

ii) 10% decrease in agricultural production benefit

Case A	:	N.P.V.	;	Rs.42.11 mil.	(by 9% discount rate)
		B/C	;	1.75	(by 9% discount rate)
Case B-1	:	E.I.R.R.	;	10.94%	
		N.P.V.	;	Rs.10.97 mil.	(by 9% discount rate)
		B/C	;	1.12	(by 9% discount rate)
Case B-2	:	E.I.R.R.	;	9.67%	
		N.P.V.	;	Rs.-0.98 mil.	(by 9% discount rate)
		B/C	;	1.01	(by 9% discount rate)

In the above analysis, N.P.V. becomes tight in case of 10% decrease for Case B-2 but these results are judged not substantially sacrificing the project viability.

Consequently, Case A has no doubt in its sensitivity and may be judged feasible. For selection of Case of B-1 or B-2, no decisive difference in their sensitivity and project viability has been discovered.

### 8.5 Comprehensive Evaluation

In addition to evaluation parameters obtained from the cost- benefit analysis, considerations on the unaccountable indirect benefits (refer to 8.2.3.) of any of the alternatives is justifiable.

Selection of alternative plans of Case A and B cases shall be made not by B/C ratio or other parameters but by various indirect effects such as promotion of livestock in the whole area, subsequent social stability and safety and ascertained environmental conservation in the whole area. Cases of B are consequently judged more advantageous.

For selection of Cases B-1 or B-2, from viewpoints of areal extension of beneficial area, large number of beneficial population and long-term policy, Case B-2 is consequently judged to be the Project.

## **8.6 Environment Assessment**

### **(1) Social Environment**

In the subject area of the Project, watershed areas are those of tribal habitats and they have their own customs and social systems. Efforts to mitigate drastic change of their nature- harmonized traditional living system, shall be required. It is anticipated that the nomads, who move into flood irrigation area in winter, may be influenced. Furthermore, gradual modification of systems of existing regulations and customs is also required so as that the benefits from watersheds and flood irrigation area are equally shared even by landless farmers, tenant farmers and minor farmers.

In the Project area, no historical or cultural legacy has been identified. After implementation of watershed conservation, land views of the watershed will be changed from those of already-familiarized denuded lands into green pasture lands. In a part of the watershed, the conservation will not be implemented as uranium mining is under operation therein.

### **(2) Natural Environment**

Neither rare species nor species of possible extinction has been identified in the Project area. Ecological influence to be caused by the Project may therefore be negligible. In flood irrigation area, change in soil moisture is anticipated to result to increase in vegetation growth. However, no influence is anticipated on soil erosion, soil salinization, loss of soil fertility and land use. Meanwhile in the watershed, the Project actively improves environment for vegetation in ample area by not only intensifying local plants but also introducing new plants. By these, the denuded lands by presently practiced disorderly over-grazing, will be restored with vegetation and it will result to considerable decrease in excessive loss of surface soil and soil erosion. Furthermore, well-programmed grazing will be introduced, and patterns of land use will be improved through increase of small farmlands formed with the conserved soil.

Purpose of watershed conservation in the Project is improvement of flood runoff patterns and sediment yield, and influence of them to the Project viability is quite significant. At present, control of flood runoff is difficult due to short concentration time and its huge quantity. However, after the conservation, flood peak flows will be smoothed and the distribution patterns will be milder to enable easier use of flood water. Furthermore in the watershed, recharging of

groundwater will be improved and accordingly, increase in quantity and number of places of spring water and year-round flow is expected. In the flood irrigation area, changes in groundwater recharging mechanism and groundwater table are not anticipated. In the watershed, reduced soil erosion and increased organic contents in soil due to developed vegetation will give effects on the recharging mechanism in ways to accelerate milder runoff patterns in rivers.

Soil erosion will be less due to the conservation, and sediment volume to be conveyed to the downstream will also decrease. This can prevent functional deterioration of structural facilities such as flood dispersion structures. On the other hand, due to less supply of sediment from the upstream, lowering of river bed is also anticipated. There will be no influence on water quality and water temperature.



## CHAPTER 9 CONCLUSION AND RECOMMENDATIONS

### 9.1. Conclusion

#### 9.1.1 Necessity of Project

The importance of the agricultural development in hill torrent farming area and the watershed area is emphasized from the following viewpoints.

- The hill torrent flood flow is the only one water resource in pachad area. However, floods give the serious and repeated damages to the canal-irrigation area and residential areas without any control measures.
- The irrigated farming based upon flood flows is the traditional method, but the planned and stable farming is quite impossible in the present situation.
- Technical and economical control of the flood flows, coincident and erosions and soil losses is feasible by means of the installation of irrigation facilities including flood dispersion structures in pachad area and the restoration of vegetation on the denuded land in watershed area based upon the farmland development and schematic pasturage.
- The establishment of development method of hill torrent area in the Project Area becomes one of the most precious pilot schemes in order to expedite the similar development in the other hill torrent areas.
- This kind of development in hill torrent area contributes to improve the regional difference of economic and living standards from those in the canal irrigation area.
- Elevation of agricultural productivity is one of the precious political targets of the Country and the Province.

#### 9.1.2 Appraisal of Development Plans

All of three(3) alternatives are valued high as the feasible schemes from the technical and economic points of view.

The result of economic evaluation is as shown below.

Case	Content	Return Period (years)	Cost ('000Rs.)	EIRR (%)
Case A	Installation of flood dispersion and Irrigation facilities in pachad area	2	106,600	19.89
Case B-1	Case A + Watershed conservation works	5	222,100	11.80
Case B-2	Case A + Watershed conservation works	10	313,200	10.43

Case A : This case is not able to secure its lasting project benefit since watershed conservation measures are not included. However, the economic evaluation of this case was made in order to affirm better effects by carrying out the watershed conservation measures.

Case B-1 : Due to the short-term implementation period as 5 years, the effects of watershed conservation are not fully emerged. In other words, vegetation covers only 17% of the watershed area, 28-30% of flood peak flow is reduced and sediment yield decreases from 1,100 to 700 cu.m/sq.km/yr. Upon 1/25 year probable flood, dispersion of the flood is not sufficient that 200 cms. of surplus water reaches downstream part. Furthermore, the implementation period of 5 years is not long enough to educate local farmers on benefits of Vetiver grass (or Saccharum munja) contour hedges and rotational grazing.

Case B-2 : Though economic feasibility of this case is marginal, the benefits from watershed conservation are of considerable amount. In other words, vegetation covers 33% of the watershed, 38- 40% of flood peak flow is reduced and sediment yield decreases to 500 cu.m/sq.km/yr. By achievement of the above, the continuity of benefits from flood control as arisen in Case A can be secured. Furthermore, after restoration of stable and productive watershed, it will become possible to promote irrigated and scheduled agriculture and other activities by constructing reservoir dams. Accordingly, this alternative plan will enable to transform the present farming from unstable flood irrigation farming into stable irrigation farming in future.

## 9.2. Recommendations

### 9.2.1 Recommendations for Implementation of the Project

- (1) The Study Team recommends prompt implementation of the Case B-2. Flood control of hill torrent is an urgent issue for the Project on one hand, but the essential for the development of the area is to transform the present unstable flood-dependent farming into stable and scheduled irrigated farming in pachad area. For achievement of this, no measures but control on deterioration of watershed and recovery of vegetation in the watershed are inevitable.

For watershed conservation, the Project employs planting of contour hedge with Vetiver grass as one of the most effective methods. Rotational grazing, in combination with the hedge, is also a major component. It is therefore quite essential to educate farmers and secure their cooperation for hedge planting, rotational grazing and introduction of sowing of seeds of fodder crops.

- (2) These technologies for watershed conservation may be managed even by farmers themselves. After implementation of the measures, what are given therefrom are those favorable to the local population such as farm lands newly formed, conserved soil and soil moisture, increase in number of livestock, etc. For the implementation, it is strongly recommended to put much stress on campaign and educational activities to the dwelling farmers.
- (3) The climatic tolerance and the effectiveness of watershed conservation of Vetiver grass have been studied and certified by the World Bank, ICRISAT and other organizations. *Saccharum munja*, locally grown wild, may similarly be applicable. The study on the possibility to introduce local grasses and trees including *Saccharum munja* is recommended.
- (4) This Project consists of neither large/many reservoir dams nor check dams as development measures. On the contrary, the Project aims to accelerate greenization by recovery of vegetation in the watershed to conserve soil from erosion. The Project will possibly enable rich landscape or even orchard farming in future. From the viewpoints of environmental conservation, the Project shall be implemented assertively as a pilot project for hill torrent area development in Pakistan.

### **9.2.2 Recommendation for the Detailed Design**

The following basic investigations and data collections are required at the time of the detailed design.

- To investigate the available amount of surface flow and underflow water at the major rivers and streams in the Watershed Area.
- To examine and confirm the varieties(species) of the vegetation growing in the Watershed Area.
- To study on the present condition of land use, farming and pasturage in order to decide the executed area of watershed conservation works.
- To conduct additional socio-economic survey in the Watershed Area.



# **TABLES**



TABLE 2.1 GROSS NATIONAL PRODUCTS

(Unit: million Rs.)

	1980/81	1985/86	1989/90
Agriculture	76,399	128,801	196,071
Mining and quarrying	1,053	3,281	5,389
Manufacturing	37,446	75,881	132,296
Construction	11,586	19,052	32,052
Electricity and gas	5,928	10,639	21,935
Transport, storage and communications	23,927	41,196	60,915
Wholesale and retail trade	37,330	72,742	128,976
Banking and insurance	5,549	14,855	21,615
Ownership of dwellings	11,237	23,462	34,126
Public administration and defence	19,257	42,053	69,115
Other services	18,119	34,357	56,859
GDP (factor cost)	247,831	466,319	759,349
Indirect taxes	35,562	58,205	115,825
Subsidies	5,197	9,992	12,722
GDP (market price)	278,196	514,532	32,262
Net factor income from abroad	22,692	41,359	791,611
GNP (factor cost)	270,523	507,678	894,714
GNP (market price)	300,888	555,891	1,048,872
Population (in million)	83.84	97.67	110.36
Per capita income (factor cost, in Rs)	3,227	5,198	7,173
Per capita income (market price, in Rs)	3,589	5,692	8,107

Source: Economic Survey, 1990/91.

TABLE 2.2 SELECTED AGRICULTURAL STATISTICS BY PROVINCE (area in acres) (1/2)

	Pakistan	Punjab	Sind	NWFP	Baluchistan
Number & area of agricultural holdings					
• Agricultural holdings, total	6,059,330	4,066,893	1,037,964	698,147	256,326
• Livestock holdings	1,989,709	1,522,373	243,235	170,235	53,866
• Farms	4,069,621	2,544,520	794,729	527,912	202,460
• Farm area	47,218,215	29,975,097	9,217,998	4,107,178	3,917,942
• Cultivated area	39,248,626	26,341,383	7,822,624	2,625,216	2,459,403
• Net area sown	37,105,339	25,379,703	7,531,229	2,408,116	1,786,291
• Farm area uncultivated	7,969,587	3,633,713	1,395,374	1,481,961	1,458,539
Farm tenure					
• Owner farms	2,226,787	1,384,801	322,879	360,550	158,557
• Owner-cum-tenant farms	789,162	618,089	85,377	72,015	13,681
• Tenant farms	1,053,506	541,543	386,447	95,315	30,201
• Owner farms area	24,533,378	14,883,036	4,350,012	2,388,131	2,912,199
• Owner-cum-tenant farms area	12,395,879	9,333,894	1,528,359	1,102,905	430,721
• Tenant farms area	10,165,428	5,680,960	3,328,266	607,549	548,653
Average size of farms					
• All farms	11.60	11.80	11.60	7.80	19.20
• Owner farms	11.00	10.70	13.50	6.60	18.40
• Owner-cum-tenant farms	15.70	15.10	17.90	15.30	31.50
• Tenant farms	9.60	10.50	8.60	6.40	18.20
Intensities					
• Average land use intensity (%)	89.00	93.00	86.00	79.00	68.00
• Average cropping intensity (%)	122.00	124.00	130.00	121.00	78.00
Irrigation					
Cultivated area actually irrigated by:					
• Any source	28,301,482	19,938,405	6,245,097	1,262,786	855,194
• Canals only	13,646,182	6,840,054	5,644,589	722,883	438,656
• Canals & other sources*	9,834,759	9,359,735	425,628	49,396	n.a.
• Tubewells only	3,370,884	3,036,961	127,978	105,221	100,724
• Wells only	398,788	342,019	8,180	27,623	20,966
• Karezes only	121,568	0	0	0	121,568
• Unspecified sources	929,302	359,592	38,729	357,667	173,314
• Area provided with irrigation facilities but not irrigated**	923,792	573,992	241,513	108,287	n.a.
• Sailaba	1,355,239	440,417	86,943	11,865	816,014
• Barani	8,668,151	5,388,608	1,249,082	1,242,270	788,191
Cropping					
• Cropped area, total	47,769,150	32,556,042	10,131,838	3,166,446	1,914,824
• Irrigated	37,241,926	26,513,602	8,053,826	1,715,472	959,026
• Unirrigated	10,527,224	6,042,440	2,078,012	1,450,974	955,798
• Kharif crops area, total	21,022,292	13,338,947	5,794,605	1,205,215	683,525
• Irrigated	17,412,656	11,770,777	4,601,225	725,157	315,497
• Unirrigated	3,609,636	1,568,170	1,193,380	480,058	368,028
• Rabi crops area, total	26,166,122	18,802,430	4,230,812	1,940,027	1,192,853
• Irrigated	19,255,877	14,333,102	3,346,315	969,726	606,734
• Unirrigated	6,910,245	4,469,328	884,497	970,301	586,119
• Orchard area, total	580,784	414,688	106,435	21,225	38,436
• Irrigated	573,443	409,740	106,307	20,598	36,798

