

表.11 事業実施による純収入増加額

Unit : Rs ,000

Crops	Without Project			With Project			Incremental Value
	Gross Income	Total Cost	Net Income	Gross Income	Total Cost	Net Income	
A. Fodder Crops							
Lucerne	584	379	205	1,092	554	538	333
Maize, others	305	229	76	576	360	216	140
Sub-total	<u>889</u>	<u>608</u>	<u>281</u>	<u>1,668</u>	<u>914</u>	<u>755</u>	<u>473</u>
B. Vegetables							
Tomato	4,567	2,988	1,579	24,220	9,440	14,780	13,201
Eggplant	1,681	903	778	11,025	4,517	6,509	5,730
Chilli	153	115	38	6,703	2,996	3,707	3,668
Sponge Gourd	1,642	841	800	36,410	6,770	29,640	28,840
Bottle Gourd	1,624	701	923	9,216	2,876	6,340	5,417
Cauliflower	4,070	684	3,386	14,688	2,604	12,084	8,698
Spinach	495	470	25	3,114	1,844	1,271	1,246
Carrot	1,011	699	312	3,432	1,749	1,683	1,371
Radish	546	434	112	3,803	1,321	2,481	2,369
Turnip	733	320	413	4,995	1,343	3,652	3,239
Peas	765	460	305	3,680	1,505	2,175	1,870
Others	2,208	1,069	1,139	18,147	6,093	12,054	10,915
Sub-total	<u>19,495</u>	<u>9,685</u>	<u>9,810</u>	<u>139,432</u>	<u>43,057</u>	<u>96,375</u>	<u>86,564</u>
C. Fruit							
Guava	6,522	1,960	4,561	9,853	2,348	7,505	2,944
Mango	3,013	1,460	1,554	5,551	1,764	3,787	2,234
Chikoo	558	322	236	728	366	362	126
Coconut	1,176	374	802	1,740	444	1,297	495
Papaya	540	261	279	629	324	306	27
Others	1,460	541	919	2,287	648	1,638	720
Sub-total	<u>13,269</u>	<u>4,918</u>	<u>8,351</u>	<u>20,788</u>	<u>5,893</u>	<u>14,894</u>	<u>6,544</u>
Total	33,653	15,211	18,442	161,888	49,864	112,024	93,581

Remarks : Refer to ANNEX-F.

表. 12 灌溉用水量概要

Item	Unit:MCM	
	Irrigation Water Demand	
	WAPDA Report*1	JICA Estimate*2 (1929 - 1988)
1	WAPDA Report (1982) (Without Project Condition)	
-	Condition in 1977	62.0
-	Projection in 1987	-
-	Projection in 2002	-
2	Present Cropping Pattern in 1987/88	-
3	Pumped Volume in 1987/88 Estimated based on KESC's Data	-

Remarks: *1 Pan evaporation data (1960-1966) were used in estimating irrigation demand.

*2 Only field application efficiency of 60% is considered, since irrigation area is limited to only 5-20 ha.

*3 Shows average irrigation water demand (1929 - 1988).

Refer to ANNEX-G.

表.13 計画作付体系に基づく灌漑用水量 (1/3)

Summary of Crop and Basic Assumption

No.	C r o p	Application Efficiency	Percolation Loss Code	Land preparation Code	Pre-irrigation Code	Growing Stages
1	1 Crucifers	0.60	0	0	1	6
2	2 Cucumber	0.60	0	0	1	8
3	3 Tomatoes	0.60	0	0	1	9
4	4 Melon	0.60	0	0	1	8
5	5 Raddish	0.60	0	0	1	6
6	6 Fodder (Maize)	0.60	0	0	1	6
7	7 Alphalfa	0.60	0	0	1	24
8	8 Chillies	0.60	0	0	1	9
9	9 Beans (green)	0.60	0	0	1	6
10	10 Orchard (Citrus) 70%	0.60	0	0	0	24
11	11 Orchard (citrus) 20%	0.60	0	0	0	24
12	12 Upland Crops	0.60	0	0	1	6

No.	C r o p	Crop Coefficient (by growing stage)											
1	1 Crucifers	0.42	0.50	0.70	0.95	0.95	0.85						
2	2 Cucumber	0.40	0.45	0.70	0.90	0.92	0.92	0.92	0.85				
3	3 Tomatoes	0.42	0.42	0.55	0.80	1.00	1.05	1.05	0.95	0.70			
4	4 Melon	0.38	0.40	0.60	0.90	0.98	0.98	0.98	0.90				
5	5 Raddish	0.45	0.55	0.80	1.05	1.05	0.75						
6	6 Fodder (Maize)	0.45	0.55	0.85	1.05	1.05	0.95						
7	7 Alphalfa	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
8	8 Chillies	0.65	0.75	0.85	0.95	1.00	1.00	1.00	0.95	0.90			
9	9 Beans (green)	0.45	0.52	0.75	0.95	0.95	0.90						
10	10 Orchard (Citrus) 70%	0.75	0.75	0.75	0.75	0.70	0.70	0.70	0.70	0.70	0.70	0.65	0.65
11	11 Orchard (citrus) 20%	0.55	0.55	0.55	0.55	0.50	0.50	0.50	0.50	0.50	0.50	0.45	0.45
12	12 Upland Crops	1.00	1.00	1.00	1.00	1.00	1.00						

Remarks: 1 growing stage = 15 days

Summary of crop and basic assumption in Malir Project (Proposed Cropping P., C.I=1.50)

No.	C r o p	Cultiva. Area(ha)	Date of Water Issue	Land Preparation Period (stages)
1	1 Crucifers	600.	7/ 1	6
3	3 Tomatoes	1500.	7/ 1	6
5	5 Raddish	500.	8/ 1	6
6	6 Fodder (Maize)	50.	8/ 1	4
7	7 Alphalfa	100.	7/ 1	12
9	9 Beans (green)	600.	8/ 1	6
10	10 Orchard (Citrus) 70%	1000.	7/ 1	12
2	2 Cucumber	1400.	1/ 1	8
3	3 Tomatoes	350.	1/ 1	8
6	6 Fodder (Maize)	50.	1/ 1	4
9	9 Beans (green)	350.	1/ 1	8
Total Project Area		4350.		

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Potential ET (mm)	110.0	125.0	192.0	224.0	253.0	233.0	193.0	176.0	179.0	166.0	123.0	101.0
Conveyance Efficiency	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Return Flow Factor	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15

Unit:mm

Code	1	2	3	4	5	6	7	8	9	10
Land Preparation	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
Percolation Losses	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
Pre-irrigation	50.	0.	0.	0.	0.	0.	0.	0.	0.	0.

表.13 計画作付体系に基づく灌漑用水量 (2/3)

Diversion Water Requirement for Malir Project (Proposed Cropping P., C.I=1.50)
(Total Area : 4350. ha)

Unit : MCM

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1929	3.29	3.24	5.87	8.15	9.00	7.23	4.49	5.83	7.85	8.89	5.22	3.44	72.50
1930	3.07	3.24	5.87	8.06	9.00	5.66	0.03	5.96	7.85	8.89	6.31	3.95	67.89
1931	3.29	3.13	5.71	8.15	9.00	7.23	5.71	5.96	7.85	8.89	6.31	3.95	75.17
1932	3.20	3.24	5.87	8.15	9.00	7.23	0.29	5.17	7.85	8.89	6.31	3.95	69.15
1933	3.29	3.21	5.87	8.10	8.79	7.23	0.01	3.84	6.55	8.89	6.31	3.95	66.06
1934	3.31	3.24	5.80	8.15	9.00	6.26	1.92	5.83	7.85	8.89	6.31	3.69	70.25
1935	2.97	2.64	5.87	7.02	9.00	7.23	5.63	5.86	7.85	8.89	6.31	3.95	73.23
1936	3.29	2.94	5.84	8.15	9.00	6.67	4.15	5.99	7.85	8.89	6.31	3.89	72.96
1937	3.31	2.74	5.87	8.15	9.00	7.23	1.16	5.99	7.85	8.89	6.31	2.23	68.74
1938	3.31	3.24	5.87	8.10	8.87	7.20	4.75	4.14	7.85	8.89	6.31	3.80	72.33
1939	3.31	2.22	4.27	8.06	9.00	7.23	5.82	5.99	7.85	8.89	6.12	3.95	72.72
1940	1.96	2.58	4.54	8.15	9.00	6.91	4.49	4.46	7.85	8.89	6.31	3.69	68.83
1941	3.26	3.24	5.87	8.15	9.00	7.23	4.68	5.99	7.85	8.89	6.31	3.95	74.43
1942	2.99	2.68	5.74	8.15	9.00	7.23	0.63	5.45	7.85	8.89	6.31	3.66	68.59
1943	2.93	3.24	5.87	8.15	9.00	7.13	4.56	5.93	7.85	8.89	6.31	3.95	73.80
1944	3.20	2.30	5.87	8.15	9.00	7.23	0.33	0.07	7.85	8.89	6.31	3.92	63.11
1945	2.28	3.24	5.87	8.15	9.00	7.23	3.24	5.93	7.71	8.89	6.31	3.89	71.74
1946	3.31	3.24	5.87	8.15	9.00	7.16	4.44	4.81	7.85	8.89	6.31	3.95	72.98
1947	3.31	3.21	5.87	8.15	9.00	7.23	5.82	4.65	7.75	8.89	6.31	3.74	73.95
1948	3.31	2.70	4.99	8.15	9.00	6.00	4.92	5.99	7.85	8.89	6.31	3.74	71.85
1949	3.31	3.24	5.87	8.15	9.00	7.23	2.51	1.14	7.85	8.89	6.31	3.95	67.45
1950	3.07	3.24	5.87	8.15	9.00	7.23	4.01	5.99	7.85	8.89	6.31	3.95	73.57
1951	3.31	3.24	5.87	8.06	9.00	7.23	4.82	5.03	7.80	8.89	6.31	3.95	73.52
1952	3.31	2.53	5.87	8.15	9.00	7.23	2.01	5.99	6.86	8.89	6.31	3.86	70.02
1953	3.29	3.24	5.87	8.15	9.00	6.00	5.79	0.74	7.85	8.89	6.31	3.74	68.87
1954	2.93	2.62	5.87	8.15	9.00	7.23	4.44	5.00	2.24	8.89	6.31	3.95	66.64
1955	3.09	2.98	5.87	8.15	9.00	7.23	5.82	5.12	4.18	8.89	6.31	3.86	70.50
1956	2.87	3.24	5.87	7.98	9.00	5.94	2.08	3.53	7.85	4.29	6.31	3.95	62.90
1957	3.24	3.24	5.87	7.94	9.00	7.23	5.39	5.80	7.85	8.89	6.12	3.80	74.39
1958	3.18	3.19	5.87	8.15	9.00	7.23	2.67	5.99	6.55	8.89	6.26	2.56	69.55
1959	3.24	3.19	5.87	8.15	9.00	7.23	0.85	4.68	0.01	8.89	3.02	3.92	58.06
1960	3.26	3.24	4.93	8.15	9.00	7.23	4.73	5.17	7.85	8.89	6.31	3.33	72.10
1961	2.95	2.18	5.87	7.71	9.00	6.73	1.83	1.11	1.68	8.89	6.31	3.92	58.17
1962	3.31	3.24	5.87	8.15	9.00	7.23	3.82	4.78	2.31	8.89	6.31	3.77	66.70
1963	3.31	3.24	5.87	8.10	9.00	7.23	5.79	5.71	7.85	8.89	5.06	3.95	74.01
1964	3.26	3.13	5.87	8.15	9.00	7.16	3.92	4.59	7.71	8.89	6.31	3.95	71.95
1965	3.31	3.24	5.87	8.02	9.00	7.23	3.22	5.45	7.85	8.89	6.31	3.95	72.35
1966	3.31	3.24	5.84	8.15	9.00	7.23	4.13	5.99	7.85	8.89	6.31	3.95	73.89
1967	3.31	3.24	2.31	7.24	9.00	6.88	0.00	3.29	7.85	8.89	6.08	3.55	61.63
1968	3.07	3.15	5.87	8.15	9.00	7.23	5.82	5.83	7.85	8.89	6.31	3.77	74.95
1969	3.31	3.21	5.87	8.15	9.00	7.23	4.85	5.99	7.85	8.89	6.31	3.95	74.62
1970	3.16	3.08	4.11	8.15	9.00	7.06	2.21	1.81	4.54	8.89	6.31	3.95	62.28
1971	3.24	3.24	5.87	8.15	9.00	7.23	4.97	5.12	7.85	8.89	6.31	3.92	73.78
1972	3.31	3.17	5.87	8.15	9.00	6.61	5.39	5.99	7.85	8.89	6.31	3.83	74.37
1973	3.31	3.24	5.87	8.15	9.00	7.23	1.47	5.40	7.85	8.89	6.31	3.71	70.43
1974	3.31	3.24	5.87	8.15	9.00	7.23	5.82	5.99	7.85	8.89	6.31	3.80	75.47
1975	3.03	2.80	4.99	8.15	9.00	7.23	5.82	3.87	6.98	8.89	6.31	3.95	71.02
1976	2.00	3.02	4.99	8.15	9.00	7.23	1.04	4.95	6.10	8.89	6.31	3.95	65.63
1977	3.09	3.24	5.87	8.06	9.00	6.20	0.18	4.73	4.47	8.89	6.08	3.95	63.77
1978	3.01	3.15	5.87	8.15	9.00	7.03	1.58	1.30	7.85	8.89	6.31	3.95	66.09
1979	3.29	1.38	5.87	8.15	9.00	7.13	5.82	0.33	7.85	8.72	6.31	3.58	67.43
1980	3.31	3.24	5.56	8.15	9.00	5.94	4.68	5.99	7.85	7.73	6.04	2.28	69.77
1981	3.31	2.72	3.81	8.02	9.00	7.23	4.80	4.76	7.85	8.89	6.31	3.95	70.65
1982	3.26	2.74	5.87	8.15	9.00	7.23	5.12	3.11	7.85	8.89	6.31	3.92	71.45
1983	3.31	3.17	5.87	6.74	9.00	7.23	4.46	1.71	6.82	8.89	6.31	3.95	67.47
1984	3.31	3.24	5.87	8.15	9.00	7.23	5.32	0.40	7.67	8.89	6.31	3.95	69.34
1985	3.31	3.24	5.87	6.42	9.00	7.23	3.85	5.26	7.85	8.89	6.31	3.95	71.17
1986	3.31	3.24	5.53	8.15	9.00	6.70	5.82	4.24	7.85	8.89	6.31	3.95	72.99
1987	3.31	3.24	5.87	8.15	9.00	7.23	5.82	5.99	7.85	8.89	6.31	3.95	75.62
1988	3.29	3.24	5.87	8.15	9.00	7.23	3.99	3.63	7.85	8.89	6.31	3.95	71.40
Ave.	3.17	3.04	5.62	8.04	9.00	7.03	3.73	4.59	7.12	8.79	6.20	3.79	70.10

表.13 計画作付体系に基づく灌漑用水量 (3/3)

Deep Percolation of Malir Project (Proposed Cropping P., C.I=1.50)
(Total Area : 4350. ha)

Unit : MCM

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1929	0.49	0.49	0.88	1.22	1.35	1.08	0.67	0.88	1.18	1.33	0.78	0.52	10.87
1930	0.46	0.49	0.88	1.21	1.35	0.85	0.00	0.89	1.18	1.33	0.95	0.59	10.18
1931	0.49	0.47	0.86	1.22	1.35	1.08	0.86	0.89	1.18	1.33	0.95	0.59	11.28
1932	0.48	0.49	0.88	1.22	1.35	1.08	0.04	0.78	1.18	1.33	0.95	0.59	10.37
1933	0.49	0.48	0.88	1.22	1.32	1.08	0.00	0.58	0.98	1.33	0.95	0.59	9.91
1934	0.50	0.49	0.87	1.22	1.35	0.94	0.29	0.88	1.18	1.33	0.95	0.55	10.54
1935	0.45	0.40	0.88	1.05	1.35	1.08	0.84	0.88	1.18	1.33	0.95	0.59	10.98
1936	0.49	0.44	0.88	1.22	1.35	1.00	0.62	0.90	1.18	1.33	0.95	0.58	10.94
1937	0.50	0.41	0.88	1.22	1.35	1.08	0.17	0.90	1.18	1.33	0.95	0.33	10.31
1938	0.50	0.49	0.88	1.22	1.33	1.08	0.71	0.62	1.18	1.33	0.95	0.57	10.85
1939	0.50	0.33	0.64	1.21	1.35	1.08	0.87	0.90	1.18	1.33	0.92	0.59	10.91
1940	0.29	0.39	0.68	1.22	1.35	1.04	0.67	0.67	1.18	1.33	0.95	0.55	10.32
1941	0.49	0.49	0.88	1.22	1.35	1.08	0.70	0.90	1.18	1.33	0.95	0.59	11.16
1942	0.45	0.40	0.86	1.22	1.35	1.08	0.10	0.82	1.18	1.33	0.95	0.55	10.29
1943	0.44	0.49	0.88	1.22	1.35	1.07	0.68	0.89	1.18	1.33	0.95	0.59	11.07
1944	0.48	0.34	0.88	1.22	1.35	1.08	0.05	0.01	1.18	1.33	0.95	0.59	9.47
1945	0.34	0.49	0.88	1.22	1.35	1.08	0.49	0.89	1.16	1.33	0.95	0.58	10.76
1946	0.50	0.49	0.88	1.22	1.35	1.07	0.67	0.72	1.18	1.33	0.95	0.59	10.95
1947	0.50	0.48	0.88	1.22	1.35	1.08	0.87	0.70	1.16	1.33	0.95	0.56	11.09
1948	0.50	0.41	0.75	1.22	1.35	0.90	0.74	0.90	1.18	1.33	0.95	0.56	10.78
1949	0.50	0.49	0.88	1.22	1.35	1.08	0.38	0.17	1.18	1.33	0.95	0.59	10.12
1950	0.46	0.49	0.88	1.22	1.35	1.08	0.60	0.90	1.18	1.33	0.95	0.59	11.04
1951	0.50	0.49	0.88	1.21	1.35	1.08	0.72	0.75	1.17	1.33	0.95	0.59	11.03
1952	0.50	0.38	0.88	1.22	1.35	1.08	0.30	0.90	1.03	1.33	0.95	0.58	10.50
1953	0.49	0.49	0.88	1.22	1.35	0.90	0.87	0.11	1.18	1.33	0.95	0.56	10.33
1954	0.44	0.39	0.88	1.22	1.35	1.08	0.67	0.75	0.34	1.33	0.95	0.59	10.00
1955	0.46	0.45	0.88	1.22	1.35	1.08	0.87	0.77	0.63	1.33	0.95	0.58	10.58
1956	0.43	0.49	0.88	1.20	1.35	0.89	0.31	0.53	1.18	0.64	0.95	0.59	9.43
1957	0.49	0.49	0.88	1.19	1.35	1.08	0.81	0.87	1.18	1.33	0.92	0.57	11.16
1958	0.48	0.48	0.88	1.22	1.35	1.08	0.40	0.90	0.98	1.33	0.94	0.38	10.43
1959	0.49	0.48	0.88	1.22	1.35	1.08	0.13	0.70	0.00	1.33	0.45	0.59	8.71
1960	0.49	0.49	0.74	1.22	1.35	1.08	0.71	0.78	1.18	1.33	0.95	0.50	10.81
1961	0.44	0.33	0.88	1.16	1.35	1.01	0.27	0.17	0.25	1.33	0.95	0.59	8.73
1962	0.50	0.49	0.88	1.22	1.35	1.08	0.57	0.72	0.35	1.33	0.95	0.57	10.00
1963	0.50	0.49	0.88	1.22	1.35	1.08	0.87	0.86	1.18	1.33	0.76	0.59	11.10
1964	0.49	0.47	0.88	1.22	1.35	1.07	0.59	0.69	1.16	1.33	0.95	0.59	10.79
1965	0.50	0.49	0.88	1.20	1.35	1.08	0.48	0.82	1.18	1.33	0.95	0.59	10.85
1966	0.50	0.49	0.88	1.22	1.35	1.08	0.62	0.90	1.18	1.33	0.95	0.59	11.08
1967	0.50	0.49	0.35	1.09	1.35	1.03	0.00	0.49	1.18	1.33	0.91	0.53	9.24
1968	0.46	0.47	0.88	1.22	1.35	1.08	0.87	0.88	1.18	1.33	0.95	0.57	11.24
1969	0.50	0.48	0.88	1.22	1.35	1.08	0.73	0.90	1.18	1.33	0.95	0.59	11.19
1970	0.47	0.46	0.62	1.22	1.35	1.06	0.33	0.27	0.68	1.33	0.95	0.59	9.34
1971	0.49	0.49	0.88	1.22	1.35	1.08	0.75	0.77	1.18	1.33	0.95	0.59	11.07
1972	0.50	0.48	0.88	1.22	1.35	0.99	0.81	0.90	1.18	1.33	0.95	0.57	11.16
1973	0.50	0.49	0.88	1.22	1.35	1.08	0.22	0.81	1.18	1.33	0.95	0.56	10.56
1974	0.50	0.49	0.88	1.22	1.35	1.08	0.87	0.90	1.18	1.33	0.95	0.57	11.32
1975	0.45	0.42	0.75	1.22	1.35	1.08	0.87	0.58	1.05	1.33	0.95	0.59	10.65
1976	0.30	0.45	0.75	1.22	1.35	1.08	0.16	0.74	0.91	1.33	0.95	0.59	9.84
1977	0.46	0.49	0.88	1.21	1.35	0.93	0.03	0.71	0.67	1.33	0.91	0.59	9.57
1978	0.45	0.47	0.88	1.22	1.35	1.05	0.24	0.20	1.18	1.33	0.95	0.59	9.91
1979	0.49	0.21	0.88	1.22	1.35	1.07	0.87	0.05	1.18	1.31	0.95	0.54	10.11
1980	0.50	0.49	0.83	1.22	1.35	0.89	0.70	0.90	1.18	1.16	0.91	0.34	10.46
1981	0.50	0.41	0.57	1.20	1.35	1.08	0.72	0.71	1.18	1.33	0.95	0.59	10.60
1982	0.49	0.41	0.88	1.22	1.35	1.08	0.77	0.47	1.18	1.33	0.95	0.59	10.72
1983	0.50	0.48	0.88	1.01	1.35	1.08	0.67	0.26	1.02	1.33	0.95	0.59	10.12
1984	0.50	0.49	0.88	1.22	1.35	1.08	0.80	0.06	1.15	1.33	0.95	0.59	10.40
1985	0.50	0.49	0.88	0.96	1.35	1.08	0.58	0.79	1.18	1.33	0.95	0.59	10.68
1986	0.50	0.49	0.83	1.22	1.35	1.00	0.87	0.64	1.18	1.33	0.95	0.59	10.95
1987	0.50	0.49	0.88	1.22	1.35	1.08	0.87	0.90	1.18	1.33	0.95	0.59	11.34
1988	0.49	0.49	0.88	1.22	1.35	1.08	0.60	0.54	1.18	1.33	0.95	0.59	10.71
Ave.	0.47	0.46	0.84	1.21	1.35	1.05	0.56	0.69	1.07	1.32	0.93	0.57	10.52

