TABLES

Table C.3 (1/2) METEOROLOGICAL DATA AT TAULIHAWA

716 TAULIHAWA El.94 m 27°33" Lati. 83°04" Long.

Mean Temperature

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1979	16.9	17.7	22.4	29.4	31.6	31.1	29.2	29.6	29.2	26.4	23.2	17.6	25.4
1980	15.4	18.7	23.2	30.0	30.4	29.6	29.0	29.0	28.8	25.8	21.4	17.8	24.9
1981	15.6	18.6	22.8	27.0	29.0	31.0	29.0	29.5	28.6	26.0	21.0		25.3
1982	16.6	16.9	21.5	27.5	29.3	29.4	29.4	29.6	28.3	25.8	21.0	16.4	24.3
1983	13.6	16.3	21.8	25.8	28.8	31.6	30.1	29.9	28.3	26.1	20.9	15.6	24.1
1984	14.1	15.5	21.9		30.5	30.1	29.5	29.9	27.7	26.7	19.7	15.8	23.8
1985	15.5	17.8	24.8	29.2	30.6	31.1	28.5	30.2	28.1	26.2	21.3	17.5	25.1
1986	15.6	17.7	23.3	26.6	27.9	31.5	29.2	29.7	28.5	26.0	22.2	17.7	24.7
AVE	15.4	17.4	22.7	27.9	29.8	30.7	29.2	29.7	28.4	26.1	21.3	16.9	24.6

Mean of Daily Minmum Temp.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1979		10.7	13.1	21.0	23.4	25.2	25.5	25.9	23.7	20.1	15.9	10.0	19.5
1980	7.5	10.6	14.1	20.2	23.6	25.2	25.3	25.6	24.4	19.8	13.0	10.0	18.3
1981	8.6	10.9	14.8	20.3	23.3	25.5	25.7	26.0	24.5	19.4	13.0	8.2	18.4
1982	9.2	9.7	14.2	20.4	20.7	24.5	25.7	25.9	24.5	19.8	14.9	9.2	18.2
1983	7.4	8.4	13.1	18.5	22.5	25.4	25.9	26.5	24.4	20.2	12.9	7.6	17.7
1984	6.2	7.0	12.2		23.4	23.9	25.2	26.1	23.8	20.8	10.4	7.5	17.0
1985	8.2	9.7	15.6	20.4	24.1	25.8	25.5	26.5	24.8	21.2	14.0	11.2	18.9
1986	9.2	10.2	14.3	17.2	20.2	25.5	25.0	25.8	24.0	19.1	15.2	10.6	18.0
AVE	8.0	9.7	13.9	19.7	22.7	25.1	25.5	26.0	24.3	20.1	13.7	9.3	18.2

Mean of Daily Maximum Temp.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1979		24.7	31.6	37.9	39.7	37.0	32.9	33.2	34.7	32.8	30.6	25.2	32.8
1980	23.6	26.8	32.2	39.8	37.1	34.0	32.8	32.5	33.1	31.9	29.8	25.5	31.6
1981	22.5	26.2	30.7	33.6	34.8	36.5	32.3	33.0	32.7	32.5	28.9		31.2
1982	24.1	24.1	28.8	34.6	37.9	34.4	33.2	33.3	32.1	31.8	27.2	23.7	30.4
1983	19.7	24.2	30.4	33.1	35.0	37.8	34.3	33.3	32.1	32.0	28.8	23.6	30.4
1984	21.9	23.9	31.5		37.6	36.2	33.7	33.7	31.5	32.5	29.0	24.1	30.5
1985	22.8	25.9	34.1	37.9	37.0	36.4	31.5	33.8	31.4	31.1	28.6	23.8	31.2
1986	21.9	25.2	32.2	35.9	35.5	37.5	33.4	33.6	32.4	32.8	29.2	24.7	31.2
AVE	22.4	25.1	31.4	36.1	36.8	36.2	33.0	33.3	32.5	32.2	29.0	24.4	31.0

Extreme Minimum Temp.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Min
1979	7.0	7.0	7.3	16.0	18.5	20.3	22.3	23.6	20.5	16.6	13.0	5.3	5.3
1980	4.0	5.7	10.0	14.8	19.0	21.5	19.8	23.4	22.0	14.8	11.0	7.5	4.0
1981	5.0	8.0	10.3	13.3	19.9	20.4	24.3	23.9	22.4	15.3	9.2	5.0	5.0
1982	5.8	6.3	9.4	14.2	17.8	20.4	23.2	23.6	21.4	17.0	8.6	7.0	5.8
1983	4.0	4.4	8.8	13.2	19.4	20.4	23.6	24.6	22.8	14.8	10.0	5.2	4.0
1984	4.0	3.4	8.2		19.4	21.0	23.4	23.4	21.0	12.8	7.4	3.2	3.2
1985	3.6	5.2	11.8	14.8	20.5	21.2	24.0	24.8	21.5	16.8	10.2	8.8	3.6
1986	7.0	7.5	10.0	13.2	15.5	21.8	20.8	24.0	20.5	15.6	12.5	9.0	7.0
AVE	5.1	5.9	9.5	14.2	18.8	20.9	22.7	23.9	21.5	15.5	10.2	6.4	5.1

Table C.3 (2/2) METEOROLOGICAL DATA AT TAULIHAWA

Relative Humidity (%)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1979	78	72	44	37	35	55	78	80	74	76	75	83	66
1980	79	64	48	27	53	71	81	82	82	76	75	82	68
1981	86	74	53	51	57	59	82	81	80	75	73	82	71
1982	95	80	62	45	42	68	78	77	82	74	78	77	72
1983	83	72	52	56	62	56	80	77	84	76	75	79	71
1984	81	74	54		48	74	80	78	82	77	72	82	73
1985	82	68	45	43	54	68	83	80	84	82	80	86	71
1986	84	74	55	42	71	77	87	83	81	81	85	84	75
AVE	84	72	52	43	53	66	81	80	81	77	77	82	71

Rainfall (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1976				10	36	181	312	586	206	12			1343
1977		10	0	32	67	68	360	353	126	75	0	6	1097
1978	8	40	40	8	21	250	679	204	195	16	2	7	1470
1979	12	18	1	2	39	204	572	184	102	26	10	27	1197
1980	1	18	16	0	104	418	511	518	353	1	0	0	1940
1981	62	14	37	39	136	437	454	328	416	0	28	2	1953
1982	31	9	85	42	41	220	640	335	398	65	13	4	1883
1983	23	0	16	30	35	61	468	190	377	124	0	15	1339
1984	12	4	0		30	390	680	130	292	30	0	16	1584
1985	13	7	0	18	91	142	841	334	442	213	0	21	2122
1986	3	20	0	97	83	230	656	148	315	65	13	60	1690
AVE	18	14	20	28	62	236	561	301	293	57	7	16	1613

Number of Rainy Days

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1978													76
1979	2	2	1	1	2	8	16	12	4	3	2	3	56
1980	0	2	4	0	8	13	18	17	9	1	0	0	72
1981	6	3	4	2	6	9	22	14	11	0	2	1	80
1982	2	3	7	2	3	13	18	17	7	2	2	1	77
1983	3	0	1	4	6	6	13	12	16	4	0	2	67
1984	1	1	0		2	19	21	11	14	2	0	2	73
1985	2	1	0	2	5	8	21	17	17	6	0	2	81
1986	1	2	0	3	6	9	15	14	11	4	1	3	69
AVE	2	2	2	2	5	11	18	14	11	3	1	2	72

Table C.4 (1/3) METEOROLOGICAL DATA AT BHAIRHAWA (AGRI)

707 BHAIRHAWA (AGRI) El.120 m 27'32" Lati. 83'28" Long.

Mean Temperature

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1976		17.4	22.1	27.1	29.0	29.2	28.8	28.5	27.7	25.4	21.6	16.4	24.8
1977	15.0	17.5	23.4	27.7	28.5	30.4	29.6	29.5	29.0	25.8	22.4	17.4	24.7
1978	14.6	17.1	20.9	27.2	30.8	29.7	29.5	30.1	28.2	27.2	22.4	19.3	24.8
1979	17.0	17.3	21.8	28.8	31.0	30.6	29.2	29.4	28.5	25.8	23.1	17.7	25.0
1980	15.5	18.3	22.6	29.0	29.8	29.6	29.6	29.2	28.8	26.0	21.6	18.0	24.8
1981	15.6	18.2	22.5	26.7	28.8	31.0	28.9	29.4	28.6	24.1	20.9	17.0	24.3
1982	16.6	16.8		26.6	29.7	29.4	29.6	29.8	28.2	25.6	21.1	16.6	24.5
1983	13.8	16.2	21.7	25.4	28.5	31.2	29.4	29.8	28.7	26.1	21.1	16.4	24.0
1984	14.6	16.4	22.5	28.2	30.8	29.3	28.9	30.0	27.6	26.9	20.8	16.8	24.4
1985	16.1	17.7	23.8	28.2	29.9	30.3	28.5	30.0	28.4	26.3	21.3	17.8	24.9
1986	16.0	17.7	23.0	26.9	28.0	30.8	29.2	29.6	28.2	25.4	22.6	17.6	24.6
AVE	15.5	17.3	22.4	27.4	29.5	30.1	29.2	29.6	28.4	25.9	21.7	17.4	24.5

Mean of Daily Minmum Temp.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1976		10.3	12.9	19.0	22.8	24.8	25.4	25.2	24.1	20.0	14.7	9.1	18.9
1977	8.2	9.6	14.3	20.9	22.8	25.8	26.4	26.5	25.7	21.4	17.0	11.2	19.2
1978	7.7	10.1	13.0	19.5	25.6	25.9	26.7	25.0	25.0	22.7	16.9	14.2	19.4
1979	10.8	10.4	12.5	21.1	23.6	25.4	26.2	26.3	24.2	20.5	17.3	11.6	19.2
1980	8.0	10.4	13.9	19.3	23.7	25.5	26.1	25.9	24.8	20.1	13.5	10.7	18.5
1981	9.1	10.6	14.4	20.1	23.0	25.8	25.6	25.9	24.6	14.7	13.4	8.9	18.0
1982	9.6	9.6	14.3	18.7	21.8	24.7	25.8	26.0	24.3	19.4	15.0	9.7	18.2
1983	7.7	7.9	12.6	17.4	22.3	25.2	25.2	25.9	25.1	20.3	12.9	8.9	17.6
1984	7.3	8.6	13.3	19.1	25.4	25.7	25.7	26.1	24.6	20.9	12.6	9.5	18.2
1985	9.5	9.7	14.6	19.6	23.9	25.2	25.5	26.3	24.6	21.5	14.0	11.4	18.8
1986	9.1	10.2	13.9	18.8	21.6	25.6	25.8	25.9	24.3	19.9	15.9	10.7	18.5
AVE	8.7	9.8	13.6	19.4	23.3	25.4	25.9	25.9	24.7	20.1	14.8	10.5	18.5

Mean of Daily Maximum Temp.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1976	22.2	24.6	31.3	35.2	35.1	33.6	32.2	31.8	31.3	30.9	28.4	23.7	30.0
1977	21.8	25.4	32.5	34.5	34.2	35.0	32.8	32.5	32.3	30.1	27.9	23.7	30.2
1978	21.5	24.1	28.8	34.8	36.1	33.5	32.3	33.6	31.4	31.6	27.9	24.4	30.0
1979	23.1	24.2	31.0	36.6	38.5	35.8	32.2	32.4	32.8	31.1	28.9	23.8	30.9
1980	23.0	26.2	31.3	38.8	35.9	33.8	33.2	32.6	32.9	31.9	29.6	25.4	31.2
1981	22.0	25.9	30.6	33.3	34.7	36.3	32.2	32.9	32.7	33.5	28.4	25.0	30.6
1982	23.7	24.0		34.6	37.6	34.2	33.4	33.7	32.1	31.9	27.2	23.6	30.5
1983	19.8	24.5	30.7	33.3	34.7	37.1	33.6	33.6	32.3	31.9	29.5	23.8	30.4
1984	21.9	24.3	31.6	37.3	36.1	32.9	32.1	33.8	31.5	32.8	29.0	24.0	30.6
1985	22.7	25.6	33.1	36.8	35.8	35.3	31.4	33.7	32.1	31.0	28.5	24.1	30.8
1986	22.8	25.2	32.0	35.0	34.3	35.9	32.5	33.2	32.0	30.9	29.2	24.5	30.6
AVE	22.2	24.9	31.3	35.5	35.7	34.9	32.5	33.1	32.1	31.6	28.6	24.2	30.5

Table C.4 (2/3) METEOROLOGICAL DATA AT BHAIRHAHA (AGRI)

Extreme Minimum Temp.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Min
1976		6.0	8.5	12.0	15.9	21.2	21.0	23.5	21.3	15.5	10.0	6.0	6.0
1977	3.3	5.0	9.0	18.0	18.5	20.5	24.0	25.0	22.0	18.0	13.2	8.0	3.3
1978	5.0	5.5	9.5	12.5	21.5	19.5	24.5	24.5	20.8	13.5	12.5	11.5	5.0
1979	7.5	6.5	5.5	16.0	18.0	20.1	22.6	24.0	21.0	16.5	14.5	7.0	5.5
1980	5.0	5.8	9.0	14.9	19.0	22.2	24.5	24.5	22.1	16.0	11.9	7.5	5.0
1981	6.0	7.5	9.5	13.5	20.2	21.0	24.0	24.4	22.4	9.5	9.5	6.0	6.0
1982	6.5	7.0	9.0	14.5	17.6	21.5	22.5	24.0	21.2	17.0	8.5	7.0	6.5
1983	4.0	3.4	8.0	11.5	18.6	19.0	18.0	20.0	23.5	12.8	11.0	5.4	3.4
1984	4.2	4.2	6.0	12.4	19.0	23.0	24.0	23.0	21.0	15.2	10.0	7.0	4.2
1985	5.0	8.0	10.4	16.0	20.0	22.0	24.0	24.0	22.0	17.0	11.0	9.0	5.0
1986	6.4	8.0	10.0	11.0	17.0	20.0	22.0	21.4	20.4	15.8	14.0	8.4	6.4
AVE	5.3	6.1	8.6	13.8	18.7	20.9	22.8	23.5	21.6	15.2	11.5	7.5	5.3

Relative Humidity (%)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1976	85	85	74	76	80	88	94	91	94	92	91	86	86
1977	91	87	84	82	80	83	89	89	84	82	84	88	85
1978	84	86	74	52	69	73	79	77	82		70		75
1979	70	73	53	39	40	55	80	81	76	77	74	79	66
1980	82	71	53	33	55	70	78	81	80	76	70	82	69
1981	86	78	59	62	64	58	81	81	80	83	79	82	74
1982	84	79	63	48	45	69	76	77	83	79	81	83	72
1983	87	73	53	48	61	59	79	79	82	76	73	79	71
1984	82	74	60	35	56	78	87	86	91	84	78	86	75
1985	86	76	55	42	56	66	82	79	84	82	77	83	72
1986	83	75	59	50	57	63	80	82	83	79	77	82	73
AVE	84	78	62	52	60	69	82	82	84	81	78	83	75

Wind Speed at 3.0 m height (km/hr)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1976				7.7	8.1	7.0	5.9	6.2	4.0	2.9	2.3	2.4	5.2
1977	2.9	2.9	4.1	7.4	7.4	9.0	7.4	6.3	4.6	3.2	1.9	1.8	4.9
1978	0.9	2.3	3.1	5.7	9.0	6.6	7.4	5.4	3.9	1.9	2.3	1.4	4.2
1979	1.3	1.5	2.5	4.9	5.4	4.1	4.5	3.4	2.0	1.9	1.0	1.0	2.8
1980	0.8	0.6	1.7	3.8	5.6	4.1	6.1	3.8	1.9	2.3	2.0	2.1	2.9
1981	2.9	2.8	4.4	6.6	7.0	6.3	6.6	5.4	4.0	2.0	2.1	2.1	4.4
1982	2.5	3.0	3.9	5.4	5.3	5.4	5.7	4.1	3.3	1.7	2.0	1.8	3.7
1983	2.3	3.3	4.7	6.2	6.7	5.4	5.3	5.0	4.3	2.2	1.7	2.0	4.1
1984	2.6	3.7	3.9	6.6	13.4	5.2	5.5	4.9	2.9	2.0	1.6	1.2	4.5
1985	2.2	2.5	4.7	6.8	6.7	6.4	6.6	4.0	4.3	2.3	1.6	1.9	4.2
1986	1.9	2.9	3.9	5.9	6.4	5.9	5.9	3.9	3.4	1.9	1.5	1.8	3.8
AVE	2.0	2.6	3.7	6.1	7.4	5.9	6.1	4.8	3.5	2.2	1.8	1.8	4.0

Table C.4 (3/3) METEOROLOGICAL DATA AT BHAIRHAWA (AGRI)

Sunshine Hours (hr/day)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1976			8.4	9.0	9.7	7.7	6.1	6.2	5.2	8.2	8.1	8.6	7.7
1977	6.9	8.5	8.6	9.2	9.2	8.7	5.3	6.4	7.2	8.4	7.3	6.6	7.7
1978	7.9	7.3	8.2	9.2	8.7	6.4	6.7	7.6	5.4	9.2	8.8	8.4	7.8
1979	7.3	7.8	8.9	10.0	10.4	8.2	6.5	4.9	8.4	8.9	7.4	7.8	8.0
1980	8.7	8.9	8.3	10.1	10.0	7.9	5.8	5.9	7.0	8.8	9.6	7.7	8.2
1981	6.7	8.0	7.7	8.1	8.1	8.2	4.2	5.3	6.7	7.4	8.4	7.9	7.2
1982	6.1	5.9	8.1	7.3	9.0	6.1	4.9	6.3	5.6	7.2	7.0	5.1	6.6
1983	5.4	8.5	8.4	8.1	9.3	9.3	6.4	7.1	6.2	8.4	9.8	8.1	7.9
1984	8.0	8.7	9.4	9.8	9.4	5.0	5.6	8.2	6.5	7.3	9.2	8.8	8.0
1985		9.0	8.3	8.7	9.8	8.3	4.4	6.8	5.6	6.1	9.1	6.8	7.5
1986	6.9	8.5	9.3	8.7	9.4			5.2	6.0	8.3		7.4	7.7
AVE	7.1	8.1	8.5	8.9	9.4	7.6	5.6	6.4	6.3	8.0	8.5	7.6	7.7

Rainfall (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1976	6	28	0	3	65	288	436	537	245	12	0	0	1620
1977	3	10	0	24	130	83	698	314	60	76	0	15	1413
1978	10	23	57	3	12	342	625	115	404	13	5	8	1617
1979	8	5	1	11	7	165	642	303	180	107	4	45	1478
1980	1	5	9	2	154	480	386	343	344	28	0	1	1753
1981	76	3	19	58	65	450	768	375	529	0	34	0	2377
1982	14	7	58	37	31	238	554	305	484	30	10	10	1778
1983	25	0	11	27					279	178	0	27	547
1984	15	5	1	5	43	1035	606	200	356	60	0	26	2352
1985	12	9	0	22	59	158	537	298	402	174	0	30	1701
1986	2	26	0	68	88	271	383	317	448	113	21	61	1798
AVE	16	11	14	24	65	351	564	311	339	72	7	20	1793

Number of Rainy Days

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1976	1	1	0	2	8	13	12	19	16	1	0	0	73
1977	2	1	0	4	10	9	23	16	7	6	0	2	80
1978	1	3	4	1	2	15	17	12	15	1	1	2	74
1979	2	3	1	3	1	11	17	13	5	4	2	3	65
1980	1	2	3	1	9	11	19	21	9	2	0	1	79
1981	5	2	4	5	6	10	20	16	13	0	2	0	83
1982	1	3	6	3	4	13	16	19	10	2	2	2	81
1983	2	0	1	4					15	7	0	2	31
1984	1	3	1	1	3	18	18	12	13	2	0	2	74
1985	3	1	0	2	8	13	20	17	15	8	0	2	89
1986	1	3	0	4	7	9	16	15	12	6	1	3	77
AVE	2	2	2	3	6	12	18	16	12	4	1	2	78

Table C.5 (1/3) METEOROLOGICAL DATA AT BHAIRHAWA (AIRPORT)

705 BHAIRHAWA(AIRPORT) El.110 m 27'31" Lati. 83'26" Long.

Mean Temperature

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1976	15.6	18.4	23.2	27.8	29.4	29.1	28.7	28.7	28.0	25.8	21.6	16.1	24.4
1977	14.6	17.7	24.0	28.0	29.6	30.6	29.0	29.2	28.8	25.3	22.4	17.8	24.8
1978	14.5	17.2	21.5	27.6	31.4	29.7	29.2	29.8	28.2	26.4	22.0	17.2	24.6
1979	16.6	17.8	22.4	29.6	32.0	31.2	29.6	29.6	29.0	26.2	23.2	17.6	25.4
1980	15.6	18.6	23.2	29.8	30.0	30.0	29.6	29.2	28.8	26.0	21.8	18.0	25.1
1981	15.0	18.8	23.0	26.8	29.2	31.4	29.0	29.6	28.6	26.0	20.9	16.8	24.6
1982	16.8	17.2	22.2	27.4	30.4	29.8	29.8	30.2	28.7	26.1	21.4	16.6	24.7
1983	13.9	16.7	22.4	26.2	28.7	31.6	29.9	30.1	28.8	26.4	21.9	16.7	24.4
1984	14.9	17.0	23.5	29.2	31.0	29.3	28.9	30.2	28.0	26.9	20.9	17.0	24.7
1985	16.0	17.8	24.8	29.1	30.2	30.8	28.6	30.2	28.3	26.2	21.4	17.9	25.1
1986	16.0	18.1	23.4	27.6	28.6	31.5	29.4	30.0	28.3	25.5	22.3	17.9	24.9
AVE	15.4	17.8	23.1	28.1	30.0	30.5	29.2	29.7	28.5	26.1	21.8	17.2	24.8

Mean of Daily Minmum Temp.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1976	8.6	11.2	13.8	19.4	23.1	24.1	24.7	25.3	24.1	20.1	14.6	8.5	18.1
1977	7.3	9.2	14.5	20.7	25.1	25.1	25.1	25.5	24.7	20.1	16.5	10.6	18.7
1978	7.1	9.8	13.6	19.7	25.7	25.3	25.8	25.9	24.4	20.8	15.8	10.3	18.7
1979	9.9	10.9	13.2	21.8	24.4	26.0	26.5	26.5	24.7	21.2	17.4	11.5	19.5
1980	8.6	11.3	15.1	20.6	24.2	26.1	26.4	26.1	25.3	21.0	14.7	11.3	19.2
1981	9.9	11.9	15.6	20.3	23.8	26.2	25.9	26.4	25.0	20.5	14.5	9.6	19.1
1982	10.3	10.5	15.2	19.7	22.5	25.2	25.9	26.5	24.9	20.0	15.2	9.5	18.8
1983	8.0	8.3	13.4	18.4	22.6	25.5	25.9	26.3	25.0	20.7	14.0	9.2	18.1
1984	7.7	9.4	14.7	20.4	25.7	25.6	25.7	26.3	24.0	21.0	12.6	10.1	18.6
1985	9.4	9.8	15.9	20.5	24.2	25.7	25.5	26.4	24.6	21.2	14.1	11.4	19.1
1986	9.3	10.8	14.4	19.9	22.2	26.4	26.3	26.4	24.4	19.8	15.5	11.3	18.9
AVE	8.7	10.3	14.5	20.1	24.0	25.6	25.8	26.1	24.6	20.6	15.0	10.3	18.8

Mean of Daily Maximum Temp.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1976	22.7	25.7	32.7	36.1	35.8	34.1	32.7	32.1	31.8	31.5	28.7	23.7	30.6
1977	21.9	26.2	33.6	35.2	34.2	36.1	32.9	33.0	32.8	30.5	28.4	25.0	30.8
1978	21.9	24.6	29.4	35.6	37.0	34.1	32.7	33.8	32.1	31.9	28.1	24.2	30.5
1979	23.3	24.6	31.5	37.3	39.6	36.5	32.8	32.8	33.3	31.3	29.0	23.8	31.3
1980	22.6	26.0	31.3	39.1	35.9	33.8	32.7	32.3	32.3	31.0	28.8	24.8	30.9
1981	21.6	25.7	30.5	33.3	34.7	36.6	32.2	32.7	32.3	31.6	27.3	24.1	30.2
1982	23.3	23.8	29.3	35.1	38.3	34.4	33.6	33.8	32.5	32.2	27.6	23.8	30.6
1983	19.7	25.1	31.4	33.9	34.8	37.7	33.8	33.9	32.6	32.0	29.7	24.1	30.7
1984	22.0	24.6	32.3	37.9	36.3	32.9	32.0	34.0	31.9	32.8	29.2	23.9	30.8
1985	22.5	25.8	33.6	37.6	36.1	35.8	31.7	33.9	31.9	31.2	28.8	24.3	31.1
1986	22.6	25.4	32.3	35.3	34.9	36.6	32.5	33.6	32.2	31.1	29.1	24.4	30.8
AVE	22.2	25.2	31.6	36.0	36.1	35.3	32.7	33.3	32.3	31.6	28.6	24.2	30.8

Table C.5 (2/3) METEOROLOGICAL DATA AT BHAIRHAHA (AIRPORT)

