u>547.5</u>	<u>407.3</u>	<u>252.3</u>	<u>954.8</u>	<u>799.8</u>

Note: 0.85 of standard conversion factor is applied to convert economic value.



TABLE K-9. ALLOCATION OF CAPITAL COST - FINANCIAL -

(Unit: million Rs)

Items	Total Cost	Specific Cost		Joint Cost 1/		Allocated Cost of Service Area
		Service Area (a)	NARC Area	Service Area (6,100ha) (b)	NARC Area (500ha)	
1. Civil Works						
1-1. Pre-Engineering Works	7.3	-	-	7.3	6.7	6.7
1-2. Dam Works	405.9	-	-	405.9	375.1	375.1
1-3. Canal Works	149.0	87.0	-	62.0	57.3	144.3
1-4. Road Works	7.9	7.9	-	-	-	7.9
1-5. Project Facilities	5.7	5.7	-	-	-	5.7
Sub Total	575.8	100.6	-	475.2	439.1	539.7
2. On-farm Development	52.2	52.2	-	-	-	52.2
3. Agricultural Supporting Facilities	20.0	20.0	-	-	-	20.0
4. Land Acquisition and Compensation	113.9	-	-	113.9	105.3	105.3
5. O & M Equipment	12.8	-	-	12.8	11.8	11.8
6. Project Administration	9.5	-	-	9.5	8.8	8.8
7. Consulting Services	83.8	-	-	83.8	77.5	77.5
Total	868.0	172.8	-	695.2	642.5	815.3
8. Contingency (10%)	86.8	17.3	-	69.5	64.2	81.5
Total	954.8	190.1	-	764.7	706.7	896.8
	(100 %)				(6.1 %)	(93.9 %)

Note: 1/ --- Allocated by the share of area.

TABLE K-10. ALLOCATION OF CAPITAL COST - ECONOMIC -

(Unit: million Rs)

Items	Total Cost	Specific Cost		Joint Cost 1/		Allocated Cost of Service Area (a) + (b)
		Service Area (a)	NARC Area	Service Area (6,100ha) (b)	NARC Area (500ha)	
1. Civil Works						
1-1. Pre-Engineering Works	7.3	-	-	7.3	0.6	6.7
1-2. Dam Works	386.6	-	-	386.6	29.3	357.3
1-3. Canal Works	139.1	81.0	-	53.7	4.4	134.7
1-4. Road Works	7.5	7.5	-	-	-	7.5
1-5. Project Facilities	5.1	5.1	-	-	-	5.1
Sub Total	545.6	93.6	-	417.7	34.3	511.3
2. On-farm Development	48.4	48.4	-	-	-	48.4
3. Agricultural Supporting Facilities	19.5	19.5	-	-	-	19.5
4. Land Acquisition and Compensation	3.4	-	-	3.4	0.3	3.1
5. O & M Equipment	12.7	-	-	12.7	1.0	11.7
6. Project Administration	8.7	-	-	8.7	0.7	8.0
7. Consulting Services	80.2	-	-	80.2	6.1	74.1
Total	718.5	161.5	-	514.6	42.4	676.1
8. Contingency (10%)	81.3	16.2	-	65.1	4.9	76.4
Total	799.8	177.7	-	622.1	47.3	752.5

Note: 1/ --- Allocated by the share of area.

TABLE K-11. REPLACEMENT COST OF THE PROJECT

Description	F/C	L/C	Total Cost	Life Period
		(Rs'000)	(Rs'000)	(Years)
1. Gate of Dam				
Irrigation Outlet of Dam	7,082	46	7,128	30
Rever Outlet of Dam	4,872	31	4,903	30
<u>Total</u>	<u>11,954</u>	<u>77</u>	<u>12,031</u>	
2. Gate of Canal	<u>314</u>	<u>206</u>	<u>520</u>	30
3. Pump	<u>1,100</u>	<u>700</u>	<u>1,800</u>	25
4. Operation and Maintenance Equipment				
<u>Main Office</u>				
Bulldozer, 8 ton	750	-	750	10
Backhoe Excavator, 0.25	1,900	-	1,900	10
Dump Truck, 4 ton	720	-	720	10
Motor Grader, L = 2.5m	800	-	800	10
Crawler Type Loader, 6 ton	600	-	600	10
Crawler Type Tractor, 6 ton	400	-	400	10
Truck with Crane, 2 ton	200	-	200	10
Truck Pickup, 2 ton	100	-	100	10
Station Wagon, 4 x 4	350	-	350	10
Jeep, 4 x 4	300	-	300	10
Motorcycle, 70 cc	80	-	80	10
Concrete Mixer, 0.2 m <sup>3</sup>	30	-	30	10
Water Pump, 2" - 4"	40	-	40	10
Transceiver	120	-	120	10
Walkie-talkie	18	-	18	10
Meteorological Station	50	-	50	10
Surveying Instrument	180	-	180	10
Miscellaneous tools and Equip.	500	-	500	10
Spare Part (10%)	750	-	750	10
<u>Sub Total</u>	<u>7,888</u>	<u>-</u>	<u>7,888</u>	
<u>Dam Operation Office</u>				
Station Wagon, 4 x 4	350	-	350	10
Jeep, 4 x 4	300	-	300	10
Motorcycle, 70 cc	60	-	60	10
<u>Sub Total</u>	<u>710</u>	<u>-</u>	<u>710</u>	
<u>Zone Office (I and II)</u>				
Station Wagon, 4 x 4	700	-	700	10
Jeep, 4 x 4	600	-	600	10
Motorcycle, 70 cc	1,040	-	1,040	10
<u>Sub Total</u>	<u>2,340</u>	<u>-</u>	<u>2,340</u>	
<u>Extension Center</u>				
Station Wagon	700	-	700	10
Pickup, 2 ton	100	-	100	10
Micro Bus	400	-	400	10
Motor Cycle	300	-	300	10
<u>Sub Total</u>	<u>1,500</u>	<u>-</u>	<u>1,500</u>	
<u>Total</u>	<u>12,438</u>	<u>-</u>	<u>12,438</u>	

TABLE K-12. ALLOCATION OF REPLACEMENT COST - FINANCIAL AND ECONOMIC -

(Unit: Rs'000)

Items	Total Cost	Specific Cost		Joint Cost 1/		Allocated Cost of Service Area	Life Period (Years)
		Service Area	NARC Area	Total	Service Area (6,100ha)		
<b>A. Financial</b>							
1. Gate of Dam	12,031	-	-	12,031	11,120	11,120	(30)
2. Gate of Canal	520	-	-	520	481	481	(30)
3. Pump	1,800	1,800	-	-	-	1,800	(25)
4. O & M Equipment	12,438	1,500	-	10,938	10,109	11,609	(10)
<b>B. Economic</b>							
1. Gate of Dam	12,020	-	-	12,020	11,109	11,109	
2. Gate of Canal	490	-	-	490	453	453	
3. Pump	1,695	1,695	-	-	-	1,695	
4. O & M Equipment	12,438	1,500	-	10,938	10,109	11,609	

Note: 1/ --- Allocated by the share of area.

TABLE K-13. ALLOCATION OF OPERATION AND MAINTENANCE COST - FINANCIAL & ECONOMIC -

(Unit: Rs '000)

Items	Total Cost	Specific Cost		Joint Cost <sup>1/</sup>		Allocated Cost of Service Area
		Service Area	NARC Area	Service Area (6,100ha)	NARC Area (500ha)	
<b>A. Financial</b>						
1. Salaries and Wages						
1-1. Main Office	531	-	-	506	25	506
1-2. Dam Operation Office	74	-	-	68	6	68
1-3. Zone Office	1,071	-	-	990	81	990
1-4. Extension Center	271	271	-	-	-	271
<u>Sub Total</u>	<u>1,747</u>	-	-	<u>1,364</u>	<u>112</u>	<u>1,635</u>
2. Administration and General Expenditure						
	175	-	-	162	13	162
3. Equipment Operation						
3-1. Machinery Operation	1,244	150	-	1,011	85	1,161
3-2. Fuel and Oil	443	53	-	360	50	415
3-5. Pump Operation	352	352	-	-	-	352
<u>Sub Total</u>	<u>2,039</u>	<u>555</u>	-	<u>1,371</u>	<u>115</u>	<u>1,926</u>
4. Office Maintenance						
4-1. Maintenance of Building	126	13	-	104	9	117
4-2. Office Surplus	283	29	-	235	19	264
<u>Sub Total</u>	<u>409</u>	<u>42</u>	-	<u>339</u>	<u>28</u>	<u>381</u>
<u>Total</u>	<u>4,370</u>	<u>868</u>	-	<u>3,502</u>	<u>226</u>	<u>4,104</u>
<b>B. Economic <sup>2/</sup></b>						
	3,715	758	-	2,751	226	3,489

Note: <sup>1/</sup> --- allocated by the share of area.

<sup>2/</sup> --- 0.85 of standard conversion factor is applied.

### CHAPTER III. PROJECT BENEFIT

TABLE K-14. FARM-GATE PRICES OF AGRICULTURAL INPUTS AND OUTPUTS

(Unit: Rs)

Items	Unit	Financial Prices	Economic Prices
1. Fertilizers			
- Nitrogen	Rs/ton	5,410	10,100
- Phosphorous	"	3,465	14,600
- Potassium	"	1,770	4,770
2. Crops			
a. Rabi Crops			
- Wheat	Rs/ton	1,750	3,260
- Fodders	"	60 (1,600)	60 (1,600)
- Cabbage	"	1,700	1,700
- House Radish	"	1,300	1,300
- Peas	"	4,300	4,300
b. Kharif Crops			
- Tomato	"	4,700 (1,900)	4,700 (1,900)
- Cucumber	"	2,100	2,100
- Cauliflower	"	3,500	3,500
- Peach	"	4,000	4,000
- Maize	"	2,000	2,410
- Fodders	"	60	60

Note: 1. Figures in the parenthesis are the price without Project.