TABLE 2.2 SELECTED AGRICULTURAL STATISTICS BY PROVINCE (area in acres) (2/2)

	Pakistan	Punjab	Sind	NWFP	Baluchistan
• Unirrigated	7,341	4,948	128	627	1,638
<b>Crop acreages</b>					
• Wheat	17,938,235	12,906,484	2,714,977	1,368,335	948,439
• Cotton	5,733,749	4,071,778	1,654,014	7,957	n.a.
• Sugarcane	1,612,056	1,153,487	280,511	177,273	785
• Paddy	5,526,291	3,093,411	2,240,737	48,839	143,304
• Maize	1,344,213	550,916	20,189	761,876	11,232
• Oilseeds	1,213,717	665,639	359,502	79,345	109,231
• Pulses	3,619,305	2,679,795	658,212	259,534	21,764
• Fruits	580,784	414,688	106,435	21,225	38,436
• Fodders	6,724,714	5,660,641	878,841	151,710	33,522
• Vegetables	689,359	326,099	184,281	71,367	107,612
• Other crops	2,786,727	1,033,104	1,034,139	218,985	500,499
<b>Plant protection measures</b>					
• Farms reporting use of ground spray	180,164	96,253	50,088	15,507	18,316
• Area sprayed	1,160,158	772,053	339,222	48,883	n.a.
<b>Use of fertilizers &amp; manures of farms</b>					
• Farms reporting use of both fertilizers & manures	1,243,883	911,210	89,675	225,888	17,110
• Farms reporting use of fertilizers only	1,612,918	1,021,271	494,411	86,687	10,549
• Farms reporting use of manures only	346,037	209,651	11,645	99,339	25,402
<b>Agricultural labor</b>					
• Households reporting permanently hired labor	198,423	159,143	21,069	14,086	4,125
• Number of permanent hired labor	386,752	301,023	52,901	23,617	9,211
• Family workers 10 years or above, total	16,465,251	11,100,391	3,071,302	1,713,741	579,817
• Male	9,447,358	6,216,525	1,760,363	1,054,185	416,285
• Female	7,017,893	4,883,866	1,310,939	659,556	163,532
<b>Use of tractors &amp; tubewells</b>					
• Farms reporting use of tractors	1,455,275	1,018,950	226,733	209,592	n.a.
• Farms reporting use of tubewell water	1,319,680	1,239,049	53,090	27,541	n.a.
<b>Livestock</b>					
• Total number of work animals	6,608,906	4,255,346	1,401,243	536,908	415,409
• Average number of work animals per farm	1.60	1.70	1.80	1.00	2.10
• Number of cattle	14,465,774	9,253,650	2,967,090	1,597,994	647,040
• Number of buffaloes	10,967,688	8,686,920	1,668,554	589,175	23,039
• Number of sheep	11,311,018	6,309,134	1,182,327	662,394	3,157,163
• Number of camels	695,636	357,571	118,917	47,878	171,270
• Number of horses	294,553	220,666	45,610	14,571	13,706
• Number of mules	33,623	27,062	1,884	3,998	679
• Number of donkeys	1,859,467	1,171,763	306,711	201,922	179,071
• Number of poultry birds	30,464,495	17,030,979	6,227,474	5,516,304	1,689,738

Source: Pakistan Census of Agriculture, 1980, Volume III.

Note: \* In the case of Baluchistan, included in unspecified sources. \*\* In the case of Baluchistan, included in Sailaba/Barani area.

TABLE 2.3 AREA, PRODUCTION AND YIELD OF IMPORTANT CROPS, THE PUNJAB (1/2)

	1985/86	1986/87	1987/88	1988/89	1989/90
WHEAT					
Total area ('000 ha)	5,343	5,574	5,344	5,589	5,668
• Irrigated	4,494	4,714	4,669	4,805	4,908
• Un-irrigated	849	860	675	784	760
Production ('000 tons)	10,432	9,200	9,204	10,517	10,518
• Irrigated	9,486	8,362	8,762	9,741	9,678
• Un-irrigated	946	838	442	776	840
Yield (kgs/ha)	1,952	1,651	1,722	1,882	1,856
• Irrigated	2,111	1,774	1,877	2,027	1,972
• Un-irrigated	1,114	974	655	990	1,105
COTTON (LINT)					
Total area ('000 ha)	1,745	1,863	1,936	2,054	2,036
• Irrigated	1,734	1,858	1,930	2,045	2,027
• Un-irrigated	11	5	6	9	9
Production ('000 bales)	5,701	6,451	7,255	7,275	7,454
Yield (kgs/ha)	556	589	638	603	623
RICE					
Total area ('000 ha)	1,113	1,175	1,085	1,187	1,282
Production (cleaned, '000 tons)	1,478	1,535	1,352	1,367	1,482
Yield (kgs/ha)	1,328	1,306	1,246	1,152	1,156
GRAM					
Total area ('000 ha)	821	860	642	763	816
• Irrigated	78	78	71	72	70
• Un-irrigated	743	782	571	691	746
Production ('000 tons)	440	430	246	294	397
• Irrigated	59	57	50	54	62
• Un-irrigated	381	373	196	240	335
Yield (kgs/ha)	536	500	383	385	487
• Irrigated	756	731	704	750	886
• Un-irrigated	513	477	343	347	449
SUGARCANE					
Total area ('000 ha)	511	487	535	530	501
• Irrigated	505	482	531	525	497
• Un-irrigated	6	5	4	5	4
Production ('000 tons)	16,755	18,478	19,406	19,494	18,683
• Irrigated	16,663	18,383	19,327	19,416	18,612
• Un-irrigated	92	95	79	78	71
Yield (tons/ha)	32.79	37.94	36.27	36.78	37.29
• Irrigated	33.00	38.14	36.40	36.98	37.45
• Un-irrigated	15.33	19.00	19.75	15.60	17.75
MAIZE					
Total area ('000 ha)	339	346	337	346	345
• Irrigated	285	291	282	288	287
• Un-irrigated	54	55	55	58	58
Production ('000 tons)	415	453	405	455	455
• Irrigated	373	408	390	412	408
• Un-irrigated	42	45	15	43	47

TABLE 2.3 AREA, PRODUCTION AND YIELD OF IMPORTANT CROPS, THE PUNJAB (2/2)

	1985/86	1986/87	1987/88	1988/89	1989/90
Yield (kgs/ha)	1,224	1,309	1,202	1,315	1,319
• Irrigated	1,309	1,402	1,383	1,431	1,422
• Un-irrigated	778	818	273	741	810
			BAJRA		
Total area ('000 ha)	282	266	255	303	296
• Irrigated	136	134	129	145	148
• Un-irrigated	146	132	126	158	148
Production ('000 tons)	154	149	117	126	127
• Irrigated	93	95	92	96	101
• Un-irrigated	61	54	25	30	26
Yield (kgs/ha)	546	560	459	416	429
• Irrigated	684	709	713	662	682
• Un-irrigated	418	409	198	190	176
			JOWAR		
Total area ('000 ha)	211	237	184	254	239
• Irrigated	96	124	97	103	99
• Un-irrigated	115	113	87	151	140
Production ('000 tons)	120	135	95	129	128
• Irrigated	66	85	66	73	72
• Un-irrigated	54	50	29	56	56
Yield (kgs/ha)	569	570	516	508	536
• Irrigated	688	685	680	709	727
• Un-irrigated	470	442	333	371	400

Source: 1990 Statistical Pocket Book of the Punjab.

TABLE 3.1 AREA DIVIDED BY HEIGHT

Hill Torrent	Total Area	Pachad						Catchment Area					
		Lower than 500 m		500 m to 1,000 m		1,000 m to 1,500 m		1,500 m to 2,000 m		More than 2,000 m			
		Area	(%)	Area	(%)	Area	(%)	Area	(%)	Area	(%)		
KAURA	564	114	(20%)	44	(8%)	268	(48%)	56	(10%)	51	(9%)	31	(5%)
VEHOWA	2,851	131	(5%)	70	(2%)	491	(17%)	976	(34%)	1,011	(35%)	172	(6%)
SANGHAR	4,962	82	(2%)	175	(4%)	1,085	(22%)	2,802	(56%)	762	(15%)	56	(1%)
SORILUND	659	139	(21%)	108	(16%)	361	(55%)	29	(4%)	17	(3%)	5	(1%)
VIDORE	966	196	(20%)	104	(11%)	394	(41%)	116	(12%)	151	(16%)	5	(1%)
SAKISARWAR	317	157	(50%)	98	(31%)	62	(20%)	-	-	-	-	-	-
MITHAWAN	915	235	(26%)	208	(23%)	236	(26%)	129	(14%)	107	(12%)	-	-
KAHA	5,849	363	(6%)	69	(1%)	2,190	(37%)	2,781	(48%)	446	(8%)	-	-
CHACHAR	1,032	232	(22%)	139	(13%)	576	(56%)	85	(8%)	-	-	-	-
PITOK	376	136	(36%)	92	(24%)	148	(39%)	-	-	-	-	-	-
SORI SHUMALI	390	60	(15%)	60	(15%)	269	(69%)	1	(0%)	-	-	-	-
ZANGI	443	43	(10%)	294	(66%)	96	(22%)	10	(2%)	-	-	-	-
SORIJANUBI	1,744	64	(4%)	687	(39%)	986	(57%)	7	(0%)	-	-	-	-
Total	21,068	1,952	(9%)	2,148	(10%)	7,162	(34%)	6,992	(33%)	2,545	(12%)	269	(1%)



TABLE 3.2 CLIMATOLOGICAL DATA OF THE STUDY AREA

1. Climatological Data at the Plain Area

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
<b>Temperature(°C)</b>														
Mean	(1)	12.3	14.7	20.4	28.3	32.1	34.6	33.3	32.7	30.0	25.8	19.7	14.6	24.9
Mean Max.	(1)	20.1	22.0	28.1	36.4	39.9	40.8	37.9	37.4	35.8	33.7	28.6	23.0	32.0
Mean Min.	(1)	4.5	7.3	12.7	20.1	24.2	28.4	28.6	28.0	24.1	17.8	10.8	6.1	17.8
Ext. Max.	(1)	24.0	29.0	37.8	48.3	47.8	46.1	43.3	42.8	40.0	38.9	36.0	28.0	48.3
Ext. Min.	(1)	-1.1	0.0	4.0	11.0	13.3	21.1	21.1	22.2	16.7	11.1	4.4	0.0	-1.1
<b>Relative Humidity(%)</b>														
Mean	(2)	70.4	63.7	61.0	48.8	41.2	46.2	62.7	66.3	64.4	61.6	71.1	75.2	61.1
Mean Max.	(2)	84.9	79.2	75.6	63.1	53.2	57.0	72.7	76.3	77.1	77.4	85.8	88.1	74.2
Mean Min.	(2)	41.4	36.4	35.3	26.9	23.9	29.0	46.9	50.1	44.7	38.2	46.3	49.8	39.1
<b>Dew Point(°C)</b>														
Mean	(2)	4.4	5.8	10.5	13.4	21.2	20.0	24.1	24.2	21.2	15.5	11.0	6.7	14.9
<b>Evaporation(mm)</b>														
Mean - Pan	(1)	80.4	99.3	168.6	258.3	325.0	348.6	296.1	268.2	220.7	169.6	111.2	82.7	2,428.7
<b>Sunshine Duration (hrs/day)</b>														
Mean	(2)	7.1	7.3	7.6	9.2	9.4	8.6	8.0	9.1	9.1	8.3	8.0	6.9	8.2
<b>Wind(km/h)</b>														
Prevailing Wind	(3)	N	NNE	NW	NW	NW	NW	NW	NW	NW	N	N	N	-
Mean Wind Speed	(2)	1.2	1.9	2.3	2.4	2.6	3.3	3.1	2.8	2.3	1.3	1.0	1.0	2.1
<b>Rainfall(mm)</b>														
Mean	(2)	7.7	9.7	18.7	12.5	10.5	16.1	71.0	31.5	14.6	1.6	2.5	1.9	198.3

2. Climatological Data at the Hilly Region

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
<b>Temperature(°C)</b>														
Mean	(4)	11.0	11.7	17.2	23.7	28.6	31.2	29.3	28.4	26.9	23.3	17.3	12.6	21.8
Mean Max.	(4)	16.2	17.5	23.5	30.1	35.1	37.9	35.3	34.5	33.5	29.9	24.2	18.9	28.1
Mean Min.	(4)	4.0	5.7	11.3	17.2	22.2	24.5	23.8	23.1	20.2	15.4	10.4	5.6	15.3
<b>Relative Humidity(%)</b>														
Mean	(4)	44.5	45.7	44.0	39.4	34.4	39.4	60.1	63.8	53.3	38.7	39.7	46.0	45.8
Mean Max.	(4)	52.1	52.0	52.4	46.8	41.2	48.6	71.4	76.5	66.6	46.7	46.1	53.3	54.5
Mean Min.	(4)	32.6	33.3	30.8	28.9	25.7	28.8	46.2	47.1	35.6	26.9	29.9	34.7	33.4
<b>Dew Point(°C)</b>														
Mean	(4)	-3.7	-2.5	2.4	6.0	8.3	12.9	18.7	18.6	13.7	6.0	0.9	-1.7	6.7
<b>Wind(km/h)</b>														
Mean Wind Speed	(4)	5.9	5.9	5.1	5.6	7.0	5.8	5.2	5.1	4.7	5.2	5.5	5.3	5.5
<b>Rainfall(mm)</b>														
Mean	(4)	11.4	22.1	29.7	30.0	18.1	31.4	105.1	92.2	49.5	6.0	4.9	5.5	405.9

