

TABLE 5.6 CROPPING PATTERN IN THE STUDY AREA (AVERAGE IN 1986-1990)

CROPS	WATER SOURCES	CROPPED ACREAGE (ha)	PERCENT TO CCA (%)
[KHARIF]			
JOWAR	H.TORRENT *	2,124	18
	TUBEWELL **	205	14
	TOTAL	2,329	17
BAJRA	H.TORRENT	313	3
	TUBEWELL	17	1
	TOTAL	330	2
K.OTHERS	H.TORRENT	61	1
	TUBEWELL	128	9
	TOTAL	189	1
SUBTOTAL	H.TORRENT	2,498	21
	TUBEWELL	350	24
	TOTAL	2,848	21

[RABI]			
WHEAT	H.TORRENT	453	4
	TUBEWELL	1,140	78
	TOTAL	1,593	12
GRAM	H.TORRENT	156	1
	TUBEWELL	31	2
	TOTAL	187	1
OILSEEDS	H.TORRENT	57	0
	TUBEWELL	16	1
	TOTAL	73	1
R.OTHERS	H.TORRENT	1	0
	TUBEWELL	65	4
	TOTAL	66	0
SUBTOTAL	H.TORRENT	667	6
	TUBEWELL	1,252	86
	TOTAL	1,919	14

[TOTAL]	H.TORRENT	3,165	24
	TUBEWELL	1,602	110
	TOTAL	4,767	36
CULTIVABLE COMMAND AREA (ha)		TOTAL	13348
		(TUBEWELL	1462)

* The cropped area irrigated by Hill Torrent

** The cropped area irrigated by Tubewell

Source: Arranged by JICA STUDY TEAM based on the data from D. G. Khan Tehsil office.

TABLE 5.7 CROP YIELD PER HECTARE IN THE STUDY AREA

CROP	1986	1987	1988	1989	1990	(unit: kg)
						Average
JOWAR	1,000	1,000	993	1,000	1,005	1,000
BAJRA	900	899	872	922	909	900
WHEAT	1,197	1,196	1,209	1,197	1,197	1,199
GRAM	902	903	859	903	893	892
OILSEEDS	680	1,000	700	690	786	771

Source: JICA STUDY TEAM estimated it on the basis of the data from D. G. Khan Tehsil Office.

TABLE 5.8 PRICES OF MAIN COMMODITIES (1990-1991)

Commodities	Support Prices (Rs./40kg)	Wholesale Prices (Rs./40kg)	Retail Prices (Rs./40kg)	Farmgate Prices (Rs./40kg)
Wheat	112.00	116.06	157.00	140
Gram	210.00	210.85	280.00	220
Oilseeds				
a) Sunflower	225.00			
b) Soybean	200.00			
c) Safflower	180.00	180.00		
d) Rape & Mustard				180
Masoor		640.69	880.00	
Mash (whole)		363.29	560.00	
Moong (split)		386.16	560.00	
Chilies		657.09	1,120.00	
Gur		269.71	280.00	
Veg. Ghee		285.00 (*1)	120.00 (*1)	
Beef		898.37	960.00	
Mutton		1,761.16	1,760.00	
Milk		262.70	320.00	
Eggs		359.81 (*2)	420.00 (*2)	
Potato		130.28	320.00	
Onion		253.48	200.00	
Salt (Rock)		43.72	80.00	
Jowar				160
Bajra				180

Source : Support Prices -- Agricultural Price Commission
 Wholesale Prices -- Economic Survey 1990-1991
 Retail Prices -- Bureau of Statistics, Field Office, D.G.Khan
 Farmgate Prices -- JICA Study Team, Result of Household
 Questionnaire at Vidore Hill Torrent &
 Tribal Area

Note *1 : Rs./5kg

*2 : Rs./1,000Nos.

TABLE 5.9 HOUSEHOLD ECONOMY IN THE STUDY AREA

Item	(Unit: Rs./year/household)			
	Upstream	Middle	Downstream	Average
1. Annual Gross Income				
Agricultural Output	14,100	20,900	21,400	18,800 (58%)
Non-agricultural Output	11,800	16,400	13,400	25,500 (42%)
Total	25,900	37,300	34,800	32,400 (100%)
2. Agricultural Input and Output				
Output				
Crops	22,500	30,800	30,200	27,800
Livestock	9,200	9,800	8,500	9,200
Input				
Crops	9,600	12,700	8,500	10,300
Livestock	8,000	7,000	8,800	7,900
Balance	14,100	20,900	21,400	18,800
3. Farm Budget				
Gross Income	25,900	37,300	34,000	32,400
Expenditure	22,300	29,200	22,100	24,500
Balance	3,600	8,100	11,900	7,900
4. Household Expenditure				
Food Grain				
Wheat	-	-	-	9,200
Others	-	-	-	860
Other Food				
Meat	-	-	-	9,200
Others	-	-	-	860
Sub-total	13,430			
				(55%)
Commodities	-	-	-	11,100 (45%)
Total	-	-	-	24,530 (100%)

TABLE 5.10 COMMAND AREA OF THE STUDY AREA

Name of Moza	Cultivable Area			Grazing & Waste	Nala etc.	Area Total	(Unit : ha)
	Flood	Flood & Pump	Canal				Moza Total
1. Bela	1,101			311	500	1,912	1,912
2. Dalana Patizai	588			286	277	1,151	1,151
3. Wahi Kingrani	144			41	5	190	190
4. Kochha Wadani	164	40		60		264	630
5. Vidore	2,516	213		251	343	3,323	3,323
6. Norwar	2,531	68		108	95	2,802	2,803
7. Dagar Chit	597	75		345	16	1,033	3,142
8. Chabri Bala Gharbi	115	19	454			588	3,317
9. Choratta Pachadh Shumali	1,484	391	69	170		2,114	3,269
10. Choratta Pachadh Janubi	231	65	88	59		443	737
11. Gadai Gharbi	602	579	99	35	19	1,334	3,670
12. Chit Sarkani		12	140			152	1,406
13. Dalana Khas	1,813			315	301	2,429	3,909
14. Rakh Bela				1,610		1,610	
Total	11,886	1,462	850	3,591	1,556	19,345	29,459

TABLE 5.11 EXISTING INTAKE DISCHARGE CAPACITY

Name of branch	2 years			5 years			10 years			25 years		
	Qf	Qi	Qf-Qi	Qf	Qi	Qf-Qi	Qf	Qi	Qf-Qi	Qf	Qi	Qf-Qi
Escape branch	195 (28%)	35 (4%)	160 (457%)	365 (33%)	35 (4%)	330 (943%)	480 (34%)	35 (4%)	445 (1271%)	595 (33%)	35 (4%)	560 (1600%)
Chhabri branch	200 (29%)	350 (36%)	-150 (-43%)	285 (26%)	350 (36%)	-65 (-19%)	335 (24%)	350 (36%)	-15 (-4%)	410 (23%)	350 (36%)	60 (17%)
Suchani branch	175 (25%)	205 (21%)	-30 (-15%)	250 (23%)	205 (21%)	45 (22%)	290 (21%)	205 (21%)	85 (41%)	340 (19%)	205 (21%)	135 (66%)
Plullar branch	120 (17%)	395 (40%)	-275 (-70%)	210 (19%)	395 (40%)	-185 (-47%)	300 (21%)	395 (40%)	-95 (-24%)	450 (25%)	395 (40%)	55 (14%)
Sub-Total	690	985	-295 (-30%)	1110	985	125 (13%)	1405	985	420 (43%)	1795	985	810 (82%)
Zai Nallah	15	50	-35 (-70%)	25	50	-25 (-50%)	30	50	-20 (-40%)	40	50	-10 (-20%)
Dalana Nallah	80	165	-85 (-52%)	130	165	-35 (-21%)	160	165	-5 (-3%)	210	165	45 (27%)
Sub-Total	95	215	-120 (-56%)	155	215	-60 (-28%)	190	215	-25 (-12%)	250	215	35 (16%)
Total	785	1200	-415 (-35%)	1265	1200	65 (5%)	1595	1200	395 (33%)	2045	1200	845 (70%)

Note: Qf: Flood discharge, Qi: Intake capacity

TABLE 5.12 PRESENT PROBABLE IRRIGATED AREA

Return Period		Chhabri Branch	Suchani Branch	Phullar Branch	Zai Nallah	Dalana Nallah	(Unit: ha) Total
1/2	Kharif	1,671	865	632	85	419	3,672
	Rabi	20	57	44	16	69	206
	Total	1,691	922	676	101	488	3,878
1/5	Kharif	1,950	1,009	738	99	489	4,285
	Rabi	23	68	50	18	81	240
	Total	1,973	1,077	788	117	570	4,525
1/10	Kharif	2,098	1,086	793	107	526	4,610
	Rabi	24	73	54	19	88	258
	Total	2,122	1,159	847	126	614	4,868
1/25	Kharif	2,257	1,168	854	115	565	4,959
	Rabi	26	79	58	21	94	278
	Total	2,283	1,247	912	136	659	5,237

TABLE 5.13 ROAD INVENTORY IN THE STUDY AREA

	Length (km)			Width (m)	
	Within the Study Area	Out of the Study Area	Total	Effective Width	Total Width
1. Existing Roads					
a. D.G.Khan	7	2.66	9.66	3	7.3
- Vidore					
b. Jhoke Yar Shah	2.7	8		3	7.3
- Kochha Wadani	13.0 (*1)				
Total	22.7	10.66	21.66		
2. Roads under Construction					
a. Ladan					
- Kochha Wadani	7	18	25	3	7.3
Total	7	18	25		
3. Roads under Planning					
a. AL-GHAZI					
Tractor Factory	16	-	16	3	7.3
- Dalana					
b. Vidore - Bela	9.7	-	9.7	3	7.3
Total	25.7		25.7		

*1 : Katcha Road

TABLE 5.14 POPULATION OF THE MAJOR VILLAGE OF THE WATERSHED (1991)

Name of Village	(Unit : persons)		
	Both Sexes	Male	Femal
1. Baga	2,000	1,100	900
2. Dehar	1,200	650	550
3. Nelagh	2,500	1,300	1,200
4. Pishi Khosa	170	80	90
5. Pishi Leghari	200	105	95
6. Taksa Shumali	2,000	1,200	800
7. Zai	150	80	70
8. Rai	150	78	72
9. Sarthouh	2,000	1,200	800
10. Mat Chandia	1,500	800	700
11. Ganden Sandh	250	120	130
12. Washafee	252	127	125
13. Khar Shakh	150	70	80
14. Shafeh	101	51	50
15. Gull Khandagh	222	122	100
16. Ban Bun	150	80	70
17. Heesi	200	100	100
18. Kaheer Nanal	60	35	25
19. Lazura	200	100	100
20. Manhi	300	160	140
21. Patra	300	150	150
22. Shambo	1,100	600	500
23. Bail Pather	4,500	2,500	2,000
24. Zahar Aff	3,500	1,800	1,700
Total	23,155	12,608	10,547

Source : JICA Study Team

TABLE 5.15 SOCIAL FACILITIES IN THE WATERSHED

Name of Village	Primary School	Secondary School	Dispensary	Postbox
1. Baga	2	-	-	-
2. Dehar	-	-	-	-
3. Nelagh	4	1	1	1
4. Pishi Khosa	-	-	-	-
5. Pishi Leghari	-	-	-	-
6. Taksa Shumali	1	-	-	-
7. Zai	-	-	-	-
8. Rai	-	-	-	-
9. Sarthouh	3	-	-	-
10. Mat Chandia	1	1	-	-
11. Ganden Sandh	1	-	-	-
12. Washafee	1	-	-	-
13. Khar Shakh	-	-	-	-
14. Shafeh	1	-	-	-
15. Gull Khandagh	2	-	-	-
16. Ban Bun	-	-	-	-
17. Heesi	-	-	-	-
18. Kaheer Nanal	-	-	-	-
19. Lazura	-	-	-	-
20. Manhi	1	1	-	-
21. Patra	-	-	-	-
22. Shambo	3	-	-	-
23. Bail Pather	5	-	-	-
24. Zahar Aff	3	-	-	-
Total	28	3	1	1

Source : JICA Study Team

TABLE 5.16 ROAD INVENTORY IN THE WATERSHED AREA

Origin & Destination	Length in Study Area	Length in without Study Area	Total (km)	Width (m)
1) Sakhi Sarwar - Baghar Chur Camp	21	20	41	3.5
2) Runghan - Bar Bun	4	-	4	3.5
3) Rungham BMP - Ek-Bhai	21	-	21	3.5
4) Maia - Bundluck	3.5	-	3.5	3.5
5) Maia - Tholagh Degar	2	-	2	3.5
6) Maia - Bulluck	6	-	6	3.5
7) Baghar Chur - Selfef	16	-	16	3.5
8) Jhand - Miskhrani	5	-	5	3.5
Total	78.5	20	98.5	

Source: Highway Division D. G. Khan

TABLE 5.17 WATER SUPPLY SCHEME IN THE WATERSHED AREA

Name of Area	No. of Villages	No. of Noses	Supplied population (persons)
1) Post Mubarki	8	9	2,155
2) Souray Koh	3	4	510
3) Nallani	2	4	800
4) Lundani Loop	4	6	1,735
5) Roonghan	5	6	700
Total	22	29	5,900

Source: Public Health Engineering D. G. Khan

TABLE 5.18 SUMMARY OF FARM SURVEY IN THE WATERSHED

	Minimum	Maximum	Average
1. Farm size (ha)			
Total	2	120	27.0
Net sown area	1	13	4.6
Cultivable waste	1	60	22.4
2. Farm Plots			
Number of farms	2	70	15.0
Plot size (ha)	0.5	60	1.3-11.8
Distance to farm (km)	0	15	0.2-3.5
3. Cropping intensity (%)			
Total	8	50	17.0
Jowar	6	50	14.0
Bajra	0	0	0.0
Wheat	0	13	3.0
Gram	0	0	0.0
Oilseeds	0	0	0.0
4. Seeding rate (kg/ha)			
Jowar	18	27	25.0
Bajra			
Wheat	100	100	100.0
Gram			
Oilseeds			
5. Crop yield (kg/ha)			
Jowar	700	1000	875.0
Bajra			
Wheat	600	800	760.0
Gram			
Oilseeds			
6. Livestock			
Cattle	1	14	6.5
Buffaloes			
Sheep	0	110	42.2
Goats	0	65	27.3
Horses	0	3	1.6
Donkeys	0	2	1.4
Camels	0	2	1.3
Poultry	4	125	32.4

TABLE 6.1 FLOOD DISCHARGE AT DARRAH POINT

(Unit: MCM)

	Case A						Case B-1						Case B-2					
	VIDORE		DALANA		Total	VIDORE	ZAI		DALANA		Total	VIDORE	ZAI		DALANA		Total	
	122.79	2.50	12.37	9.88	137.66		115.26	2.11	9.34	126.71	110.68		2.12	9.34	122.14			
Average	107.54	2.00	9.88	9.88	119.42	100.01	1.64	7.17	108.82	95.80	1.64	7.17	104.61					
Return Period	149.97	3.04	15.02	15.02	168.03	141.30	2.56	11.33	155.19	136.12	2.56	11.33	150.01					
2 Years	186.39	4.07	20.19	20.19	210.65	177.12	3.52	15.64	196.28	171.23	3.52	15.64	190.39					
5 Years	242.18	5.86	29.12	29.12	277.16	232.53	5.21	23.28	261.02	225.58	5.21	23.28	254.07					
10 Years																		
25 Years																		

Source: Water year is from May to April.

TABLE 6.2 CALCULATION OF CANAL CAPACITY (1/4)

NAME	W (m)	D (m)	A (sqm)	P (m)	R (m)	n	I	v (m/s)	Q (cms)	T (hour)	V (x1000m ³)	Area (sqm)	V (x1000m ³)	Q (cms)	Remarks
[Chhabri branch]															
C-1	7.0	0.15	1.16	8.53	0.136	0.04	1/300	0.38	0.44	15.0	24.00	40,000.00	60.00	0.37	L-Direct
-2	5.0	0.15	0.86	6.53	0.132	0.04	1/300	0.37	0.32	15.0	17.44	30,000.00	45.00	0.28	L-Direct
-3	5.0	0.60	3.90	8.23	0.474	0.04	1/350	0.81	3.17	15.0	171.04	500,000.00	750.00	2.78	L-Wah
-4	10.2	2.80	36.40	18.12	2.009	0.04	1/270	2.42	88.17	15.0	4,761.26	180,000.00	270.00	1.67	R-Wah
-5	10.0	2.80	35.84	17.92	2.000	0.04	1/300	2.29	82.12	13.0	3,843.14	1,700,000.00	2,550.00	5.45	R-Wah
-6	2.7	0.60	2.13	4.79	0.445	0.04	1/300	0.84	1.80	13.0	84.08	910,000.00	1,365.00	5.83	L-Wah
-7	5.4	0.30	2.07	8.46	0.245	0.04	1/350	0.52	1.08	13.0	50.65	40,000.00	60.00	0.43	L-Direct
-8	7.2	0.90	6.48	9.00	0.720	0.40	1/350	1.07	6.96	13.0	325.55	100,000.00	150.00	1.07	R-Direct
-9	4.1	0.30	1.68	7.16	0.235	0.04	1/400	0.48	0.80	13.0	37.39	50,000.00	75.00	0.53	L-Direct
-10	10.0	0.20	2.40	14.02	0.171	0.04	1/400	0.39	0.92	13.0	43.29	130,000.00	195.00	1.39	R-Direct
-11	5.0	0.20	1.40	9.02	0.155	0.03	1/500	0.43	0.60	13.0	28.21	180,000.00	270.00	1.92	R-Direct
-12	9.7	0.95	10.72	13.39	0.800	0.03	1/630	1.14	12.27	10.0	441.77	380,000.00	570.00	5.28	L-Wah
-13	12.6	0.15	2.12	15.61	0.135	0.04	1/400	0.33	0.70	10.0	25.10	150,000.00	225.00	2.08	R-Direct
-14	4.0	0.20	1.20	8.02	0.150	0.04	1/400	0.35	0.42	10.0	15.22	90,000.00	135.00	1.25	R-Wah
-15	8.2	1.10	10.75	12.04	0.893	0.04	1/390	1.17	12.62	10.0	454.25	13,530,000.00	20,295.00	22.55	R-Wah
-16	4.5	1.25	10.83	13.20	0.821	0.04	1/360	1.17	12.69	10.0	456.83	60,000.00	90.00	0.83	L-Direct
-17	6.5	2.00	23.00	17.27	1.332	0.04	1/510	1.59	36.68	10.0	1,320.60	7,080,000.00	10,620.00	14.15	L-Wah
-18	10.0	1.80	26.10	19.69	1.325	0.03	1/510	1.78	46.48	7.0	1,171.34	7,610,000.00	11,415.00	22.65	R-Wah
-19	9.9	0.50	6.20	15.00	0.413	0.03	1/550	0.79	4.89	7.0	123.23	30,000.00	45.00	0.60	L-Direct
-20	4.0	0.30	1.50	6.09	0.246	0.03	1/550	0.56	0.84	7.0	21.12	860,000.00	1,290.00	10.24	L-Wah
-21	8.1	1.30	14.76	15.10	0.977	0.03	1/550	1.40	20.65	7.0	520.39	70,000.00	105.00	1.39	L-Direct
-22	11.7	0.90	14.58	20.88	0.698	0.03	1/550	1.12	16.31	7.0	411.05	150,000.00	225.00	2.98	R-Direct
-23												4,730,000.00	7,095.00		
Sub-Total									350.94		14,346.93				

Note)

W: Channel width

A: Flow area

P: Wetted perimeter

R: Hydraulic mean depth

n: Coefficient of roughness

I: Gradient of channel

v: Velocity of flow = $1/n \times R^{2/3} \times I^{1/2}$

Q: Discharge = $A \times V$

Area: Irrigated area

V: Water requirement for irrigation

Q: Discharge for irrigation

L-Direct: Direct intake system from river-left-bank

R-Direct: Direct intake system from river-right-bank

L-Wah: Canal intake system from river-left-bank

R-Wah: Canal intake system from river-right-bank

TABLE 6.2 CALCULATION OF CANAL CAPACITY (2/4)

NAME	W (m)	D (m)	A (sqm)	P (m)	R (m)	n	I	v (m/s)	Q (cms)	T (hour)	V (x1000m ³)	Area (sqm)	V' (x1000m ³)	Q' (cms)	Remarks
[Suchani branch]															
S-1	6.3	0.50	4.40	11.40	0.386	0.04	1/250	0.84	3.69	15.0	199.16	70,000.00	105.00	0.65	L-Direct
-2	3.2	0.30	1.14	4.54	0.251	0.04	1/250	0.63	0.72	15.0	38.73	500,000.00	750.00	2.78	R-Direct
-3	3.5	0.50	2.25	5.74	0.392	0.04	1/250	0.85	1.91	15.0	102.94	60,000.00	90.00	0.56	R-Direct
-4	6.0	0.65	4.96	9.50	0.522	0.04	1/250	1.02	5.08	15.0	274.24	140,000.00	210.00	1.30	R-Direct
-5	4.0	0.60	3.00	6.33	0.474	0.04	1/250	0.96	2.88	15.0	155.66	80,000.00	120.00	0.74	R-Direct
-6	3.5	0.50	2.25	5.74	0.392	0.04	1/250	0.85	1.91	15.0	102.94	70,000.00	105.00	0.65	L-Direct
-7	5.0	0.55	3.76	8.83	0.426	0.04	1/250	0.89	3.36	15.0	181.60	240,000.00	360.00	2.22	R-Direct
-8	4.0	0.50	2.50	6.24	0.401	0.04	1/250	0.86	2.15	15.0	116.05	70,000.00	105.00	0.65	L-Direct
-9	4.7	0.70	4.92	9.57	0.514	0.04	1/240	1.04	5.10	15.0	275.41	650,000.00	975.00	3.61	R-Wah
-10	5.0	0.65	4.10	7.91	0.518	0.04	1/250	1.02	4.18	15.0	225.48	50,000.00	75.00	0.46	L-Direct
-11	2.5	1.20	4.44	5.89	0.753	0.03	1/570	1.16	5.13	15.0	277.14	870,000.00	1,305.00	4.83	R-Wah
-12	2.5	1.50	6.96	7.73	0.901	0.03	1/500	1.39	9.68	15.0	522.89	250,000.00	375.00	2.31	R-Wah
-13	4.0	0.40	1.92	5.79	0.332	0.04	1/300	0.69	1.33	15.0	71.70	100,000.00	150.00	0.93	L-Direct
-14	6.4	1.45	12.78	12.04	1.062	0.04	1/340	1.41	18.04	15.0	974.35	350,000.00	525.00	3.24	L-Wah
-15	4.5	1.20	9.00	10.96	0.821	0.04	1/300	1.27	11.39	13.0	533.05	960,000.00	1,440.00	6.15	L-Wah
-16	8.0	1.05	11.16	13.65	0.817	0.04	1/300	1.26	14.07	13.0	658.63	690,000.00	1,035.00	4.42	L-Wah
-17	7.4	1.40	16.89	17.14	0.985	0.04	1/200	1.75	29.57	13.0	1,383.94	770,000.00	1,155.00	4.94	R-Wah
-18	5.0	0.60	3.60	7.33	0.491	0.04	1/200	1.10	3.96	13.0	185.36	70,000.00	105.00	0.75	L-Direct
-19	8.0	0.50	4.50	10.24	0.440	0.04	1/200	1.02	4.60	13.0	215.25	11,920,000.00	17,880.00	15.28	L-Wah
-20	4.0	0.65	3.13	6.08	0.514	0.04	1/250	1.02	3.18	10.0	114.31	50,000.00	75.00	0.96	L-Direct
-21	4.5	0.50	2.75	6.74	0.408	0.04	1/250	0.87	2.39	10.0	86.14	340,000.00	510.00	4.72	R-Wah
-22	3.0	0.30	1.08	4.34	0.249	0.04	1/250	0.63	0.68	10.0	24.32	440,000.00	660.00	6.11	R-Wah
-23	3.0	0.40	1.73	5.78	0.300	0.04	1/300	0.65	1.12	10.0	40.33	30,000.00	45.00	0.42	R-Direct
-24	11.7	0.50	7.10	16.80	0.423	0.04	1/300	0.81	5.77	10.0	207.77	30,000.00	45.00	0.42	R-Direct
-25	4.5	0.30	1.65	6.59	0.250	0.04	1/300	0.57	0.95	10.0	34.07	200,000.00	300.00	2.78	L-Direct
-26	4.5	0.50	3.50	9.60	0.365	0.04	1/170	0.98	3.43	10.0	123.30	1,970,000.00	2,955.00	8.21	R-Wah
-27	20.0	0.40	9.60	28.04	0.342	0.04	1/300	0.71	6.78	10.0	244.13	30,000.00	45.00	0.42	R-Direct
-28	5.0	0.30	1.80	7.09	0.254	0.04	1/300	0.58	1.04	10.0	37.51	210,000.00	315.00	2.92	L-Direct
-29	5.4	0.95	5.13	7.30	0.703	0.04	1/300	1.14	5.85	10.0	210.70	70,000.00	105.00	0.97	L-Direct
-30	8.0	0.40	3.73	10.78	0.346	0.04	1/300	0.71	2.66	7.0	66.95	20,000.00	30.00	0.40	L-Direct
-31	8.5	0.30	3.00	11.56	0.260	0.04	1/400	0.51	1.53	7.0	38.45	210,000.00	315.00	4.17	L-Direct
-32	30.0	0.40	12.53	32.78	0.382	0.04	1/400	0.66	8.25	7.0	207.96	60,000.00	90.00	1.19	R-Direct
-33	25.0	0.40	10.53	27.78	0.379	0.04	1/400	0.65	6.90	7.0	173.80	130,000.00	195.00	2.58	R-Direct
-34	18.0	0.30	5.70	20.09	0.284	0.04	1/400	0.54	3.08	7.0	77.53	1,640,000.00	2,460.00	9.76	R-Wah
-35	7.5	1.20	11.40	12.16	0.937	0.04	1/410	1.18	13.48	7.0	339.67	9,030,000.00	13,545.00	26.88	L-Wah
-36	23.0	0.40	9.73	25.78	0.377	0.04	1/400	0.65	6.35	7.0	160.14	2,490,000.00	3,735.00	14.82	R-Wah
-37	12.0	0.40	5.33	14.78	0.361	0.04	1/400	0.63	3.38	7.0	85.14	20,000.00	30.00	0.40	L-Direct
Sub-Total									205.55		8,766.75				