表.14 モルダムの計画諸元

	Unit	Mol Dam
a) General		
Location		8.3 km upstream of Super Highway Bridge.
River		Mol tributary of Maril River
Type of dam		Rockfill (Zone type)
Purpose		Groundwater recharge (Irrigation + Domestic Water Supply)
b) Hydrology		
Catchment area	km ²	596
Mean annual rainfall	mm	231
Mean annual runoff	MCM	44.9
c) Reservoir		
Live storage	MCM	35.0
Flood control storage	MCM	0.0
Dead storage	MCM	10.7
Gross storage	MCM	45.7
Maximum reservoir area	km ²	5.5
d) Dam		
Type		Rockfill (Zone type)
Maximum height	m	48.8
Length of crest	m	2,347
Top width	m	10.0
Crest elevation of dam	EL. m	175.3
Nomal full water level	EL. m	169.6
Maximum water level	EL. m	173.0
Slope: Upstream		1 : 2.5
Downstream		1 : 2.0
Dam volume	10 ³ m ³	1,730
e) Spillway		
Type		Submerged weir (ungated)
Portable maximum flood	m ³ /sec	4,280
Design capacity	m ³ /sec	4,100
Surcharge for design flood	m	3.4
Crest elevation	EL. m	169.6
Energy dissipation		No Stilling Basin
f) Off-take Structure		
		2.4 m dia tunnel with control gate at outlet end and emergency control gate at inlet end with stilling basin on downstream end.
Outfall Channel		Channel into natural Nullah.
g) Irrigation System		
		Recharging aquifer by controlled releases from Mol Dam
h) Irrigation Area (Cropped area) ha		
		4,350 (6,500)
Domestic Water Supply	MCM	3.3

Refer to ANNEX-H

表. 15 事業費概要

Unit: Rs.10⁶

Item	Foreign Currency	Local Currency	Total
1. Direct Construction Cost			
1.1 Preparatory Works	27.0	5.9	32.9
1.2 Mol Dam	362.6	76.8	439.4
A. Main Dam	212.3	36.5	248.8
B. Saddle Dam	10.9	2.0	12.9
C. Spillway	51.8	16.7	68.5
D. Intake Facility	68.9	13.2	82.1
E. Diversion Works	9.9	3.5	13.4
F. Access Road	8.8	3.8	12.6
G. Land Acquisition	0.0	1.1	1.1
1.3 Causeway	2.4	3.8	6.2
1.4 Pilot Demonstration Farm	10.4	2.9	13.3
1.5 Project Office	0.4	0.8	1.2
Sub-total	402.8	90.2	493.0
2. Procurement of O & M Equipment	10.3	0.0	10.3
3. Physical Contingency	58.2	12.8	71.0
4. Administration Cost	0.0	6.7	6.7
5. Engineering Services	59.6	16.4	76.0
Sub-total	530.9	126.1	657.0
6. Price Contingency	0.0	28.6	28.6
Grand Total	530.9	154.7	685.6

表.16 事業費詳細

Work Item	Unit	Unit Rate (Rs.)		Qty	Amount (1000 Rs.)		Total
		F/C	L/C		F/C	L/C	
1. Direct Construction Cost							
1.1 Preparatory Works				7%	27,029	5,903	32,933
1.2 Mol Dam					362,656	76,840	439,496
A. Main Dam							
1) Excavation							
a) Common (Backhoe)	m3	39.0	6.5	38,100	1,486	248	1,734
b) Common (Bulldozer) (1)	m3	57.7	7.4	44,500	2,568	329	2,897
c) Common (Bulldozer) (2)	m3	57.7	7.4	44,400	2,562	329	2,890
d) W. Rock (1)	m3	88.7	10.8	36,900	3,273	399	3,672
e) W. Rock (2)	m3	40.1	4.8	86,000	3,449	413	3,861
f) Rock (1)	m3	129.2	24.5	15,800	2,041	387	2,428
g) Rock (2)	m3	76.1	26.9	36,800	2,800	990	3,790
2) Filling							
a) Zone 1 (Core)	m3	119.9	16.4	298,900	35,838	4,902	40,740
b) Zone 2 (Random) (1)	m3	63.7	9.1	154,300	9,829	1,404	11,233
c) Zone 2 (Random) (2)	m3	63.7	9.1	99,300	6,325	904	7,229
d) Zone 2 (Random) (3)	m3	87.4	11.7	312,400	27,304	3,655	30,959
e) Zone 3 (Rock) (1)	m3	81.9	10.0	81,100	6,642	811	7,453
f) Zone 3 (Rock) (2)	m3	81.9	10.0	162,000	13,268	1,620	14,888
g) Zone 3 (Rock) (3)	m3	136.4	23.5	323,800	44,166	7,609	51,776
h) Rock facing	m3	136.4	23.5	83,000	11,321	1,951	13,272
i) Filler	m3	168.5	21.1	181,100	30,515	3,821	34,337
3) Foundation Treatment							
a) Curtain Grouting	m	555.8	421.6	9,500	5,280	4,005	9,285
b) Blanket Grouting	m	555.8	421.6	6,600	3,668	2,783	6,451
Total (A)					212,336	36,558	248,895
B. Saddle Dam							
1) Excavation							
a) Common (Bulldozer) (1)	m3	57.7	7.4	5,200	300	38	339
b) Common (Bulldozer) (2)	m3	16.1	2.4	5,100	82	12	94
c) W. Rock (1)	m3	88.7	10.8	15,400	1,366	166	1,532
d) W. Rock (2)	m3	40.1	4.8	35,900	1,440	172	1,612
e) Rock (1)	m3	129.2	24.5	12,300	1,589	301	1,891
f) Rock (2)	m3	76.1	26.9	28,800	2,192	775	2,966
2) Filling							
a) Zone 1 (Core)	m3	119.9	16.4	24,800	2,974	407	3,380
b) Zone 3 (Rock)	m3	81.9	10.0	4,200	344	42	386
c) Rock Facing	m3	136.4	23.5	4,400	600	103	704
Total (B)					10,886	2,018	12,904
C. Spillway							
1) Excavation							
a) Common (1)	m3	57.7	7.4	35,600	2,054	263	2,318
b) Common (2)	m3	16.1	2.4	35,600	573	85	659
c) W. Rock (1)	m3	88.7	10.8	32,000	2,838	346	3,184
d) W. Rock (2)	m3	40.1	4.8	74,800	2,999	359	3,359
e) Rock (1)	m3	129.2	24.5	53,400	6,899	1,308	8,208
f) Rock (2)	m3	63.8	16.8	124,600	7,949	2,093	10,043
2) Concrete Works							
a) Concrete (210 kg/cm2)	m3	1435.1	503.7	1,400	2,009	705	2,714
b) Concrete (180 kg/cm2)	m3	1134.4	405.9	18,800	21,327	7,631	28,958
c) Reinforcement bar	ton	13003.4	9827.1	400	5,201	3,931	9,132
Total (C)					51,851	16,722	68,573
D. Intake Facilities							
1) Earth Works							
a) Common Excavation	m3	57.7	7.4	14,900	860	110	970
b) W. Rock	m3	88.7	10.8	124,100	11,008	1,340	12,348
c) Rock	m3	133.5	33.8	53,200	7,102	1,798	8,900
2) Concrete Works							
a) Concrete (210kg/cm2)	m3	1435.1	503.7	11,100	15,930	5,591	21,521
b) Reinforcement bar	ton	13003.4	9827.1	440	5,721	4,324	10,045
c) Steel pipe	ton	28600.0	0.0	100	2,860	0	2,860
d) High pressure gate	set			2	11,424	0	11,424
e) Gates	set			4	14,000	0	14,000
Total (D)					68,905	13,164	82,068
E. Diversion Works					9,900	3,540	13,440
F. Access Road					8,778	3,762	12,540
G. Land Acquisition					0	1,076	1,076
1.3 Causeway	Nos.	605,328	946,553	4	2,421	3,786	6,208
1.4 Pilot Demonstration Farm					10,393	2,869	13,262
1.5 Project Office					360	840	1,200
2. O & M Equipment		10,300	0		10,300	0	10,300
3. Physical Contingency					58,152	12,750	70,902
4. Administration Cost					0	6,700	6,700
5. Engineering Services					59,600	16,400	76,000
Total(1-5)					530,912	126,088	657,000

表.17 年次別事業費

Work Item	(Unit: Rs.10 ³)								
	Amount			1,991			1,992		
	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total
1. Preparatory Works	27,029	5,903	32,933	-	-	-	27,029	5,903	32,933
2. Mol Dam									
A. Main Dam	212,336	36,558	248,895	-	-	-	15,479	4,254	19,733
B. Saddle Dam	10,886	2,018	12,904	-	-	-	-	-	-
C. Spillway	51,851	16,722	68,573	-	-	-	16,320	3,119	19,438
D. Intake Facilities	68,905	13,164	82,068	-	-	-	26,103	4,665	30,768
E. Diversion Works	9,900	3,540	13,440	-	-	-	9,900	3,540	13,440
F. Access Road	8,778	3,762	12,540	-	-	-	8,778	3,762	12,540
G. Land Acquisition	0	1,076	1,076	0	538	538	0	538	538
Sub-total(2)	362,656	76,840	439,496	0	538	538	76,579	19,878	96,457
3. Causeway	2,421	3,786	6,208	-	-	-	-	-	-
4. Pilot Demonstration Farm	10,393	2,869	13,262	-	-	-	-	-	-
5. Project Office	360	840	1,200	-	-	-	360	840	1,200
6. O & M Equipment	10,300	0	10,300	-	-	-	-	-	-
Total (2-6)	386,131	84,335	470,465	0	538	538	76,939	20,718	97,657
7. Physical Contingency	58,152	12,750	70,902	0	81	81	11,564	3,118	14,682
Total (1 - 7)	471,311	102,989	574,300	0	619	619	115,533	29,739	145,272
8. Administration Cost	0	6,700	6,700	-	-	-	0	1,675	1,675
9. Engineering Services	59,600	16,400	76,000	10,575	3,600	14,175	14,900	4,100	19,000
Total (1 - 8)	530,912	126,088	657,000	10,575	4,219	14,794	130,433	35,514	165,947
10. Price Contingency	0	28,642	28,642	0	295	295	0	5,146	5,146
Grand Total	530,912	154,730	685,642	10,575	4,514	15,089	130,433	40,660	171,093

Work Item	1,993			1,994			1,995		
	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total
1. Preparatory Works	-	-	-	-	-	-	-	-	-
2. Mol Dam									
A. Main Dam	91,524	16,191	107,715	82,183	12,778	94,961	23,151	3,335	26,486
B. Saddle Dam	-	-	-	10,886	2,018	12,904	-	-	-
C. Spillway	24,830	9,003	33,833	10,701	4,600	15,302	-	-	-
D. Intake Facilities	42,801	8,499	51,300	-	-	-	-	-	-
E. Diversion Works	-	-	-	-	-	-	-	-	-
F. Access Road	-	-	-	-	-	-	-	-	-
G. Land Acquisition	-	-	-	-	-	-	-	-	-
Sub-total(2)	159,155	33,693	192,848	103,771	19,396	123,167	23,151	3,335	26,486
3. Causeway	0	0	0	2,421	3,786	6,208	-	-	-
4. Pilot Demonstration Farm	10,393	2,869	13,262	-	-	-	-	-	-
5. Project Office	-	-	-	-	-	-	-	-	-
6. O & M Equipment	-	-	-	10,300	0	0	-	-	-
Total (2-6)	169,548	36,562	206,110	116,492	23,182	129,374	23,151	3,335	26,486
7. Physical Contingency	25,524	5,524	31,049	17,543	3,507	21,050	3,521	520	4,041
Total (1 - 7)	195,072	42,086	237,159	134,035	26,690	160,724	26,672	3,855	30,527
8. Administration Cost	0	2,233	2,233	0	2,233	2,233	0	558	558
9. Engineering Services	15,167	3,867	19,033	15,167	3,867	19,033	3,792	967	4,758
Total (1 - 8)	210,239	48,186	258,425	149,201	32,790	181,991	30,463	5,380	35,843
10. Price Contingency	0	10,844	10,844	0	10,191	10,191	0	2,166	2,166
Grand Total	210,239	59,030	269,269	149,201	42,980	192,182	30,463	7,545	38,009

表.18 財務經濟指標

Cost Component	Unit: %								Weighted Conversion Factor
	Financial Cost				Economic Cost				
	Local Cost				Local Cost				
Foreign Cost	Transfer Payment	Un-skilled labour	Others	Foreign Cost	Transfer Payment	Un-skilled labour	Others		
A. Capital Cost									
1. Preparatory Works	82	0	4	14	82	0	3	12	97
2. Mol Dam	83	0	4	13	83	0	3	11	97
3. Causeway	39	0	14	47	39	0	10	40	89
4. Pilot Demonstration Farm	78	0	5	17	78	0	4	14	96
5. Project Office	30	0	17	54	30	0	12	45	87
6. O&M Equipment	100	0	0	0	100	0	0	0	100
7. Physical Contingency	82	0	4	14	82	0	3	12	97
8. Administration Cost	0	0	24	76	0	0	16	65	81
9. Engineering Services	78	0	5	17	78	0	4	14	96
B. O&M Cost									
1. Administration Staff	0	0	0	100	0	0	0	85	85
2. Operation Cost of O&M Equipment	0	0	0	100	0	0	0	85	85
3. Office Operation Cost	0	0	0	100	0	0	0	85	85

表.19 経済費用及び便益のフロー

EIRR= 10.60%
 NPV(8%)= 196.4 million Rs.
 B/C(8%)= 1.36

Unit: Rs.1,000

Year	Cost			Benefit			Balance	
	Investment	Annual O&M	Replacement	Total	Irrigation	Well Ope.		Total
1 1991	13,662			13,662	0		0	-13,662
2 1992	159,528			159,528	0		0	-159,528
3 1993	249,731			249,731	0		0	-249,731
4 1994	175,373			175,373	0		0	-175,373
5 1995	34,507			34,507	0		0	-34,507
6 1996		4,335		4,335	50,137	2,551	52,688	48,353
7 1997		4,335		4,335	63,210	2,551	65,761	61,426
8 1998		4,335		4,335	76,283	2,551	78,833	74,498
9 1999		4,335		4,335	84,998	2,551	87,548	83,213
10 2000		4,335		4,335	93,713	2,551	96,264	91,929
11 2001		4,335		4,335	93,713	4,450	98,163	93,828
12 2002		4,335		4,335	93,713	4,450	98,163	93,828
13 2003		4,335		4,335	93,713	4,450	98,163	93,828
14 2004		4,335		4,335	93,713	4,450	98,163	93,828
15 2005		4,335	10,300	14,635	93,713	4,450	98,163	83,528
16 2006		4,335		4,335	93,713	1,203	94,916	90,581
17 2007		4,335		4,335	93,713	1,203	94,916	90,581
18 2008		4,335		4,335	93,713	1,203	94,916	90,581
19 2009		4,335		4,335	93,713	1,203	94,916	90,581
20 2010		4,335		4,335	93,713	1,203	94,916	90,581
21 2011		4,335		4,335	93,713	1,203	94,916	90,581
22 2012		4,335		4,335	93,713	1,203	94,916	90,581
23 2013		4,335		4,335	93,713	1,203	94,916	90,581
24 2014		4,335		4,335	93,713	1,203	94,916	90,581
25 2015		4,335	10,300	14,635	93,713	1,203	94,916	80,281
26 2016		4,335		4,335	93,713	1,203	94,916	90,581
27 2017		4,335		4,335	93,713	1,203	94,916	90,581
28 2018		4,335		4,335	93,713	1,203	94,916	90,581
29 2019		4,335		4,335	93,713	1,203	94,916	90,581
30 2020		4,335	25,500	29,835	93,713	1,203	94,916	65,081
31 2021		4,335		4,335	93,713	1,203	94,916	90,581
32 2022		4,335		4,335	93,713	1,203	94,916	90,581
33 2023		4,335		4,335	93,713	1,203	94,916	90,581
34 2024		4,335		4,335	93,713	1,203	94,916	90,581
35 2025		4,335	10,300	14,635	93,713	1,203	94,916	80,281
36 2026		4,335		4,335	93,713	1,203	94,916	90,581
37 2027		4,335		4,335	93,713	1,203	94,916	90,581
38 2028		4,335		4,335	93,713	1,203	94,916	90,581
39 2029		4,335		4,335	93,713	1,203	94,916	90,581
40 2030		4,335		4,335	93,713	1,203	94,916	90,581
41 2031		4,335		4,335	93,713	1,203	94,916	90,581
42 2032		4,335		4,335	93,713	1,203	94,916	90,581
43 2033		4,335		4,335	93,713	1,203	94,916	90,581
44 2034		4,335		4,335	93,713	1,203	94,916	90,581
45 2035		4,335	10,300	14,635	93,713	1,203	94,916	80,281
46 2036		4,335		4,335	93,713	1,203	94,916	90,581
47 2037		4,335		4,335	93,713	1,203	94,916	90,581
48 2038		4,335		4,335	93,713	1,203	94,916	90,581
49 2039		4,335		4,335	93,713	1,203	94,916	90,581
50 2040		4,335		4,335	93,713	1,203	94,916	90,581
51 2041		4,335		4,335	93,713	1,203	94,916	90,581
52 2042		4,335		4,335	93,713	1,203	94,916	90,581
53 2043		4,335		4,335	93,713	1,203	94,916	90,581
54 2044		4,335		4,335	93,713	1,203	94,916	90,581
55 2045		4,335		4,335	93,713	1,203	94,916	90,581

表.20 自作農及び小作農の農家収支

Unit : Rs.

Item	Holding Size (ha)				
	1.0	3.0	5.0	10.0	20.0
1 Owner Operated Farm					
A. Without Project					
Gross income	6,851	20,552	34,253	68,505	137,011
Production cost incl. labor cost	3,094	9,282	15,469	30,939	61,878
Gross margin	<u>3,757</u>	<u>11,270</u>	<u>18,783</u>	<u>37,567</u>	<u>75,133</u>
B. With project					
Gross income	30,794	92,383	153,971	307,942	615,884
Production cost incl. labor cost	10,483	31,448	52,414	104,827	209,654
Gross margin	<u>20,311</u>	<u>60,934</u>	<u>101,557</u>	<u>203,115</u>	<u>406,229</u>
C. Increment					
Gross income	23,944	71,831	119,718	239,436	478,873
Production cost incl. labor cost	7,389	22,166	36,944	73,888	147,777
Gross margin	<u>16,555</u>	<u>49,664</u>	<u>82,774</u>	<u>165,548</u>	<u>331,096</u>
2 Tenant Operated Farm					
A. Without Project					
Gross income	3,425	10,276	17,126	34,253	68,505
Production cost incl. labor cost	2,926	8,779	14,631	29,263	58,526
Family labor cost	1,379	4,138	6,897	13,793	27,587
Farmer's income	<u>1,878</u>	<u>5,635</u>	<u>9,392</u>	<u>18,783</u>	<u>37,567</u>
B. With project					
Gross income	15,397	46,191	76,985	153,971	307,942
Production cost incl. labor cost	9,978	29,933	49,888	99,775	199,551
Family labor cost	4,736	14,209	23,681	47,362	94,724
Farmer's income	<u>10,156</u>	<u>30,468</u>	<u>50,779</u>	<u>101,557</u>	<u>203,115</u>
C. Increment					
Gross income	11,972	35,915	59,859	119,718	239,436
Production cost incl. labor cost	7,051	21,154	35,256	70,513	141,025
Family labor cost	3,357	10,071	16,784	33,569	67,137
Farmer's income	<u>8,278</u>	<u>24,833</u>	<u>41,387</u>	<u>82,775</u>	<u>165,548</u>

