THE ISLAMIC REPUBLIC OF PAKISTAN

FEASIBILITY REPORT

ON

AGRICULTURAL DEVELOPMENT PROJECT

WITH

WIDENING OF PAT FEEDER CANAL

VOLUME IV

(SUPPLEMENTARY STUDY)

DECEMBER 1982

JAPAN INTERNATIONAL COOPERATION AGENCY

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STAGED DEVELOPMENT PLAN

I. INTRODUCTION

The Feasibility Study on Agricultural Development Project with Widening of Pat Feeder Canal has been prepared based on the concept of the integrated agricultural development of the Project Area which consists of three major project components, namely, provision of irrigation and drainage facilities, establishment of the Pilot Project and promotion of the agricultural development. In the Feasibility Study, four alternative studies of Cases-1 to -4 have been carried out depending upon water resources available in the Project Area as discussed in the Report and then alternative Case-3 and Case-4 are concluded technically sound and economically viable.

Through the meetings held between the Government of Pakistan and the JICA Mission on the Draft Final Report of the Project, it is concluded that supplementary study on the Staged Development Plan shall be prepared assuming that the existing Rabi cultivation and the Kharif cropping pattern are so adjusted that the peak water requirement can appear in July and August, and the engineering work is separated from the agricultural development of the area. The Staged Development Plan is seriously considered the various conditions for the implementation where the priority should be given to the completion of engineering works on the Widening of Pat Feeder Canal and the distribution system and the agricultural development project could be taken up at the second phase depending upon availability of funds.

II. DEVELOPMENT PLAN

II-1. Project Component

The Staged Development Plan should be formulated by the following components in order to achieve the above-mentioned objectives as the first phase development;

i) Irrigation Facilities

Widening and improvement of the main canals, distributaries, minor canals and related structures.

ii) On-farm Development

Construction of on-farm facilities

iii) Roads

Construction of road networks including the improvement of service road and the rehabilitation of existing roads. Asphalt and gravel pavement scheduled in the Case-3 and Case-4 are excluded.

II-2. Proposed Agricultural Development

Based on the agricultural development discussed in the alternative plan of Case-3 and Case-4, cropping intensity of Kharif and Rabi is planned at 54.0 percent and 23.7 percent, respectively, resulting in the total cropping intensity of 77.7 percent for the Staged Development Plan as shown in Table-1 "Proposed Cropping Plan".

The cropping pattern is so adjusted that available water resource in Kharif is 6,700 cusec and the peak water requirement can appear in July and August. Water supply in the Pat Feeder during Rabi season would be stricted within the existing supplies, so that the cropping pattern in Rabi could be maintained with the existing cropping intensity.

Table - 1 Proposed Cropping Plan

Unit; Intensity : %
Area : acre

Crops	Case-3 Plan Intensity	Case-3 Plan Area	Case-4 Plan Intensity	Case-4 Plan Area	Staged Development Plan Intensity	Staged Development Plan Area
1. Kharif						
a. Sorghum	(9.0)	55,100	(7.0)	42,800	(15.0)	91,800
b. Rice	(20.0)	122,400	(17.0)	104,100		-
c. Oilseeds	(14.0)	85,700	(12.0)	73,400	(12.0)	73,500
d. Pulses	(12.0)	73,400	(10.0)	61,200	(23.0)	140,700
e. Sugarcane	(5.0)	30,600	(4.0)	24,500	(4.0)	24,500
Sub-total	(60.0)	367,200	(50.0)	306,000	(54.0)	330,500
2. Rabi						
a. Wheat	(34.0)	208,100	(34.0)	208,100	(13.0)	80,000
b. Oilseeds	(13.0)	79,600	(13.0)	79,600	(5.6)	34,000
c. Pulses	(8.0)	48,900	(8.0)	48,900	(0.7)	4,000
d. Fodders, Misc.	(5.0)	30,600	(5.0)	30,600	(4.4)	27,000
Sub-total	(60.0)	367,200	(60.0)	367,200	(23.7)	145,000
Total	(120.0)	734,400	(110.0)	673,260	(77.7)	475,500

Note: Proposed total cultivable area = 612 000 acres (100%).

II-3. Water Requirement

Seasonal crop water requirement including drinking water and total water requirement, are calculated by applying same method with Case-4 as shown in Table-2. According to the said table, the peak water requirement will be occurred in the 3rd decade of August and the annual water requirement for the Staged Development Plan calculated by 10-day basis is rather smaller amount than that of the Case-3 and Case-4 as follows:

Annual Water Requirement

(Unit: MAF)

	Case-3	Case-4	Staged Development
Water Requirement at the Guddu			
Kharif Crop	2.069	1.714	1.427
Rabi Crop	0.837	0.837	0.325
Drinking Water	0.053	0.048	0.048
Total	2.959	2.599	1.800
Water Requirement at Outlet			
Kharif Crop	1.422	1.180	0.982
Rabi Crop	0.575	0.575	0.223
Drinking Water	0.036	0.033	0.033
Total	2.033	1.788	1.238

Table - 2 WATER REQUIREMENT FOR STAGED DEVELOPMENT PLAN (Q = 6,700 cusec)