TABLE 6.2 CALCULATION OF CANAL CAPACITY (3/4)

NAME	W (m)	D (m)	A (sqm)	P (m)	R (m)	n	I	v (m/s)	Q (cms)	T (hour)	V (x1000m ³)	Area (sqm)	V (x1000m ³)	Q (cms)	Remarks
[Phuliar branch]															
P-1	3.0	2.30	20.13	15.39	1.308	0.04	1/460	1.39	28.06	15.0	1,515.07	850,000.00	1,275.00	4.72	R-Wah
-2	6.3	0.90	8.37	12.56	0.666	0.04	1/450	0.90	7.52	15.0	406.30	230,000.00	345.00	2.13	R-Direct
-3	19.8	0.40	8.32	21.95	0.379	0.04	1/450	0.62	5.13	15.0	277.28	100,000.00	150.00	0.93	L-Direct
-4	14.8	0.65	11.73	21.43	0.548	0.04	1/450	0.79	9.25	15.0	499.71	330,000.00	495.00	3.06	R-Direct
-5	4.2	0.95	5.79	8.45	0.686	0.03	1/500	1.16	6.72	15.0	362.82	290,000.00	435.00	2.69	R-Wah
-6	11.7	0.35	4.50	14.14	0.319	0.03	1/500	0.70	3.13	15.0	169.09	90,000.00	135.00	0.83	L-Direct
-7	6.4	1.00	9.73	13.36	0.729	0.04	1/480	0.92	8.99	15.0	485.59	2,310,000.00	3,465.00	6.42	L-Wah
-8	16.2	0.50	8.93	19.68	0.454	0.03	1/500	0.88	7.87	15.0	424.74	50,000.00	75.00	0.46	R-Direct
-9	4.8	1.50	14.70	15.24	0.965	0.03	1/740	1.20	17.58	15.0	949.56	1,290,000.00	1,935.00	3.58	R-Wah
-10	11.5	0.30	3.90	14.56	0.268	0.03	1/500	0.62	2.42	13.0	113.06	17,200,000.00	25,800.00	18.38	R-Wah
-11		- Not Work -													
-12		- Not Work -													
-13	23.4	0.65	17.32	30.03	0.577	0.03	1/500	1.03	17.89	13.0	837.46	170,000.00	255.00	1.82	R-Direct
-14		- Not Work -													
-15	18.0	0.50	9.83	21.48	0.458	0.03	1/500	0.89	8.71	13.0	407.49	300,000.00	450.00	3.21	R-Direct
-16	76.5	0.60	49.50	88.56	0.559	0.03	1/500	1.01	50.07	13.0	2,343.28	140,000.00	210.00	1.50	L-Direct
-17		- Not Work -													
-18	40.5	0.65	30.55	53.56	0.570	0.03	1/500	1.03	31.32	13.0	1,465.79	100,000.00	150.00	1.07	R-Direct
-19	13.5	0.60	9.90	19.62	0.505	0.03	1/500	0.94	9.35	10.0	336.75	300,000.00	450.00	4.17	R-Direct
-20	8.1	0.70	6.90	11.87	0.581	0.03	1/500	1.04	7.16	10.0	257.61	60,000.00	90.00	0.83	L-Direct
-21	15.3	0.80	15.44	23.46	0.658	0.03	1/500	1.13	17.42	10.0	626.96	50,000.00	75.00	0.69	R-Direct
-22	20.7	0.95	22.67	27.31	0.830	0.03	1/500	1.32	29.85	10.0	1,074.77	90,000.00	135.00	1.25	L-Direct
-23	14.4	0.75	12.21	18.44	0.662	0.03	1/500	1.13	13.82	10.0	497.56	30,000.00	45.00	0.43	R-Direct
-24		- Not Work -													
-25	20.5	0.90	22.50	29.68	0.758	0.03	1/3600	0.46	10.39	10.0	374.15	200,000.00	300.00	2.78	L-Wah
-26	3.1	1.00	5.10	7.57	0.674	0.04	1/360	1.01	5.16	10.0	185.88	30,000.00	45.00	0.43	R-Wah
-27	18.0	0.55	11.41	23.61	0.483	0.04	1/400	0.77	8.79	10.0	316.32	40,000.00	60.00	0.56	R-Direct
-28	28.8	0.50	15.65	33.90	0.462	0.04	1/400	0.75	11.69	7.0	294.47	200,000.00	300.00	3.97	L-Direct
-29	5.0	0.50	3.33	8.48	0.393	0.04	1/450	0.63	2.11	7.0	53.12	210,000.00	315.00	4.17	R-Wah
-30	46.8	0.55	27.25	52.41	0.520	0.03	1/500	0.96	26.27	7.0	662.02	100,000.00	150.00	1.98	L-Direct
-31	19.8	0.70	15.49	24.67	0.628	0.03	1/500	1.09	16.94	7.0	426.81	90,000.00	135.00	1.79	L-Direct
-32	13.5	0.50	7.58	16.98	0.447	0.03	1/500	0.87	6.60	7.0	166.44	1,110,000.00	1,665.00	6.60	L-Direct
-33	7.2	0.50	4.85	12.30	0.394	0.03	1/500	0.80	3.89	7.0	97.98	330,000.00	495.00	6.55	R-Direct
-34	9.0	0.70	8.75	16.14	0.542	0.03	1/500	0.99	8.67	7.0	218.56	0.00	0.00	0.00	R-Direct
-35	14.5	0.70	11.78	19.37	0.608	0.03	1/500	1.07	12.61	7.0	317.78	330,000.00	495.00	6.55	R-Direct
Sub-Total									395.39		16,164.42				

TABLE 6.2 CALCULATION OF CANAL CAPACITY (4/4)

NAME	W (m)	D (m)	A (sqm)	P (m)	R (m)	n	I	v (m/s)	Q (cms)	T (hour)	V (x1000m ³)	Area (sqm)	V' (x1000m ³)	Q' (cms)	Remarks
[Zai Nala]															
Z-1	7.2	1.90	19.70	14.59	1.350	0.04	1/300	1.76	34.73	15.0	1,875.60	970,000.00	1,455.00	5.39	R-Direct
-2	11.7	0.50	8.35	21.75	0.384	0.04	1/400	0.66	5.51	13.0	258.03	310,000.00	465.00	3.31	R-Direct
-3	13.5	0.50	9.25	23.55	0.393	0.03	1/500	0.80	7.40	10.0	266.24	280,000.00	420.00	3.39	R-Direct
-4	1.9	1.10	6.12	9.56	0.641	0.03	1/710	0.93	5.69	7.0	143.47	1,410,000.00	2,115.00	3.39	R-Wah
Sub-Total									53.34		2,543.34				
[Dalana Nala]															
D-1	13.5	1.60	26.72	20.66	1.294	0.04		1.71	45.79	15.0	2,472.55	1,020,000.00	1,530.00	2.83	L-Direct
-2	9.0	2.40	31.20	18.33	1.702	0.04	1/300	2.06	64.20	15.0	3,466.81	256,090,000.00	384,135.00	23.23	R-Direct
-3	9.0	0.25	2.88	14.02	0.205	0.04	1/350	0.46	1.34	13.0	62.51	50,000.00	75.00	0.53	L-Direct
-4	16.7	0.90	16.65	20.72	0.803	0.04	1/400	1.08	17.99	13.0	841.75	250,000.00	375.00	2.67	R-Wah
-5	27.0	0.45	14.18	36.04	0.393	0.04	1/400	0.67	9.51	10.0	342.39	230,000.00	345.00	3.19	R-Direct
-6	9.9	1.10	14.92	17.56	0.850	0.04	1/400	1.12	16.74	10.0	602.61	990,000.00	1,485.00	8.25	R-Direct
-7	14.4	0.65	10.77	18.92	0.569	0.04	1/450	0.81	8.71	7.0	219.60	90,000.00	135.00	1.79	R-Direct
Sub-Total									164.27		8,008.22				
[Escape branch]															
E-1	17.1	0.60	11.46	21.28	0.539	0.04	1/250	1.05	12.00	15.0	647.75	60,000.00	90.00	0.56	R-Direct
-2	19.8	0.25	5.58	24.82	0.225	0.04	1/250	0.58	3.26	15.0	175.87	200,000.00	300.00	1.85	R-Direct
-3	22.5	0.30	7.65	28.53	0.268	0.04	1/300	0.60	4.59	15.0	247.94	140,000.00	210.00	1.30	R-Wah
-4	5.0	0.55	3.76	8.83	0.426	0.04	1/300	0.82	3.07	15.0	165.78	0.00	0.00	0.00	L-Direct
-5	3.0	0.30	1.35	6.06	0.223	0.04	1/350	0.49	0.66	13.0	31.03	120,000.00	180.00	1.28	R-Wah
-6	9.0	0.80	8.80	13.31	0.661	0.04	1/350	1.01	8.93	13.0	417.71	0.00	0.00	0.00	L-Wah
-7															
-8	6.3	0.25	1.89	8.85	0.213	0.04	1/400	0.45	0.84	13.0	39.42	0.00	0.00	0.00	L-Direct
Sub-Total									33.34		1,725.49				

TABLE 6.3 PROPOSED PROBABLE IRRIGATED AREAS (CASE A)

		Chhabri Branch	Suchani Branch	Phullar Branch	Zai Nallah	Dalana Nallah	Total
1/2	Kharif	1,488	1,488	1,488	92	453	5,009
	Rabi	307	280	169	16	67	839
	Total	1,795	1,768	1,657	108	520	5,848
1/5	Kharif	2,145	2,145	2,145	132	652	7,219
	Rabi	442	403	244	23	97	1,208
	Total	2,587	2,548	2,389	155	749	8,427
1/10	Kharif	2,632	2,632	2,632	162	801	8,860
	Rabi	543	494	299	28	119	1,483
	Total	3,175	3,126	2,931	190	920	10,343
1/25	Kharif	3,303	3,303	2,662	204	1,005	10,477
	Rabi	681	620	375	35	149	1,861
	Total	3,984	3,923	3,037	239	1,154	12,338

TABLE 6.4 PROPOSED PROBABLE IRRIGATED AREAS (CASE B-1)

		Chhabri Branch	Suchani Branch	Phullar Branch	Zai Nallah	Dalana Nallah	Total
1/2	Kharif	1,380	1,380	1,380	76	333	4,549
	Rabi	290	277	170	14	58	809
	Total	1,670	1,657	1,550	90	391	5,358
1/5	Kharif	2,021	2,021	2,021	111	489	6,663
	Rabi	425	405	250	20	85	1,185
	Total	2,446	2,426	2,271	131	574	7,848
1/10	Kharif	2,506	2,506	2,506	138	606	8,262
	Rabi	528	502	310	25	105	1,470
	Total	3,034	3,008	2,816	163	711	9,732
1/25	Kharif	3,182	3,182	2,662	176	770	9,972
	Rabi	670	638	393	32	133	1,866
	Total	3,852	3,820	3,055	208	903	11,838

TABLE 6.5 PROPOSED PROBABLE IRRIGATED AREAS (CASE B-2)

		Chhabri Branch	Suchani Branch	Phullar Branch	Zai Nallah	Dalana Nallah	Total
1/2	Kharif	1,298	1,298	1,298	74	328	4,296
	Rabi	352	264	169	14	57	856
	Total	1,650	1,562	1,467	88	385	5,152
1/5	Kharif	1,915	1,915	1,915	110	483	6,338
	Rabi	519	390	250	21	83	1,263
	Total	2,434	2,305	2,165	131	566	7,601
1/10	Kharif	2,386	2,386	2,386	137	601	7,896
	Rabi	647	486	311	26	104	1,574
	Total	3,033	2,872	2,697	163	705	9,470
1/25	Kharif	3,047	3,047	2,662	174	766	9,696
	Rabi	826	620	398	33	133	2,010
	Total	3,873	3,667	3,060	207	899	11,706

表6. 6 流域各ゾーンの特長

ゾーン	標高 (m)	勾配	地質	風化度/侵食	植生	土地利用	河川水
I	1,000~2,300	急	白亜紀~先第三紀 堆積岩	高/弱	あり	放牧地	通年流下
II	700~1,100	急~緩	先第三紀 堆積岩	高/強	点在	放牧地 灌漑農地	通年流下
III	600~800	緩~平坦	新第三紀~更新世 堆積岩	顕著/強	点在	放牧地 非灌漑農地	季節的流下
IV	500~700	緩~平坦	段丘砂礫	中/弱	点在	放牧地 非灌漑農地	季節的流下
V	250~500	急~緩	先第三紀~新第三紀 堆積岩	顕著/顕著	まれ	放牧地 非灌漑農地	季節的流下

TABLE 6.7 SALIENT FEATURES OF PROPOSED DISPERSION STRUCTURES

Item	Dispersion Structure I	Dispersion Structure II
River	Vidore Hilltorrent	Chhabri-Suchani Branch
Catchment Area (sq.km)	770	513
Design Flood Discharge (cms)	1,795	1,197
Weir		
Type of Weir	Fited Type	Fited Type
Top of Weir (m)	215.6	184.7
High Water Level (m)	217.6	186.2
Flood Water Depth (m)	2.0	1.5
Slope of River Bed	1 : 110	1 : 250
Weir Height (m)	0.8	0.7
Length of Weir (m)	337.0	335.0
Length of Apron (m)	20.8	20.2
Riprap		
Type of Riprap	Boulder Riprap	Gabion Riprap
U/S Riprap (sq.m)	1,500.0	1,500.0
D/S Riprap (sq.m)	3,000.0	3,000.0
Dike		
Length of Dike (m)	1,230.0	5,290.0
Dike Height (m)	2.0 - 3.8	2.5 - 3.0
Top Width (m)	5.0	5.0
Slope of Dike	1 : 2.0	1 : 2.0

TABLE 6.8 TYPICAL CROSS SECTION OF CANALS (1/2)

Name of Canal	Chhabri branch					Phullar branch				
	C-6	C-14	C-15	C-20	E-5	P-10	P-29	Z-4		
b (m)	3.60	7.50	11.00	7.00	3.00	12.50	6.50	5.00		
B (m)	7.50	9.00	17.40	10.90	5.10	16.40	8.90	10.60		
hb (m)	1.00	0.30	1.30	1.00	0.50	1.00	0.60	1.10		
Fb (m)	0.30	0.20	0.30	0.30	0.20	0.30	0.20	0.30		
H (m)	1.30	0.50	1.60	1.30	0.70	1.30	0.80	1.40		
N	1.5	1.5	2.0	1.5	1.5	1.5	1.5	2.0		
Area & A (sq.m)	5.10	2.39	17.68	8.50	1.88	14.00	4.44	7.92		
Wetted peri. : P (m)	7.20	8.58	16.82	10.60	4.80	16.10	8.66	9.92		
Hydr. radivs : R (m)	0.708	0.279	1.051	0.802	0.392	0.870	0.512	0.798		
Coeff. roughness : n	0.040	0.040	0.040	0.030	0.040	0.030	0.040	0.030		
Slope : I	1/300	1/400	1/390	1/550	1/350	1/500	1/450	1/710		
Velocity : V (m/s)	1.15	0.53	1.31	1.23	0.72	1.36	1.01	1.08		
Capacity : Q (cms)	5.87	1.27	23.16	10.46	1.34	19.01	4.17	8.53		
Length : L (m)	1,650	350	4,660	3,000	280	4,800	437	1,880		

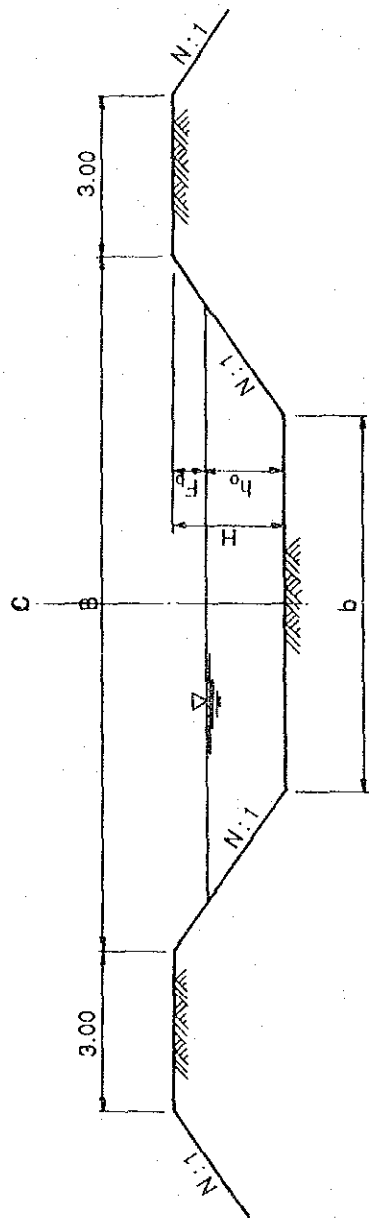
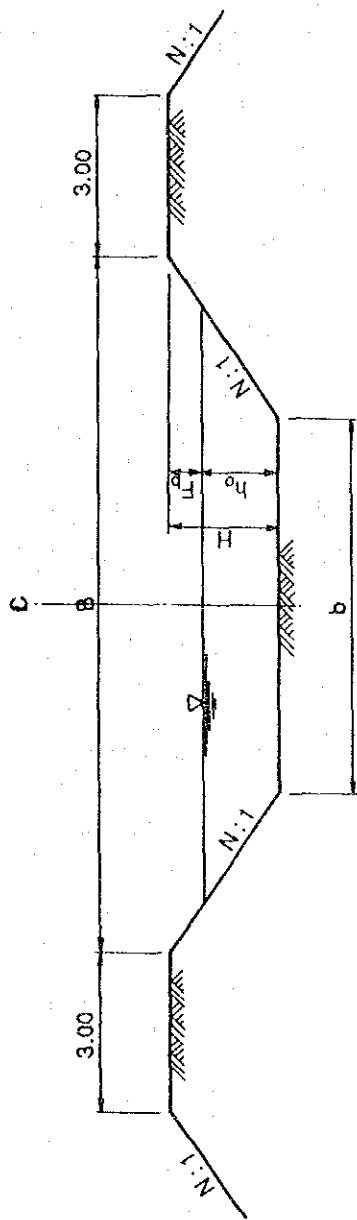


TABLE 68 TYPICAL CROSS SECTION OF CANALS (2/2)

Name of Canal	Suchani branch									
	S-19	S-21	S-22	S-26	S-34	S-35	S-36	S-36	S-36	S-36
b (m)	8.50	7.00	5.50	6.00	11.50	10.50	17.50	10.50	17.50	17.50
B (m)	12.40	9.40	8.50	9.00	14.50	17.70	20.50	14.50	17.70	20.50
hb (m)	1.00	0.60	0.80	0.80	0.80	1.50	0.80	0.80	1.50	0.80
Fb (m)	0.30	0.20	0.20	0.20	0.20	0.30	0.20	0.20	0.30	0.20
H (m)	1.30	0.80	1.00	1.00	1.00	1.80	1.00	1.80	1.80	1.00
N	1.5	1.5	1.5	1.5	1.5	2.0	1.5	2.0	2.0	1.5
Area & A (sq.m)	10.00	4.74	5.36	5.76	10.16	20.25	14.96	10.16	20.25	14.96
Wetted peri. : P (m)	12.10	9.16	8.38	8.88	14.38	17.20	20.38	14.38	17.20	20.38
Hydr. radii : R (m)	0.826	0.517	0.640	0.649	0.707	1.177	0.734	0.707	1.177	0.734
Coeff. roughness : n	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040
Slope : I	1/200	1/250	1/250	1/170	1/400	1/410	1/400	1/400	1/410	1/400
Velocity : V (m/s)	1.56	1.02	1.17	1.44	0.99	1.38	1.02	0.99	1.38	1.02
Capacity : Q (cms)	15.60	4.83	6.29	8.28	10.06	27.88	15.22	10.06	27.88	15.22
Length : L (m)	3,750	500	1,500	575	1,800	3,000	3,000	1,800	3,000	3,000



Figure

TABLE 6.9 CONSTRUCTION UNIT COST

Description	Unit	Rate (Rs)	F.C. (Rs)	L.C. (Rs)
1. For Irrigation				
Excavation (Labour)	cu.m	22.1	0.0	22.1
Excavation (Back hoe)	cu.m	56.5	43.7	12.8
Excavation (Bulldozer)	cu.m	70.5	54.0	16.5
Backfill (Labour)	cu.m	18.8	2.1	16.7
Embankment (Bulldozer)	cu.m	44.4	34.5	9.9
Dressing Slope	sq.m	1.6	0.0	1.6
Plain Concrete	cu.m	1,158.9	421.8	737.1
Reinforcement Concrete	cu.m	2,399.7	873.4	1,526.3
Dry Rubble Masonry	cu.m	562.4	0.0	562.4
Grouted Rubble Masonry	cu.m	1,158.8	224.9	933.9
Stone Pitching (Top layer)	cu.m	454.5	0.0	454.5
Stone Pitching (Spawl fitting)	cu.m	142.9	0.0	142.9
Boulder Riprap	cu.m	353.4	88.2	265.2
Gabion Riprap	cu.m	589.9	242.8	347.1
Asphaltic Concrete Wearing	sq.m	85.0	30.0	55.0
Asphaltic Concrete Binding	sq.m	145.0	50.0	95.0
Base Course	cu.m	180.0	20.0	160.0
Sub-Base Course	cu.m	155.0	15.0	140.0
2. For Watershed Management				
Bund Type A	unit	14,697.0	6,294.0	8,403.0
Bund Type B	unit	19,403.0	6,707.0	12,696.0
Bund Type C	unit	17,305.0	5,207.0	12,098.0
Seedbed	ha	7,160.0	0.0	7,160.0
Planting Zone II or V	km	15,080.0	700.0	14,380.0
Planting Zone III	km	15,200.0	800.0	14,400.0
Planting Zone IV	km	15,150.0	760.0	14,390.0
Gully Plugging	unit	3,608.0	5.0	3,603.0
Pond	unit	762,554.0	190,136.0	572,418.0
Water Point	unit	815,147.0	629,990.0	185,157.0
Seeding	ha	147.5	40.0	107.5

TABLE 6.10 SUMMARY OF PROJECT COST (CASE A)

Item	(Unit: '000 Rs)		
	Total	Foreign	Local
1. Dispersion Structure			
1.1 Dispersion Structure I	15,159	4,454	10,705
1.2 Dispersion Structure II	27,521	6,968	20,553
1.3 Separating Dike	9,456	2,268	7,188
2. Distribution Structure			
2.1 Chhabri Branch	4,188	3,154	1,034
2.2 Suchani Branch	4,756	3,581	1,175
3.3 Phllar Branch	3,700	2,798	902
3. Road	7,397	2,619	4,778
<u>Sub-Total</u>	<u>72,177</u>	<u>25,842</u>	<u>46,335</u>
4. Engineering Fee	7,223	4,709	2,514
<u>Total (1-4)</u>	<u>79,400</u>	<u>30,551</u>	<u>48,849</u>
5. Price Escalation	27,200	3,080	24,120
<u>Grand Total</u>	<u>106,600</u>	<u>33,631</u>	<u>72,969</u>

Note: 10 % of contingency is included in items 1-5 above.