Note (1): Muzaffargarh Station, operated by SURFACE WATER HYDROLOGY, WAPDA

Latitude: 30° 04' Longitude: 71° 12' Elevation of Station Above MSL: 116 m  
 Data period: 1970 - 1975, 1977, 1979 - 1980, 9years

(2): Multan Station, operated by METEOROLOGICAL DEPARTMENT

Latitude: 30° 10' Longitude: 71° 25' Elevation of Station Above MSL: 123 m  
 Data period: 1971 - 1988, 18years (Relative Humidity, Dew Point, Wind Speed)  
 1969 - 1988, 20years (Rainfall)  
 1984 - 1991, 8years (Sunshine Duration)

(3): D.G.Khan Station, operated by AGRICULTURAL DEPARTMENT

Latitude: 30° 04' Longitude: 70° 38' Elevation of Station Above MSL: 122 m  
 Data period: July 1987 - Aug. 1991, 5years

(4): Barkhan Station, operated by METEOROLOGICAL DEPARTMENT

Latitude: 29° 54' Longitude: 69° 32' Elevation of Station Above MSL: 1113 m  
 Data period: 1971 - 1988, 18years (Temperature, Relative Humidity, Dew Point)  
 1971 - 1976, 6years (Wind Speed)  
 1969 - 1988, 20years (Rainfall)

TABLE 3.3 HILL TORRENT-WISE LAND USE DATA

Hill Torrent	Pachad area		Subtotal (1)	Canal irrigated area (proposed)			Total area (1)+(2)
	Cultivable area	Uncultivable area		Cultivable area	Uncultivable area	Subtotal (2)	
Kaura	11,170	220	11,390	6,140	1,940	8,080	19,470
Vehowa	12,300	800	13,100	13,930	6,390	20,320	33,420
Sanghar	6,680	1,560	8,240	19,090	5,020	24,110	32,350
Sori Lund	12,320	1,540	13,860	3,340	-	3,340	17,200
Vidore	14,198	5,152	19,350	-	-	0	19,350
Sakhi Sarwar	4,190	11,500	15,690	-	-	0	15,690
Mithawan	11,010	12,460	23,470	-	-	0	23,470
Chachar	17,100	6,120	23,220	-	-	0	23,220
Pitok	12,730	900	13,630	24,460	-	24,460	38,090
Sori Shumali	5,970	30	6,000	16,980	-	16,980	22,980
Zangi	1,390	2,910	4,300	7,690	4,430	12,120	16,420
Sori Janubi	3,070	3,470	6,540	13,110	170	13,280	19,820
Total	112,128	46,662	158,790	104,740	17,950	122,690	281,480

TABLE 3.4 HILL TORRENT-WISE LAND CLASSIFICATION (PACHAD AREA)

Hill torrent	Land classification					Total
	1	2	3	4	5	
Kaura	0	8,070	3,100	0	220	11,390
Vehowa	6,360	3,640	2,300	0	800	13,100
Sanghar	6,680	0	0	420	1,140	8,240
Sori Lund	0	12,320	0	930	610	13,860
Vidore	5,250	7,180	1,770	3,590	1,560	19,350
Sakhi Sarwar	0	850	3,340	10,140	1,360	15,690
Mithawan	0	6,870	4,140	10,710	1,750	23,470
Chachar	0	0	17,100	3,740	2,380	23,220
Pitok	0	0	12,730	900	0	13,630
Sori Shumali	0	0	5,970	0	30	6,000
Zangi	0	0	1,390	2,600	310	4,300
Sori Janubi	0	0	3,070	2,620	850	6,540

TABLE 3.5 PRESENT CROPPING PATTERN IN PACHAD AREA

(Unit: ha, %)

Hill Torrent [CCA]	Jowar	Bajra	Others	S-total	Weart	Gram	Oilseed	S-total	Total
KAURA [17,310] *	1,619 (9.4)	560 (3.2)	177 (1.0)	2,356 (13.6)	742 (4.3)	298 (1.7)	710 (4.1)	1,750 (10.1)	4,106 (23.7)
VEHOWA [26,230]	2,721 (10.4)	548 (2.1)	591 (2.3)	3,860 (14.7)	4,430 (16.9)	798 (3.0)	1,440 (5.5)	6,668 (25.4)	10,528 (40.1)
SANGHAR [25,770]	4,791 (18.6)	1,176 (4.6)	480 (1.9)	6,447 (25.0)	2,001 (7.8)	1,086 (4.2)	886 (3.4)	3,973 (15.4)	10,420 (40.4)
SORI LUND [15,660]	1,188 (7.6)	573 (3.7)	65 (0.4)	1,826 (11.7)	104 (0.7)	242 (1.5)	5 (0.0)	351 (2.2)	2,177 (13.9)
VIDORE** [13,348]	2,124 (15.9)	313 (2.3)	61 (0.5)	2,498 (18.7)	453 (3.4)	156 (1.2)	58 (0.4)	667 (5.0)	3,165 (23.7)
SAKHI SARWAR [4,190]	47 (1.1)	68 (1.6)	0 (0.0)	115 (2.7)	3 (0.1)	18 (0.4)	3 (0.1)	24 (0.6)	139 (3.3)
MITHAWAN [11,010]	1,074 (9.8)	240 (2.2)	0 (0.0)	1,314 (11.9)	142 (1.3)	274 (2.5)	0 (0.0)	416 (3.8)	1,730 (15.7)
CHACHAR [17,100]	1,515 (8.9)	73 (0.4)	60 (0.4)	1,648 (9.6)	0 (0.0)	24 (0.1)	103 (0.6)	127 (0.7)	1,775 (10.4)
PITOK [0]	0	0	0	0	0	0	0	0	0
SORI SHUMALI [0]	0	0	0	0	0	0	0	0	0
ZANGI [9,080]	434 (4.8)	27 (0.3)	30 (0.3)	491 (5.4)	0 (0.0)	0 (0.0)	38 (0.4)	38 (0.4)	529 (5.8)
SORI JANUBI [16,180]	398 (2.5)	25 (0.2)	27 (0.2)	450 (2.8)	0 (0.0)	0 (0.0)	35 (0.2)	35 (0.2)	485 (3.0)
TOTAL [152,460]	15,911 (10.4) ***	3,603 (2.4)	1,491 (1.0)	21,005 (13.8)	7,875 (5.2)	2,896 (1.9)	3,278 (2.2)	14,049 (9.2)	35,054 (23.0)

\*[ ] : Cultivable Area

\*\* : cropped Area irrigated by tubewell is excluded.

\*\*\* ( ) : Cropping Intensity (%) = TOTAL/[CCA]\*100

Source : Based on data from Revenue Office and field survey

TABLE 3.6 RESULTS OF FARM SURVEY (1/2)

## (1) HOUSEHOLD AND FARM SIZE

Hill Torrent	Household Members			Farm Size (ha)			C.Waste*
	Total	Male	Female	Total	Net Sown	Fallow	
Kaura	11	6	5	96	34	16	47
Vehowa	9	5	4	51	32	8	19
Sanghar	13	6	7	30	12	10	16
Sori Lund	12	6	6	30	11	4	15
Vidore	13	7	6	16	8	0	8
Sakhi Sarwar	10	6	4	37	9	0	29
Chachar	19	9	10	24	9	1	15
Zangi	10	5	5	15	6	0	9
Sori Janubi	9	5	4	22	7	0	15
Total	106	55	51	321	128	39	173
Average	12	6	6	36	14	4	19

\*: Cultivable Waste

## (2) FARM CONDITIONS

Hill Torrent	Farm Plots			Distance to Farm (km)	
	No.	Size(acre)		Min.	Max.
		Min.	Max.		
Kaura	14	3	26	1	4
Vehowa	10	9	56	0	9
Sanghar	8	3	11	1	5
Sori Lund	5	4	18	2	6
Vidore	5	2	8	0.4	2
Sakhi Sarwar	5	1	4	0	4
Chachar	4	6	24	0.4	3
Zangi	5	4	11	3	8
Sori Janubi	5	5	17	3	6
Total	61	37	175	10.8	47
Average	7	4	19	1	5

## (3) CROPPING INTENSITY (%)

Hill Torrent	Total	(Unit: %)						
		Jowar	Bajra	Wheat	Gram	Oilseed	Cotton	Others
Kaura	36	9	3	14	6	2		
Vehowa	52	9	2	23	6	6	4	
Sanghar	36	19	2	1	3	2		
Sori Lund	34	13	4	13	3	5		
Vidore	44	36	1	3		2		
Sakhi Sarwar	23	14	2	5		1		1
Chachar	34	22				12		
Zangi	39	39						
Sori Janubi	33	33						
Total	331	194	14	59	18	30	4	1
Average	37	22	2	7	2	3	0	0

TABLE 3.6 RESULTS OF FARM SURVEY (2/2)

## (4) CROP YIELD

Hill Torrent	(Unit: kg/ha)					
	Jowar	Bajra	Wheat	Gram	Oilseeds	Cotton
Kaura	744	672	858	563	500	
Vehowa	1,236	625	1,756	917	788	500
Sanghar	813		1,186	868	595	
Sori Lund	1,178	1,117	1,644	1,050	975	
Vidore	1,167	1,117	900		940	
Sakhi Sarwar	913	950	950		867	
Chachar	836				863	
Zangi	481	100				
Sori Janubi	650					
Total	8,018	4,581	7,294	3,398	5,528	500
Average	891	764	1,216	850	790	500

## (5) LIVESTOCK

Hill Torrent	(Unit: head)							
	Cattle	Buffa- loes	Sheep	Goats	Horses	Donkeys (Mules)	Camels	Poultry
Kaura	6	2	4	6	0.4	0.1	1	6
Vehowa	5	3	4	7	0.1	0.0	0.2	9
Sanghar	6	3	8	7		1	0.2	12
Sori Lund	9	1	25	8	0.4	0.3	1	14
Vidore	6	0.3	1	9	0.1	0.4	0.1	42
Sakhi Sarwar	8	0	18	10	0	0.3	0.4	18
Chachar	13	1	39	18	0.4	2	3	12
Zangi	8	0	11	13	0	1	0.4	10
Sori Janubi	9		39	7	1	2	3	8
Total	70	10.3	149	85	2.4	7.1	9.3	131
Average	8	1	17	9	0	1	1	15

## (6) FARM INPUTS

Hill Torrent	(Unit: kg/ha)						
	Seeds					Fertilizers *	
	Jowar	Bajra	Wheat	Gram	Oilseed	N	P
Kaura	38	18	91	59	8	165	125
Vehowa	48	18	102	81	11	100	62
Sanghar	28	15	92	62	7	165	125
Sori Lund	32	15	97	74	8		
Vidore	31	22	100		6		
Sakhi Sarwar	21	6	31		2		
Chachar	26				9		
Zangi	22	10					
Sori Janubi	18						
Total	264	104	513	276	51		
Average	29	15	86	69	7		

\*: Fertilizers are only used for wheat

TABLE 3.7 LIVESTOCK OF PACHAD AREA

	(Unit: head)						
	D. G. Khan District	Taunsa Tehsil	D. G. Khan Tehsil	Rajanpur District	Jampur Tehsil	Rajanpur Tehsil*	Total
Buffalo	105,083	11,207	93,876	67,159	30,795	36,364	172,242 (29,000)
Cattle	237,830	109,370	128,460	111,062	39,410	71,652	348,892 (160,000)
Sheep	454,772	238,611	216,161	265,203	98,587	166,616	719,975 (350,000)
Goats	339,713	163,750	175,963	176,542	37,145	139,397	516,255 (260,000)
Camels	20,680	14,369	6,311	8,514	2,599	5,915	29,194 (16,000)
Horses	4,283	1,082	3,201	5,218	1,899	3,319	9,501 (3,000)
Mules	139	29	110	90	31	59	229 (100)
Donkey	24,491	10,035	14,456	12,953	4,717	8,236	37,444 (16,000)
Poultry	434,356	108,403	325,953	278,614	139,489	139,125	712,970 (250,000)

\* Figures for Rojhan Tehsil is included in those for Rajampur Tehsil.

( ): Estimated livestock population in the Study Area

Source: Livestock & Dairy Development

TABLE 3.8 LENGTH OF ROADS (DISTRICT: RAJANPUR) (2/2)  
(MAINTAINED BY HIGHWAY DEPTT.)