2. Prices of vegetable and fruit are mainly decided based on the monthly wholesale price for the last 3 years in Rawalpindi market.

TABLE K-15. ECONOMIC PRICE OF TRADE CROPS

Items	Economic Price		
	Unit	Wheat	Maize
1. Forecasted Price in 2000, 1985 constant Dollars <sup>*1</sup>	US\$/ton	140	98
2. Convert to 1987 constant Dollars <sup>*2</sup>	"	168	118
3. Convert to Pakistan Rupees <sup>*3</sup>	Rs/ton	2,856	2,006
4. Shadow rate <sup>*4</sup> of Rs 530 of freight charges between port and wholesale market	"	+450	+450
5. Shadow rate <sup>*4</sup> of Rs 50 of transportation between wholesale market and farm-gate	"	-43	-43
6. Farm-gate price of products	"	3,260 (3,263)	2,410 (2,413)

Note: \*1 ... IBRD's projected price

(Source: IBRD, February, 1987)

\*2 ... 120.1 of international price index (1985 = 100) is applied.

\*3 ... US\$1 = Rs 17

\*4 ... 0.85 of standard Conversion Factor (SCF) is applied.



TABLE K-16. ECONOMIC PRICE OF FERTILIZER

Items	Unit	1. Urea	2. DAP	3. Potassium Chloride
1. Forecasted price in 2000, 1985 constant Dollars <sup>*1</sup>	US\$/ton	179	216	93
2. Convert to 1987 constant Dollars <sup>*2</sup>	"	215	259	112
3. Freight (US\$30) & insurance (2% of FOB price)	"	34	38	33
4. CIF price at Karachi port	"	249	297	145
5. Convert to Pakistan Rupees <sup>*3</sup>	Rs/ton	4,233	5,049	2,465
6. Shadow rate <sup>*4</sup> of Rs50 of port handling charges	"	43	43	43
7. Shadow rate <sup>*4</sup> of Rs300 of transport from port to wholesale center	"	255	255	255
8. Shadow rate <sup>*4</sup> of Rs110 of transport from market to farm-gate	"	94	94	94
9. Farm-gate price of Urea	"	4,625	10,066	2,857
10. Farm-gate price of nutrient price	"	10,100 <sup>*5</sup> (10,054)	14,600 <sup>*6</sup> (14,636)	4,770 <sup>*7</sup> (4,767)

Note: \*1 ... IBRD's projected price (source: IBRD, February, 1987)

\*2 ... 120.1 of international price index (1985 = 100) is applied.

\*3 ... US\$1 = Rs17

\*4 ... 0.85 of SCF is applied.

\*5 ... Nitrogen (46 percent of Nitrogen)

\*6 ... Phosphorous (N.P.K. ratio is 18-46-0)

\*7 ... Potassium (60 percent of Potassium)

TABLE K-17. FINANCIAL PRICES OF FERTILIZERS

Items	(Unit: Rs/ton)		
	1. Urea	2. DAP	3. N.P.K. Mixed
1) Retail price	2,600	2,700	1,650
2) Transportation cost from retail shop to farm	110	110	110
3) Farm-gate price	2,490	2,590	1,540
4) Farm-gate price of nutrient	5,410 <sup>1/</sup>	3,465 <sup>2/</sup>	1,770 <sup>3/</sup>

Note: 1/ --- Nitrogen (46 percent of N)

2/ --- Phosphate (N.P.K. ratio is 18 - 46 - 0)

3/ --- Potassium (N.P.K. ratio is 10 - 20 - 20)

TABLE K-18. CROP BUDGETS PER HECTARE - PRESENT & WITHOUT PROJECT -  
- 1987 CONSTANT PRICE -

Items	Rabi Crops						Kharif Crops							
	Wheat		Fodders		Vegetable (Cabbage)		Maize		Pulses		Vegetable (Cucumber)			
	Fi.	Eco.	Fi.	Eco.	Fi.	Eco.	Fi.	Eco.	Fi.	Eco.	Fi.	Eco.		
A. Present														
1. Yield (tons/ha)	1.7		70.0		13.0		2.0		0.8		15.0			
2. Farm-gate Price (Rs/ton)	1,750	3,260	60	60	1,600	1,600	2,000	2,410	3,000	3,000	1,900	1,900		
3. GPV (Rs/ha)	2,980	5,540	4,200	4,200	20,800	20,800	4,000	4,820	2,400	2,400	28,500	28,500		
4. Production Cost (Rs/ha)														
a) Seeds	100	190	200	200	350	300	60	50	90	80	350	300		
b) Fertilizer	260	650	430	1,070	680	1,700	360	890	30	80	750	1,880		
c) Pesticide	-	-	-	-	-	-	-	-	-	-	-	-		
d) Animal & Machinery	560	470	590	490	620	530	390	330	700	600	770	650		
e) Labor	890	750	1,480	1,260	1,470	1,250	1,040	880	1,050	890	2,890	2,460		
f) Others	270	310	400	340	940	800	280	320	280	250	1,430	1,590		
Total	2,080	2,370	3,100	3,360	4,060	4,580	2,130	2,470	2,150	1,900	6,190	6,880		
5. Net Production (Rs/ha)	900	3,170	1,100	840	16,740	16,220	1,870	2,350	250	500	22,310	21,620		
B. Without Project														
1. Yield (tons/ha)	2.0		75.0		13.9		2.4		1.0		16.0			
2. Farm-gate Price (Rs/ton)	1,750	3,260	60	60	1,600	1,600	2,000	2,410	3,000	3,000	1,900	1,900		
3. GPV (Rs/ha)	3,500	6,520	4,500	4,500	22,240	22,240	4,800	5,780	3,000	3,000	30,400	30,400		
4. Production Cost (Rs/ha)	2,440	2,790	3,320	3,600	4,340	4,900	2,560	2,960	2,680	2,370	6,600	7,340		
5. Net Production	1,060	3,730	1,180	900	17,900	17,340	2,240	2,820	320	630	23,800	23,060		

TABLE K-19. CROP BUDGETS PER HECTARE WITH PROJECT - RABI CROPS -

Items	Wheat		Fodders		Leat Vegetable (Cabbage)		Root Vegetable (H. Radish)		Pulse Crop (Peas)	
	Fi.	Eco.	Fi.	Eco.	Fi.	Eco.	Fi.	Eco.	Fi.	Eco.
1. Field (ton/ha)	5.0		85.0		25.0		20.0		12.0	
2. Farm-gate Price (Rs/ton)	1,750	3,260	60	60	1,700	1,700	1,300	1,300	4,300	4,300
3. GPV (Rs/ha)	8,750	16,300	5,100	5,100	42,500	42,500	26,000	26,000	51,600	51,600
4. Production Cost (Rs/ha)										
a) Seeds	110	210	200	200	440	370	690	590	880	750
b) Fertilizer	1,000	2,670	530	1,320	1,200	2,880	610	1,540	410	1,090
c) Pesticide	10	10	-	-	1,170	1,000	350	300	890	1,180
d) Animal & Machinery	1,190	1,010	720	610	2,030	1,730	2,940	2,500	2,030	1,730
e) Labor	1,390	1,180	1,780	1,510	3,950	3,360	3,280	2,790	5,390	4,580
f) Others	560	480	320	270	2,640	2,240	2,360	2,010	2,880	2,450
<u>Total</u>	4,260	5,560	3,550	3,910	11,430	11,580	10,230	9,730	12,480	11,780
5. <u>Net Production (Rs/ha)</u>	4,490	10,740	1,550	1,190	31,070	30,920	15,770	16,270	39,120	39,820

TABLE K-20. CROP BUDGETS PER HECTARE WITH PROJECT - KHARIF CROPS -

Items	Fruit Vegetable (Tomato)		Fruit Vegetable (Cucumber)		Flower Vegetable (Cauliflower)		Fruit (Peach)		Maize		Fodders	
	Fi.	Eco.	Fi.	Eco.	Fi.	Eco.	Fi.	Eco.	Fi.	Eco.	Fi.	Eco.
1. Yield (ton/ha)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	2.5	2.5	60.0	60.0
2. Farm-gate Price (Rs/ton)	4,700	4,700	2,100	2,100	3,500	3,500	4,000	4,000	2,000	2,410	60	60
3. GPV (Rs/ha)	94,000	94,000	42,000	42,000	70,000	70,000	80,000	80,000	5,000	6,030	3,600	3,600
4. Production Cost (Rs/ha)												
a) Seeds & Seedling	1,100	940	820	700	3,000	2,550	-	-	60	50	210	210
b) Fertilizer	730	1,830	610	1,540	930	2,380	890	2,270	480	1,380	530	1,320
c) Pesticider	1,800	1,530	1,360	1,160	1,960	1,660	3,200	2,720	610	520	-	-
d) Animal & Machinery	3,200	2,720	2,920	2,480	3,260	2,770	3,500	2,970	580	490	450	380
e) Labor	7,190	6,110	6,560	5,580	3,610	3,060	6,550	5,570	1,510	1,280	1,310	1,110
f) Others	4,210	3,580	3,680	3,130	3,830	3,250	4,240	3,600	490	420	380	320
<u>Total</u>	<u>18,230</u>	<u>16,710</u>	<u>15,950</u>	<u>14,590</u>	<u>16,590</u>	<u>15,670</u>	<u>18,380</u>	<u>17,130</u>	<u>3,730</u>	<u>4,140</u>	<u>2,880</u>	<u>3,340</u>
5. Net Production (Rs/ha)	<u>75,770</u>	<u>77,290</u>	<u>26,050</u>	<u>27,410</u>	<u>53,410</u>	<u>54,330</u>	<u>61,620</u>	<u>62,870</u>	<u>1,270</u>	<u>1,890</u>	<u>720</u>	<u>260</u>