TABLE 6.11 SUMMARY OF PROJECT COST (CASE B-1)

Item	(Unit: '000 Rs)		
	Total	Foreign	Local
1. Dispersion Structure			
1.1 Dispersion Structure I	15,159	4,454	10,705
1.2 Dispersion Structure II	27,521	6,968	20,553
1.3 Separating Dike	9,456	2,268	7,188
2. Distribution Structure			
2.1 Chhabri Branch	4,188	3,154	1,034
2.2 Suchani Branch	4,756	3,581	1,175
3.3 Phllar Branch	3,700	2,798	902
3. Road	7,397	2,619	4,778
<u>Sub-Total</u>	<u>72,177</u>	<u>25,842</u>	<u>46,335</u>
4. Watershed Management			
4.1 Bund	30,519	11,595	18,924
4.2 Vetiver Grass	22,467	435	22,032
4.3 Gully Plugging	7,859	12	7,847
4.4 Pond	5,033	1,255	3,778
4.5 Water Point	1,061	815	246
4.6 Grass Seeding	1,960	532	1,428
<u>Sub-Total</u>	<u>68,899</u>	<u>14,644</u>	<u>54,255</u>
5. Engineering Fee	9,874	6,402	3,472
<u>Total (1-5)</u>	<u>150,950</u>	<u>46,888</u>	<u>104,062</u>
5. Price Escalation	71,150	5,576	65,574
<u>Grand Total</u>	<u>222,100</u>	<u>52,464</u>	<u>169,636</u>

Note: 10 % of contingency is included in items 1-5 above.

TABLE 6.12 SUMMARY OF PROJECT COST (CASE B-2)

Item	(Unit: '000 Rs)		
	Total	Foreign	Local
1. Dispersion Structure			
1.1 Dispersion Structure I	15,159	4,454	10,705
1.2 Dispersion Structure II	27,521	6,968	20,553
1.3 Separating Dike	9,456	2,268	7,188
2. Distribution Structure			
2.1 Chhabri Branch	4,188	3,154	1,034
2.2 Suchani Branch	4,756	3,581	1,175
3.3 Phllar Branch	3,700	2,798	902
3. Road	7,397	2,619	4,778
Sub-Total	<u>72,177</u>	<u>25,842</u>	<u>46,335</u>
4. Watershed Management			
4.1 Bund	46,568	17,162	29,406
4.2 Vetiver Grass	31,589	600	30,989
4.3 Gully Plugging	14,289	22	14,267
4.4 Pond	5,033	1,255	3,778
4.5 Water Point	4,385	3,370	1,015
4.6 Grass Seeding	4,002	1,087	2,915
Sub-Total	<u>105,866</u>	<u>23,496</u>	<u>82,370</u>
5. Engineering Fee	12,457	8,114	4,343
Total (1-5)	<u>190,500</u>	<u>57,452</u>	<u>133,048</u>
5. Price Escalation	122,700	8,271	114,429
Grand Total	<u>313,200</u>	<u>65,723</u>	<u>247,477</u>

Note: 10 % of contingency is included in items 1-5 above.

TABLE 7.1 BREAKDOWN OF ANNUAL O/M COST

Description	Qty's	Unit	Rate (Rs)	Amount ('000 Rs)
1. Dispersion & Separating				
1.1 Dispersion Structure				
(1) Grouted Rubble Masonry	230	cu.m	1,158.8	266.5
(2) Boulder Riprap	135	cu.m	353.4	47.7
(3) Gabion Riprap	135	cu.m	589.9	79.6
(4) Stone Pitching (Top)	480	cu.m	454.5	218.2
(5) Stone Pitching (Spawl)	240	cu.m	142.9	34.3
1.2 Separating Dike				
(1) Embankment	640	cu.m	44.4	28.4
(2) Stone Pitching (Top)	200	cu.m	454.5	90.9
(3) Stone Pitching (Spawl)	100	cu.m	142.9	14.3
Sub-Total				<u>779.9</u>
2. Distribution Structure				
2.1 Excavation	9,400	cu.m	56.5	531.1
Sub-Total				<u>531.1</u>
3. Road				
3.1 Asphaltic Con. Wearing	400	sq.m	85.0	34.0
3.2 Asphaltic Con. Binding	533	sq.m	145.0	77.3
3.3 Gravelling	2,440	sq.m	85.0	207.4
3.4 Base Course	290	cu.m	180.0	52.2
Sub-Total				<u>370.9</u>
(Case A Annual O/M Cost)				<u>(1,681.9)</u>
4. Watershed Management				
4.1 Pond	1,080	cu.m	70.5	76.1
4.2 Water Point	2,090	cu.m	70.5	147.3
Sub-Total				<u>223.4</u>
Total (Case B-1, Case B-2 Annual O/M Cost)				<u><u>(1,905.3)</u></u>

Note: This table shows the annual O/M cost in Case B-1 and Case B-2 (1,905.3 thousand Rs).

In Case A, the annual O/M cost consists of items 1, 2 and 3 in the above table

(1,681.9 thousand Rs).

TABLE 8.1 ESTIMATION OF AVERAGE ANNUAL FLOOD DAMAGE (1/3)

Case -A		Remained Damages Post Project		
Frequency	Benefits (million Rs.)	Average Benefits (million Rs.)	Frequency Interval	Annual Benefits (million Rs.)
0.90	0.0			
		0.0	0.10	0.00
0.80	0.0	0.0	0.10	0.00
0.70	0.0	0.0	0.10	0.00
0.60	0.0	0.0	0.10	0.00
0.50	0.0	0.0	0.10	0.00
0.40	0.0	0.0	0.10	0.00
0.30	0.0	0.0	0.10	0.00
0.20	0.0	0.0	0.10	0.00
0.10	6.0	3.0	0.10	0.30
0.04	13.0	9.5	0.06	0.57
				0.87
Benefit		5.45-0.87=		4.58 million Rs.

TABLE 8.1 ESTIMATION OF AVERAGE ANNUAL FLOOD DAMAGE (2/3)

Case B-1		Remained Damages Post Project		
Frequency	Benefits (million Rs.)	Average Benefits (million Rs.)	Frequency Interval	Annual Benefits (million Rs.)
0.90	0.0			
		0.0	0.10	0.00
0.80	0.0	0.0	0.10	0.00
0.70	0.0	0.0	0.10	0.00
0.60	0.0	0.0	0.10	0.00
0.50	0.0	0.0	0.10	0.00
0.40	0.0	0.0	0.10	0.00
0.30	0.0	0.0	0.10	0.00
0.20	0.0	0.0	0.10	0.00
0.10	0.0	0.0	0.10	0.00
0.04	4.0	2.0	0.06	0.12
				0.12
Benefit		5.45-0.12=		5.33 million Rs.

TABLE 8.1 ESTIMATION OF AVERAGE ANNUAL FLOOD DAMAGE (3/3)
Case B-2

Frequency	Benefits (million Rs.)	Average Benefits (million Rs.)	Frequency Interval	Annual Benefits (million Rs.)
0.90	0.0			
		0.2	0.10	0.02
0.80	0.4			
		0.8	0.10	0.08
0.70	1.2			
		1.8	0.10	0.18
0.60	2.4			
		3.1	0.10	0.31
0.50	3.7			
		4.8	0.10	0.48
0.40	5.8			
		7.1	0.10	0.71
0.30	8.4			
		10.0	0.10	1.00
0.20	11.5			
		14.3	0.10	1.43
0.10	17.0			
		21.0	0.06	1.26
0.04	25.0			
				5.45
<u>Benefit</u>				<u>5.45 million Rs.</u>

TABLE 8.3 NET RETURN WITH AND WITHOUT PROJECT IN THE STUDY AREA (1/3)

Case A			(Unit: '000 Rs)			
Crop	Project	Return Period				
		2	5	10	25	
[Kharif]						
Jowar	With (a)	18,375	27,218	35,290	47,691	
	Without(b)	13,220	15,426	16,595	17,853	
	(a)-(b)	5,155	11,792	18,695	29,838	
Bajra	With (a)	2,648	3,939	5,016	6,839	
	Without(b)	1,901	2,218	2,386	2,567	
	(a)-(b)	747	1,721	2,630	4,272	
K.Fodders	With (a)	241	357	458	618	
	Without(b)	174	202	218	234	
	(a)-(b)	67	155	240	384	
Sub-Total	With (a)	21,265	31,514	40,763	55,148	
	Without(b)	15,294	17,846	19,198	20,654	
	(a)-(b)	5,971	13,668	21,565	34,494	
[Rabi]						
Wheat	With (a)	2,043	2,985	3,863	5,555	
	Without(b)	485	566	609	655	
	(a)-(b)	1,558	2,419	3,254	4,900	
Gram	With (a)	749	1,113	1,417	2,051	
	Without(b)	179	209	225	242	
	(a)-(b)	570	904	1,192	1,809	
Oilseeds	With (a)	192	282	361	522	
	Without(b)	46	53	57	62	
	(a)-(b)	146	229	304	460	
R.Fodders	With (a)	1	2	2	3	
	Without(b)	0	0	0	0	
	(a)-(b)	1	2	2	3	
Sub-Total	With (a)	2,986	4,382	5,644	8,131	
	Without(b)	710	829	891	959	
	(a)-(b)	2,276	3,553	4,753	7,172	
[Total]						
	With (a)	24,250	35,895	46,407	63,279	
	Without(b)	16,004	18,674	20,090	21,612	
	(a)-(b)	8,246	17,221	26,317	41,667	

TABLE 8.3 NET RETURN WITH AND WITHOUT PROJECT IN THE STUDY AREA (2/3)

(Unit: '000 Rs)

Case B-1	Crop	Project	Return Period			
			2	5	10	25
[Kharif]						
Jowar		With (a)	16,688	25,123	32,910	45,392
		Without(b)	13,220	15,426	16,595	17,853
		(a)-(b)	3,468	9,697	16,315	27,539
Bajra		With (a)	2,405	3,635	4,678	6,509
		Without(b)	1,901	2,218	2,386	2,567
		(a)-(b)	504	1,417	2,292	3,942
K.Fodders		With (a)	219	329	427	588
		Without(b)	174	202	218	234
		(a)-(b)	45	127	209	354
Sub-Total		With (a)	19,312	29,088	38,015	52,489
		Without(b)	15,294	17,846	19,198	20,654
		(a)-(b)	4,018	11,242	18,817	31,835
[Rabi]						
Wheat		With (a)	1,970	2,927	3,828	5,570
		Without(b)	485	566	609	655
		(a)-(b)	1,485	2,361	3,219	4,915
Gram		With (a)	722	1,091	1,404	2,057
		Without(b)	179	209	225	242
		(a)-(b)	543	882	1,179	1,815
Oilseeds		With (a)	185	276	358	523
		Without(b)	46	53	57	62
		(a)-(b)	139	223	301	461
R.Fodders		With (a)	1	2	2	4
		Without(b)	0	0	0	0
		(a)-(b)	1	2	2	4
Sub-Total		With (a)	2,878	4,297	5,592	8,154
		Without(b)	710	829	891	959
		(a)-(b)	2,168	3,468	4,701	7,195
[Total]		With (a)	22,191	33,385	43,607	60,643
		Without(b)	16,004	18,674	20,090	21,612
		(a)-(b)	6,187	14,711	23,517	39,031

TABLE 8.3 NET RETURN WITH AND WITHOUT PROJECT IN THE STUDY AREA (3/3)

(Unit: '000 Rs)

Case B-2	Crop	Project	Return Period			
			2	5	10	25
[Kharif]						
Jowar		With (a)	15,761	23,900	31,451	44,134
		Without(b)	13,220	15,426	16,595	17,853
		(a)-(b)	2,541	8,474	14,856	26,281
Bajra		With (a)	2,272	3,458	4,470	6,329
		Without(b)	1,901	2,218	2,386	2,567
		(a)-(b)	371	1,240	2,084	3,762
K.Fodders		With (a)	207	313	408	572
		Without(b)	174	202	218	234
		(a)-(b)	33	111	190	338
Sub-Total		With (a)	18,240	27,672	36,329	51,035
		Without(b)	15,294	17,846	19,198	20,654
		(a)-(b)	2,946	9,826	17,131	30,381
[Rabi]						
Wheat		With (a)	2,084	3,119	4,099	6,001
		Without(b)	485	566	609	655
		(a)-(b)	1,599	2,553	3,490	5,346
Gram		With (a)	764	1,163	1,504	2,216
		Without(b)	179	209	225	242
		(a)-(b)	585	954	1,279	1,974
Oilseeds		With (a)	196	294	383	564
		Without(b)	46	53	57	62
		(a)-(b)	150	241	326	502
R.Fodders		With (a)	1	2	3	4
		Without(b)	0	0	0	0
		(a)-(b)	1	2	3	4
Sub-Total		With (a)	3,045	4,576	5,989	8,784
		Without(b)	710	829	891	959
		(a)-(b)	2,335	3,747	5,098	7,825
[Total]		With (a)	21,285	32,249	42,318	59,819
		Without(b)	16,004	18,674	20,090	21,612
		(a)-(b)	5,281	13,575	22,228	38,207

TABLE 8.4 ESTIMATION OF AVERAGE ANNUAL PRE-PROJECT AGRICULTURAL PRODUCTION Without Project

Frequency	Benefits (million Rs.)	Average Benefits (million Rs.)	Frequency Interval	Annual Benefits (million Rs.)
0.90	12.0			
		12.6	0.10	1.26
0.80	13.2	13.8	0.10	1.38
0.70	14.3	14.8	0.10	1.48
0.60	15.3	15.7	0.10	1.57
0.50	16.0	16.5	0.10	1.65
0.40	16.9	17.4	0.10	1.74
0.30	17.8	18.3	0.10	1.83
0.20	18.7	19.4	0.10	1.94
0.10	20.1	20.9	0.10	1.94
0.04	21.6		0.06	1.25
Benefit				14.08 million Rs.

TABLE 8.5 ESTIMATION OF AVERAGE ANNUAL POST-PROJECT AGRICULTURAL BENEFITS (1/3)
Agricultural Benefits

Case A

Frequency	Benefits (million Rs.)	Average Benefits (million Rs.)	Frequency Interval	Annual Benefits (million Rs.)
0.90	16.3			
		17.0	0.10	1.70
0.80	17.7	18.5	0.10	1.85
0.70	19.3	20.3	0.10	2.03
0.60	21.3	22.7	0.10	2.27
0.50	24.0	25.4	0.10	2.54
0.40	26.8	28.8	0.10	2.88
0.30	30.8	33.4	0.10	3.34
0.20	36.0	41.2	0.10	4.12
0.10	46.4	54.9	0.10	4.12
0.04	63.3		0.06	3.29
Benefit				24.02
Benefit			24.02-14.08=	9.94 million Rs.

TABLE 8.5 ESTIMATION OF AVERAGE ANNUAL POST-PROJECT AGRICULTURAL BENEFITS (2/3)
Case B-1

Frequency	Benefits (million Rs.)	Average Benefits (million Rs.)	Frequency Interval	Annual Benefits (million Rs.)
0.90	16.3			
0.80	17.3	16.8	0.10	1.68
0.70	18.6	18.0	0.10	1.80
0.60	20.2	19.4	0.10	1.94
0.50	22.2	21.2	0.10	2.12
0.40	24.5	23.4	0.10	2.34
0.30	28.0	26.3	0.10	2.63
0.20	33.2	30.6	0.10	3.06
0.10	43.6	38.4	0.10	3.84
0.04	60.0	51.8	0.06	3.11
				22.50
		Benefit	22.50-14.08=	8.43 million Rs.

TABLE 8.5 ESTIMATION OF AVERAGE ANNUAL POST-PROJECT AGRICULTURAL BENEFITS (3/3)
Case B-2

Frequency	Benefits (million Rs.)	Average Benefits (million Rs.)	Frequency Interval	Annual Benefits (million Rs.)
0.90	16.3			
0.80	17.0	16.7	0.10	1.67
0.70	17.8	17.4	0.10	1.74
0.60	19.0	18.4	0.10	1.84
0.50	21.2	20.1	0.10	2.01
0.40	23.6	22.4	0.10	2.24
0.30	27.0	25.3	0.10	2.53
0.20	32.3	29.7	0.10	2.97
0.10	42.3	37.3	0.10	3.73
0.04	59.8	51.1	0.06	3.06
				21.78
		Benefit	21.78-14.08=	7.71 million Rs.

TABLE 8.6 SALVAGE VALUE (IRRIGATION AREA) (1/3)

(used year: 25 years)

item	Construction Cost (million Rs.)	Life year	Salvage Ratio (%)	Salvage Value (million Rs.)
1. Disresion Structure				
Earth Works	10.34	80	70	7.24
Masonry Works	33.86	30	15	5.08
Concrete Works	3.20	50	50	1.60
other Works				
2. Distribution Structure				
Earth Works	12.64	20	0	0
3. Road				
Earth Works	2.15	80	70	1.50
Pavement Works	5.25	10	0	0
Total	67.44			15.42

TABLE 8.6 SALVAGE VALUE (WATERSHED AREA, CASE B-1) (2/3)

(used year: 25 years)

item	Construction Cost (million Rs.)	Life year	Salvage Ratio (%)	Salvage Value (million Rs.)
Watershed Management				
Burd	10.83	80	70	7.59
Masonry	19.69	30	15	2.95
Vetiver Gross	22.47	∞	100	22.47
Gully Plugging	7.86	80	70	5.50
Pond	5.03	80	70	3.52
Water Point	1.06	80	70	0.74
Grass Seeding	1.96	∞	100	1.96
Total	68.90			44.73

TABLE 8.6 SALVAGE VALUE (WATERSHED AREA, CASE B-2) (3/3)

(used year: 25 years)

item	Construction Cost (million Rs.)	Life year	Salvage Ratio (%)	Salvage Value (million Rs.)
Watershed Management				
Burd	15.67	80	70	10.97
Masonry	30.90	30	15	4.64
Vetiver Gross	31.59	∞	100	31.59
Gully Plugging	14.29	80	70	10.00
Pond	5.03	80	70	3.52
Water Point	4.39	80	70	3.07
Grass Seeding	4.00	∞	100	4.00
Total	105.87			67.79

TABLE 8.7 CASH FLOW IN MARKET PRICE (CASE A) (1/3)

(Unit : million Rs.)									
Year	Project Cost	O.M. Cost	Total cost	Benefits				Total Benefits	Net Benefit Value
				(1)	(2)	(3)	(4)		
1	53.35		53.35						Δ 53.35
2	26.05	0.53	26.58						Δ 26.58
3		1.68	1.68	4.58	9.94	0		14.52	12.84
4		1.68	1.68	4.58	9.94	0		14.52	12.84
5		1.68	1.68	4.58	9.94	0		14.52	12.84
6		1.68	1.68	4.58	9.94	0		14.52	12.84
7		1.68	1.68	4.58	9.94	0		14.52	12.84
8		1.68	1.68	4.58	9.94	0		14.52	12.84
9		1.68	1.68	4.58	9.94	0		14.52	12.84
10		1.68	1.68	4.58	9.94	0		14.52	12.84
11		1.68	1.68	4.58	9.94	0		14.52	12.84
12		1.68	1.68	4.58	9.94	0		14.52	12.84
13		1.68	1.68	4.58	9.94	0		14.52	12.84
14		1.68	1.68	4.58	9.94	0		14.52	12.84
15		1.68	1.68	4.58	9.94	0		14.52	12.84
16		1.68	1.68	4.58	9.94	0		14.52	12.84
17		1.68	1.68	4.58	9.94	0		14.52	12.84
18		1.68	1.68	4.58	9.94	0		14.52	12.84
19		1.68	1.68	4.58	9.94	0		14.52	12.84
20		1.68	1.68	4.58	9.94	0		14.52	12.84
21		1.68	1.68	4.58	9.94	0		14.52	12.84
22		1.68	1.68	4.58	9.94	0		14.52	12.84
23		1.68	1.68	4.58	9.94	0		14.52	12.84
24		1.68	1.68	4.58	9.94	0		14.52	12.84
25		1.68	1.68	4.58	9.94	0		14.52	12.84
26		1.68	1.68	4.58	9.94	0		14.52	12.84
27		1.68	1.68	4.58	9.94	0	15.42	29.94	28.26

F.I.R.R = 14.23 %

Source : Benefit (1) : Flood Control Benefit
 (2) : Agricultural Benefit
 (3) : Livestock Benefit
 (4) : Solvage Value

TABLE 8.7 CASH FLOW IN MARKET PRICE (CASE B-1) (2/3)

(Unit : million Rs.)