(Unit: km)				
NO.	NAME OF ROAD	FROM km	TO km	TOTAL LENGTH
1	D.G.KAHN - MITHAN KOT ROAD	32.20	129.77	97.57
2	RAJANPUR - KASHMORE ROAD	0.00	103.80	103.80
3	JANPUR - DAJAL ROAD	9.66	22.53	12.87
4	FAZILPUR - HAJIPUR ROAD	0.00	14.49	14.49
5	RAJANPUR - AQILPUR ROAD	0.00	8.05	8.05
6	KOTLA ISAN - SHIKARPUR ROAD	0.00	5.23	5.23
7	DAJAL - CANAL REST HOUSE	0.00	2.21	2.21
8	KOT JONU - KOT TAHIR ROAD	0.00	4.02	4.02
9	MITHAN KOT - WANG ROAD	0.00	4.83	4.83
10	MUHAMMADPUR - RAKH BAGH WALA ROAD	0.00	6.44	6.44
11	MIRANPUR LINK ROAD	0.00	9.65	9.65
12	UMAR KOT LINK ROAD	0.00	8.05	8.05
13	JAMPUR - KOTLA MUGHLAN ROAD	0.00	10.86	10.86
14	JAMPUR - DARKHAST MINAR ROAD	0.00	9.66	9.66
15	BADLI LINK ROAD	0.00	4.83	4.83
16	FAZILPUR MEHREWALA KOTLA SHER MOHAMMAD	0.00	12.88	12.88
17	DAJAL HAJIPUR VIA TIBBI SOLGI ROAD	0.00	8.05	8.05
18	MOHAMMAD - DAJAL VIA TIBBI SOLGI ROAD	0.00	3.22	3.22
19	SHAHWALI - SHAHWALI RAILWAY STATION	0.00	3.22	3.22
20	AQILPUR - BET SAMTRA	0.00	4.83	4.83
21	DAJAL CANAL TO HARRAND ROAD	0.00	19.32	19.32
22	RAJANPUR KASHMORE ROAD TO RAJHAN MARKAZ	0.00	3.22	3.22
TOTAL LENGTH OF ROADS IN THE DIST. ON				357.30

TABLE 3.8 LENGTH OF ROADS (DISTRICT: DERA GHAZI KHAN) (1/2)  
(MAINTAINED BY HIGHWAY DEPTT:)

NO.	NAME OF ROAD	(Unit: km)		
		FROM km	TO km	TOTAL LENGTH
1	D.G.KAHN - RAMAK ROAD	0.00	151.30	151.30
2	MUZAFFAR GARH - BEWATA ROAD	33.80	151.60	117.80
3	DAUWALI - VEHOWA ROAD	0.00	19.00	19.00
4	KATHGARH - VEHOWA ROAD	0.00	25.00	25.00
5	LITRI JANUBI - KATHGARH ROAD	0.00	11.70	11.70
6	KOT QAISRANI - DODAK ROAD	0.00	33.80	33.80
7	KOT QAISRANI - MANGROTHA ROAD	0.00	13.70	13.70
8	CHOWKIWALA - BARTH ROAD	0.00	27.50	27.50
9	CEMENT FACTORY ROAD	0.00	24.50	24.50
10	YARU - DRAHMA ROAD	0.00	17.50	17.50
11	D.G.KHAN - YARU ROAD	0.00	8.00	8.00
12	D.G.KHAN - VIDOR ROAD	0.00	9.70	9.70
13	D.G.KHAN - SAMINA ROAD	0.00	9.00	9.00
14	BASTI MUHAMMAD KHAN - MUBARAK WALA ROAD	0.00	19.80	19.80
15	DARAWALA - MAHTAM ROAD	0.00	9.80	9.80
16	KOT CHHUTA - JHOK UTRA ROAD	0.00	8.50	8.50
17	JHOK UTRA - MAHTAM ROAD	0.00	6.80	6.80
18	JHOK UTRA - JHAKAR IMAM ROAD	0.00	6.50	6.50
19	NOTUK MAHMID - SHERU ROAD	0.00	7.20	7.20
20	MANKA CANAL ROAD	0.00	15.00	15.00
21	ISHAMWALA - BASTI KHOSA ROAD	0.00	29.80	29.80
22	BATIL ROAD	0.00	5.60	5.60
23	SHAH SADRUDDIN - YARU ROAD	0.00	15.30	15.30
24	KHARAH - HINGLUM ROAD	0.00	22.70	22.70
25	MANGROTHA - FAZILA KACH ROAD	4.20	27.00	22.80
26	CHOTI - BASTI JUGIANI ROAD	0.00	19.30	19.30
TOTAL LENGTH OF ROADS IN THE DIST. ON				657.60



TABLE 3.9 COST OF FLOOD DAMAGES FOR EACH MAJOR HILL TORRENTS

(Unit: Million R.s.)

Name of Hill Torrent	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Total	
1. Kaura	1.85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. Vehowa	-	-	4.00	12.00	-	2.00	-	2.34	-	-	-	0.30	1.33	0.97	0.12	1.11	0.30	26.32	
3. Sanghar	-	-	-	-	-	-	-	-	-	-	0.08	3.06	4.91	1.71	0.18	4.65	0.02	14.61	
4. Sori Lund	-	-	10.65	2.24	-	-	-	-	-	-	-	0.30	-	1.18	-	0.49	0.50	15.36	
5. Vidore	-	-	10.25	2.85	-	-	-	-	-	-	-	0.30	0.50	6.24	-	1.53	0.20	21.87	
6. Sakhi Sarwar	-	-	-	6.61	-	-	-	-	-	-	-	-	0.45	0.66	-	0.20	0.20	8.12	
7. Mithawan	-	-	(38.38)	(26.91)	-	(66.88)	-	-	-	-	-	-	-	-	-	-	-	(132.17)	
8. Chachar	-	-	-	-	-	1.14	3.00	-	-	-	0.80	22.69	0.50	23.53	-	0.80	18.57	71.03	
9. Pitok	-	-	-	-	-	-	-	-	-	-	-	0.20	-	0.30	-	0.30	0.30	1.10	
10. Sori Shumali	-	-	-	-	-	-	-	-	-	-	-	14.94	-	11.92	-	0.10	0.20	27.16	
11. Zangi	-	-	-	-	-	-	-	-	-	-	-	26.35	-	22.87	-	0.20	3.98	53.40	
12. Sori Janubi	-	-	-	-	-	-	-	-	-	-	-	8.85	-	11.05	-	-	-	19.90	
Total *	1.85	-	24.90	23.70	-	3.14	3.00	2.34	-	-	0.88	76.99	7.69	80.43	0.30	9.38	24.27	258.87	

\* Excluding Mithawan

TABLE 5.1 POPULATION STATISTICS IN THE STUDY AREA

Name of Moza	Unit : persons		
	Both Sexes	Male	Female
1. Bela	4,963	2,504	2,459
2. Dalana	1,800	942	858
3. Wahi Kingrani	478	248	230
4. Kochha Wadani	713	357	356
5. Vidore	4,365	2,317	2,048
6. Noor Wah	1,479	757	722
7. Dagat Chit	2,575	1,302	1,273
8. Chhabri Bala Gharbi	4,192	2,183	2,009
9. Choratta Pachadh Shumali	1,925	995	930
10. Choratta Pachadh Janubi	1,708	931	777
11. Gadai Ghabri	10,202	5,369	4,833
12. Chit Sarkani	3,023	1,387	1,636
13. Dalana Khas	870	466	404
14. Rakh Bela	652	359	293
Total	38,945	20,117	18,828
Share (%)	(100)	(51.7)	(48.3)

Source : 1981 District Census Report of D.G.Khan

TABLE 5.2 ESTIMATED POPULATION IN THE STUDY AREA (1981/1991)

	Unit : persons		
	Population of Moza	Share of the Study Area	Population in the Study Area
1. Bela	4,963	100	4,963
2. Dalana	1,800	100	1,800
3. Wahi Kingrani	478	100	478
4. Kochha Wadani	713	42	300
5. Vidore	4,365	100	4,365
6. Noor Wah	1,479	100	1,479
7. Dagat Chit	2,575	33	850
8. Chhabri Bala Gharbi	4,192	18	755
9. Choratta Pachadh Shumali	1,925	65	1,250
10. Choratta Pachadh Janubi	1,708	60	1,025
11. Gadai Ghabri	10,202	36	3,670
12. Chit Sarkani	3,023	11	333
13. Dalana Khas	870	62	540
14. Rakh Bela	652	100	652
Estimated Population 1981 in the Study Area 1991			22,460
Estimated Population of Canal Irrigated Area 1991			32,500 (*1)
			23,900 (*2)

\*1 : (1981)x(1+0.0377)10

\*2 : 56,400-32,500

Source : JICA Study Team

TABLE 5.3 MAJOR INDUSTRIES IN TEHSIL D.G.KHAN

Name of Firm	Annual Capacity
A) Textile Industries	
1. Ghazi Textile Mills	
2. Rahim Bakhish Textile Ltd.	12,480-Spdl
3. Al-Hamd Textile Mills Ltd.	12,400-Spdl
4. Arain Textile Mills Ltd.	15,360-Spdl
5. Suleman Textile Mills Ltd.	14,400-Spdl
6. Arain Mills Ltd.	17,280-Spdl
7. Yahya Textile Mills Ltd.	17,280-Spdl
B) Flour Mills Industries	
1. Ghazi Flour Mills	50 M-tons
2. Nasuha Flour Mills	100 M-tons
3. Atta Ullah Flour Mills	100 M-tons
C) Auto Mobile Industries	
1. Al-Ghazi Tractor Co.	15,000 Units
D) Cement Plant Industries	
1. D.G.Khan Cement Co.	
E) Oil Mills Industries	
1. Sardar Oil Mills	20 M-tons
F) Food Industries	
1. Bombino Food Industries	
2. Lungar Sulemani Industries	54 M-Packets
G) Plastic Industries	
1. Plastiman Ltd.	

Source : Assistant Director of Industries, D.G.Khan

TABLE 5.4 NUMBER OF HOUSEHOLDS AND TENURE CLASSIFICATION OF FARMERS

	NAME OF MOZA	CULTIVABLE AREA	HOUSE HOLD	CULTIVABLE AREA PER HOUSEHOLD	OWNER %	OWNER CUM- TENANT %	TENANT %
1	BELA *	1,101	560	2.0	52	16	32
2	DALANA PATIZAI	588	142	4.1	45	38	17
3	WAHI KINGRANI	144	62	2.3	59	14	27
4	KOCHHA WADANI	204	63	3.2	59	27	14
5	VIDORE	2,729	674	4.0	53	26	21
6	NORWAR	2,599	412	6.3	49	17	34
7	DAGAR CHIT	672	133	5.1	45	30	25
8	CHABRI BALA GHARBI	588	108	5.4	37	20	43
9	CHORATTA PACHADH SHUMALI	1,944	479	4.1	45	27	28
10	CHORATTA PACHADH JANUBI	384	106	3.6	95	3	2
11	GADAI GHARBI	1,280	548	2.3	49	19	32
12	CHIT SARKANI	152	62	2.5	48	19	33
13	DALANA KHAS KHAS	1,813	620	3.5	50	25	25
TOTAL		14,198*	3,969	3.6	54	21	25

\* MOZA RAKH BELA is included.

\*\* 850 ha of Canal Irrigated Area is included.

TABLE 5.5 SUMMARY OF FARM SURVEY IN THE STUDY AREA

	Minimum	Maximum	Average
<b>1. Farm size (ha)</b>			
Total	2	40	12.7
Net sown area	1	25	5.6
Cultivable waste	1	20	7.2
<b>2. Farm Plots</b>			
Number of farms	2	15	5
Plot size (ha)	0.25	11.2	2.6-8.6
Distance to farm (km)	0	5	0.3-2.0
<b>3. Cropping intensity (%)</b>			
Total	17	75	41
Jowar	0	75	32
Bajra	0	10	1
Wheat	0	33	4
Gram	0	17	2
Oilseeds	0	12	2
<b>4. Seeding rate (kg/ha)</b>			
Jowar	20	33	27
Bajra	20	30	24
Wheat	100	100	100
Gram	20	50	25
Oilseeds	6	8	6
<b>5. Crop yield (kg/ha)</b>			
Jowar	1,000	1,600	1,359
Bajra	1,000	1,300	1,163
Wheat	700	1,800	1,278
Gram	1,400	1,600	1,560
Oilseeds	900	1,600	1,013
<b>6. Livestock</b>			
Cattle	0	12	5.5
Buffaloes	0	3	0.4
Sheep	0	35	4.4
Goats	0	40	10.4
Horses	0	2	0.4
Donkeys	0	2	0.3
Camels	0	4	2
Poultry	0	90	19.5

Source: JICA STUDT TEAM

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						(unit: kg)
	1986	1987	1988	1989	1990	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

(Unit: Rs./year/household)				
Item	Upstream	Middle	Downstream	Average
<b>1. Annual Gross Income</b>				
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%)
<b>2. Agricultural Input and Output</b>				
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
<b>3. Farm Budget</b>				
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
<b>4. Household Expenditure</b>				
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%)
Phullar 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
<b>I. Existing Roads</b>					
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		
<b>2. Roads under Construction</b>					
a. Ladan					
- Kochha Wadani	7	18	25	3	7.3
Total	7	18	25		
<b>3. Roads under Planning</b>					
a. AL-GHAZI					
Tractor Factory	16	-	16	3	7.3
- Dalana					
b. Vidore	9.7	-	9.7	3	7.3
- Bela					
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	Femail
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
<b>1. Farm size (ha)</b>			
Total	2	120	27.0
Net sown area	1	13	4.6
Cultivable waste	1	60	22.4
<b>2. Farm Plots</b>			
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
<b>3. Cropping intensity (%)</b>			
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
<b>4. Seeding rate (kg/ha)</b>			
Jowar	18	27	25.0
Bajra			
Wheat	100	100	100.0
Gram			
Oilseeds			
<b>5. Crop yield (kg/ha)</b>			
Jowar	700	1000	875.0
Bajra			
Wheat	600	800	760.0
Gram			
Oilseeds			
<b>6. Livestock</b>			
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	ZAI	DALANA	Total	VIDORE	ZAI	DALANA	Total	VIDORE	ZAI	DALANA	Total
	Average	122.79	2.50	12.37	137.66	115.26	2.11	9.34	126.71	110.68	2.12	9.34
Return Period												
2 Years	107.54	2.00	9.88	119.42	100.01	1.64	7.17	108.82	95.80	1.64	7.17	104.61
5 Years	149.97	3.04	15.02	168.03	141.30	2.56	11.33	155.19	136.12	2.56	11.33	150.01
10 Years	186.39	4.07	20.19	210.65	177.12	3.52	15.64	196.28	171.23	3.52	15.64	190.39
25 Years	242.18	5.86	29.12	277.16	232.53	5.21	23.28	261.02	225.58	5.21	23.28	254.07