TABLE K-21. CROP PRODUCTION AT PRESENT AND WITHOUT PROJECT  
- EXCLUDED NARC AREA -

Crops	Cropped Area (ha)	Present		Without Project*	
		Yield (Tons/ha)	Production (tons)	Yield (Tons/ha)	Production (tons)
1. Service Area (6,800 ha)					
a. Rabi Crops					
- Wheat	3,140	1.7	5,340	2.0	6,280
- Fodders	380	70.0	26,600	75.0	28,500
- Vegetable (Cabbage)	190	13.0	2,470	13.9	2,640
b. Kharif Crops					
- Maize	1,610	2.0	3,220	2.4	3,860
- Pulses	1,710	0.8	1,370	1.0	1,710
- Vegetable (Cucumber)	190	15.0	2,850	16.0	3,040
<u>Sub Total</u>	<u>7,220</u>				
2. K-2 Dam Area (130 ha)					
a. Rabi Crops (Wheat)	70	1.7	120	2.0	140
b. Kharif Crops (Maize)	60	2.0	120	2.4	140
<u>Sub Total</u>	<u>130</u>				
<u>Total</u>	<u>7,350</u>	(Cropping intensity = 106 %)			

Note: + --- 15 years after.

TABLE K-22. CROP PRODUCTION WITH PROJECT  
- EXCLUDED NARC AREA -

Crops	Cropped Area (ha)	Average Yield (Tons/ha)	Crop Production (tons)
<b>1. Rabi Crops</b>			
- Wheat	3,790	5.0	18,950
- Fodders	650	85.0	55,250
- Vegetable			
◦ Leaf Vegetable (Cabbage)	460	25.0	11,500
◦ Root Vegetable (H. Radish)	460	20.0	9,200
◦ Pulse Crop (Peas)	370	12.0	4,400
<b>1-2. Kharif Crops</b>			
- Vegetable			
◦ Fruit Vegetable (Tomato)	1,200	20.0	24,000
◦ Fruit Vegetable (Cucumber)	930	15.0	13,950
◦ Flower Vegetable (Cauliflower)	370	20.0	7,400
- Fruit (Peach)	370	20.0	7,400
- Maize *	790	2.5	1,975
- Fodders *	790	60.0	47,400
<u>Total</u>	<u>10,180</u>		(Cropping intensity = 167%)
<u>Total of Irrigated Crops</u>	<u>8,600</u>		(Cropping intensity = 141%)
(Cultivable Commanded Area)	(6,100)		

Note: \* --- Un-irrigated crops.

TABLE K-23. PROJECT BENEFIT AT THE TARGET YEAR

Crops	Cropping Area <sup>1/</sup> (ha)	Financial (Rs'000)		Economic (Rs'000)	
		Gross Production	Net Production	Gross Production	Net Production
<b>1. Present</b>					
<b>1-1. Service Area</b>					
a. Rabi - Wheat	3,140	9,357	2,826	17,396	9,954
- Fodders	380	1,596	418	1,596	319
- Vegetable	190	3,952	3,181	3,952	3,082
b. Kharif - Maize	1,610	6,440	3,011	7,760	3,784
- Pulses	1,710	4,104	428	4,104	855
- Vegetable	190	5,415	4,239	5,415	4,108
<u>Sub Total</u>	<u>7,220</u>	<u>30,864</u>	<u>14,103</u>	<u>40,223</u>	<u>22,102</u>
<b>1-2. K-2 Dam Area</b>					
a. Rabi - Wheat	70	209	63	388	222
b. Kharif - Maize	60	240	112	289	141
<u>Sub Total</u>	<u>130</u>	<u>449</u>	<u>175</u>	<u>677</u>	<u>363</u>
<u>Total</u>	<u>7,350</u>	<u>31,313</u>	<u>14,278</u>	<u>40,900</u>	<u>22,465</u>
<b>2. Without Project</b>					
<b>2-1. Service Area</b>					
a. Rabi - Wheat	3,140	10,990	3,328	20,473	11,712
- Fodders	380	1,710	448	1,710	342
- Vegetable	190	4,226	3,401	4,226	3,295
b. Kharif - Maize	1,610	7,728	3,606	9,306	4,540
- Pulses	1,710	5,130	547	5,130	1,077
- Vegetable	190	5,776	4,522	5,776	4,381
<u>Sub Total</u>	<u>7,220</u>	<u>35,560</u>	<u>15,852</u>	<u>46,621</u>	<u>25,347</u>
<b>2-2. K-2 Dam Area</b>					
a. Rabi - Wheat	70	245	74	456	261
b. Kharif - Maize	60	288	134	347	169
<u>Sub Total</u>	<u>130</u>	<u>533</u>	<u>208</u>	<u>803</u>	<u>430</u>
<u>Total</u>	<u>7,350</u>	<u>36,093</u>	<u>16,060</u>	<u>47,424</u>	<u>25,777</u>
<b>3. With Project</b>					
<b>3-1. Rabi</b>					
- Wheat	3,790	33,163	17,017	61,777	40,705
- Fodders	650	3,315	1,008	3,315	774
- Leaf Vegetable	460	19,550	14,292	19,550	14,223
- Root Vegetable	460	11,960	7,254	11,960	7,484
- Pulse Crops	370	19,092	14,474	19,092	14,733
<b>3-2. Kharif</b>					
- Fruit Vegetable (1)	1,200	112,800	90,924	112,800	92,748
- Fruit Vegetable (2)	930	25,900	24,227	29,295	25,491
- Flower Vegetable	370	29,600	19,762	29,600	20,102
- Fruit	370	29,600	22,799	29,600	23,262
- Maize	790	3,950	1,003	4,764	1,493
- Fodders	790	2,844	569	2,844	205
<u>Total</u>	<u>10,180</u>	<u>291,774</u>	<u>213,329</u>	<u>324,597</u>	<u>241,220</u>
<b>4. Annual Benefit at the Target Year</b>			<u>197,269</u>	<u>215,443</u>	

Note: <sup>1/</sup> --- excluded NARC Area.



TABLE K-24. BENEFIT STREAM WITH PROJECT  
- ECONOMIC -

(Unit: Rs'000)

Year	Net Production Without Project			Net Production With Project			Benefit
	Service Area 1/ Area	K-2 Dam Area	Total	Service Area 1/ Area	K-2 Dam Area	Total	
1987	22,102	363	22,465	22,102	363	22,465	0
1990	22,525	372	22,897	22,525	372	22,897	0
1991	22,666	375	23,040	22,666	-	22,666	- 375
1992	22,807	378	23,185	22,807	-	22,807	- 378
1993	22,949	380	23,329	22,949	-	22,949	- 380
1994	23,090	383	23,473	23,090	-	23,090	- 383
1995	23,231	386	23,617	23,231	-	23,231	- 386
1996	23,372	389	23,761	36,183	-	36,183	12,422
1997	23,513	392	23,905	50,656	-	50,656	26,751
1998	23,654	395	24,049	72,366	-	72,366	48,317
1999	23,795	398	24,193	96,488	-	96,488	72,295
2000	23,936	401	24,337	120,610	-	120,610	96,273
2001	24,077	404	24,481	147,144	-	147,144	122,663
2002	24,218	407	24,625	173,678	-	173,678	149,053
2003	24,359	410	24,769	192,976	-	192,976	168,207
2004	24,500	413	24,913	207,449	-	207,449	182,536
2005	24,642	415	25,057	219,510	-	219,510	194,453
2006	24,783	418	25,201	226,747	-	226,747	201,546
2007	24,924	421	25,345	231,572	-	231,572	206,227
2008	25,065	424	25,489	236,396	-	236,396	210,907
2009	25,206	427	25,633	238,808	-	238,808	213,175
2010~	25,347	430	25,777	241,220	-	241,220	215,443

Note: 1/ --- excluded NARC Area.