Year	Project Cost	O.M. Cost	Total cost	Benefits				Total Benefits	Net Benefit Value
				(1)	(2)	(3)	(4)		
1	65.69		65.69					Δ 65.69	
2	37.98	0.53	38.51					Δ 38.51	
3	16.94	1.68	18.62	4.88	9.94		14.82	Δ 3.80	
4	16.94	1.68	18.62	5.03	9.44		14.47	Δ 4.15	
5	13.40	1.68	15.08	5.18	8.94		14.12	Δ 0.96	
6		1.91	1.91	5.33	8.43		13.76	11.85	
7		1.91	1.91	5.33	8.43		13.76	11.85	
8		1.91	1.91	5.33	8.43		13.76	11.85	
9		1.91	1.91	5.33	8.43	2.50	16.26	14.35	
10		1.91	1.91	5.33	8.43	2.50	16.26	14.35	
11		1.91	1.91	5.33	8.43	2.50	16.26	14.35	
12		1.91	1.91	5.33	8.43	2.50	16.26	14.35	
13		1.91	1.91	5.33	8.43	2.50	16.26	14.35	
14		1.91	1.91	5.33	8.43	2.50	16.26	14.35	
15		1.91	1.91	5.33	8.43	2.50	16.26	14.35	
16		1.91	1.91	5.33	8.43	2.50	16.26	14.35	
17		1.91	1.91	5.33	8.43	2.50	16.26	14.35	
18		1.91	1.91	5.33	8.43	2.50	16.26	14.35	
19		1.91	1.91	5.33	8.43	2.50	16.26	14.35	
20		1.91	1.91	5.33	8.43	2.50	16.26	14.35	
21		1.91	1.91	5.33	8.43	2.50	16.26	14.35	
22		1.91	1.91	5.33	8.43	2.50	16.26	14.35	
23		1.91	1.91	5.33	8.43	2.50	16.26	14.35	
24		1.91	1.91	5.33	8.43	2.50	16.26	14.35	
25		1.91	1.91	5.33	8.43	2.50	16.26	14.35	
26		1.91	1.91	5.33	8.43	2.50	16.26	14.35	
27		1.91	1.91	5.33	8.43	2.50	60.15	74.50	

F.I.R.R = 8.18 %

Source : Benefit (1) : Flood Control Benefit
 (2) : Agricultural Benefit
 (3) : Livestock Benefit
 (4) : Solvage Value

TABLE 8.7 CASH FLOW IN MARKET PRICE (CASE B-2) (3/3)

Year	Project Cost	O.M. Cost	Total cost	Benefits				Total Benefits	Net Benefit Value
				(1)	(2)	(3)	(4)		
1	66.14		66.14					Δ 66.14	
2	37.06	0.53	37.59					Δ 37.59	
3	12.20	1.68	13.88	4.73	9.94		14.67	0.79	
4	13.45	1.68	15.13	4.82	9.66		14.48	Δ 0.65	
5	13.45	1.68	15.13	4.91	9.38		14.29	Δ 0.84	
6	13.71	1.91	15.62	5.00	9.10		14.10	Δ 1.52	
7	11.60	1.91	13.51	5.09	8.82		13.91	0.42	
8	7.63	1.91	9.54	5.18	8.54		13.72	4.18	
9	7.63	1.91	9.54	5.27	8.26		13.53	3.99	
10	7.63	1.91	9.54	5.36	7.98		13.34	3.80	
11		1.91	1.91	5.45	7.71	4.75	17.91	16.00	
12		1.91	1.91	5.45	7.71	4.75	17.91	16.00	
13		1.91	1.91	5.45	7.71	4.75	17.91	16.00	
14		1.91	1.91	5.45	7.71	4.75	17.91	16.00	
15		1.91	1.91	5.45	7.71	4.75	17.91	16.00	
16		1.91	1.91	5.45	7.71	4.75	17.91	16.00	
17		1.91	1.91	5.45	7.71	4.75	17.91	16.00	
18		1.91	1.91	5.45	7.71	4.75	17.91	16.00	
19		1.91	1.91	5.45	7.71	4.75	17.91	16.00	
20		1.91	1.91	5.45	7.71	4.75	17.91	16.00	
21		1.91	1.91	5.45	7.71	4.75	17.91	16.00	
22		1.91	1.91	5.45	7.71	4.75	17.91	16.00	
23		1.91	1.91	5.45	7.71	4.75	17.91	16.00	
24		1.91	1.91	5.45	7.71	4.75	17.91	16.00	
25		1.91	1.91	5.45	7.71	4.75	17.91	16.00	
26		1.91	1.91	5.45	7.71	4.75	17.91	16.00	
27		1.91	1.91	5.45	7.71	4.75	83.21	101.12	
								99.21	

F.I.R.R = 7.23 %

Source : Benefit (1) : Flood Control Benefit
 (2) : Agricultural Benefit
 (3) : Livestock Benefit
 (4) : Salvage Value

TABLE 8.8 CONSTRUCTION COST IN ACCOUNTING PRICE

Item	(Unit: million Rs.)								
	Case A			Case B-1			Case B-2		
	MP	CF	AP	MP	CF	AP	MP	CF	AP
Direct Construction Cost	13.02	0.80	9.37	44.51	0.75	33.38	60.20	0.76	45.75
Material Cost	24.61	0.80	19.68	38.96	0.80	31.17	47.33	0.80	37.85
Machinery Cost	15.22	0.60	9.13	22.10	0.60	13.27	26.22	0.60	15.73
Contingency	5.75	0.80	4.60	11.23	0.80	8.97	14.16	0.80	11.33
Engineering Fee	6.32	0.90	5.69	8.64	0.90	7.76	10.90	0.90	9.81
Overhead Cost	4.57	0.80	3.65	6.64	0.80	5.32	7.88	0.80	6.30
Total	69.49		52.12	132.08		99.87	166.69		126.77

TABLE 8.9 DISBURSEMENT SCHEDULE FOR PROJECT COST(CASE A) (1/3)

Item/year	(Unit: million Rs.)		
	1	2	Total
Direct Construction Cost	5.91	3.46	9.37
Material Cost	11.57	8.11	19.68
Machinery Cost	6.97	2.16	9.13
Contingency	2.99	1.61	4.60
Engineering Fee	4.68	1.01	5.69
Overhead Cost	2.79	0.86	3.65
Total	34.91	17.21	52.12

TABLE 8.9 DISBURSEMENT SCHEDULE FOR PROJECT COST(CASE B-1) (2/3)

Item/year	(Unit: million Rs.)					
	1	2	3	4	5	Total
Direct Construction Cost	10.85	8.05	5.24	5.24	4.00	33.38
Material Cost	13.72	10.41	2.51	2.51	2.02	31.17
Machinery Cost	7.55	2.88	1.02	1.02	0.80	13.27
Contingency	3.82	2.41	0.98	0.98	0.78	8.97
Engineering Fee	6.01	1.06	0.23	0.23	0.23	7.76
Overhead Cost	3.01	1.14	0.41	0.41	0.35	5.32
Total	44.96	25.95	10.39	10.39	8.18	99.87

TABLE 8.9 DISBURSEMENT SCHEDULE FOR PROJECT COST(CASE B-2) (3/3)

Item/year	(Unit: million Rs.)										
	1	2	3	4	5	6	7	8	9	10	Total
Direct Construction Cost	11.16	8.14	3.98	4.11	4.11	4.08	3.57	2.20	2.20	2.20	45.75
Material Cost	14.04	10.22	1.70	2.12	2.12	2.28	1.74	1.21	1.21	1.21	37.85
Machinery Cost	7.52	2.76	0.72	0.80	0.80	0.83	0.72	0.53	0.53	0.52	15.73
Contingency	3.88	2.38	0.72	0.79	0.79	0.80	0.68	0.43	0.43	0.43	11.33
Engineering Fee	6.37	1.33	0.27	0.27	0.27	0.26	0.26	0.26	0.26	0.26	9.81
Overhead Cost	3.01	1.11	0.29	0.32	0.32	0.33	0.29	0.21	0.21	0.21	6.3
Total	45.98	25.94	7.68	8.41	8.41	8.58	7.26	4.84	4.84	4.83	126.77

TABLE 8.10 UNIT PRICE OF CROPS IN ACCOUNTING COST

Crops	(Unit: Rs/kg)		
	Unit Price(MP)	CF	Unit Price(AP)
Jawar	4.0	0.80	3.20
	0.3	0.80	0.24
Bajra	4.5	0.80	3.60
	0.3	0.80	0.24
K.Fodders	0.3	0.80	0.24
Wheat	3.5	1.18	4.13
	0.3	0.80	0.24
Gram	5.5	0.80	4.40
Oilseed	4.5	0.80	3.60
R.Fodders	0.3	0.80	0.24

MP: Market Price

AP: Accounting Price

TABLE 8.11 PRODUCTION COST IN ACCOUNTING PRICE

Case: Present (Unit: Rs/ha)

		Jawar	Bajra	K.Fodders	Wheat	Gram	Oilseed	R.Fodders
Seeds	(MP)	100	125	75	400	360	75	75
(CF: 0.8)	(AP)	80	100	60	320	288	60	60
Cultivation		180	180	180	180	180	180	180
Harvesting		685	685	555	685	625	625	375
sub total	(MP)	865	865	735	865	805	805	555
(CF: 0.5)	(AP)	432	432	367	432	402	402	277
Total	(MP)	965	990	810	1265	1165	880	630
	(AP)	512	532	427	752	690	462	337

Case: Return Period 2 (Unit: Rs/ha)

		Jawar	Bajra	K.Fodders	Wheat	Gram	Oilseed	R.Fodders
Seeds	(MP)	102	128	77	408	367	77	77
(CF: 0.8)	(AP)	82	102	62	326	294	62	62
Cultivation		187	187	187	187	187	187	187
Harvesting		699	699	566	638	638	625	383
sub total	(MP)	886	886	753	825	825	812	570
(CF: 0.5)	(AP)	443	443	376	412	412	406	285
Total	(MP)	988	1014	830	1233	1192	889	647
	(AP)	525	545	438	738	706	468	347

Case: Return Period 5 (Unit: Rs/ha)

		Jawar	Bajra	K.Fodders	Wheat	Gram	Oilseed	R.Fodders
Seeds	(MP)	105	131	79	420	378	79	79
(CF: 0.8)	(AP)	84	105	63	336	302	63	63
Cultivation		199	199	199	199	199	199	199
Harvesting		720	720	583	720	657	657	394
sub total	(MP)	919	919	782	919	856	856	593
(CF: 0.5)	(AP)	459	459	391	459	428	428	296
Total	(MP)	1024	1050	861	1339	1234	935	672
	(AP)	543	564	454	795	730	491	359

Case: Return Period 10 (Unit: Rs/ha)

		Jawar	Bajra	K.Fodders	Wheat	Gram	Oilseed	R.Fodders
Seeds	(MP)	110	138	83	442	398	83	83
(CF: 0.8)	(AP)	88	110	66	354	318	66	66
Cultivation		219	219	219	219	219	219	219
Harvesting		757	757	613	757	690	690	414
sub total	(MP)	976	976	832	976	909	909	633
(CF: 0.5)	(AP)	488	488	416	488	454	454	316
Total	(MP)	1086	1114	915	1418	1307	992	716
	(AP)	576	598	482	842	772	520	382

Case: Return Period 25 (Unit: Rs/ha)

		Jawar	Bajra	K.Fodders	Wheat	Gram	Oilseed	R.Fodders
Seeds	(MP)	128	160	96	513	462	96	96
(CF: 0.8)	(AP)	102	128	77	410	370	77	77
Cultivation		295	295	295	295	295	295	295
Harvesting		878	878	712	878	802	802	481
sub total	(MP)	1173	1173	1007	1173	1097	1097	776
(CF: 0.5)	(AP)	586	586	503	586	548	548	388
Total	(MP)	1301	1333	1103	1686	1559	1193	872
	(AP)	688	714	580	996	918	625	465

TABLE 8.12 CASH FLOW IN ACCOUNTING PRICE (CASE A) (1/3)

(Unit : million Rs.)									
Year	Project Cost	O.M. Cost	Total cost	Benefits				Total Benefits	Net Benefit Value
				(1)	(2)	(3)	(4)		
1	34.91		34.91						Δ 34.91
2	17.21	0.37	17.58						Δ 17.58
3		1.16	1.16	3.66	9.42	0		13.08	11.92
4		1.16	1.16	3.66	9.42	0		13.08	11.92
5		1.16	1.16	3.66	9.42	0		13.08	11.92
6		1.16	1.16	3.66	9.42	0		13.08	11.92
7		1.16	1.16	3.66	9.42	0		13.08	11.92
8		1.16	1.16	3.66	9.42	0		13.08	11.92
9		1.16	1.16	3.66	9.42	0		13.08	11.92
10		1.16	1.16	3.66	9.42	0		13.08	11.92
11		1.16	1.16	3.66	9.42	0		13.08	11.92
12		1.16	1.16	3.66	9.42	0		13.08	11.92
13		1.16	1.16	3.66	9.42	0		13.08	11.92
14		1.16	1.16	3.66	9.42	0		13.08	11.92
15		1.16	1.16	3.66	9.42	0		13.08	11.92
16		1.16	1.16	3.66	9.42	0		13.08	11.92
17		1.16	1.16	3.66	9.42	0		13.08	11.92
18		1.16	1.16	3.66	9.42	0		13.08	11.92
19		1.16	1.16	3.66	9.42	0		13.08	11.92
20		1.16	1.16	3.66	9.42	0		13.08	11.92
21		1.16	1.16	3.66	9.42	0		13.08	11.92
22		1.16	1.16	3.66	9.42	0		13.08	11.92
23		1.16	1.16	3.66	9.42	0		13.08	11.92
24		1.16	1.16	3.66	9.42	0		13.08	11.92
25		1.16	1.16	3.66	9.42	0		13.08	11.92
26		1.16	1.16	3.66	9.42	0		13.08	11.92
27		1.16	1.16	3.66	9.42	0	12.34	25.42	24.26

E.I.R.R = 19.89 %

Source : Benefit (1) : Flood Control Benefit
 (2) : Agricultural Benefit
 (3) : Livestock Benefit
 (4) : Solvage Value

TABLE 8.12 CASH FLOW IN ACCOUNTING PRICE (CASE B-1) (2/3)

(Unit : million Rs.)

Year	Project Cost	O.M. Cost	Total cost	Benefits				Total Benefits	Net Benefit Value
				(1)	(2)	(3)	(4)		
1	44.96		44.96					Δ 44.96	
2	25.95	0.37	26.32					Δ 26.32	
3	10.39	1.16	11.55	3.90	9.24		13.32	1.77	
4	10.39	1.16	11.55	4.02	8.96		12.98	1.43	
5	8.18	1.16	9.34	4.14	8.50		12.64	3.30	
6		1.32	1.32	4.26	8.04		12.30	10.98	
7		1.32	1.32	4.26	8.04		12.30	10.98	
8		1.32	1.32	4.26	8.04		12.30	10.98	
9		1.32	1.32	4.26	8.04	2.00	14.30	12.98	
10		1.32	1.32	4.26	8.04	2.00	14.30	12.98	
11		1.32	1.32	4.26	8.04	2.00	14.30	12.98	
12		1.32	1.32	4.26	8.04	2.00	14.30	12.98	
13		1.32	1.32	4.26	8.04	2.00	14.30	12.98	
14		1.32	1.32	4.26	8.04	2.00	14.30	12.98	
15		1.32	1.32	4.26	8.04	2.00	14.30	12.98	
16		1.32	1.32	4.26	8.04	2.00	14.30	12.98	
17		1.32	1.32	4.26	8.04	2.00	14.30	12.98	
18		1.32	1.32	4.26	8.04	2.00	14.30	12.98	
19		1.32	1.32	4.26	8.04	2.00	14.30	12.98	
20		1.32	1.32	4.26	8.04	2.00	14.30	12.98	
21		1.32	1.32	4.26	8.04	2.00	14.30	12.98	
22		1.32	1.32	4.26	8.04	2.00	14.30	12.98	
23		1.32	1.32	4.26	8.04	2.00	14.30	12.98	
24		1.32	1.32	4.26	8.04	2.00	14.30	12.98	
25		1.32	1.32	4.26	8.04	2.00	14.30	12.98	
26		1.32	1.32	4.26	8.04	2.00	14.30	12.98	
27		1.32	1.32	4.26	8.04	2.00	48.12	61.10	

E.I.R.R = 11.80 %

Source : Benefit (1) : Flood Control Benefit
 (2) : Agricultural Benefit
 (3) : Livestock Benefit
 (4) : Salvage Value

TABLE 8.12 CASH FLOW IN ACCOUNTING PRICE (CASE B-2) (3/3)

(Unit : million Rs.)									
Year	Project Cost	O.M. Cost	Total cost	Benefits				Table Benefits	Net Benefit Value
				(1)	(2)	(3)	(4)		
1	45.98		45.98						Δ 45.98
2	25.94	0.37	26.31						Δ 26.31
3	7.68	1.16	8.84	3.78	9.42			13.20	4.36
4	8.41	1.16	9.57	3.86	9.14			13.00	3.43
5	8.41	1.16	9.57	3.93	8.86			12.79	3.22
6	8.58	1.32	9.90	4.00	8.58			12.58	2.68
7	7.26	1.32	8.58	4.07	8.30			12.37	3.79
8	4.84	1.32	6.16	4.14	8.02			12.16	6.00
9	4.84	1.32	6.16	4.22	7.74			11.96	5.80
10	4.83	1.32	6.15	4.29	7.46			11.75	5.60
11		1.32	1.32	4.36	7.18	3.80		15.34	14.02
12		1.32	1.32	4.36	7.18	3.80		15.34	14.02
13		1.32	1.32	4.36	7.18	3.80		15.34	14.02
14		1.32	1.32	4.36	7.18	3.80		15.34	14.02
15		1.32	1.32	4.36	7.18	3.80		15.34	14.02
16		1.32	1.32	4.36	7.18	3.80		15.34	14.02
17		1.32	1.32	4.36	7.18	3.80		15.34	14.02
18		1.32	1.32	4.36	7.18	3.80		15.34	14.02
19		1.32	1.32	4.36	7.18	3.80		15.34	14.02
20		1.32	1.32	4.36	7.18	3.80		15.34	14.02
21		1.32	1.32	4.36	7.18	3.80		15.34	14.02
22		1.32	1.32	4.36	7.18	3.80		15.34	14.02
23		1.32	1.32	4.36	7.18	3.80		15.34	14.02
24		1.32	1.32	4.36	7.18	3.80		15.34	14.02
25		1.32	1.32	4.36	7.18	3.80		15.34	14.02
26		1.32	1.32	4.36	7.18	3.80		15.34	14.02
27		1.32	1.32	4.36	7.18	3.80	66.57	81.91	80.59

E.I.R.R = 10.43 %

Source : Benefit (1) : Flood Control Benefit
 (2) : Agricultural Benefit
 (3) : Livestock Benefit
 (4) : Solvage Value

TABLE 8.13 CASH FLOW ANALYSIS (ACCOUNTING PRICE) (CASE A) (1/3)

I.R.R = 19.886 % (Unit: million Rs.)

Year	Original Value		Present Value		N.P.V
	Cost	Benefit	Cost	Benefit	
1	34.91	0.00	29.12	0.00	-29.12
2	17.58	0.00	12.23	0.00	-12.23
3	1.16	13.08	0.67	7.59	6.92
4	1.16	13.08	0.56	6.33	5.77
5	1.16	13.08	0.47	5.28	4.81
6	1.16	13.08	0.39	4.41	4.01
7	1.16	13.08	0.33	3.67	3.35
8	1.16	13.08	0.27	3.07	2.79
9	1.16	13.08	0.23	2.56	2.33
10	1.16	13.08	0.19	2.13	1.94
11	1.16	13.08	0.16	1.78	1.62
12	1.16	13.08	0.13	1.48	1.35
13	1.16	13.08	0.11	1.24	1.13
14	1.16	13.08	0.09	1.03	0.94
15	1.16	13.08	0.08	0.86	0.78
16	1.16	13.08	0.06	0.72	0.65
17	1.16	13.08	0.05	0.60	0.55
18	1.16	13.08	0.04	0.50	0.46
19	1.16	13.08	0.04	0.42	0.38
20	1.16	13.08	0.03	0.35	0.32
21	1.16	13.08	0.03	0.29	0.26
22	1.16	13.08	0.02	0.24	0.22
23	1.16	13.08	0.02	0.20	0.18
24	1.16	13.08	0.01	0.17	0.15
25	1.16	13.08	0.01	0.14	0.13
26	1.16	13.08	0.01	0.12	0.11
27	1.16	25.42	0.01	0.19	0.18
Total	81.49	339.34	45.37	45.37	0.00

(B/C = 1.000)

TABLE 8.13 CASH FLOW ANALYSIS (ACCOUNTING PRICE) (CASE B-1) (2/3)

Year	Original Value		Present Value		N.P.V
	Cost	Benefit	Cost	Benefit	
	I.R.R = 11.795 % (Unit: million Rs.)				
1	44.96	0.00	40.22	0.00	-40.22
2	26.32	0.00	21.06	0.00	-21.06
3	11.55	13.32	8.27	9.53	1.27
4	11.55	12.98	7.39	8.31	0.92
5	9.34	12.64	5.35	7.24	1.89
6	1.32	12.30	0.68	6.30	5.62
7	1.32	12.30	0.60	5.64	5.03
8	1.32	12.30	0.54	5.04	4.50
9	1.32	14.30	0.48	5.24	4.76
10	1.32	14.30	0.43	4.69	4.26
11	1.32	14.30	0.39	4.19	3.81
12	1.32	14.30	0.35	3.75	3.41
13	1.32	14.30	0.31	3.36	3.05
14	1.32	14.30	0.28	3.00	2.72
15	1.32	14.30	0.25	2.69	2.44
16	1.32	14.30	0.22	2.40	2.18
17	1.32	14.30	0.20	2.15	1.95
18	1.32	14.30	0.18	1.92	1.74
19	1.32	14.30	0.16	1.72	1.56
20	1.32	14.30	0.14	1.54	1.40
21	1.32	14.30	0.13	1.38	1.25
22	1.32	14.30	0.11	1.23	1.12
23	1.32	14.30	0.10	1.10	1.00
24	1.32	14.30	0.09	0.98	0.89
25	1.32	14.30	0.08	0.88	0.80
26	1.32	14.30	0.07	0.79	0.71
27	1.32	62.42	0.07	3.08	3.01
Total	132.76	395.66	88.14	88.14	0.00

(B/C = 1.000)

TABLE 8.13 CASH FLOW ANALYSIS (ACCOUNTING PRICE) (CASE B-2) (3/3)

I.R.R = 10.431 % (Unit: million Rs.)