Refer to ANNEX - J

附 圖

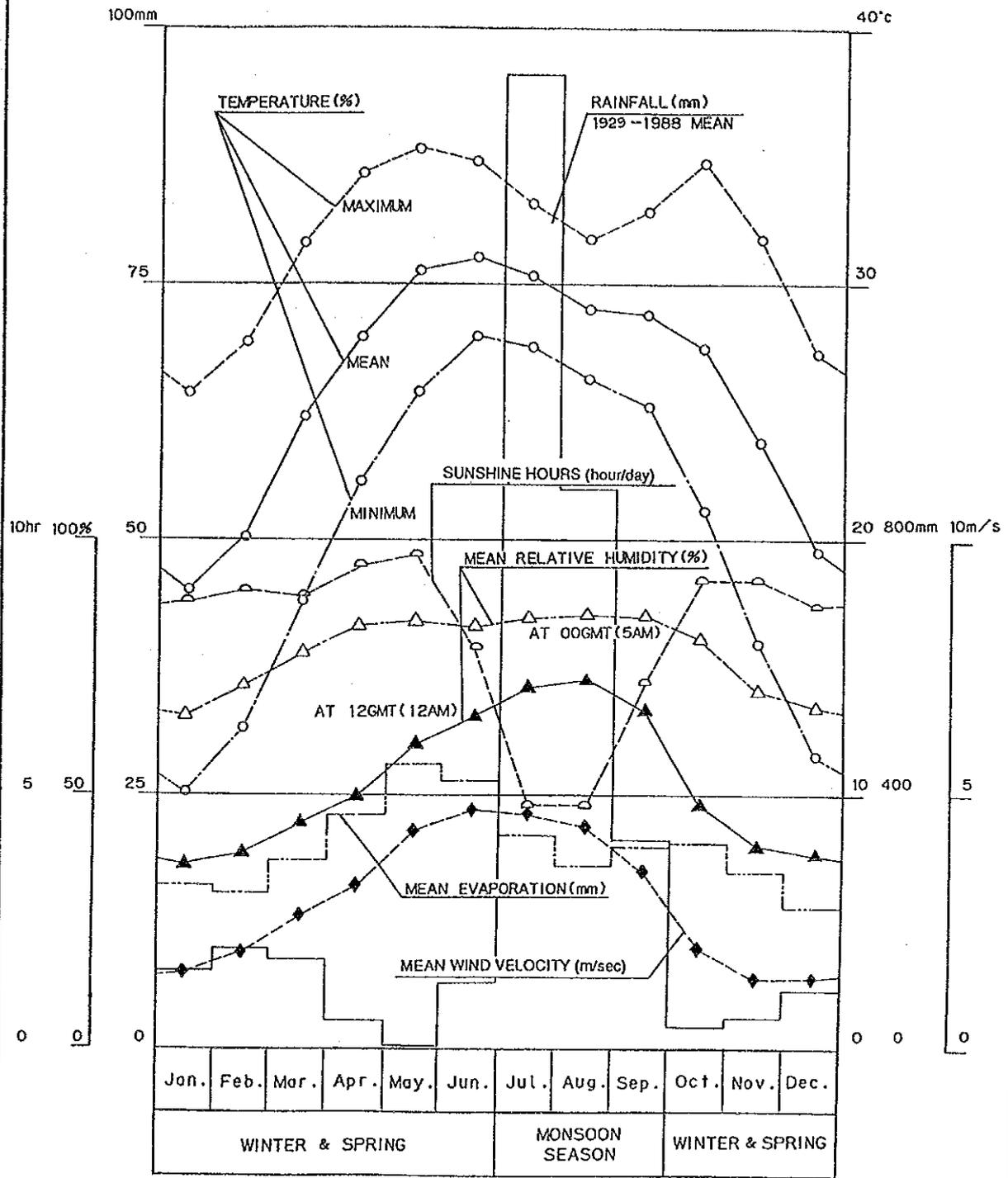


图 - 1 气候特性

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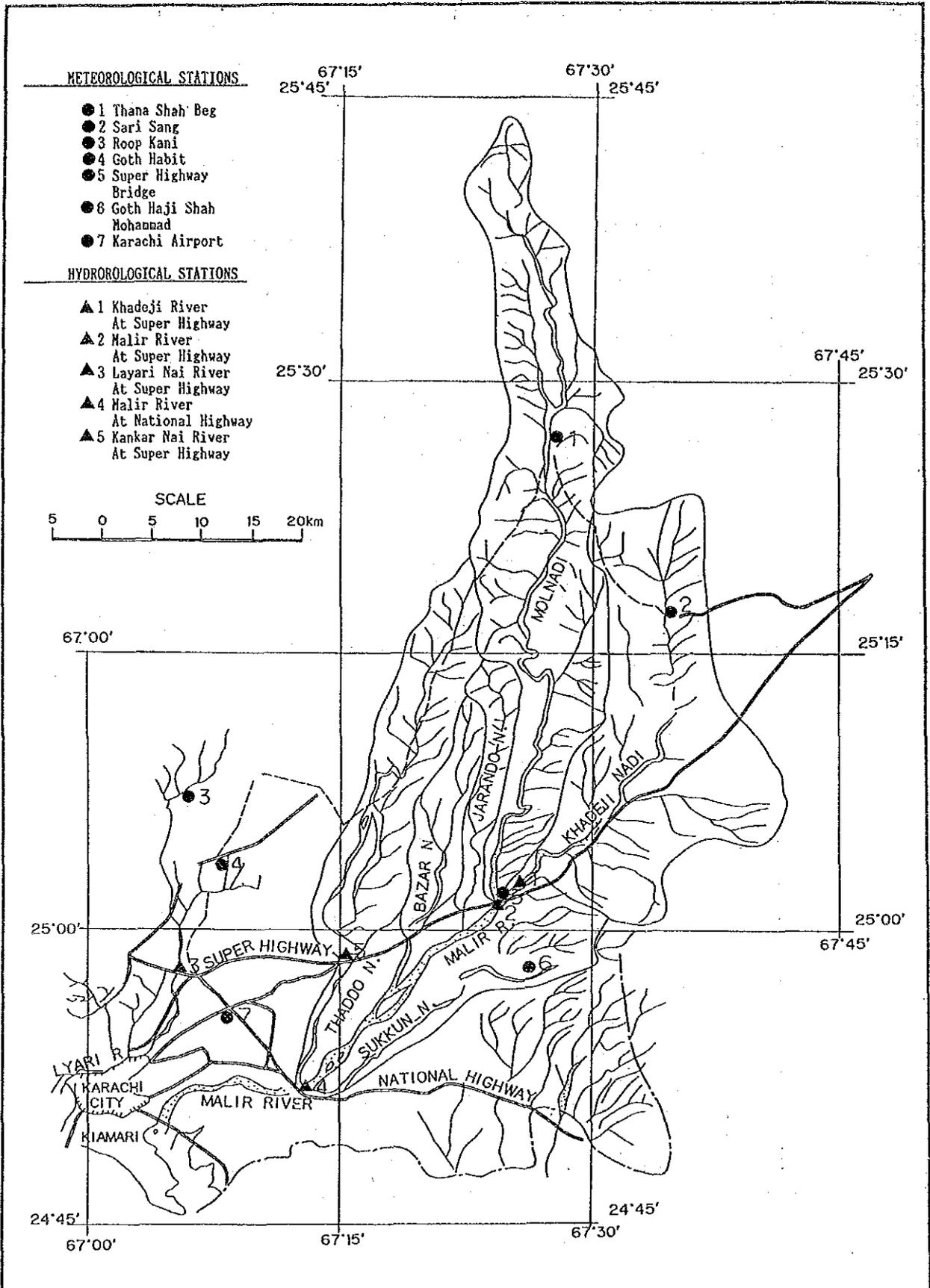
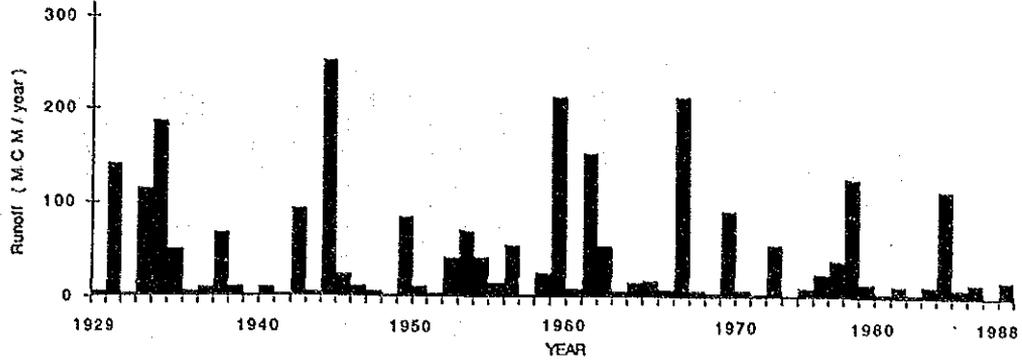


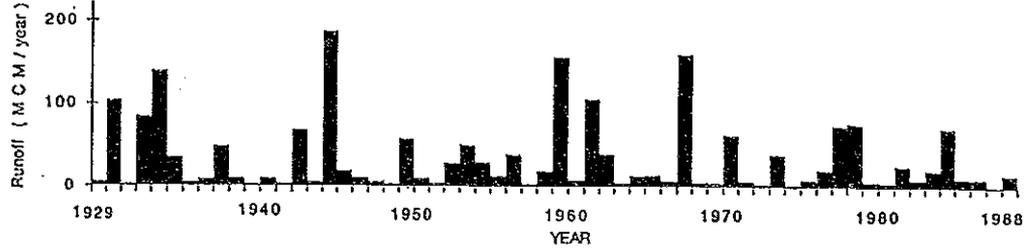
图 - 2 气象·水文观测所位置图

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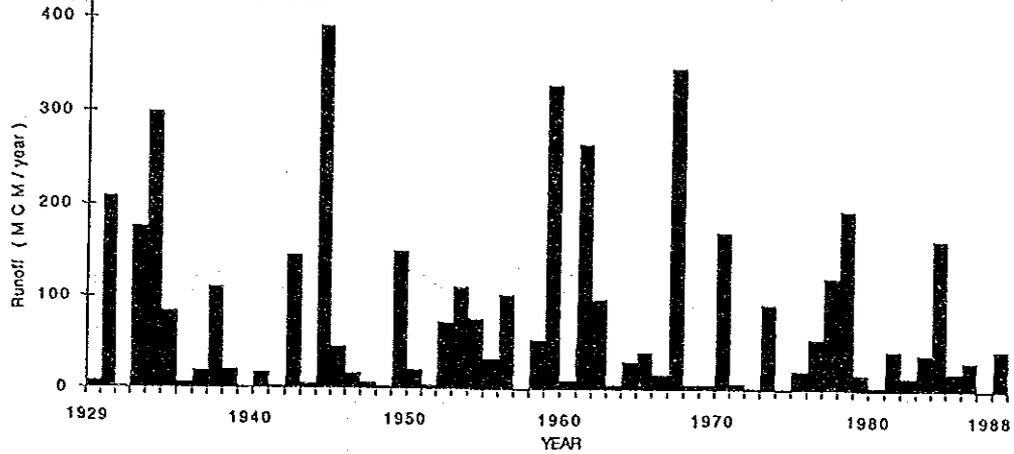
MOL RIVER AT DAM SITE



KHADEJI RIVER AT DAM SITE



MALIR RIVER AT SUPER HIGHWAY BRIDGE



MALIR RIVER AT NATIONAL HIGHWAY BRIDGE

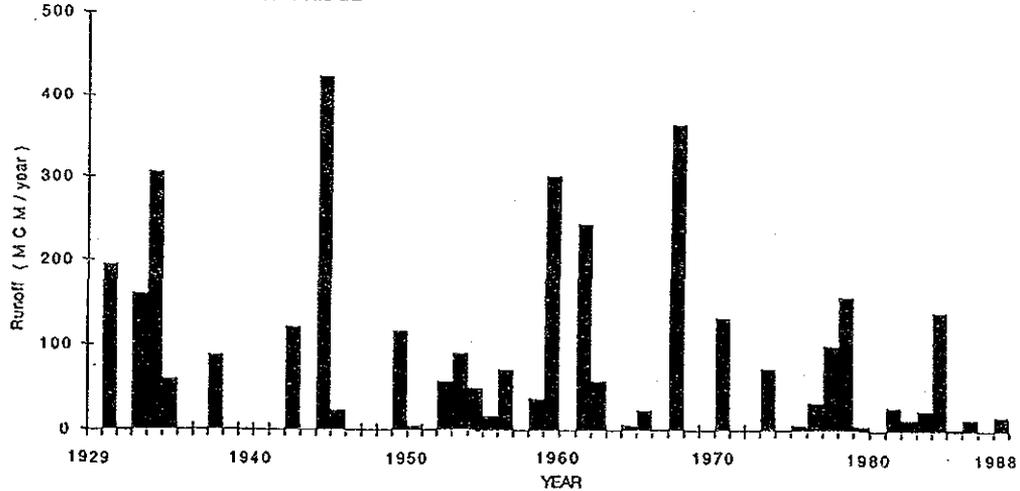


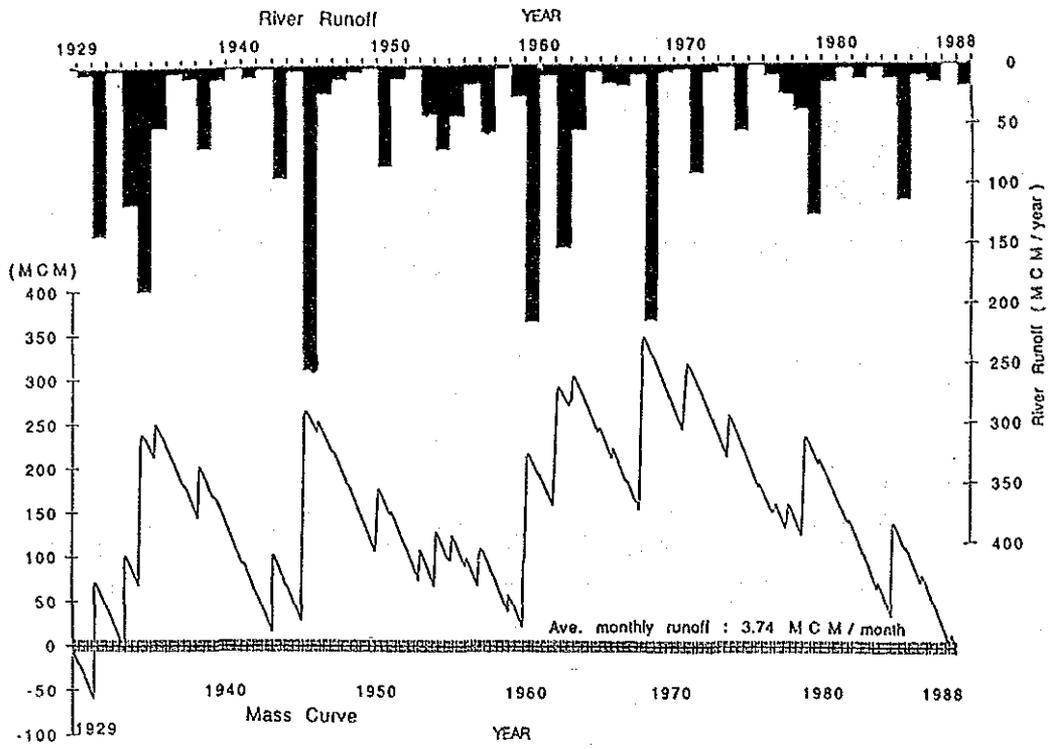
図 - 3 主要地点の年流出量

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MOL RIVER AT DAM SITE



KHADEJI RIVER AT DAM SITE

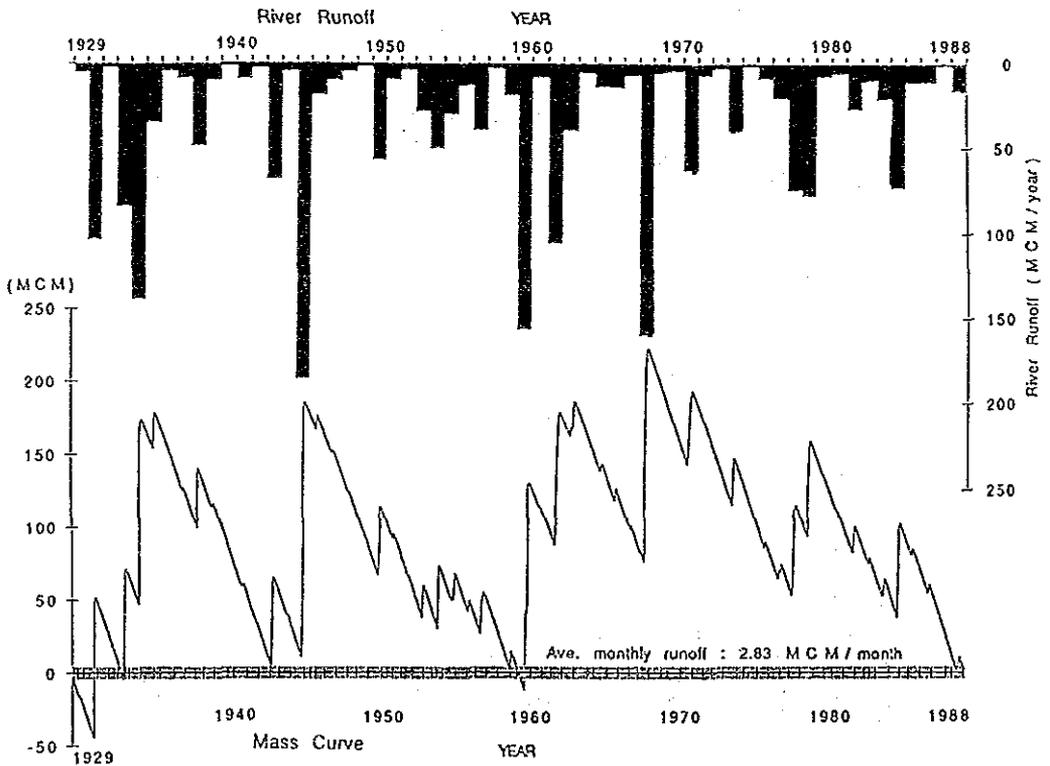
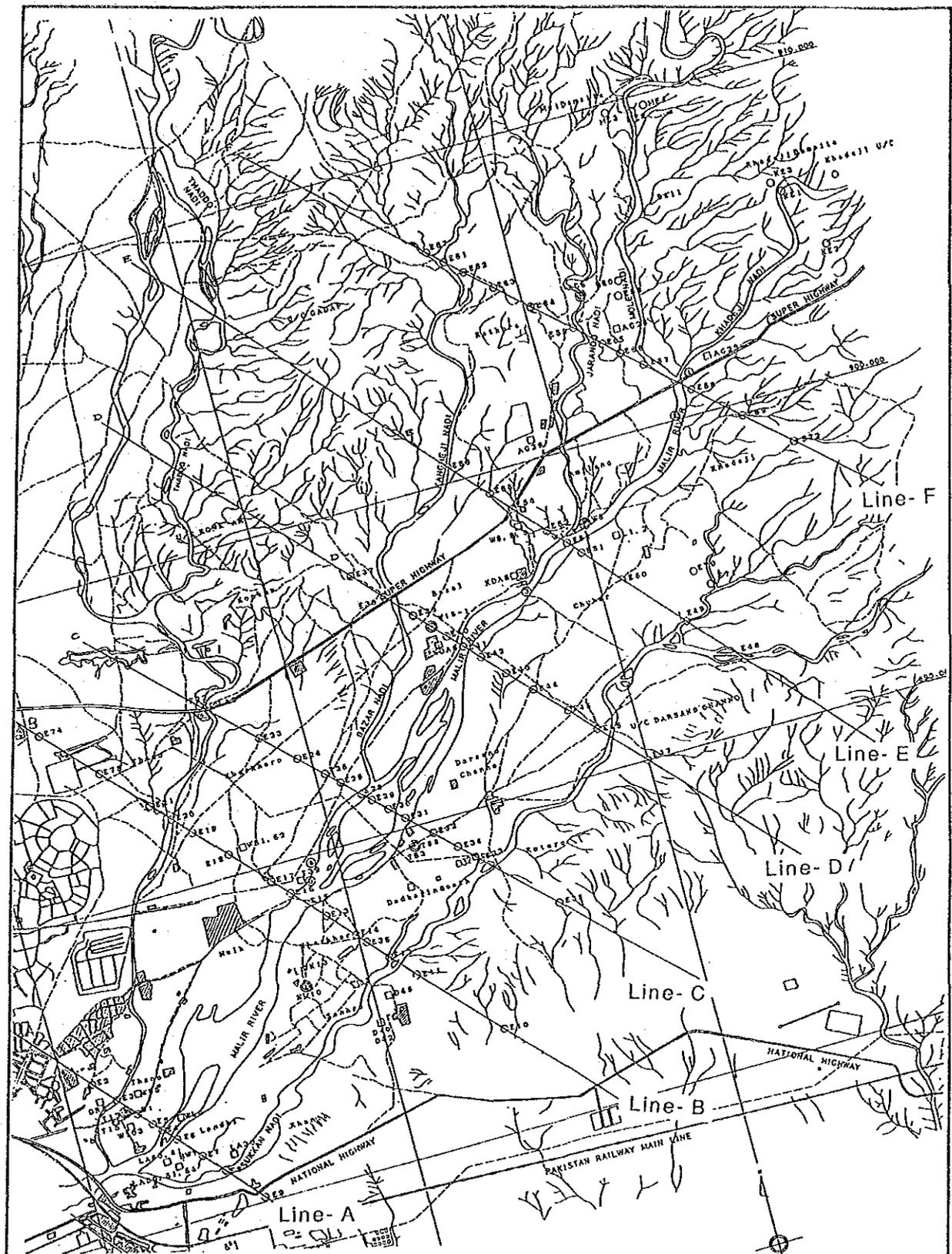


図 - 4 流出パターン及びマスカーブ
(カデジ及びモル・ダム地点)

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FEASIBILITY STUDY ON WATER RESOURCES DEVELOPMENT PROJECT IN THE MALIR BASIN
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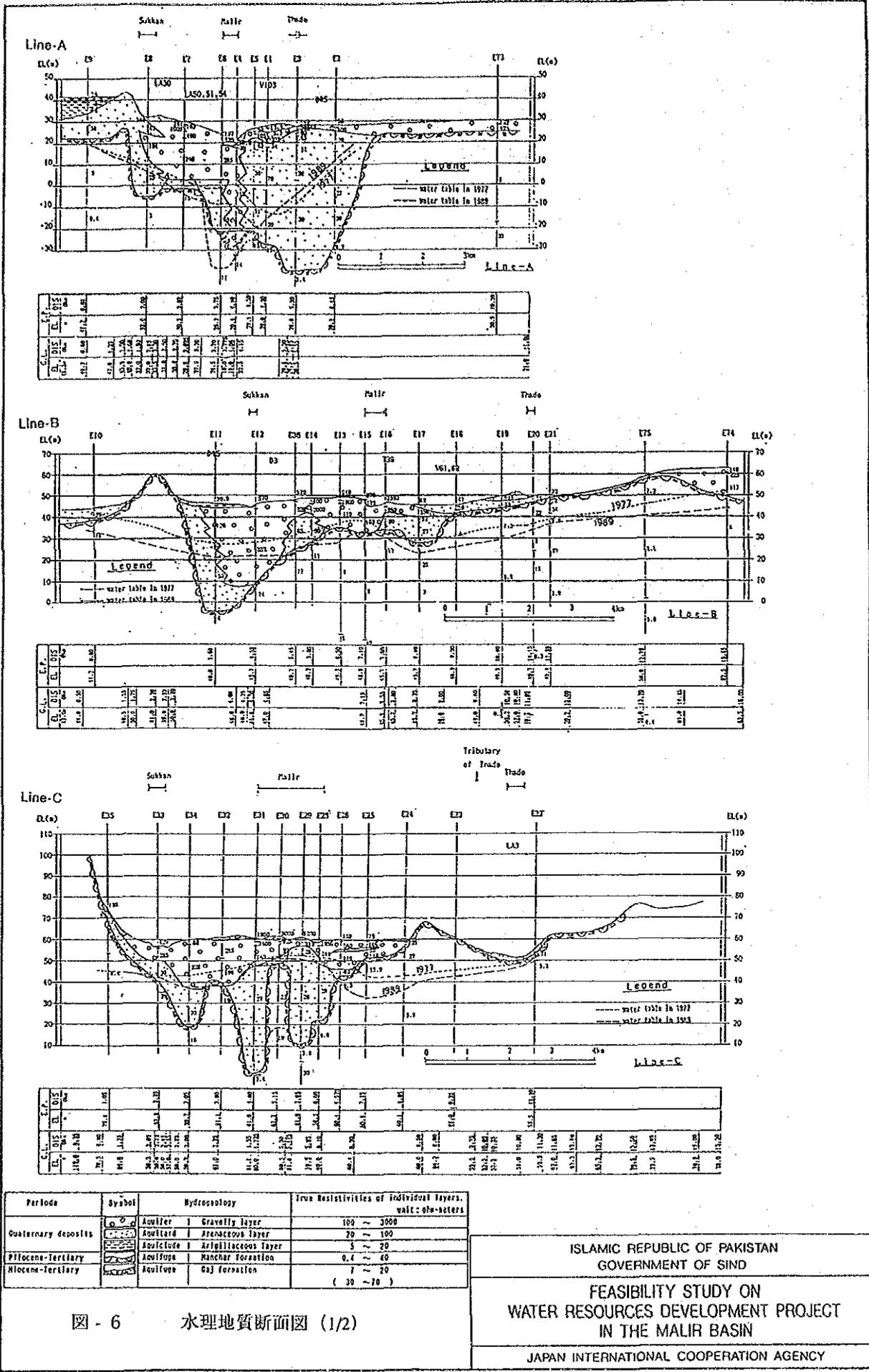