## CHAPTER IV. COMPARISON OF PROJECT COST AND BENEFIT

TABLE K-25. SENSITIVITY TEST OF THE PROJECT

Alternative	EIRR	BC Ratio by Discount Rate		
		8 %	10 %	12 %
(1) Proto-type	12.7	1.91	1.42	1.09
(2) 10% increase in capital cost	12.0	1.74	1.30	0.99
(3) 10% reduction in benefit	11.9	1.72	1.28	0.98
(4) Five years delay in benefit	11.5	1.68	1.23	0.92
(5) Combination of (2) and (3)	11.2	1.57	1.17	0.90
(6) Combination of (2) and (4)	10.8	1.53	1.12	0.84
(7) Combination of (3) and (4)	10.7	1.51	1.11	0.83
(8) Combination of (2), (3) and (4)	10.1	1.38	1.01	0.75

TABLE K-26. PROJECT COST AND BENEFITS, PROTO-TYPE -ECONOMIC-

( UNIT : MILLION RS. )

YEAR	PROJECT COST		TOTAL	BENEFITS	RETURN	8 %		10 %		12 %	
	CAPITAL	O & M				(COST)	(BENEFITS)	(COST)	(BENEFITS)	(COST)	(BENEFITS)
1 1987	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
2 1988	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
3 1989	5.2	0.0	5.2	0.0	-5.2	4.13	0.00	3.91	0.00	3.70	0.00
4 1990	2.2	0.0	2.2	0.0	-2.2	1.62	0.00	1.50	0.00	1.40	0.00
5 1991	13.5	0.0	13.5	-0.4	-13.9	9.19	-0.27	8.38	-0.25	7.66	-0.73
6 1992	197.3	0.0	197.3	-0.4	-197.7	124.33	-0.25	111.37	-0.23	99.96	-0.20
7 1993	202.1	0.0	202.1	-0.4	-202.5	117.92	-0.23	103.71	-0.21	91.42	-0.18
8 1994	226.6	0.0	226.6	-0.4	-227.0	122.43	-0.22	105.71	-0.19	91.52	-0.16
9 1995	105.6	0.0	105.6	-0.4	-106.0	52.83	-0.20	44.79	-0.17	38.08	-0.14
10 1996	0.0	3.4	3.4	12.4	9.0	5.74	5.74	1.31	4.78	1.09	3.99
11 1997	0.0	3.4	3.4	26.8	23.4	1.46	11.49	1.19	9.39	0.98	7.70
12 1998	0.0	3.4	3.4	48.3	44.9	1.35	19.18	1.08	15.39	0.87	12.40
13 1999	0.0	3.4	3.4	72.3	68.9	1.25	26.58	0.98	20.94	0.78	16.57
14 2000	0.0	3.4	3.4	96.3	92.9	1.16	32.79	0.90	25.36	0.70	19.71
15 2001	0.0	3.4	3.4	122.7	119.3	1.07	38.68	0.81	29.37	0.62	22.42
16 2002	0.0	3.4	3.4	149.1	145.7	0.99	43.52	0.74	32.45	0.55	24.32
17 2003	0.0	3.4	3.4	168.2	164.8	0.92	45.46	0.67	35.28	0.50	24.50
18 2004	0.0	3.4	3.4	182.3	179.1	0.85	45.67	0.61	32.82	0.44	23.73
19 2005	0.0	15.0	15.0	198.5	193.5	3.48	46.00	2.45	32.46	1.74	23.05
20 2006	0.0	3.4	3.4	201.5	198.1	0.73	43.23	0.51	29.95	0.35	20.89
21 2007	0.0	3.4	3.4	206.2	202.8	0.68	40.96	0.46	27.86	0.31	19.09
22 2008	0.0	3.4	3.4	210.9	207.5	0.63	38.79	0.42	25.91	0.28	17.43
23 2009	0.0	3.4	3.4	213.2	209.8	0.58	36.31	0.38	23.81	0.25	15.73
24 2010	0.0	3.4	3.4	215.4	212.0	0.54	33.97	0.35	21.87	0.22	14.19
25 2011	0.0	3.4	3.4	215.4	212.0	0.50	31.45	0.31	19.88	0.20	12.67
26 2012	0.0	3.4	3.4	215.4	212.0	0.46	29.12	0.29	18.07	0.18	11.31
27 2013	0.0	3.4	3.4	215.4	212.0	0.43	26.97	0.26	16.43	0.16	10.10
28 2014	0.0	3.4	3.4	215.4	212.0	0.39	24.97	0.24	14.94	0.14	9.02
29 2015	0.0	15.0	15.0	215.4	200.4	1.61	23.12	0.95	13.58	0.56	8.05
30 2016	0.0	3.4	3.4	215.4	212.0	0.34	21.41	0.19	12.34	0.11	7.19
31 2017	0.0	3.4	3.4	215.4	212.0	0.31	19.82	0.18	11.22	0.10	6.42
32 2018	0.0	3.4	3.4	215.4	212.0	0.29	18.55	0.16	10.20	0.09	5.73
33 2019	0.0	3.4	3.4	215.4	212.0	0.27	16.99	0.15	9.27	0.08	5.12
34 2020	0.0	4.9	4.9	215.4	210.5	0.36	15.73	0.19	8.43	0.10	4.57
35 2021	0.0	3.4	3.4	215.4	212.0	0.23	14.57	0.12	7.67	0.06	4.08
36 2022	0.0	3.4	3.4	215.4	212.0	0.21	13.49	0.11	6.97	0.06	3.64
37 2023	0.0	3.4	3.4	215.4	212.0	0.20	12.49	0.10	6.33	0.05	3.25
38 2024	0.0	3.4	3.4	215.4	212.0	0.18	11.57	0.09	5.76	0.05	2.90
39 2025	0.0	26.5	26.5	215.4	188.9	1.32	10.71	0.64	5.24	0.32	2.59
40 2026	0.0	3.4	3.4	215.4	212.0	0.16	9.92	0.08	4.76	0.04	2.31
41 2027	0.0	3.4	3.4	215.4	212.0	0.14	9.18	0.07	4.33	0.03	2.07
42 2028	0.0	3.4	3.4	215.4	212.0	0.13	8.50	0.06	3.93	0.03	1.85
43 2029	0.0	3.4	3.4	215.4	212.0	0.12	7.87	0.06	3.58	0.03	1.65
44 2030	0.0	3.4	3.4	215.4	212.0	0.11	7.29	0.05	3.25	0.02	1.47
45 2031	0.0	3.4	3.4	215.4	212.0	0.11	6.75	0.05	2.96	0.02	1.31
46 2032	0.0	3.4	3.4	215.4	212.0	0.10	6.25	0.04	2.69	0.02	1.17
47 2033	0.0	3.4	3.4	215.4	212.0	0.09	5.79	0.04	2.44	0.02	1.05
48 2034	0.0	3.4	3.4	215.4	212.0	0.08	5.36	0.04	2.22	0.01	0.93
49 2035	0.0	15.0	15.0	215.4	200.4	0.35	4.96	0.14	2.02	0.06	0.83
50 2036	0.0	3.4	3.4	215.4	212.0	0.07	4.59	0.03	1.83	0.01	0.75
TOTAL	752.5	198.8	951.3	7722.7	6771.4	458.25	874.42	396.86	564.96	345.99	376.84

BENEFIT COST RATIO BY DISCOUNT RATE (B/C) = 1.91 ( 8%), 1.42 (10%), 1.09 (12%)  
INTERNAL RATE OF RETURN (IRR)

TABLE K-27. PROJECT COST AND BENEFITS, CASE 3 (10 % REDUCTION OF BENEFIT)

( UNIT : MILLION RS. )

YEAR	PROJECT COST		TOTAL	BENEFITS	RETURN	8 %		10 %		12 %	
	CAPITAL	O & M				(COST)	(BENEFITS)	(COST)	(BENEFITS)	(COST)	(BENEFITS)
1 1987	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
2 1988	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
3 1989	5.2	0.0	5.2	0.0	-5.2	4.15	0.00	3.91	0.00	3.70	0.00
4 1990	2.2	0.0	2.2	0.0	-2.2	1.62	0.00	1.50	0.00	1.40	0.00
5 1991	13.5	0.0	13.5	-0.4	-13.9	9.19	-0.27	8.38	-0.25	7.66	-0.23
6 1992	197.3	0.0	197.3	-0.4	-197.7	124.33	-0.25	111.37	-0.23	99.96	-0.20
7 1993	202.1	0.0	202.1	-0.4	-202.5	117.92	-0.23	103.71	-0.21	91.42	-0.18
8 1994	226.6	0.0	226.6	-0.4	-227.0	122.43	-0.22	105.71	-0.19	91.52	-0.16
9 1995	105.6	0.0	105.6	-0.4	-106.0	52.83	-0.20	44.79	-0.17	38.08	-0.14
10 1996	0.0	3.4	3.4	11.2	7.8	1.57	5.19	1.51	4.52	1.09	3.61
11 1997	0.0	3.4	3.4	24.1	20.7	1.46	10.34	1.19	8.45	0.98	6.93
12 1998	0.0	3.4	3.4	43.5	40.1	1.35	17.27	1.08	13.86	0.87	11.17
13 1999	0.0	3.4	3.4	65.1	61.7	1.25	23.94	0.98	18.86	0.78	14.92
14 2000	0.0	3.4	3.4	86.7	83.3	1.16	29.52	0.90	22.85	0.70	17.74
15 2001	0.0	3.4	3.4	110.4	107.0	1.07	34.80	0.81	26.43	0.62	20.17
16 2002	0.0	3.4	3.4	134.2	130.8	0.99	39.17	0.74	29.21	0.55	21.89
17 2003	0.0	3.4	3.4	151.4	148.0	0.92	40.92	0.67	29.95	0.50	22.05
18 2004	0.0	3.4	3.4	164.3	160.9	0.85	41.12	0.61	29.55	0.44	21.57
19 2005	0.0	15.0	15.0	178.7	175.3	0.78	41.41	0.51	29.22	0.37	20.75
20 2006	0.0	3.4	3.4	185.6	182.2	0.73	38.92	0.46	26.96	0.35	18.81
21 2007	0.0	3.4	3.4	198.8	195.4	0.68	36.87	0.42	25.08	0.31	17.18
22 2008	0.0	3.4	3.4	191.9	188.5	0.63	36.57	0.38	24.42	0.28	16.43
23 2009	0.0	3.4	3.4	193.9	190.5	0.58	32.68	0.35	21.43	0.25	14.16
24 2010	0.0	3.4	3.4	193.9	190.5	0.54	30.58	0.33	19.69	0.22	12.77
25 2011	0.0	3.4	3.4	193.9	190.5	0.50	28.51	0.31	17.90	0.20	11.41
26 2012	0.0	3.4	3.4	193.9	190.5	0.46	26.22	0.29	16.27	0.18	10.18
27 2013	0.0	3.4	3.4	193.9	190.5	0.43	24.27	0.26	14.79	0.16	9.09
28 2014	0.0	3.4	3.4	193.9	190.5	0.39	22.68	0.24	13.45	0.14	8.12
29 2015	0.0	15.0	15.0	193.9	178.9	0.34	20.81	0.21	12.22	0.11	7.25
30 2016	0.0	3.4	3.4	193.9	190.5	0.31	19.27	0.19	11.11	0.10	6.47
31 2017	0.0	3.4	3.4	193.9	190.5	0.29	17.84	0.18	10.10	0.09	5.78
32 2018	0.0	3.4	3.4	193.9	190.5	0.27	16.52	0.16	9.18	0.08	5.16
33 2019	0.0	3.4	3.4	193.9	190.5	0.25	15.30	0.15	8.35	0.08	4.61
34 2020	0.0	4.9	4.9	193.9	189.0	0.23	14.16	0.12	7.59	0.10	4.11
35 2021	0.0	3.4	3.4	193.9	190.5	0.21	13.11	0.11	6.90	0.06	3.67
36 2022	0.0	3.4	3.4	193.9	190.5	0.20	12.14	0.11	6.27	0.06	3.28
37 2023	0.0	3.4	3.4	193.9	190.5	0.20	11.24	0.10	5.70	0.05	2.93
38 2024	0.0	3.4	3.4	193.9	190.5	0.18	10.41	0.09	5.18	0.05	2.61
39 2025	0.0	26.5	26.5	193.9	167.4	0.16	9.64	0.08	4.71	0.04	2.33
40 2026	0.0	3.4	3.4	193.9	190.5	0.16	8.93	0.08	4.28	0.04	2.08
41 2027	0.0	3.4	3.4	193.9	190.5	0.14	8.26	0.07	3.89	0.03	1.86
42 2028	0.0	3.4	3.4	193.9	190.5	0.13	7.65	0.06	3.54	0.03	1.66
43 2029	0.0	3.4	3.4	193.9	190.5	0.12	7.09	0.06	3.22	0.03	1.48
44 2030	0.0	3.4	3.4	193.9	190.5	0.12	6.56	0.05	2.93	0.02	1.32
45 2031	0.0	3.4	3.4	193.9	190.5	0.11	6.07	0.05	2.66	0.02	1.18
46 2032	0.0	3.4	3.4	193.9	190.5	0.10	5.62	0.04	2.42	0.02	1.06
47 2033	0.0	3.4	3.4	193.9	190.5	0.09	5.21	0.04	2.20	0.02	0.94
48 2034	0.0	3.4	3.4	193.9	190.5	0.08	4.82	0.04	2.00	0.01	0.84
49 2035	0.0	15.0	15.0	193.9	178.9	0.08	4.47	0.04	1.82	0.01	0.75
50 2036	0.0	3.4	3.4	193.9	190.5	0.07	4.15	0.03	1.65	0.01	0.67
TOTAL	752.5	198.8	951.3	6960.6	6009.3	458.25	788.67	396.86	509.57	345.99	359.88