Year	Original Value		Present Value		N.P.V
	Cost	Benefit	Cost	Benefit	
1	45.98	0.00	41.64	0.00	-41.64
2	26.31	0.00	21.57	0.00	-21.57
3	8.84	13.20	6.56	9.80	3.24
4	9.57	13.00	6.43	8.74	2.31
5	9.57	12.79	5.83	7.79	1.96
6	9.90	12.58	5.46	6.94	1.48
7	8.58	12.37	4.28	6.18	1.89
8	6.16	12.16	2.79	5.50	2.71
9	6.16	11.96	2.52	4.90	2.37
10	6.15	11.75	2.28	4.36	2.08
11	1.32	15.34	0.44	5.15	4.71
12	1.32	15.34	0.40	4.66	4.26
13	1.32	15.34	0.36	4.22	3.86
14	1.32	15.34	0.33	3.82	3.49
15	1.32	15.34	0.30	3.46	3.16
16	1.32	15.34	0.27	3.14	2.87
17	1.32	15.34	0.24	2.84	2.60
18	1.32	15.34	0.22	2.57	2.35
19	1.32	15.34	0.20	2.33	2.13
20	1.32	15.34	0.18	2.11	1.93
21	1.32	15.34	0.16	1.91	1.75
22	1.32	15.34	0.15	1.73	1.58
23	1.32	15.34	0.13	1.57	1.43
24	1.32	15.34	0.12	1.42	1.30
25	1.32	15.34	0.11	1.28	1.17
26	1.32	15.34	0.10	1.16	1.06
27	1.32	81.91	0.09	5.62	5.53
Total	159.66	427.16	103.19	103.19	0.00

(B/C = 1.000)

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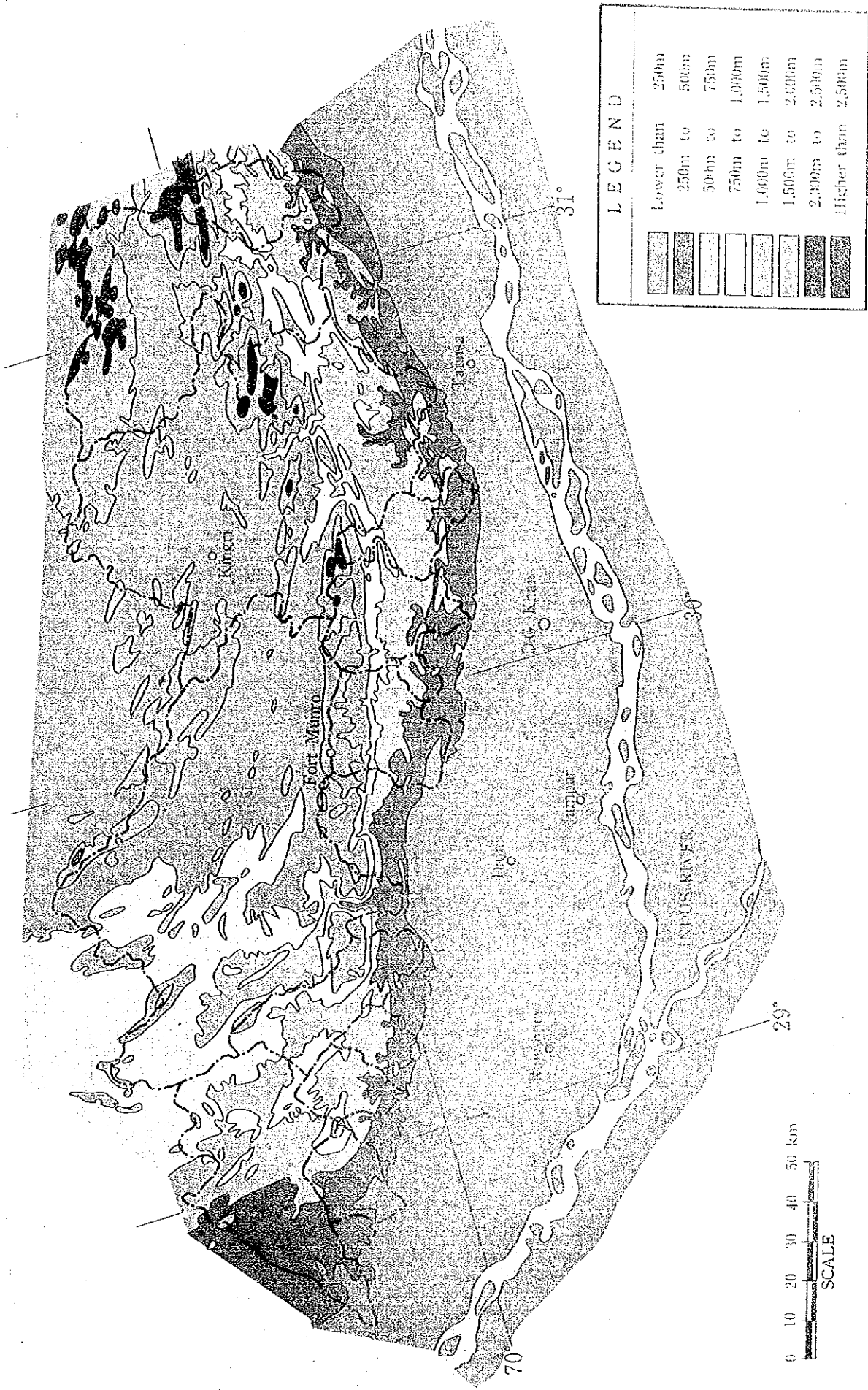
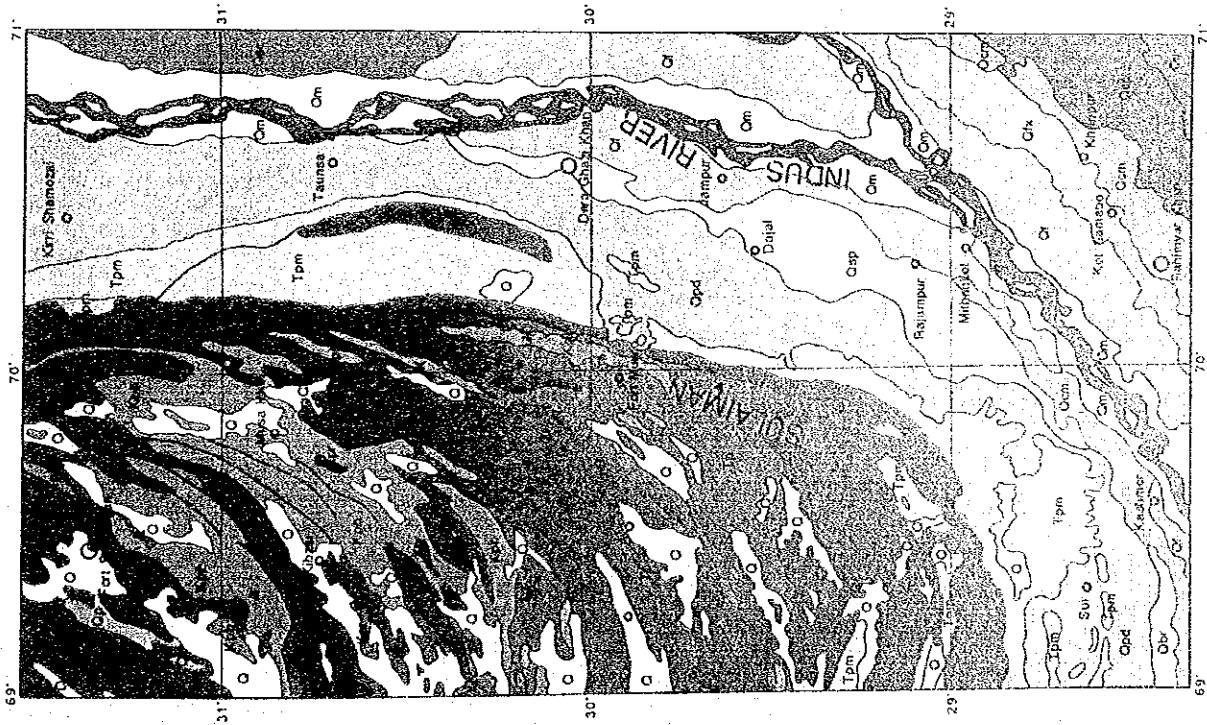


FIGURE 3.1 TOPOGRAPHICAL MAP OF THE STUDY AREA



LEGEND

- | | | |
|--|---|--|
| <p>QUATERNARY</p> <ul style="list-style-type: none"> ○ Unconsolidated surficial deposits of silt, sand and gravel ○ Braided-stream deposits ○ Streambed and meander-belt deposits ○ Flood-plain deposits ○ Flood-plain deposits (lower terraces) ○ Eolian sand ○ Eolian sand, undivided ○ Piedmont deposits; coarse detrital material derived from adjacent highland ○ Subpedmont deposits; finer detrital material derived from adjacent highlands ○ Older terrace deposits ; mostly loess deposits of the upper terrace ○ Older terrace deposits ; loess and flood-plain deposits of the middle terrace ○ Pleistocene sedimentary rocks ; mostly clay and silt, some conglomerate and sandstone | <p>TERTIARY</p> <ul style="list-style-type: none"> ○ Pliocene and Miocene sedimentary rocks ; sandstone, conglomerate, siltstone, shale ○ Oligocene and Eocene sedimentary rocks ○ Eocene Sedimentary rocks ; limestone, sandstone, agglomerate, shale ○ Paleocene sedimentary rocks ; alternating shale, sandstone, and limestone | <p>TRIASSIC JURASSIC AND CRETACEOUS</p> <ul style="list-style-type: none"> ○ Undivided Cretaceous rocks ; sandstone, limestone ○ Cretaceous and Jurassic sedimentary rocks ; Sandstone with marly limestone near base ○ Cretaceous and Jurassic sedimentary rocks ; Sandstone, limestone ○ Jurassic sedimentary rocks ; limestone ○ Jurassic and Triassic sedimentary rocks ; mostly limestone and interbedded shale |
| <p>— Faults</p> | | |

FIGURE 3.2 SCALE 1:2,000,000
GEOLOGICAL MAP OF THE STUDY AREA

From GEOLOGICAL MAP OF PAKISTAN, 1964

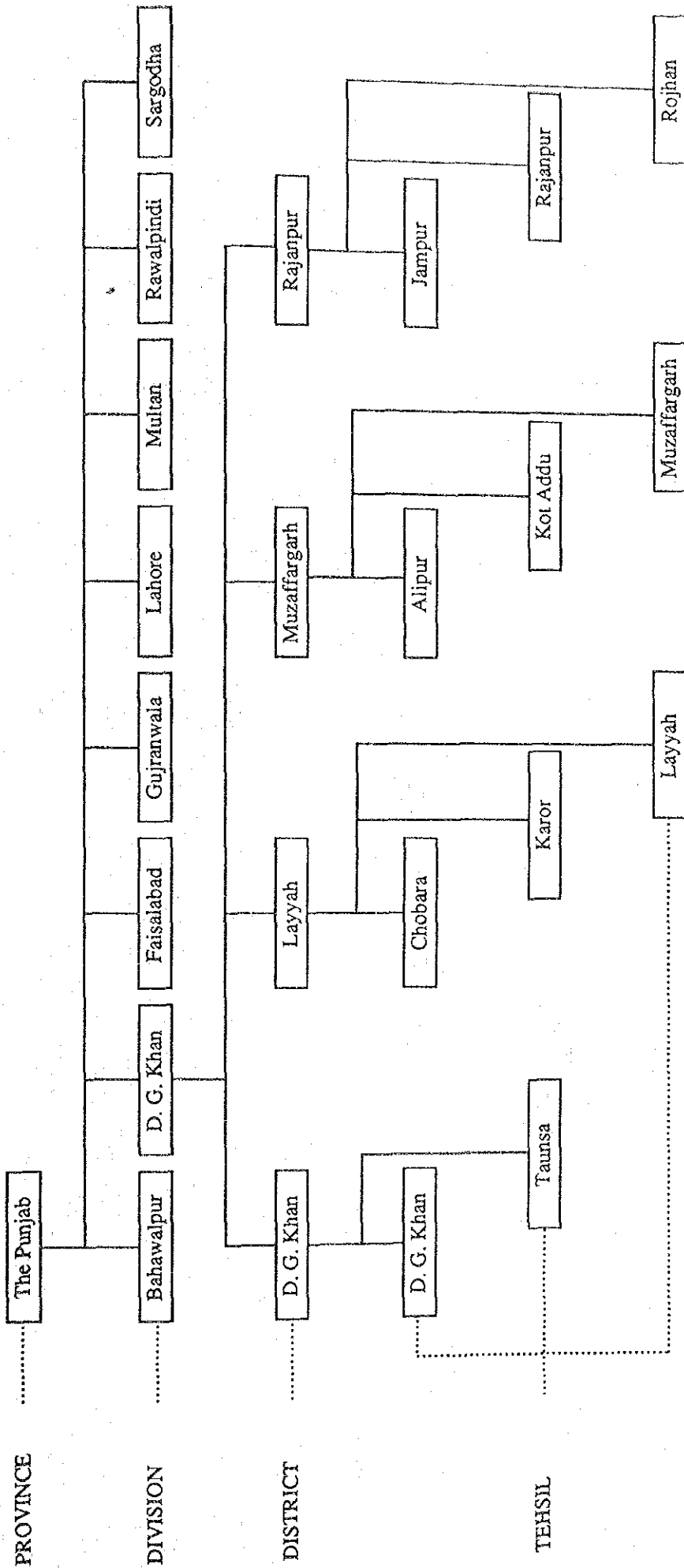


FIGURE 3.3 ADMINISTRATIVE DIVISIONS OF THE PUNJAB

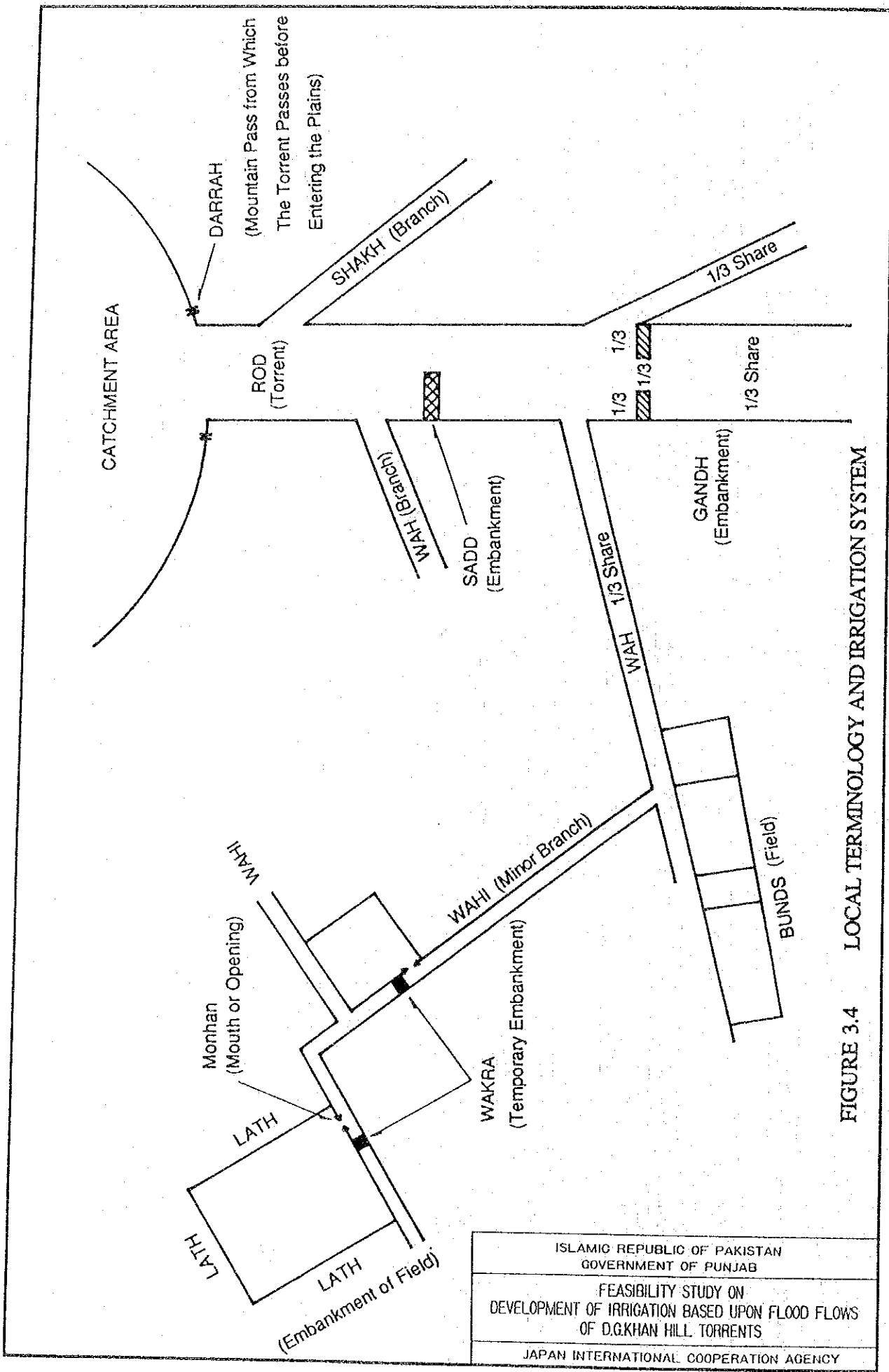


FIGURE 3.4 LOCAL TERMINOLOGY AND IRRIGATION SYSTEM

ISLAMIC REPUBLIC OF PAKISTAN
 GOVERNMENT OF PUNJAB
 FEASIBILITY STUDY ON
 DEVELOPMENT OF IRRIGATION BASED UPON FLOOD FLOWS
 OF D.G.KHAN HILL TORRENTS
 JAPAN INTERNATIONAL COOPERATION AGENCY

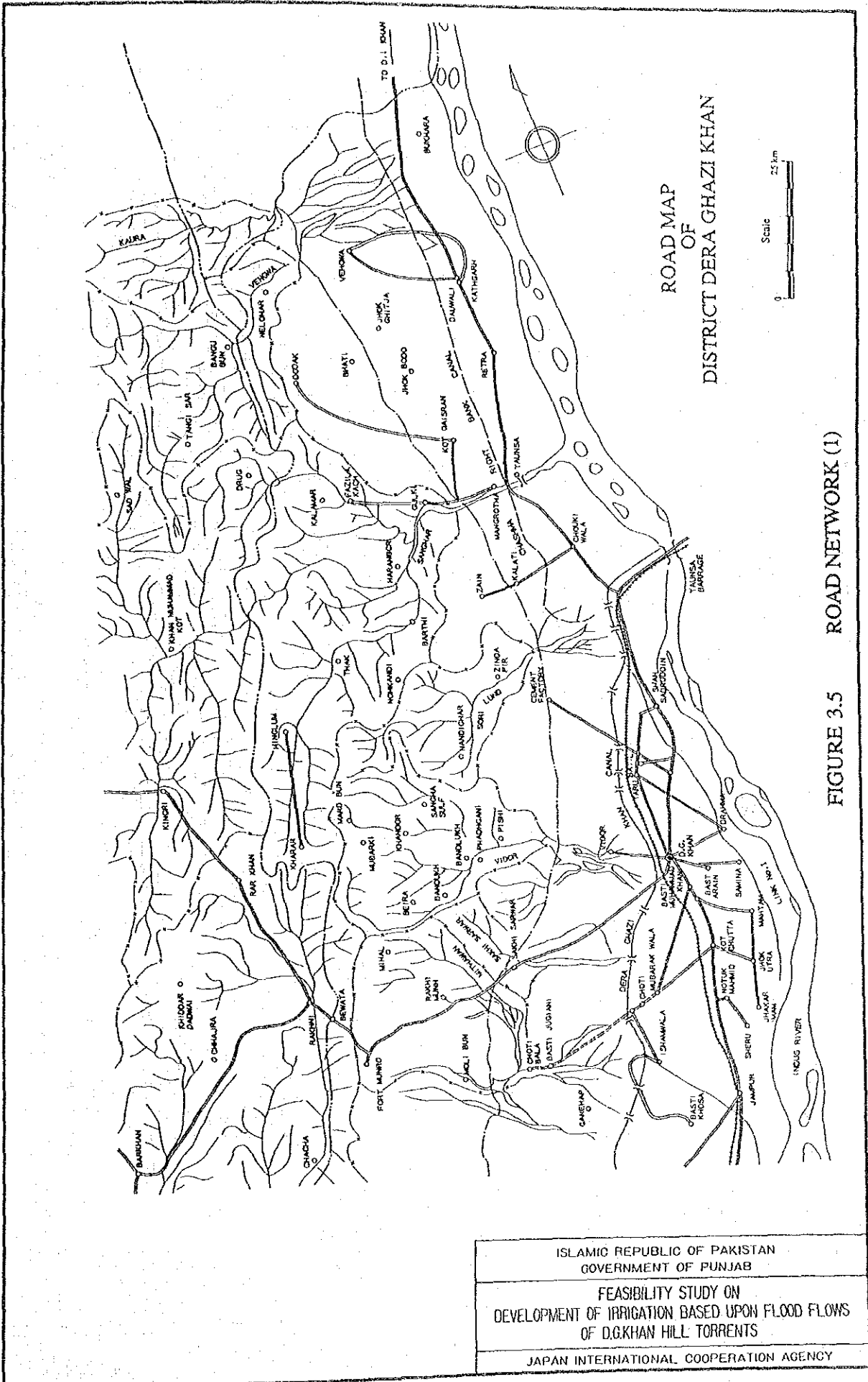


FIGURE 3.5 ROAD NETWORK (1)

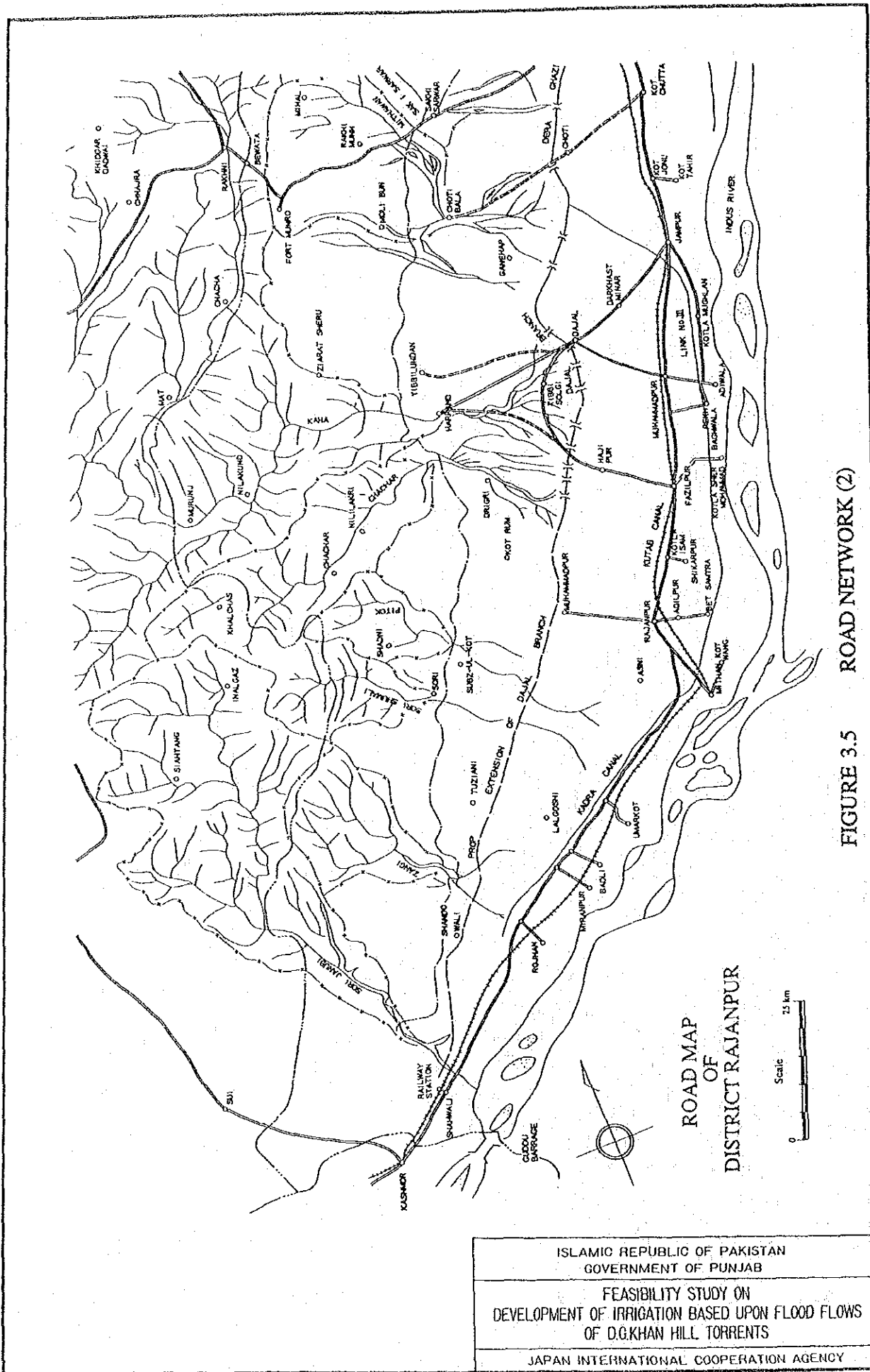
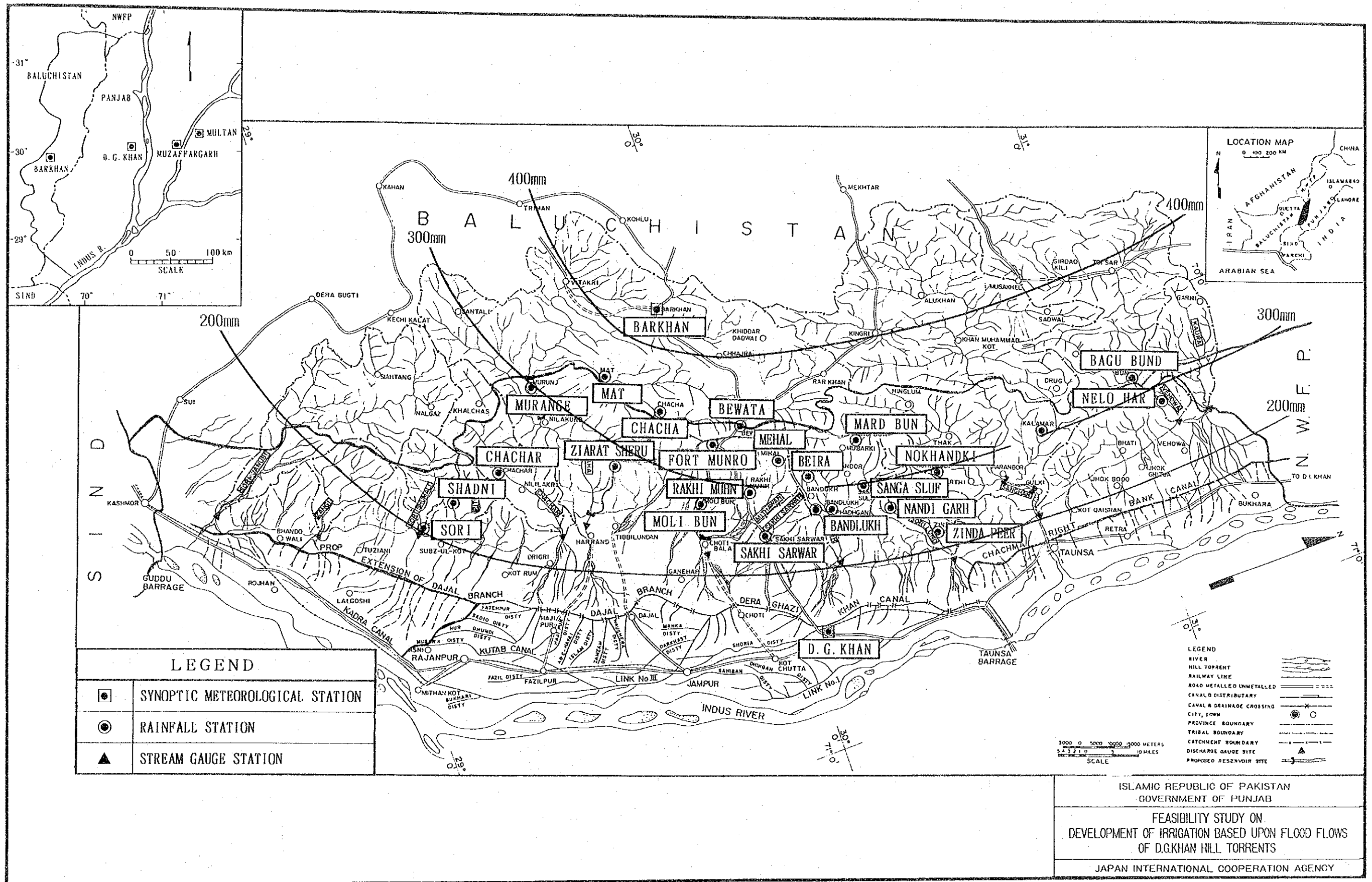