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	1/350	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	1/360	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															
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 <sup>3</sup> )	Area (sqm)	V' (x1000m <sup>3</sup> )	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 <sup>3</sup> )	Area (sqm)	V' (x1000m <sup>3</sup> )	Q' (cms)	Remarks
[Phullar 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 <sup>3</sup> )	Area (sqm)	V (x1000m <sup>3</sup> )	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)

							(Unit:ha)
		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)

							(Unit:ha)
		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)

							(Unit:ha)
		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

TABLE 6.6 ZONAL FEATURES IN THE WATERSHED

Zone	Altitude	Average Slope	Geology	Weathering /Erosion	Vegetation	Land Use	Streamflow
I	EL.1,000m - EL.2,300m	Steep	Sedimentary Cretaceous to Paleogene	High/ Resistant	Medium	Grazing	Perennial
II	EL.700m - EL.1,100m	Gentle - Steep	Sedimentary Paleogene	High/ High	Sparse	Grazing & Crop Land Irrigated	Perennial
III	EL.600m - EL.800m	Gentle - Flat	Sedimentary Neogene and Pleistocene	Extreme/ High	Sparse	Grazing & Crop Land Rainfed	Seasonal
IV	EL.500m - EL.700m	Gentle - Flat	Terrace Gravel	Medium/ Resistant	Sparse	Grazing & Crop Land Rainfed	Seasonal
V	EL.250m - EL.500m	Gentle - Steep	Sedimentary Paleogene and Neogene	Extreme/ Extreme	Rare	Grazing & Crop Land Rainfed	Seasonal

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. radius : 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		

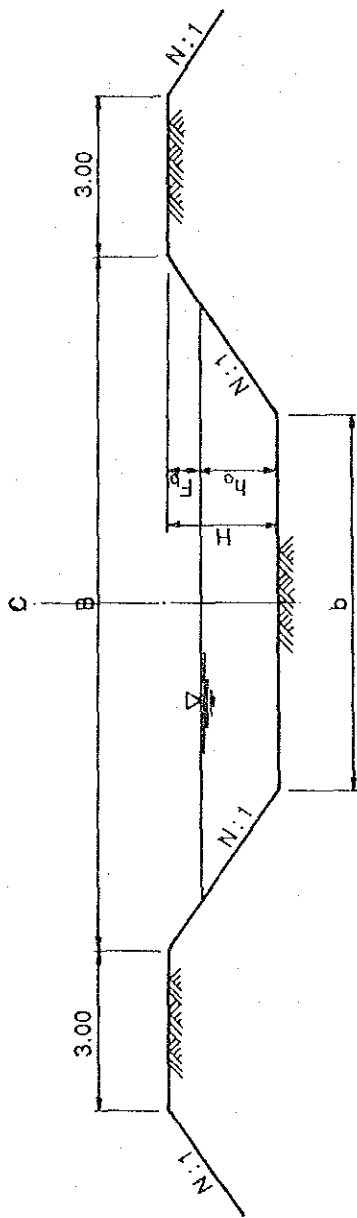




TABLE 6.8 TYPICAL CROSS SECTION OF CANALS (2/2)

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

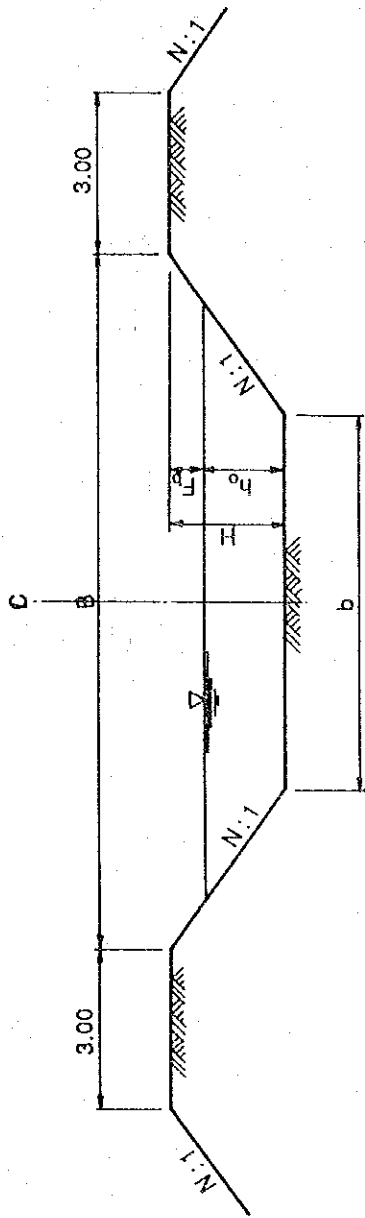


TABLE 6.9 CONSTRUCTION UNIT COST

Description	Unit	Rate (Rs)	F.C. (Rs)	L.C. (Rs)
<b>1. For Irrigation</b>				
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
<b>2. For Watershed Management</b>				
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	Total	(Unit: '000 Rs)	
		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	Total	(Unit: '000 Rs)	
		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
2.3 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	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
<u>Sub-Total</u>	<u>105,866</u>	<u>23,496</u>	<u>82,370</u>
5. Engineering Fee	12,457	8,114	4,343
<u>Total (1-5)</u>	<u>190,500</u>	<u>57,452</u>	<u>133,048</u>
5. Price Escalation	122,700	8,271	114,429
<u>Grand Total</u>	<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)
<b>1. Dispersion &amp; Separating</b>				
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				779.9
<b>2. Distribution Structure</b>				
2.1 Excavation	9,400	cu.m	56.5	531.1
Sub-Total				531.1
<b>3. Road</b>				
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				370.9
(Case A Annual O/M Cost)				(1,681.9)
<b>4. Watershed Management</b>				
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				223.4
<b>Total (Case B-1, Case B-2 Annual O/M Cost)</b>				<b>(1,905.3)</b>

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
			Benefit	5.45 million Rs.



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

(Unit: '000 Rs)

Case A	Crop	Project	Return Period			
			2	5	10	25
<b>[Kharif]</b>						
	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
<b>[Rabi]</b>						
	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
<b>[Total]</b>						
		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		Return Period			
Crop	Project	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			
		16.8	0.10	1.68
0.80	17.3	18.0	0.10	1.80
0.70	18.6	19.4	0.10	1.94
0.60	20.2	21.2	0.10	2.12
0.50	22.2	23.4	0.10	2.34
0.40	24.5	26.3	0.10	2.63
0.30	28.0	30.6	0.10	3.06
0.20	33.2	38.4	0.10	3.84
0.10	43.6	51.8	0.06	3.11
0.04	60.0			
				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			
		16.7	0.10	1.67
0.80	17.0	17.4	0.10	1.74
0.70	17.8	18.4	0.10	1.84
0.60	19.0	20.1	0.10	2.01
0.50	21.2	22.4	0.10	2.24
0.40	23.6	25.3	0.10	2.53
0.30	27.0	29.7	0.10	2.97
0.20	32.3	37.3	0.10	3.73
0.10	42.3	51.1	0.06	3.06
0.04	59.8			
				21.78
	Benefit	21.78-14.08=		7.71 million Rs.

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

item	Construction Cost (million Rs.)	Life year	( used year: 25 years)	
			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)

item	Construction Cost (million Rs.)	Life year	( used year: 25 years)	
			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)

item	Construction Cost (million Rs.)	Life year	( used year: 25 years)	
			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	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)

(Unit : million Rs.)

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) : Solvage 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	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	62.42	

E.I.R.R = 11.80 %

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-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	

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)