BENEFIT COST RATIO BY DISCOUNT RATE (B/C) = 1.72 ( 8%), 1.28 (10%), 0.98 (12%)  
 INTERNAL RATE OF RETURN (IRR) = 11.9%

TABLE K-28. PROJECT COST AND BENEFITS, CASE 4 (5 YEARS DELAY IN BENEFIT)

( UNIT : MILLION RS. )

YEAR	PROJECT COST		TOTAL	BENEFITS	RETURN	PRESENT WORTH VALUE BY DISCOUNT RATE			12 % (BENEFITS)
	CAPITAL	O & M				(COST)	(BENEFITS)	(COST)	
1 1987	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00
2 1988	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00
3 1989	5.2	0.0	5.2	0.0	-5.2	4.13	3.91	0.00	3.70
4 1990	2.2	0.0	2.2	0.0	-2.2	1.62	1.50	0.00	1.40
5 1991	13.5	0.0	13.5	-0.4	-13.9	9.19	8.38	-0.25	7.66
6 1992	197.3	0.0	197.3	-0.4	-197.7	124.33	111.37	-0.23	99.96
7 1993	202.1	0.0	202.1	-0.4	-202.5	117.92	103.71	-0.21	91.42
8 1994	226.6	0.0	226.6	-0.4	-227.0	122.43	105.71	-0.19	91.52
9 1995	105.6	0.0	105.6	-0.4	-106.0	52.83	44.79	-0.17	38.08
10 1996	0.0	3.4	3.4	7.6	4.2	1.57	1.31	2.93	2.45
11 1997	0.0	3.4	3.4	19.5	16.1	1.46	1.19	8.35	5.61
12 1998	0.0	3.4	3.4	33.8	30.4	1.35	1.08	10.77	8.68
13 1999	0.0	3.4	3.4	48.2	44.8	1.25	0.98	13.96	11.05
14 2000	0.0	3.4	3.4	63.3	63.9	1.16	0.90	17.72	13.77
15 2001	0.0	3.4	3.4	86.5	83.1	1.07	0.81	20.71	15.80
16 2002	0.0	3.4	3.4	105.6	102.2	0.99	0.74	22.98	17.23
17 2003	0.0	3.4	3.4	127.2	123.8	0.92	0.67	25.17	18.53
18 2004	0.0	3.4	3.4	143.9	140.5	0.85	0.61	25.88	18.71
19 2005	0.0	3.4	3.4	160.7	145.7	0.78	0.51	26.28	18.66
20 2006	0.0	3.4	3.4	172.6	169.2	0.73	0.46	25.66	17.89
21 2007	0.0	3.4	3.4	184.5	181.1	0.68	0.42	24.93	17.08
22 2008	0.0	3.4	3.4	191.6	188.2	0.63	0.38	23.54	15.83
23 2009	0.0	3.4	3.4	198.7	193.3	0.58	0.35	22.19	14.66
24 2010	0.0	3.4	3.4	203.4	200.0	0.54	0.31	20.65	13.40
25 2011	0.0	3.4	3.4	205.8	202.4	0.50	0.29	18.99	12.11
26 2012	0.0	3.4	3.4	208.2	204.8	0.46	0.26	17.47	10.93
27 2013	0.0	3.4	3.4	210.6	207.2	0.43	0.24	16.06	9.88
28 2014	0.0	3.4	3.4	213.0	209.6	0.39	0.24	14.77	8.92
29 2015	0.0	3.4	3.4	215.4	200.4	0.34	0.19	13.58	8.05
30 2016	0.0	3.4	3.4	215.4	212.0	0.31	0.18	12.34	7.19
31 2017	0.0	3.4	3.4	215.4	212.0	0.29	0.16	11.22	6.42
32 2018	0.0	3.4	3.4	215.4	212.0	0.27	0.15	10.20	5.73
33 2019	0.0	3.4	3.4	215.4	210.5	0.26	0.14	9.27	5.12
34 2020	0.0	3.4	3.4	215.4	210.5	0.25	0.13	8.43	4.57
35 2021	0.0	3.4	3.4	215.4	212.0	0.23	0.11	7.67	4.08
36 2022	0.0	3.4	3.4	215.4	212.0	0.21	0.10	6.97	3.64
37 2023	0.0	3.4	3.4	215.4	212.0	0.20	0.09	6.33	3.25
38 2024	0.0	3.4	3.4	215.4	212.0	0.18	0.09	5.76	2.90
39 2025	0.0	3.4	3.4	215.4	188.9	0.17	0.08	5.24	2.59
40 2026	0.0	3.4	3.4	215.4	212.0	0.16	0.08	4.75	2.31
41 2027	0.0	3.4	3.4	215.4	212.0	0.14	0.07	4.33	2.07
42 2028	0.0	3.4	3.4	215.4	212.0	0.13	0.06	3.93	1.85
43 2029	0.0	3.4	3.4	215.4	212.0	0.12	0.06	3.58	1.65
44 2030	0.0	3.4	3.4	215.4	212.0	0.12	0.05	3.25	1.47
45 2031	0.0	3.4	3.4	215.4	212.0	0.11	0.05	2.96	1.31
46 2032	0.0	3.4	3.4	215.4	212.0	0.10	0.04	2.69	1.17
47 2033	0.0	3.4	3.4	215.4	212.0	0.09	0.04	2.44	1.05
48 2034	0.0	3.4	3.4	215.4	212.0	0.08	0.04	2.22	0.93
49 2035	0.0	3.4	3.4	215.4	200.4	0.07	0.03	2.02	0.83
50 2036	0.0	3.4	3.4	215.4	212.0	0.07	0.03	1.83	0.75
TOTAL	752.5	198.8	951.3	7325.5	6374.2	458.25	396.86	487.49	345.99

BENEFIT COST RATIO BY DISCOUNT RATE (B/C) = 1.68 (8%), 1.23 (10%), 0.92 (12%)  
 INTERNAL RATE OF RETURN (IRR) = 11.5%

TABLE K-29. PROJECT COST AND BENEFITS, CASE 7

(10% REDUCTION AND 5 YEARS DELAY IN BENEFIT)

(UNIT: MILLION RS.)