FIGURE 3.5 ROAD NETWORK (2)



LEGEND	
●	SYNOPTIC METEOROLOGICAL STATION
○	RAINFALL STATION
▲	STREAM GAUGE STATION

LEGEND	
	RIVER
	HILL TOPRENT
	RAILWAY LINE
	ROAD METALLED UNMETALLED
	CANAL DISTRIBUTARY
	CANAL & DRAINAGE CROSSING
	CITY, TOWN
	PROVINCE BOUNDARY
	TRIBAL BOUNDARY
	CATCHMENT BOUNDARY
	DISCHARGE GAUGE SITE
	PROPOSED RESERVOIR SITE

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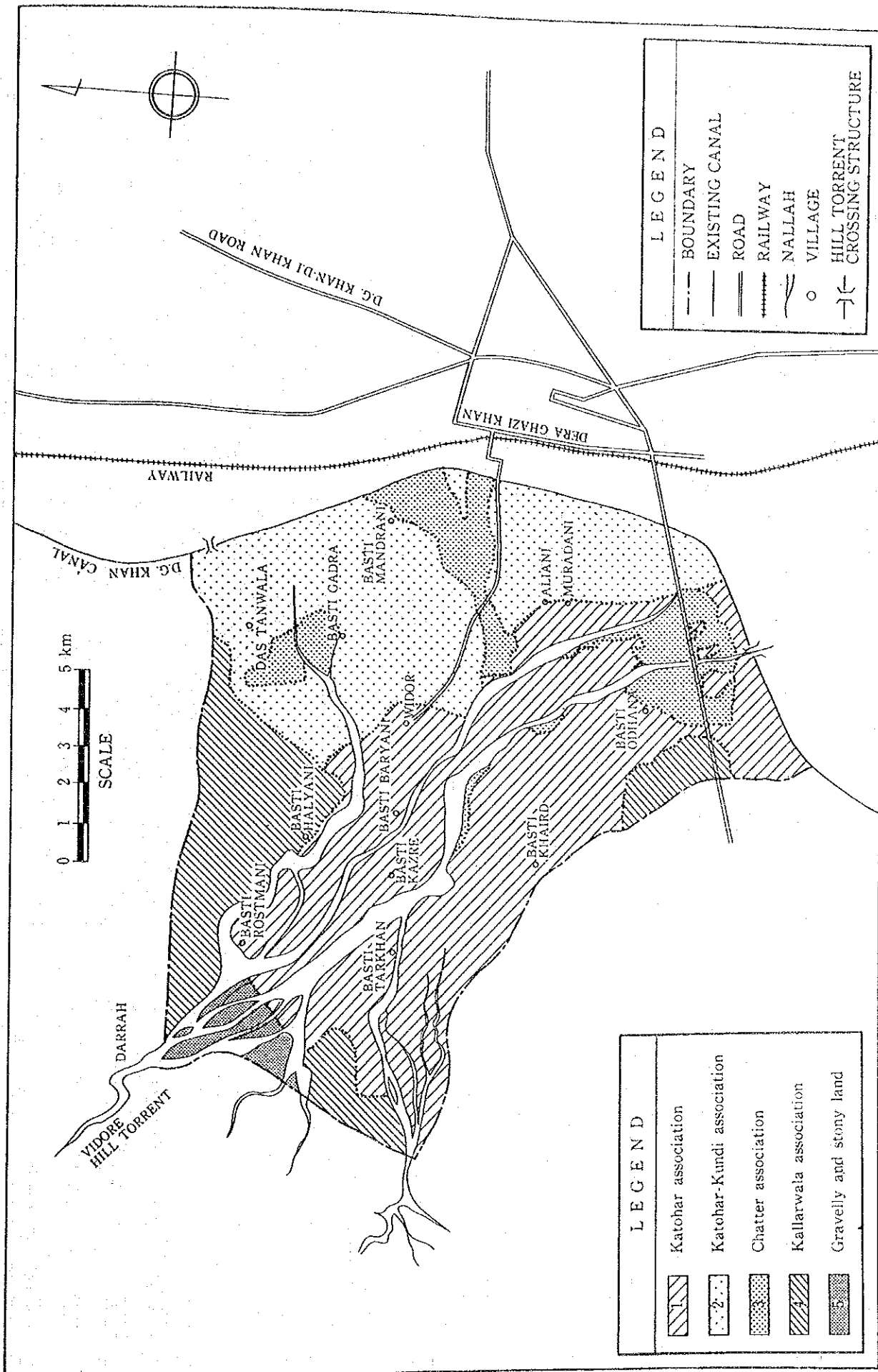


FIGURE 5.2 SOIL MAP OF THE STUDY AREA

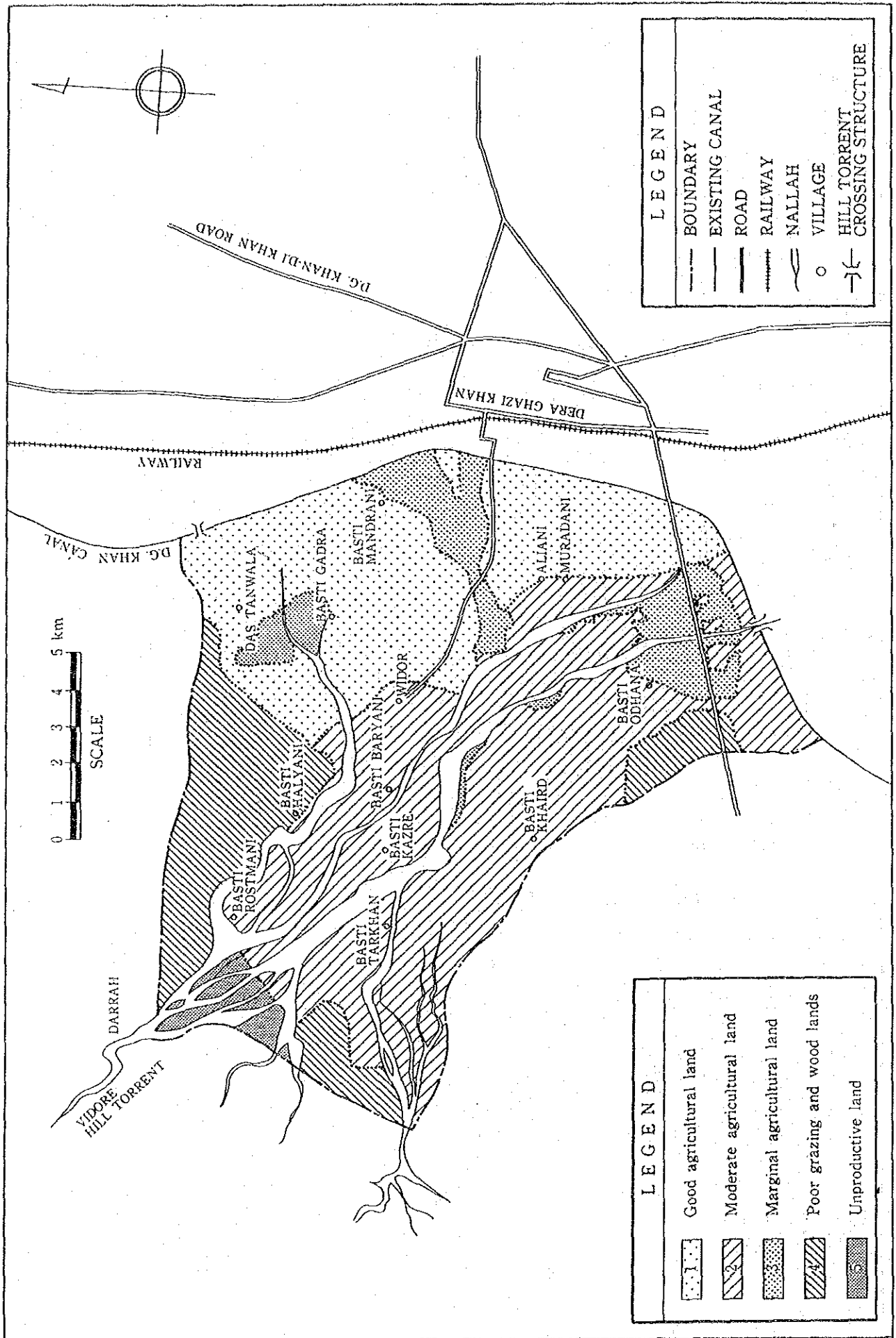


FIGURE 5.3 LAND CAPABILITY MAP OF THE STUDY AREA

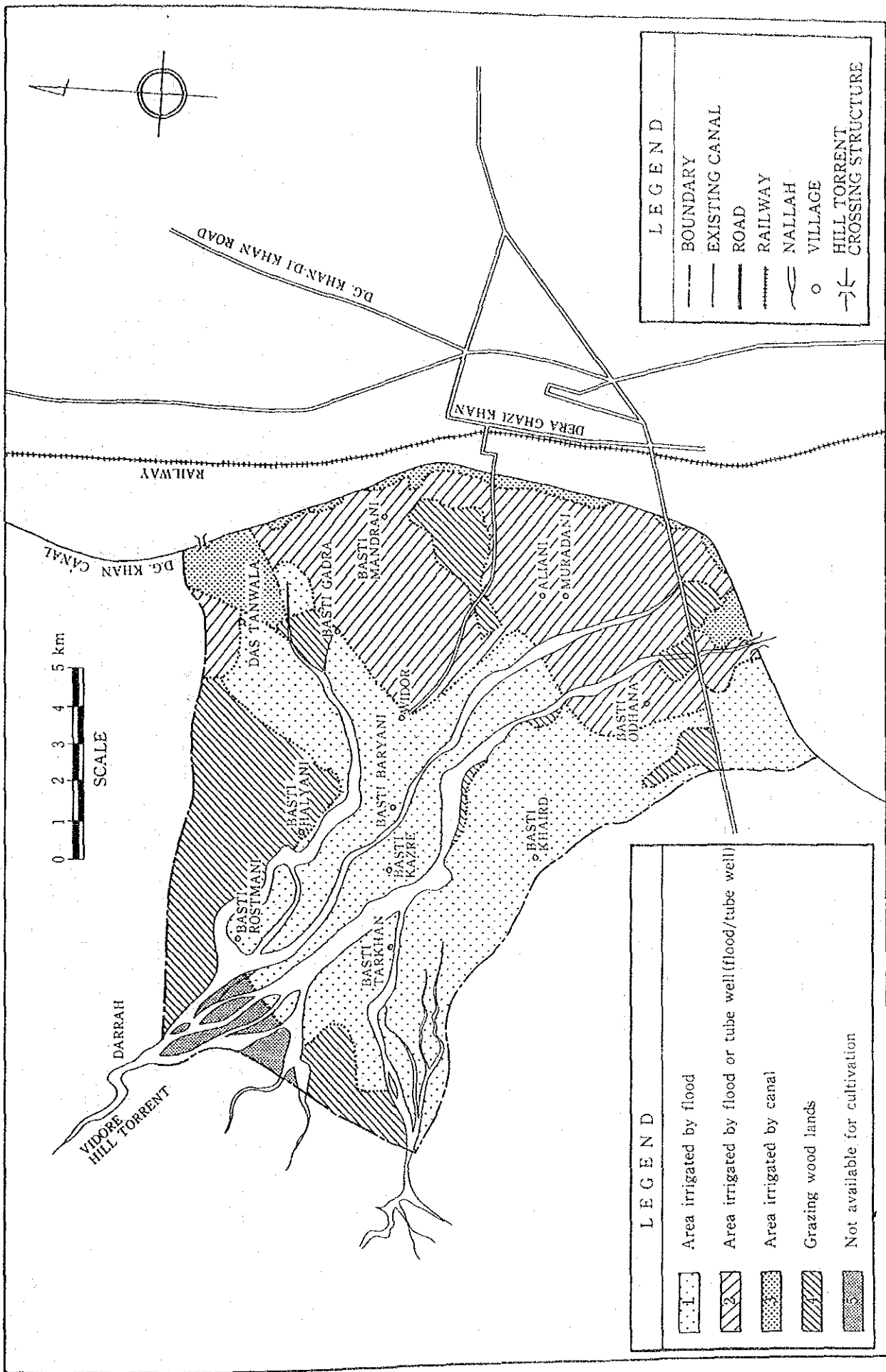


FIGURE 5.4 PRESENT LAND USE MAP OF THE STUDY AREA

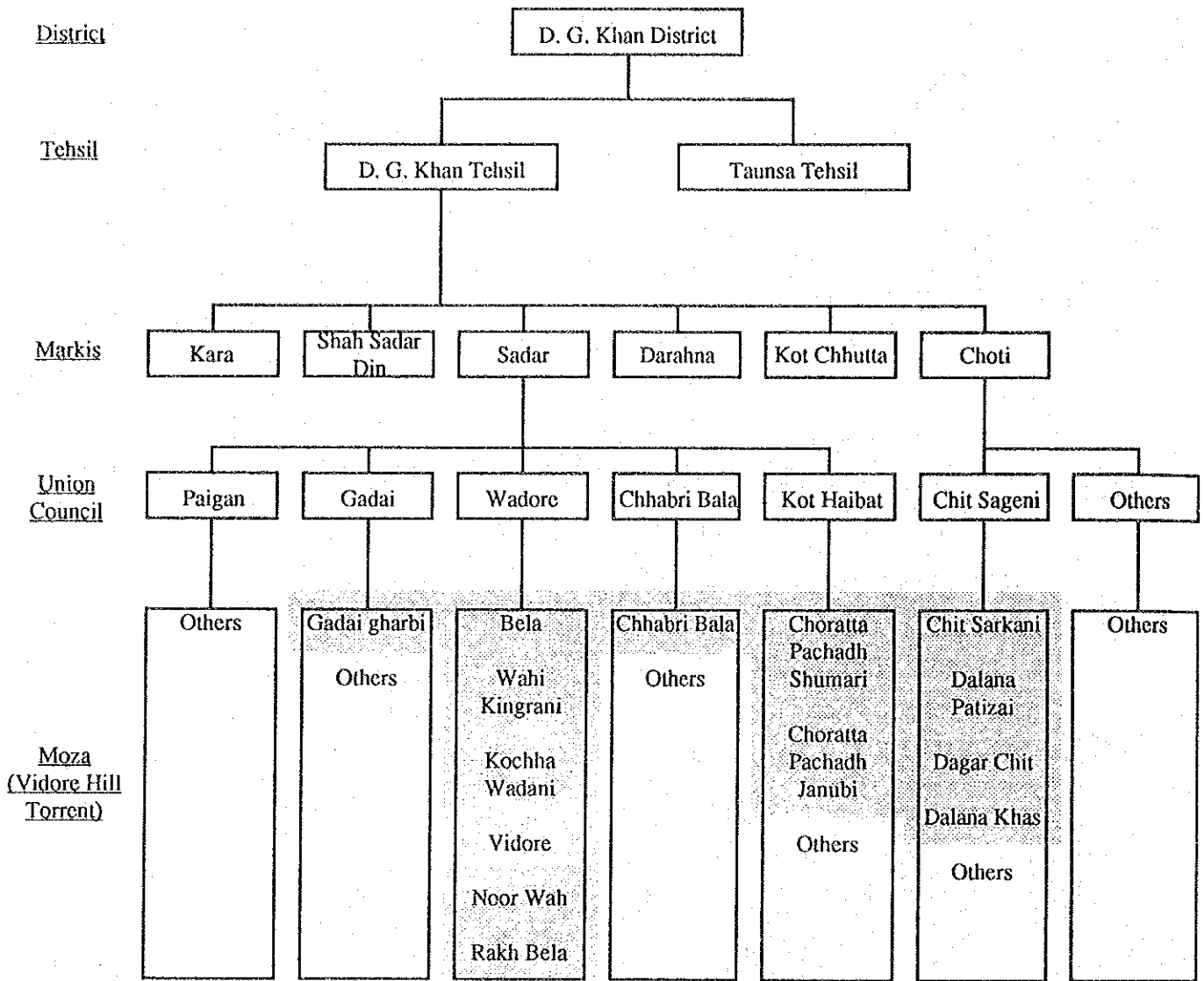


FIGURE 5.5 ADMINISTRATIVE DIVISIONS OF THE STUDY AREA

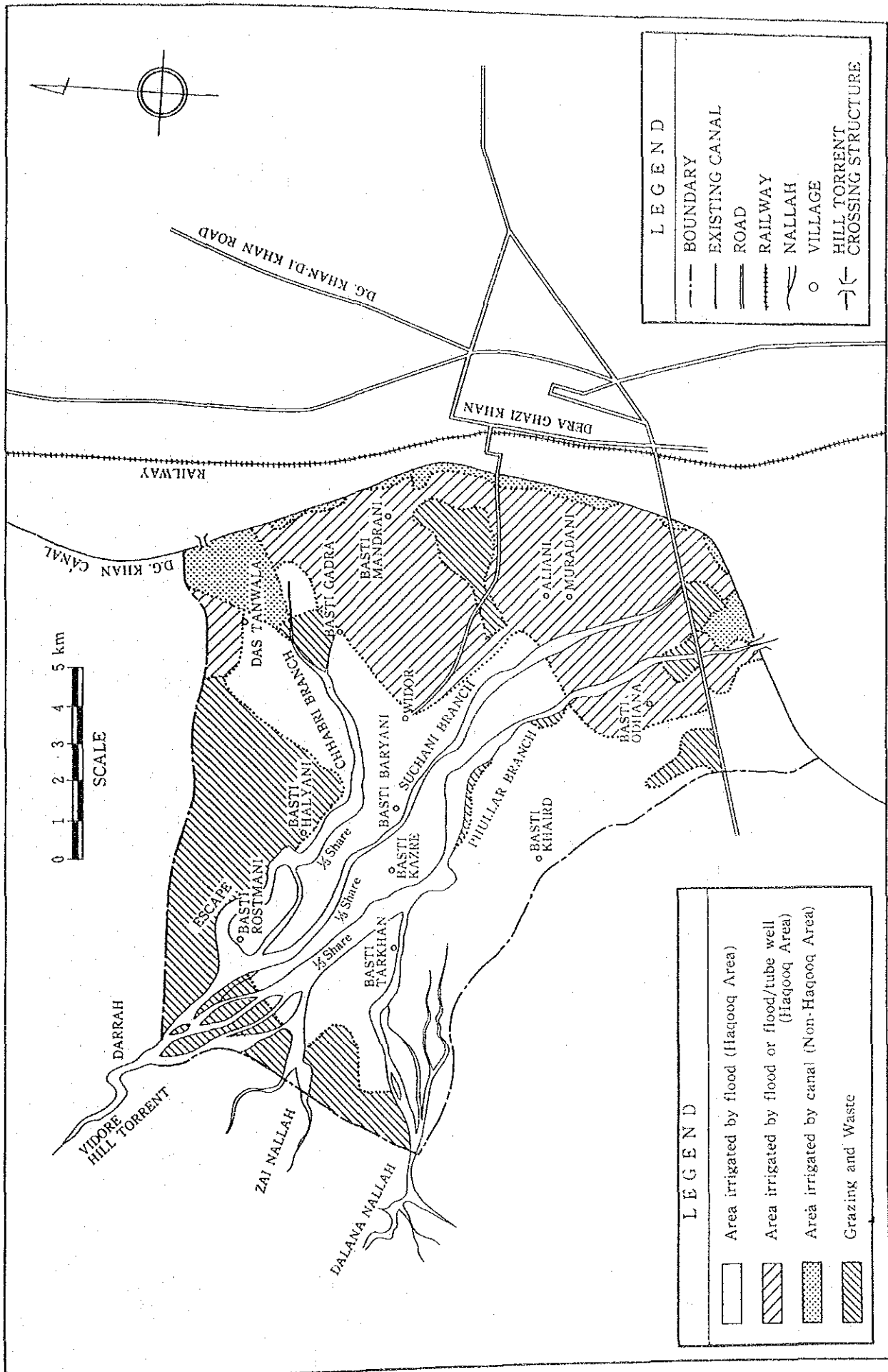


FIGURE 5.6 AREA CLASSIFIED BY WATER RESOURCES

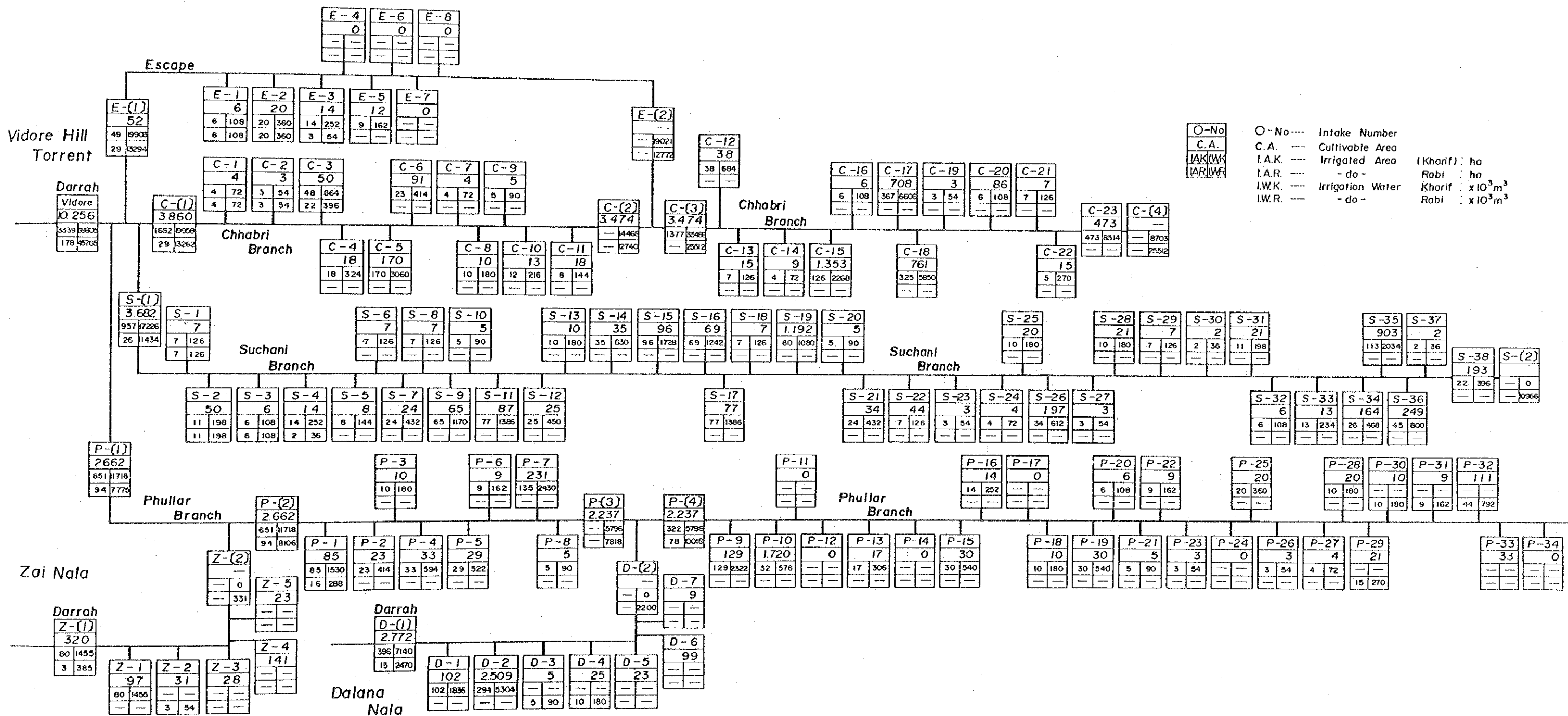


FIGURE 5.7 SCHEMATIC DIAGRAM OF PRESENT IRRIGATION SYSTEM (1978)