## **FIGURES**



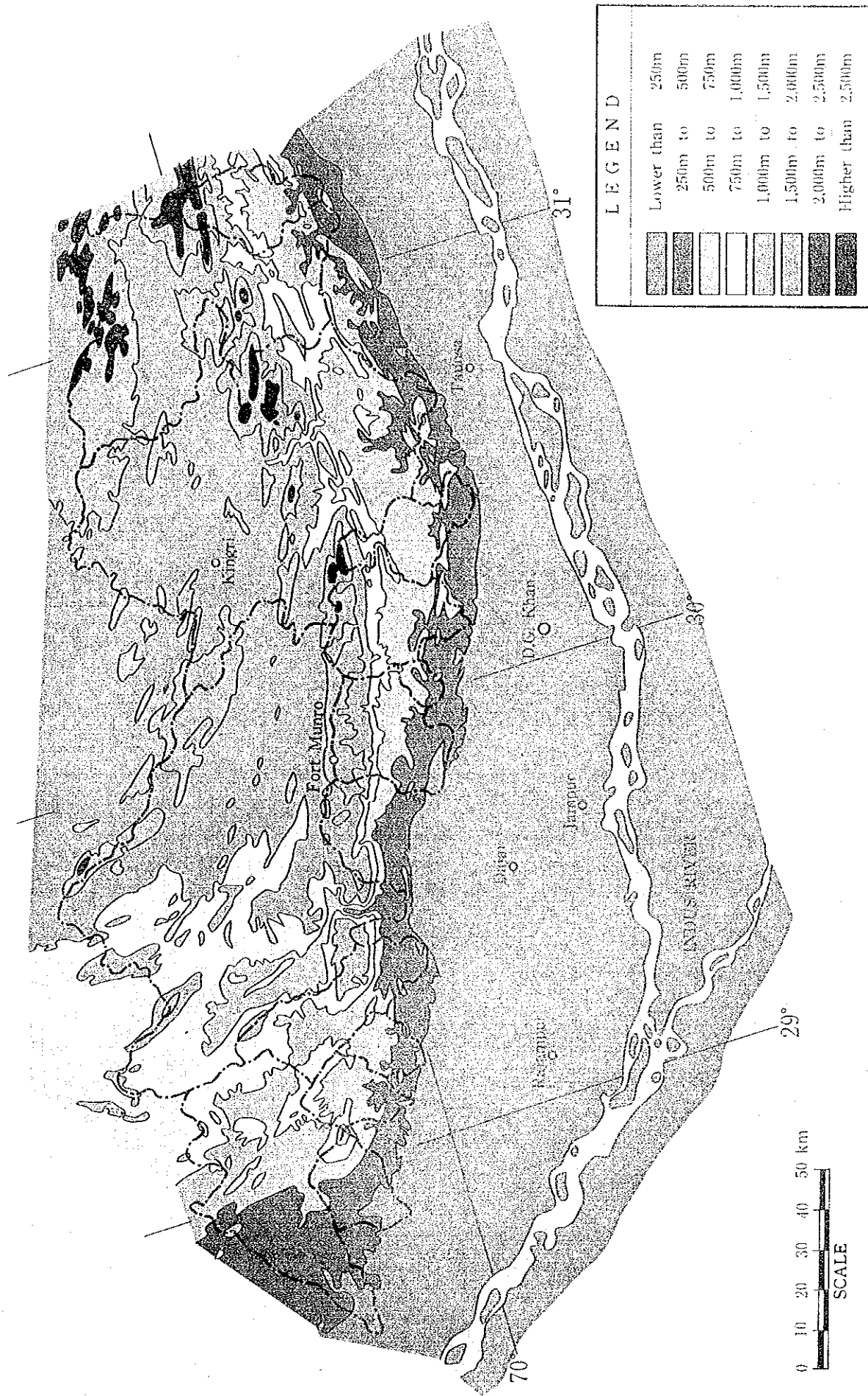


FIGURE 3.1 TOPOGRAPHICAL MAP OF THE STUDY AREA









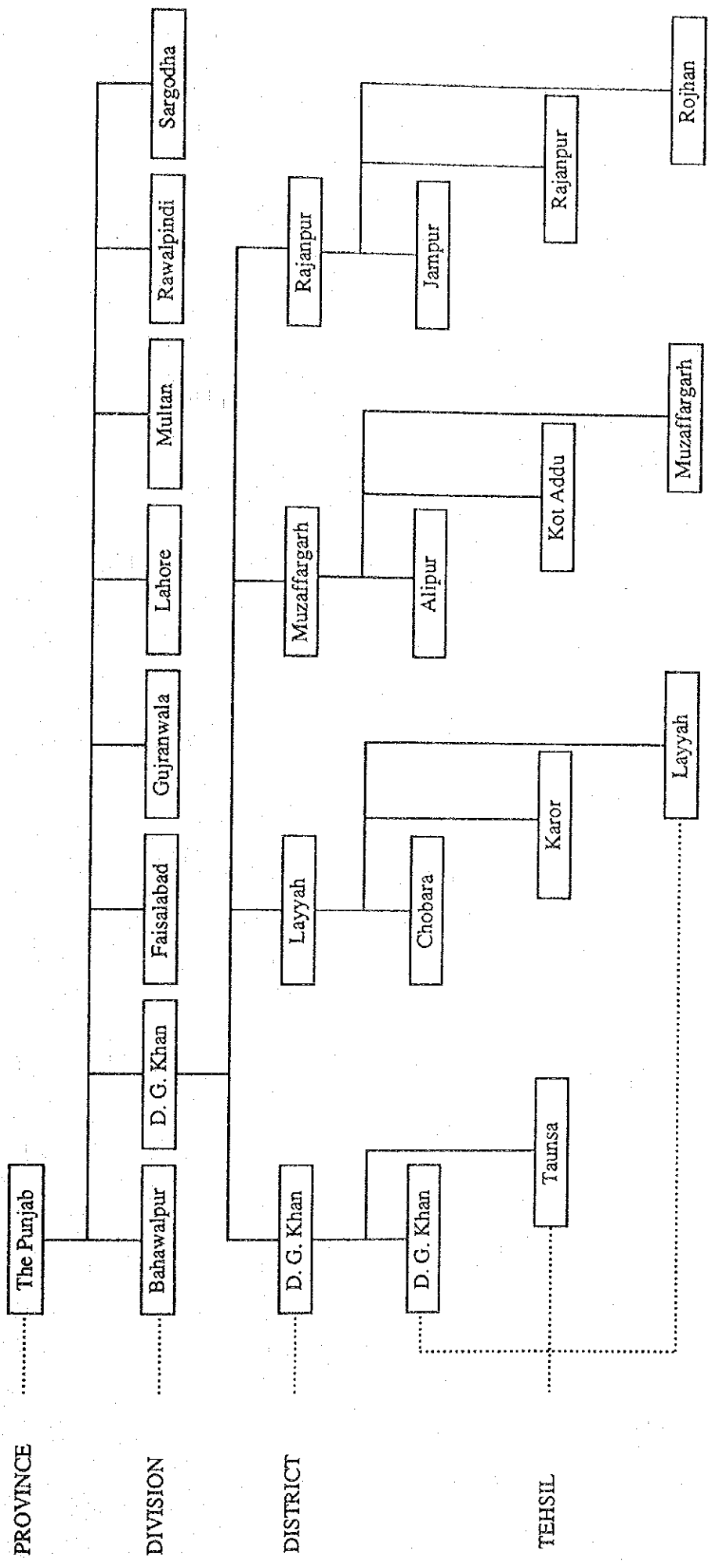


FIGURE 3.3 ADMINISTRATIVE DIVISIONS OF THE PUNJAB

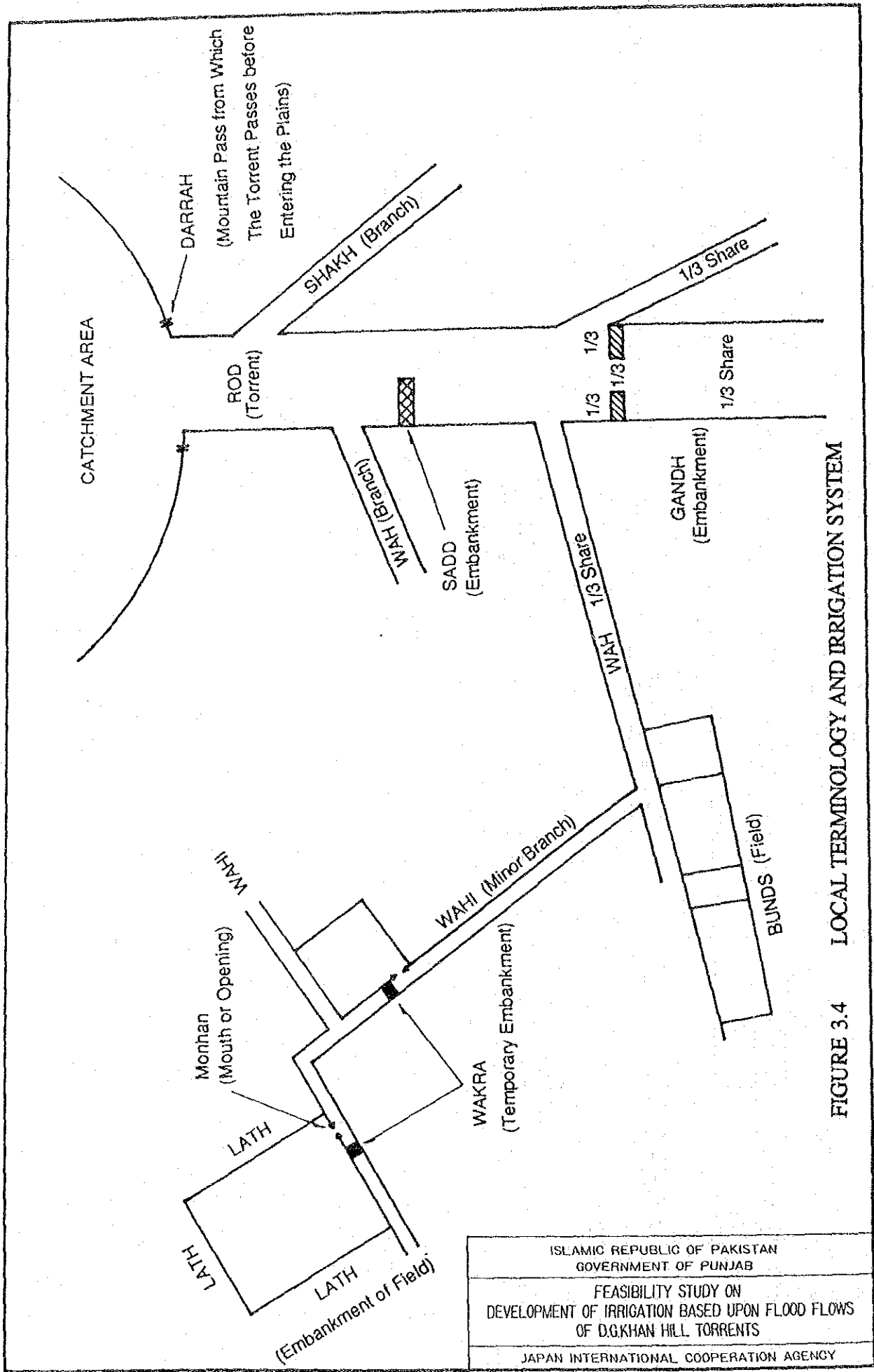
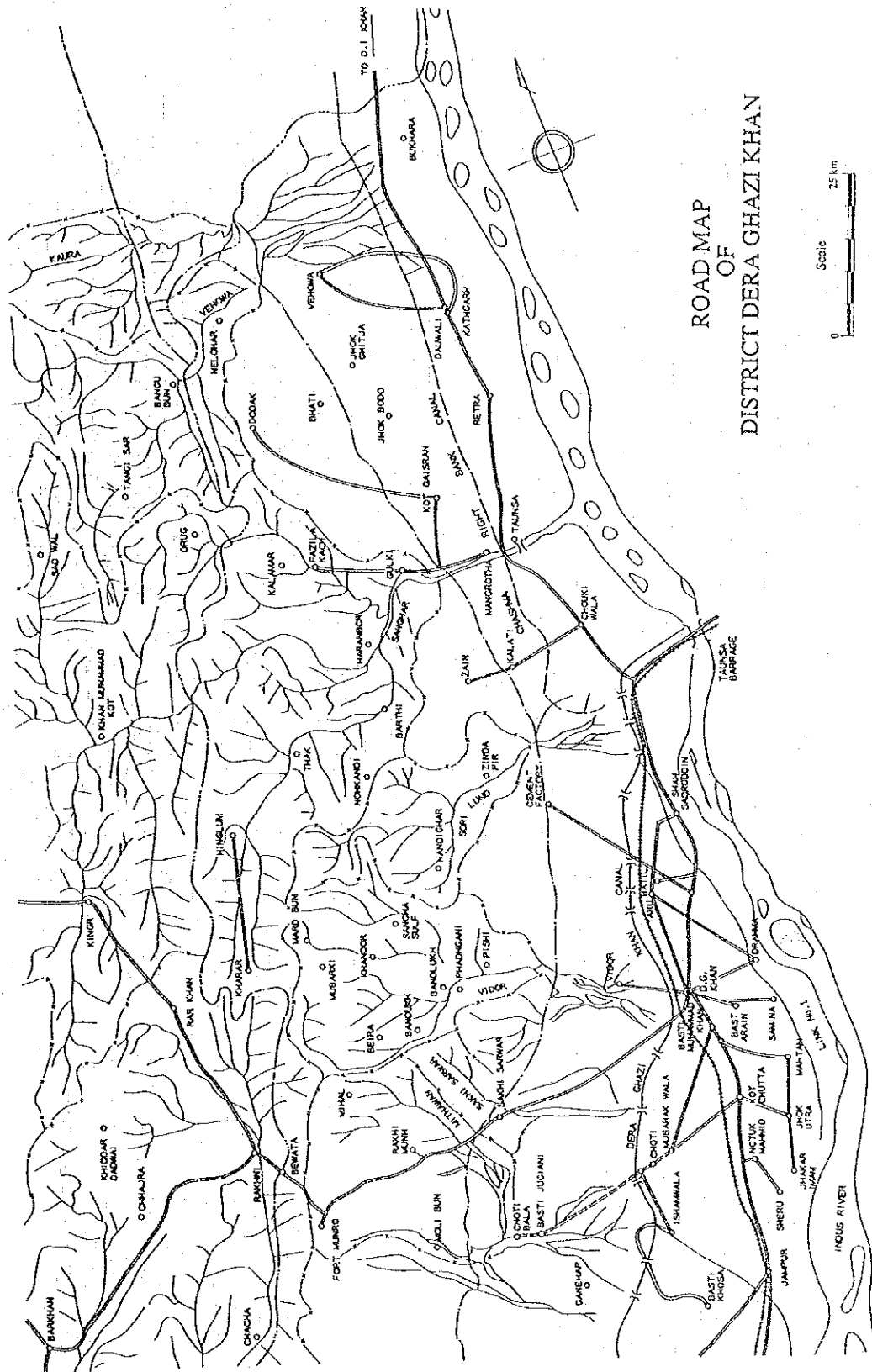


FIGURE 3.4 LOCAL TERMINOLOGY AND IRRIGATION SYSTEM



ROAD MAP  
OF  
DISTRICT DERA GHAZI KHAN

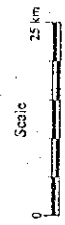


FIGURE 3.5 ROAD NETWORK (1)