YEAR	PROJECT COST		TOTAL	BENEFITS	RETURN	PRESENT WORTH VALUE BY DISCOUNT RATE			12% (BENEFITS)	12% (COST)	12% (BENEFITS)
	CAPITAL	O & M				8% (COST)	8% (BENEFITS)	10% (COST)			
1 1987	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
2 1988	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00
3 1989	5.2	0.0	5.2	0.0	-5.2	4.13	0.00	3.91	0.00	3.70	0.00
4 1990	2.2	0.0	2.2	0.0	-2.2	1.62	0.00	1.50	0.00	1.40	0.00
5 1991	13.5	0.0	13.5	-0.4	-13.9	9.19	-0.27	8.38	-0.25	7.66	-0.23
6 1992	197.3	0.0	197.3	-0.4	-197.7	124.33	-0.25	111.37	-0.23	99.96	-0.20
7 1993	202.1	0.0	202.1	-0.4	-202.5	117.92	-0.21	103.71	-0.21	91.42	-0.18
8 1994	226.6	0.0	226.6	-0.4	-227.0	122.43	-0.22	105.71	-0.19	91.52	-0.16
9 1995	105.6	0.0	105.6	-0.4	-106.0	52.83	-0.20	44.79	-0.17	38.08	-0.14
10 1996	0.0	3.4	3.4	6.8	3.4	1.57	3.15	1.31	2.62	1.09	2.19
11 1997	0.0	3.4	3.4	17.6	14.2	1.46	7.55	1.19	6.17	0.98	5.06
12 1998	0.0	3.4	3.4	30.4	27.0	1.35	12.07	1.08	9.69	0.87	7.80
13 1999	0.0	3.4	3.4	43.4	40.0	1.25	15.96	0.98	12.57	0.78	9.95
14 2000	0.0	3.4	3.4	60.6	57.2	1.16	20.63	0.90	15.96	0.70	12.40
15 2001	0.0	3.4	3.4	77.9	74.5	1.07	24.56	0.81	18.65	0.62	14.23
16 2002	0.0	3.4	3.4	95.0	91.6	0.99	27.73	0.74	20.68	0.55	15.50
17 2003	0.0	3.4	3.4	114.5	111.1	0.92	30.95	0.67	22.65	0.50	16.68
18 2004	0.0	3.4	3.4	129.5	126.1	0.85	32.41	0.61	23.29	0.44	16.84
19 2005	0.0	3.4	3.4	144.6	129.6	0.78	33.51	0.55	23.64	0.38	16.79
20 2006	0.0	3.4	3.4	155.3	151.9	0.73	33.32	0.51	23.08	0.35	16.10
21 2007	0.0	3.4	3.4	166.1	162.7	0.68	33.00	0.46	22.45	0.31	15.37
22 2008	0.0	3.4	3.4	172.4	169.0	0.63	31.71	0.42	21.18	0.28	14.25
23 2009	0.0	3.4	3.4	178.8	175.4	0.58	30.45	0.38	19.97	0.25	13.19
24 2010	0.0	3.4	3.4	183.1	179.7	0.54	28.88	0.35	18.59	0.22	12.06
25 2011	0.0	3.4	3.4	185.2	181.8	0.50	27.04	0.31	17.09	0.20	10.89
26 2012	0.0	3.4	3.4	187.4	184.0	0.46	25.34	0.29	15.72	0.18	9.84
27 2013	0.0	3.4	3.4	189.5	186.1	0.43	23.72	0.26	14.45	0.16	8.89
28 2014	0.0	3.4	3.4	191.7	188.3	0.39	22.22	0.24	13.29	0.14	8.03
29 2015	0.0	3.4	3.4	193.9	190.5	0.34	19.27	0.19	11.11	0.11	7.25
30 2016	0.0	3.4	3.4	193.9	190.5	0.31	17.84	0.18	10.10	0.10	6.47
31 2017	0.0	3.4	3.4	193.9	190.5	0.29	16.52	0.16	9.18	0.09	5.78
32 2018	0.0	3.4	3.4	193.9	190.5	0.27	15.30	0.15	8.35	0.08	5.16
33 2019	0.0	3.4	3.4	193.9	190.5	0.26	14.16	0.14	7.59	0.10	4.61
34 2020	0.0	3.4	3.4	193.9	189.0	0.25	13.11	0.13	6.90	0.06	4.11
35 2021	0.0	3.4	3.4	193.9	190.5	0.23	12.14	0.12	6.27	0.06	3.67
36 2022	0.0	3.4	3.4	193.9	190.5	0.21	11.24	0.11	5.70	0.05	3.28
37 2023	0.0	3.4	3.4	193.9	190.5	0.20	10.41	0.10	5.18	0.05	2.93
38 2024	0.0	3.4	3.4	193.9	190.5	0.18	9.64	0.09	4.71	0.05	2.61
39 2025	0.0	3.4	3.4	193.9	167.4	0.16	8.93	0.08	4.28	0.04	2.33
40 2026	0.0	3.4	3.4	193.9	190.5	0.15	8.28	0.07	3.89	0.04	2.08
41 2027	0.0	3.4	3.4	193.9	190.5	0.14	7.65	0.06	3.54	0.03	1.86
42 2028	0.0	3.4	3.4	193.9	190.5	0.12	7.09	0.06	3.22	0.03	1.66
43 2029	0.0	3.4	3.4	193.9	190.5	0.11	6.56	0.05	2.93	0.02	1.48
44 2030	0.0	3.4	3.4	193.9	190.5	0.11	6.07	0.05	2.66	0.02	1.32
45 2031	0.0	3.4	3.4	193.9	190.5	0.10	5.62	0.04	2.42	0.02	1.18
46 2032	0.0	3.4	3.4	193.9	190.5	0.09	5.21	0.04	2.20	0.02	1.06
47 2033	0.0	3.4	3.4	193.9	190.5	0.08	4.82	0.04	2.00	0.01	0.94
48 2034	0.0	3.4	3.4	193.9	178.9	0.35	4.47	0.14	1.82	0.01	0.84
49 2035	0.0	15.0	15.0	193.9	178.9	0.07	4.15	0.03	1.65	0.01	0.75
50 2036	0.0	3.4	3.4	193.9	190.5	0.07	3.86	0.03	1.51	0.01	0.67
TOTAL	752.5	198.8	951.3	6593.6	5642.3	458.25	692.29	396.86	438.66	345.99	287.21

BENEFIT COST RATIO BY DISCOUNT RATE (B/C) = 1.51 (8%), 1.11 (10%), 0.83 (12%)

INTERNAL RATE OF RETURN (IRR) = 10.7%

## CHAPTER V. FINANCIAL ANALYSIS



TABLE K-30. FARM BUDGETS WITH PROJECT - 1.6 HA AVERAGE SIZE<sup>1/</sup> (3.9 ACRE) -

Crops	Planted Area (ha)			Gross Production (Rs/year)						Net Income (Rs/year)						Farm Household Income <sup>2/</sup> (Rs/year)							
	Vegetable Farm		Fruit Farm		Vegetable Farm		Fruit Farm		Grain Farm		Vegetable Farm		Fruit Farm		Vegetable Farm		Fruit Farm		Vegetable Farm		Fruit Farm		
	0.8	1.3	0.3	1.3	7,000	11,580	5,590	5,840	4,700	4,700	5,590	5,840	4,700	4,700	5,590	5,840	4,700	4,700	5,590	5,840	4,700	4,700	
1. Rabi Crops																							
- Wheat	0.8	1.3	-	-	7,000	11,580	-	-	11,580	-	-	5,590	5,840	4,700	4,700	-	-	-	-	-	-	7,640	7,640
- Fodders	-	0.3	-	-	-	1,530	-	-	1,530	-	-	-	470	-	-	-	-	-	-	-	-	1,000	1,000
- Leaf Vegetable	0.3	-	-	-	12,750	-	-	-	-	-	9,520	-	-	10,510	-	-	-	-	-	-	-	-	-
- Root Vegetable	0.3	-	-	-	7,800	-	-	-	-	-	4,730	-	-	5,720	-	-	-	-	-	-	-	-	-
- Pulse Crops	0.2	-	-	-	10,320	-	-	-	-	-	7,820	-	-	8,900	-	-	-	-	-	-	-	-	-
2. Kharif Crops																							
- Fruit Vegetable (I)	0.7	-	-	-	65,800	-	-	-	-	-	53,040	-	-	58,070	-	-	-	-	-	-	-	-	-
- Fruit Vegetable (II)	0.4	-	-	-	16,800	-	-	-	-	-	10,420	-	-	15,040	-	-	-	-	-	-	-	-	-
- Flower Vegetable	0.4	-	-	-	28,000	-	-	-	-	-	21,360	-	-	22,810	-	-	-	-	-	-	-	-	-
- Fruit	-	1.6	-	-	-	128,000	-	-	-	-	-	98,590	-	-	109,070	-	-	-	-	-	-	-	-
- Maize	-	-	0.4	-	-	2,000	-	-	2,000	-	-	-	510	-	-	-	-	-	-	-	-	1,110	1,110
- Fodders	-	-	0.4	-	-	1,440	-	-	1,440	-	-	-	290	-	-	-	-	-	-	-	-	810	810
<b>Total</b>	<b>3.1</b>	<b>1.6</b>	<b>2.4</b>	<b>2.4</b>	<b>148,470</b>	<b>128,000</b>	<b>128,000</b>	<b>16,350</b>	<b>110,280</b>	<b>98,590</b>	<b>7,110</b>	<b>123,750</b>	<b>109,070</b>	<b>10,560</b>	<b>109,070</b>	<b>109,070</b>	<b>10,560</b>	<b>109,070</b>	<b>109,070</b>	<b>10,560</b>	<b>10,560</b>	<b>10,560</b>	<b>10,560</b>

Note: 1/ --- Area of on-farm facilities is excluded.  
1.7ha/farm x 0.916 = 1.56 ≈ 1.6

2/ --- included the production cost of family labor.



**ANNEX L. PRE-ENGINEERING WORKS**



ANNEX L. PRE-ENGINEERING WORKS

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CHAPTER I. TOPOGRAPHIC SURVEY .....	L-1
CHAPTER II. GEOLOGICAL INVESTIGATION .....	L-2



## CHAPTER I. TOPOGRAPHIC SURVEY

### 1.1. Project Area

Topographic map of the Project Area of 12,900 ha (16,310 acre) should be provided prior to commence the detailed design.