Description	Unit	Jan.			Feb.			Mar.			Apr.			May			Jun.			Jul.			Aug.			Sept.		
Unit Crop Water Requirement																												
· Sorghum	inch																	0.50	0.72	0.89	1.16	1.20	1.32	1.83	2.51	2.26	2.38	2.[illegible]
· Rice	"																0.86	2.12	3.63	4.28	4.31	4.24	2.98	3.03	3.39	2.66	2.64	2.[illegible]
· Oilseed (Sunflower)	"																					0.44	0.62	0.85	1.24	1.26	1.49	2.[illegible]
· Pulses (Mungbeans)	"																	0.60	0.82	1.02	1.39	1.56	1.76	2.31	2.99	2.41	2.22	1.[illegible]
· Pulses (Soybeans)	"																	0.50	0.72	0.92	1.22	1.26	1.40	1.89	2.56	2.29	2.40	2.[illegible]
· Sugarcane & Others	"	0.25	0.22	0.11	0.22	0.47	0.56	0.89	1.10	0.97	1.36	1.53	1.68	2.86	3.18	3.89	3.50	3.76	3.91	3.35	3.44	3.82	3.03	3.06	3.36	2.62	2.60	2.[illegible]
· Wheat	"	0.82	0.84	0.93	1.09	0.98	0.65	1.12	0.70	0.42	0.21	0.03																
· Oilseed (Rapes Mustard)	"	0.75	0.76	0.79	0.86	0.65	0.35	0.46	0.18																			
· Pulses (Gram)	"	0.81	0.84	0.91	1.09	1.01	0.72	1.34	1.04	0.81	0.66	0.34	0.13															0.[illegible]
· Fodder (Berseem) & Others	"	0.66	0.65	0.72	0.78	0.89	0.73	1.15	0.88	0.50																		
Water Requirement																												
· Sorghum 15 %	inch																	0.08	0.11	0.13	0.17	0.18	0.20	0.27	0.38	0.34	0.36	0.[illegible]
· Rice 0 %	"																	-	-	-	-	-	-	-	-	-	-	
· Oilseed (Sunflower) 12 %	"																					0.05	0.07	0.10	0.15	0.15	0.18	0.[illegible]
· Pulses (Mungbeans) 16 %	"																	0.10	0.13	0.16	0.22	0.25	0.28	0.37	0.48	0.39	0.36	0.[illegible]
· Pulses (Soybeans) 7 %	"																	0.04	0.05	0.06	0.09	0.09	0.10	0.13	0.18	0.16	0.17	0.[illegible]
· Sugarcane & Others 4 %	"	0.01	0.01	0.00	0.01	0.02	0.02	0.04	0.04	0.04	0.05	0.06	0.07	0.11	0.13	0.16	0.14	0.15	0.16	0.13	0.14	0.15	0.12	0.12	0.13	0.10	0.10	0.[illegible]
· Wheat 13.0 %	"	0.11	0.11	0.12	0.14	0.13	0.08	0.15	0.09	0.05	0.03	0.00																
· Oilseed (Rapes Mustard) 5.6 %	"	0.04	0.04	0.04	0.05	0.04	0.02	0.03	0.01																			
· Pulses (Gram) 0.7 %	"	0.005	0.006	0.006	0.008	0.007	0.005	0.009	0.007	0.006	0.005	0.002	0.001															0.[illegible]
· Fodder (Berseem) & Others 4.4 %	"	0.03	0.03	0.03	0.03	0.04	0.03	0.05	0.04	0.02																		
Total 77.7 %	"	0.195	0.196	0.196	0.238	0.237	0.155	0.279	0.187	0.116	0.085	0.062	0.071	0.11	0.13	0.16	0.14	0.37	0.45	0.48	0.62	0.72	0.77	0.99	1.32	1.14	1.17	1.[illegible]
Water Requirement (Net)	cusecs	0.82	0.82	0.75	1.00	1.00	0.81	1.17	0.79	0.44	0.36	0.26	0.30	0.46	0.55	0.61	0.59	1.55	1.89	2.02	2.60	2.75	3.23	4.16	5.04	4.79	4.92	4.[illegible]
— do — Including Field Losses	"	1.03	1.03	0.94	1.25	1.25	1.01	1.46	0.99	0.55	0.45	0.33	0.38	0.58	0.69	0.76	0.74	1.93	2.36	2.53	3.25	3.44	4.04	5.20	6.30	5.99	6.15	6.[illegible]
Drinking Water Requirement	"	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.[illegible]
Water Requirement Including F.L and D.W	"	1.09	1.09	1.00	1.31	1.31	1.07	1.52	1.05	0.61	0.51	0.39	0.44	0.64	0.75	0.72	0.80	1.99	2.42	2.59	3.31	3.50	4.10	5.26	6.36	6.05	6.21	6.[illegible]
— do — Including Water Course	"	1.28	1.28	1.18	1.54	1.54	1.25	1.79	1.24	0.72	0.60	0.46	0.52	0.75	0.88	0.85	0.94	2.34	2.85	3.05	3.89	4.12	4.82	6.19	7.48	7.12	7.31	7.[illegible]
— do — Including Minor	"	1.42	1.42	1.31	1.71	1.71	1.40	1.99	1.37	0.80	0.67	0.51	0.58	0.84	0.98	0.94	1.05	2.60	3.16	3.39	4.33	4.58	5.36	6.88	8.31	7.91	8.12	8.[illegible]
— do — Including Conveyance Losses	"	1.86	1.86	1.71	2.24	2.24	1.83	2.60	1.79	1.04	0.87	0.67	0.75	1.09	1.28	1.23	1.37	3.40	4.14	4.43	5.66	5.98	7.01	8.99	10.87	10.34	10.61	10.[illegible]
Total Water Requirement	"	1,140	1,140	1,047	1,371	1,371	1,120	1,591	1,095	636	532	410	459	667	783	753	838	2,081	2,533	2,711	3,464	3,660	4,290	5,502	6,652	6,328	6,493	6,[illegible]
— do —	M.A.F	0.023	0.023	0.023	0.027	0.027	0.018	0.032	0.022	0.014	0.011	0.008	0.009	0.013	0.016	0.016	0.017	0.042	0.050	0.054	0.069	0.080	0.085	0.109	0.145	0.126	0.129	0.[illegible]

GED DEVELOPMENT PLAN (Q = 6,700 cusec)