- Legend
- Electric Resistivity Survey
 - ② Infiltration Test and Soil Sampling
 - ⊙ Pumping Test
 - Well

图 - 5 水理地質調査地点

0 1 2 3 4 5 Km

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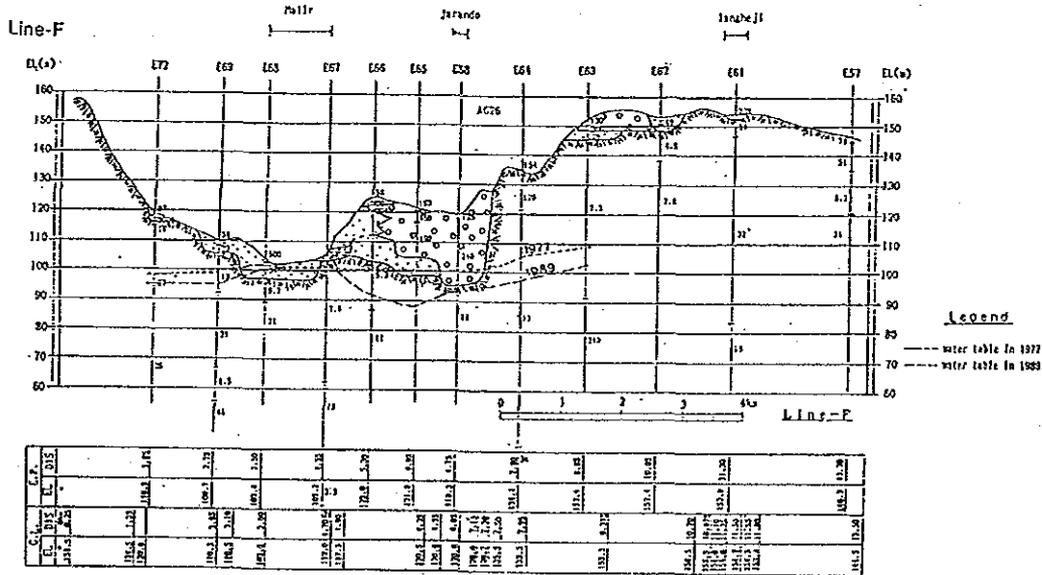
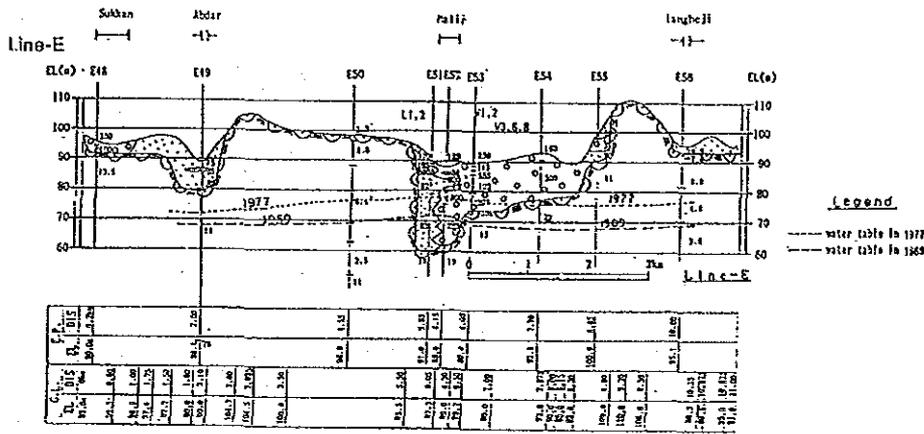
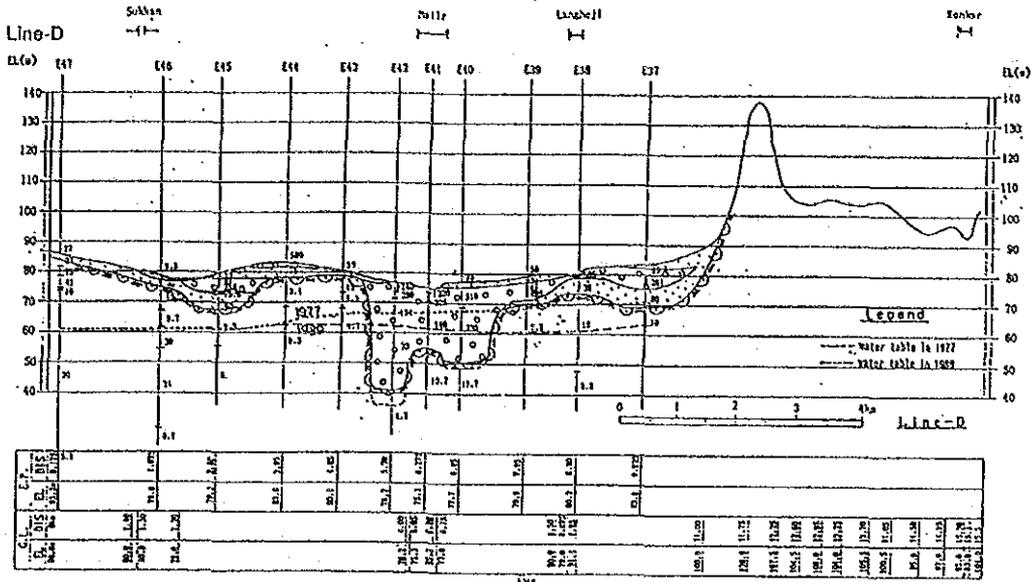
Period	Symbol	Hydrogeology	True Resistivities of individual layers, unit: ohm-meters
Quaternary deposits		Aquifer Gravelly layer	100 ~ 3000
		Aquiclude Arenaceous layer	20 ~ 100
		Aquiclude Argillaceous layer	5 ~ 20
Pliocene-Tertiary		Aquifuge Manchar formation	0.4 ~ 40
Miocene-Tertiary		Aquifuge Gaj formation	7 ~ 20 (30 ~ 70)

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图 - 6 水理地質断面图 (1/2)



Periods	Symbol	Hydrogeology	In-situ Resistivities of individual layers.
Quaternary deposits	Gravelly layer	Gravelly layer	100 ~ 3000
	Araceous layer	Araceous layer	20 ~ 100
	Argillaceous layer	Argillaceous layer	5 ~ 20
Pliocene-Tertiary	Maschar formation	Maschar formation	0.4 ~ 40
Miocene-Tertiary	Gaj formation	Gaj formation	7 ~ 20
			(20 ~ 70)

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图 - 6 水理地質断面图 (2/2)

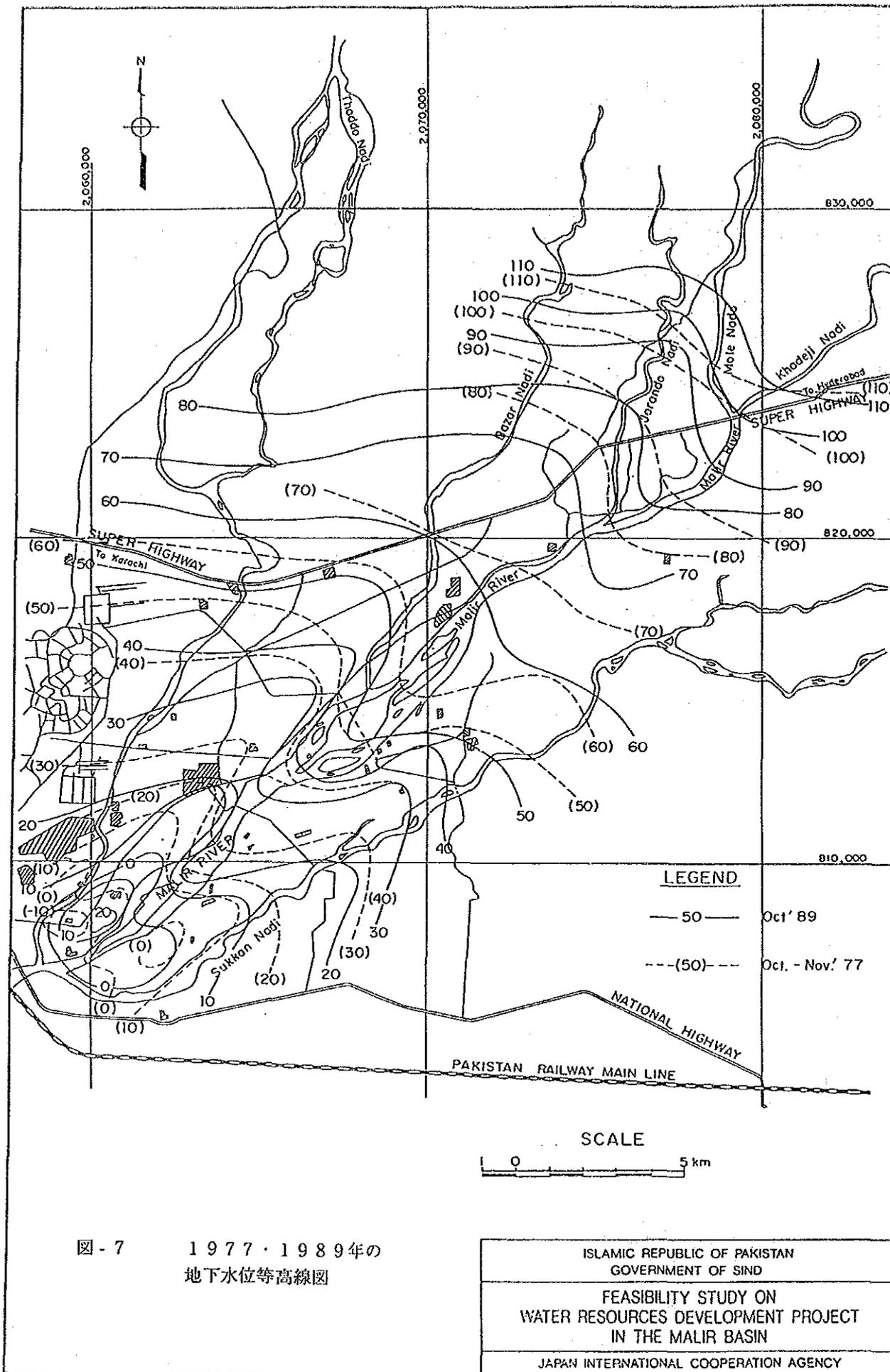


図 - 7 1977・1989年の
地下水位等高線図

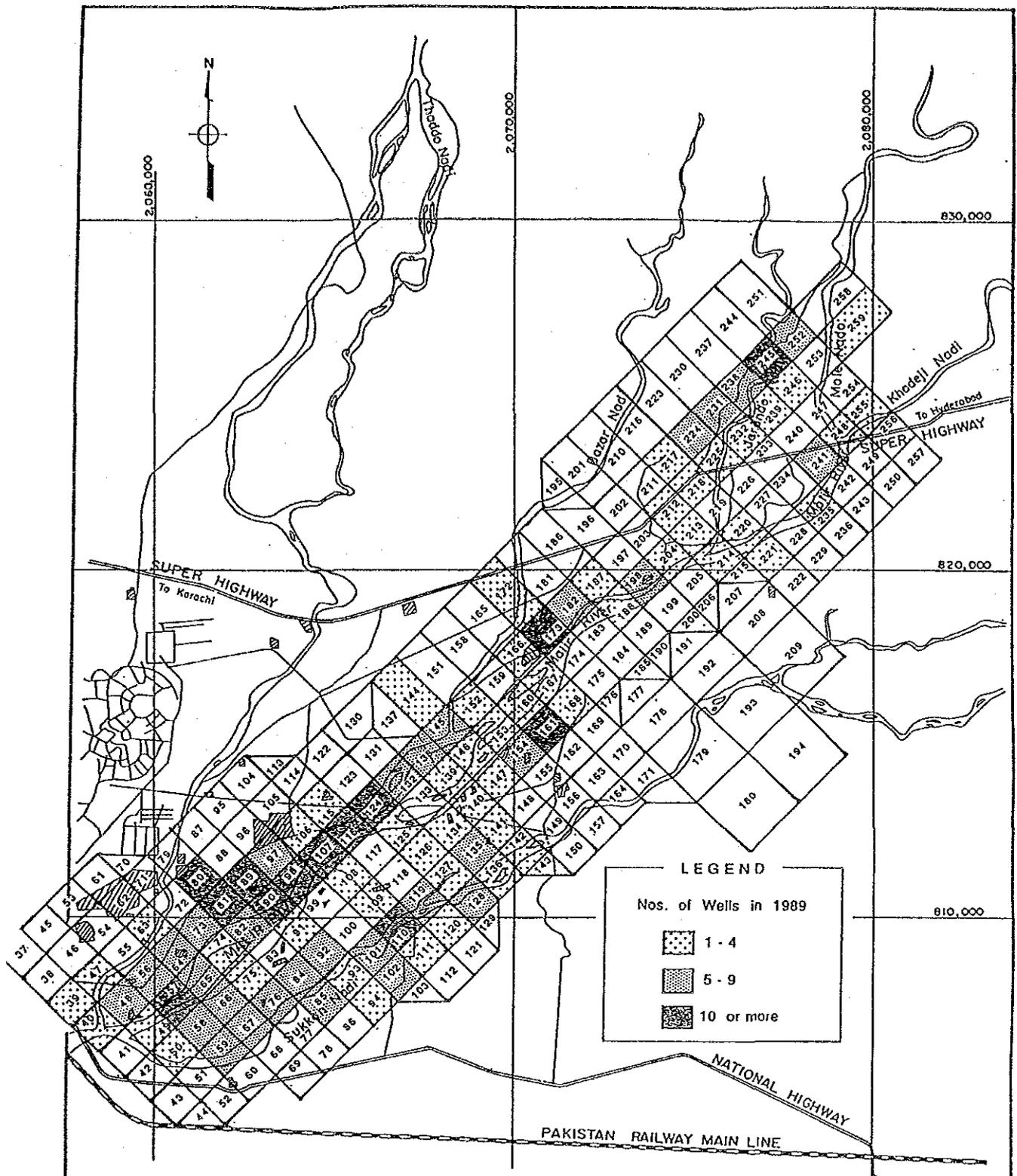


图 - 8 生産井密度

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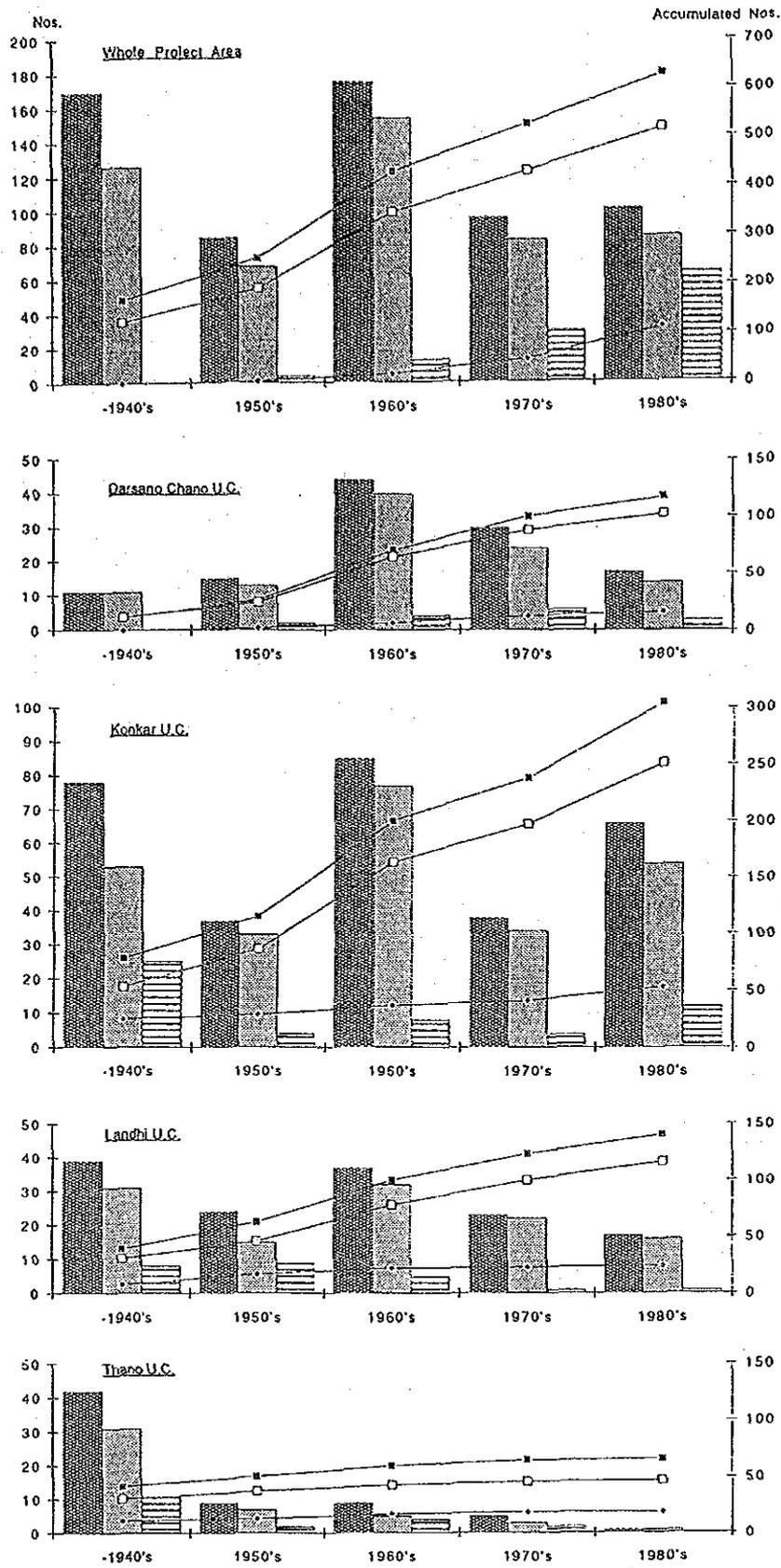