- Topographic Map (S = 1/5,000)                      12,900 ha

### 1.2. K-2 Dam

Following topographic survey related with K-2 Dam should be carried out by the beginning of the detailed design stage.

- Topographic Survey .... ° Downstream Area of Main Dam, 100 ha  
(S = 1/5,000)
- Topographic Survey .... ° Satra Mile - Angoli Road, 50 ha  
(S = 1,000)                      ° (relocated)  
   ° Saddle Dam  
   ° Dam Operation Office, etc.
- Route Survey ..... ° Satra Mile - Angoli Road, 20 km  
   ° (relocated)  
   ° Saddle Dam  
   ° Spillway, etc.

### 1.3. Irrigation Canal

Topographic and route survey of the proposed alignment of main, branch, distributary and minor irrigation canals should be carried out by the beginning of the detailed design, and their length will be as follows:

Main Canal .....	17.7 km
Branch Canal .....	42.2
Distributary Canal .....	4.8
Minor Canal .....	65.3
<u>          Total          </u>	<u>130.0 km</u>

## CHAPTER II. GEOLOGICAL INVESTIGATION

### 2.1. K-2 Damsite

#### 1) Core Drilling

Following core drilling should be made for the detailed design.

- Foundation of Core Zone			
Right Abutment	50 m x 6 holes (Vertical 4, Inclined 2)	=	300 m
River Bed	60 m x 3 holes (Vertical 1, Inclined 2)	=	180 m
Left Abutment	50 m x 4 holes (Vertical 2, Inclined 2)	=	200 m
"	30 m x 2 holes (Vertical)	=	60 m
- Foundation of Shell			
Upstream	50 m x 4 holes (Vertical)	=	200 m
Downstream	50 m x 4 holes (Vertical)	=	200 m
- Spillway	30 m x 10 holes (Vertical)	=	300 m
- Saddle Dam	20 m x 15 holes (Vertical)	=	300 m
Total	48 holes		1,740 m

#### 2) Testing

Following tests should be made in the bore holes.

- Lugeon Test .....	350 Nos. (5 m interval)
- Loading Test .....	90 Nos. (20 m interval)

#### 3) Seismic Prospecting

- Damsite .....	1,900 m
- Spillway .....	900
- Diversion Tunnel .....	500
<u>Total</u> .....	<u>3,300 m</u>



## 2.2. Borrow Area of Impervious Material

- 1) Test Pits ..... 60 places (Depth 3 - 5 m)

Test pits will be excavated at the location of cross point in 50 m grid.

- 2) Field Density Test ..... 20 Nos.

## 2.3. Irrigation Canal Route

- 1) Core Drilling ..... 10 m x 2 holes = 20 m
- 2) Hand Auger Boring ..... 160 Nos. (500 m interval, Depth 3 - 4 m) including sounding

## 2.4. Laboratory Test

- 1) Dam Embankment Materials

- Rock Test ..... 30 samples

- ° Specific Gravity/Absorption
- ° Unconfined Compression
- ° Physical Weathering

- Soil Test

° Physical Test ..... 30 samples

- Specific Gravity
- Moisture Content
- Gradation
- Atterberg Limit

° Mechanical Test ..... 30 samples

- Compaction
- Triaxial Compression
- Permeability
- Consolidation

- 2) Canal Embankment Materials

° Physical Test ..... 10 samples

° Mechanical Test ..... 10 samples



**ANNEX M. COLLECTED DATA AND PAKISTANI GOVERNMENT  
OFFICIALS CONTACTED BY STUDY TEAM**



ANNEX M. COLLECTED DATA AND PAKISTAN GOVERNMENT  
OFFICIALS CONTACTED BY STUDY TEAM

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CHAPTER II. PAKISTANI OFFICIALS CONTACTED BY STUDY TEAM .....	M-6



## CHAPTER I. COLLECTED DATA

Following data relevant to the project were collected by the Study Team;

### 1.1. Drawing and Aerial Photograph

1. Topographic Map, Scale 1:50,000, Surveyor General of Pakistan, 1964.
2. Federal Capital Area Map, Scale 1:21,120 (3 inch to a mile), Surveyor General of Pakistan, 1961.
3. Islamabad and Surroundings, Scale 1:50,000, Surveyor General of Pakistan.
4. Islamabad/Rawalpindi Guide Map, Scale 1:30,000 Surveyor General of Pakistan, 1982.
5. Aerial Photograph (Damsite Area only), Scale 1:40,000 (15 sheets) and 1:10,000 (60 sheets), Survey of Pakistan.
6. Map of Administrative Division in Islamabad.
7. Surveyed Map indicating Dam and Canal Route

### 1.2. Reports

1. Agrometeorological Data collected at NARC Islamabad for 1982-1986, prepared by NARC, 1987.
2. ABAD in Retrospect, 1978-1983, prepared by ABAD, 1984.
3. Small Dams Project, 1984, prepared by ADB.
4. Feasibility Study on the Conduction of Water from Khanpur to Islamabad/Rawalpindi, prepared by JICA, 1985.
5. Interim Report for the Regional Study for Water Resources Development Potential for the Metropolitan Area of Islamabad-Rawalpindi, prepared by JICA, 1987.
6. Rawal Dam Completion Report, prepared by WAPDA, 1967.
7. Simly Dam Completion Report, prepared by WAPDA, 1985

8. Annual Progress Report of Water Use Crop Production Technology and Consumptive Use of Water in the Northern Punjab Zone of Pakistan (1982-1983), prepared by WAPDA, 1984.
9. Annual Progress Report of Water Use Crop Production Technology and Consumptive Use of Water in the Northern Punjab Zone of Pakistan (1984-1985), prepared by WAPDA, 1985.
10. Reconnaissance Soil Survey, Rawalpindi Area, prepared by Directorate of Soil Survey, West Pakistan, 1967.
11. Geological Map of Pakistan, prepared by Geological Survey of Pakistan.
12. Geological Map of Islamabad, prepared by Geological Survey of Pakistan.
13. Consumptive Use of Water for Crops in Pakistan, prepared by Pakistan Agricultural Research Council, 1982.
14. On-farm Water Management Field Manual, prepared by Ministry of Food, Agriculture and Cooperatives, Government of Pakistan, 1980.
15. Master Plan for Barani Area Development Project, prepared by ABAD, 1987.
16. Shahpur Dam, Walana Dam, Surla Dam, Khokhar Dam Design Report, prepared by SDO, 1985-1986.
17. The Sixth Five Year Plan. 1983-1988, prepared by Planning Commission, Government of Pakistan, 1983.
18. 1981 Population Census Report of Islamabad, 1983.
19. Islamabad Rural Area Five Year (1985-1988) Development Programme and Plan of Action, prepared by Rural Area Coordination Committee, Islamabad, 1985.
20. Storage Capacity Sedimentation of Rawal Dam Hydrological Survey, prepared by Irrigation Research Institute, Lahore, May 1985.
21. Field Irrigation Practices, ADBP Modern Farming Booklet Series, prepared by Agricultural Technology Department, Agricultural Development Bank of Pakistan, March 1986.
22. Draft Final Report for the Regional Study for Water Resources Development Potential for the Metropolitan Area of Islamabad - Rawalpindi, prepared by JICA, December 1987.



23. On-Farm Water Management Field Manual (Volume I-V), prepared by Water Management Wing, Ministry of Food, Agriculture and Cooperatives (MFA), March 1986.
24. No.1 ADBP Technical Handbook Series, Vegetables, Technology for Agriculture, August 1986.
25. Maize in the Irrigated Farming Systems of the Punjab: an Exploratory Suaver, PARC/CIMMYT Paper No.86-14, 1986.
26. Farmer Managed Verification of Improved Maize Technology: Results and Experiences from Swat, 1985. PARC/CIMMYT Paper No.86-12, 1986.
27. Maize Production Manual, PARC Islamabad, 1986.
28. Wheat in the Irrigated Farming Systems of Mardan District, Implications for Research and Extension, NWFP April 1985.
29. Maize in the Irrigated Farming Systems of the Central Punjab: Farmers Production Practices, PARC/CIMMYT Paper No.87-15, 1987.
30. Status of Livestock Production and Health in the District of Islamabad PARC, P.O.Box No.1031, Islamabad.
31. Sunflower in the Irrigation Farming System of Mardan District Implications for Research and Extension, PARC, Peshawar.
32. The Sunflower Cropping System and Farmers Perceptions about the Prospects of Spring and Autumn Sunflower in Mardan District, a view from Farmer's Field by Munir Ahmed Sociologist, PARC Peshawar.
33. Composite Schedule of Rates, 1979, corrected upto 31st December 1981, Standing Rates Committee for the Punjab, Government of the Punjab.