Extreme Minimum Temp.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Min
1976	6.4	8.4	9.6	11.9	18.7	20.8	21.4	23.5	21.2	16.0	10.2	4.9	4.9
1977	3.4	4.2	8.8	17.4	17.4	19.4	22.8	23.9	22.4	17.0	12.4	7.5	3.4
1978	4.3	5.0	9.8	12.3	20.7	20.0	23.9	24.0	22.0	18.4	9.4	8.0	4.3
1979	7.7	7.0	7.0	17.0	18.4	20.5	23.0	24.4	21.6	18.5	14.2	7.0	7.0
1980	6.0	6.5	10.4	16.0	19.2	22.2	24.8	24.5	22.4	16.5	13.0	8.7	6.0
1981	6.6	8.7	10.5	15.5	20.9	21.6	24.0	24.2	22.6	16.3	10.9	6.8	6.6
1982	7.5	7.6	10.0	15.5	17.9	21.4	22.6	24.3	21.5	17.5	8.6	6.7	6.7
1983	3.5	3.5	8.8	12.2	18.6	18.1	23.9	23.2	23.2	15.4	11.3	6.4	3.5
1984	5.0	5.0	9.8	12.8	20.5	23.0	23.2	24.0	20.8	15.4	9.5	6.9	5.0
1985	5.0	7.8	11.0	15.8	19.0	22.6	24.0	24.2	22.0	17.3	10.5	9.2	5.0
1986	6.4	8.5	10.2	13.5	17.4	21.2	24.6	24.3	20.6	15.7	13.2	9.0	6.4
AVE	5.6	6.6	9.6	14.5	19.0	21.0	23.5	24.0	21.8	16.7	11.2	7.4	5.6

Relative Humidity (%)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1976	75	67	38	36	48	65	77	79	80	74	72	76	66
1977	75	63	40	42	58	59	79	82	77	74	74	77	67
1978	78	70	51	38	48	68	76	74	80	72	72	75	67
1979	80	68	42	32	31	50	76	78	72	74	72	81	63
1980	75	62	46	27	51	69	79	80	79	73	68	75	65
1981	80	70	51	47	52	56	81	79	79	70	72	74	68
1982	78	73	58	42	37	68	75	76	78	72	76	80	68
1983	82	64	45	45	58	55	77	77	81	75	70	78	67
1984	79	68	54	32	55	77	80	76	81	73	69	82	69
1985	81	67	46	37	54	66	81	78	81	78	76	82	69
1986	80	70	48	42	52	59	79	79	84	82	75	79	69
AVE	78	67	47	38	49	63	78	78	79	74	72	78	67

Rainfall (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1976	6	3	0	4	72	285	439	523	299	11	0	0	1642
1977	4	10	0	19	110	52	629	476	64	90	0	6	1460
1978	9	14	46	5	16	318	574	193	329	29	3	8	1544
1979	6	11	1	4	7	84	774	293	107	54	4	51	1396
1980	2	5	7	0	106	480	514	286	318	5	0	2	1725
1981	83	2	18	58	51	446	891	417	457	0	45	0	2468
1982	12	4	61	17	31	184	581	398	357	16	8	4	1673
1983	21	0	11	33	126	78	558	278	230	149	0	30	1514
1984	5	2	2	6	65	941	610	255	314	39	0	1	2240
1985	12	5	0	14	51	148	389	234	468	182	0	37	1540
1986	1	21	0	87	53	309	416	323	419	131	27	62	1849
AVE	15	7	13	22	63	302	580	334	306	64	8	18	1732

Table C.5 (3/3) METEOROLOGICAL DATA AT BHAIRHAWA (AIRPORT)

Number of Rainy Days

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1976	1	1	0	1	8	11	14	16	13	1	0	0	66
1977	1	1	0	4	8	6	22	13	7	8	0	1	71
1978	1	4	4	2	4	15	16	14	16	2	1	2	81
1979	2	2	0	2	1	11	16	17	5	4	2	4	66
1980	1	1	3	0	9	14	22	21	10	1	0	1	83
1981	5	1	4	4	7	8	22	19	12	0	2	0	84
1982	1	2	5	3	4	13	20	18	8	2	2	1	79
1983	2	0	1	4	9	8	19	15	15	6	0	2	81
1984	1	2	1	2	3	20	22	14	13	2	0	0	80
1985	2	1	0	2	8	10	19	16	15	7	0	2	82
1986	1	3	0	6	6	7	19	12	10	7	1	3	75
AVE	2	2	2	3	6	11	19	16	11	4	1	1	77

Table C.6 (1/2) METEOROLOGICAL DATA AT BUTWAL

703 BUTWAL El.205 m 27°42" Lati. 83°28" Long.

Mean Temperature

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1976	18.2	19.7	25.2	29.4	29.9	29.2	28.8	28.3	26.8	26.4	23.9	18.8	25.4
1982			23.2	28.6	31.2	29.2	29.2	29.6	27.8			19.0	
1983	15.0	18.3	23.6	27.4	28.7	32.0	29.6	29.6	28.2	26.4	23.1	18.1	25.0
1984	16.1	17.7	24.6	30.8	31.1	29.0	27.8	28.6	26.3	26.4	21.9	17.7	24.8
1985	16.9	19.8		30.3	29.8	30.5	27.9	29.4	27.7	25.9	22.5	19.2	25.4
1986	16.8	19.0	24.3	28.1	28.0	30.4							
AVE	16.6	18.9	24.2	29.1	29.8	30.1	28.7	29.1	27.4	26.3	22.9	18.6	25.1

Mean of Daily Minmum Temp.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1976	13.2	13.9	18.2	23.1	24.7	25.3	25.4	25.0	21.9	21.6	18.8	13.8	20.4
1982			17.7	22.5	24.7	24.8	25.4	25.7	24.2			13.8	22.4
1983	10.3	12.5	17.0	20.6	23.6	27.1	26.0	26.2	24.5	21.2	17.2	12.7	19.9
1984	10.3	11.6	17.9	24.0	25.5	25.0	24.1	23.9	21.5	20.8	15.2	12.0	19.3
1985	11.5	14.6		23.7	24.3	25.9	24.8	25.7	24.0	21.1	16.8	13.8	20.6
1986	11.5	13.0	18.1	21.7	21.5	24.9							
AVE	11.4	13.1	17.8	22.6	24.1	25.5	25.1	25.3	23.2	21.2	17.0	13.2	20.0

Mean of Daily Maximum Temp.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1976	23.3	25.5	32.2	35.6	35.1	33.2	32.3	31.6	31.8	31.1	27.0	23.8	30.2
1982			28.6	34.8	37.8	33.7	33.1	33.4	31.5			24.1	
1983	19.6	24.1	30.1	34.1	33.8	36.8	33.1	33.0	31.8	31.6	29.0	23.4	30.0
1984	21.5	23.8	31.3	37.5	36.6	32.9	31.5	33.3	31.0	31.9	28.6	23.4	30.3
1985	22.2	25.0		36.8	35.2	35.1	31.0	33.0	31.4	30.6	28.1	24.6	
1986	22.1	24.9	30.4	34.5	34.5	35.9	32.7	33.2	31.4	30.1	28.1	24.4	30.2
AVE	21.7	24.7	30.5	35.6	35.5	34.6	32.3	32.9	31.5	31.1	28.2	24.0	30.2

Extreme Minimum Temp.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Min
1976	9.4	8.4	12.9	17.9	17.9	22.4	22.9	23.4	21.9	19.9	15.4	9.9	8.4
1982			10.8	19.6	13.0	21.3	20.4	19.4	21.5			10.0	
1983	3.4	7.6	10.9	15.8	18.2	22.0	23.2	20.8	22.4	17.8	15.1	7.6	3.4
1984	7.2	6.0	11.4	20.2	21.8	21.8	22.2	20.0	19.1	16.4	10.4	5.8	5.8
1985	6.2	10.8		19.4	18.2	23.0	23.4	23.8	21.2	18.4	12.3	8.0	6.2
1986	7.0	10.2	13.0	18.0	15.4	24.0							
AVE	6.6	8.6	11.8	18.5	17.4	22.4	22.4	21.5	21.2	18.1	13.3	8.3	6.6

Table C.6 (2/2) METEOROLOGICAL DATA AT BUTWAL

Relative Humidity (%)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1976	63	59	32	31	48	68	77	80	76	66	61	65	61
1982			53	39	37	77	77	78	77			71	
1983	77	61	47	42	60	55	81	81	83	74	64	72	66
1984	70	67	57	39	52	78	84	80	84	74	61	72	68
1985	74	62		42	55	69	85	83	84	74	66	72	70
1986	74	69	47	46	56	67	82	83	85	76	68	63	68
AVE	72	64	47	40	51	69	81	81	82	73	64	69	66

Rainfall (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1976	18	14	0	1	154	551	652	470	339	53	0	0	2252
1977	7	8	1	117	94	127	494	704	181	143	0	30	1906
1978	7	33	24	3	36	586	124	313	290	130	6	4	1556
1979	4	18	0	10	10	340	642	573	208	160	12	35	2012
1980	0	8	6	0	52	353	691	398	243	100	0	0	1851
1981	40	1	26	35	110	266	631	547	320	0	33	0	2009
1982			83	19	62	549	684	494	626				
1983	14	0	5	24	229	105	663	405	522	190	0	64	2221
1984	0	4	6	4	16	695	1170	516	473	55	0	3	2942
1985	4	6	2	9	198	286	694	271	635	163	0	53	2321
1986	0	44	1	24	89	577	580	381	418	192	10	58	2374
AVE	9	14	14	22	95	403	639	461	387	119	6	25	2194

Number of Rainy Days

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1976	2	1	0	1	7	15	23	25	13	4	0	0	91
1982			5	3	3	17	14	20	17				
1983	2	0	2	3	11	10	23	22	20	6	0	3	102
1984	0	1	1	1	2	22	30	24	19	2	0	1	103
1985	1	1	1	1	11	12	29	23	20	9	0	2	110
1986	0	4	1	4	10	17	23	16	19	6	1	3	104
AVE	1	1	2	2	7	16	24	22	18	5	0	2	100

Table C.7 (1/2) METEOROLOGICAL DATA AT TAMGHAS

725 TAMGHAS El.1530 m 28'04" Lati. 83'15" Long.

Mean Temperature

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1981	9.1	12.5	14.8	18.2	19.9	22.2	22.0	22.4	20.8	18.3	13.6	10.0	17.0
1982	10.5	10.1	13.6	18.4	21.5	21.6	22.5	22.4	20.7	17.7	13.6	10.4	16.9
1983	8.6	10.1	15.4	17.9	19.4	22.7	22.7	22.6	20.9	17.9	13.9	9.8	16.8
1984	8.5	12.6	18.4	20.6	21.4	22.1	21.9	22.8	20.2	19.1	13.8	10.8	17.7
1985	9.6	11.5	18.1	21.0	20.3	22.2	21.2	22.6	20.7	17.5	13.4	11.2	17.4
1986	9.9	11.4	15.6	18.7	19.4							9.4	
AVE	9.4	11.4	16.0	19.1	20.3	22.2	22.1	22.6	20.7	18.1	13.7	10.3	17.1

Mean of Daily Minimum Temp.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1981	4.8	7.4	9.7	13.1	15.6	18.0	19.1	19.0	17.3	13.4	8.9	5.3	12.6
1982	6.1	5.8	8.7	12.7	15.7	17.9	19.1	18.6	16.9	12.6	9.6	5.6	12.4
1983	3.9	4.9	9.6	12.3	14.8	17.8	19.2	18.9	17.6	13.6	8.9	5.1	12.2
1984	3.7	8.2	13.5	14.6	17.1	18.8	18.6	18.6	16.3	14.2	8.3	5.9	13.2
1985	4.9	6.2	12.1	14.7	15.2	18.2	18.3	18.8	16.9	13.4	8.6	6.4	12.8
1986	4.9	6.2	9.7	12.8	14.1							3.8	
AVE	4.7	6.5	10.5	13.4	15.4	18.1	18.9	18.8	17.0	13.4	8.9	5.4	12.6

Mean of Daily Maximum Temp.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1981	13.4	17.6	19.8	23.2	24.2	26.3	24.9	25.7	24.4	23.2	16.3	14.7	21.1
1982	14.9	14.4	18.4	24.0	27.3	25.2	25.9	26.1	24.5	22.8	17.7	15.2	21.4
1983	13.3	15.3	21.2	23.5	24.0	27.5	26.1	26.2	24.2	22.3	18.9	14.4	21.4
1984	13.3	16.9	23.2	26.6	25.6	25.4	25.1	27.0	24.0	24.0	19.2	15.7	22.2
1985	14.3	16.8	24.0	27.2	25.3	26.2	24.0	26.3	24.4	21.6	18.2	16.0	22.0
1986	14.8	16.5	21.5	24.6	24.6	26.6	25.1	26.2	24.0	21.5	19.0	15.0	21.6
AVE	14.0	16.3	21.4	24.9	25.2	26.2	25.2	26.3	24.3	22.6	18.2	15.2	21.6

Extreme Minimum Temp.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Min
1981	1.6	2.4	7.0	9.5	13.0	14.3	18.0	17.8	15.0	10.5	5.6	3.1	1.6
1982	4.0	1.6	2.4	9.8	11.5	16.3	17.2	17.0	13.0	10.4	5.4	2.0	1.6
1983	1.8	1.0	5.2	8.1	11.5	13.5	17.8	17.8	15.8	9.6	6.5	0.7	0.7
1984	1.0	5.5	10.7	10.3	13.0	17.0	14.3	16.6	13.5	9.7	6.2	3.7	1.0
1985	2.0	4.1	8.8	11.0	11.0	15.1	16.7	17.4	15.0	10.4	6.4	1.5	1.5
1986	3.0	3.6	6.0	6.4	12.0							1.5	
AVE	2.2	3.0	6.7	9.2	12.0	15.2	16.8	17.3	14.5	10.1	6.0	2.1	2.1

Table C.7 (2/2) METEOROLOGICAL DATA AT TAMGHAS

Relative Humidity (%)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1981	77	69	63	66	75	76	91	89	86	75	79	90	78
1982	85	79	72	56	59	88	93	86	85	78	84	86	79
1983	87	85	82	85	90	88	94	93	94	90	90	91	89
1984	88	86	60	45	79	97	99	98	99	78	70	77	81
1985	76	73	68	45	79	79	91	87	88	81	79	78	77
1986	76	73	55	52	65	75	87	85	87	81	81	74	74
AVE	82	78	67	58	75	84	93	90	90	81	81	83	80

Rainfall (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1981	53	16	22	89	195	266	489	404	497	0	64	8	2103
1982	64	24	94	81	51	279	367	476	328	8	14	7	1793
1983	29	4	20	36	207	164	381	292	687	211	0	37	2068
1984	47	8	10	63	128	388	562	208	380	19	0	15	1828
1985	17	4	0	18	283	256	760	276	288	118	55	63	2138
1986	1	54	6	57	100	469	381	384	330	61	9	87	1939
AVE	35	18	25	57	161	304	490	340	418	70	24	36	1978

Number of Rainy Days

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1981	4	4	6	6	15	15	26	21	16	0	3	0	116
1982	4	5	10	8	5	18	20	27	10	1	2	1	111
1983	2	1	5	5	17	10	19	23	22	8	0	2	114
1984	2	2	1	6	9	22	22	19	13	2	0	2	100
1985	3	1	0	2	13	16	24	23	16	12	11	2	123
1986	1	3	2	6	17	21	22	17	16	5	1	4	115
AVE	3	3	4	6	13	17	22	22	16	5	3	2	113

Table C.8 (1/3) METEOROLOGICAL DATA AT KHANCHIKOT

715 KHANCHIKOT El.1760 m 27'56" Lati. 83'09" Long.

Mean Temperature

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1977		11.6	17.4	17.6	17.6	20.0	20.2	20.3	19.9	16.6	14.2	10.0	16.9
1978	8.1	10.3	13.0	17.8	19.7	19.7	19.7	20.4	18.6	17.2	13.3	11.5	15.8
1979	10.5	10.0	14.6	19.2	21.4	21.0	19.8	20.2	19.6	17.5	15.1	9.9	16.6
1980	9.1	10.8	14.5	21.4	19.7	19.7	20.2	19.9	19.2	16.3	14.0	10.7	16.3
1981	7.7	11.4	13.4	16.0	18.2	20.4	20.0	20.0	18.6	17.2	12.8	9.2	15.4
1982	9.8	8.7	11.8	17.1	19.8	19.7	20.3	20.4	18.9	16.5	12.6	9.1	15.4
1983	7.6	8.8	13.8	16.6	17.8	20.8	20.3	20.5	18.9	17.1	13.3	9.3	15.4
1984	7.5	10.5	15.8	19.2					18.6	17.6	13.0	10.2	
1985	9.1	10.3	16.9	19.4	18.8	20.1	19.0	20.5	18.4	16.5	12.7	10.8	16.0
1986	9.4	10.6	14.3	17.3	17.8	20.5	19.6	20.3	18.2	15.9	13.0	9.9	15.6
AVE	8.8	10.3	14.6	18.2	19.0	20.2	19.9	20.3	18.9	16.8	13.4	10.1	15.9

Mean of Daily Minimum Temp.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1977		7.5	13.1	13.3	14.0	16.6	17.7	17.6	16.4	12.8	10.2	6.2	13.2
1978	4.2	6.2	9.1	13.5	16.2	16.5	16.9	17.2	15.7	13.3	9.5	7.1	12.1
1979	6.1	5.9	10.3	14.7	17.0	17.6	17.2	17.3	16.2	13.8	11.3	6.2	12.8
1980	5.2	6.6	10.2	17.3	14.9	16.5	17.2	16.9	15.8	12.4	9.5	6.5	12.4
1981	3.8	7.9	9.3	12.2	13.8	16.9	17.4	17.2	15.6	13.2	9.0	5.1	11.8
1982	5.2	5.1	8.1	12.8	15.4	15.9	17.2	16.8	15.5	12.3	8.5	5.2	11.5
1983	3.2	4.2	9.0	12.6	14.1	17.5	17.7	17.5	16.2	13.4	9.2	5.7	11.7
1984	3.9	6.2	11.6	14.8	16.1	16.9	16.8	17.0	15.2	13.8	9.1	6.4	12.3
1985	5.2	6.0	12.9	15.3	14.9	16.8	16.7	17.4	15.7	13.1	8.8	7.4	12.5
1986	5.6	6.5	10.1	13.0	13.5	17.3	17.0	17.1	15.2	12.0	9.3	6.0	11.9
AVE	4.7	6.2	10.4	14.0	15.0	16.9	17.2	17.2	15.8	13.0	9.4	6.2	12.2

Mean of Daily Maximum Temp.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1977		15.7	21.6	21.8	21.2	23.5	22.8	23.0	23.4	20.4	18.1	13.7	20.5
1978	12.0	14.4	16.9	22.0	23.2	22.9	22.5	23.5	21.4	21.1	17.0	15.9	19.4
1979	14.9	14.0	18.9	23.7	25.8	24.3	22.4	23.2	22.9	21.2	18.9	13.6	20.3
1980	12.9	14.9	18.7	25.4	24.4	22.8	23.2	22.9	22.5	20.1	18.4	14.9	20.1
1981	11.6	14.9	17.6	19.7	22.5	23.8	22.6	22.9	21.7	21.1	16.7	13.2	19.0
1982	14.1	12.3	15.4	21.4	24.1	23.5	23.4	23.9	22.3	20.7	16.7	13.0	19.2
1983	11.9	13.3	18.6	20.5	21.4	24.0	22.9	23.4	21.5	20.8	17.3	12.9	19.0
1984	11.1	14.7	20.0	23.5					22.0	21.4	16.9	13.9	
1985	12.9	14.5	20.8	23.5	22.7	23.3	21.3	23.6	21.1	19.9	16.6	14.1	19.5
1986	13.2	14.6	18.5	21.5	22.1	23.6	22.1	23.4	21.2	19.8	16.7	13.7	19.2
AVE	12.7	14.3	18.7	22.3	23.0	23.5	22.6	23.3	22.0	20.7	17.3	13.9	19.5

Table C.8 (2/3) METEOROLOGICAL DATA AT KHANCHIKOT

Extreme Minimum Temp.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Min
1977		2.7	10.8	9.0	8.0	13.1	16.7	16.0	14.5	10.5	8.6	1.5	
1978	0.5	2.1	3.0	9.1	11.2	12.7	15.1	16.0	13.7	11.7	4.4	4.1	0.5
1979	3.1	2.4	5.1	10.0	14.3	12.7	15.8	15.5	14.2	11.4	9.1	2.0	2.0
1980	3.3	3.1	4.9	11.5	10.5	13.7	15.9	16.0	13.5	10.2	7.1	5.0	3.1
1981	0.2	1.0	6.5	7.0	9.0	14.3	16.7	16.0	13.4	10.5	5.9	3.0	0.2
1982	4.0	0.5	2.2	9.1	10.3	13.2	15.7	15.2	13.5	10.0	4.5	1.0	0.5
1983	0.7	-0.1	4.0	8.2	10.7	10.7	16.0	16.0	15.0	10.0	6.9	0.0	-0.1
1984	0.0	3.2	6.8	9.5	11.5	15.3	16.0	15.1	14.0	10.5	6.8	3.5	0.0
1985	2.2	3.6	8.7	10.7	9.2	14.0	15.5	16.2	13.6	10.1	6.5	2.7	2.2
1986	3.4	3.6	5.9	6.5	10.2	13.3	15.7	15.9	12.5	9.8	4.3	2.2	2.2
AVE	1.9	2.2	5.8	9.1	10.5	13.3	15.9	15.8	13.8	10.5	6.4	2.5	1.9

Relative Humidity (%)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1977		72	57	51	66	77	92	88	85	77	79	77	75
1978	68	65	56	56	74	88	87	87	88	74	78	65	74
1979	70	64	42	47	48	70	92	89	83	75	74	72	69
1980	66	67	49	37	65	87	92	93	87	73	69	70	71
1981	80	57	59	68	76	80	94	92	83	70	71	75	75
1982	74	84	69	53	42	84	88	88	82	74	84	72	75
1983	74	67	60	76	77	73	92	92	93	78	76	69	77
1984	68	74	61	42	74	90	94	89	89	75	67	62	74
1985	69	70	46	44	71	81	95	90	90	79	71	68	73
1986	68	73	54	58	68	79	93	90	90	72	82	70	75
AVE	71	69	55	53	66	81	92	90	87	75	75	70	74

Wind Speed at 3.5 m height (km/hr)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1977		9.9	11.0	11.7	10.5	9.8	9.1	8.9	8.9	7.2	7.4	7.6	9.3
1978	9.4	8.8	9.6	11.0	10.6	7.8	8.6	8.0	6.4		8.2	7.3	8.7
1979	7.4	9.4	10.9	11.4	10.5	9.9	7.7	8.1	7.5	8.5	9.0	7.2	9.0
1980	9.6	9.3	10.9	12.0	11.2	8.9	7.4	4.5	7.2	7.1	8.6	8.0	8.7
1981	8.2	6.4	10.6	12.0	9.7	9.5	5.7	4.8	7.4	7.8	7.7	6.4	8.0
1982	7.8	8.2	8.8	10.0	9.2	9.4	9.7	6.6	8.6	6.2	5.4	9.2	8.3
1983	4.9	7.9	11.1	10.9	8.0	9.8	8.5	8.8	7.6	6.7	6.7	7.1	8.2
1984	9.4	8.9	10.0	12.8	11.9	10.7	8.4	7.3	7.5	7.0	7.4	8.9	9.2
1985	4.6	9.2	12.0	11.9	8.7	7.9	6.7	4.1	7.8	6.7	5.6	10.5	8.0
1986	7.5	6.7	11.8	11.4	10.5	8.9	9.5	7.4	10.1	7.7	5.6	6.7	8.7
AVE	7.6	8.5	10.7	11.5	10.1	9.3	8.1	6.9	7.9	7.2	7.2	7.9	8.6

Table C.8 (3/3) METEOROLOGICAL DATA AT KHANCHIKOT

Sunshine Hours (hr/day)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1981										8.6	7.9	6.7	7.7
1982	5.8		7.9										
1983			8.5	7.6	9.3	9.4	6.5	6.7	6.0	8.0	9.1	7.2	7.8
1984	7.2	7.7	8.9	9.2	8.4	4.3	5.2	7.5	6.2	7.9	8.4	6.8	7.3
1985	4.6	9.2	12.0	11.9	8.7	7.9	6.7	4.1	7.8	6.7	5.6	10.5	8.0
1986	7.5	6.7	11.8	11.4	10.5	8.9	9.5	7.4	10.1	7.7	5.6	6.7	8.7
AVE	6.3	7.9	9.8	10.0	9.2	7.6	7.0	6.4	7.5	7.8	7.3	7.6	7.9

Rainfall (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1976	14	23	2	1	112	262	326	302	234	11	0	0	1287
1977	5	6	11	50	156	235	430	617	73	36	0	49	1668
1978	20	43	52	39	82	476	736	308	321	55	4	24	2160
1979	14	73	3	20	37	254	562	389	52	6	20	98	1528
1980	2	29	25	6	145	379	710	423	729	4	0	0	2452
1981	63	10	33	48	111	264	514	537	823	0	66	0	2469
1982	79	22	94	15	74	186	425	436	413	24	19	4	1791
1983	27	5	27	18	313	198	343	239	857	269	0	53	2349
1984	43	11	4	16	64	443	626	208	433	44	0	22	1914
1985	10	3	1	21	171	188	803	277	449	146	3	80	2152
1986	1	58	7	24	82	575	382	203	426	70	22	88	1938
AVE	26	26	26	26	124	320	553	364	458	65	13	42	2042

Number of Rainy Days

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1976													88
1977	2	1	1	6	13	6	28	20	10	5	0	5	97
1978	2	3	5	4	10	16	23	23	20	6	1	2	115
1979	3	3	1	3	5	12	22	20	9	2	1	3	84
1980	1	2	3	1	9	19	27	25	9	1	0	0	97
1981	5	2	7	5	12	15	23	22	10	0	3	0	104
1982	3	5	8	3	4	14	19	21	10	3	2	1	93
1983	2	1	3	3	19	10	21	24	20	10	0	2	115
1984	1	3	1	3	4	19	24	21	15	2	0	3	96
1985	3	1	0	3	12	20	27	20	20	9	0	2	117
1986	0	3	3	7	12	16	23	15	16	6	2	3	106
AVE	2	2	3	4	10	15	24	21	14	4	1	2	102

Table C.9 (1/2) MONTHLY RAINFALL (mm)