図 - 9 地区別井戸建設数の推移

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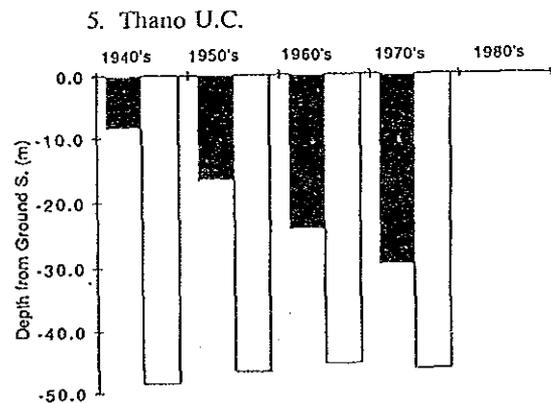
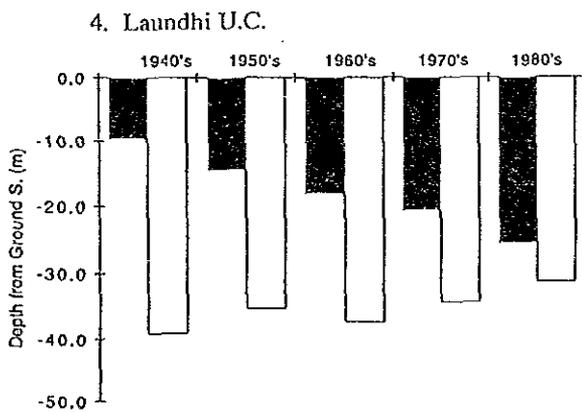
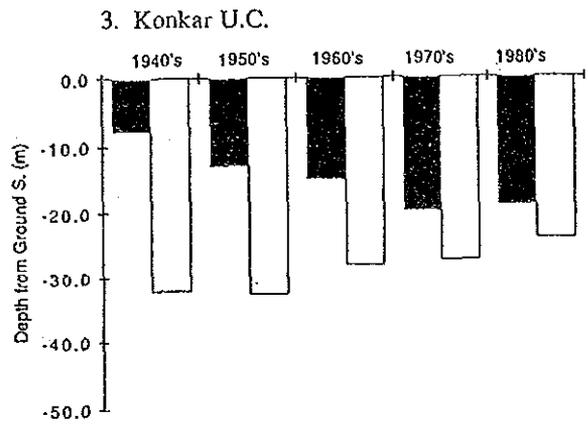
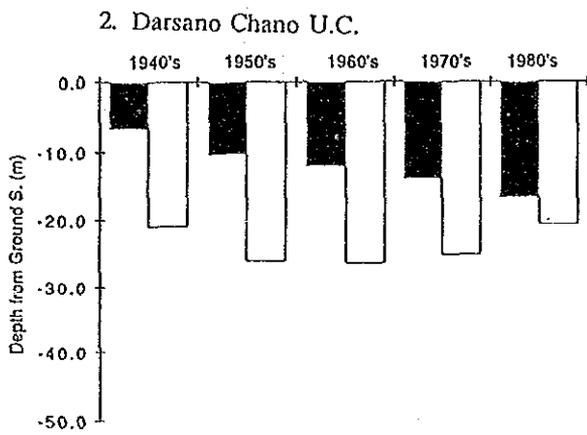
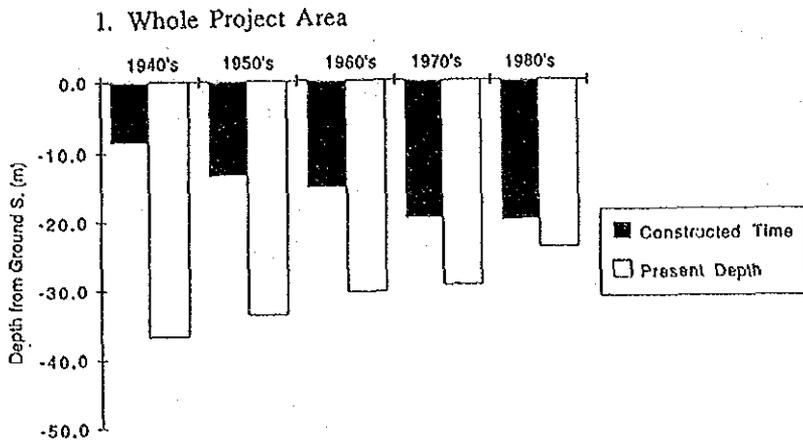
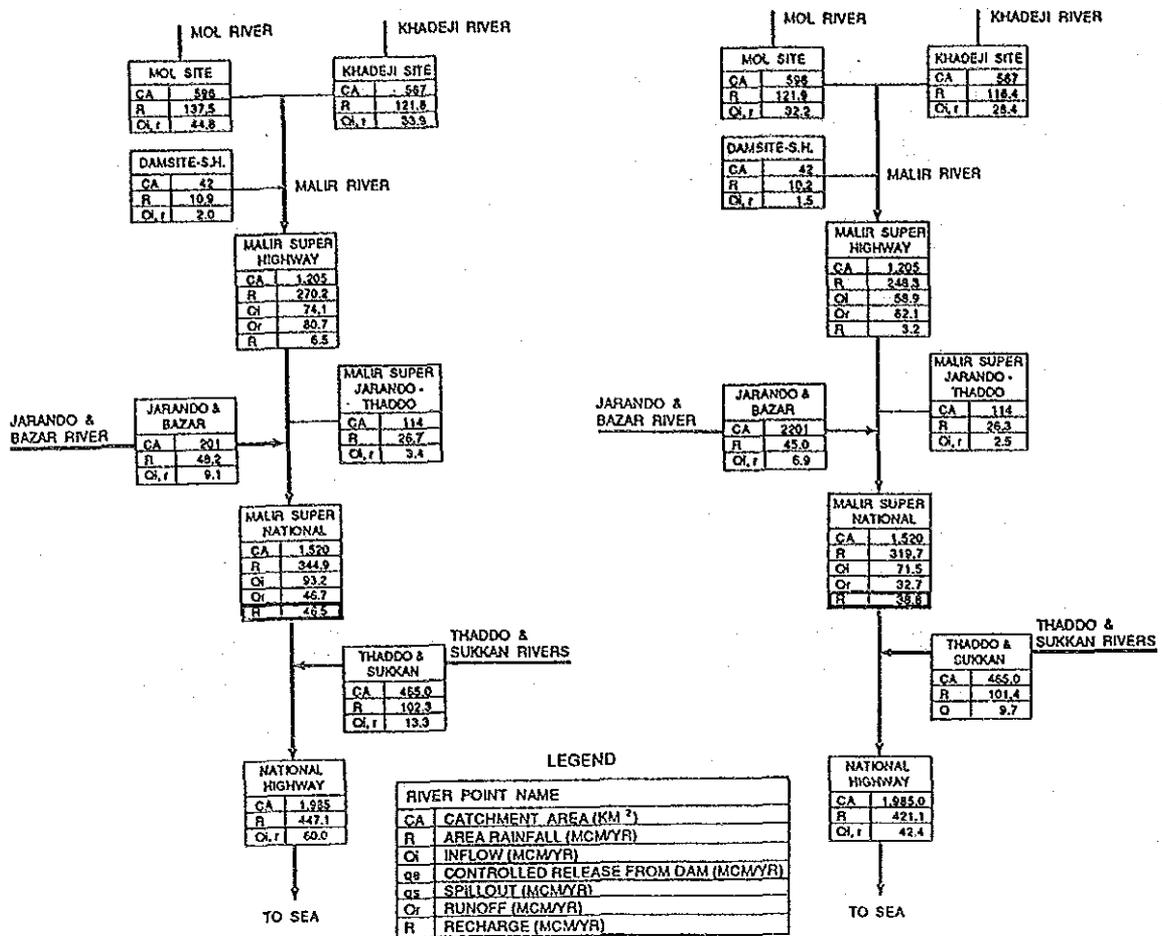


図 - 10 地区別の生産井平均深度

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1. Natural Condition (1929 - 1988)

2. Natural Condition (1977 - 1988)

図 - 1 1 水収支図 (自然状態)

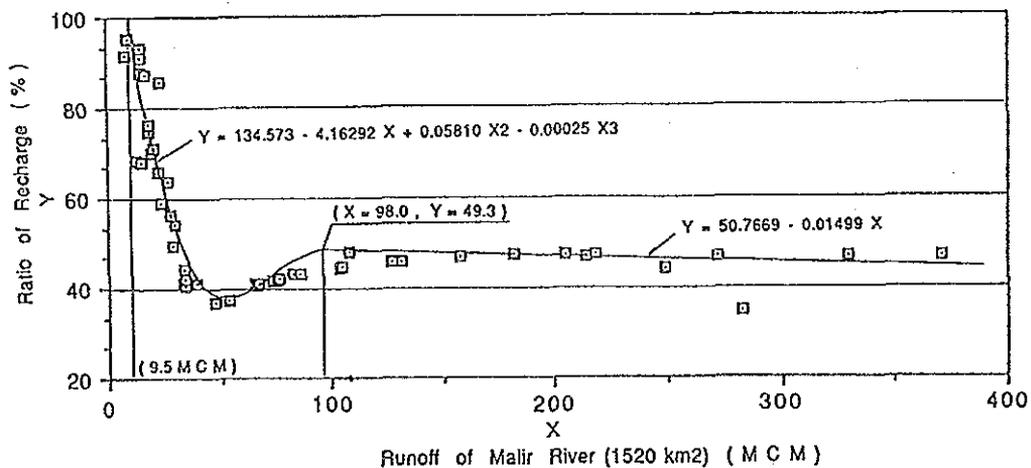
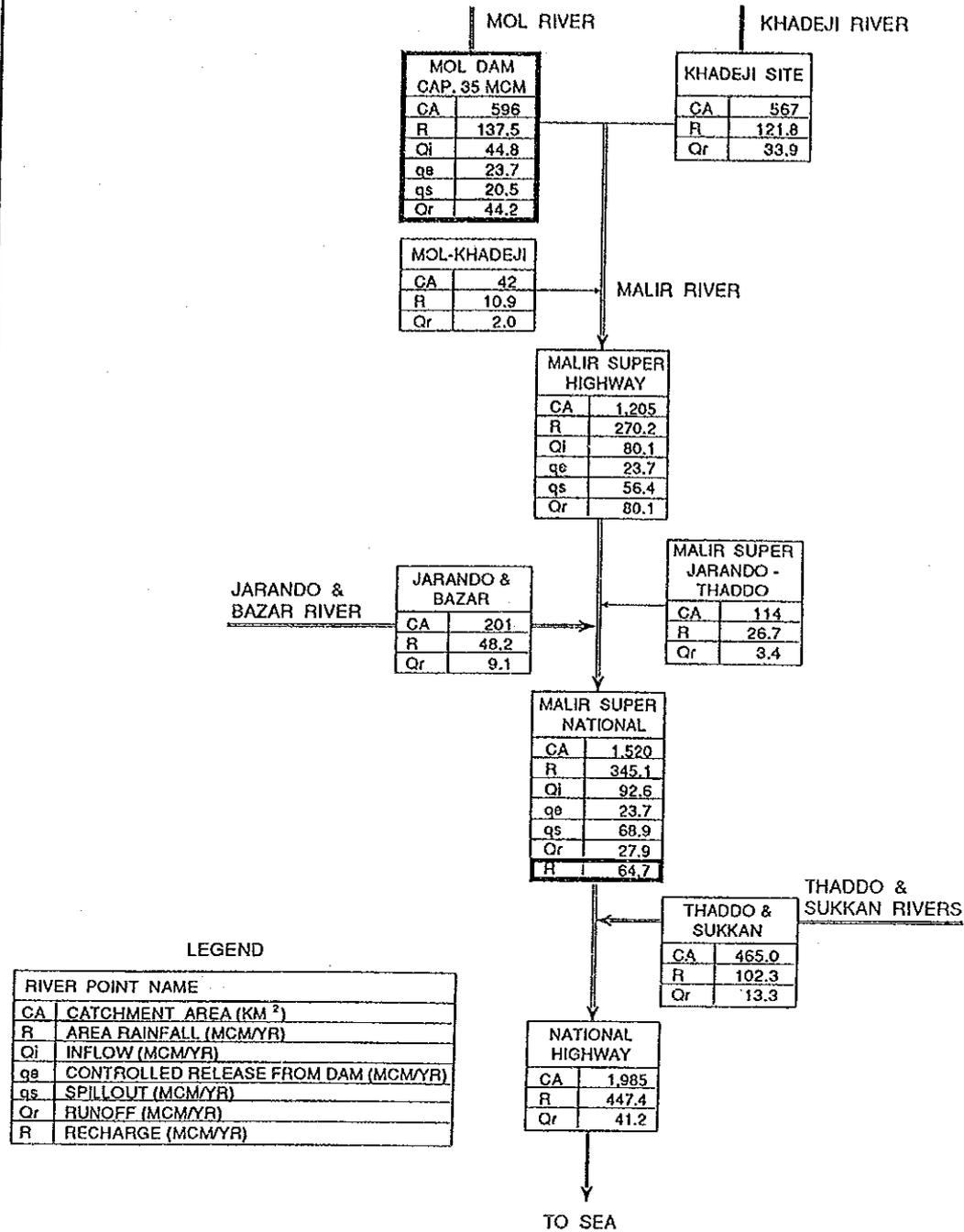


図 - 1 2 流出量及び自然涵養量との関係

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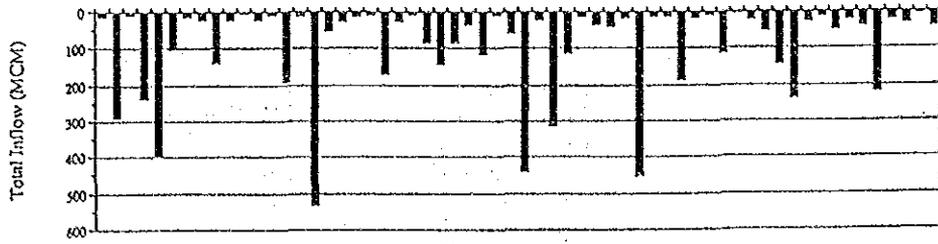
Case-4 Mol Dam : 35 MCM
(1929 - 1988)

図 - 13 事業実施後水収支図
(モルダム : 35 MCM)

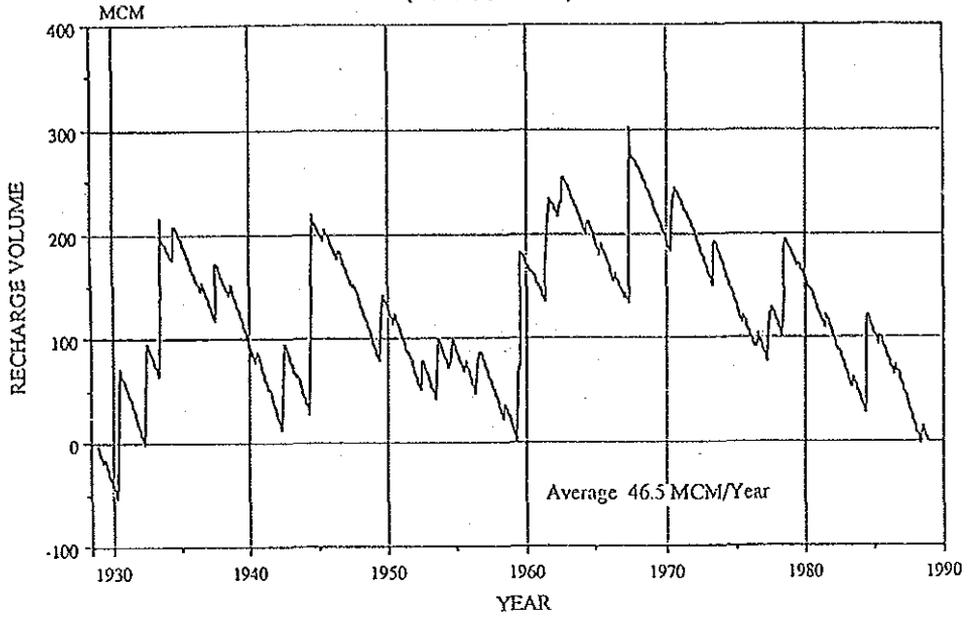
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NATURAL RECHARGE VOLUME
(WITHOUT DAM)



ARTIFICIAL RECHARGE VOLUME
(Case 4, Mol: 35.0 MCM)

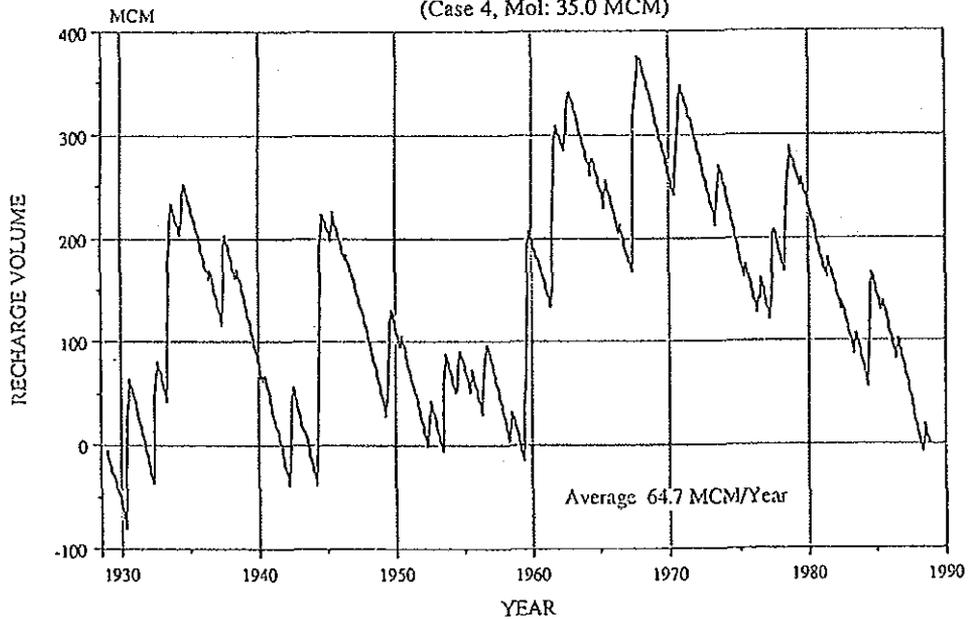


図 - 14 地下水涵養量マスカープ
(モルダム: 35 MCM)

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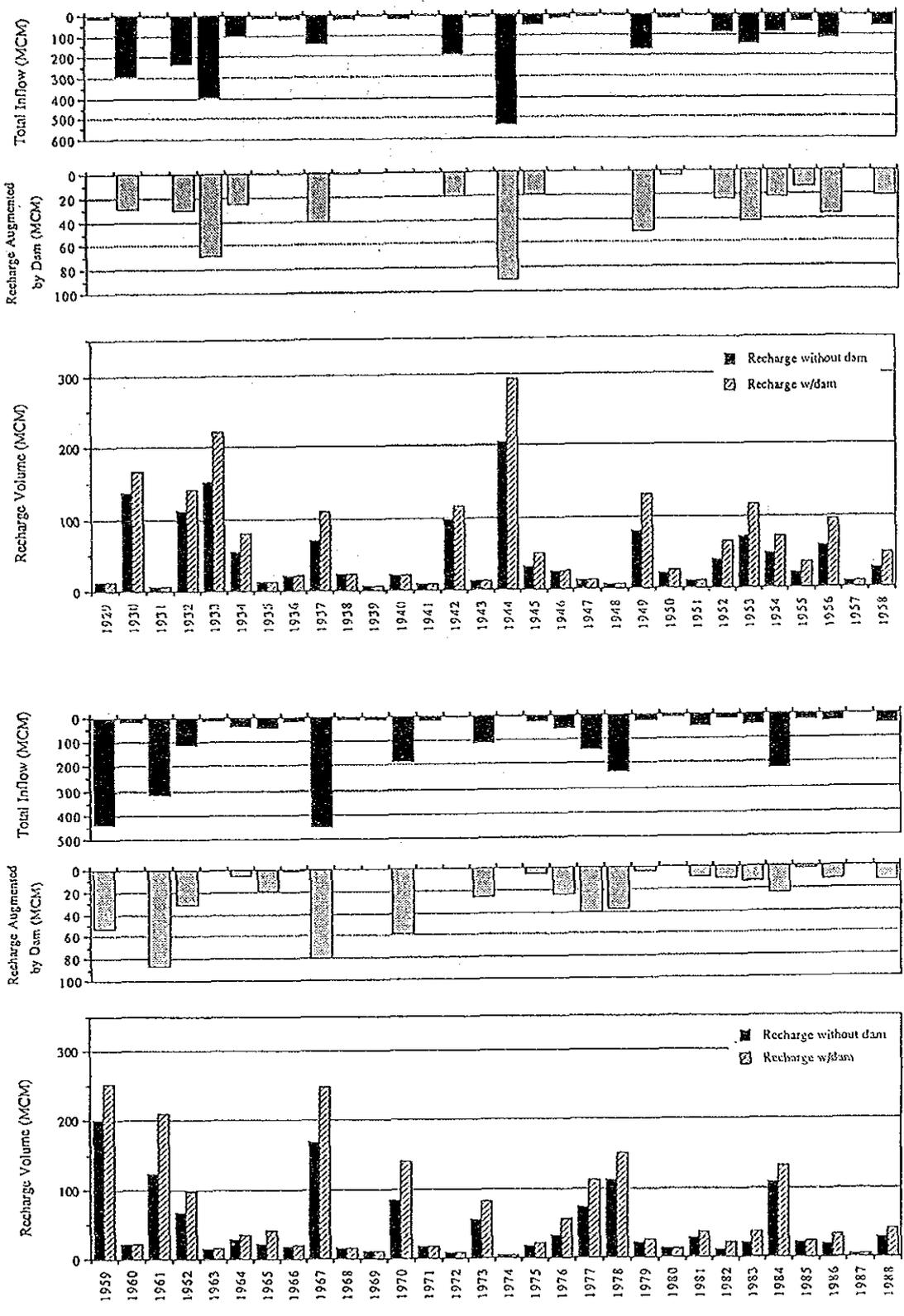


図 - 15 人工涵養量
(モルダム 3 5 MCM)

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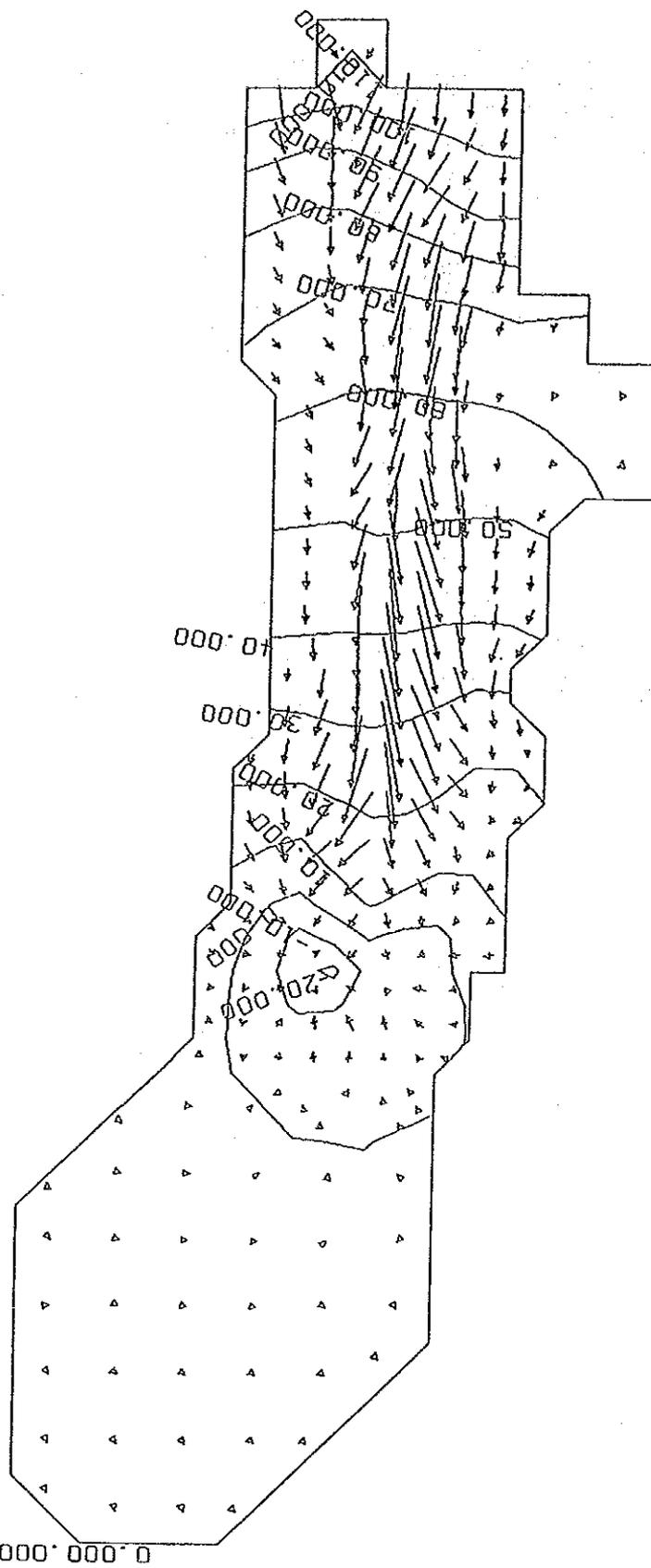