	Feb.			Mar.			Apr.			May			Jun.			Jul.			Aug.			Sept.			Oct.			Nov.			Dec.			Total
														0.50	0.72	0.89	1.16	1.20	1.32	1.83	2.51	2.26	2.38	2.35	1.84	1.64	1.52	0.56	0.34	0.15				23.17
													0.86	2.12	3.63	4.28	4.31	4.24	2.98	3.03	3.39	2.66	2.64	2.55	1.99	1.44	1.56	0.27						41.95
																		0.44	0.62	0.85	1.24	1.26	1.49	2.08	1.84	1.97	1.88	0.99	0.71	0.48	0.13	0.02		16.00
														0.60	0.82	1.02	1.39	1.56	1.76	2.31	2.99	2.41	2.22	1.80	0.98	0.52	0.20							20.58
														0.50	0.72	0.92	1.22	1.26	1.40	1.89	2.56	2.29	2.40	2.40	1.90	1.71	1.56	0.57	0.32	0.12				23.74
0.11	0.22	0.47	0.56	0.89	1.10	0.97	1.36	1.53	1.68	2.86	3.18	3.89	3.50	3.76	3.91	3.35	3.44	3.82	3.03	3.06	3.36	2.62	2.60	2.58	2.10	2.02	2.15	1.14	1.08	1.00	0.50	0.38	0.28	68.97
0.93	1.09	0.98	0.65	1.12	0.70	0.42	0.21	0.03																	0.17	0.37	0.59	0.58	0.72	0.91	0.65	0.61	0.77	13.16
0.79	0.86	0.65	0.35	0.46	0.18																				0.20	0.35	0.52	0.48	0.63	0.62	0.46	0.64	0.69	9.39
0.91	1.09	1.01	0.72	1.34	1.04	0.81	0.66	0.34	0.13															0.33	0.46	0.59	0.80	0.71	0.88	0.75	0.53	0.61	0.75	16.11
0.72	0.78	0.89	0.73	1.15	0.88	0.50																			0.50	0.78	1.13	1.04	0.75	0.82	0.54	0.60	0.72	13.84
														0.08	0.11	0.13	0.17	0.18	0.20	0.27	0.38	0.34	0.36	0.35	0.28	0.25	0.23	0.08	0.05	0.02				3.48
														-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						0.00
																		0.05	0.07	0.10	0.15	0.15	0.18	0.25	0.22	0.24	0.23	0.12	0.09	0.06	0.02	0.00		1.93
														0.10	0.13	0.16	0.22	0.25	0.28	0.37	0.48	0.39	0.36	0.29	0.16	0.08	0.03							3.30
														0.04	0.05	0.06	0.09	0.09	0.10	0.13	0.18	0.16	0.17	0.17	0.13	0.12	0.11	0.04	0.02	0.01				1.67
0.00	0.01	0.02	0.02	0.04	0.04	0.04	0.05	0.06	0.07	0.11	0.13	0.16	0.14	0.15	0.16	0.13	0.14	0.15	0.12	0.12	0.13	0.10	0.10	0.10	0.08	0.08	0.09	0.05	0.04	0.04	0.02	0.02	0.01	2.74
0.12	0.14	0.13	0.08	0.15	0.09	0.05	0.03	0.00																	0.02	0.05	0.08	0.08	0.09	0.12	0.08	0.08	0.10	1.71
0.04	0.05	0.04	0.02	0.03	0.01																				0.01	0.02	0.03	0.03	0.04	0.03	0.03	0.04	0.04	0.54
0.006	0.008	0.007	0.005	0.009	0.007	0.006	0.005	0.002	0.001															0.002	0.003	0.004	0.006	0.005	0.006	0.005	0.004	0.004	0.005	0.111
0.03	0.03	0.04	0.03	0.05	0.04	0.02																			0.02	0.03	0.05	0.05	0.03	0.04	0.02	0.03	0.03	0.60
0.196	0.238	0.237	0.155	0.279	0.187	0.116	0.085	0.062	0.071	0.11	0.13	0.16	0.14	0.37	0.45	0.48	0.62	0.72	0.77	0.99	1.32	1.14	1.17	1.162	0.923	0.874	0.856	0.455	0.366	0.325	0.174	0.174	0.185	16.081
0.75	1.00	1.00	0.81	1.17	0.79	0.44	0.36	0.26	0.30	0.46	0.55	0.61	0.59	1.55	1.89	2.02	2.60	2.75	3.23	4.16	5.04	4.79	4.92	4.88	3.88	3.67	3.27	1.91	1.54	1.37	0.73	0.73	0.71	
0.94	1.25	1.25	1.01	1.46	0.99	0.55	0.45	0.33	0.38	0.58	0.69	0.76	0.74	1.93	2.36	2.53	3.25	3.44	4.04	5.20	6.30	5.99	6.15	6.10	4.85	4.59	4.09	2.39	1.93	1.71	0.91	0.91	0.89	
0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	
1.00	1.31	1.31	1.07	1.52	1.05	0.61	0.51	0.39	0.44	0.64	0.75	0.72	0.80	1.99	2.42	2.59	3.31	3.50	4.10	5.26	6.36	6.05	6.21	6.16	4.91	4.65	4.15	2.45	1.99	1.77	0.97	0.97	0.95	
1.18	1.54	1.54	1.25	1.79	1.24	0.72	0.60	0.46	0.52	0.75	0.88	0.85	0.94	2.34	2.85	3.05	3.89	4.12	4.82	6.19	7.48	7.12	7.31	7.25	5.78	5.47	4.88	2.88	2.34	2.08	1.14	1.14	1.12	
1.31	1.71	1.71	1.40	1.99	1.37	0.80	0.67	0.51	0.58	0.84	0.98	0.94	1.05	2.60	3.16	3.39	4.33	4.58	5.36	6.88	8.31	7.91	8.12	8.05	6.42	6.08	5.42	3.20	2.60	2.31	1.27	1.27	1.24	
1.71	2.24	2.24	1.83	2.60	1.79	1.04	0.87	0.67	0.75	1.09	1.28	1.23	1.37	3.40	4.14	4.43	5.66	5.98	7.01	8.99	10.87	10.34	10.61	10.53	8.39	7.95	7.09	4.19	3.40	3.02	1.66	1.66	1.62	
,047	1,371	1,371	1,120	1,591	1,095	636	532	410	459	667	783	753	838	2,081	2,533	2,711	3,464	3,660	4,290	5,502	6,652	6,328	6,493	6,444	5,135	4,865	4,339	2,564	2,081	1,848	1,016	1,016	991	
0.023	0.027	0.027	0.018	0.032	0.022	0.014	0.011	0.008	0.009	0.013	0.016	0.016	0.017	0.042	0.050	0.054	0.069	0.080	0.085	0.109	0.145	0.126	0.129	0.128	0.102	0.096	0.095	0.051	0.041	0.037	0.020	0.020	0.022	1.800

II-4. Proposed Facilities

Proposed facilities for the Staged Development Plan are involved widening of Desert-Pat Feeder Canal and Pat Feeder Canal, construction/rehabilitation of distributaries, construction of minor canals, construction of related structures, construction/rehabilitation of roads and bridges except works on pavement of roads and construction of on-farm facilities.