Station: 701 RIDI BAZAR El.442 m 27'57" Lati. 83'26" Long.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Rainy Days
1976	6	17	1	26	115	150	275	220	170	0	0	0	980	67
1977	2	17	5	127	96	159	237	503	22	38	0	35	1241	85
1978	10	33	26	62	108	511	467	266	334	23	14	16	1870	107
1979	14	50	1	81	70	164	414	195	67	15	60	35	1166	76
1980	1	27	14	13	109	220	494	294	407	5	0	0	1585	94
1981	35	9	17	78	210	182	639	338	532	0	50	0	2090	96
1982	59	5	62	18	105	250	389	348	264	6	16	3	1525	82
1983	26	1	25	45	186	119	395	172	463	186	0	40	1658	95
1984	25	8	5	21	125	375	678	171	379	18	0	21	1826	84
1985	6	0	0	17	59	336	414	75	32	8	0	63	1010	65
1986	0	27	0	17	99	436	498	175	442	72	6	70	1842	89
AVE	17	18	14	46	117	264	445	251	283	34	13	26	1527	85

Station: 721 PATHARKOT WEST El.200 m 27'46" Lati. 83'03" Long.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Rainy Days
1976	20	10	0	0	120	494				24				
1977		0	0	24	51	159	491	481	122	190	0	30		
1978	13	44	29	43	33	408	962	341	390	34	3	10	2309	99
1979	17	34	1	5	8	423	516	439	314	106	7	46	1916	75
1980	0	5	14	10	172	569	652	672	331	46	0	0	2471	84
1981	62	8	55	45	100	266	893	665	561	0	58	4	2717	86
1982	15	8	7	18	64	283	627	543	432	23	39	6	2065	81
1983	25	3	0	25	109	81	465	608	679	255	0	78	2328	93
1984	30	4	5	4	36	655	765	306	344	129	0	24	2302	88
1985	6	10	0	23	190	185	757	506	445	179	0	34	2335	93
1986	0	24	3	36	84	266	572	625	490	70	82	62	2314	95
AVE	19	14	10	21	88	344	670	519	411	96	19	29	2240	88

Station: 722 MUSIKOT El.1280 m 28'10" Lati. 83'16" Long.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Rainy Days
1976	27	35	0	94	232	436	602	383	216	82	0	0	2107	112
1977	6	21	6	69	153	324	448	777	92	129	0	35	2060	111
1978	8	39	51	177	172	672	546	537	412	19	14	11	2658	115
1979	14	62	6	61	84	490	416	413	106	64	5	65	1786	105
1980	0	32	15	13	110	272	522	437	474	93	0	0	1968	110
1981	33	8	60	76	286	228	653	497	483	0	38	0	2362	117
1982	47	23	86	125	52	343	381	459	302	33	17	11	1879	107
1983	24	2	27	41	263	137	481	403	740	196	0	33	2347	105
1984	26	19	0	43	199	362	818	376	245	8	20	15	2131	96
1985	36	0	18	18	211	358	459	370	299	138	0	60	1967	86
1986	0	35	19	47	214	457	470	246	410	78	9	71	2056	93
AVE	20	25	26	69	180	371	527	445	344	76	9	27	2120	105

Table C.9 (2/2) MONTHLY RAINFALL (mm)

Station: 723 BHAGWANPUR El.80 m 27'41" Lati. 82'48" Long.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Rainy Days
1976	7	20	0	18	45	163	489	373	197	44	0	0	1356	60
1977	32	0	17	26	31	76	870	530	78	74	0	14	1748	60
1978	14	19	58	28	23	377	1038	244	142	28	2	14	1987	66
1979	16	26	0	27	75	132	611	359	111	27	3	30	1417	57
1980	2	0	0	0	54	317	837	491	268					
1981	26	9	36	21	193	234	627	406	620	0	22	8	2202	75
1982	30	8	64	11	35	103	405	160	392	37	13	7	1265	65
1983	22	0	3	4	77	62	304	255	529	209	0	37	1502	73
1984	41	4	5	8	54	434	519	412	343	40	0	24	1884	75
1985	20	9	0	14	53	310	1032	351	509	132	0	24	2454	79
1986	0	31	0	55	109	305	512	291	354	23	22	68	1770	68
AVE	19	11	17	19	68	228	659	352	322	61	6	23	1786	68

Station: 727 LUNBINI 27'28" Lati. 83'17" Long.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Rainy Days
1981	56	2	20	39	178	356	842	362	476	0	28	0	2359	70
1982	23	6	34	26	26	208	626	360	565	21	9	2	1906	70
1983	21	0	7	28	50	94	755	205	307	155	0	25	1647	71
1984	25	17	3	2	54	853	539	135	450	35	0	25	2138	77
1985	21	0	0	33	63	277	724	401	510	130	1	21	2181	68
1986	5	18	0	70	79	215	318	221	405	34	0	30	1395	57
AVE	25	7	11	33	75	334	634	281	452	63	6	17	1938	69

Table C.10 SUMMARY TABLE OF MEAN MONTHLY FLOW IN GULMI DISTRICT

Predicted Hydrograph m3/sec

No.	Name of the River	C.A. (Km2)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1.	Kali Gandki *1	6,630	48.50	37.40	33.50	52.20	90.50	307.00	927.00	946.00	703.00	280.00	128.00	71.90	302.08
2.	Badi Gad	1,990	5.56	4.15	3.24	2.44	2.95	17.73	44.36	66.54	51.02	22.18	9.61	7.39	19.76
3.	Hugdi Khola	125	1.52	1.16	0.90	0.68	0.82	4.94	12.36	18.54	14.22	6.18	2.68	2.06	5.51
4.	Chhaldi Khola	480	1.03	0.78	0.61	0.46	0.56	3.34	8.36	12.54	9.62	4.18	1.81	1.39	3.72
5.	Panaha Khola	160	1.19	0.90	0.70	0.53	0.64	3.85	9.63	14.45	11.08	4.82	2.09	1.60	4.29
6.	Ridi Khola	550	3.24	2.46	1.93	1.45	1.75	10.54	29.36	39.54	30.32	13.18	5.71	4.39	11.99
7.	Kharjeng Khola	145	1.19	0.90	0.70	0.53	0.64	3.85	9.63	14.45	11.08	4.82	2.09	1.60	4.29
8.	Bharse Khola	20	0.36	0.27	0.21	0.16	0.19	1.16	2.91	4.36	3.34	1.45	0.63	0.48	1.29
9.	Daram Khola	255	1.19	0.90	0.70	0.53	0.64	3.85	9.63	14.45	11.08	4.82	2.09	1.60	4.29
10.	Nisti Khola	110	0.81	0.61	0.48	0.36	0.44	2.62	6.54	9.82	7.53	3.27	1.42	1.09	2.92
11.	Gyadi Khola	31.5	0.96	0.73	0.57	0.43	0.52	3.13	7.82	11.74	8.99	3.91	1.69	1.30	3.48
12.	Baudi Khola	-	0.29	0.22	0.18	0.13	0.16	0.96	2.39	3.59	2.75	1.20	0.52	0.40	1.07
13.	Tal Khola	14	0.47	0.36	0.28	0.21	0.25	1.53	3.83	5.74	4.40	1.91	0.83	0.64	1.70
14.	Harewa Khola	15.2	0.36	0.27	0.21	0.16	0.19	1.16	2.91	4.36	3.34	1.45	0.63	0.48	1.29
15.	Lumdi Khola	13	0.67	0.51	0.40	0.30	0.36	2.18	5.45	8.18	6.27	2.73	1.18	0.91	2.43
16.	Jumdi Khola	17	0.45	0.34	0.27	0.20	0.24	1.45	3.64	5.45	4.18	4.18	1.82	0.61	1.90
17.	Ulli Khola	30	0.31	0.24	0.19	0.14	0.17	1.02	2.54	3.82	2.93	1.27	0.55	0.42	1.13
18.	Dhodwa Khola	-	0.36	0.27	0.21	0.16	0.19	1.16	2.91	4.36	3.34	1.45	0.63	0.40	1.29
19.	Jhedi Khola	-	0.25	0.19	0.15	0.11	0.13	0.80	2.00	3.00	2.30	1.00	0.43	0.33	0.89
20.	Raiti Khola	-	0.22	0.17	0.13	0.10	0.12	0.73	1.82	2.73	2.09	0.91	0.39	0.30	0.81

*1: Average of 3 years from 1974 to 1976 at Seti Beni near Dumrichar

Table C.11 SUMMARY TABLE OF MEAN MONTHLY FLOW IN ARGHAKHANCHI DISTRICT

Predicted Hydrograph m3/sec

No.	Name of the River	C.A. (Km2)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1.	Rapti Khola *1	-	31.70	26.30	21.40	18.20	22.80	60.30	192.00	259.00	268.00	117.90	58.60	39.80	92.93
2.	Jhimruk Khola *2	-	6.31	5.29	4.76	3.70	3.34	15.50	64.90	85.20	72.60	34.40	13.10	7.70	26.40
3.	Wakle Khola	25	0.27	0.20	0.16	0.12	0.15	0.87	2.18	3.27	2.51	1.08	0.47	0.36	0.97
4.	Sisne Khola	76	0.42	0.32	0.25	0.19	0.23	1.38	3.45	5.18	3.97	1.72	0.75	0.58	1.54
5.	Durga Khola	35	0.22	0.17	0.13	0.10	0.12	0.73	1.82	2.73	2.09	0.91	0.39	0.30	0.81
6.	Kedua Khola	40	0.25	0.19	0.15	0.11	0.13	0.80	2.00	3.00	2.30	1.00	0.43	0.33	0.89
7.	Kharjyang Khola	30	0.34	0.26	0.20	0.15	0.18	1.11	2.79	4.18	3.21	1.39	0.60	0.46	1.24
8.	Panere Khola	-	0.03	0.02	0.02	0.01	0.02	0.10	0.24	0.36	0.28	0.12	0.05	0.04	0.11
9.	Pahilapani Khola	-	0.05	0.04	0.03	0.02	0.03	0.16	0.41	0.62	0.47	0.21	0.09	0.07	0.18
10.	Bangi Khola	50	0.38	0.29	0.23	0.17	0.20	1.24	3.09	4.64	3.55	1.55	0.67	0.52	1.38
11.	Gachhe Khola	22	0.10	0.07	0.06	0.04	0.05	0.32	0.79	1.18	0.91	0.39	0.17	0.13	0.35
12.	Ghoche Khola	22	0.06	0.04	0.03	0.02	0.03	0.18	0.46	0.69	0.53	0.23	0.10	0.08	0.20
13.	Khanchi Khola	125	0.57	0.43	0.34	0.25	0.31	1.84	4.61	6.91	5.30	2.30	1.00	0.77	2.05
14.	Mathura Khola	85	0.34	0.25	0.20	0.15	0.18	1.09	2.73	4.09	3.14	1.36	0.59	0.45	1.21
15.	Chauwa Khola	22	0.18	0.14	0.11	0.08	0.10	0.58	1.45	2.18	1.67	0.73	0.32	0.24	0.65
16.	Pharjeng Khola	-	0.07	0.05	0.04	0.03	0.04	0.22	0.54	0.82	0.63	0.27	0.12	0.09	0.24
17.	Duware Khola	15	0.25	0.19	0.15	0.11	0.13	0.80	2.00	3.00	2.30	1.00	0.43	0.33	0.89
18.	Sirling Khola	38	0.23	0.18	0.14	0.1	0.13	0.76	1.89	2.84	2.17	0.94	0.41	0.32	0.84
19.	Bongseri Khola	37	0.14	0.11	0.08	0.06	0.08	0.46	1.16	1.74	1.34	0.58	0.25	0.19	0.52
20.	Sit Khola	160	0.81	0.62	0.48	0.36	0.44	2.64	6.60	9.90	7.59	3.30	1.43	1.10	2.94
21.	Soile Khola	-	0.04	0.03	0.03	0.02	0.02	0.14	0.36	0.54	0.42	0.18	0.08	0.06	0.16
22.	Kusum Khola	-	0.15	0.12	0.09	0.07	0.08	0.49	1.24	1.85	1.42	0.62	0.27	0.21	0.55
23.	Kathe Khola	-	0.03	0.02	0.02	0.01	0.02	0.10	0.24	0.36	0.28	0.12	0.05	0.04	0.11
24.	Siling Khola	52	0.07	0.05	0.04	0.03	0.04	0.23	0.58	0.87	0.67	0.29	0.13	0.10	0.26
25.	Rangsing Khola	-	0.18	0.14	0.11	0.08	0.10	0.58	1.45	2.18	1.67	0.73	0.32	0.24	0.65
26.	Mandre Khola	25	0.31	0.24	0.19	0.14	0.17	1.02	2.54	3.82	2.93	1.27	0.55	0.42	1.13
27.	Ganga Khola (Ban Ganga)	200	1.1	0.84	0.65	0.49	0.60	3.58	8.95	13.42	10.29	4.48	1.94	1.49	3.99
28.	Riste Khola	-	0.09	0.07	0.05	0.04	0.05	0.29	0.73	1.09	0.84	0.36	0.16	0.12	0.32
29.	Ridi Khola	400	2.73	2.07	1.62	1.22	1.48	8.87	22.18	33.27	25.51	11.09	4.81	3.70	9.88
30.	Areli Khola and Masane Khola	-	0.04	0.03	0.03	0.02	0.02	0.14	0.36	0.54	0.42	0.18	0.18	0.06	0.17
31.	Chidika Khola	-	0.05	0.04	0.03	0.02	0.03	0.16	0.41	0.62	0.47	0.21	0.09	0.07	0.18
32.	Pangrapani Khola a Paudi Khola	-	0.04	0.03	0.03	0.02	0.02	0.14	0.36	0.54	0.42	0.18	0.08	0.06	0.16
33.	Seri Khola, Sarnu K and Bad Khola	-	0.06	0.04	0.03	0.02	0.03	0.18	0.46	0.69	0.53	0.23	0.10	0.08	0.20
34.	Dhod Khola	-	0.04	0.03	0.02	0.02	0.02	0.12	0.30	0.45	0.35	0.15	0.06	0.05	0.13
35.	Jore Khola	-	0.02	0.02	0.01	0.01	0.01	0.07	0.18	0.27	0.21	0.09	0.04	0.03	0.08
36.	Bhadri Khola	-	0.01	0.01	0.01	0.01	0.01	0.05	0.12	0.18	0.14	0.06	0.03	0.02	0.05
37.	Lewase Khola	-	0.07	0.05	0.04	0.03	0.04	0.22	0.54	0.82	0.63	0.27	0.12	0.19	0.25

*1: Average of 10 years from 1976 to 1985 at Bagasoti Gaon near Bhaluwang
*2: Average of 18 years from 1965 to 1984 at Tigra Village

Table C.12 SUMMARY TABLE OF MEAN MONTHLY FLOW IN KAPILVASTU DISTRICT

Predicted Hydrograph m3/sec

No.	Name of the River	C.A. (Km2)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1.	Banganga river	340	1.09	0.73	0.46	0.33	1.16	1.98	4.62	11.55	11.22	3.96	2.48	1.65	3.44
2.	Murthi river	195	0.13	0.09	0.06	0.04	0.14	0.24	0.56	1.40	1.36	0.48	0.30	0.20	0.42
3.	Kothi river	125	1.02	0.68	0.43	0.31	1.08	1.86	4.34	10.85	10.54	3.72	2.32	1.55	3.23
4.	Jamuwar Nala	92	0.10	0.07	0.04	0.03	0.10	0.18	0.42	1.05	1.02	0.36	0.22	0.15	0.31
5.	Beti Nadi	95	0.10	0.07	0.04	0.03	0.10	0.18	0.42	1.05	1.02	0.36	0.22	0.15	0.31
6.	Kaila Khola	123	0.79	0.52	0.33	0.24	0.84	1.43	3.34	8.40	8.12	2.87	1.79	1.19	2.49
7.	Gurumuwa Khola	99	0.33	0.22	0.14	0.10	0.35	0.60	1.40	3.50	3.40	1.20	0.75	0.50	1.04
8.	Kanchani river	80	0.16	0.11	0.07	0.05	0.18	0.30	0.70	1.75	1.70	0.60	0.38	0.25	0.52
9.	Surahi river	70	0.16	0.11	0.07	0.05	0.18	0.30	0.70	1.75	1.70	0.60	0.38	0.25	0.52
10.	Jawai river	-	0.41	0.28	0.18	0.12	0.44	0.75	1.75	4.38	4.25	1.50	0.94	0.62	1.30
11.	Arra Nala	118.0	0.82	0.55	0.35	0.25	0.88	1.50	3.50	8.75	8.50	3.00	1.88	1.25	2.60

Table C.13 SUMMARY TABLE OF MEAN MONTHLY FLOW IN RUPANDEHI DISTRICT

Predicted Hydrograph m3/sec

No.	Name of the River	C.A. (Km2)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1.	Tinau Khola *1	554	4.36	3.03	2.36	2.16	2.35	15.10	58.30	108.00	46.70	24.70	7.61	4.94	23.30
2.	Dano Khola	502	2.58			measured at intake site of Marchawar Lift Irrigation Project (Jan. 31 '84)									
3.	Rohini Khola	193	0.98			measured at Baikunthapur (Dhakdhai Panchayat) (Jan. 28 '84)									

*1: Average of 6 years from 1964 to 1969 at suspension bridge, 4.2 km downstream from Dobhan Khola at Butwal

Table C.16 (1/3) Existing Irrigation Projects

Kapilvastu District

Name of Project	Command Area (ha)	Present Condition
I. Completed		
1. Banganga Irrigation Project	6,000	Sediment, weeds
2. Kapilvastu Tube Well Project	-	Investigation
3. Surai Irrigation Project	400	Damaged, sediment
4. Jamai Irrigation Project	270	Sediment
5. Bhataha Bandh Scheme	1,520	
6. Murthi Nale (Pakadi) Scheme	720	
7. Patharkot (Gurumuwa Khola)	480	
II. Under Construction		
1. DOI Project		
a. Sakuniya - Doni Bandh	300	
b. Jahadi Bandh	200	
c. Karma Bandh	310	
d. Kanchaniya Bandh	500	
e. Amiya Kachuwa	450	
f. Ratkurahawa	900	
g. Ghaghuwa Nalla	200	
h. Ghaghna Bandh	150	
i. Dhankuali Jaswaric	300	
j. Ghorahi Maorma	150	
k. Shankerpur Reservoir	150	
2. DP Scheme (for irrigation)		
a. Kauna Bandh	-	
b. Jahadi Bandh	-	
c. Agia Kuchawa	-	
d. Kanchania Dam	-	
e. Dohani Dam	-	
f. Sakuniya Tal	-	
g. Rajkudwa	900	
3. DP Scheme (for river training)		
a. Banganga Khola	1 site	
b. Surai Khola	1 site	

Table C.16 (2/3) Existing Irrigation Projects

Rupandehi District

Name of Project	Command Area (ha)	Present Condition
I. Completed		
1. Bhairahawa-Lumbini Groundwater Project Stage I	7,680	
2. Tube Well Water and Distribution Project	1,000	
3. Siyari Irrigation Project	1,000	Not functioning
4. Sorah-Chattis Mahia Kulo Irrigation Scheme	12,000	Damaged, sediment
5. Panch Majha-Aath Majha Kulo Scheme	11,200	Damaged
6. Mahau Irrigation Scheme	2,880	Sediment, Damaged
II. Under Construction		
1. DOI Project		
a. Madhuvani Irrigation	1,050	
b. Karaiya Ga. Panchayat - Kantalupur	135	
c. Paruha Ga. Panchayat	1,350	
d. Gamari Ga. Panchayat (not fixed yet)		
e. Tenuhawa Ga. Panchayat	135	
f. Gahaghar River Irrigation	2,000	
g. Brairahawa - Lumbini Groundwater Project Stage II	1,920	
h. Marchawar Lift Irrigation Project Pump station, main canal, branch canals and transmission line will be completed in 1989/90. Other facilities such as secondary and tertiary canals service roads, etc. will be constructed under the fund to be provided in future.	5,770	
2. DP Scheme (for irrigation) Not clarified		
3. DP Scheme (for river training)		
a. Tinau/Dano Rivers	1 site	
b. Sakaura Khola	1 site	

Table C.16 (3/3) Existing Irrigation Projects

Gulmi District

Name of Project	Command Area (ha)	Present Condition
I. Completed		
1. Argentichhap Chaur Irrigation Project	50	
2. Aapchaur Coffee Kheti	75	
II. Under Construction		
1. DOI Project		
a. Aap Chuar Coffee Kheti	100	
b. Chhaldi Khola	67	
c. Arbeni Thumka - Kanchhi Jethi Kulo	60	
d. Wamitaksar	130	
2. DP Scheme (for irrigation)		
Not clarified		
3. DP Scheme (for river training)		
a. Chhali IKhola	7 sites	
b. Badi gad	5 sites	
c. Pan gad	3 sites	
d. Kahrjang Khola	3 sites	
e. Arjai Khola	1 site	
f. Araudi Khola	1 site	
g. Ulli Khola	1 site	

Arghakhauchi District

Name of Project	Command Area (ha)	Present Condition
I. Completed		
1. Pharsawa Naya Kulo System	20	
2. Khahare Khet Kulo System	100	
3. Sera Kulo System	70	
4. Khamari Kulo System	30	
II. Under Construction		
1. DOI Project		
a. Pawartar	50	
b. Sit Khola Farm Irrigation	105	
c. Chidika Farm Irrigation	20	
d. Bangi Khola Farm Irrigation	50	
e. Jukena Farm Irrigation Project	80	

Table C.21 Grouping and Priority Ranking of Irrigation Projects

No. of Group	No.	No. of Project	Command Area (ha)	Capital Cost (mil. NRs)	Net Present Value at 10% Dis. Rate Cost*3 (mil. NRs)	Benefit*4 (mil. NRs)	B - C (mil. NRs)	B/C	IRR (%)	House-hold (Nos.)	Concrete-ness of the Project *1	Problem of Water Right *2	Priority Rank-ing
Kapilvastu District													
1.	a.	Rajkudwa I.P.	2,400	281.4	211	287	76	1.36	13.4	1,121	5	-1	1
2.	c.	Bel Nadi I.P.	400	37.6									
	d.	Khanchaniya I.P.	160	15.0									
	h.	Charanga I.P.	320	30.1	Total of c, d, h								
		Sub-total	880	82.7	63	87	24	1.38	12.9	411	3	-2	2
3.	e.	Phulika I.P.	1,500	141.0									
	f.	Patana I.P.	540	50.8									
	g.	Jakira Bandh I.P.	700	65.8	Total of e, f, g.								
		Sub-total	2,740	257.6	199	272	82	1.43	13.5	1,280	3	-5	3
		District Total	6,020	621.7	464	646	182			2,812			
Gulmi District													
1.	h.	Sprinkler I.P.	100	48.4	62	62	0	1.00	9.9	131	1	-2	3
	a.	Ghamir Khola I.P.	250	35.2	26	34	8	1.31	12.5	329	2	-2	2
		Sub-total	350	83.6									
2.	h.	Sprinkler I.P.	100	48.4	62	62	0	1.00	9.9	131	1	-2	3
	b.	Khadga Kat I.P.	110	15.5									
	c.	Paudi Areba	110	15.5	Total of b, c, d								
	d.	Chaldi Khola	100	14.1	34	44	10	1.29	12.5	421	2	-2	2
		Sub-total	420	93.5									
3.	h.	Sprinkler I.P.	100	48.4	62	62	0	1.00	9.9	131	1	-2	3
	e.	Purti Ghat I.P.	90	12.7									
	f.	Sirseni I.P.	140	19.7	Total of e, f, g								
	g.	Lahata I.P.	40	5.6	28	37	9	1.32	12.5	355	2	-2	2
		Sub-total	370	86.4									
		District Total	1,140	263.5	274	301	37			684			
Arghakhanchi District													
1.	h.	Sprinkler	200	96.8	124	125	1	1.01	10.1	263	1	-2	3
	a.	Rindi Wangla	70	9.8									
	b.	Chauwatar	70	9.8	Total of a, b, c								
	c.	Mil Mile Khola	220	30.9	38	50	12	1.32	12.5	315	2	-2	2
		Sub-total	560	147.3									
2.	h.	Sprinkler	200	96.8	124	125	1	1.01	10.1	263	1	-2	3
	d.	Pipalta I.P.	100	14.1									
	e.	Rajvang I.P.	110	15.5	Total of d, e, g								
	g.	Khanchi I.P.	160	22.5	39	51	12	1.31	12.5	402	2	-2	2
		Sub-total	570	148.9									
3.	h.	Sprinkler	200	96.8	124	125	1	1.01	10.1	263	1	-2	3
	f.	Durga Khola I.P.	400	56.3	42	55	13	1.31	12.6	435	2	-2	2
		Sub-total	600	153.1									
		District Total	1,730	449.3	491	531	40						
Total			8,890	1,334.5									

*1: 5 very clear, 4 clear, 3 good, 2 fair, 1 not clear
*2: -5 very difficult, -4 difficult, -3 not clear, -2 a few problem, -1 few problem
*3: Conversion factor is at 0.9 as mentioned in the Annex C "Agriculture and Agro-economy".
*4: Benefit per ha for Terai area NRs. 16,800 per year.
Benefit per ha for Hill area NRs. 23,250 per year in surface irrigation.
Benefit per ha for Hill area NRs. 103,570 per year in sprinkler irrigation.