図 - 16 現況地下水モデル

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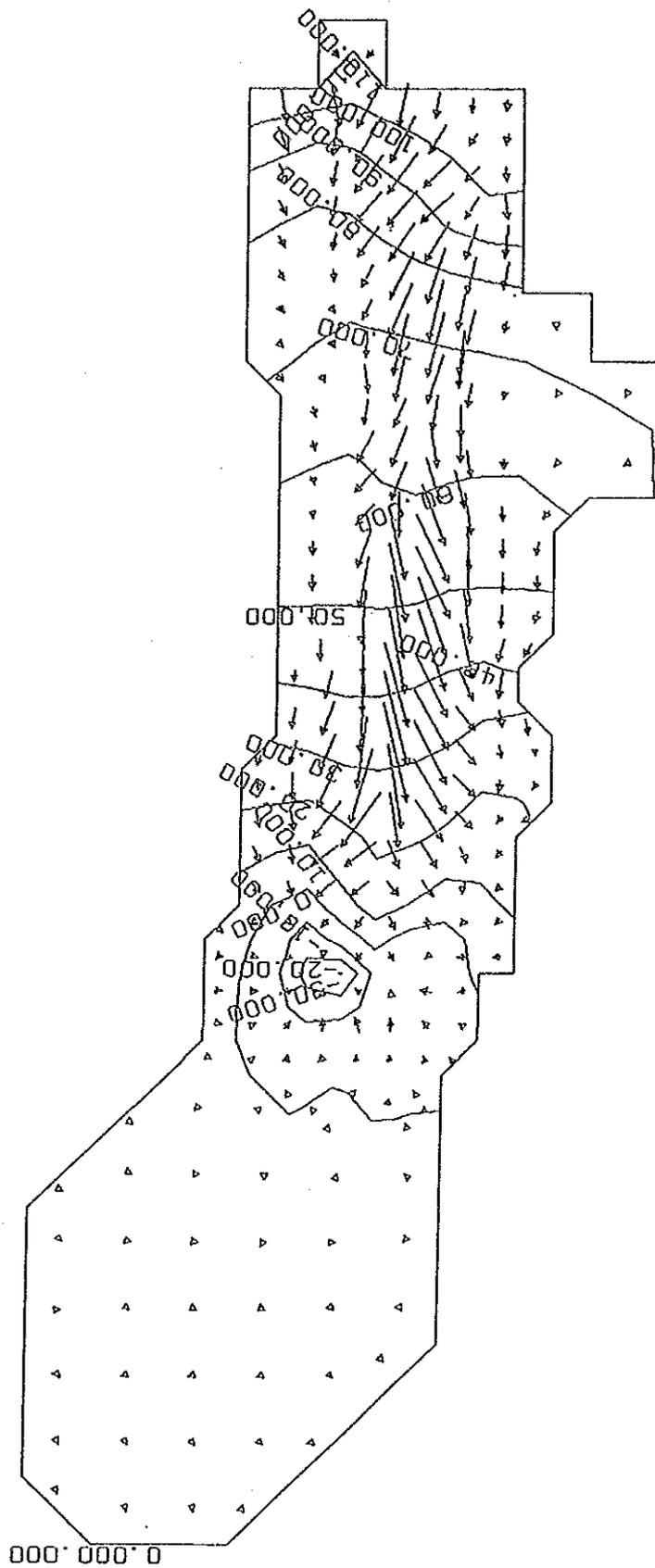


図 - 17 事業実施後予想地下水モデル

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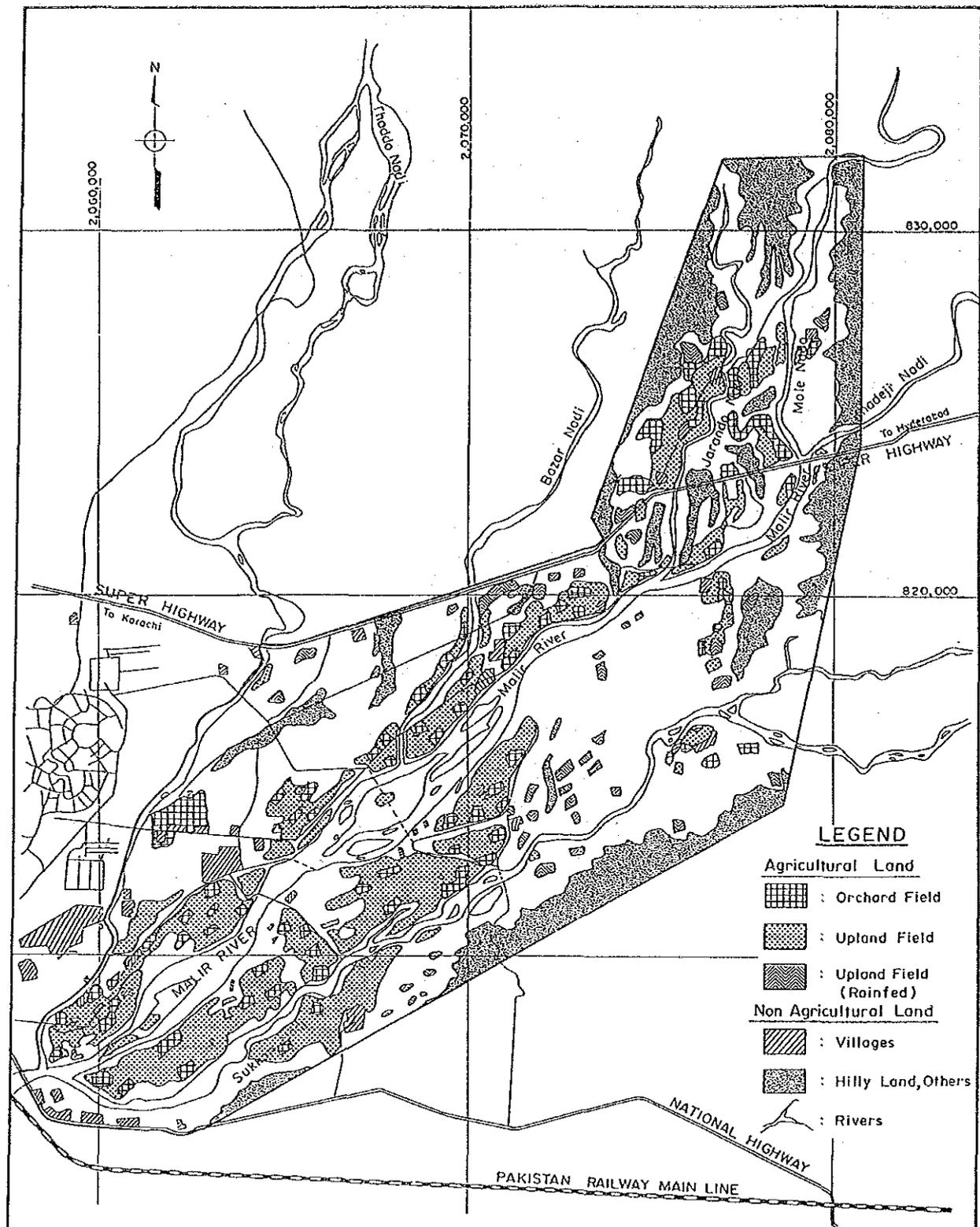


図 - 18 調査地区現況土地利用図

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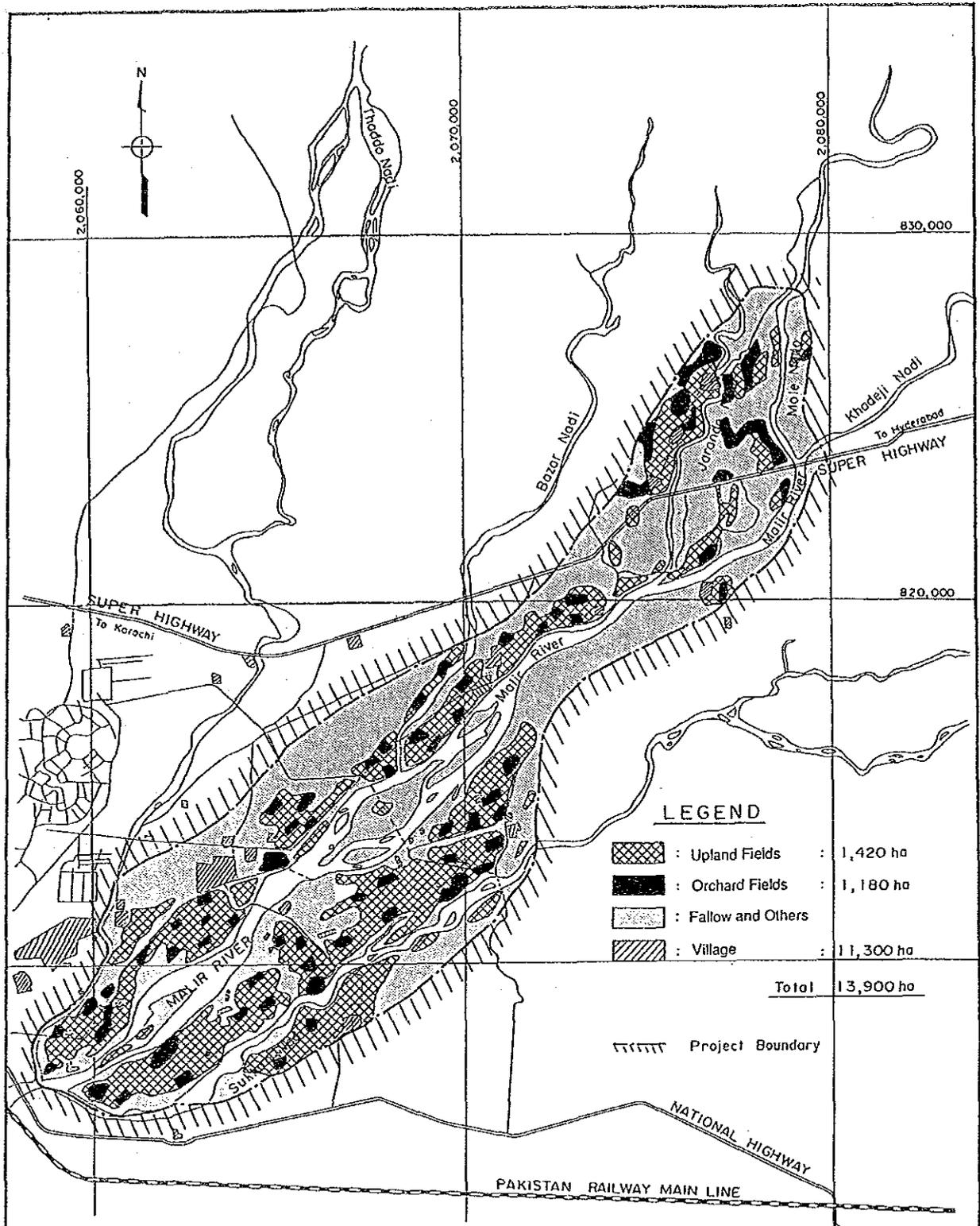


図 - 19 計画地区境界及び土地利用図

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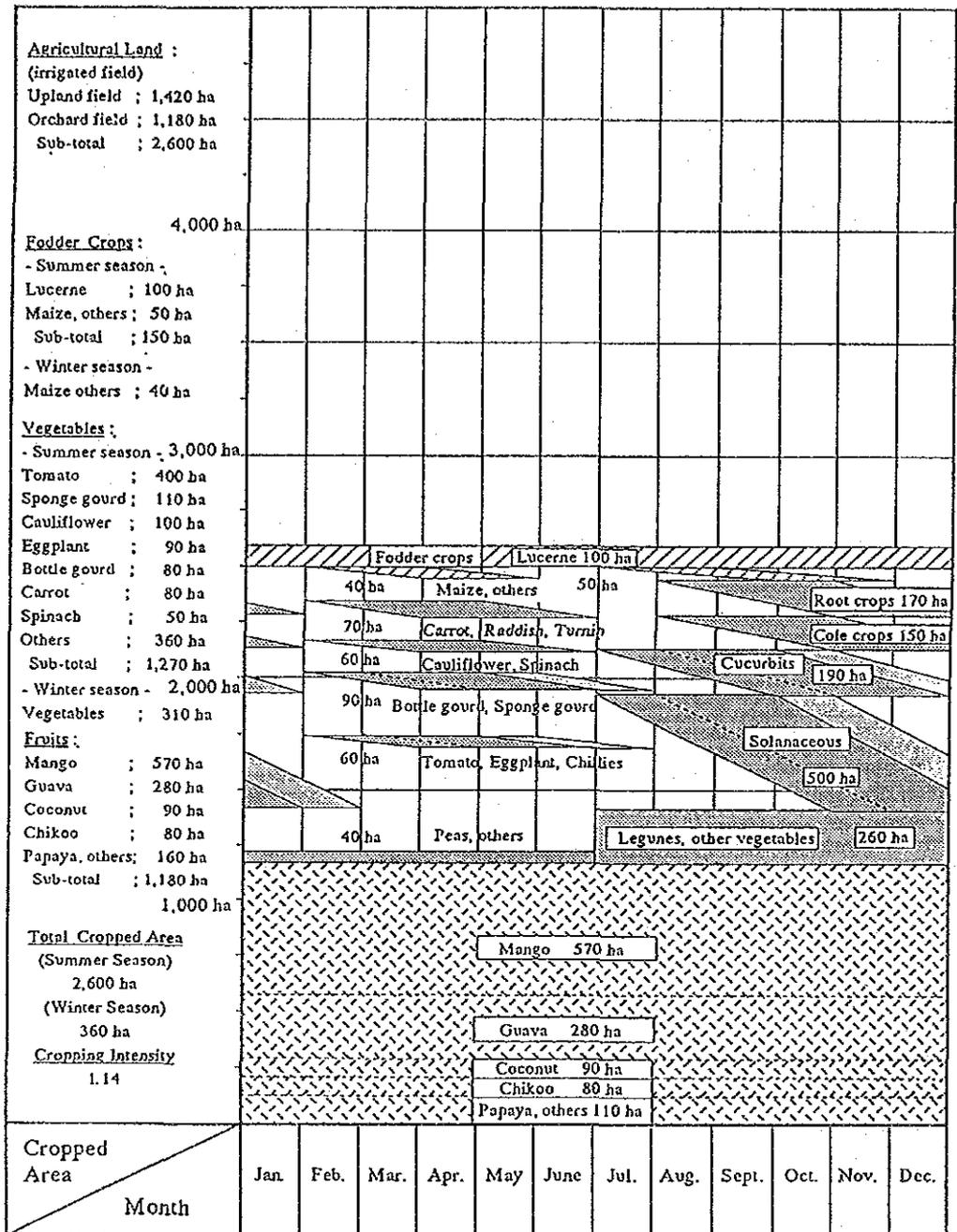


図 - 20 現況作付体系

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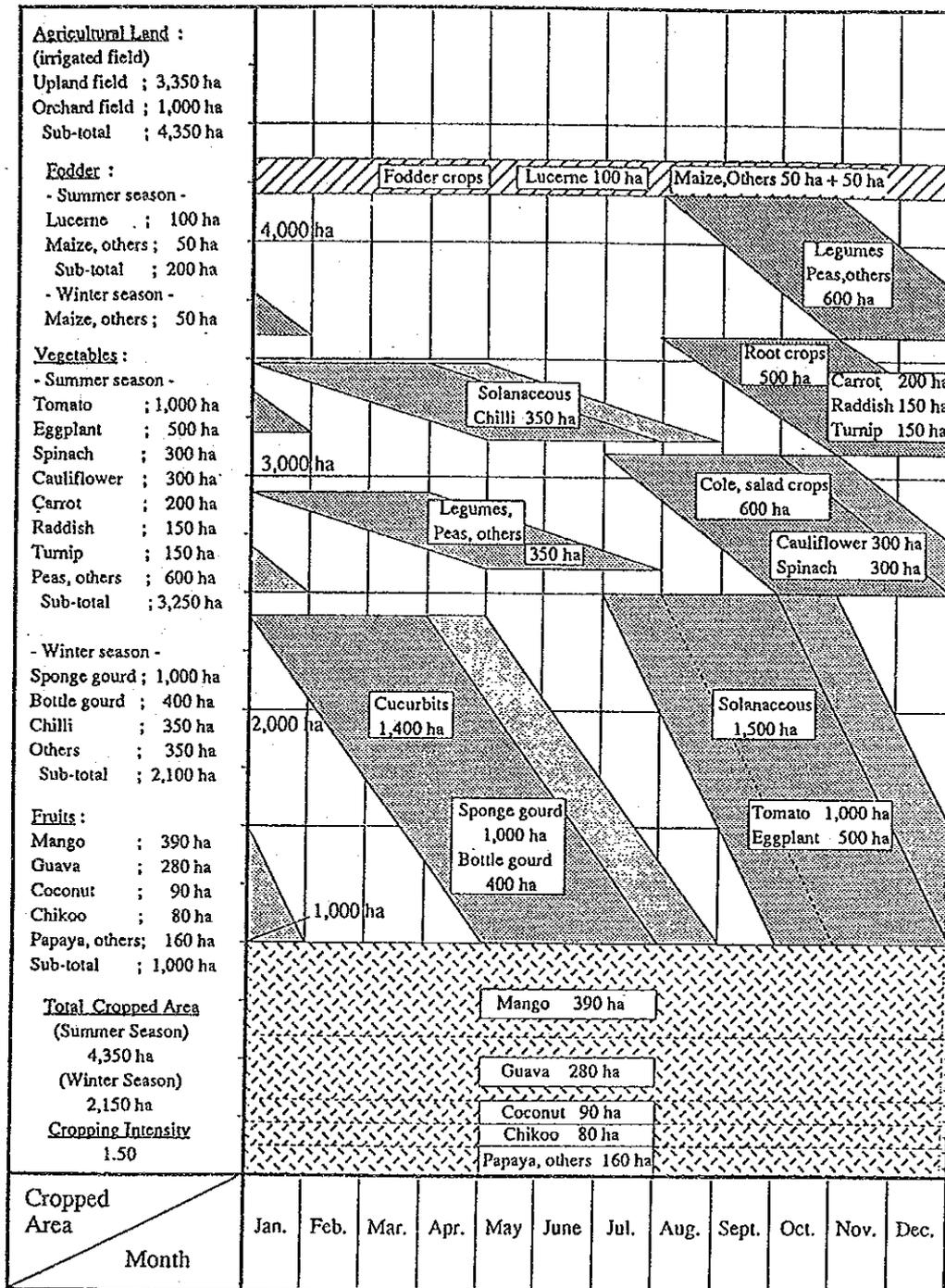


図 - 2 1 計画作付体系

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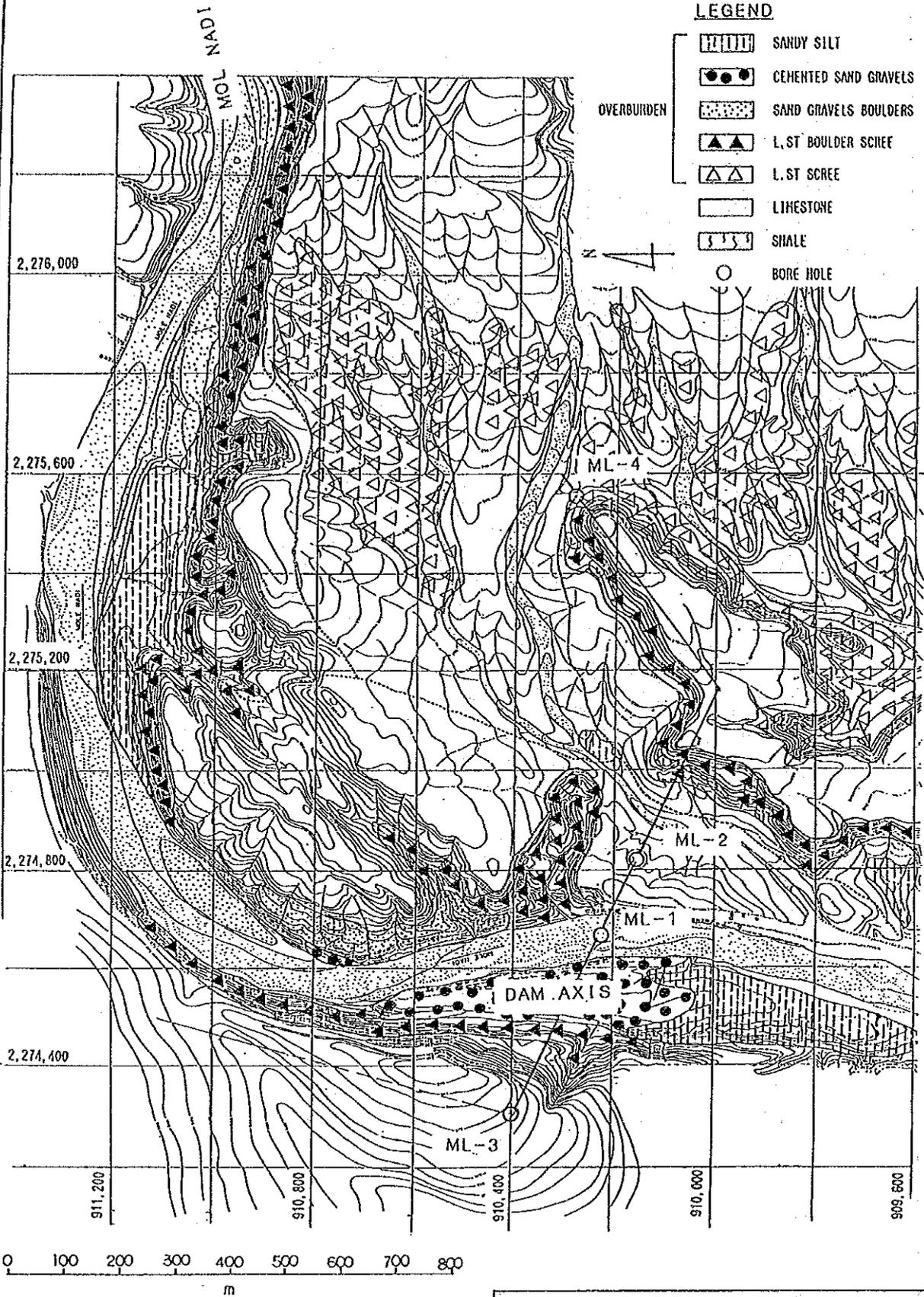