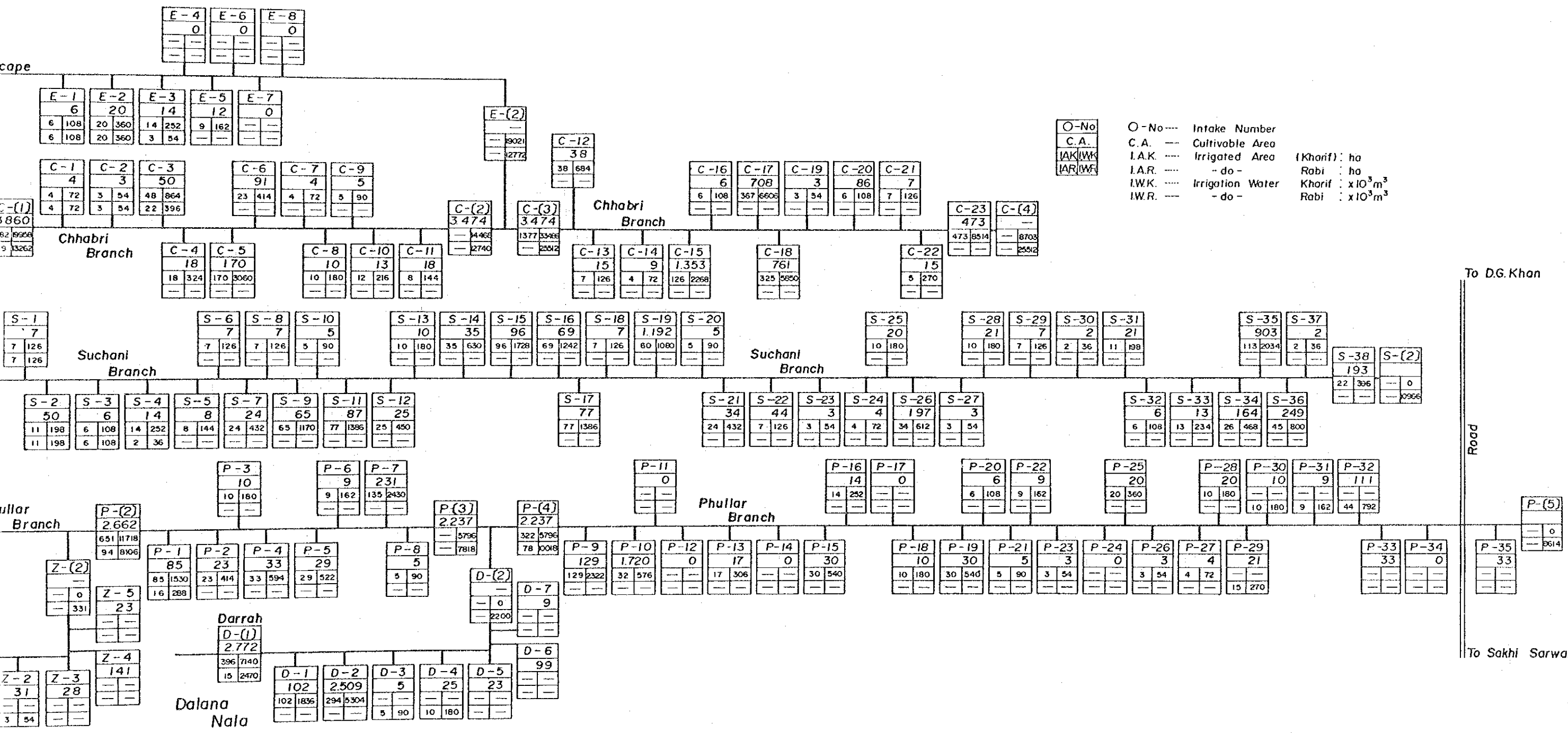


FIGURE 5.7 SCHEMATIC DIAGRAM OF PRESENT IRRIGATION SYSTEM (1978)

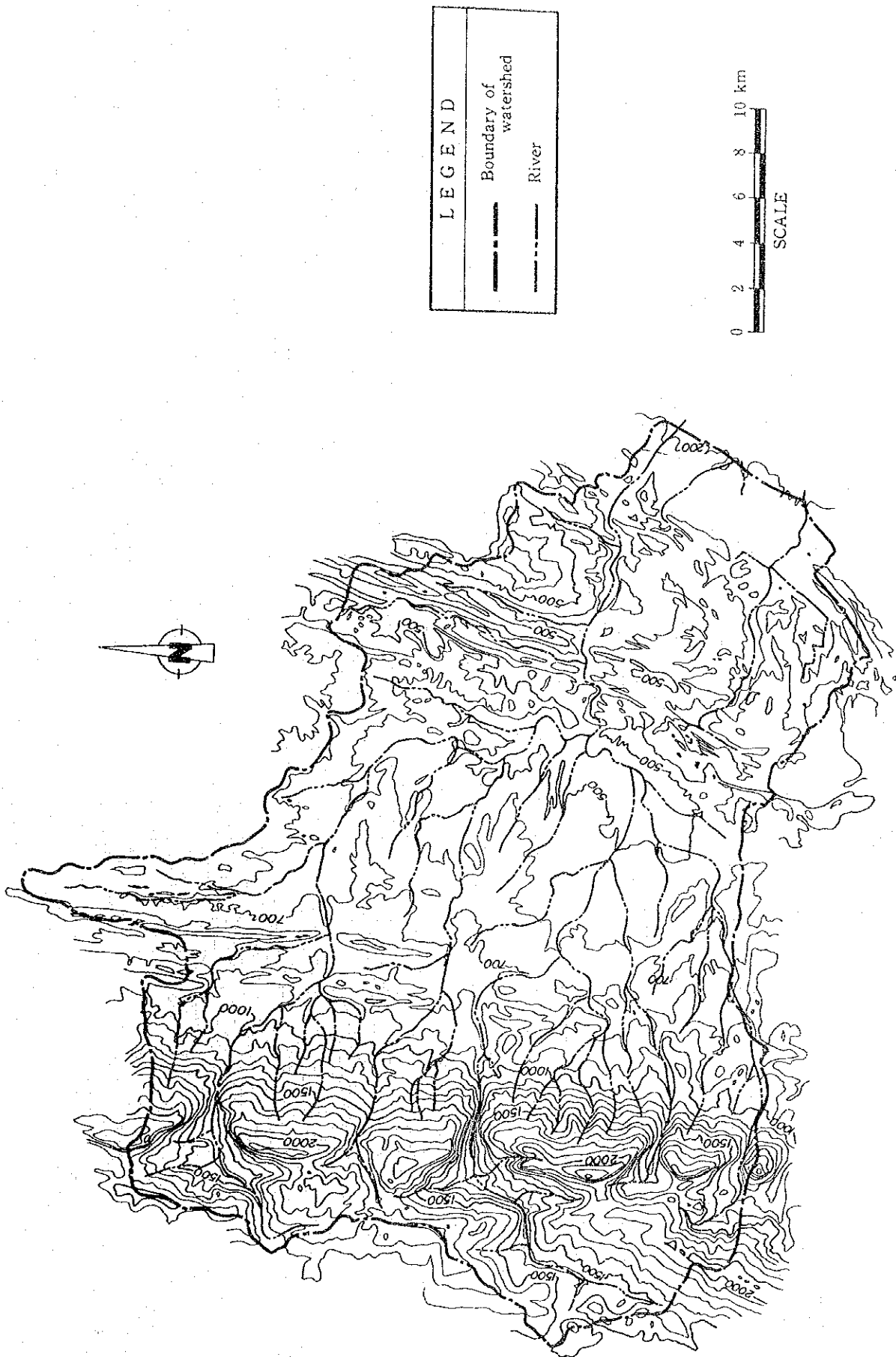
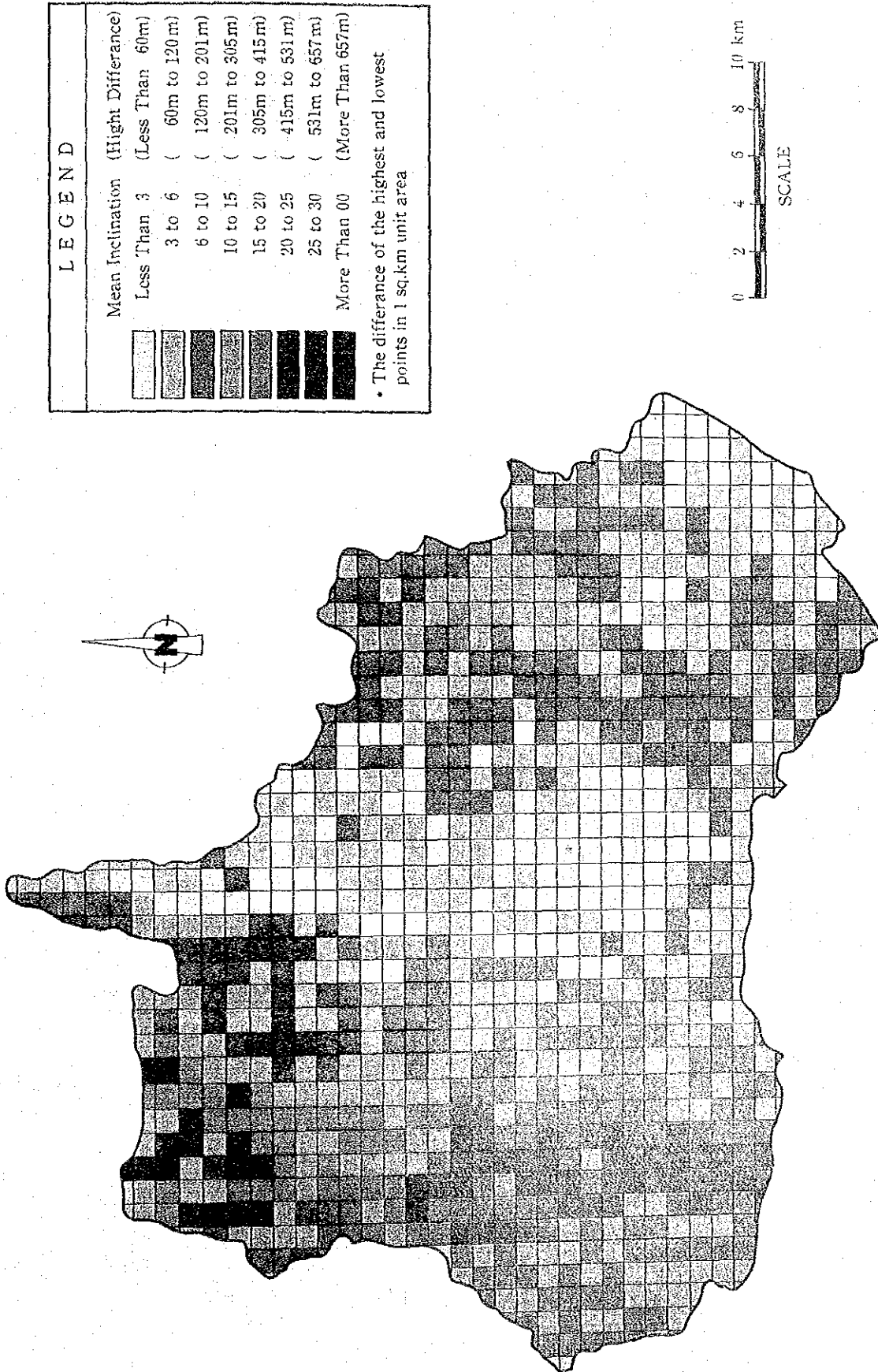


FIGURE 5.8 RELIEF MAP OF VIDORE WATERSHED



LEGEND

Mean Inclination	(Height Difference)
Less Than 3	(Less Than 60m)
3 to 6	(60m to 120m)
6 to 10	(120m to 201m)
10 to 15	(201m to 305m)
15 to 20	(305m to 415m)
20 to 25	(415m to 531m)
25 to 30	(531m to 657m)
More Than 30	(More Than 657m)