Design of these proposed facilities is same with that of Case-4 discussed in the Chapter IV of the Main Report and Appendix.

Irrigation System Diagram for the Staged Development Plan is shown in Fig.-1 which has same dimension with the alternative Case-4 plan.

II-5. Project Cost

The total investment cost of the Staged Development Plan including the price escalation during the implementation period is estimated at Rupees 1,389 million (US$ 126.27 million) while the total investment cost including the interest at 8% during construction but excluding the price escalation is estimated at Rupees 1,148.3 million (US$ 104.39 million) as shown in Table-3.

Fig. - 1
IRRIGATION SYSTEM DIAGRAM

STAGED DEVELOPMENT PLAN (6,700 cusec)

REGEND

DY: DISTRIBUTARY
A: CULTIVABLE COMMANDED AREA (ACR
Q: DISCHARGE (CUSEC) (ACRE)

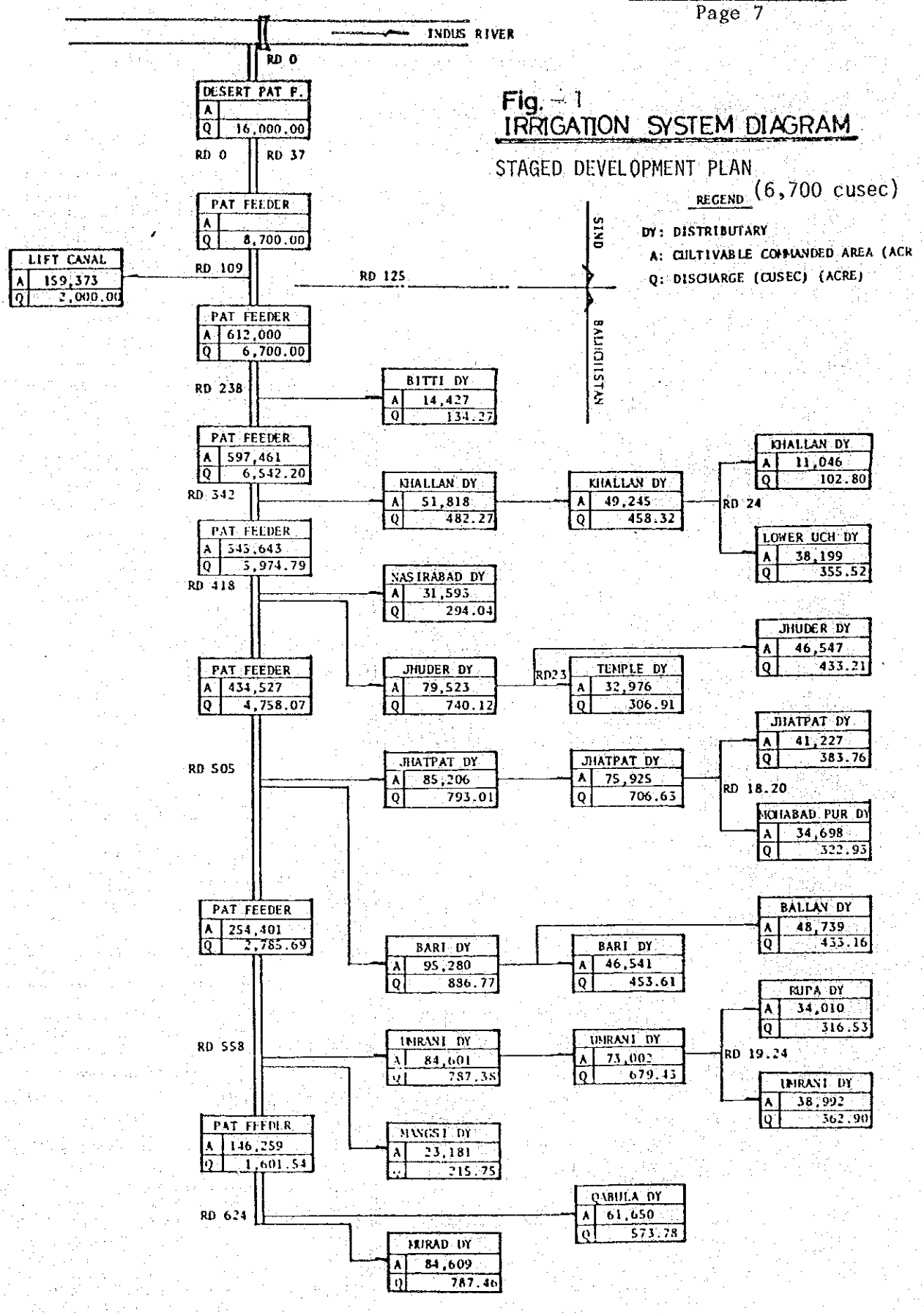


TABLE - 3 INVESTMENT COST OF THE PROJECT

(Unit : Rs.'000)