図 - 2 2 モルダムサイト地質図

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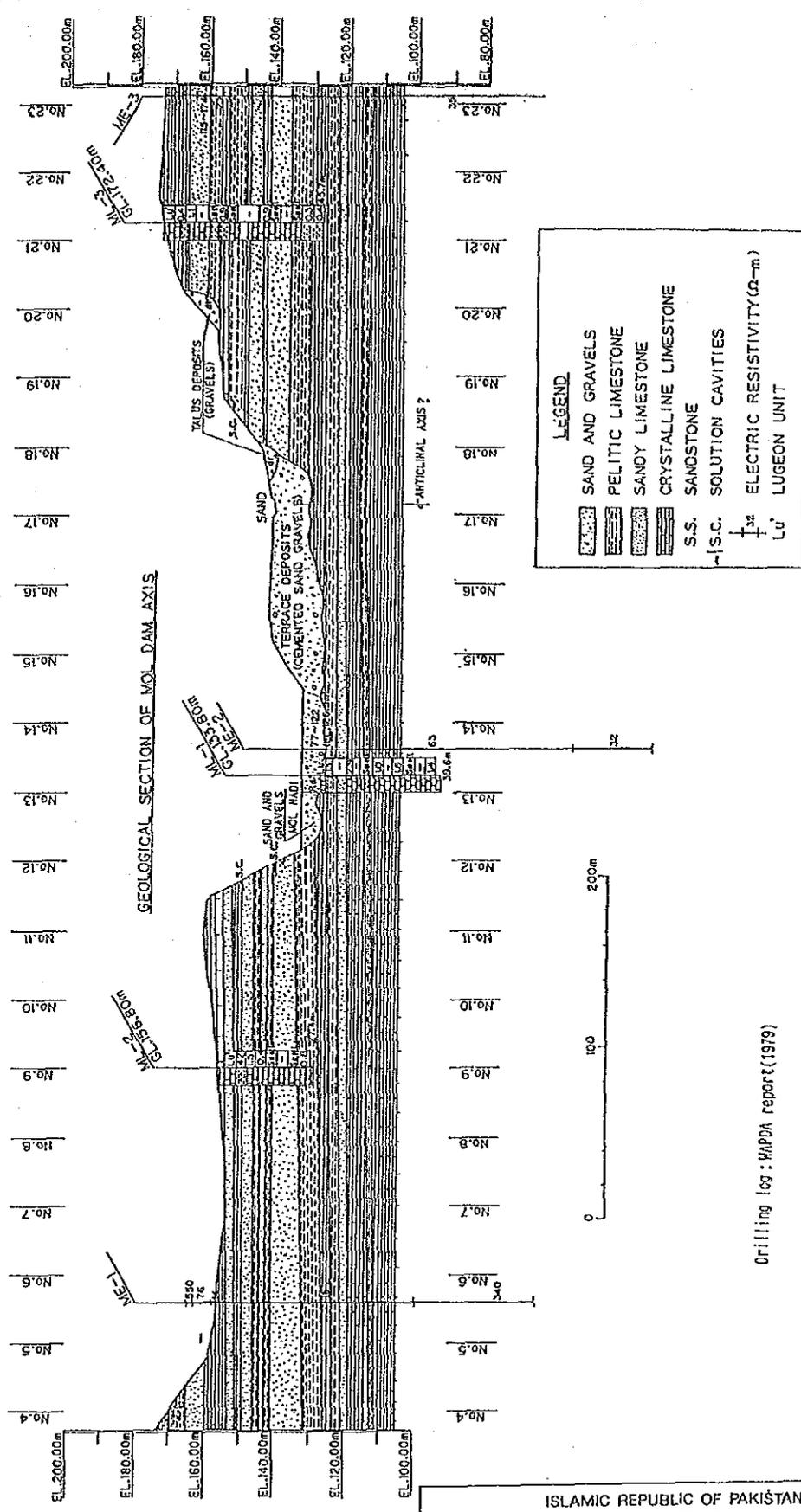


図 - 23 モルダム軸地質断面図

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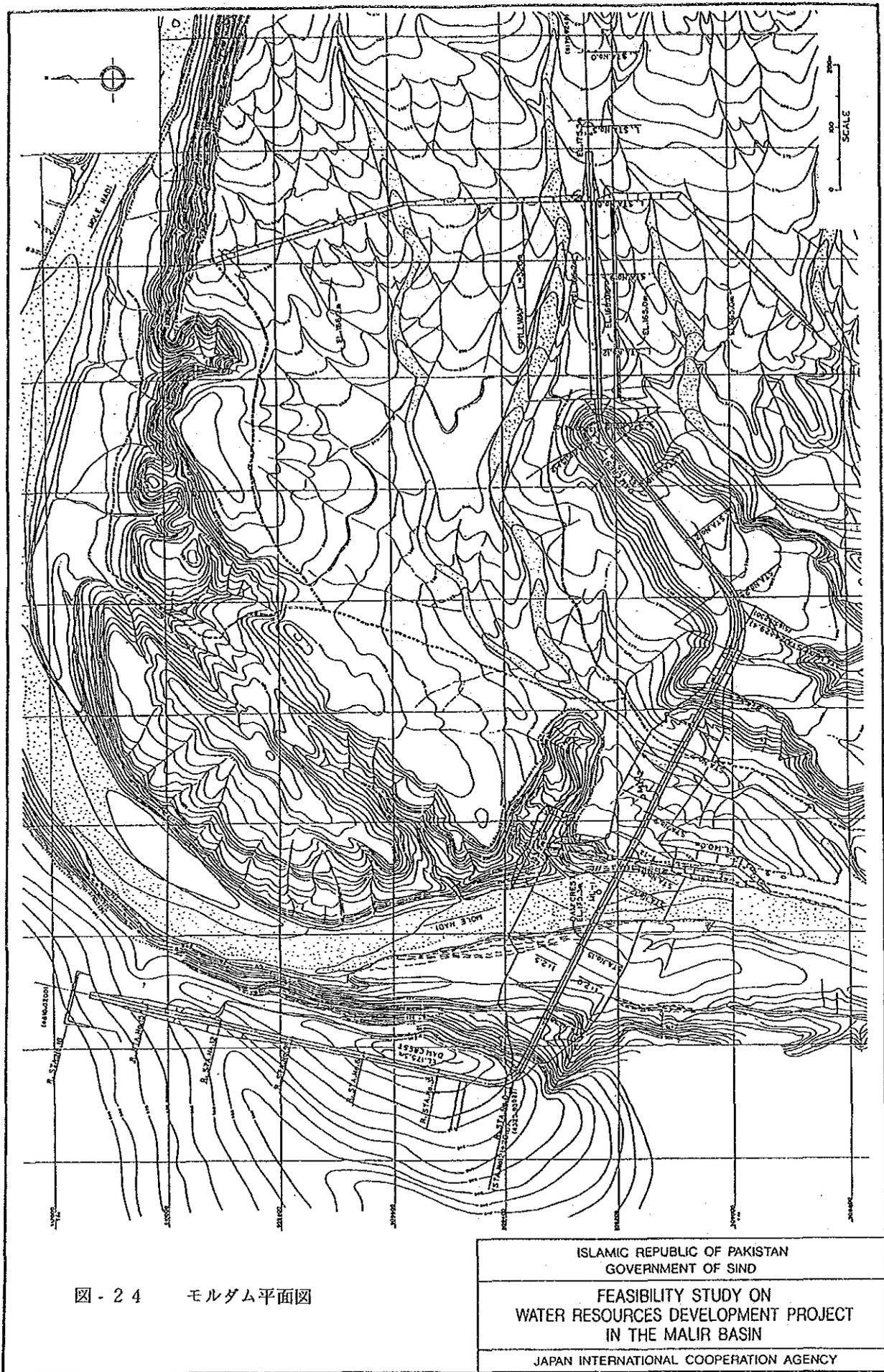


図 - 24 モルダム平面図

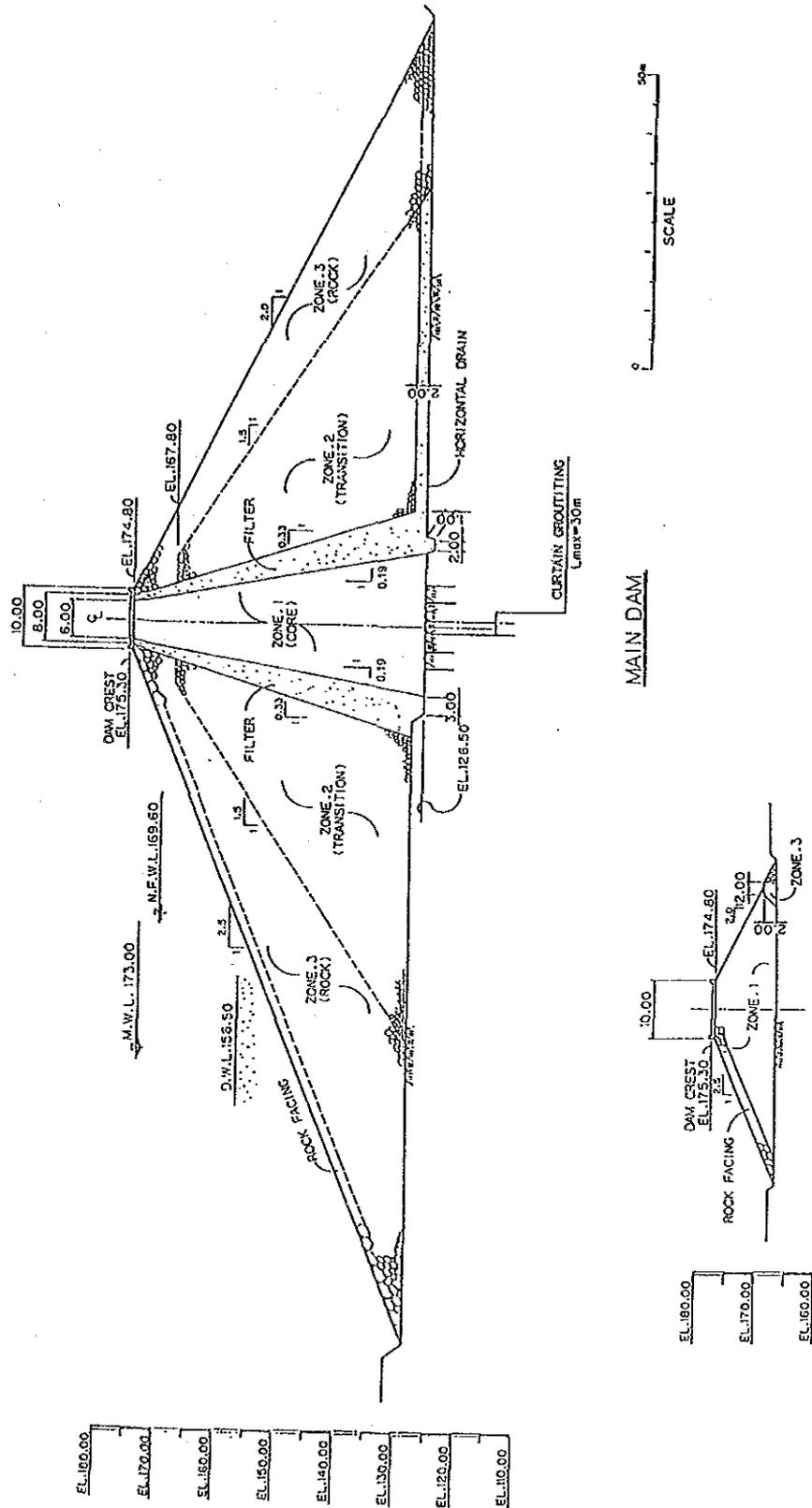


図 - 2 5 モルダム標準断面図

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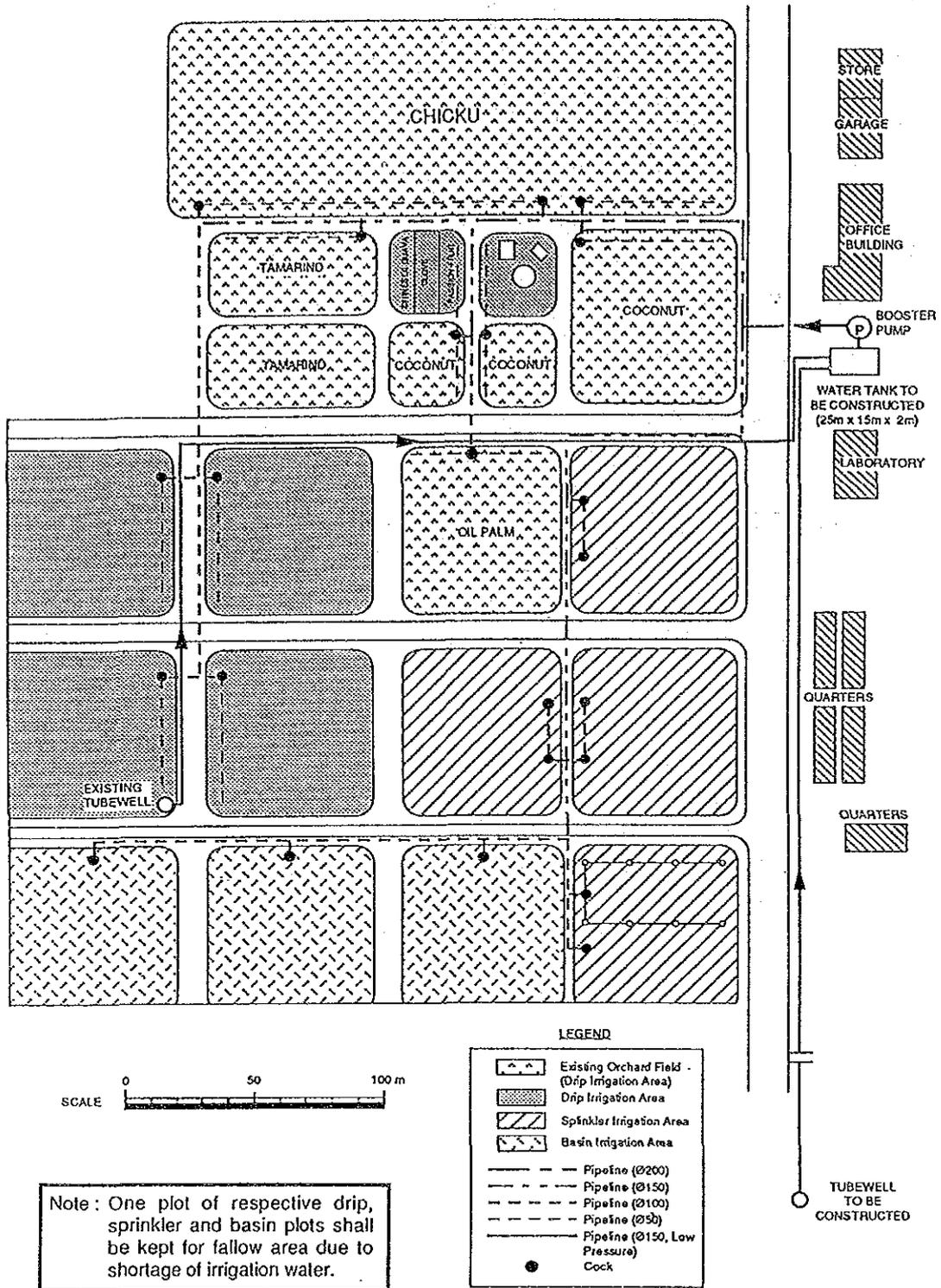


図 - 2 6 パイロット試験圃場一般図

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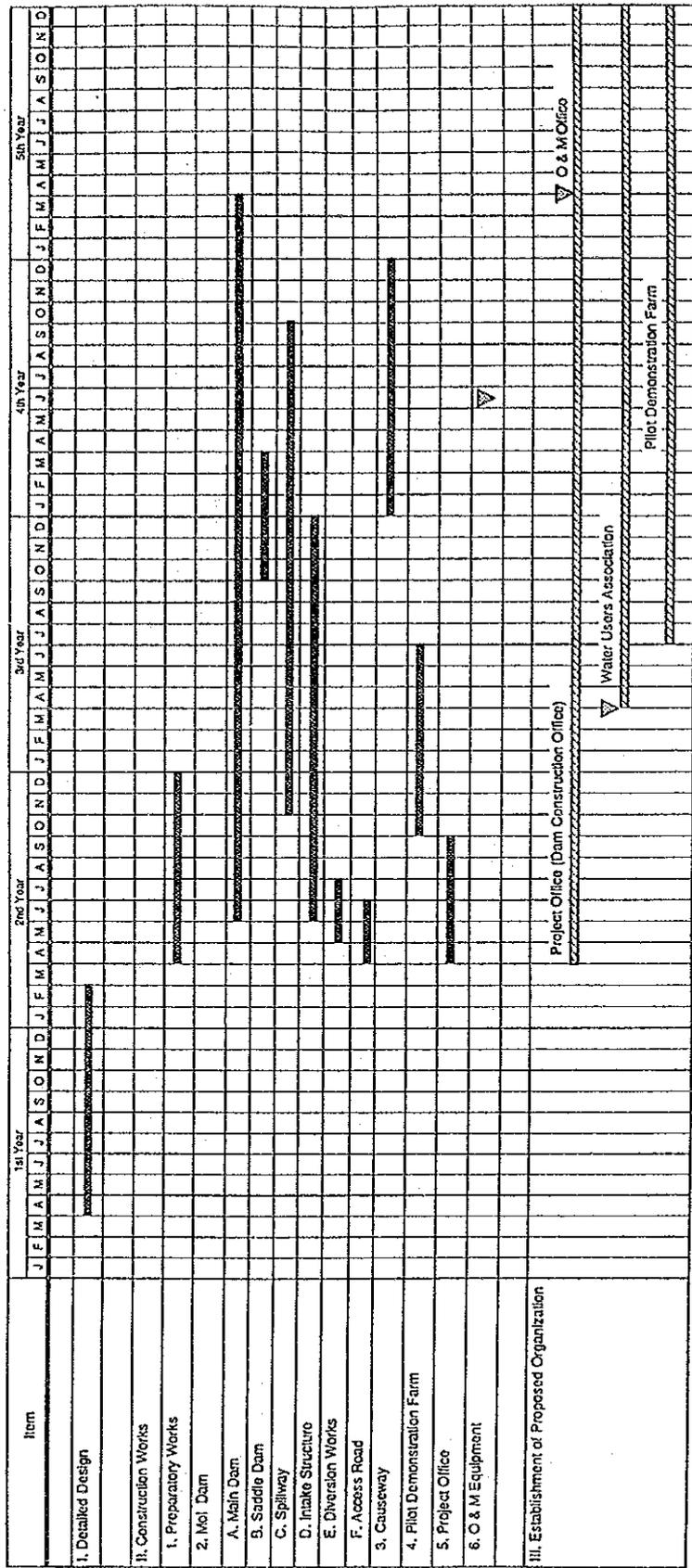
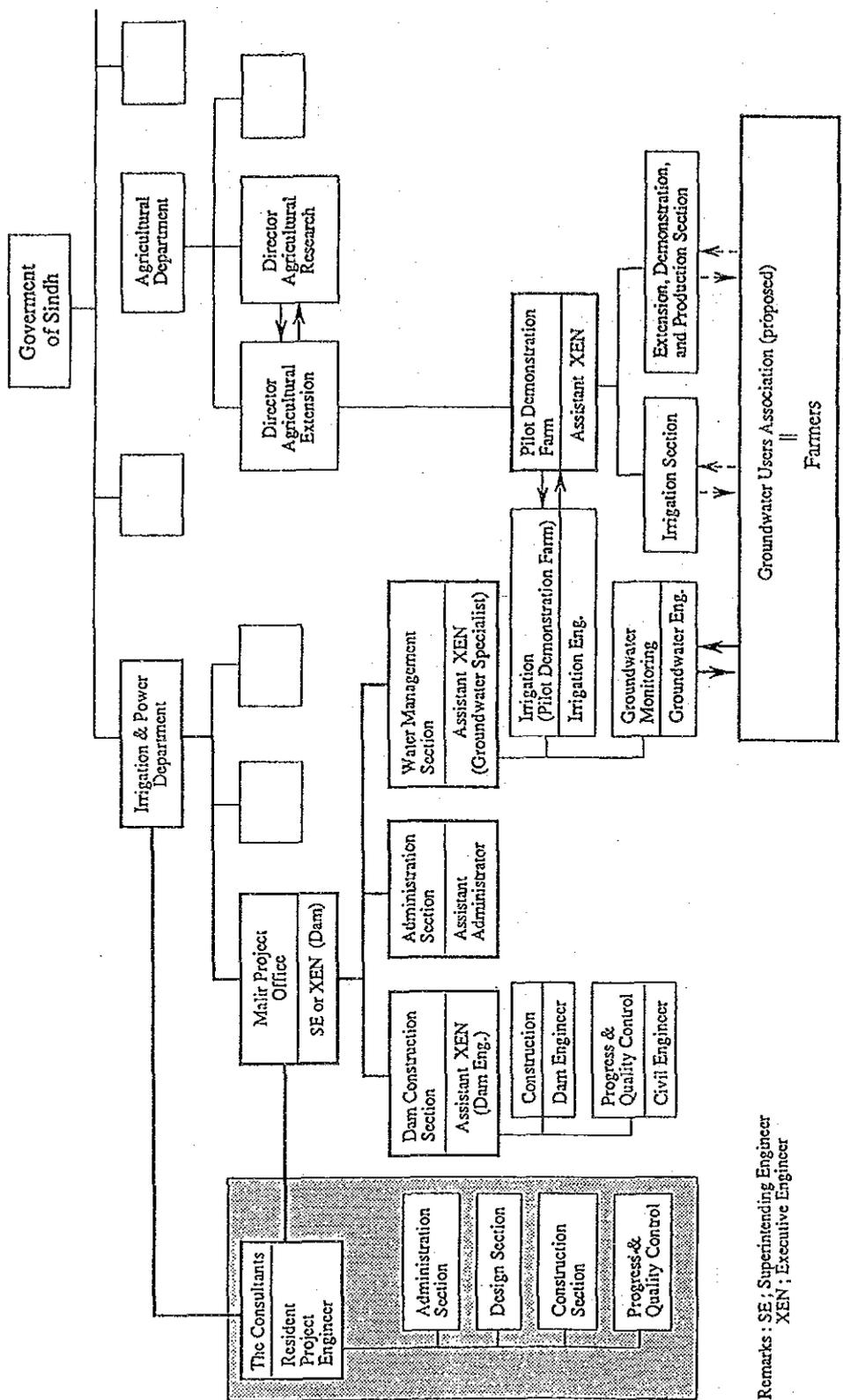