Table C.23 Effective Rainfall

(mm)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Patharkot (Kapilvastu)													
Probable rainfall	19	14	10	21	86	338	658	510	404	94	19	28	2200
Effective rainfall in the paddy field	13	10	7	14	61	237	461	357	283	66	13	20	1540
Taulihawa (Kapilvastu)													
Probable rainfall	16	12	17	24	54	205	487	261	254	49	6	14	1400
Effective rainfall in the paddy field	11	9	12	17	38	143	341	183	178	35	4	10	980
Musikot (Gulmi)													
Probable rainfall	22	22	23	62	161	333	473	399	308	68	8	24	1900
Effective rainfall in the paddy field	16	16	16	43	113	233	331	279	216	48	6	17	1333
Khanchikot (Arghakhanchi)													
Probable rainfall	22	22	22	22	103	266	460	303	381	54	11	35	1700
Effective rainfall in the paddy field	15	15	15	15	72	186	322	212	267	38	8	24	1190

Table C.24 Construction Cost of Irrigation

	Name of District/ Project	Command Area (ha)	Construction Cost (million NRs.)
(1)	Central Level		
	1) Kapilvastu		
	- Rajkudwa I.P.	2,400	281.4
	- Other I.P.	3,620	340.3
	Sub-total		621.7
	2) Gulmi		
	- Surface I.P.	840	118.3
	- Sprinkler I.P.	300	145.2
	Sub-total		263.5
	3) Arghakhanchi		
	- Surface I.P.	1,130	158.9
	- Sprinkler I.P.	600	290.4
	Sub-total		449.3
	Total of Central Level	8,890	1,334.5
(2)	District Level		
	1) Kapilvastu	9,000	176.9
	2) Gulmi	600	11.8
	3) Arghakhanchi	280	5.5
	Total of District Level	9,880	194.2
(3)	Grand Total of Irrigation	18,770	1,528.7

Table C.25 Annual Disbursement Schedule of Irrigation Development (million NRs.)

Central Level	1990		1991		1992		1993		1994		1995		1996		1997		1998	
	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.
Construction cost																		
1) Kapilvastu		18	63	95	42	63							7	10	13	20	13	20
2) Gulmi			3	4	9	13	9	13	9	13	5	7	4	5	10	14	10	14
3) Arghkahnchi			4	6	15	23	15	23	15	23	10	15	4	6	15	23	15	23
Sub-total	0	18	70	105	66	99	24	36	24	36	15	22	14	22	38	57	38	57
Price escalation	0	0.2	18	4	27	7	14	4	18	5	14	4	17	5	56	16	68	18
Total	0	18	88	109	93	106	37	39	42	41	29	26	32	26	94	73	106	75

	1999		2000		2001		2002		2003		2004		2005		Total
	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	
Construction cost															
1) Kapilvastu					21	31	28	41	28	41	28	41			622
2) Gulmi	10	14	5	7	3	5	9	13	9	13	9	13	5	7	264
3) Arghkahnchi	15	23	10	15	5	7	16	24	16	24	16	24	10	15	450
Sub-total	25	37	15	22	28	42	52	78	52	78	52	78	15	22	1335
Price escalation	52	14	36	9	81	19	175	40	203	44	233	48	74	15	1339
Total	77	51	51	31	109	62	228	118	255	122	285	127	89	36	2674

District Level	1990		1991		1992		1993		1994		1995		1996		1997		1998	
	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.
Construction cost																		
Terai			5	7	5	7	5	7	5	7	5	7	5	7	5	7	5	7
Hill			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Sub-total			5	8	5	8	5	8	5	8	5	8	5	8	5	8	5	8
Price escalation	0	0	1	0	2	1	3	1	4	1	5	2	6	2	8	2	9	3
Total	0	0	7	9	7	9	8	9	9	10	10	10	12	10	13	11	15	11

	1999		2000		2001		2002		2003		2004		2005		Total
	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	
Construction cost															
Terai	5	7	5	7	5	7	5	7	5	7	5	7	5	7	177
Hill	1	1	1	1											17
Sub-total	5	8	5	8	5	7	5	7	5	7	5	7	5	7	194
Price escalation	11	3	13	3	14	3	16	4	18	4	21	4	24	5	194
Total	16	11	18	12	18	10	21	11	23	11	26	11	29	12	388

Summary

Construction Cost	
Central Level	1335
District Level	194
Sub-total	1529
Price Escalation	1533
Total	3062

Table C.26 Cost Estimate of Priority Projects (Irrigation)

(Thousand NRs.)

Item		Amount
Rajkudwa, and Gorshinghiya and Rajipur Ponds Irrigation Project		
1. Intake Facilities		
Diversion Weir		18,897
Intake		1,921
Settling Basin		5,020
Guide Bank		2,372
Sub-total		28,210
2. Main Canal & Related Structures		
Preparatory Works	L.S.	6,272
Main Canal		78,338
Pond	L.S.	20,190
Related Structures	L.S.	41,430
Miscellaneous Works		2,198
Sub-total		148,428
3. Secondary & Tertiary Canals	L.S.	18,960
4. Total Direct Cost		195,598
5. Physical Contingency	L.S.	19,560
6. Base Cost		215,158
7. Overhead & Profit	L.S.	32,274
8. Contract Tax	L.S.	1,614
9. Design & S/V*1	L.S.	32,376
10. Total Cost		281,422

*1: Cost for mapping and feasibility study is not included.

Table C.27 Construction Cost of Rajkudwa Irrigation Project

Description	Unit	Unit Price	Q'ty	Amount (thousand NRs.)
I. Weir				
1. Concrete (1:2:4)	m3	1,920	2,490	4,780.80
2. Concrete (1:4:8)	m3	1,549	30	46.47
3. Reinforcement bar	ton	27,915	88.5	2,470.48
4. Gabion	m3	519	150	77.85
5. Form work	m2	271.5	1,130	1,121.30
6. Sheet piling	ton	38,130	93	3,546.09
7. Excavation at H/W	m3	67	7,100	475.70
8. Back fill	m3	8.8	1,100	9.68
9. Embankment	m3	22.3	4,930	109.94
10. Clearing	m2	1.2	10,900	13.08
11. Gate 2.5 x 25 m	nos.	501,200	2	1,002.40
12. Permeable apron		L.S.		4,942.67
13. Bridge girder		L.S.		300.38
Sub-toal				18,896.84
II. Intake (Offtake Structure)				
1. Concrete (1:2:4)	m3	1,920	200	384.00
2. Concrete (1:4:8)	m3	1,549	30	46.47
3. Reinforcement bar	ton	27,915	20	558.30
4. Form work	m2	271.5	570	154.76
5. Excavation in canal	m3	26.9	2,490	66.98
6. Back fill	m3	8.8	130	1.14
7. Embankment	m3	22.3	240	5.35
8. Cleaning	m2	1.2	490	0.59
9. Gate 1.6 x 1.2 m	nos.	316,400	2	632.80
10. Trash rack		L.S.		70.31
Sub-total				1,920.70
III. Settling Basin				
1. Concrete (1:2:4)	m2	1,920	740	1,420.80
2. Concrete (1:4:8)	m3	1,549	90	139.41
3. Reinforcement bar	ton	27,915	74	2,065.71
4. Form work	m2	271.5	1,950	529.43
5. Excavation	m3	26.9	7,640	205.52
6. Back filling	m3	8.8	2,800	24.64
7. Clearing	m2	1.2	1,390	1.67
8. Gate 1.6 x 1.2	nos.	316,400	2	632.80
Sub-total				5,019.98
IV. Guide banks				
1. Embankment	m3	22.3	24,210	542.10
2. Gabion	m3	L.S.		1,728.79
3. Dry boulder pitchings	m3	L.S.		101.92
Sub-total				2,372.82
V. Main Canal				
1. Concrete (1:2:4)	m3	1,920	8,940	17,164.80
2. Concrete (1:4:8)	m3	1,549	250	387.25
3. Form work	m2	271.5	36,300	9,855.45
4. Excavation	m3	26.9	392,870	10,568.20
5. Embankment	m3	22.3	85,700	1,911.11
6. Back fill	m3	8.8	302,070	2,658.22
7. Clearing	m2	1.2	58,800	70.56
8. Sod facing	m2	2.4	34,360	82.46
9. Reinforcement bar	ton	27,915	894	24,956.01
10. Gravel pavement	m3	356	8,400	2,990.40
11. Stripping	m3	13.4	10,110	135.47
Sub-total				78,338.17
VI. Pond				
1. Embankment	m2	22.3	184,680	4,118.36
2. Remove	m3	26.9	103,000	2,770.70
3. Gabion	m3	519	20,160	10,463.04
4. Sod facing	m2	2.4	272,160	653.18
5. Stripping	m3	13.4	163,080	2,185.30
Sub-total				20,190.58

Table C.28 Cost Estimate of Sprinkler Irrigation System

Description	Unit	Unit Price	Q'ty	Amount (thousand NRs.)
1. Concrete (1:2:4)	m3	1,920	201	385.92
2. Concrete (1:4:8)	m3	1,549	40	61.96
3. Reinforcement bar	ton	27,915	20.1	561.09
4. Excavation	m3	26.9	1,430	38.27
5. Embankment	m3	22.3	340	7.58
6. Back fill	m3	8.8	830	7.3
7. Form work	m2	27.15	590	16.02
8. Clearing	m2	1.2	1,010	1.21
9. Pipe dia. 50	m	84	910	76.44
10. Pipe dia. 60	m	120	95	11.4
11. Pipe dia. 120	m	371	2,060	373.06
12. Lying pipe	m	74	3,360	248.64
Sub-total				1,789.09
(US$ Portion)		(US$)		(US$)
1. Pipe dia. 70	nos.	5.67	3	17.10
2. Joint bending	nos.	34.11	34	1,159.74
3. Joint straight dia. 50	nos.	2.34	200	468.00
4. Joint straight dia. 60	nos.	4.06	20	81.20
5. Joint straight dia. 120	nos.	21.67	453	9,816.51
6. Valve Da. 120	nos.	46.88	10	468.80
7. Discharge valve	nos.	1,326.24	1	1,326.24
8. Air valve	nos.	1,148.94	3	3,446.82
9. Sprinkler set	set	511.35	10	5,113.50
10. Miscellaneous		L.S.		656.93
Sub-total				22,554.75
				= 631.533 thousand NRs.
Total				2,420.06 thousand NRs.
				484,100 NRs./ha