Description	Staged Development Plan			Case-2 and Case-4 Plan		
	Total	Foreign Currency	Local Currency	Total	Foreign Currency	Local Currency
A. Pilot Project						
1. Construction of Facilities				53,213	10,945	42,268
2. Land Acquisition & Compensation				1,700	-	1,700
3. Agricultural Development				19,936	8,786	11,150
4. Consulting Services				10,450	8,470	1,980
Sub-total (1 to 4)				85,299	28,201	57,098
5. Contingency				12,701	3,799	8,902
Sub-total (1 to 5)				98,000	32,000	66,000
6. Price Escalation				15,000	3,000	12,000
Total (1 to 6)	0	0	0	113,000	35,000	78,000
7. Interest during Construction at 8%				10,000		
Total (1 to 5 and 7)	0			108,000		
B. Stage-I Implementation						
1. Civil Works	222,576	90,496	132,080	245,207	96,391	148,816
Desert Pat Feeder Canal	45,389	27,883	17,506	45,389	27,883	17,506
Pat Feeder Canal	159,529	56,105	103,424	159,529	56,105	103,424
Distributaries	3,855	1,915	1,940	3,855	1,915	1,940
Minor Canals	8,803	4,593	4,210	8,803	4,593	4,210
Road	-	-	-	22,631	5,895	16,736
Pre-Engineering	5,000	-	5,000	5,000	-	5,000
2. Land Acquisition & Compensation	1,326	-	1,326	1,326	-	1,326
3. Construction Equipment	149,714	134,742	14,972	149,714	134,742	14,972
4. Agricultural Development	-	-	-	4,562	2,533	2,029
5. Operation & Maintenance	4,167	2,944	1,223	4,167	2,944	1,223
6. Project Facilities	3,298	750	2,548	6,308	750	5,558
7. Project Administration	12,770	-	12,770	14,512	-	14,512
8. Consulting Services	44,880	37,400	7,480	44,880	37,400	7,480
Sub-total (1 to 8)	438,731	266,332	172,399	470,676	274,760	195,916
9. Contingency	57,969	33,068	24,901	62,324	34,240	28,084
Sub-total (1 to 9)	496,700	299,400	197,300	533,000	309,000	224,000
10. Price Escalation	169,300	81,600	87,700	187,000	86,000	101,000
Total (1 to 10)	666,000	381,000	285,000	720,000	395,000	325,000
11. Interest during Construction at 8%	99,800			109,000		
Total (1 to 9 and 11)	596,500			642,000		
C. Stage-II Implementation						
1. Civil Works	313,535	159,587	153,948	438,611	176,026	262,585
Desert Pat Feeder	-	-	-	-	-	-
Pat Feeder Canal	131,754	69,723	62,031	131,754	69,723	62,031
Distributaries	98,780	52,815	45 965	98,780	52,815	45,965
Minor Canals	71,001	37,049	33,952	71,001	37,049	33,952
Road	-	-	-	125,076	16,439	108,637
Pre-Engineering	12,000	-	12 000	12,000	-	12,000
2. Land Acquisition & Compensation	10,884	-	10,884	10,884	-	10,884
3. Construction Equipment	-	-	-	-	-	-
4. Agricultural Development	-	-	-	16,418	-	16,418
5. Operation & Maintenance	9,892	-	9,892	9,892	-	9,892
6. Project Facilities	8,884	-	8,884	29,404	-	29,404
7. Project Administration	15,010	-	15,010	24,055	-	24,055
8. Consulting Services	23 870	19,800	4,070	23,870	19,800	4,070
Sub-total (1 to 8)	382,075	179,387	202,688	553,134	195,826	357,308
9. Contingency	57,025	26,813	30,212	82,866	29,174	53,692
Sub-total (1 to 9)	439,100	206,200	232,900	636,000	225,000	411,000
10. Price Escalation	283,900	114,800	169,100	423,000	126,000	297,000
Total (1 to 10)	723,000	321,000	402,000	1,059,000	351,000	708,000
11. Interest during Construction at 8%	112,700			160,000		
Total (1 to 9 and 11)	551,800			796,000		
Grand Total (A + B + C)	1,389,000	702,000	687,000	1,892,000	781,000	1,111,000
Implementation Cost	820,806	445,719	375,087	1,109,109	498,787	610,322
Contingency	114,994	59,881	55,113	157,891	67,213	90,678
Price Escalation	453,200	196,400	256,800	625,000	215,000	410,000
Grand Total including Interest	1,148,300			1,546,000		
Implementation Cost & Contingency	935,800			1,267,000		
Interest during Construction	212,500			279,000		

Table -4 Annual Phasing of Expenditures and Interest for Staged Development Plan

(Unit: Million Rs.)

Description	Period	Capital Cost	Interest at 3% ann.	Interest at 8% ann.
B. Stage - I Impl.				
	1st Year	28.600	0.429	1.144
	2nd Year	221.000	10.166	27.183
	3rd Year	101.500	7.816	21.620
	4th Year	100.600	10.965	31.186
	5th Year	44.700	6.392	18.506
	6th Year	0.300	0.053	0.158
Sub-total		496.700	35.821	99.797
Say			35.900	99.800
C. Stage - II Impl.				
	1st Year	12.500	0.188	0.500
	2nd Year	75.400	3.468	9.274
	3rd Year	140.400	10.811	29.905
	4th Year	141.800	15.456	43.958
	5th Year	65.000	9.295	26.910
	6th Year	4.000	0.708	2.108
Sub-total		439.100	39.926	112.655
Say			40.000	112.700
Total			75.900	212.500

III. PROJECT IMPLEMENTATION

The contract-basis implementation is recommended for the Project works involving voluminous excavation of those canals of the Desert-Pat Feeder, the Pat Feeder, distributaries and minor canals and the work should be under supervision of the Government agency concerned with assistance of consultants as discussed for Case-3 and Case-4 in the Main Report.

Executing agency and construction method are same with the Cases-3 and -4 stated also in the Report. Implementation of the Project will take two stages, Stage-I and Stage-II. The construction period of three years each for Stage-I and Stage-II starting from September 1985 and September 1987, respectively, has been contemplated, and the detailed design and tendering for construction of civil works and procurement of construction equipment would be executed one after another so as to be completed before September 1985 as shown in Fig.-2.

For the successful project execution, a due consideration shall be paid to the following points:

i) The Feasibility Study on the Project will be completed by the end of 1982 so that the financial arrangements for the Project implementation can be made within 1983.