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

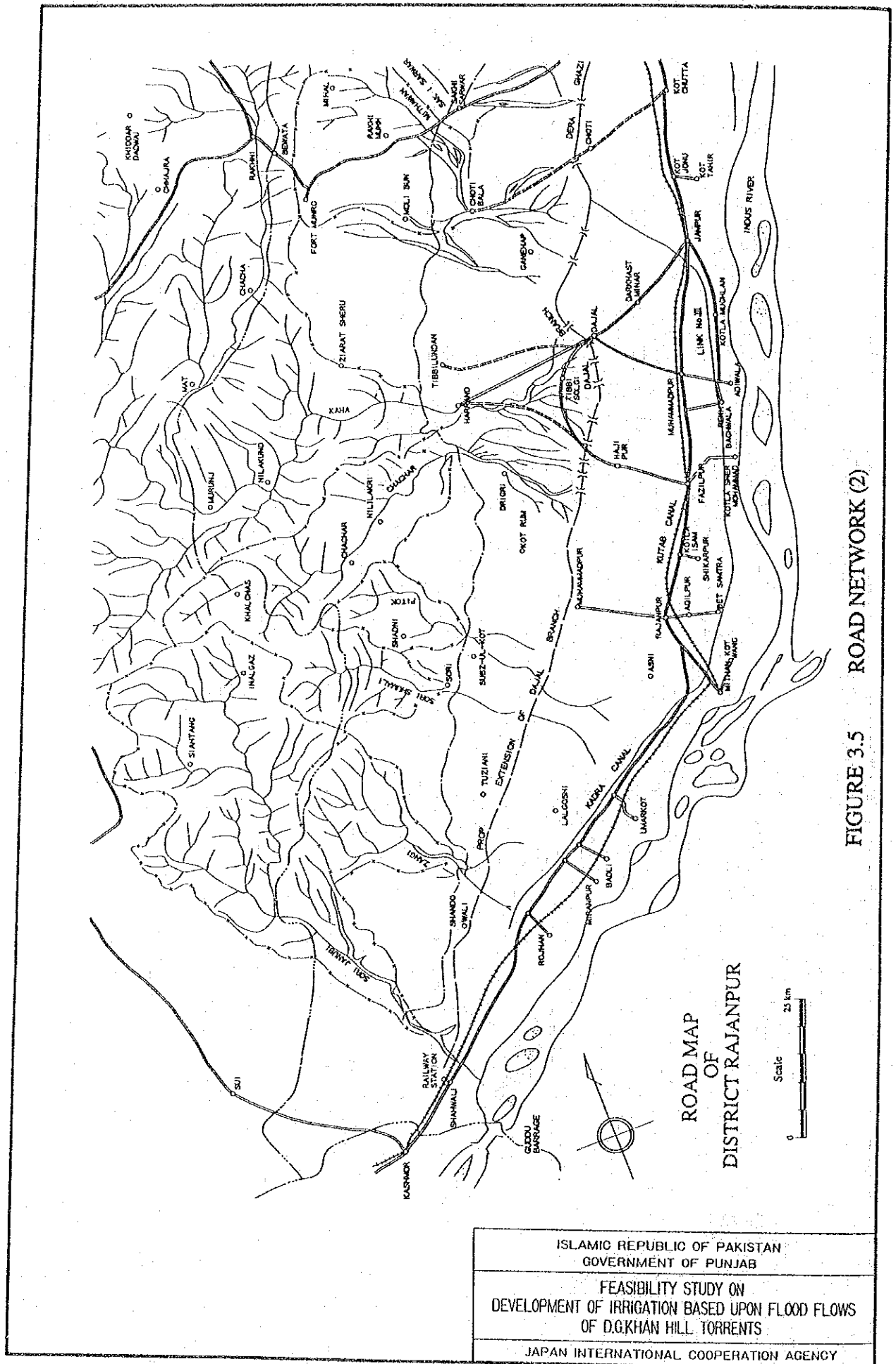
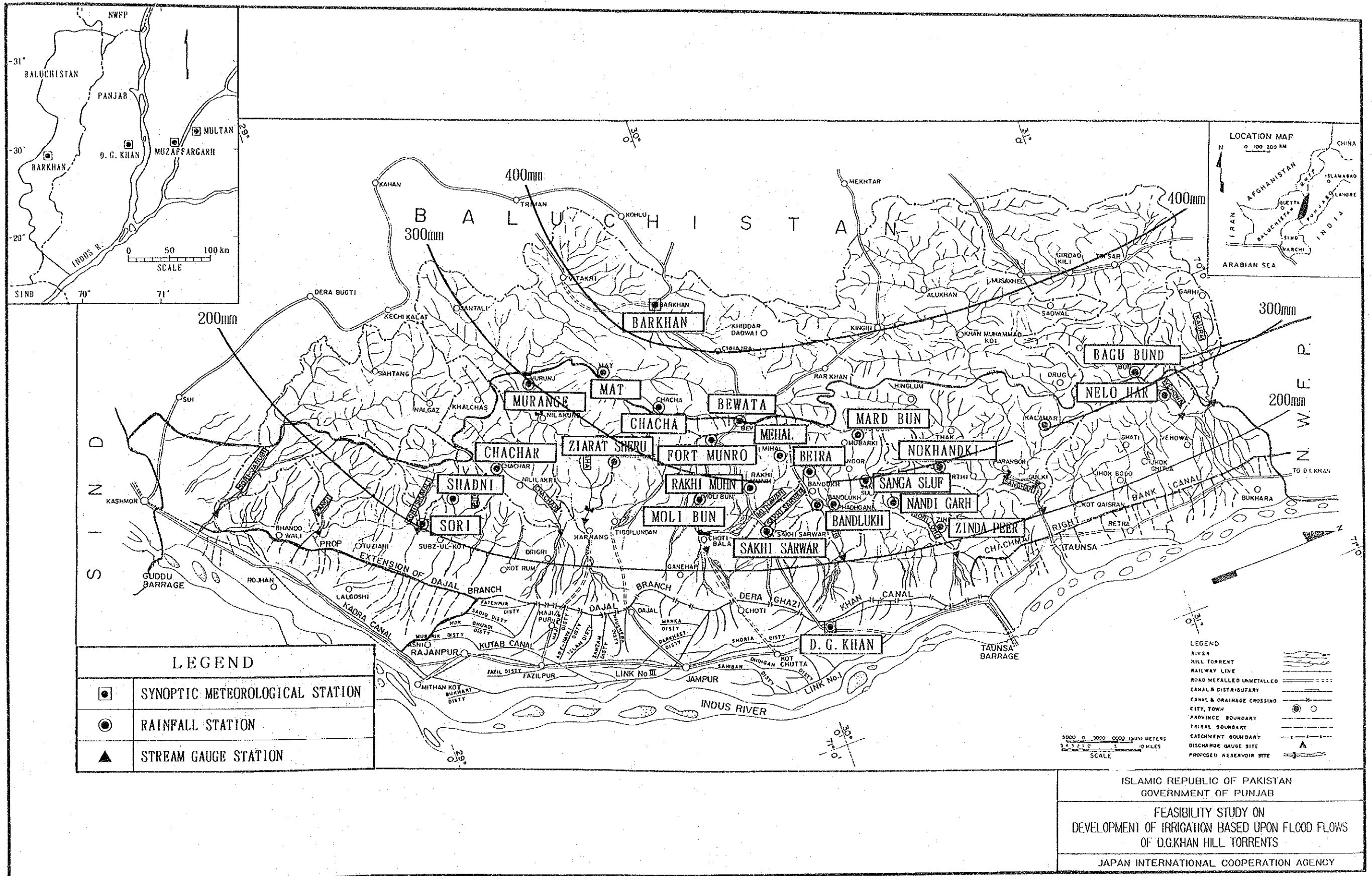


FIGURE 3.5 ROAD NETWORK (2)