FIGURES

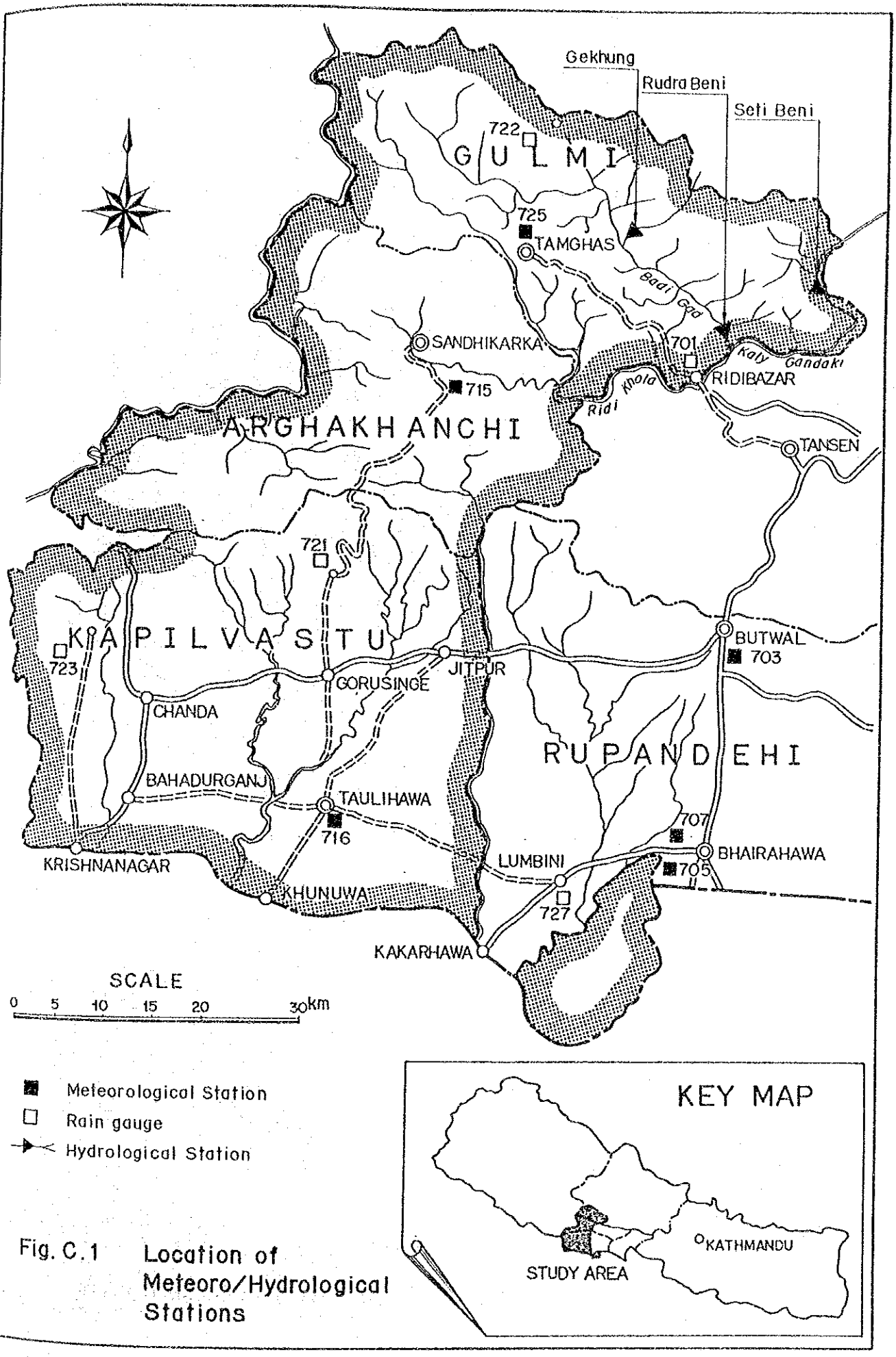


Fig. C.1 Location of Meteoro/Hydrological Stations

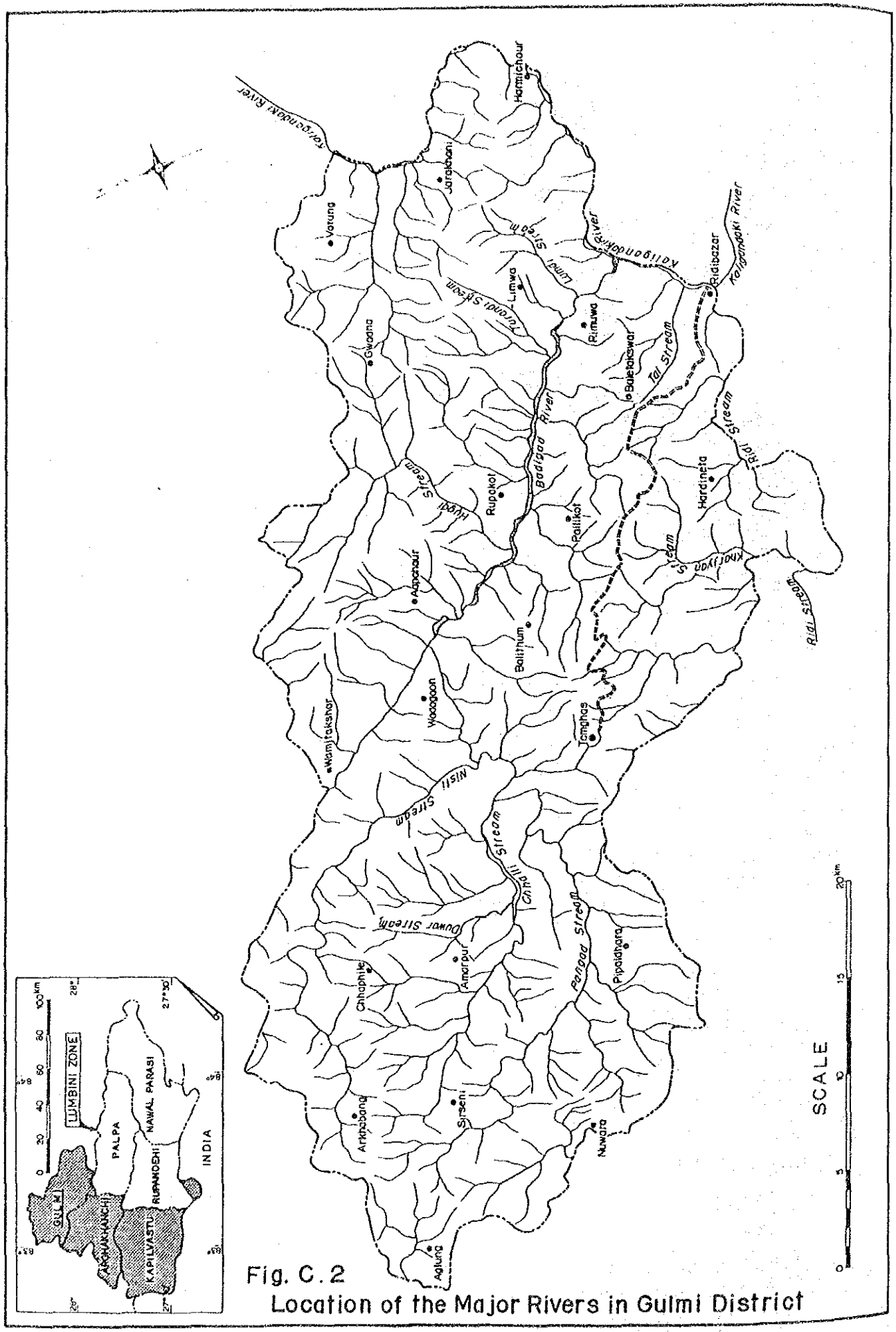


Fig. C.2
Location of the Major Rivers in Gulmi District

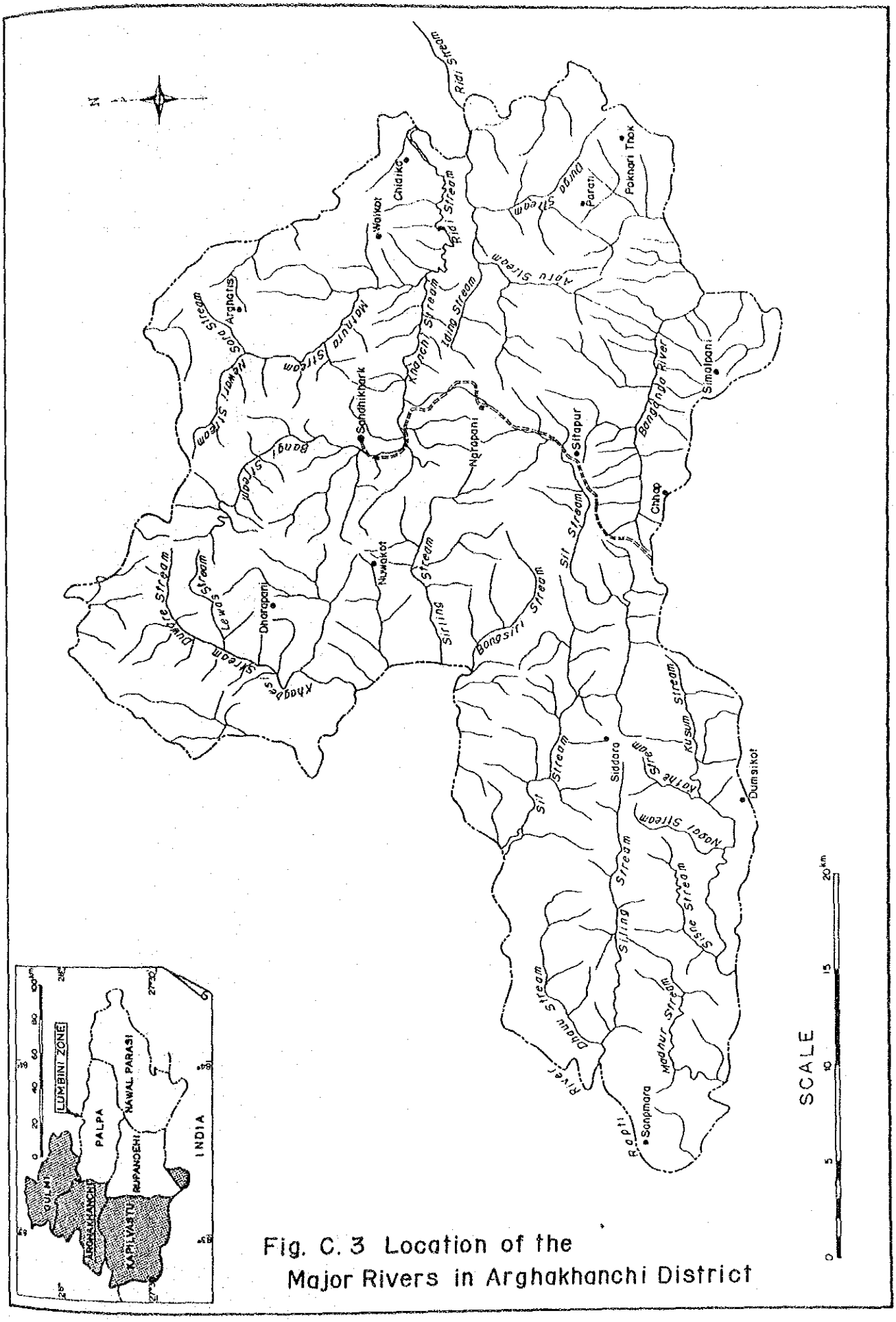


Fig. C. 3 Location of the Major Rivers in Arghakhanchi District

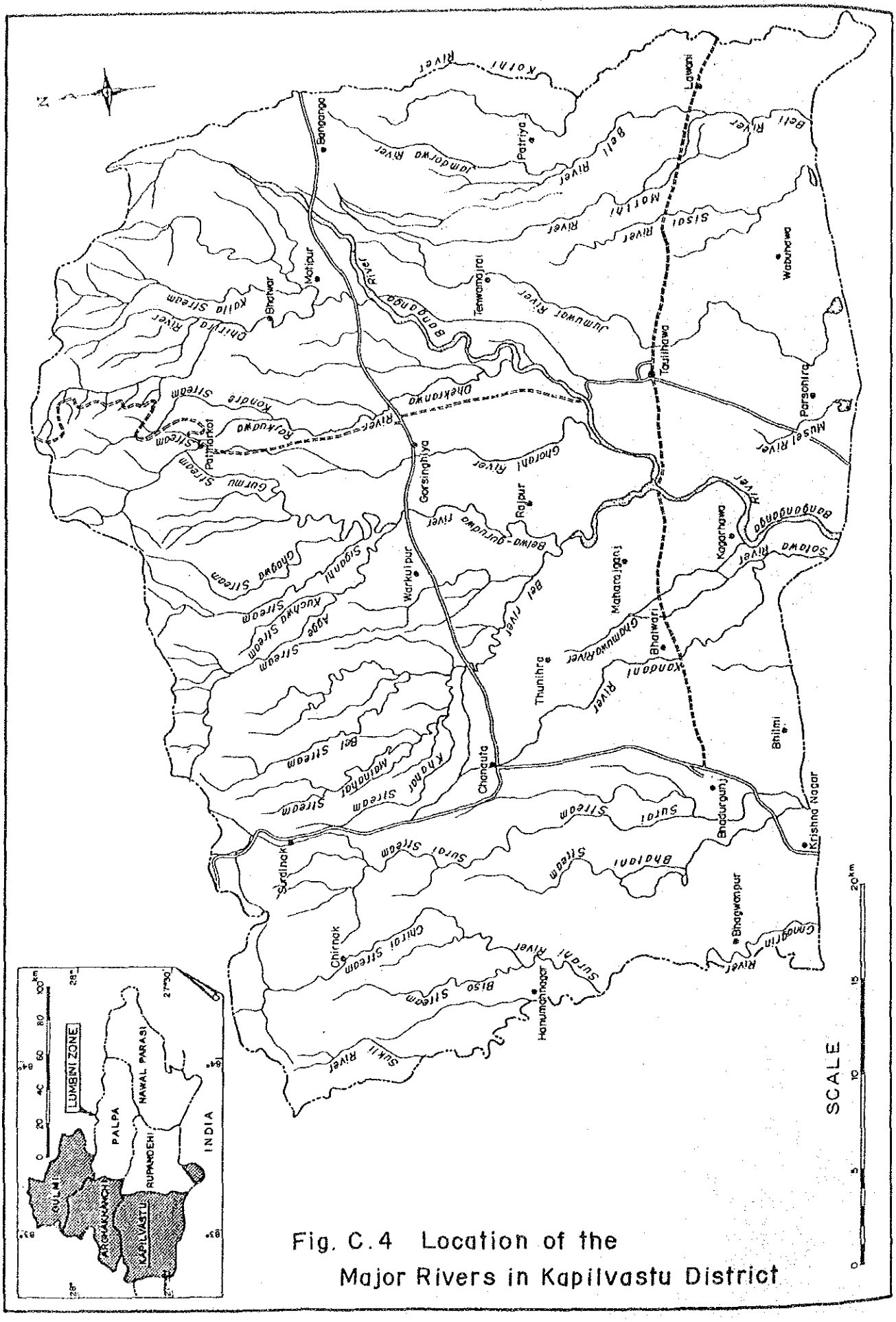


Fig. C.4 Location of the Major Rivers in Kapilvastu District

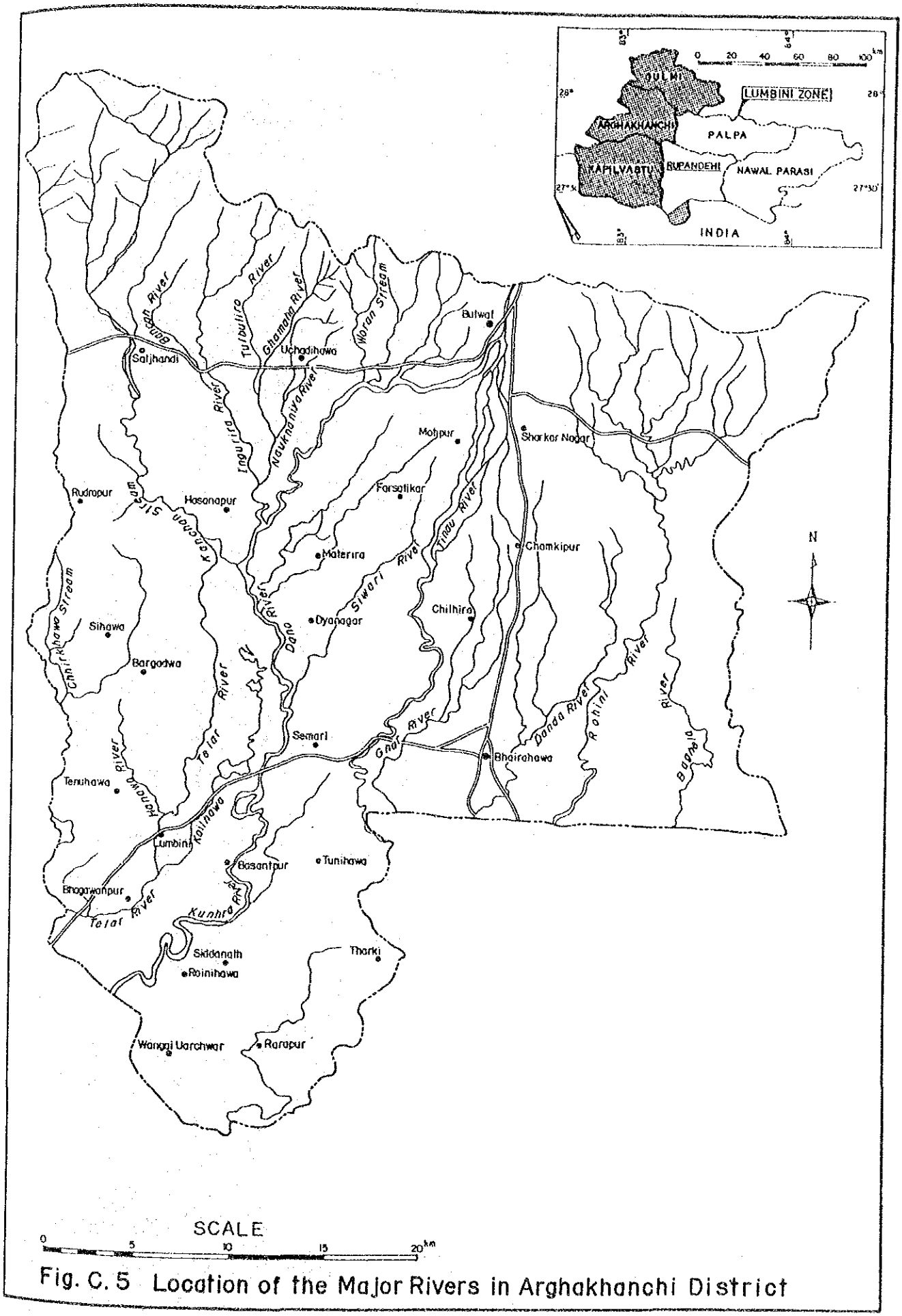


Fig. C. 5 Location of the Major Rivers in Arghakhanchi District

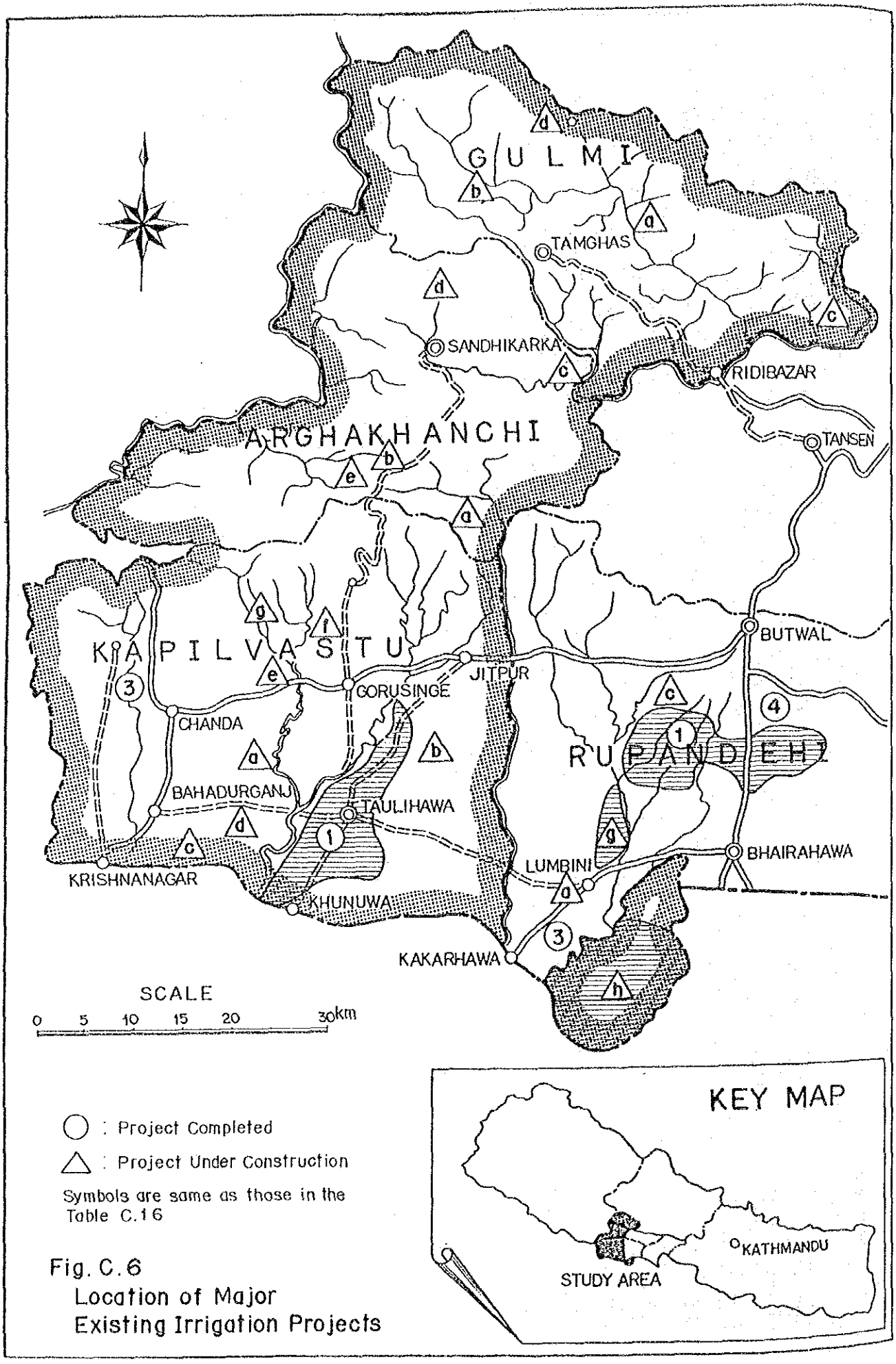


Fig. C.6
Location of Major
Existing Irrigation Projects

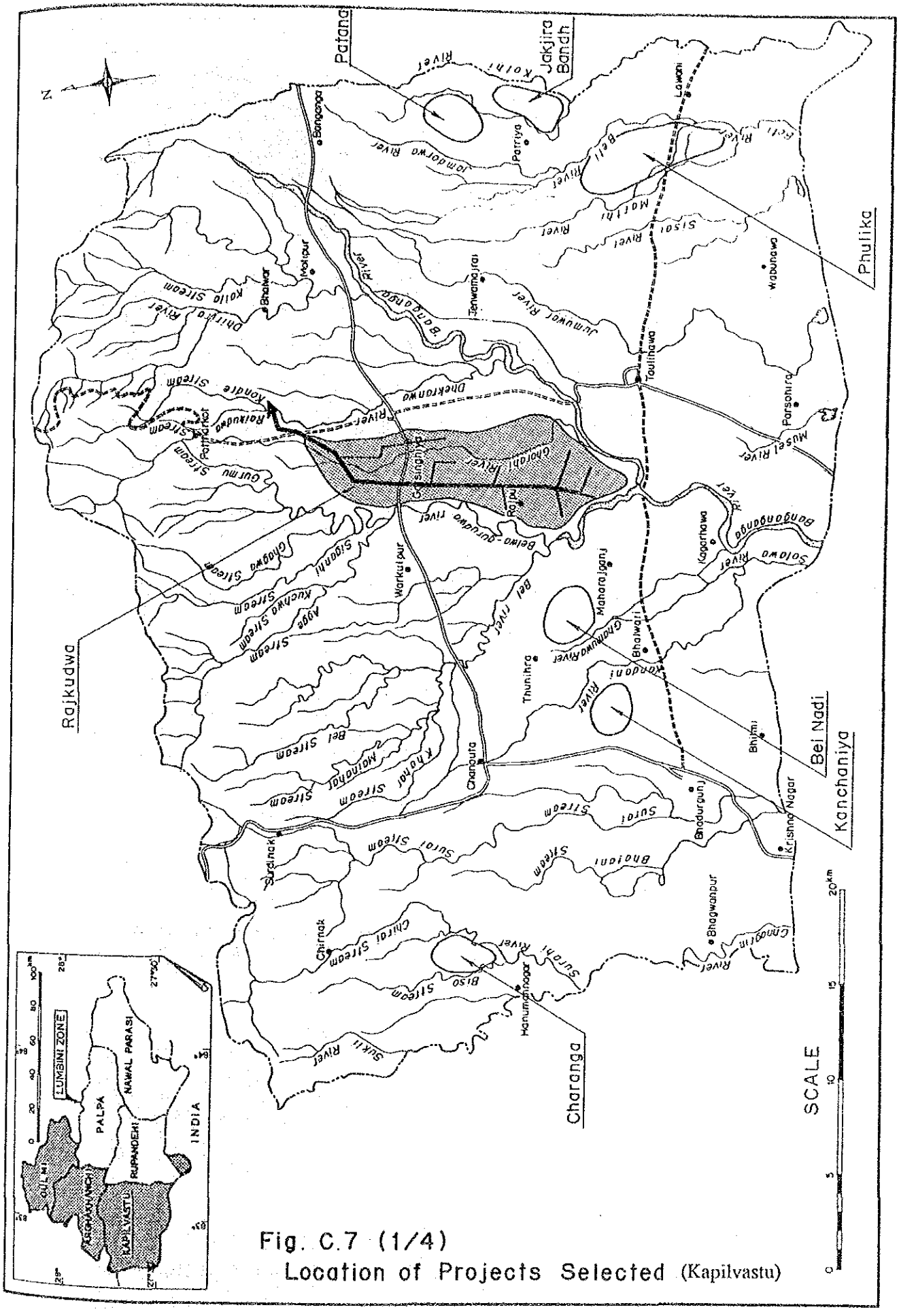
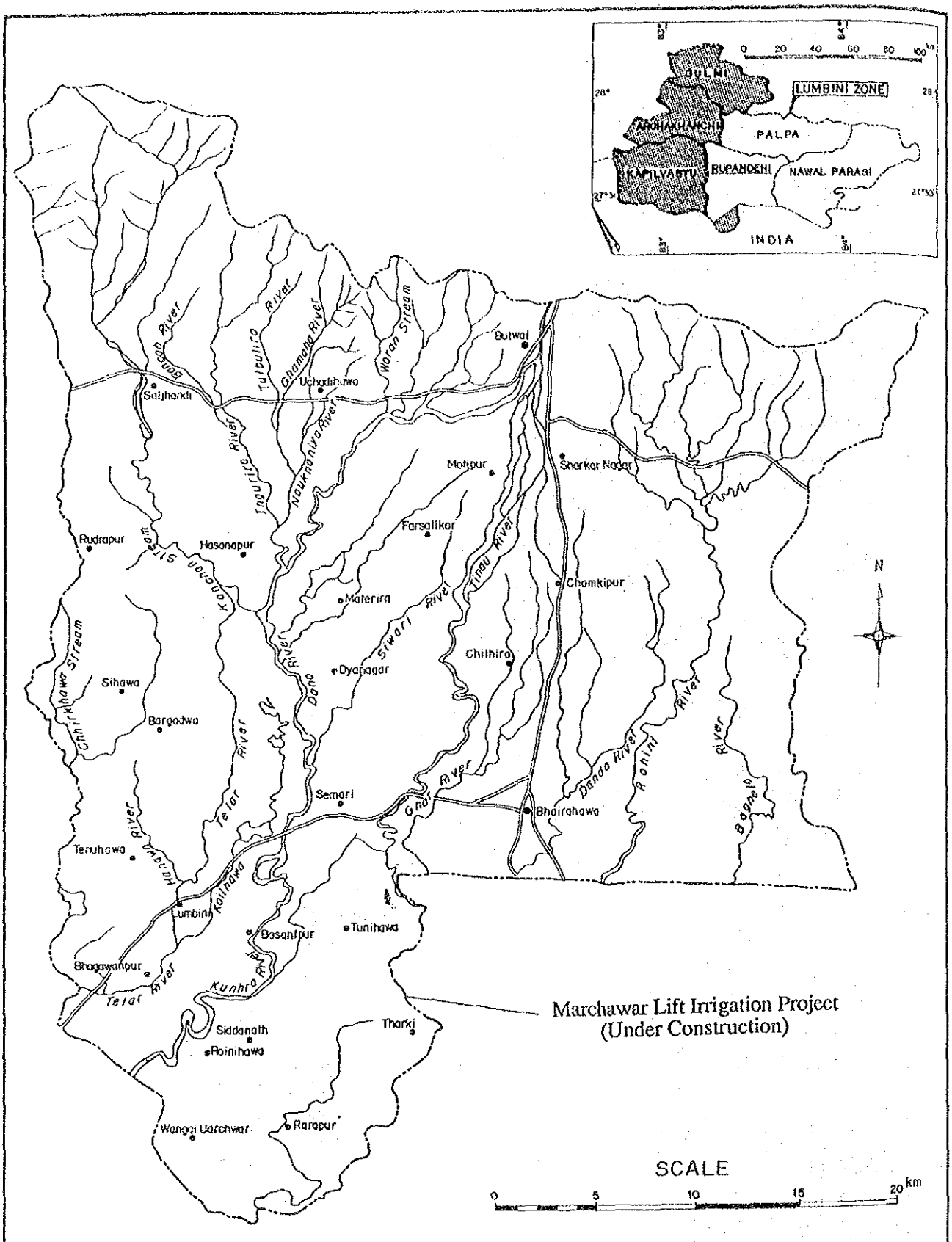


Fig. C.7 (1/4)
Location of Projects Selected (Kapilvastu)



(Rupandehi)

Fig.C.7 (2/4) Location of Projects Selected

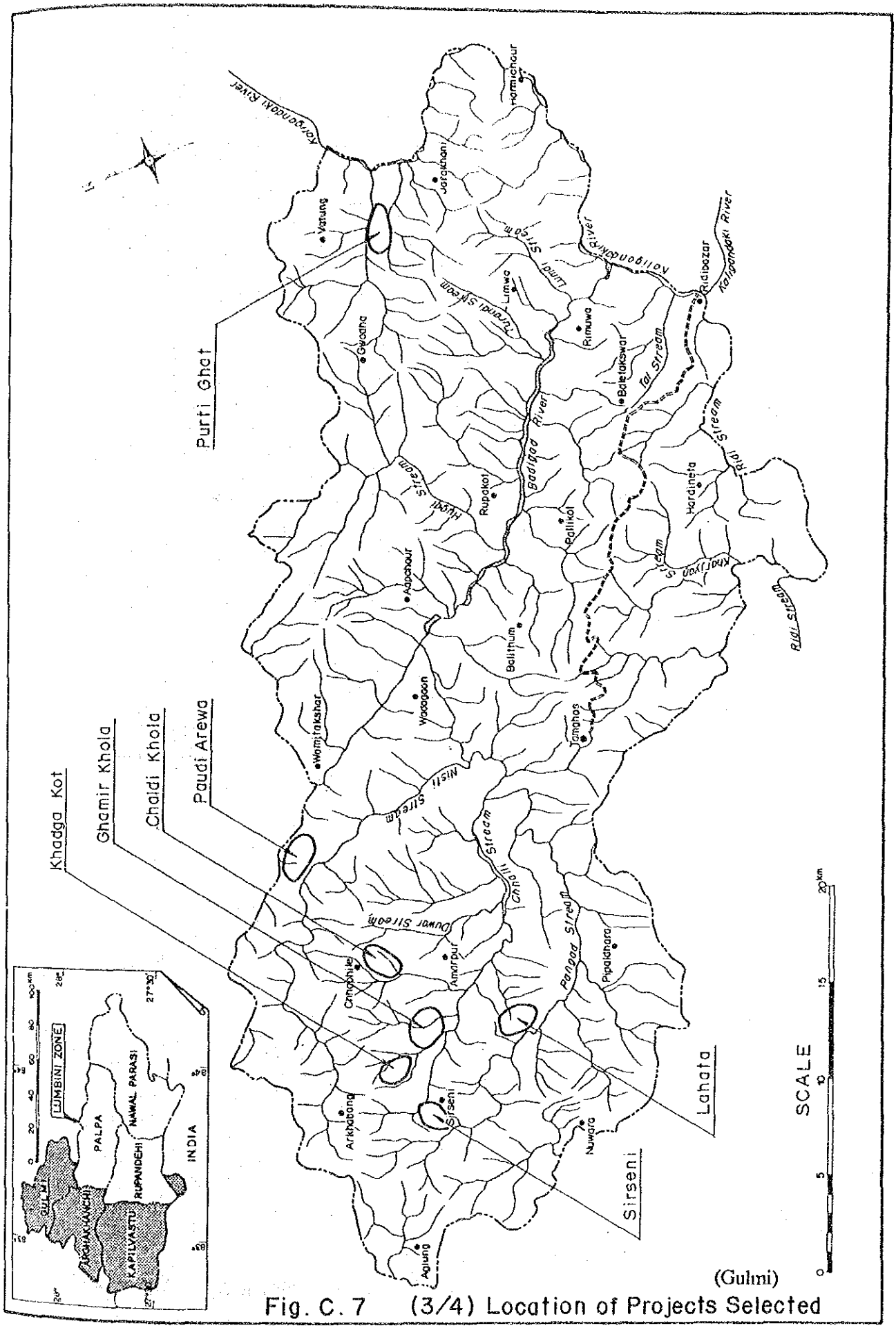


Fig. C. 7 (3/4) Location of Projects Selected

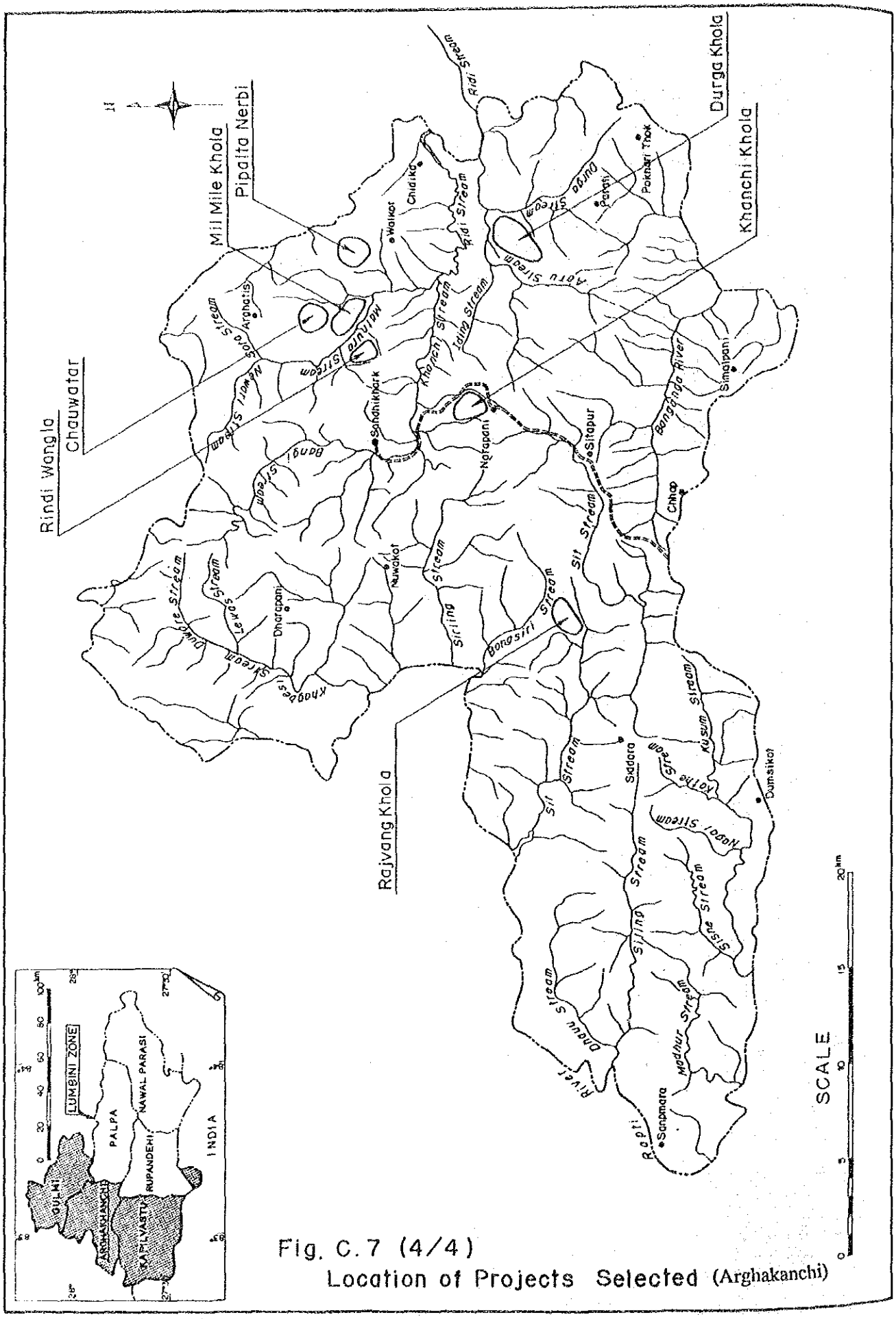
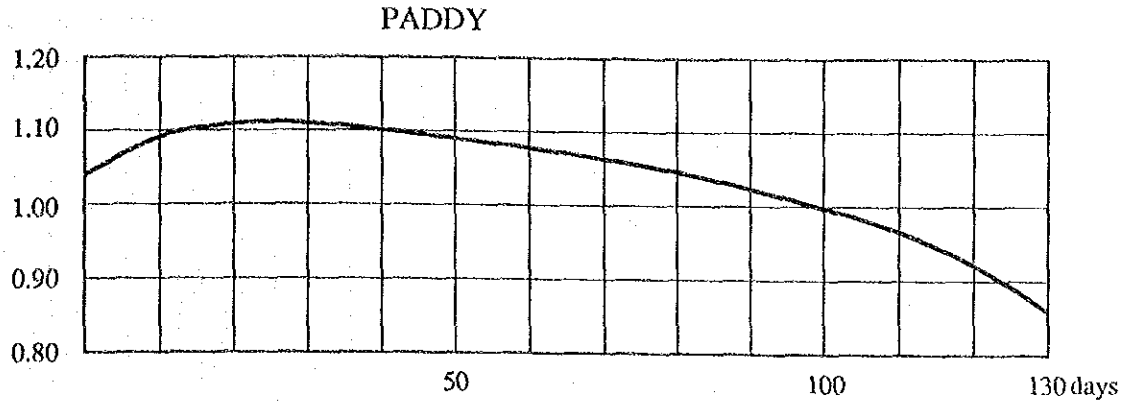
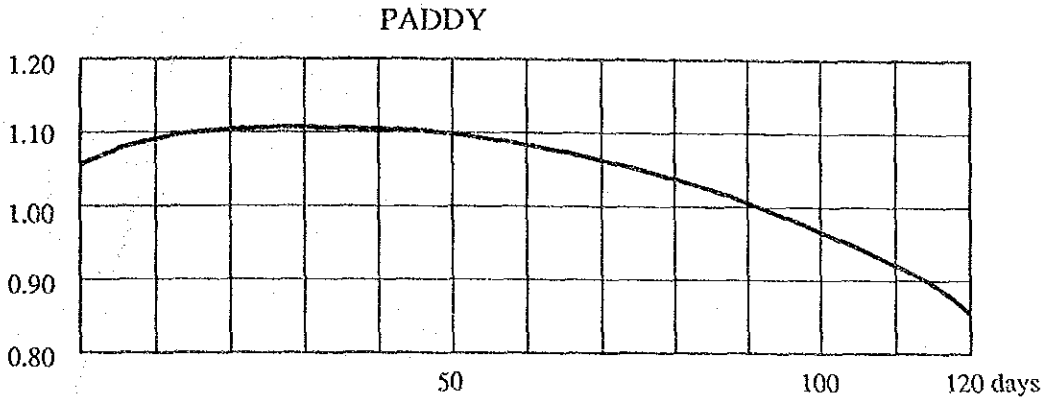


Fig. C.7 (4/4)
Location of Projects Selected (Arghakanchi)