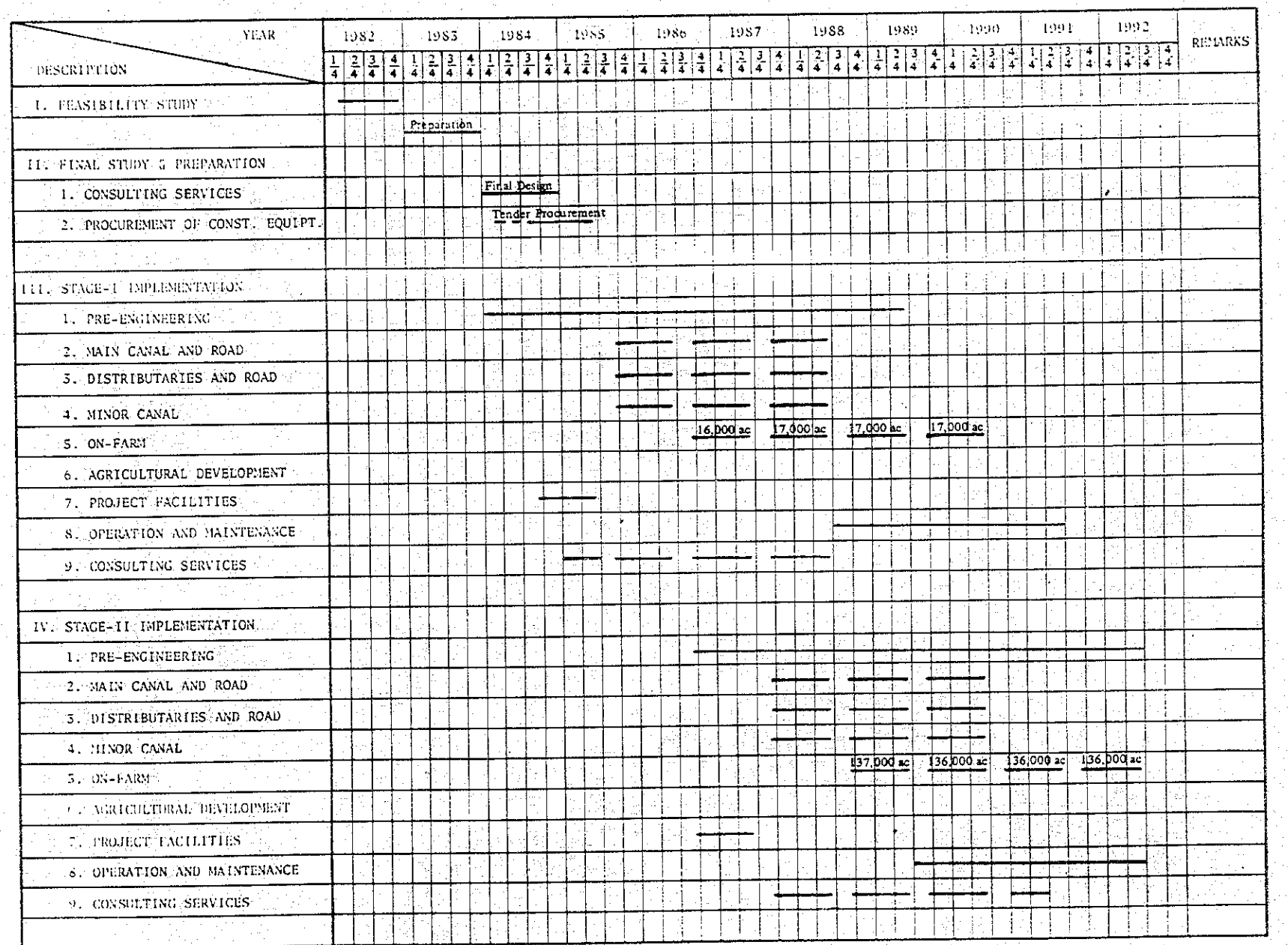
ii) The final design for the Project, including construction survey and preparation of tender documents for the construction works will be finished in one year of 1984, and such pre-engineering works shall be made early in this period as preparation of tender documents and tendering and contracting of procurements of construction equipment and materials.

iii) The construction works are scheduled to be staged into two. The Stage-I construction is programmed to be commenced in the middle of 1985, and will take three years up to the middle of 1988

while the Stage-II construction, in the middle of 1987, taking three years for completion in the middle of 1990.

iv) On-farm development will be undertaken by farmers themselves under the engineering assistance of the Project. The said on-farm development is scheduled to be made in four years from one year after the completion of the related distributaries and minor canals.

Fig.-2. IMPLEMENTATION SCHEDULE FOR STAGED DEVELOPMENT PLAN



IV. PROJECT JUSTIFICATION

The Project aims, among others, to improve the farm economy in the Project Area so as to contribute to Pakistan's national economy as a whole. At the farm economic level, the improvement of the farm economy could be attained through the stabilization and increase in farm production supported by more expanded farm land and intensive farming than those at present. It involves also an increase in cash income for the upgrading of farmers' living standard. At the national level, it should comply with the requirements in the national policies such as the stable supply of agricultural products, saving and increase in foreign exchange earnings by self-sufficiency and export of agricultural products, creation of employment opportunities and correcting the existing income disparity among industries as well as regions.

The Project benefits are to be generated through an increased crop production in the cultivable area of 612,000 acres. The Project benefits of the agricultural development would be created by the integrated agricultural development, however, the Staged Development Plan of the Project aims to cover engineering works separated from the agricultural development. By execution of the engineering works alone, the development of the area will be taken a long period from the completion of the Project up to reach the targeted full development.

For reference, the internal economic rate of return (IERR) are applied to the evaluation of the Project from the standpoints of the national economy.

In the economic evaluation, an incremental crop production are calculated as the direct benefits of the Project by applying the same method with the economic evaluation on alternative studies discussed in the Report.

On the other hand, the construction cost of the Project is estimated as the economic cost that certain construction cost of Desert-Pat Feeder Canal and Pat Feeder Canal is allocated to the Phase-II Project (Pump Irrigated Project located at the left bank of the Pat Feeder Canal) and

financial cost is converted to the economic cost. The construction cost for economic evaluation is included the cost of on-farm development which will be made by the farmers themselves.

Economic value of construction cost for the Staged Development Plan is estimated as shown in Table-5 and disbursement schedule is provided based on the construction cost estimate and implementation schedule as shown in Table-6.

The economic feasibility of the Project programmed by the Staged Development Plan is examined by employing the IERR method in discounting two series of benefits and costs. The benefits of the agricultural production is evaluated that 30 years after the completion of the Project to realize full colonization of the Project Area and to attain the target yields in the entire Project Area.