図 - 27 事業実施計画

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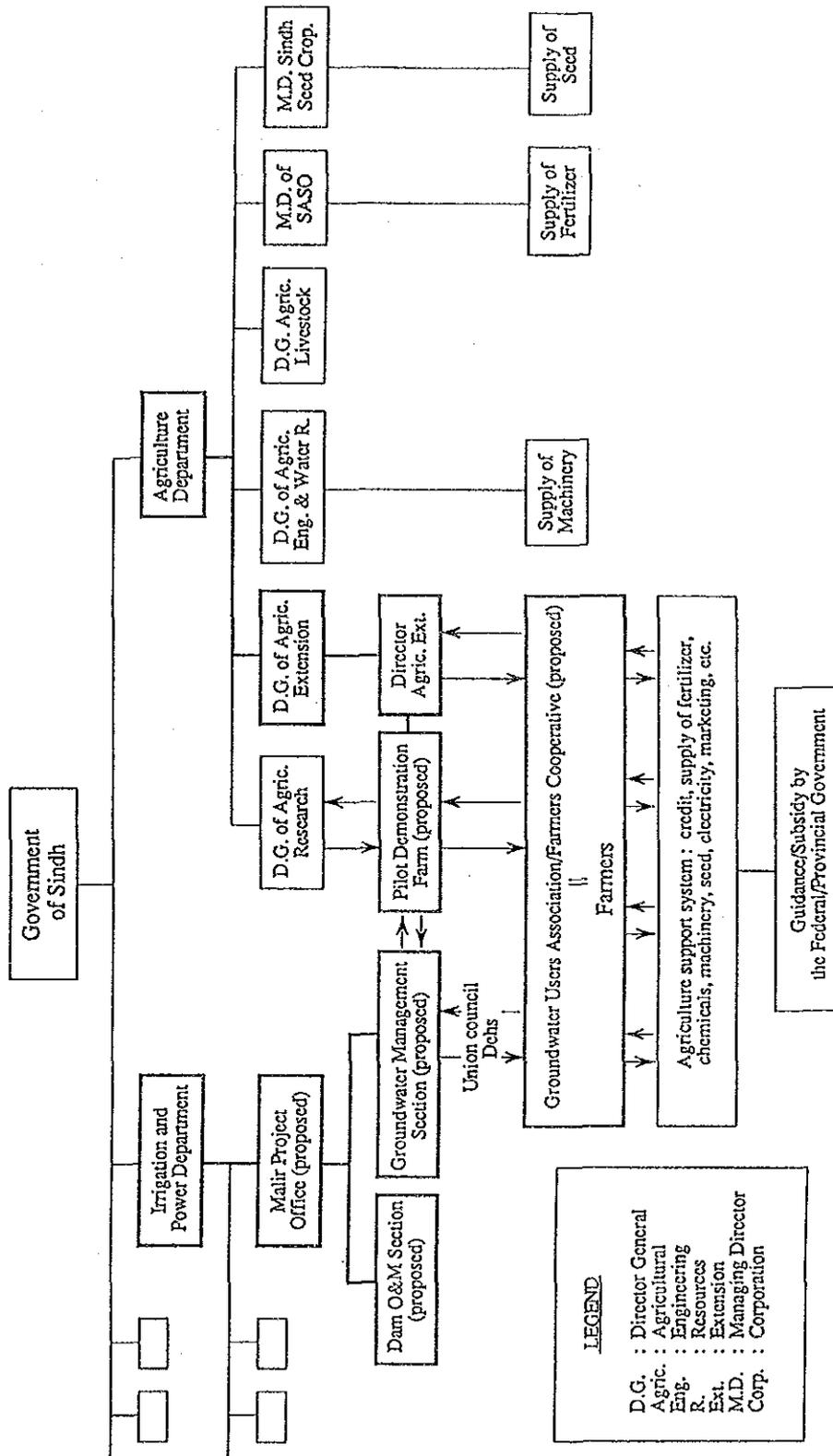
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Remarks : SE ; Superintending Engineer
XEN ; Executive Engineer

図 - 2 8 事業実施組織図

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FEASIBILITY STUDY ON
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LEGEND

D.G. : Director General
 Agric. : Agricultural
 Eng. : Engineering
 R. : Resources
 Ext. : Extension
 M.D. : Managing Director
 Corp. : Corporation

圖 - 29 維持管理組織圖

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 IN THE MALIR BASIN

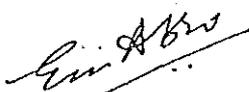
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附属資料

SCOPE OF WORK
FOR
THE FEASIBILITY STUDY
WATER RESOURCES DEVELOPMENT PROJECT
IN
MALIR BASIN

AGREED UPON BETWEEN
THE GOVERNMENT OF SIND
ISLAMIC REPUBLIC OF PAKISTAN
AND
THE JAPAN INTERNATIONAL COOPERATION AGENCY

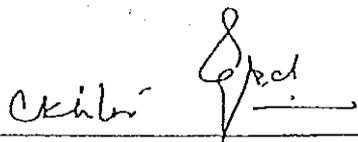
Karachi, February 6, 1989



Ghulam Mustafa Abro
Chief Water and Power,
Planning and Development:
Government of Sind



Mr. Norio UCHIYAMA
Leader of the Preliminary
Survey Team
Japan International
Cooperation Agency.



Mr. Akhtar Iqbal
Deputy Secretary,
Economic Affairs Division,
Ministry of Finance & Economics,
The Government of Pakistan,
Islamabad.

I. INTRODUCTION

In response to the request of the Government of the Islamic Republic of Pakistan (hereinafter referred to as "Pakistan"), the Government of Japan decided to conduct the feasibility study on Water Resources Development in Malir Basin (hereinafter referred to as "the Study") in accordance with the relevant laws and regulations in force in Japan.

Accordingly, Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of technical cooperation programmes of the Government of Japan, will undertake the Study in close cooperation with the authorities concerned of Pakistan. The present document sets forth the Scope of Work with regard to the Study.

II. OBJECTIVES OF THE STUDY

The objectives of the Study are:

1. to formulate the Agricultural and Water Resources Development project in Malir Basin and verify the feasibility of the project
2. to undertake technology transfer to the counterpart personnel in the course of the study

III. STUDY AREA

The study area is to cover the Malir River Basin, about 30,000ha, including agricultural land, (map attached)

IV. SCOPE OF THE STUDY

The study to be undertaken by the team will be carried out in two phases as follows:

Phase 1

- (1) Collection of data and information and review of the various studies already conducted.

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a) Physical conditions

- Topography
- Meteorology and hydrology
- Geology and soil mechanics
- Ground Water Survey
- Hydrogeological survey, (electrical resistivity if needed)
- Vegetation

b) Socio-economic status

- Demographic conditions
- Regional and national economy
- Rural infrastructure
- Municipal water demand

c) Agriculture

- Agriculture
- Agro-economy and institutional arrangement.
- Land use
- Soil
- Irrigation and drainage

(2) Home Office Work

analysis of the result of field survey and investigation

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Phase 2

(1) Supplement field survey and investigations

- Soil land use and land capability
- Irrigation and drainage survey
- Agro-economy and institutional arrangement.
- Regional economy
- Geological investigation at dam site
- Construction material and cost

(2) Establishment of basic concept

- Outline of agricultural development plan
- Outline of ground water recharge plan
- Basic layout of major structures
- Rough cost estimation
- Strategy for implementation

(3) Home Office Work

Analysis of the field survey and investigations including the following work items

- Final delineation of the project area paying particular attention to the results of ground water study
- Formulation of agriculture development, water resources development and management plan
- Layout of the project works including preliminary design of major structure
- Establishment of implementation plan and schedule
- Benefit and cost estimation
- Economic evaluation

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V. WORKING SCHEDULE

The Study will be executed in accordance with the attached tentative schedule.

VI. RE-PORTS

JICA will prepare and submit the following reports in English to the Government of Pakistan.

(1) Inception Report

Thirty (30) copies at the commencement of the first stage of the work

(2) Progress Report

Thirty (30) copies at the middle of the field work.

(3) Interim Report

Thirty (30) copies at the end of the field work.

(4) Draft Final Report

Thirty (30) copies within one (1) month after the end of the second stage home office work.

The Government of Pakistan will provide its comments on the draft final report within one (1) month after its reception.

(5) Final Report

Fifty (50) copies within two (2) months after the receipt of the comments on the draft final report.

VII. UNDERTAKING OF THE GOVERNMENT OF PAKISTAN

1. To facilitate smooth conduct of the Study, the Government of Pakistan will take necessary measures;

(1) to secure the safety of the Japanese study team,

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- (2) to permit the members of the Japanese study team to enter, leave and sojourn in Pakistan for the duration of their assignment therein, and exempt them from alien registration requirements and consular fees,
 - (3) to exempt the members of the Japanese study team from taxes, duties, fees and other charges on equipment, machinery and other materials brought into Pakistan for the conduct of the study,
 - (4) to exempt the members of the Japanese Study team from income tax and other charges of any kind imposed on or in connection with any emoluments or allowance paid to the members of the Japanese study team for their services in connection with the implementation of the Study,
 - (5) to provide necessary facilities to the Japanese study team for remittances as well as utilization of the funds introduced into Pakistan from Japan in connection with implementation of the Study.
 - (6) to secure permission for entry into private properties or restricted areas for the conduct of the Study,
 - (7) to secure permission for the Japanese team to take all data and documents (including photographs) related to the Study out of Pakistan to Japan by the Japanese study team, and
 - (8) to provide medical services as needed. Its expenses will be chargeable on the members of the Japanese study team.
2. The Government of Pakistan shall bear claims, if any arises, against the members of the Japanese study team resulting from, occurring in the course of, or otherwise connected with the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or wilful misconduct on the part of the members of the Japanese study team.

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3. Irrigation Department, the Government of Sind (hereinafter referred to as "the Department") shall act as a counterpart agency to the Japanese study team and also as a coordinating body to other relevant organizations for the smooth implementation of the Study.
4. The Department shall provide or arrange the Japanese study team with the following, in cooperation with other agencies concerned.
 - (1) Available data and information related to the Study
 - (2) Counterpart personnel
 - (3) Suitable office with necessary equipment and furniture
 - (4) Credentials or ID cards
 - (5) Necessary number of vehicles with drivers

VIII. UNDERTAKING OF JICA

For the implementation of the Study, JICA shall take following measures:

1. To dispatch, at its own expense, the study teams
2. To pursue technology transfer to the Pakistani counterpart personnel in the course of the Study

IX. OTHERS

JICA and the Department shall consult with each other in respect of any matter that arise from or in connection with the Study.

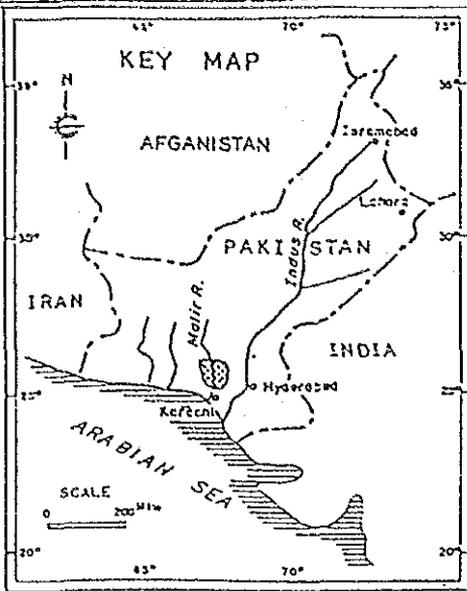
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TENTATIVE SCHEDULE

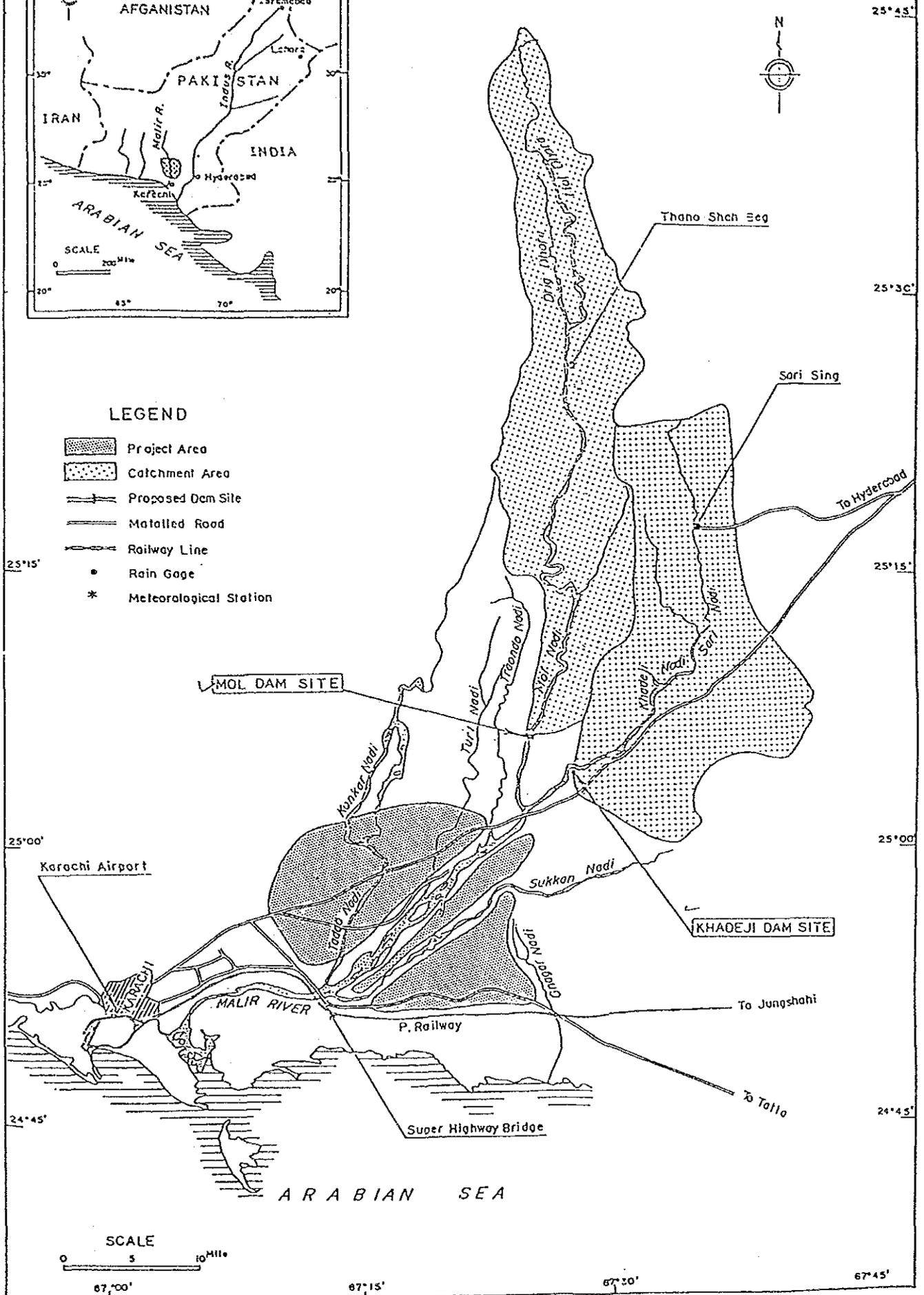
Item Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
WORK IN PAKISTAN		(Phase I)				(Phase II)													
		▬▬▬▬				▬▬▬▬													
WORK IN JAPAN																			
		□						▬											
REPORTS		△			△		△			△				△			△		
		Inc. R			P. R. 1		P. R. 2			Int. R				D. F. R.			F. R.		

(Remarks) Inc. R. : Inception Report P. R. : Progress Report
 Int. R. : Interim Report D. F. R. : Draft Final Report
 F. R. : Final Report
 ○ Comments on D. F. R. by Pakistan side

▬▬▬▬ : Field Work
 □ : Home Office Work

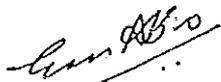


LOCATION MAP

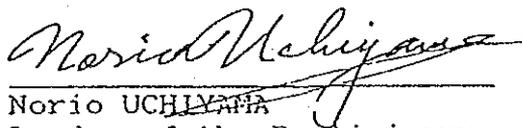


MINUTES OF MEETING
FOR
THE FASIBILITY STUDY
WATER RESOURCES DEVELOPMENT PROJECT IN MALIR RIVER BASIN
IN
THE ISLAMAIC REPUBLIC OF PAKISTAN

KARACHI, FEBRUARY 6, 1989



Ghulam Mustafa Abro
Chief Water and Power,
Planning and Development
Government of Sind.



Norio UCHIYAMA
Leader of the Preliminary
Survey Team
Japan International
Cooperation Agency.

The preliminary survey team for the Feasibility Study of Water Resources Development project in Malir Basin sent by JICA had series of discussions on the above mentioned project with the relevant officials of the Government of Sind from 30th January, 1989 to 10th February, 1989. The followings are summarized conclusions of the discussions.

1. The both sides agreed that this project sets the highest priority on irrigation.
2. The team requested to carry out the following items by the time of commencement of the study.

(1) Hydrology

- . to obtain copies of the data observed by the Surface Water and Hydrology Division WAPDA concerning with the Malir River
- . to obtain the basic data from WAPDA in Lahore concerning with the dam, justifying the proposed sediment volume and scale of spillway
- . to observe the front line of the surface water in the Malir River in case of any occurrence of the flood

(2) Ground Water

- . to prepare the geological map, concerning the whole study area about 30,000 ha
- . to obtain detailed map of the solution cavities or solution channels of KHADEJI dam from WAPDA

3. The team suggested as follows :

(1) Hydrology

- . that it would be necessary to repair the automatic rain gauge at the metrological observation station on super highway

(2) Ground Water

- . that the Govt. of Sind, Irrigation Department, would record the long term fluctuation of ground water level and quality
- . that the Govt of Sind would make contour map of ground water surface in rainy and dry season respectively.

(3) Agriculture

- . that the Govt. of Sind would study the possibility of expanding the planted area

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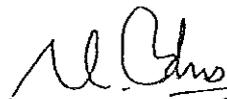
4. The team recommended that the Govt. of Sind carry out the pumping tests.
5. Pakistan side requested that the study would include the application of new irrigation method in relation to the scope of work IV. phase 2. (3).
6. Pakistan side requested that the Govt. of Japan would provide the necessary vehicles and measuring equipment for the study.

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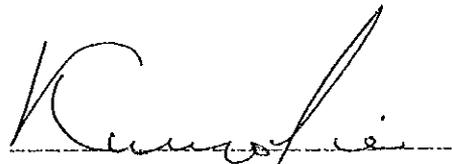
Minutes of Meeting
on
Draft Final Report
of
Feasibility Study
on
Water Resources Development Project
in
Malir Basin

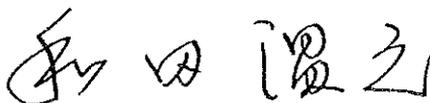
Agreed upon Between
The Government of Sindh
Islamic Republic of Pakistan
and
Japan International Cooperation Agency

Karachi, Dated 25th August, 1990


25.8.90

MOHAMMED IDRESS RAJPUT
Additional Secretary,
Irrigation and Power Dept.
The Government of Sindh


KUNIO IRIE
Team Leader
JICA Study Team



Witness
DR. MASAYUKI WADA
Chairman of JICA
Advisory Committee

PRESENTATION OF THE DRAFT FINAL REPORT OF
FEASIBILITY STUDY ON WATER RESOURCES DEVELOPMENT PROJECT
IN MALIR BASIN

Date : August 23, 1990

Place : 9:00 - The Conference Room of Planning and Development Dept.

12:00 - The Office of Secretary of Agriculture and Livestock Dept.

14:30 - The Office of Additional Secretary of Irrigation and Power Dept.

Attendants : As per annexure

In accordance with the Scope of Works for Feasibility Study on Water Resources Development Project in Malir Basin signed on February 6, 1989 between the Japan International Cooperation Agency (JICA) and the Government of Sindh (GOS), Islamic Republic of Pakistan, the JICA Study Team (the Team) carried out the Study. As a result of the Study, the Team prepared and submitted the Draft Final Report on August 22nd and meeting was held for the discussion on the Draft Final Report presenting the results of the Study. Both parties have mutually confirmed the following:

1. The JICA Study Team briefly explained the results of the Study, and the Draft Final Report describing results of the Study was accepted by GOS.
2. GOS requested to describe the staffing and O & M costs of the proposed Pilot Demonstration Farm. The Team agreed to do it in the Final Report.
3. GOS requested to submit eighty (80) copies of the Final Report, instead of 50 copies stipulated in the Scope of Work. The Team agreed to transfer the GOS's request to JICA.
4. GOS is keen to implement the project as early as possible, in due consideration of the socio-economic conditions in the project area.
5. GOS will send comments if any before September 21st, 1990 in accordance with the Scope of Work agreed upon between JICA and GOS on February 06, 1989. The Team expressed to receive comments if any as early as possible, and prepare the Final Report in due consideration of comments if necessary within two (2) months after receiving comments.
6. GOS expressed thanks to the Team for their dedicated works on this project, and is pleased to receive the Final Report for early implementation.

LIST OF ATTENDANTS

A. The Government of Sindh

A-1 9:00 -

- | | |
|--------------------------|--|
| 1. Mr. Fazlullah Qureshi | Additional Chief Secretary (Dev), P & D Dept. |
| 2. Mr. Munmir A. Qazi | Chief (Agriculture), P & D Dept. |
| 3. Mr. Ghulam M. Abro | Chief (Water & Power), P & D Dept. |
| 4. Mr. Khair M. Soomro | Deputy Secretary (Technical) Agriculture & Livestock Dept. |
| 5. Mr. G. Sarwar Khero | Chief (Foreign Aid) P & D Dept. |
| 6. Mr. Allah B. Kalhoro | Assistant Chief (Foreign Aid) P & D Dept. |
| 7. Mr. M. Iqbal Shaikh | Executive Engineer Irrigation & Power Dept. |

A-2 12:00 -

- | | |
|----------------------------|--|
| 1. Mr. Kamaluddin Qureshi | Secretary, Agriculture & Livestock Dept. |
| 2. Mr. Shaukat Rahmo | Deputy Secretary (Technical) Agriculture & Livestock Dept. |
| 3. Mr. Khair M. Soomro | Deputy Secretary (Technical) Agriculture & Livestock Dept. |
| 4. Mr. Masood Ahmed Bhutto | Director, Agricultural Engineering, Sindh, Hyderabad. |
| 5. Mr. M. Arif Ali | Section Officer, Agriculture & Livestock Dept. |
| 6. Mr. M. Arif Khairi | Section Officer, Agriculture & Livestock Dept. |

A-3 14:30-

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|---------------------------|---|
| 1. Mr. Mohammed I. Rajput | Additional Secretary, Irrigation and Power Dept. |
| 2. Mr. Iqbal Shaikh | Executive Engineer Irrigation & Power Dept. |
| 3. Mr. Noor Ahmed Memon | Assistant Ex. Engineer Irrigation and Power Dept. |

B. JICA Advisory Committee

- | | |
|---------------------|--------------------------------------|
| 1. Dr Masayuki Wada | Chairman of Advisory Committee, MAFF |
|---------------------|--------------------------------------|

C. JICA Study Team

- | | |
|--------------------------|--------------------|
| 1. Mr. Kunio Irie | Team Leader |
| 2. Mr. Shunichi Muramoto | Deputy Team Leader |
| 3. Mr. Motoo Taki | Dam Engineer |



JICA