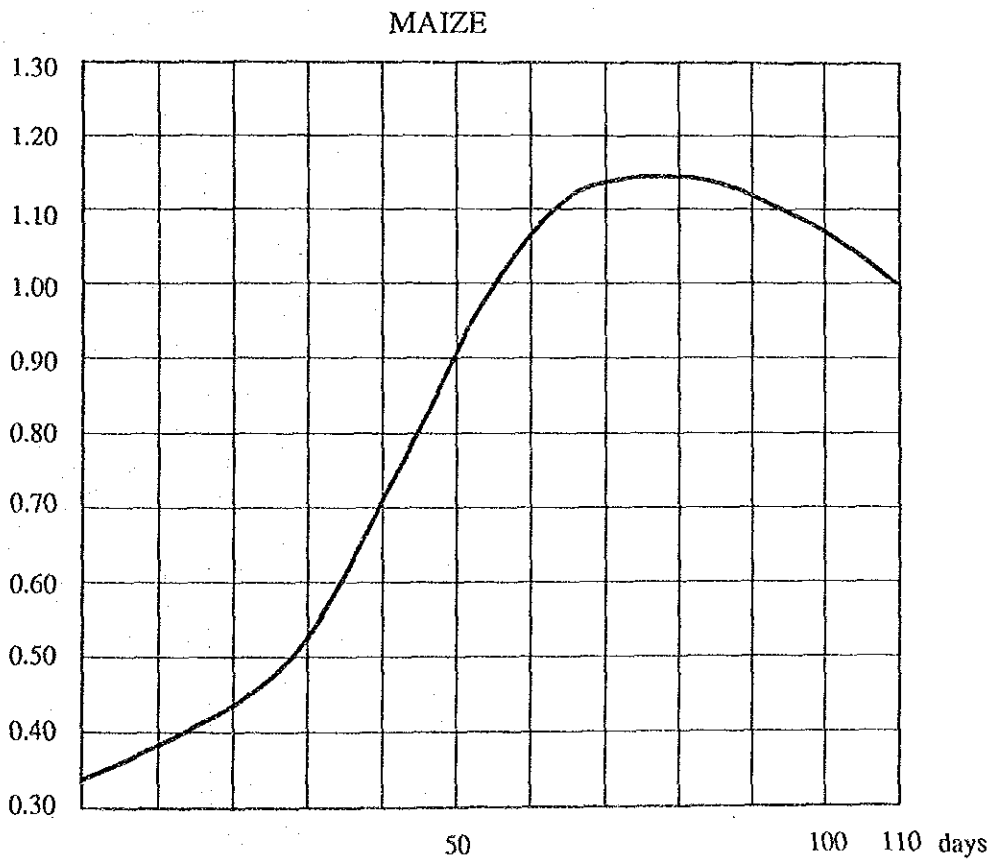
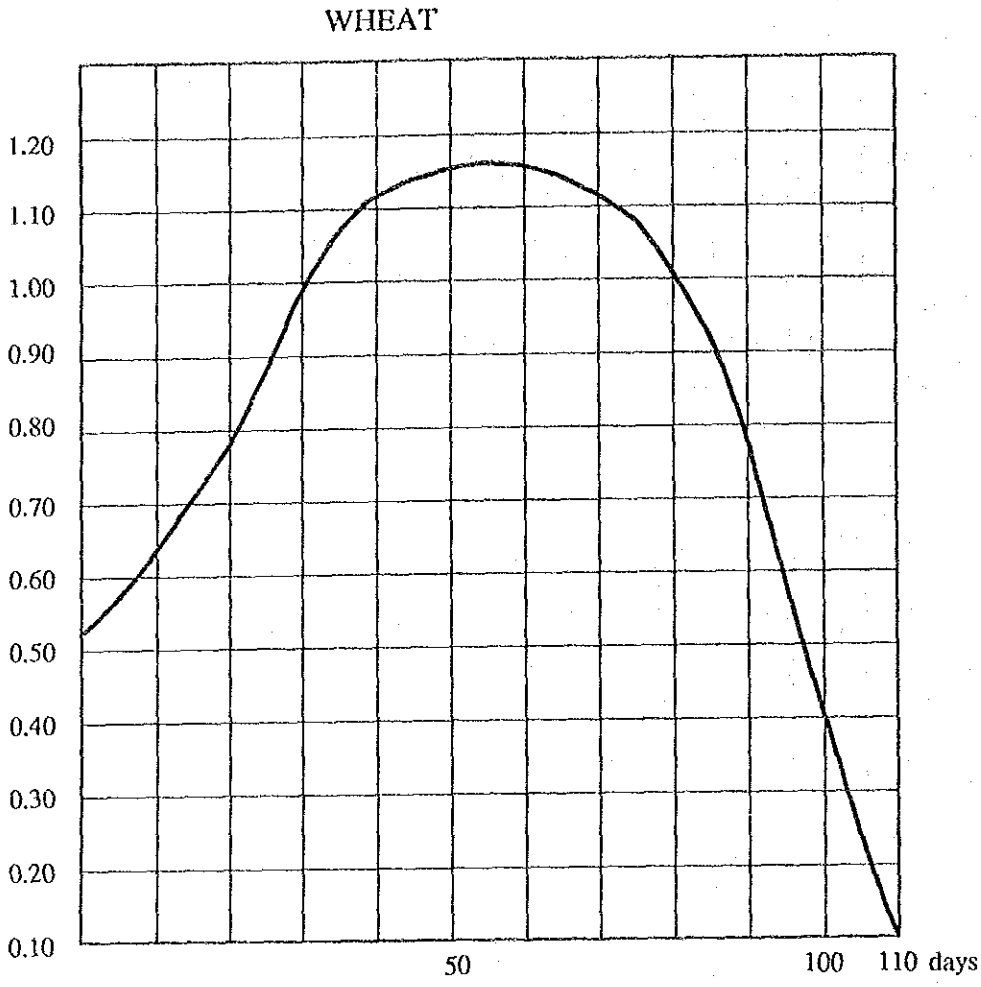


Fig. C.8 (1/4) Crop Coefficient Curve



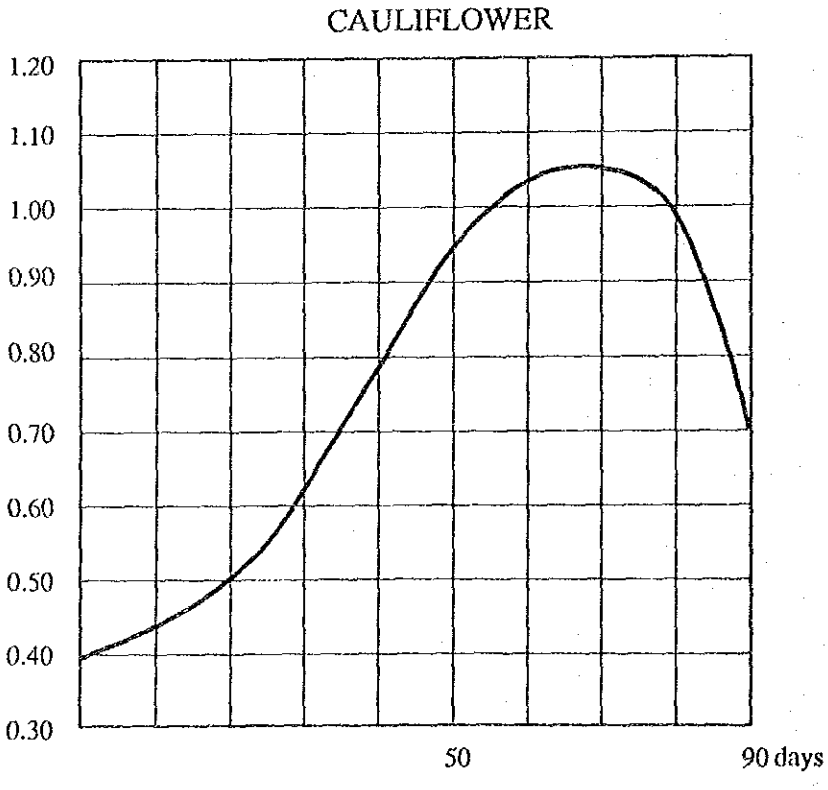
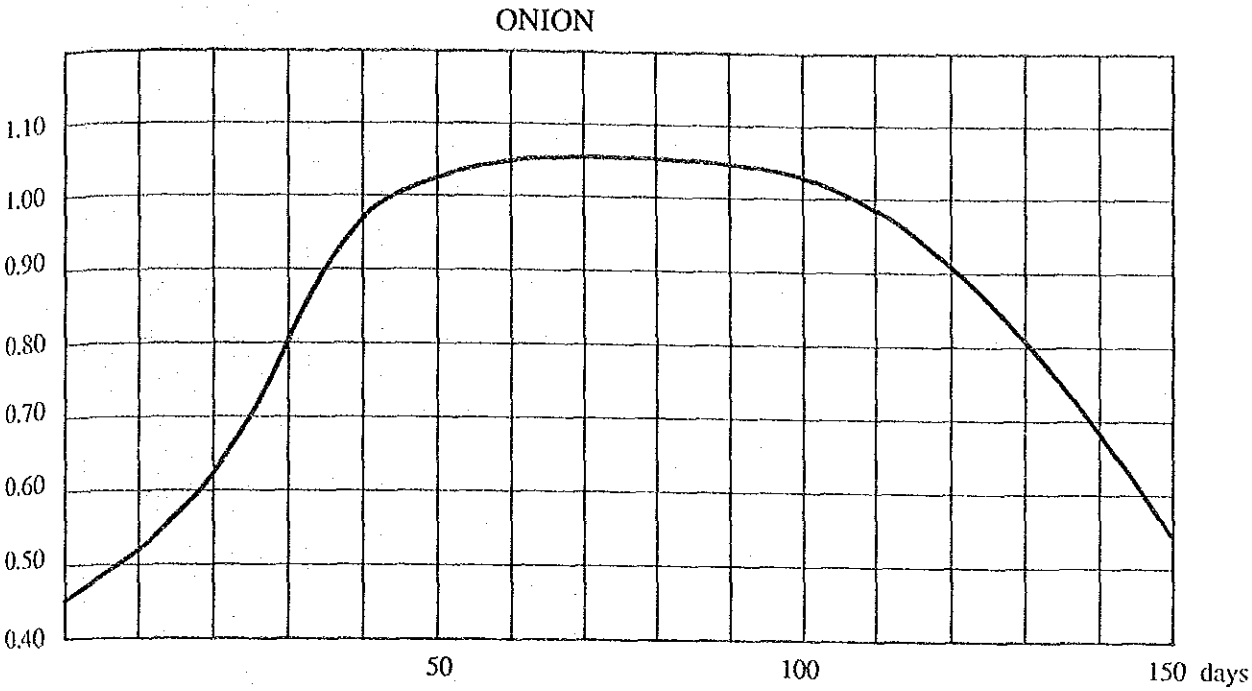


Fig. C.8 (2/4) Crop Coefficient Curve



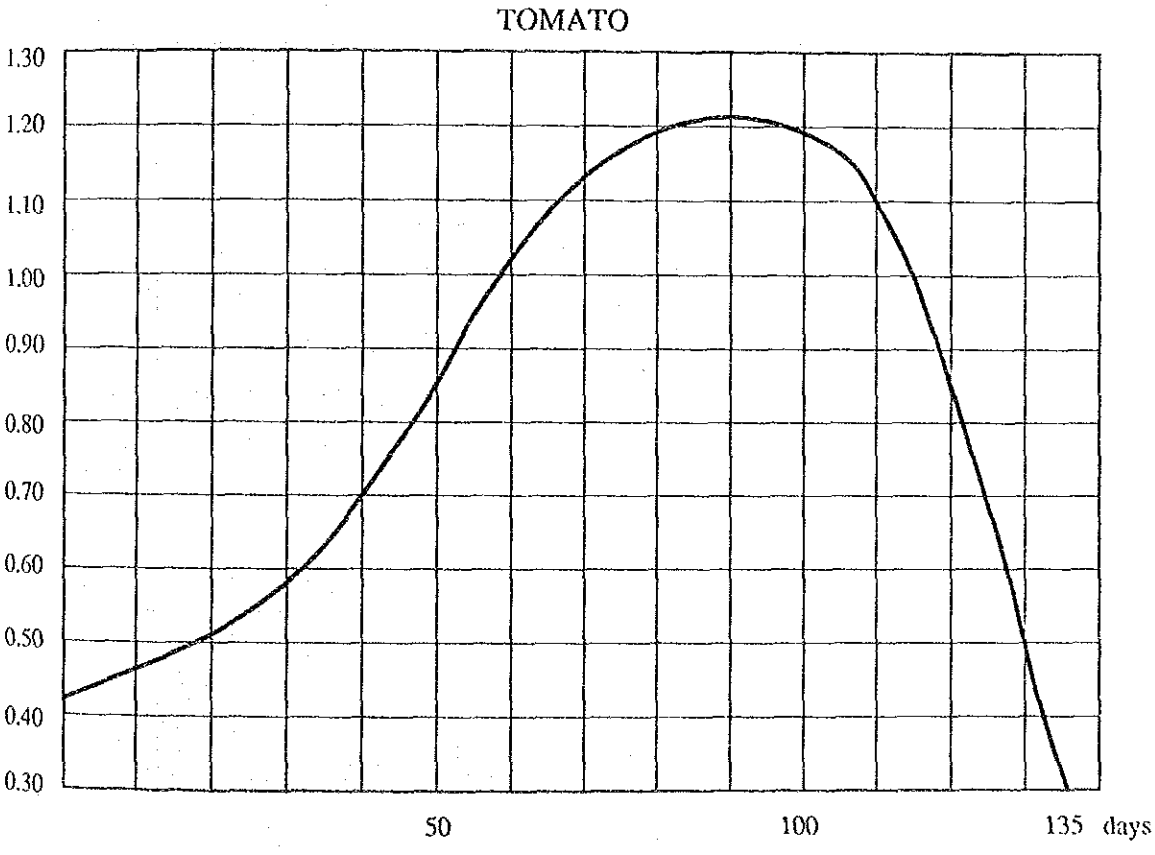
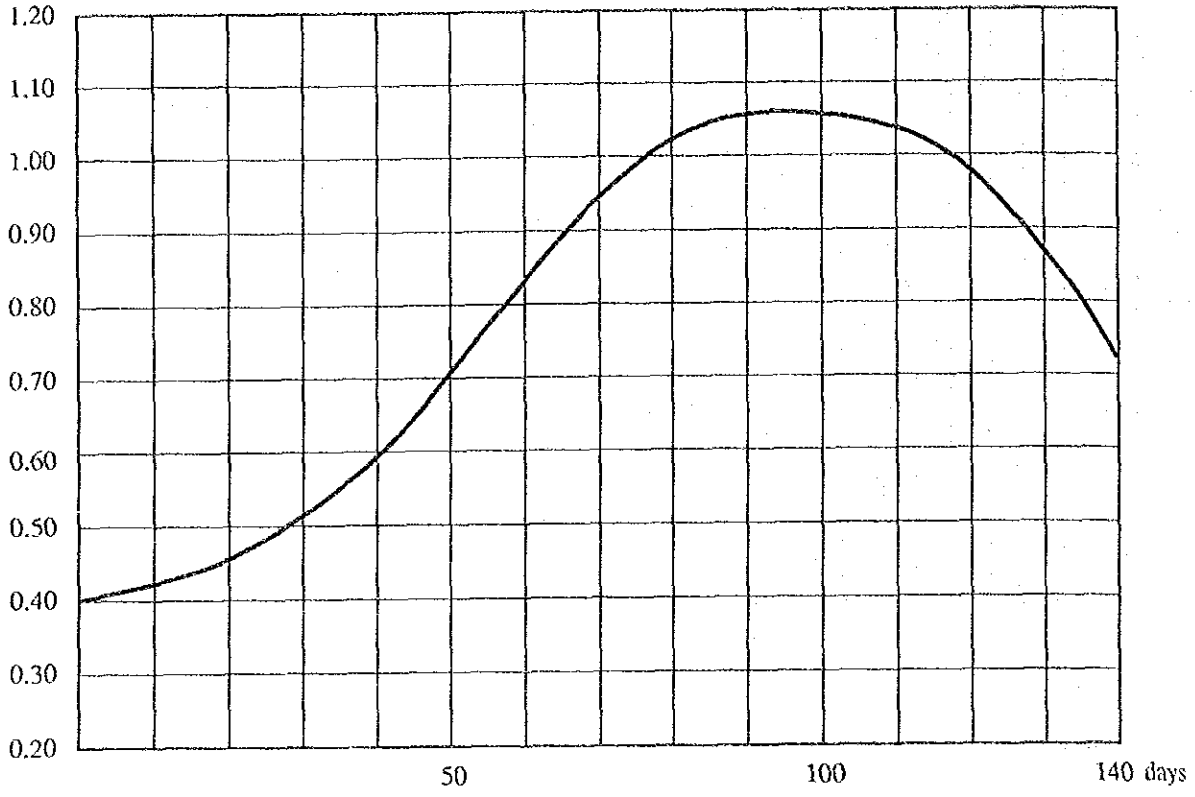


Fig. C.8 (3/4) Crop Coefficient Curve

EGG PLANT



In Terai Plain

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Onion	-	-	0.60	1.00	1.05	0.98	0.75	-	-	-	-	-
Eggplant	-	-	-	-	-	-	0.45	0.67	0.97	1.03	0.85	-
Tomato	1.15	1.13	0.57	-	-	-	-	-	-	-	0.50	0.80
Average	1.15	1.13	0.59	1.00	1.05	0.98	0.60	0.67	0.97	1.03	0.65	0.80

In Hill Area

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Cauliflower	-	-	0.47	0.85	0.97	-	-	-	-	-	-	-
Tomato	-	-	-	-	-	-	0.50	0.80	1.15	1.13	0.57	-
Onion	1.05	0.98	0.75	-	-	-	-	-	-	-	0.60	1.00
Average	1.05	0.98	0.61	0.81	0.97	-	0.50	0.80	1.15	1.13	0.59	1.00
Coffee	0.90 throughout the year											
Citrus	0.69 throughout the year											

Average = 0.80

Fig. C.8 (4/4) Crop Coefficient Curve

Paddy (A, Terai Plain)

			Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
			Land preparation and nursery					No irrigation	
(1)	ETo	(mm)	-	164	155	129	105	81	
(2)	Kc		-	1.11	1.09	1.04	0.97	0.97	
(3)	= (1) x (2)	(mm)	-	180	169	134	102	79	
(4)	Percolation	(mm)	-	31	31	30	31	30	
(5)	Effective Rainfall	(mm)	-	461	357	283	66	13	
(6)	= (3) + (4) - (5)	(mm)	-	-	-	-	67	96	
(7)	Area Factor-A		-	0.063	0.937	1.0	0.875	0.125	
(8)	= (6) x (7)	(mm)	-	-	-	-	59	12	
(9)	Land Preparation	(mm)	190	190	190	-	-	-	
(10)	Area Factor-B		0.042	0.583	0.375	-	-	-	
(11)	= (9) x (10)	(mm)	8	110	72	-	-	-	
(12)	= (8) + (11)	(mm)	8	110	72	-	59	12	
(13)	= (12)/EF (= 65%)	(mm)	12	169	111	-	91	18	
		(lit/sec/ha)	0.05	0.63	0.41	-	0.34	0.07	

Fig. C.9 (1/11) Irrigation Water Requirement

Maize (Terai Plain)

				Mar.	Apr.	May	Jun.	Jul.
(1)	ETo	(mm)		152	210	248	204	164
(2)	Kc			0.44	0.80	1.12	1.07	1.07
(3)	= (1) x (2)	(mm)		67	168	278	218	175
(4)	Probable Rainfall	(mm)		10	21	86	338	658
(5)	Effective Rainfall	(mm)		9	20	85	184	176
(6)	= (3) - (5)	(mm)		58	148	193	34	-
(7)	Area Factor-A			0.375	0.958	1.0	0.958	0.375
(8)	= (6) x (7)	(mm)		22	142	193	33	-
(9)	Pre-irrigation	(mm)		75	75	-	-	-
(10)	Area Factor-B			0.75	0.25	-	-	-
(11)	= (9) x (10)	(mm)		56	19	-	-	-
(12)	= (8) + (11)	(mm)		78	161	193	33	-
(13)	= (12)/EF (= 50%)	(mm)		156	322	386	66	-
		(lit/sec/ha)		0.58	1.24	1.44	0.25	-

Fig. C.9 (2/11) Irrigation Water Requirement

Wheat (Terai Plain)

				Nov.	Dec.	Jan.	Feb.	Mar.
(1)	ETo	(mm)		90	62	65	84	152
(2)	Kc			0.58	0.88	1.13	0.78	0.78
(3)	= (1) x (2)	(mm)		52	55	73	66	119
(4)	Probable Rainfall	(mm)		19	28	19	14	10
(5)	Effective Rainfall	(mm)		10	19	17	12	9
(6)	= (3) - (5)	(mm)		42	36	56	54	110
(7)	Area Factor			0.056	0.778	1.00	1.00	0.50
(8)	= (6) x (7)	(mm)		2	28	56	54	55
(9)	Pre-irrigation	(mm)		75	75	-	-	-
(10)	Area Factor			0.334	0.666	-	-	-
(11)	= (9) x (10)	(mm)		25	50	-	-	-
(12)	= (8) + (11)	(mm)		27	78	56	54	55
(13)	= (12)/EF (= 50%)	(mm)		54	156	112	108	110
		(lit/sec/ha)		0.21	0.58	0.42	0.45	0.41

Fig. C.9 (3/11) Irrigation Water Requirement

Vegetables (Terai Plain)

			Jan.	Feb.	Mar.	Apr.	May	Jun.	
(1)	ETo	(mm)	65	84	152	210	248	204	
(2)	Kc		1.15	1.13	0.59	1.00	1.05	0.98	
(3)	= (1) x (2)	(mm)	75	95	90	210	260	200	
(4)	Probable Rainfall	(mm)	19	14	10	21	86	338	
(5)	Effective Rainfall	(mm)	14	10	8	20	80	200	
(6)	= (3) - (5)	(mm)	61	85	72	190	180	-	
(7)	Area Factor		1.0	1.0	1.0	1.0	1.0	-	
(8)	= (6) x (7)	(mm)	61	85	72	190	180	-	
(9)	= (8)/EF (=50%)	(mm)	122	160	144	380	360	-	
		(lit/sec/ha)	0.46	0.66	0.54	1.47	1.34	-	

			Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
(1)	ETo	(mm)	164	155	129	121	90	62	
(2)	Kc		0.60	0.67	0.97	1.03	0.65	0.80	
(3)	= (1) x (2)	(mm)	98	104	130	125	59	50	
(4)	Probable Rainfall	(mm)	658	510	404	94	19	28	
(5)	Effective Rainfall	(mm)	98	104	130	65	15	20	
(6)	= (3) - (5)	(mm)	-	-	-	60	44	30	
(7)	Area Factor		1.0	1.0	1.0	1.0	1.0	1.0	
(8)	= (6) x (7)	(mm)	-	-	-	60	44	30	
(9)	= (8)/EF (=50%)	(mm)	-	-	-	120	88	60	
		(lit/sec/ha)	-	-	-	0.45	0.34	0.22	

Fig. C.9 (4/11) Irrigation Water Requirement

Paddy (B, Hill Area)

			Jun.	Jul.	Aug.	Sep.	Oct.	Nov.
			Land preparation and nursery				No irrigation	
(1)	ETo	(mm)	-	143	133	120	62	81
(2)	Kc		-	1.10	1.07	0.98	1.02	0.96
(3)	= (1) x (2)	(mm)	-	157	142	118	63	78
(4)	Percolation	(mm)	-	31	31	30	31	30
(5)	Effective Rainfall	(mm)	-	322	212	267	38	8
(6)	= (3) + (4) - (5)	(mm)	-	-	-	-	56	100
(7)	Area Factor-A		-	0.375	0.958	0.990	0.500	0.010
(8)	= (6) x (7)	(mm)	-	-	-	-	23	1.0
(9)	Land Preparation	(mm)	190	190	190	-	-	-
(10)	Area Factor-B		0.375	0.583	0.042	-	-	-
(11)	= (9) x (10)	(mm)	72	110	8	-	-	-
(12)	= (8) + (11)	(mm)	72	110	8	-	23	1.0
(13)	= (12)/EF (= 65%)	(mm)	111	169	12	-	35	2
		(lit/sec/ha)	0.43	0.63	0.04	-	0.13	0.01

Fig. C.9 (5/11) Irrigation Water Requirement

Paddy (C, Hill Area)

			Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
			Land preparation and nursery					No irrigation	
(1)	ETo	(mm)		-	133	120	62	78	
(2)	Kc			-	1.10	1.05	0.98	0.98	
(3)	= (1) x (2)	(mm)		-	146	126	61	76	
(4)	Percolation	(mm)		-	31	30	31	30	
(5)	Effective Rainfall	(mm)		-	212	267	38	8	
(6)	= (3) + (4) - (5)	(mm)		-	-	-	54	98	
(7)	Area Factor-A			-	0.50	1.00	0.875	0.125	
(8)	= (6) x (7)	(mm)		-	-	-	47	12	
(9)	Land Preparation	(mm)		190	190	-	-	-	
(10)	Area Factor-B			0.50	0.50	-	-	-	
(11)	= (9) x (10)	(mm)		95	95	-	-	-	
(12)	= (8) + (11)	(mm)		95	95	-	47	12	
(13)	= (12)/EF (= 65%)	(mm)		146	146	-	72	18	
		(lit/sec/ha)		0.55	0.55	-	0.27	0.07	

Fig. C.9 (6/11) Irrigation Water Requirement

Paddy (D, Hill Area)

			Mar.	Apr.	May	Jun.	Jul.	
			Land preparation and nursery				No irrigation	
(1)	ETo	(mm)	-	201	186	165	143	
(2)	Kc		-	1.10	1.05	0.98	0.98	
(3)	= (1) x (2)	(mm)	-	221	195	162	140	
(4)	Percolation	(mm)	-	60	62	60	62	
(5)	Effective Rainfall	(mm)	-	15	72	186	322	
(6)	= (3) + (4) - (5)	(mm)	-	266	185	36	-	
(7)	Area Factor		-	0.50	1.00	0.875	0.125	
(8)	= (6) x (7)	(mm)	-	133	185	32	-	
(9)	Land Preparation	(mm)	190	190	-	-	-	
(10)	Area Factor		0.50	0.50	-	-	-	
(11)	= (9) x (10)	(mm)	95	95	-	-	-	
(12)	= (8) + (11)	(mm)	95	228	185	32	-	
(13)	= (12)/EF (= 65%)	(mm)	146	351	285	49	-	
		(lit/sec/ha)	0.55	1.35	1.06	0.19	-	

Fig. C.9 (7/11) Irrigation Water Requirement

Maize (Hill Area)