As a result, IERR in the Staged Development Plan is computed at 6.8 percent as shown in Table-7. As a sensitivity analysis, IERR in case of the Project cost overrun by 20 percent is analyzed at 6.0 percent.

Table-5 Economic Value of Construction Cost for Staged Development Plan

(Unit: Rs.'000)

Item	Financial Value (Basic)	Financial Value for Project Capital Cost Evaluation	Phase I Project	
			Financial 1/	Economic
1. Civil Works				
a. Main Canal	336,672	336,672	296,508	274,212
b. Others	199,439	199,439	199,439	185,010
2. Land Aquisition	12,210	12,210	12,210	-
3. Construction Equipment	149,714	149,714	149,714	147,618
4. Agricultural Development	-	-	-	-
5. Project Facilities	12,182	12,182	12,182	10,582
6. Operation & Maintenance	14,059	-	-	-
7. Project Administration	27,780	27,780	27,780	23,891
8. Consulting Services	68,750	68,750	68,750	67,133
9. On-farm Development & Drainage	-	313,344	313,344	269,476
10. Contingency	114,994	114,994	109,970	101,752
Total	935,800	1,235,085	1,188,897	1,079,674

Note: 1/ Widening of Desert-Pat Feeder Canal is considered by a capacity of flow for Phase-1 (Gravity Irrigation) and Phase-2 (Pump Lift cum Gravity Irrigation) so that construction cost of Main Canal is included the cost of both phases.
For economic evaluation, the financial cost of Phase-1 Project of Rupees 296.508 million is estimated by allocating cost of Phase-2 from the total financial value of Rupees 336.672 million.

Table - 6 Disbursement Schedule (Staged Development Plan)

Description	Total			1984			1985		
	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total
B. Stage - I Implementation									
1. Civil Works	90,496	132,080	222,576	-	1,250	1,250	13,575	20,313	33,888
Main Canal	83,988	120,930	204,918				12,598	18,140	30,738
Distributaries	1,915	1,940	3,855				288	291	579
Minor Canals	4,593	4,210	8,803				689	632	1,321
Road	-	-	-						
Pre-Engineering	-	5,000	5,000	-	1,250	1,250	-	1,250	1,250
2. Land Acquisition & Compensation	-	1,326	1,326				-	1,326	1,326
3. Construction Equipment	134,742	14,972	149,714				134,742	14,972	149,714
4. Agricultural Development	-	-	-						
5. Operation & Maintenance	2,944	1,223	4,167				2,944	201	3,145
6. Project Facilities	750	2,548	3,298	750	2,548	3,298			
7. Project Administration	-	12,770	12,770	-	570	570	-	3,050	3,050
8. Consulting Services									
Final Design	16,500	3,300	19,800	16,500	3,300	19,800			
Supervision	20,900	4,180	25,080			-	6,270	1,338	7,608
Sub-total (1 to 8)	266,332	172,399	438,731	17,250	7,668	24,918	157,531	41,200	198,731
9. Contingency	33,068	24,901	57,969	2,550	1,132	3,682	16,869	5,400	22,269
Sub-total (1 to 9)	299,400	197,300	496,700	19,800	8,800	28,600	174,400	46,600	221,000
10. Price Escalation	81,600	87,700	169,300	2,800	1,600	4,400	39,200	13,700	52,900
Total	381,000	285,000	666,000	22,600	10,400	33,000	213,600	60,300	273,900

1986			1987			1988			1989		
F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total
31,674	45,727	77,401	31,674	44,977	76,651	13,573	19,563	33,136	-	250	250
29,396	42,325	71,721	29,396	42,325	71,721	12,598	18,140	30,738			
670	679	1,349	670	679	1,349	287	291	578			-
1,608	1,473	3,081	1,608	1,473	3,081	688	632	1,320			
-	1,250	1,250	-	500	500	-	500	500	-	250	250
-	410	410	-	410	410	-	202	202			
-	3,780	3,780	-	3,720	3,720	-	1,630	1,630	-	20	20
5,643	1,086	6,729	5,643	1,086	6,729	3,344	670	4,014			
37,317	51,003	88,320	37,317	50,193	87,510	16,917	22,065	38,982	-	270	270
5,583	7,597	13,180	5,583	7,507	13,090	2,483	3,235	5,718	-	30	30
42,900	58,600	101,500	42,900	57,700	100,600	19,400	25,300	44,700	-	300	300
13,300	24,100	37,400	16,600	31,000	47,600	9,700	17,100	26,800	-	200	200
56,200	82,700	138,900	59,500	88,700	148,200	29,100	42,400	71,500	-	500	500

Description	Total			1986			1987		
	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total
C. Stage - II Implementation									
1. Civil Works	159,587	153,948	313,535	-	1,200	1,200	23,937	23,693	47,630
Main Canal	69,723	62,031	131,754				10,458	9,305	19,763
Distributaries	52,815	45,965	98,780				7,922	6,895	14,817
Minor Canals	37,049	33,952	71,001				5,557	5,093	10,650
Road	-	-	-						
Pre-Engineering	-	12,000	12,000	-	1,200	1,200	-	2,400	2,400
2. Land Acquisition & Compensation	-	10,884	10,884				-	10,884	10,884
3. Construction Equipment	-	-	-						
4. Agricultural Development	-	-	-						
5. Operation & Maintenance	-	9,892	9,892				-	1,646	1,646
6. Project Facilities	-	8,884	8,884	-	8,884	8,884			
7. Project Administration	-	15,010	15,010	-	800	800	-	2,940	2,940
8. Consulting Services	19,800	4,070	23,870				1,980	488	2,468
Sub-total (1 to 8)	179,387	202,688	382,075	-	10,884	10,884	25,917	39,651	65,568
9. Contingency	26,813	30,212	57,025	-	1,616	1,616	3,883	5,949	9,832
Sub-total (1 to 9)	206,200	232,900	439,100	-	12,500	12,500	29,800	45,600	75,400
10. Price Escalation	114,800	169,100	283,900	-	5,100	5,100	12,000	24,500	36,500
Total	321,000	402,000	723,000	-	17,600	17,600	41,800	70,100	111,900