• The difference of the highest and lowest points in 1 sq.km unit area

FIGURE 5.9 RELATIVE RELIEF OF VIDORE WATERSHED

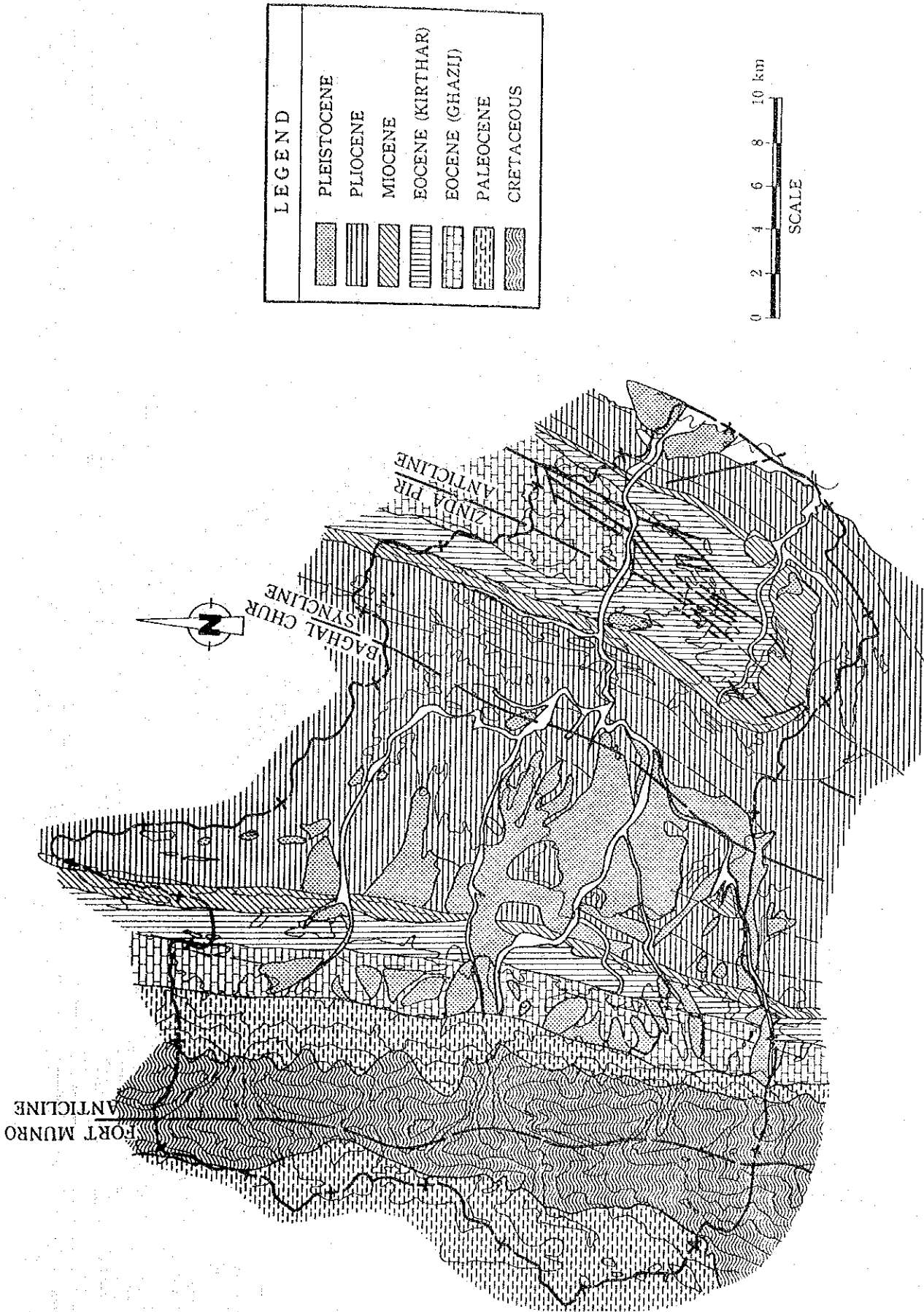


FIGURE 5.10 GEOLOGICAL MAP OF VIDORE WATERSHED

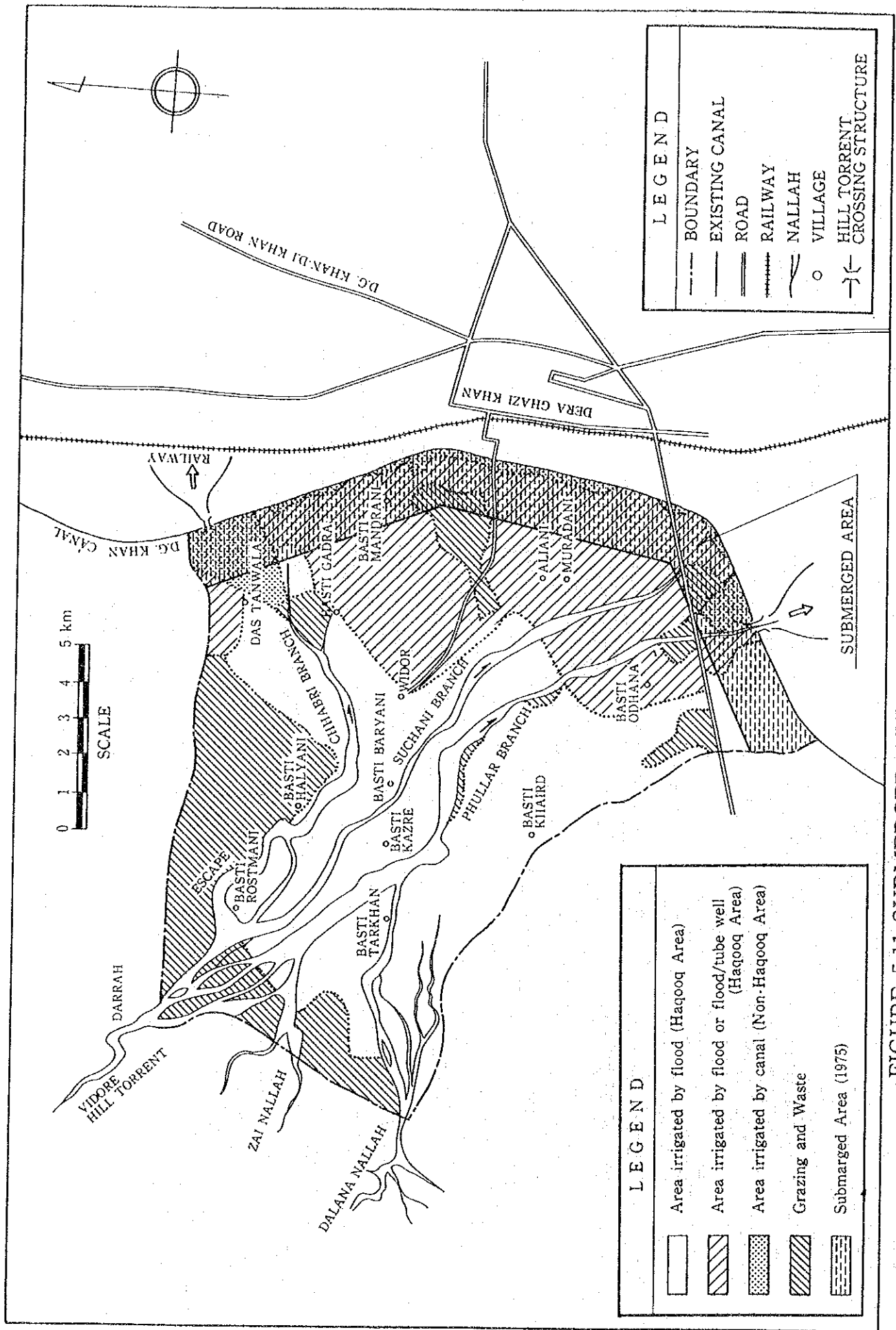


FIGURE 5.11 SUBMERGED AREA BY FLOOD WATER AS OF 1975

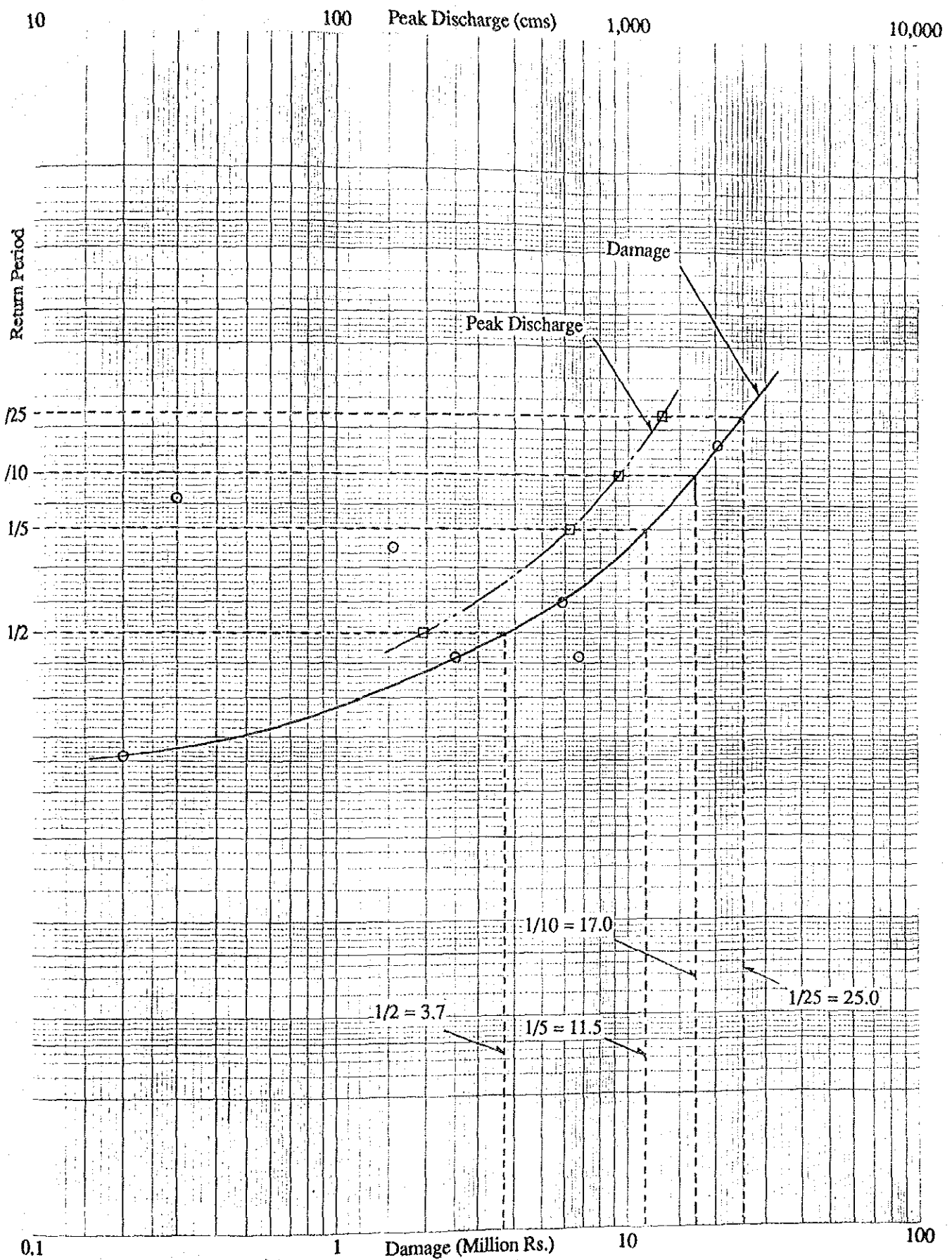
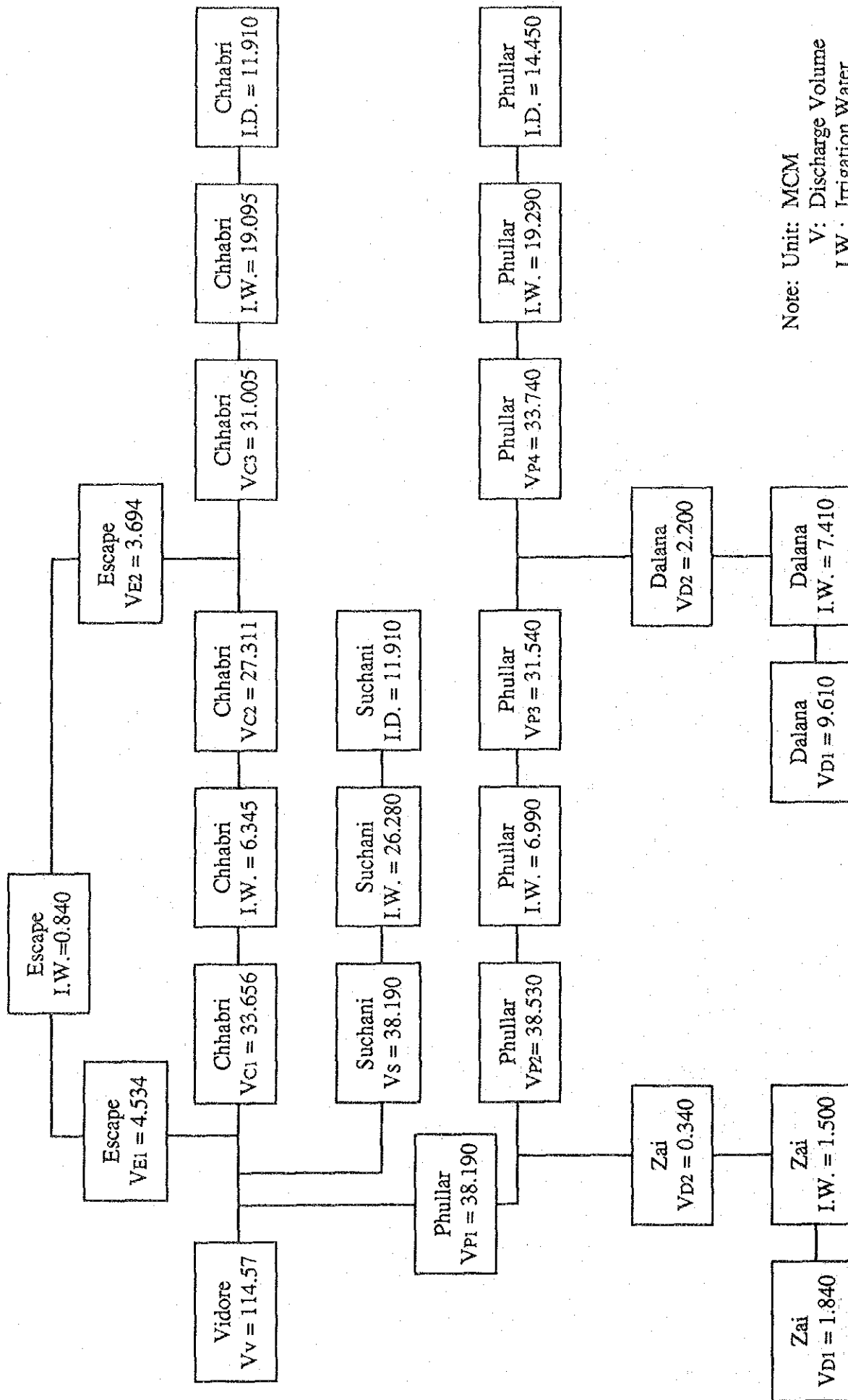


FIGURE 5.12 PRESENT FLOOD DAMAGE



Note: Unit: MCM
 V: Discharge Volume
 I.W.: Irrigation Water
 I.D.: Ineffective Discharge

FIGURE 6.1 WATER BALANCE (CASE A / 1978)

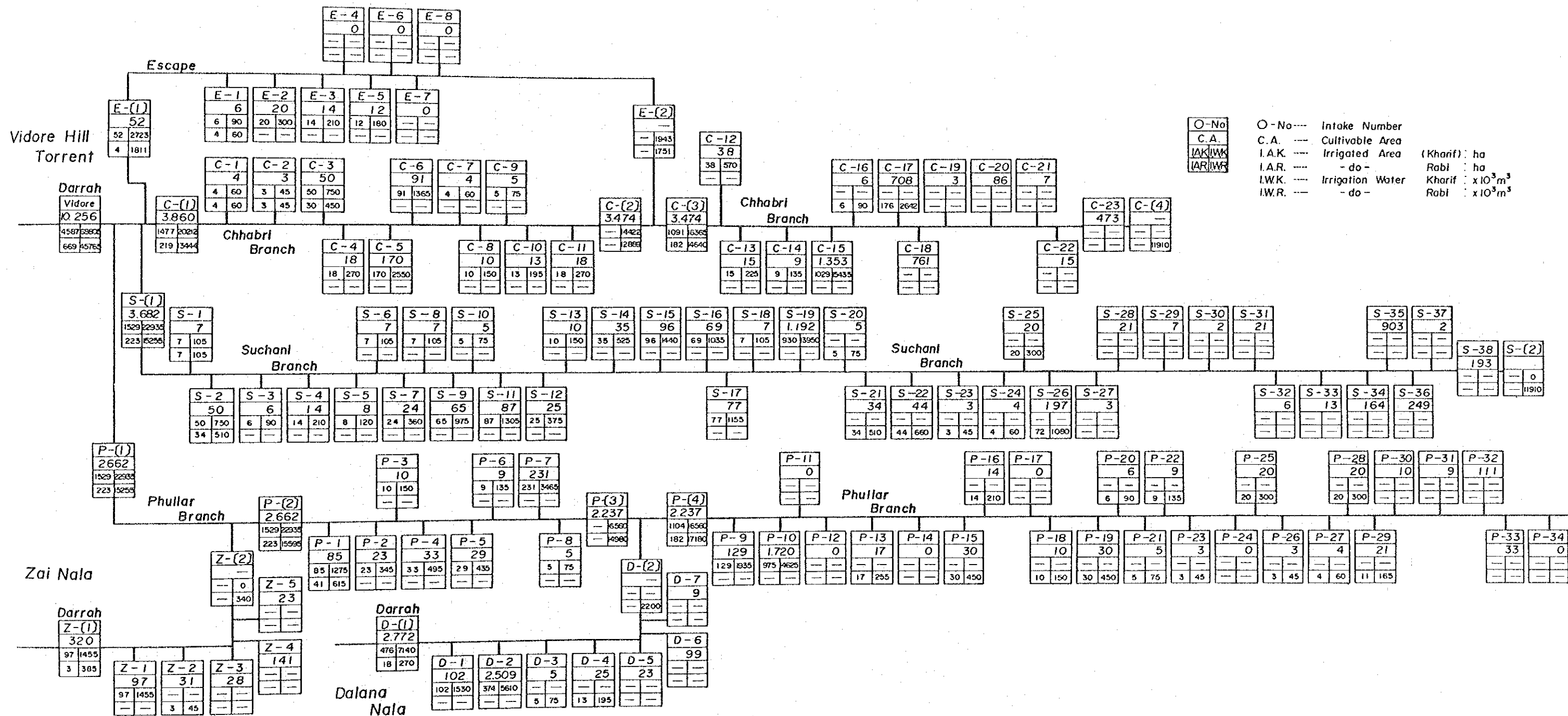


FIGURE 6.2 SCHEMATIC DIAGRAM OF PROPOSED IRRIGATION SYSTEM(Case A/1978)

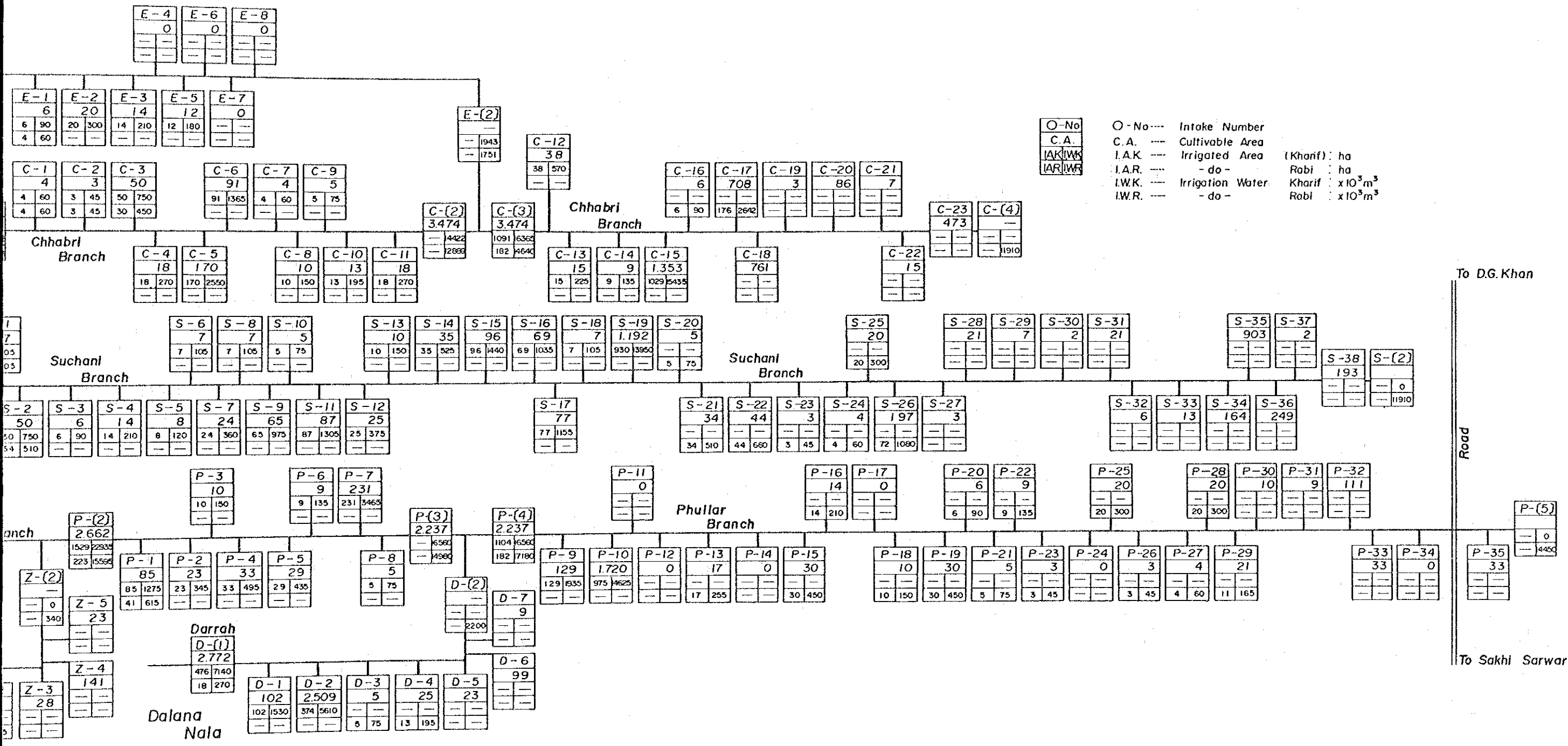


FIGURE 6.2 SCHEMATIC DIAGRAM OF PROPOSED IRRIGATION SYSTEM(Case A/1978)

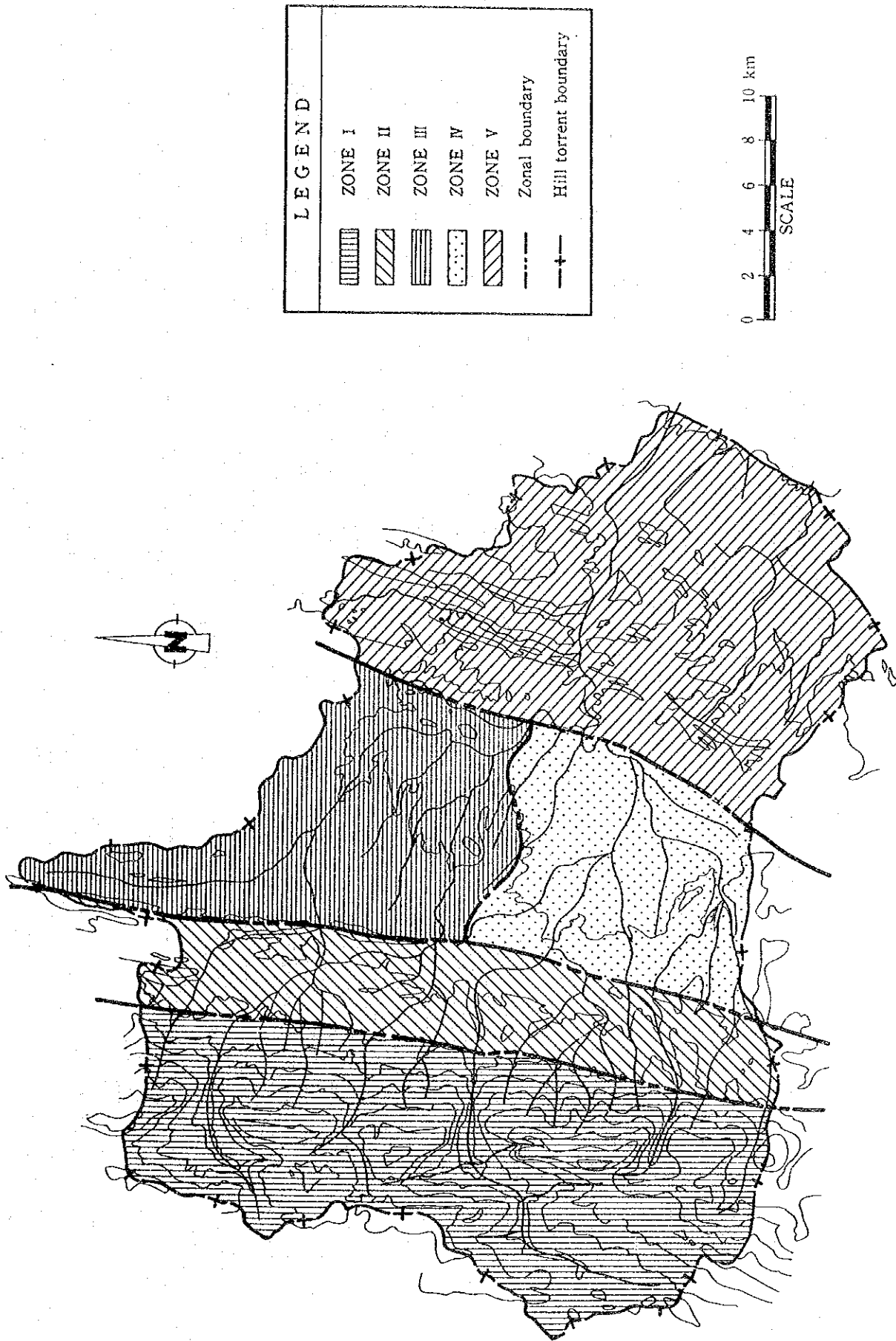


FIGURE 6.3 ZONED WATERSHED BY PHYSICAL CHARACTERISTICS

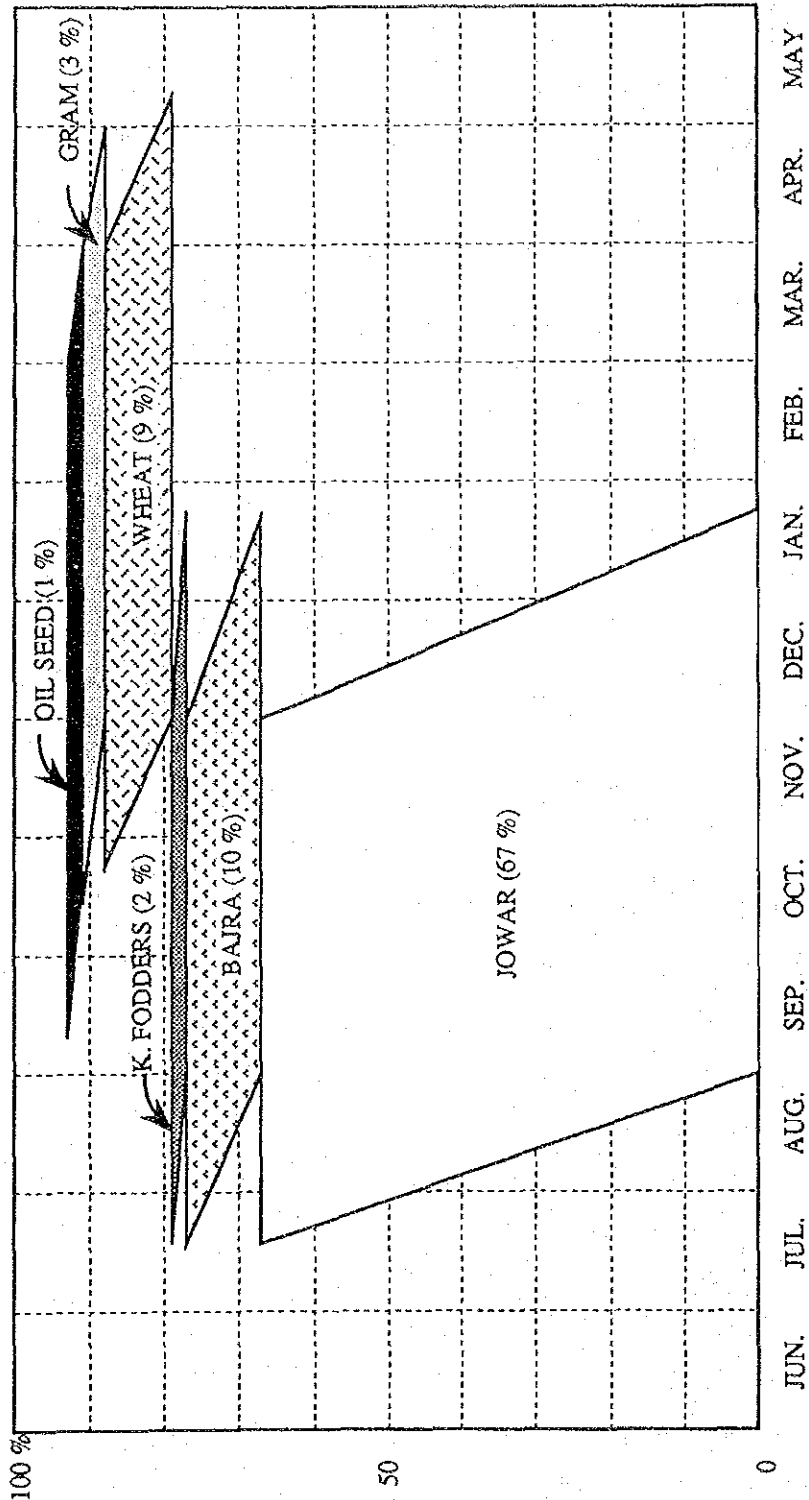


FIGURE 6.4 PROPOSED CROPPING PATTERN IN CASE A (RETURN PERIOD 25-YEAR)

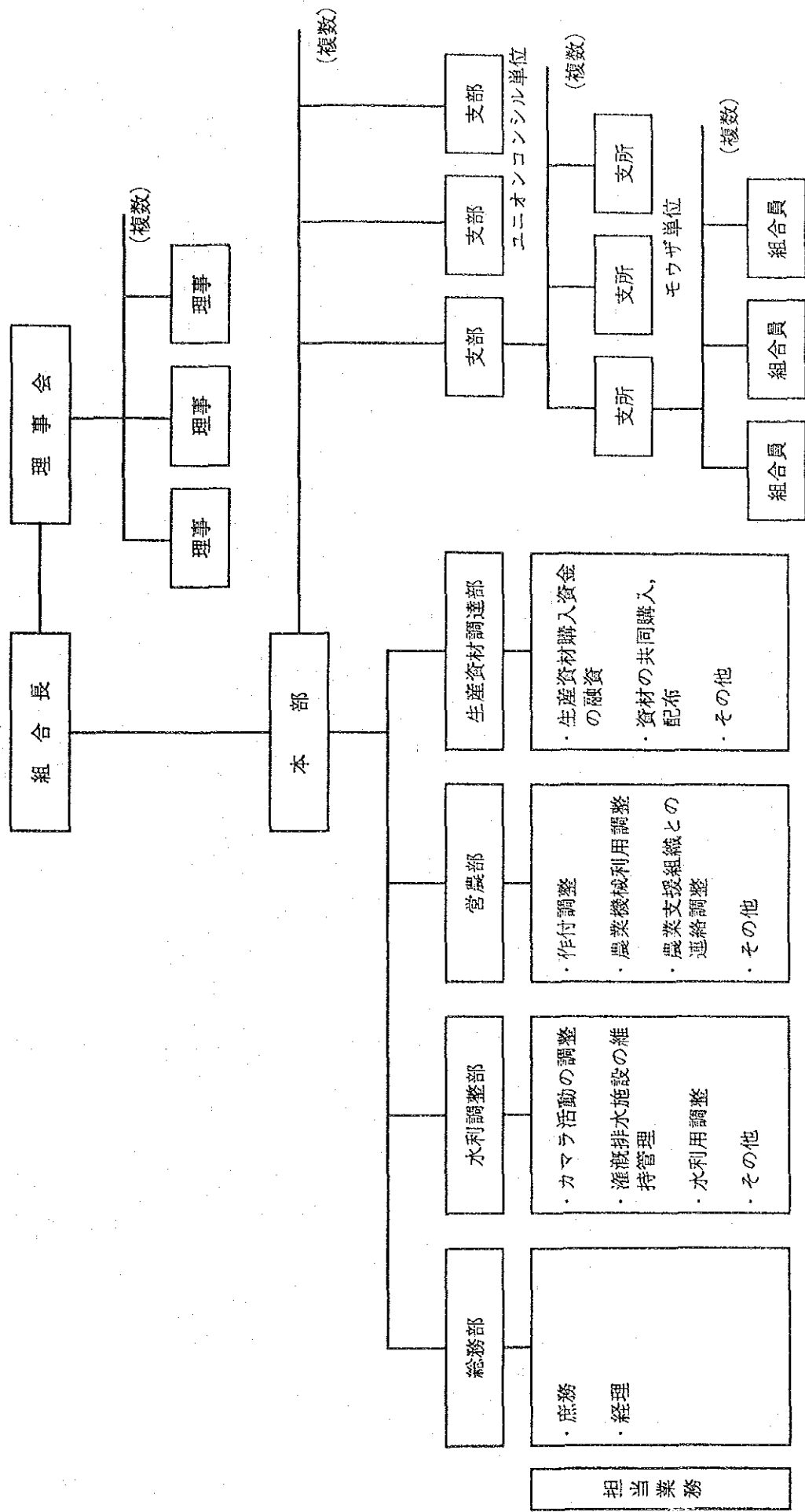


図 6. 5 ヒルトレント灌漑農業協同組合の計画組織図