				Mar.	Apr.	May	Jum.	Jul.
(1)	ETo	(mm)		155	201	186	165	143
(2)	Kc			0.44	0.80	1.12	1.07	1.07
(3)	= (1) x (2)	(mm)		78	161	208	177	153
(4)	Probable Rainfall	(mm)		22	22	103	266	460
(5)	Effective Rainfall	(mm)		16	21	84	157	33
(6)	= (3) - (5)	(mm)		62	140	124	20	-
(7)	Area Factor-A			0.50	1.00	1.00	0.944	0.222
(8)	= (6) x (7)	(mm)		31	140	124	19	-
(9)	Pre-irrigation	(mm)		75	-	-	-	-
(10)	Area Factor-B			1.00	-	-	-	-
(11)	= (9) x (10)	(mm)		75	-	-	-	-
(12)	= (8) + (11)	(mm)		106	140	124	19	-
(13)	= (12)/EF (= 50%)	(mm)		212	280	248	38	-
		(lit/sec/ha)		0.79	1.08	0.93	0.15	-
(14)	= (12)/EF (= 75%)	(mm)		141	187	165	25	-
		(lit/sec/ha)		0.53	0.72	0.62	0.10	-

Fig. C.9 (8/11) Irrigation Water Requirement

Wheat (Hill Area)

				Nov.	Dec.	Jan.	Feb.	Mar.
(1)	ETo	(mm)		78	68	65	95	155
(2)	Kc			0.73	1.12	1.05	0.40	0.40
(3)	= (1) x (2)	(mm)		57	76	68	38	62
(4)	Probable Rainfall	(mm)		11	35	22	22	22
(5)	Effective Rainfall	(mm)		8	25	15	13	17
(6)	= (3) - (5)	(mm)		49	51	53	25	45
(7)	Area Factor			0.50	1.00	1.00	0.944	0.222
(8)	= (6) x (7)	(mm)		25	51	53	24	10
(9)	Pre-irrigation	(mm)		75	-	-	-	-
(10)	Area Factor			1.0	-	-	-	-
(11)	= (9) x (10)	(mm)		75	-	-	-	-
(12)	= (8) + (11)	(mm)		100	51	53	24	10
(13)	= (12)/EF (= 50%)	(mm)		200	102	106	48	20
		(lit/sec/ha)		0.77	0.38	0.40	0.29	0.07
(14)	= (12)/EF (= 75%)	(mm)		133	68	71	32	13
		(lit/sec/ha)		0.51	0.25	0.27	0.13	0.05

Fig. C.9 (9/11) Irrigation Water Requirement

Vegetables (Hill Area)

			Jan.	Feb.	Mar.	Apr.	May	Jum.
(1)	ETo	(mm)	65	95	155	201	186	165
(2)	Kc		1.05	0.98	0.61	0.85	0.97	-
(3)	= (1) x (2)	(mm)	68	93	95	171	175	-
(4)	Probable Rainfall	(mm)	22	22	22	22	103	266
(5)	Effective Rainfall	(mm)	15	16	17	20	74	-
(6)	= (3) - (5)	(mm)	53	77	78	151	101	-
(7)	Area Factor		1.0	1.0	1.0	1.0	1.0	-
(8)	= (6) x (7)		53	77	78	151	101	-
(9)	= (8)/EF (= 50%)	(mm)	106	154	156	302	202	-
		(lit/sec/ha)	0.40	0.63	0.58	1.17	0.75	-
(10)	= (8)/EF (= 75%)	(mm)	71	103	104	201	135	-
		(lit/sec/ha)	0.27	0.43	0.39	0.78	0.50	-

			Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
(1)	ETo	(mm)	143	133	120	62	60	68
(2)	Kc		0.50	0.80	1.15	1.13	0.59	1.00
(3)	= (1) x (2)	(mm)	72	106	138	70	35	68
(4)	Probable Rainfall	(mm)	460	303	381	54	11	35
(5)	Effective Rainfall	(mm)	72	106	138	33	7	20
(6)	= (3) - (5)	(mm)	-	-	-	37	28	48
(7)	Area Factor		1.0	1.0	1.0	1.0	1.0	1.0
(8)	= (6) x (7)		-	-	-	37	28	48
(9)	= (8)/EF (= 50%)	(mm)	-	-	-	74	56	96
		(lit/sec/ha)	-	-	-	0.28	0.22	0.36
(10)	= (8)/EF (= 75%)	(mm)	-	-	-	49	37	64
		(lit/sec/ha)	-	-	-	0.18	0.14	0.24

Fig. C.9 (10/11) Irrigation Water Requirement

Orchard (Coffee and Citrus, in Hill Area)

			Jan.	Feb.	Mar.	Apr.	May	Jum.
(1)	ETo	(mm)	65	95	155	201	186	165
(2)	Kc		0.80	0.80	0.80	0.80	0.80	0.80
(3)	= (1) x (2)	(mm)	52	76	124	161	149	132
(4)	Probable Rainfall	(mm)	22	22	22	22	103	266
(5)	Effective Rainfall	(mm)	16	19	20	20	80	132
(6)	= (3) - (5)	(mm)	36	57	104	141	69	-
(7)	= (6)/EF (= 50%)	(mm)	72	114	208	282	138	-
		(lit/sec/ha)	0.27	0.47	0.78	1.09	0.52	-
(8)	= (6)/EF (= 75%)	(mm)	48	76	139	188	92	-
		(lit/sec/ha)	0.18	0.31	0.52	0.73	0.34	-

			Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
(1)	ETo	(mm)	143	133	120	62	78	68
(2)	Kc		0.80	0.80	0.80	0.80	0.80	0.80
(3)	= (1) x (2)	(mm)	114	106	96	50	62	54
(4)	Probable Rainfall	(mm)	460	303	381	54	11	35
(5)	Effective Rainfall	(mm)	114	106	96	35	9	22
(6)	= (3) - (5)	(mm)	-	-	-	15	53	32
(7)	= (6)/EF (= 50%)	(mm)	-	-	-	30	106	64
		(lit/sec/ha)	-	-	-	0.11	0.41	0.24
(8)	= (6)/EF (= 75%)	(mm)	-	-	-	20	71	43
		(lit/sec/ha)	-	-	-	0.07	0.27	0.16

Fig. C.9 (11/11) Irrigation Water Requirement

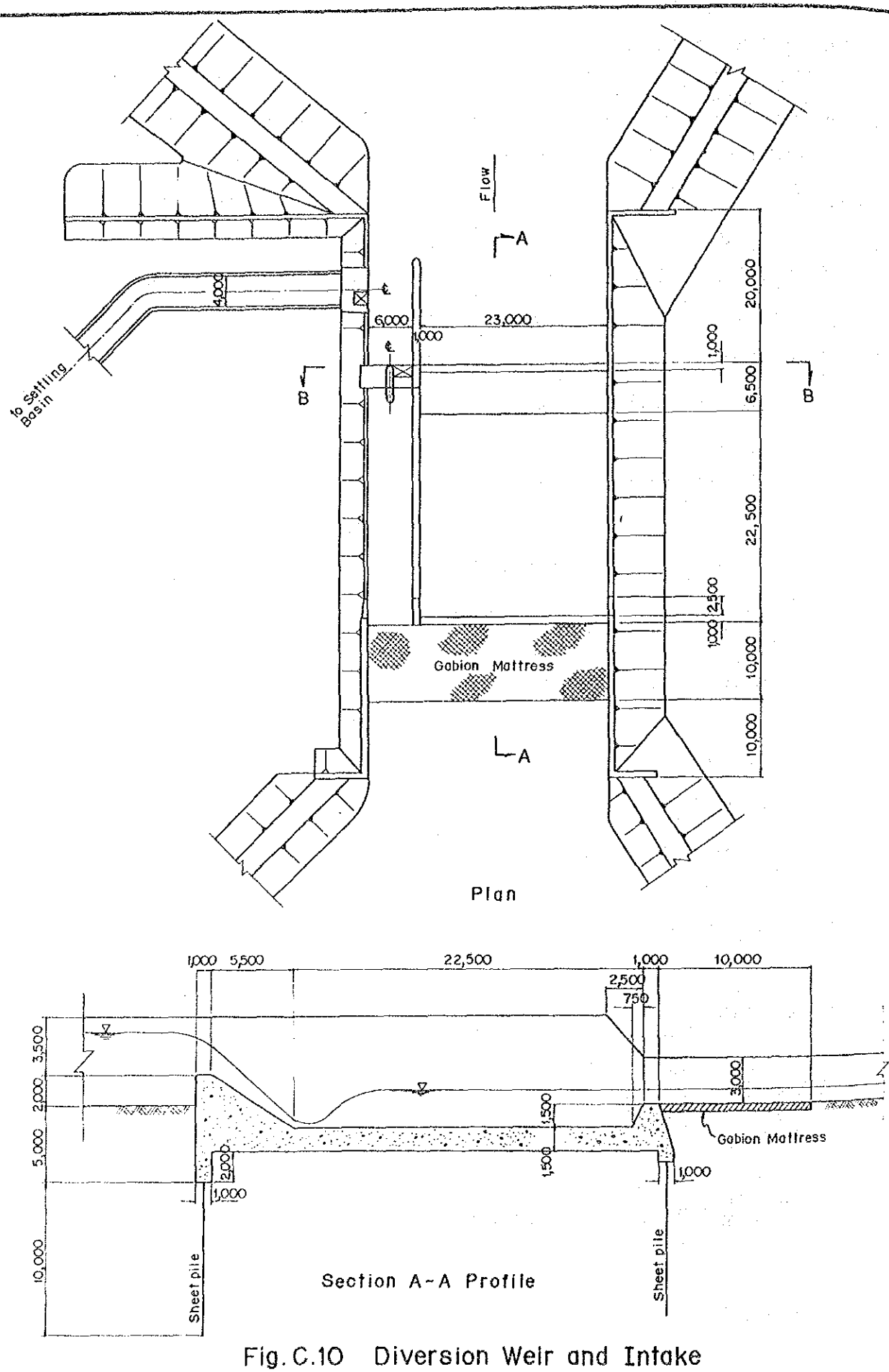
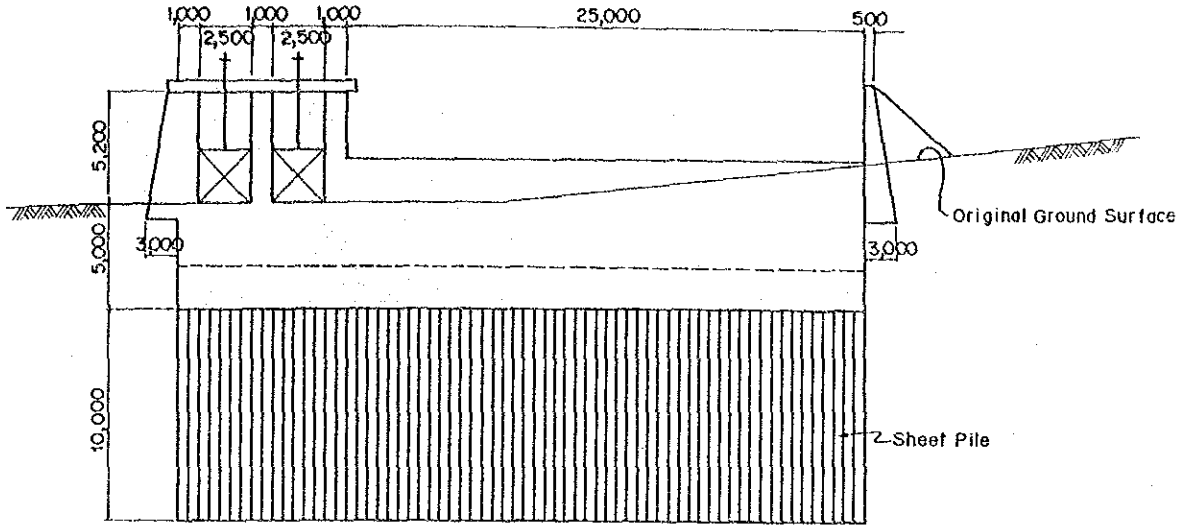
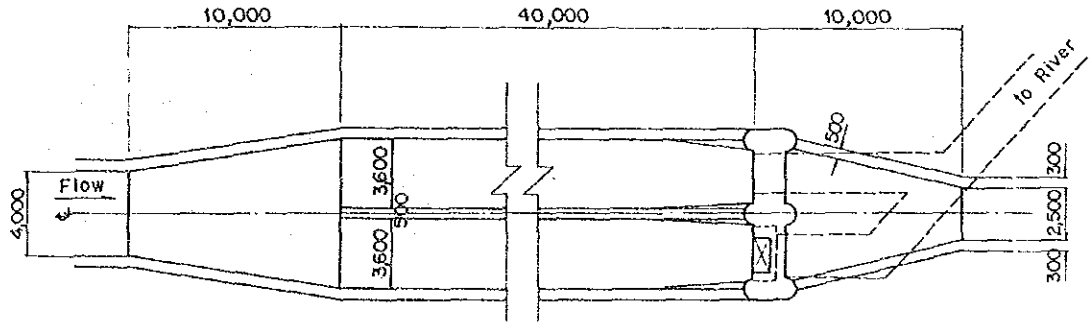


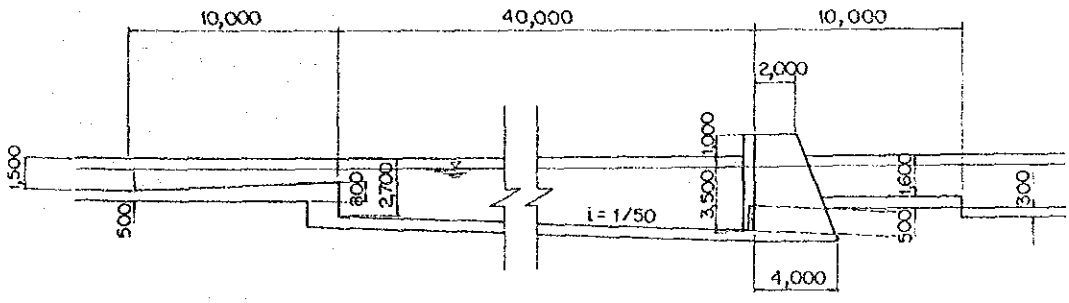
Fig. C.10 Diversion Weir and Intake



Section B-B

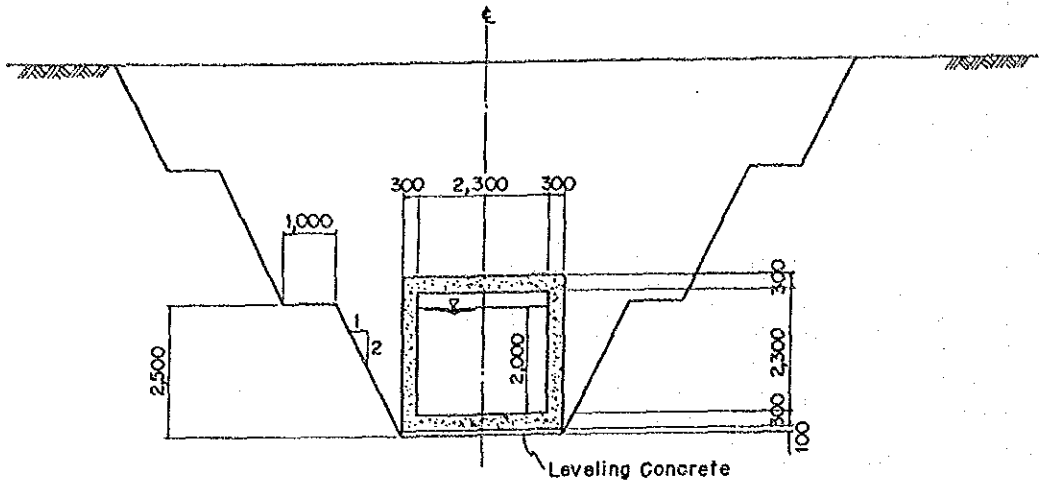


Settling Basin Plan



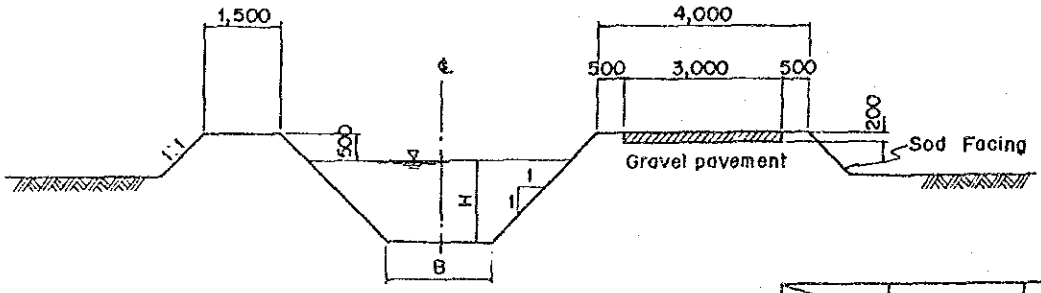
Settling Basin Profile

Fig. C.11 Diversion Weir and Settling Basin



Main Canal Type I

Rajkuduwa Irrigation Project

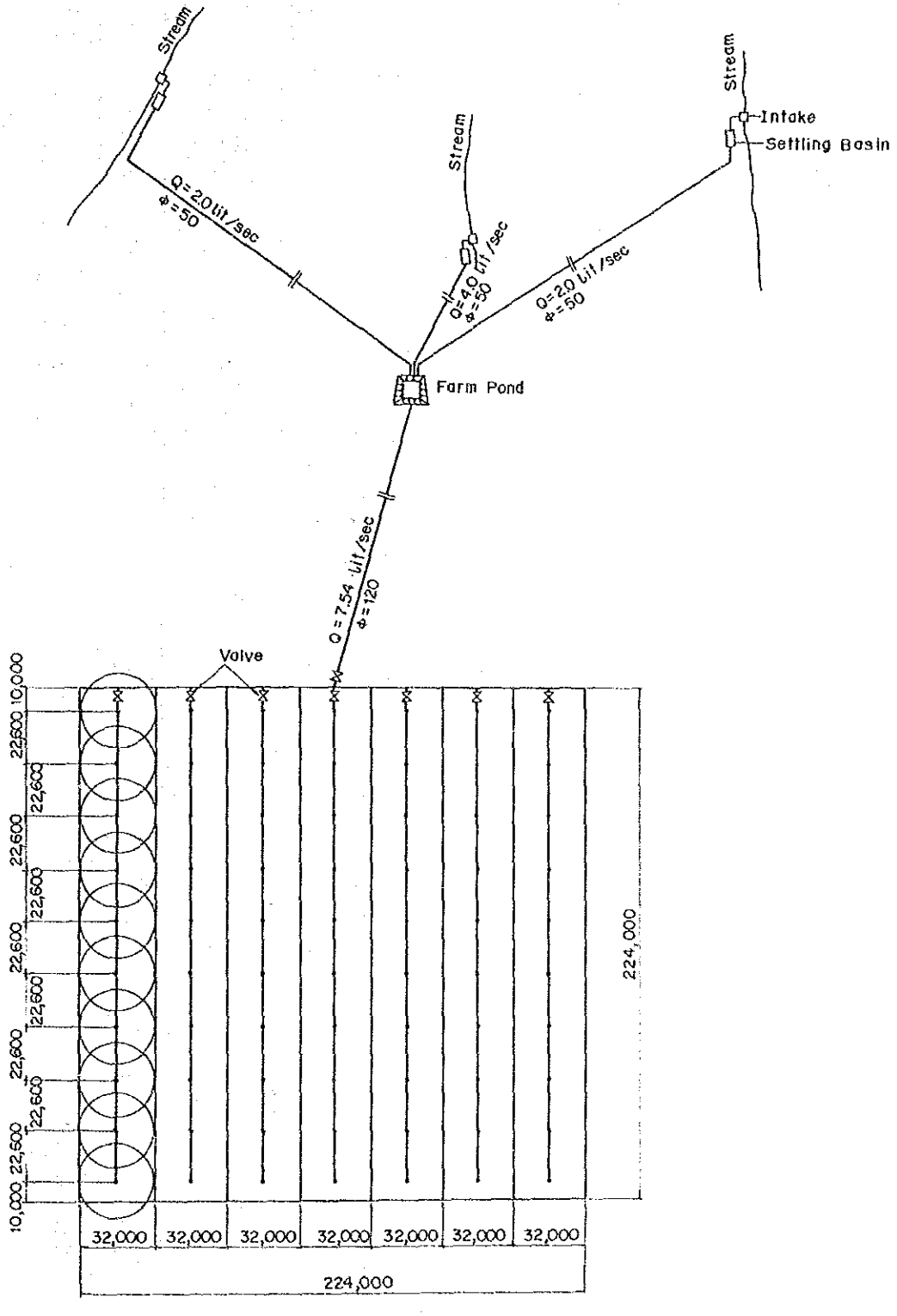


	Type II	Type III
B(mm)	2,000	1,500
H(mm)	1,600	1,400
Q(m^3/s)	3.00	1.50

Main Canal Type II & III

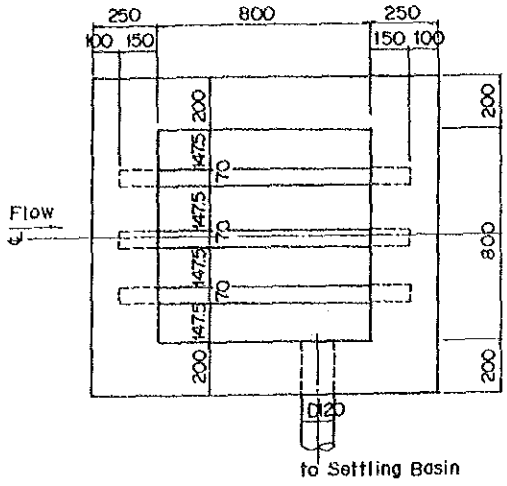
Rajkuduwa Irrigation Project

Fig. C. 12 Typical Cross Section of Main Canal

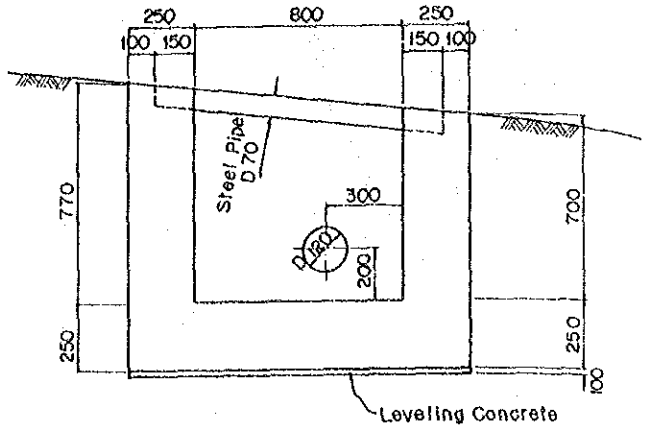


Typical Layout of Sprinkler Irrigation System

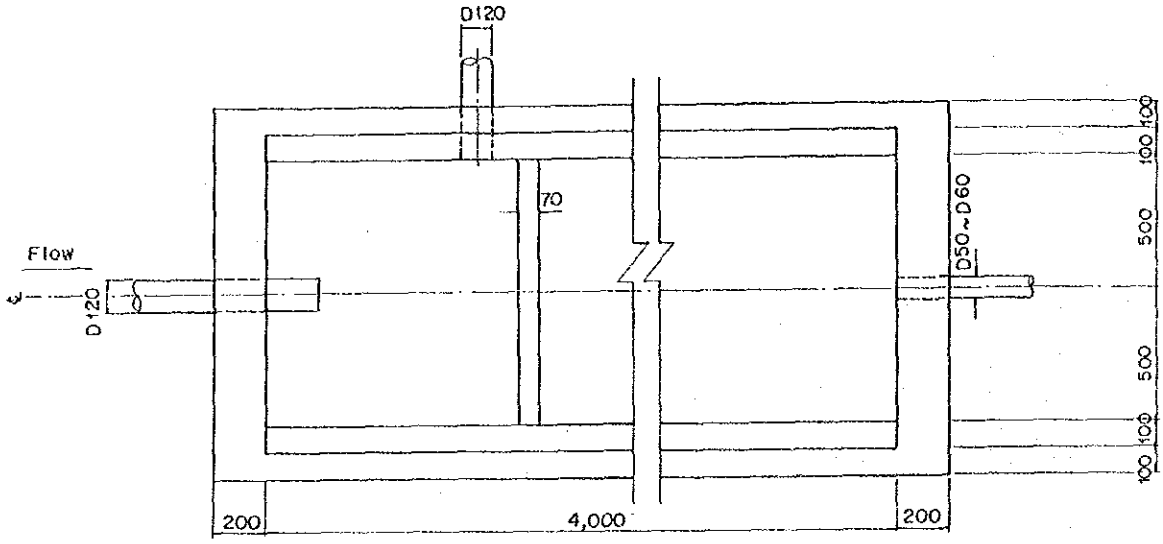
Fig. C.13(1/3) Typical Design of Sprinkler Irrigation System