1988			1989			1990			1991		
F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total
55,855	52,082	107,937	55,855	52,082	107,937	23,940	23,091	47,031	-	1,800	1,800
24,403	21,711	46,114	24,403	21,711	46,114	10,459	9,304	19,763			
18,485	16,088	34,573	18,485	16,088	34,573	7,923	6,894	14,817			
12,967	11,883	24,850	12,967	11,883	24,850	5,558	5,093	10,651			
-	2,400	2,400	-	2,400	2,400	-	1,800	1,800	-	1,800	1,800
-	3,300	3,300	-	3,300	3,300	-	1,646	1,646			
-	4,530	4,530	-	4,530	4,530	-	2,050	2,050	-	160	160
5,148	1,262	6,410	6,336	1,262	7,598	4,950	895	5,845	1,386	163	1,549
61,003	61,174	122,177	62,191	61,174	123,365	28,890	27,682	56,572	1,386	2,123	3,509
9,097	9,126	18,223	9,309	9,126	18,435	4,310	4,118	8,428	214	277	491
70,100	70,300	140,400	71,500	70,300	141,800	33,200	31,800	65,000	1,600	2,400	4,000
35,100	47,500	82,600	42,600	57,600	100,200	23,800	31,500	55,300	1,300	2,900	4,200
105,200	117,800	223,000	114,100	127,900	242,000	57,000	63,300	120,300	2,900	5,300	8,200

TABLE-7 PROJECT ECONOMIC COST AND RETURN
STAGED DEVELOPMENT PLAN

(UNIT : MILLION RUPEES)

YEAR	PROJECT COST			INCREMENTAL BENEFITS (2)	PROJECT RETURN (3) =(2)-(1)	PRESENT WORTH VALUE (3)*DISCOUNT RATE	
	CAPITAL	O & M	TOTAL (1)			(6 %)	(7 %)
1 1983	0.0	-1.59	-1.59	0.0	1.59	1.50	1.49
2 1984	27.11	-1.75	25.36	0.0	-25.36	-22.57	-22.15
3 1985	205.33	7.18	212.51	0.0	-212.51	-178.43	-173.47
4 1986	99.65	1.44	101.09	0.0	-101.09	-80.07	-77.12
5 1987	147.71	5.98	153.69	0.0	-153.69	-114.85	-109.58
6 1988	196.22	6.86	203.08	0.0	-203.08	-143.16	-135.32
7 1989	190.07	6.29	196.36	0.0	-196.36	-130.59	-122.28
8 1990	120.04	1.75	121.79	0.0	-121.79	-76.41	-70.88
9 1991	64.27	3.38	67.65	0.0	-67.65	-40.04	-36.80
10 1992	29.27	9.68	38.95	8.51	-30.44	-17.00	-15.47
11 1993	0.0	3.38	3.38	17.03	13.65	7.19	6.49
12 1994	0.0	3.38	3.38	25.54	22.16	11.01	9.84
13 1995	0.0	3.38	3.38	34.06	30.68	14.38	12.73
14 1996	0.0	3.38	3.38	42.57	39.19	17.33	15.20
15 1997	0.0	3.38	3.38	51.08	47.70	19.90	17.29
16 1998	0.0	3.38	3.38	59.60	56.22	22.13	19.04
17 1999	0.0	9.68	9.68	68.11	58.43	21.70	18.50
18 2000	0.0	3.38	3.38	76.63	73.25	25.66	21.67
19 2001	0.0	3.38	3.38	85.14	81.76	27.02	22.61
20 2002	0.0	3.38	3.38	93.66	90.28	28.15	23.33
21 2003	0.0	3.38	3.38	102.17	98.79	29.06	23.86
22 2004	0.0	3.38	3.38	110.68	107.30	29.78	24.22
23 2005	0.0	3.38	3.38	119.20	115.82	30.32	24.43
24 2006	0.0	9.68	9.68	127.71	118.03	29.15	23.27
25 2007	0.0	3.38	3.38	136.23	132.85	30.95	24.48
26 2008	0.0	3.38	3.38	144.74	141.36	31.07	24.34
27 2009	0.0	3.38	3.38	153.25	149.87	31.08	24.12
28 2010	0.0	3.38	3.38	161.77	158.39	30.99	23.82
29 2011	0.0	3.38	3.38	170.28	166.90	30.80	23.46
30 2012	0.0	3.38	3.38	178.80	175.42	30.54	23.04
31 2013	0.0	9.68	9.68	187.31	177.63	29.18	21.81
32 2014	0.0	3.38	3.38	195.83	192.45	29.82	22.08
33 2015	0.0	3.38	3.38	204.34	200.96	29.38	21.55
34 2016	0.0	3.38	3.38	212.85	209.47	28.89	20.99
35 2017	0.0	3.38	3.38	221.37	217.99	28.36	20.42
36 2018	0.0	3.38	3.38	229.88	226.50	27.80	19.83
37 2019	0.0	3.38	3.38	238.40	235.02	27.21	19.23
38 2020	0.0	9.68	9.68	246.91	237.23	25.92	18.14
39 2021	0.0	3.38	3.38	255.42	252.04	25.98	18.01
40 2022	0.0	3.38	3.38	255.42	252.04	24.50	16.83
41 2023	0.0	3.38	3.38	255.42	252.04	23.12	15.73
42 2024	0.0	3.38	3.38	255.42	252.04	21.81	14.70
43 2025	0.0	3.38	3.38	255.42	252.04	20.57	13.74
44 2026	0.0	3.38	3.38	255.42	252.04	19.41	12.84
45 2027	0.0	9.68	9.68	255.42	245.74	17.85	11.70
46 2028	0.0	3.38	3.38	255.42	252.04	17.28	11.22
47 2029	0.0	3.38	3.38	255.42	252.04	16.30	10.48
48 2030	0.0	3.38	3.38	255.42	252.04	15.37	9.80
49 2031	0.0	3.38	3.38	255.42	252.04	14.50	9.16
50 2032	0.0	3.38	3.38	255.42	252.04	13.68	8.56
TOTAL	1079.67	205.92	1285.59	6768.69	5483.10	153.56	-39.04

I E R R = 0.06 +153.56 / (153.56 + 39.04) * 0.01 = 0.0680

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