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

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



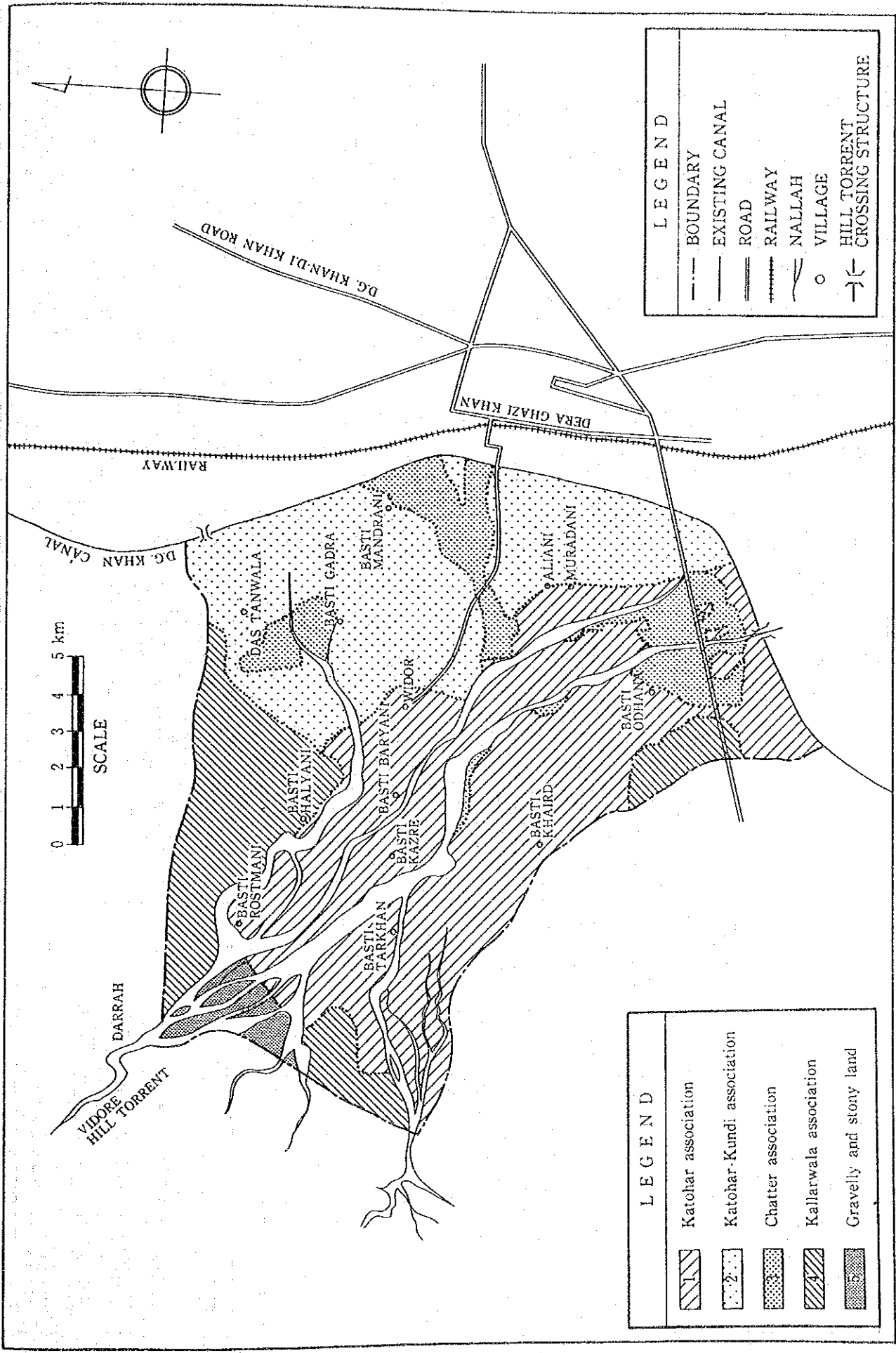


FIGURE 5.2 SOIL MAP OF THE STUDY AREA

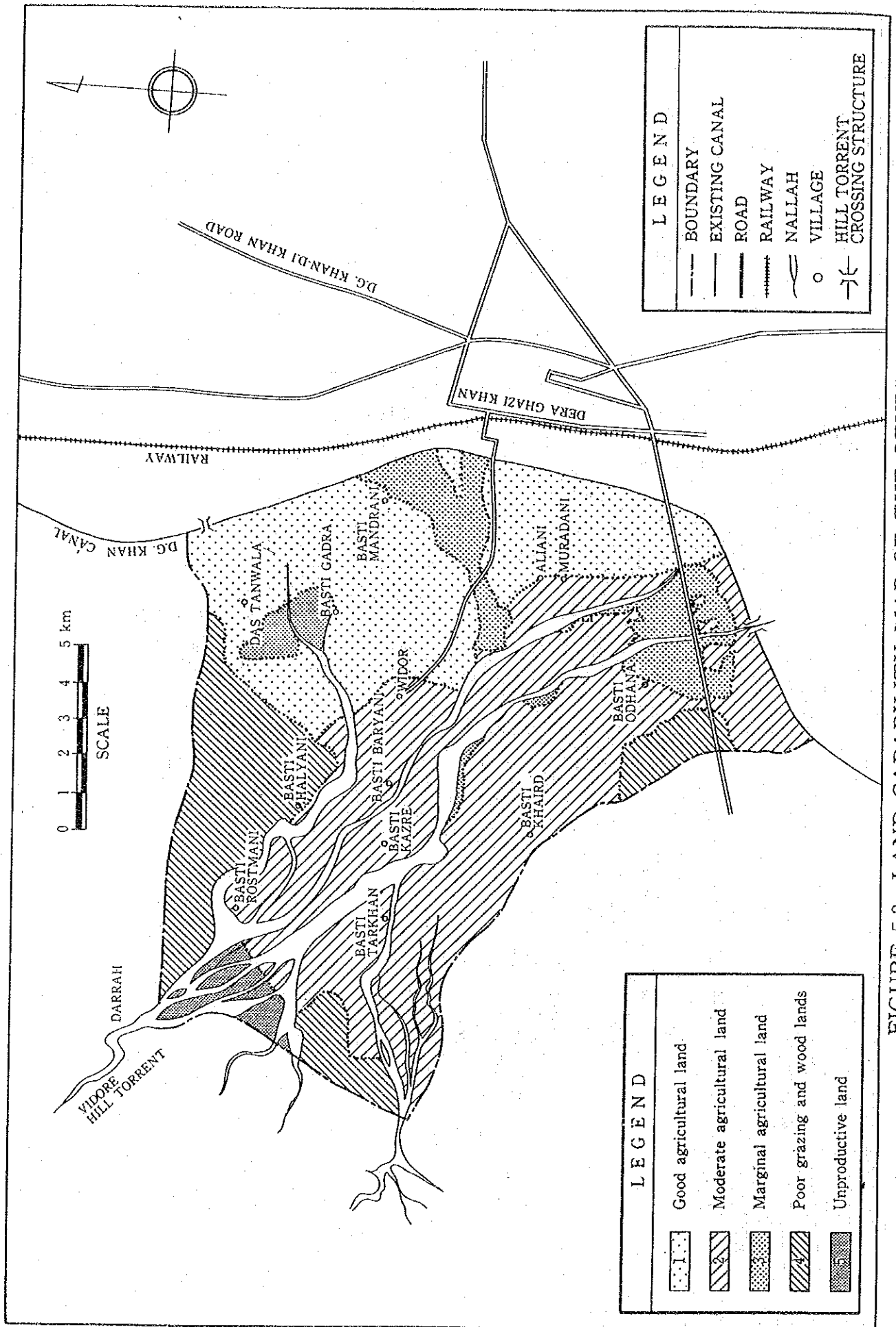


FIGURE 5.3 LAND CAPABILITY MAP OF THE STUDY AREA



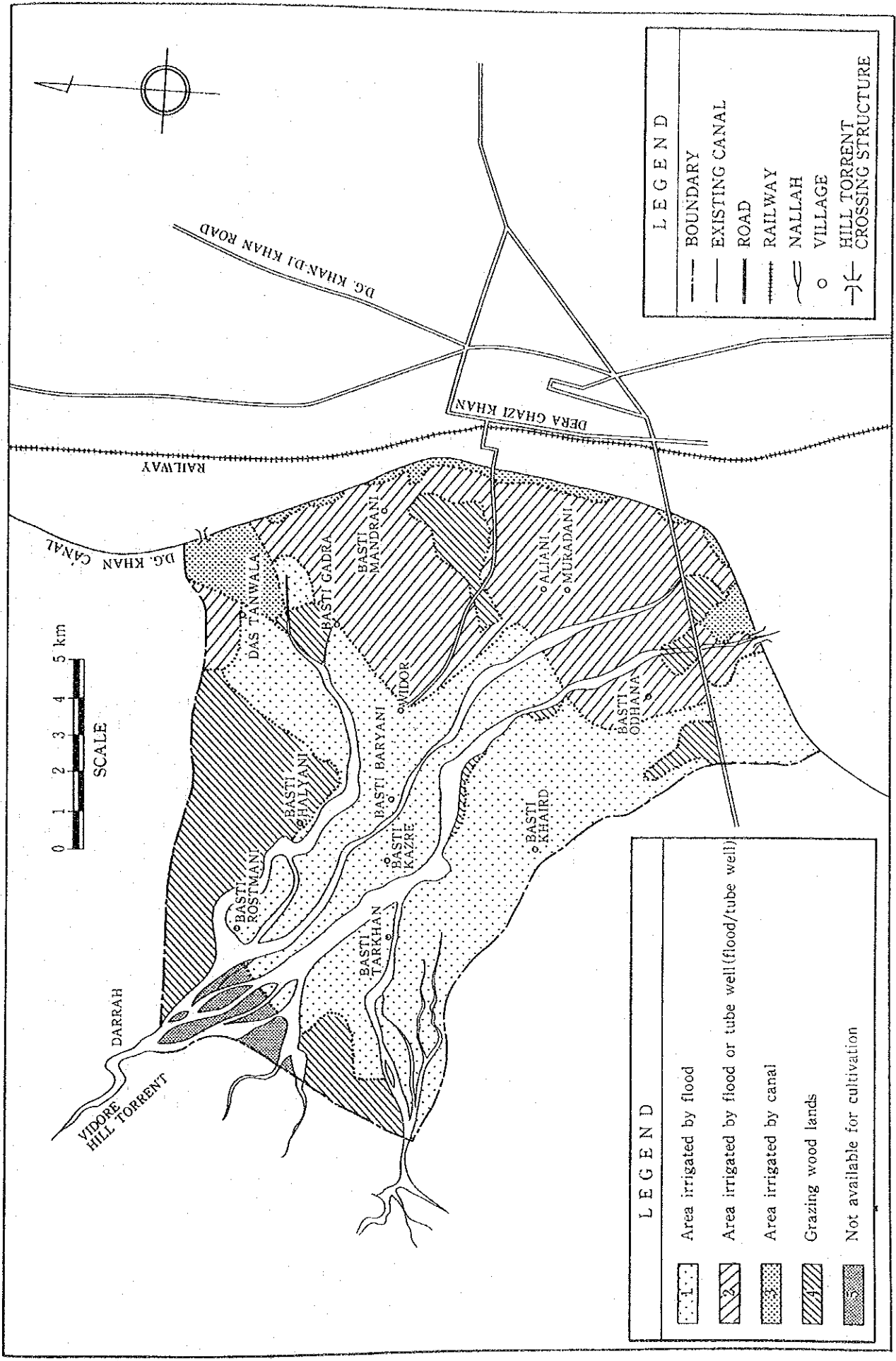


FIGURE 5.4 PRESENT LAND USE MAP OF THE STUDY AREA

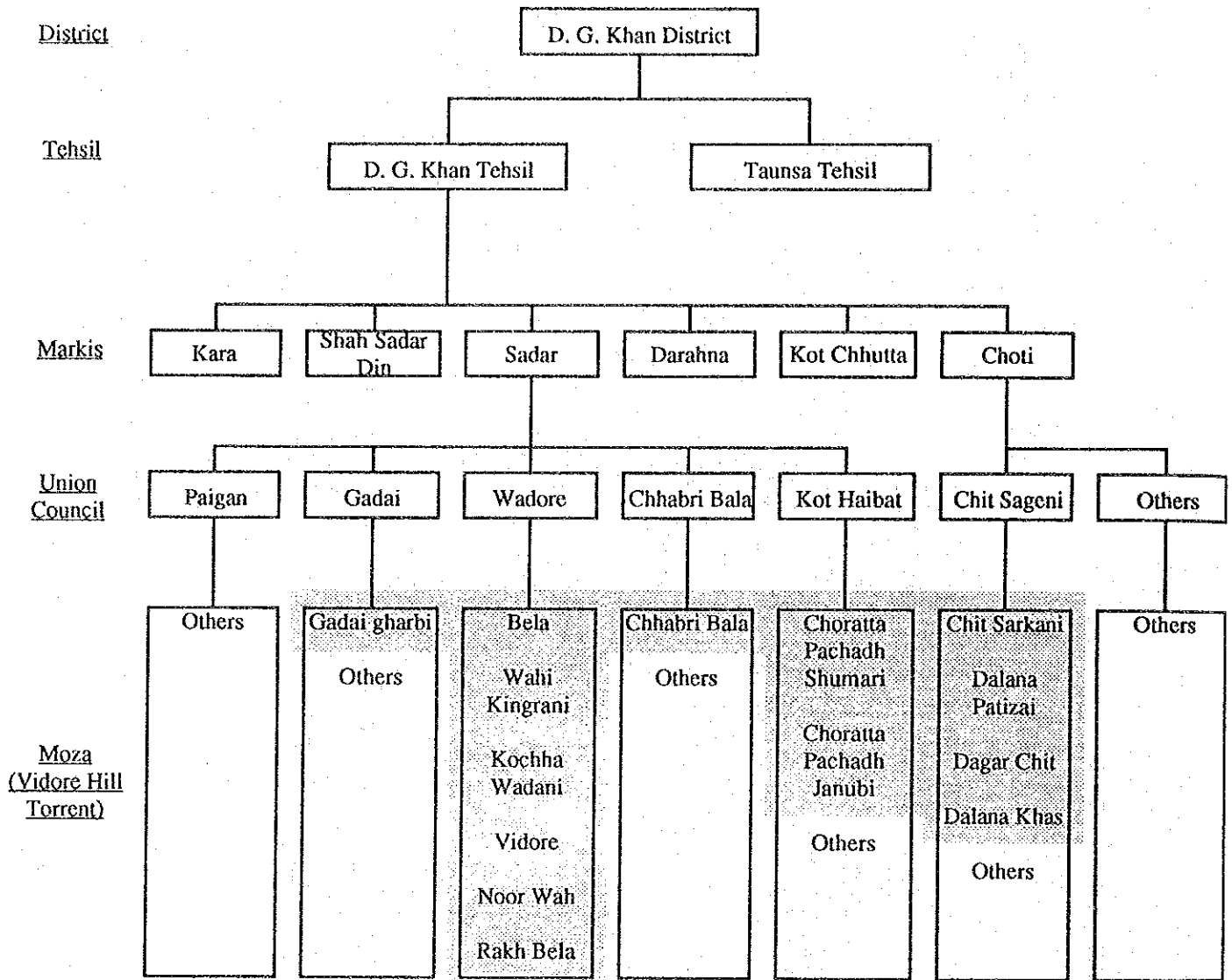


FIGURE 5.5 ADMINISTRATIVE DIVISIONS OF THE STUDY AREA

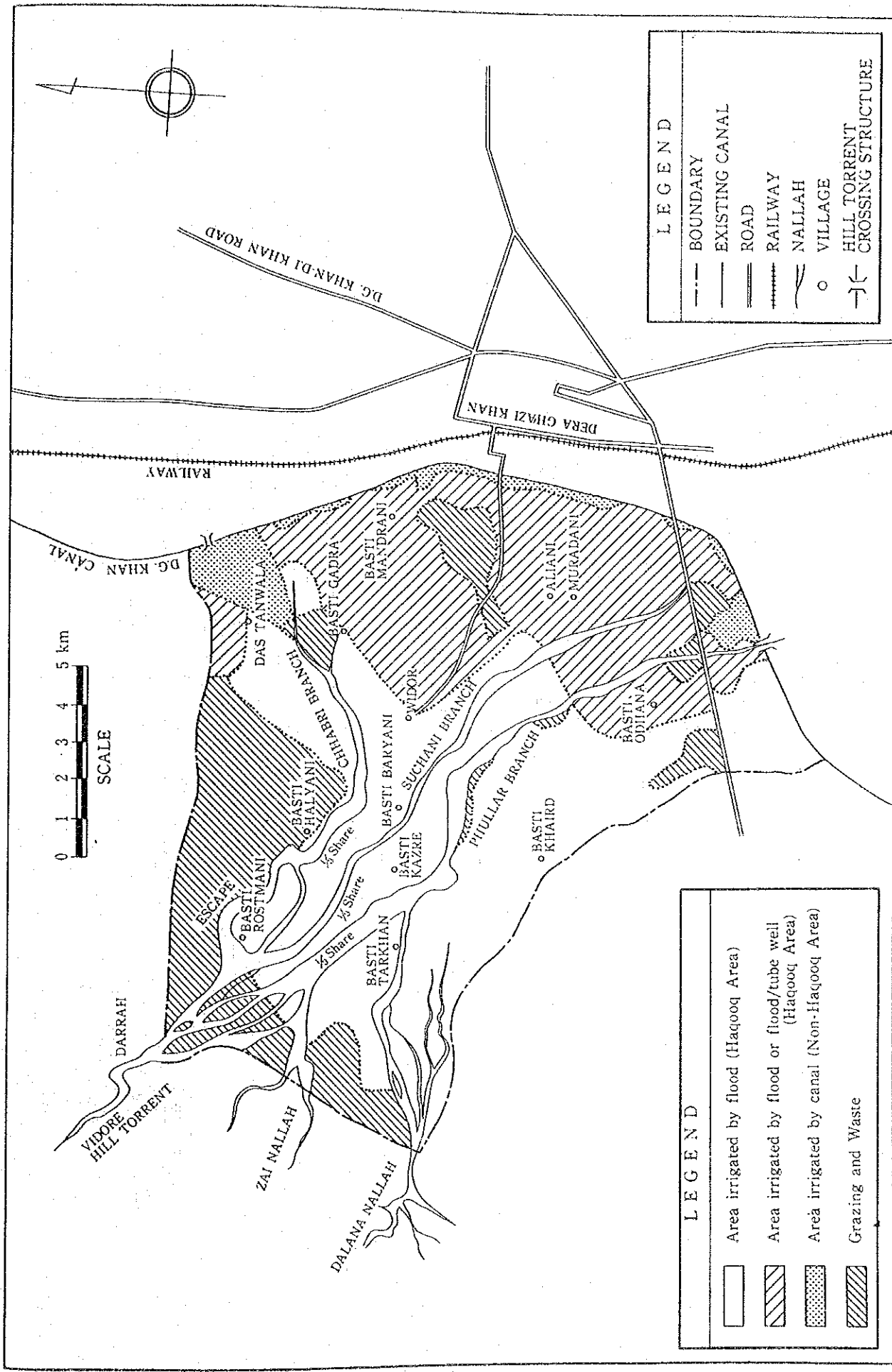


FIGURE 5.6 AREA CLASSIFIED BY WATER RESOURCES

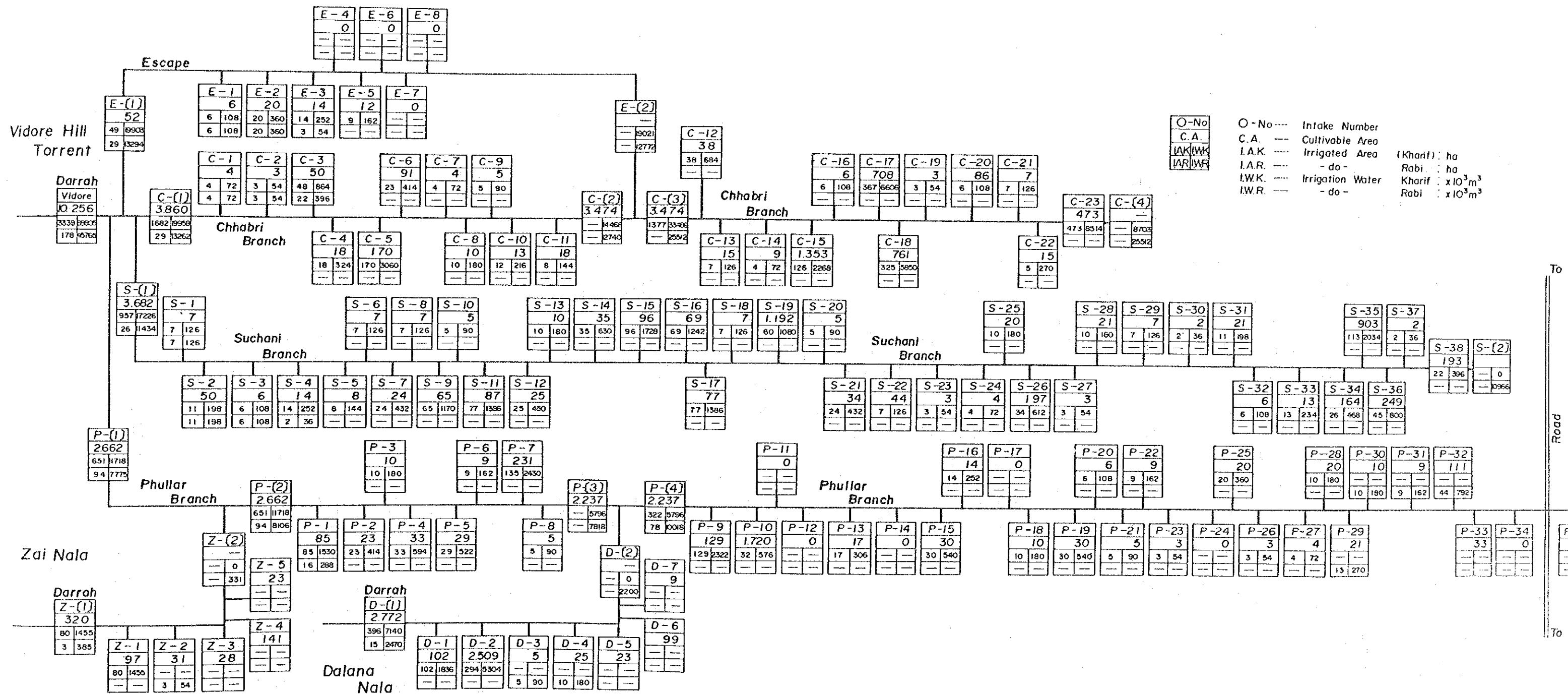


FIGURE 5.7 SCHEMATIC DIAGRAM OF PRESENT IRRIGATION SYSTEM (1978)