### 1.3. Data and Information

#### 1. Daily Rainfall Record around Project Area

- Rawal Dam	(1963 - 1979)
- NARC	(1982 - 1986)
- Kuri	(1952 - 1968)
- Bharakau	(1952 - 1969)
- Kirpa	(1952 - 1968)
- Tamir	(1952 - 1968)
- Tret	(1952 - 1968)

2. Meteorological Record at Following Stations
  - Chaklala (1954-1986)
  - Murree (1954-1986)
  - Rawal Dam (1963-1979)
  - NARC (1982-1986)
3. Runoff Discharge Data at Following Stations
  - Bari Kangran (1971-1981)
  - Chhattar (1971-1981)
  - Rawal Dam (1965-1968)
  - Dhok Khanna (1965-1967)
  - Lohi Bher (1971-1981)
  - Khanpur (1960-1980)
  - Cherah (1960-1980)
4. Result of Water Quality Analysis, conducted by JICA Study Team, 1987.
5. Results of Soil Chemical Test conducted by JICA Study Team, 1987.
6. Reconnaissance Soil Survey - Rawalpindi Area, prepared by Government of Pakistan, 1967.
7. Released Discharge Record from Rawal Dam (1962-1987), prepared by SDO.
8. Irrigation Requirement of Crop in the Punjab, prepared by Irrigation and Power Department, Government of Punjab.
9. Crop Water Requirement, Technical Paper No.24.
10. Result of Soil Physical Test for Upland Irrigation conducted by JICA Study Team, 1987.
11. Schedule of Rate 1982, prepared by Government of Pakistan, Pakistan Public Works Department.
12. Schedule of Tariffs, prepared by WAPDA.
13. Village Profile Survey, prepared by LGRD, 1986.
14. PC-1 Scheme for the Model Integrated Rural Area Development Project (MIRAD), Phase I (1986-1988), prepared by ICTA, 1987.
15. Progress Report of Agricultural Extension Services, 1986/1987, prepared by NARC, TTU.
16. Agricultural Extension Services in Islamabad District.

17. Brief Description of Rural Development, Markaz Tarlai, 1986.
18. Achievement of Works, Soil Conservation Department, ICTA.
19. Achievement of Works, Fishery Department, ICTA.
20. Cropped Area by Village, 1984 to 1986, Land Development Department, ICTA.
21. Barani Farming System of the Punjab.
22. Hand Book of Population Census Data, 1985, prepared by Population Census Organization, Statistic Division.
23. Population Census of Pakistan, 1972, Islamabad, prepared by Population Census Organization, Statistic Division.
24. Economic Survey, 1986-1987, Economic Adviser's Wing, Ministry of Finance.
25. Monthly Statistical Bulletin, Vol. 33, No.12, 1985 Federal Bureau of Statistics, Statistic Division.
26. Pakistan Basic Facts, 1985-1986, 24 Edition, Economic Adviser's Wing, Ministry of Finance.
27. Statistical Pocket Book of Pakistan, 1986, Federal Bureau of Statistics, Statistic Division.
28. Cost of Production of Field Crops, Rice, Cotton and Wheat, Agricultural Price Commission, MFA.
29. Results of Water Quality Analysis of Kurang River conducted by JICA Study Team, December 1987.
30. On-Farm Development Programme of Khanpur Dam Project.
31. Conveyance Application Losses in its Lower Part, Remedial Measures taken and their Impact on Agriculture, prepared by Water Management Wing, MFA, December 1987.
32. Monthly Wholesale Price of Vegetable and Fruit for the Last 3 Years, Market Committee, Rawalpindi City.
33. Standard Section and Cost of Metalled Road and Katcha Road, LGRD, Islamabad.

## CHAPTER II. PAKISTANI OFFICIALS CONTACTED BY STUDY TEAM

During the field work, Study Team contacted the following Pakistani Officials so as to get various information and data relevant to the Upper Kurang River Irrigation Project.

### 1. Islamabad Capitals Territory Administration (ICTA)

Mr. Jamshaid Burki	:	Administrator
Mr. Naguibullah Malik	:	Deputy Commissioner
Mr. Mian Niaz Gul	:	Director, Development and Finance
Mr. Qasim M. Niaz	:	Additional Deputy Commissioner
Mr. Raja Abdul Hameed	:	Assistant Director, Local Government & Rural Development
Mr. Saif Ullah	:	Assistant Engineer
Mrs. Yasmin Masood	:	Assistant Commissioner
Dr. Shaukat Ali Bhatti	:	Assistant Director, Live Stock and Dairy Development
Mr. Muhammad Ali Tehsil Dar	:	Chief, Land Revenue Department
Mr. Bukhari	:	Assistant Director, Fishery Department
Mr. Arshad Khan	:	Assistant Agricultural Engineer, Soil Conservation

### 2. Economic Affairs Division (EAD)

Mr. Akhtar Iqbal	:	Deputy Secretary
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### 3. Ministry of Food, Agriculture and Cooperative (MFA)

Mr. Abdul Salam	:	Farm Production Economic Division, Agricultural Price Commission
Mr. Shan Muhammad Chaudhry	:	Economic Consultant, Water Management Wing

- Mr. Abdul Ghaffar Arain : Water Management Engineer, Water Management Wing
- Mr. S.M. Aslam Jafri : Deputy Agricultural Commissioner, Economic Research
4. Ministry of Planning and Development
- Mr. S. Faiz Ahmed Zaidi : Chief, Water Resources Section
- Mr. Abdul Hafeez Qaiser : Deputy Chief, Water Resources Section
- Mr. Sahibzada Ghiasul Haq : Assistant Chief, Project Appraisal and Evaluation Section
- Miss Shamin Sahibzada : Chief, Project Evaluation Section, Pakistan Institute of Development Economics
5. Small Dams Organization (SDO)
- Mr. Mian Hafiz Ullah : Project Director
- Mr. Malik Ahmad Khan : Deputy Director
- Mr. Abdul Gahffar : Assistant Director
- Mr. Bashir Ahmed Raja : Senior Geologist
- Mr. M. Bashir Ahmad : Economist
- Mr. Bashir Chohan : Economist, Department of Irrigation and Power
- Mr. Mian M. Aslam : Agronomist
- Mr. Muhammad Ayub : Sub-Divisional Officer
- Mr. Khalid Mahmood Khan : Sub-Divisional Officer
6. Capital Development Authority (CDA)
- Mr. Manzoor Ahmd : BGIR.
- Mr. Maqbool Ilahi Malik : D.G. Planning
- Mr. Shafiq Ali Siddiqui : Director, Survey & Research Planning Wing

Mr. A.R. Javaid : Deputy Director General  
 Mr. A.Q. Nomani : Director (Water Supply)  
 Mr. Mirza Agha : Deputy Director (Geology)  
 Muhammad Azam  
 Mr. Mahbood Ali Uhan : Town Planner, Institutional  
 Planning Section  
 Mr. Mohammad Aslam : Director, Water Resources  
 Development

7. National Agricultural Research Center (NARC)

Dr. Abdus Salam Akhtar : Director General  
 Dr. M. Salim : Principal Scientific Officer  
 Dr. Abdul Rashid : Principal Scientific Officer Land  
 Research Section  
 Dr. Shahid Mohamood : Senior Scientific Officer  
 Dr. Ahmad Yar Panjha : Principal Scientific Officer  
 Water Research Section  
 Mr. Naeem Iqbal Hashim : Agronomist  
 Mr. Akbar Ali Khan : Scientific Officer, Water  
 Research Section  
 Mr. Ikram Saeed : Agricultural Economist  
 Socio-Economic Section  
 Mr. Nbor Mohammad : Senior Scientific Officer  
 Mr. Noor Mohammad : Director, Agro-Forest  
 Mr. Khalid Masud : Agricultural Extension Director  
 Mr. Taj Mohammad Uhan : Agricultural Extension Assistant  
 Director  
 Mr. Khalid Masud Chaudhry : Director, Technology Transfer  
 Unit (TTU)  
 Mr. Muhammad Salim Zia : Assistant Director, TTU  
 Dr. N.I. Hashmi : Crop Sciences (Wheat) NARC  
 Research Institutes

- Dr. Muhammad Ashurat : Crop Sciences (Vegetable), NARC Research Institute
- Mr. Abdul Ghaffar : Animal Sciences/Nutrition
- Mr. M.S. Khan Rana : Director, Training Institute
- Mr. Nasim Akhtar : Deputy, Director Fisheries Research
8. Pakistan Agricultural Research Council (PARC)
- Dr. Amir Muhammad : Chairman, PARC
- Mr. Khalid Masud Chaudhry: Director, Agricultural Extension
- Dr. Daud Ahmad Khan : Consultants of Horticulture
9. Public Health Engineering Department (PHED)
- Mr. Mohammad Iqbal Shah : Executive Engineer
10. Soil Conservation Department (SCD)
- Mr. Amanullah Khan Niazi : Director, Punjab Government
11. Agency for Barani Area Development (ABAD)
- Miss Zareen Bano : Chief
12. Water and Power Development Authority (WAPDA)
- Mr. M. Aslam Raja : Chief Resident Engineer, Simly Dam Project
13. Geological Survey of Pakistan
- Mr. Ayub Khalili : Deputy Director
14. Khanpur Dam Project Office
- Mr. Fazullah Khan Shinwari: Executive Engineer

15. Agricultural Research Institute, Peshawar, NWFP
- Dr. Abdul Qadim Syed : Director General
- Mr. Iftikhar-Ul-Haq : Horticulturalist
- Mr. Waheed Ullah : Agronomist
- Mr. Syed Sajidin Haussain: Agricultural Economist
16. Department of Fisheries, Punjab
- Mr. Mohammad Iqbal : Deputy Director, Fisheries,  
Punjab Fish Hatchery, Rawal Town,  
Islamabad
17. Rural Development Markaz Center
- Mr. Nazir Ahmed : Project Manager
- Mr. Abdul Qaddus : Project Manager
- Mr. Arshad Mahmood Khan : Development Officer
18. National Agrometeorological Center
- Mr. Surfraz Mahmood : Director
19. United Bank Limited
- Mr. Shekh Tahir Azmat : Assistant Vice President
20. Allied Bank of Pakistan
- Mr. Munir Akhlter : Manager, Tarlai Office
21. Agricultural Development Bank of Pakistan
- Mr. Shafqat Ahmad : Assistant Director, Training Farm
22. Samli Sanatorium Station
- Dr. Rafi Ul Qadar : Medical Superintendent









JICA