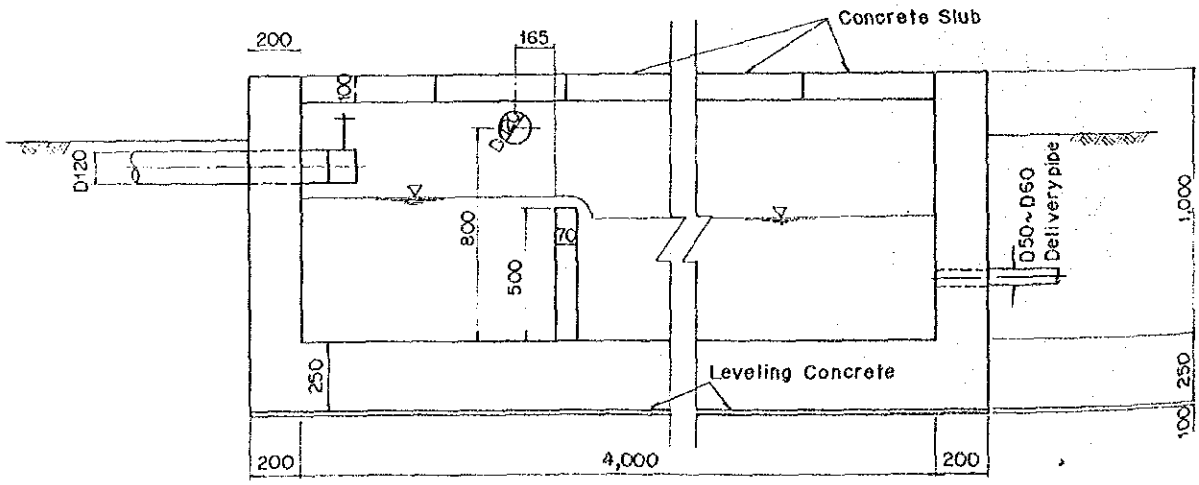
Intake Plan



Intake Profile

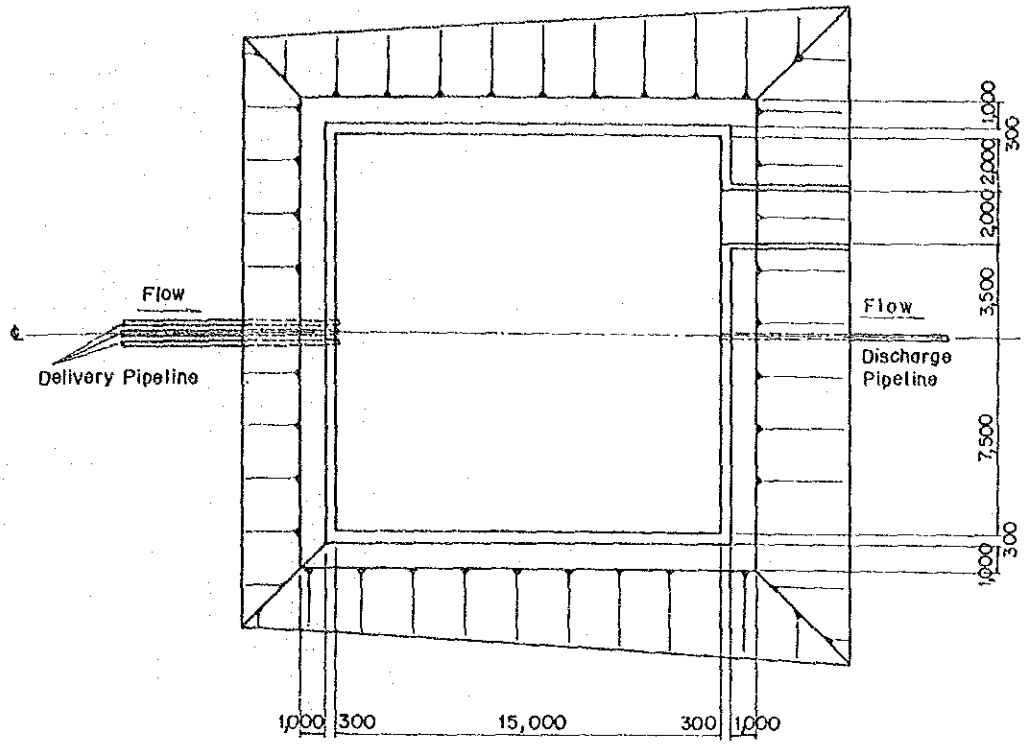


Settling Basin Plan

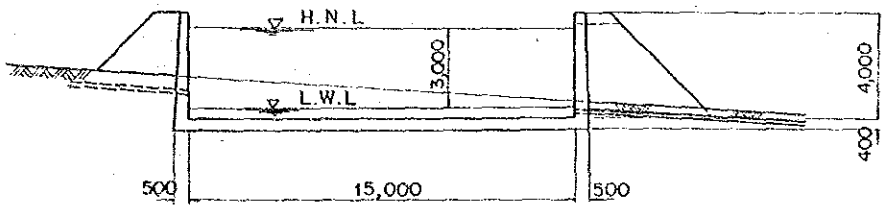


Setting Basin Profile

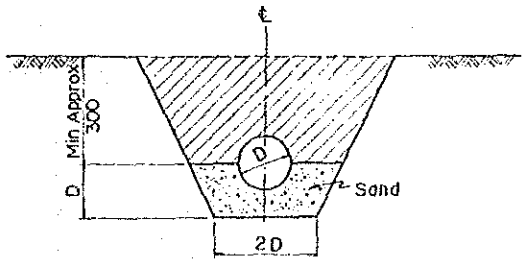
Fig. C.13 (2/3) Typical Design of Sprinkler Irrigation System



Farm Pond Plan



Farm Pond Profile



TYPICAL SECTION OF PIPELINE

Fig. C.13 (3/3) Typical Design of Sprinkler Irrigation System

Fig. C.14 IMPLEMENTATION SCHEDULE OF IRRIGATION PROJECTS

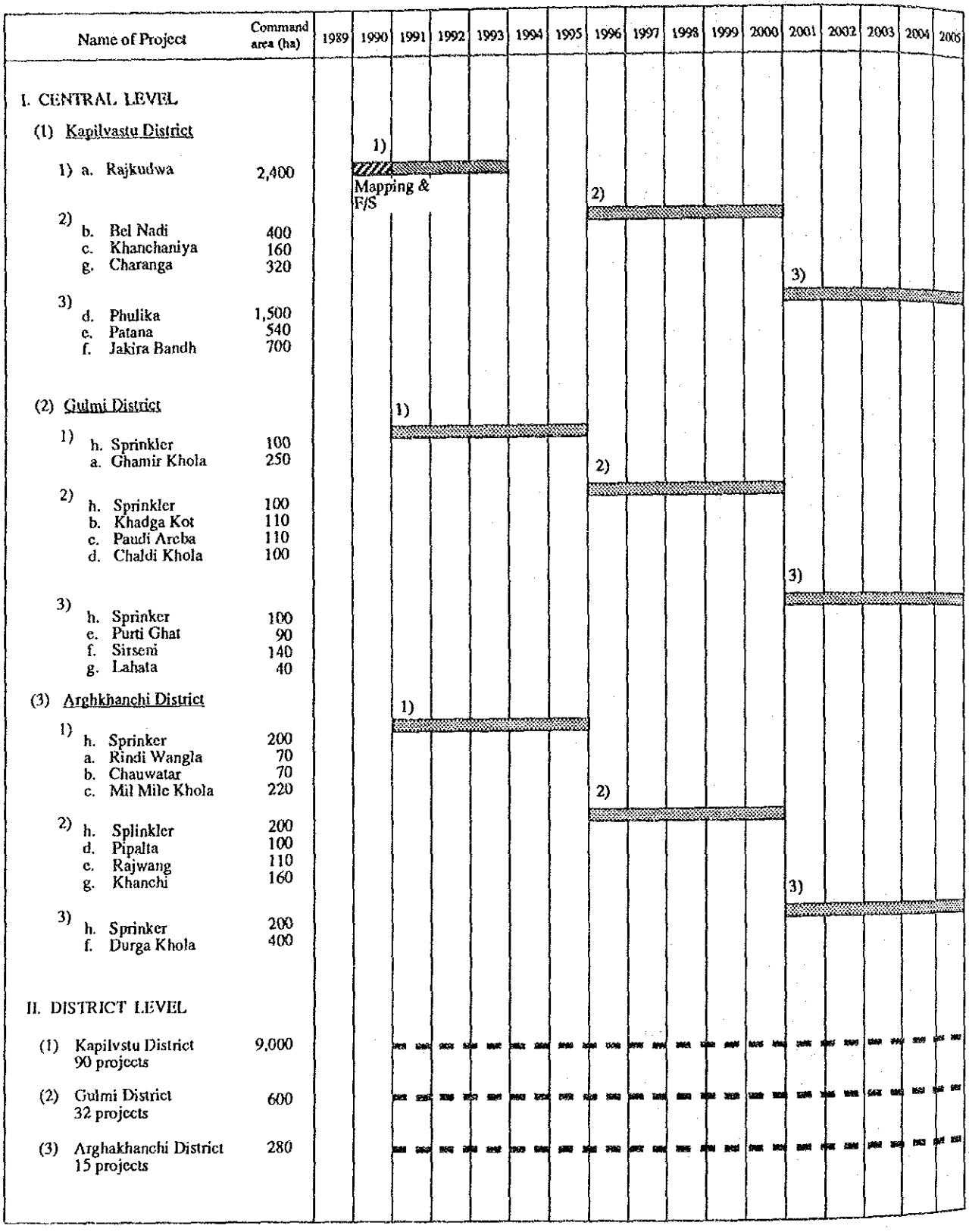
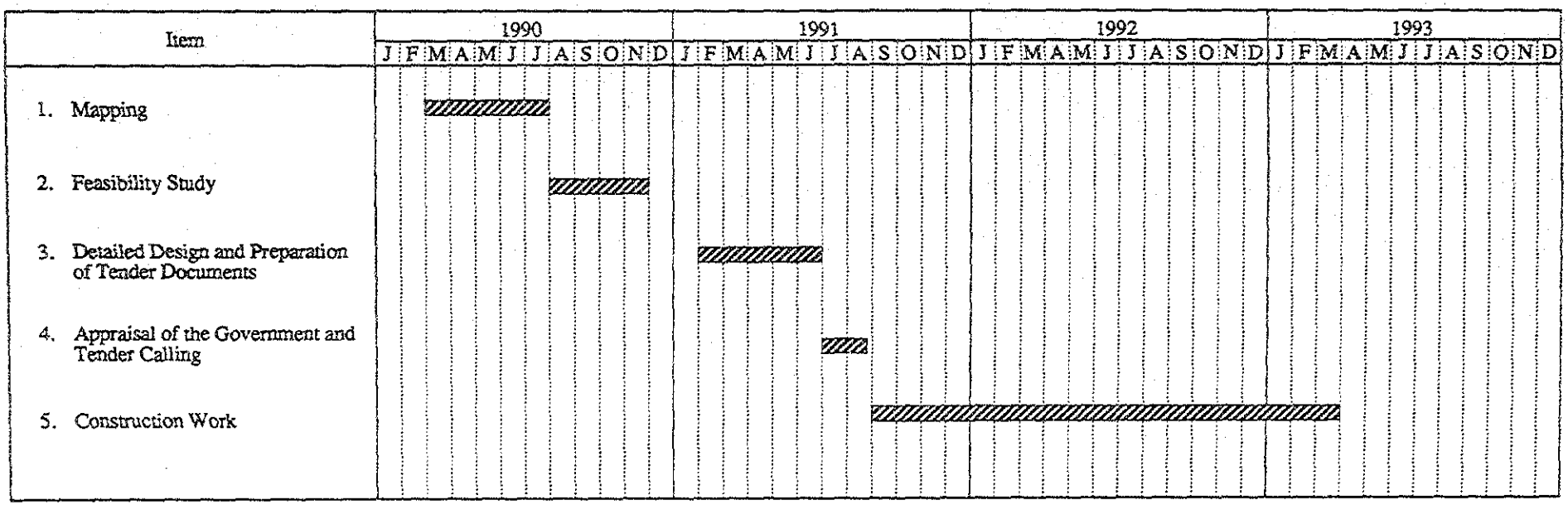


Fig. C.15 Implementation Schedule of Priority Projects (Irrigation)



APPENDIX

Major Existing Irrigation Projects and Schemes

Although details of existing irrigation projects have to be clarified by a water resources inventory study in future, the major ones completed so far or under construction are as follows.

a) Gulmi District

1) Argentichhap Chaur Irrigation Project

(1)	Irrigable area	:	50 ha (GCA)
(2)	Water resource	:	Argenti Khola
(3)	Major facilities	:	Headworks
			Canals; (not recorded)
(4)	Executing body	:	Department of Irrigation, MOWD
(5)	Fund source	:	HMGN
(6)	Completion	:	Not recorded
(7)	Present situation	:	Functioning well for monsoon paddy.

2) Aapchaur Coffee Kheti

(1)	Irrigable area	:	75 ha (GCA)
(2)	Water resource	:	Gyadi Khola
(3)	Major facilities	:	Intake
			Canals; (not recorded)
(4)	Executing body	:	Department of Irrigation
(5)	Fund source	:	HMGN
(6)	Completion	:	1988/89
(7	Present situation	:	Not completed yet.

b) Arghakhanchi District

1) Pharsawa Naya Kulo System

(1)	Irrigable area	:	20 ha (GCA)
(2)	Water resource	:	Wakla Khola
(3)	Major facilities	:	Permanent headworks
			Canal (5.1 km)
			Aqueduct (1 no.)
			Superpassage (10 nos.)

(4)	Executing body	:	MPLD
(5)	Fund source	:	Grant by West Germany
(6)	Completion	:	1984
(7)	Present situation	:	Functioning well

2) Khahare Khet Kulo System

(1)	Irrigable area	:	100 ha (GCA)
(2)	Water resource	:	Keduma Khola
(3)	Major facilities	:	Temporary headworks
			Canal (5.5 km)
			Cross drain (9 nos.)
(4)	Executing body	:	Farmers' community
(5)	Fund source	:	Farmers' community and HMGN
(6)	Completion	:	Not recorded
(7)	Present situation	:	Functioning in the monsoon season

3) Sera Kulo System

(1)	Irrigable area	:	70 ha (GCA) in the monsoon season
			20 ha in the dry season
(2)	Water resource	:	Khanchi Khola
(3)	Major facilities	:	Temporary intake
			Canal (3 km)
(4)	Executing body	:	Farmers's community
(5)	Fund source	:	Farmers's community
(6)	Completion	:	Not recorded
(7)	Present situation	:	Functioning

4) Khamari Kulo System

(1)	Irrigable area	:	30 ha (GCA)
(2)	Water resource	:	Mandre Khola
(3)	Major facilities	:	Permanent intake
			Canal (1.5 km)
(4)	Executing body	:	Lumbini Farm Irrigation Project, DOI
(5)	Fund source	:	HMGN
(6)	Completion	:	1988
(7)	Present situation	:	Functioning well

c) Kapilvastu District

1) Banganga Irrigation Project

(1)	Irrigable area	:	6,000 ha in the rainy season 2,850 ha in the dry season
(2)	Water resource	:	Banganga river 0.25 m^3/sec Kaila river 0.42 m^3/sec
(3)	Major facilities	:	Headworks Reservoir (85 ha, 4.76 x 10^6 m^3) Link canal (4.75 km) Main canal (20.5 km) Distributory canals (3 nos., 2.5 km, 4.5 km, 5.5 km) Minor distributories (30 nos.) Tertiary canals constructed by farmers (____km)
(4)	Executing body	:	Department of Irrigation
(5)	Fund source	:	ADB and HMGN
(6)	Completion	:	In July 1989
(7)	Present Situation	:	Functioning fairly well.

2) Kapilvastu Tubewell Project (Investigation Project)

(1)	Irrigable area	:	-
(2)	Major facilities	:	Deep tubewells (39 nos.) Shallow tubewells (35 nos.) Pumps installed (7 deep tubewells)
(3)	Executing body	:	Department of Irrigation
(4)	Fund source	:	Supply of drilling rigs and tubewell construction materials by grant of Japanese Government and UNDP, and construction cost by HMGN
(5)	Completion	:	This investigation project is scheduled to be ended in July 1989, and actual implementation will be started in 1989 under the irrigation lines of credit by the World Bank

3) Surai Irrigation Project

(1)	Irrigable area	:	400 ha
(2)	Water resource	:	Surai river

(3)	Major facilities	:	Headworks Main canal (5 km) Distribution canals (4 nos.)
(4)	Executing body	:	Department of Irrigation
(5)	Fund source	:	HMGN
(6)	Completion	:	Not recorded
(7)	Present situation	:	Not functioning well because of damage and sediment to headworks and breach and sediment to canals.

4) Jamai Irrigation Project

(1)	Irrigable area	:	270 ha
(2)	Water resource	:	Jamai river
(3)	Major facilities	:	Headworks Canals (6 km)
(4)	Executing body	:	Department of Irrigation
(5)	Fund source	:	HMGN
(6)	Completion	:	Not recorded
(7)	Present situation	:	Not functioning well because of damage and sediment to headworks and canals.

5) Bhutaha Bandh Scheme

(1)	Irrigable area	:	1,520 ha
(2)	Water resource	:	Bhutaha Nala
(3)	Major facilities	:	Temporary headworks Main canal (12.5 km)
(4)	Executing body	:	Farmers' community
(5)	Fund source	:	Farmers' community and HMGN
(6)	Completion	:	Not recorded
(7)	Present situation	:	Irrigated only in the monsoon season because of few water of the Nala in the dry season

6) Murthi Nala (Pakadi) Scheme

(1)	Irrigable area	:	720 ha
(2)	Water resource	:	Murthi Nala
(3)	Major facilities	:	Permanent headworks Canals (13 km of both main and 3 branches)
(4)	Executing body	:	Farmers' community

(5) Fund source : Farmers' community and HMGN
(6) Completion : Not recorded.
(7) Present situation : Irrigated only in the monsoon season because of less flow in the dry season.

7) Pattharkot Bandh (Gurumuwa Khola)

(1) Irrigable area : 480 ha
(2) Water resource : Gurumuwa Khola
(3) Major facilities : Permanent headworks
Canals (14 km)
(4) Executing body : Farmers' community
(5) Fund source : Farmers' community and HMGN
(6) Completion : Not recorded.
(7) Present situation : Irrigated 200 ha for year round.

d) Rupandehi District

1) Bhairahawa - Lumbini Groundwater Project (stages I, II, and III)

i) Stage I (completed)

(1) Irrigable area : 7,680 throughout the year
(2) Water resource :
- Deep tubewells with turbine pumps and pump houses (64 Nos.)
- Average discharge per tubewell (125 l/sec)

(3) Major facilities :
- Canals (Lining 80 km, earth 146 km)
- Field canals constructed by beneficiaries (370 km)
- Gravelled farm roads (96 km)
- Electric transmission lines (96 km)

(4) Executing body : Department of irrigation
(5) Consultant : Tahal Consulting Engineers, Ltd., Israel
(6) Fund source : The World Bank and HMGN
(7) Completion : July 1983
(8) Present situation : Functioning well.

ii) Stage II (under construction)

(1) Irrigable area : 1,920 ha (Phase I)
2,640 ha (Phase II)

(2) Water resource : - Deep tubewells with turbine pumps and Pump houses (16 nos., in Phase I and 22 nos. in Phase II)
- Average discharge per tubewell (125 l/sec)

(3) Major facilities : - Head tanks and pipe lines (126 km, for phase I)
Head tanks and pipe lines (proposed) (196 km, for phase II)
- Gravelled farm roads (27 km for phase I and 28.5 km for phase II)
- Electric transmission lines (36 km for phase I and 26 km for phase II)

(4) Executing body : Department of Irrigation

(5) Consultant : Tahal Consulting Engineers, Ltd.

(6) Fund source : The World Bank and HMGN

(7) Completion : Yet to be set.

iii) Stage III (under planning)

(1) Irrigable area : 20,000 ha in gross

(2) Nos. of tubewell : Not clarified yet

2) Marchawar Lift Irrigation Project

(1) Irrigable area : 5,770 ha

(2) Water resource : River flow at confluence of the Tinau and the Dano

(3) Major facilities : - Pump station with 4 nos. of 0.75 m^3/sec centrifugal pump and 6 nos. of 0.65 m^3/sec centrifugal pump (to be completed in 1988/89)
- Electric transmission line 18 km
- Desalting basin 1 no
- Canals;

Link	3 km
Main	9 km
Main tributary	12.7 km
Other canals	64 km
Service roads;	
Main	20 km

		Sub-main	1.3 km
		Secondary	0.4 km
(4)	Executing body	:	Department of Irrigation
(5)	Consultant	:	Delft Hydraulics of Netherland
(6)	Fund source	:	UNCDF and HMGN
(7)	Completion	:	Pump station with pumps, main canal, 2 branch canals and transmission line will be completed in 1988/89, and completion of other facilities such as secondary and tertiary canals, service roads, etc., is depending on the fund to be provided.
(8)	Present situation	:	Not functioning at all because the pump station is yet to be constructed.

3) Tubewell Water and Distribution Project

(1)	Irrigable area	:	1,000 ha
(2)	Water resources	:	- Deep tubewells (18 nos.) - Average discharge per well (50 l/sec)
(3)	Major facilities	:	- Pump houses - Water measuring tanks - Operator hats - Brick lined canals - Field canals constructed by beneficiaries (____km)
(4)	Executing body	:	Farm Irrigation and Water Utilization Division (FIWUD), MOA
(5)	Consultant	:	None
(6)	Fund source	:	HMGN
(7)	Completion	:	July 1985
(8)	Present situation	:	Most of these systems are functioning fairly well

4) Siyari Irrigation Project

(1)	Irrigable area	:	1,000 ha
(2)	Water resource	:	Siyari/Ranibar rivers and spring
(3)	Major facilities	:	- Barrage with 6 gates - Intake; 1 no - Canal ; 3 km

- Field canals constructed by beneficiaries; _____ km

(4) Executing body : Department of Irrigation, Hydrology and Meteorology, MOWR

(5) Fund source : HMGN

(6) Completion : July 1983

(7) Present situation : Functioning fairly well.

5) Sorah - Chattis Mahja Kulo Irrigation Scheme

(1) Irrigable area : 12,000 ha

(2) Water resource : Tinau river at Butwal

(3) Major facilities :
- Intake; 2 nos.
- Walled flow control device; 1 no.
- Main canal;
  12 km long Sorah Mahjo Kulo
  12 km long 36 Mahjo Kulo
- Field canals constructed by beneficiaries (____ km)

(4) Executing body : Farmers' community

(5) Fund source : Farmers' community and HMGN

(6) Completion : Around 1932

(7) Present situation : Not functioning well because of damage and sediment to intake and control device and breach and sediment to main canals

6) Panch Majha - Aath Majha Kulo Scheme

(1) Irrigable area : 11,200 ha

(2) Water resource : Dano river

(3) Major facilities : Intake; 1 no
Canals; 26 km

(4) Executing body : Farmers' community

(5) Fund source : Farmers' community and HMGN

(6) Completion : Not recorded

(7) Present situation : Not functioning well because of damage and sediment to intake and breach and sediment to canals

7) Mahau Irrigation Scheme

(1)	Irrigable area	:	2,880 ha
(2)	Water resource	:	Mahau river
(3)	Major facilities	:	Intake; 1 no Canals; 9.6 km
(4)	Executing body	:	Farmers' community
(5)	Fund source	:	Farmers' community and HMGN
(6)	Completion	:	Not recorded
(7)	Present situation	:	Not functioning well due to damage and sediment to intake and breach and sediment to canals

ANNEX D

MARKETING AND PROCESSING

THE MASTER PLAN STUDY
ON
THE INTEGRATED RURAL DEVELOPMENT PROJECT
IN
THE LUMBINI ZONE

ANNEX D MARKETING AND PROCESSING

Table of Contents

List of Tables

List of Figures

1. PRESENT SITUATION AND CONSTRAINTS

1.1 Agricultural Input Supply

1.1.1 Supply System in Nepal

Agricultural inputs such as fertilizers, agro-chemicals, certified seed and tools are procured by the Agricultural Input Corporation (AIC), and AIC operates 11 zonal offices and 64 branch or sub-branch offices to supply inputs to district level. In the district level, branch or sub-branch offices wholesale inputs to retailers such as cooperatives and individual dealers, and retailers retail inputs to farmers. In 1988, AIC appoints 672 cooperatives and 1,088 individual dealers as retailers to retail in the whole country.

(1) Fertilizers

All of the fertilizers and agro-chemicals are imported because Nepal has no source of fertilizers and agro-chemicals, and are procured through the international tender or foreign assistance. These fertilizers and agro-chemicals procured by AIC are transported to the 13 border towns located at Nepal-India border sides through India. The AIC owns warehouses for the fertilizers and agro-chemicals at the 13 border towns, and transport the fertilizers and agro-chemicals the wholesale points in each districts. The import amount of major fertilizers during 1983/84 to 1986/87 are as follows;

(unit:ton)

Item	1983/84	1984/85	1985/86	1986/87
Ammonium sulphate	6,300	-	5,000	8,390
Urea	30,000	45,100	62,100	60,270
Complex	36,930	53,000	70,200	53,810
Potash	-	2,000	-	60
TSP	5,000	-	-	7,340
Total	78,230	100,100	137,600	129,870

Source: Some Important Statistics in Agriculture, Nepal Rastra Bank, 1987.
Foreign Trade Statistics, 1986/87.

(2) Seed Multiplication and Processing

Certified seed of cereals and vegetables are produced and marketed by AIC. Research stations under the National Agricultural Research Service Center (NARSC) develop and introduce the new varieties of crops, and multiplicate Breeders seed. NARSC supplies the breeders seed to AIC. From breeders seed, AIC multiplicates foundation seed and certified seed. Foundation seeds is multiplicated in the government seed farms, but certified seed is produced by the contract seed growers under the supervision of AIC. AIC tests processes the seed, and supply seed as the certified seed to each district. There are 6 cereal seed processing plants in Nepal as follows;

Location	Capacity	Location	Capacity
Hetauda	3 ton/hr.	Bhairahawa	2 ton/hr.
Janakapur	1 ton/hr.	Ithahali	2 ton/hr.
Nepalganj	1 ton/hr.	Dhangadi	0.3 ton/hr.

Source: Agricultural Input Corporation, Annual Report, 1988.

AIC produces vegetable seed mainly in the hill and mountain districts, and processes in each production point using small processing machines. The main production districts and main seed are as follows;

District	Vegetable
Dolpa	Cauliflower
Mustan	Cabbage and Carrot
Kaski	Broad leaf mustard
Rukum	Onion
Kathmandu valley	Radish
Sarlahi	Summer vegetables (tomato, okra, pea, pumpkin, gourds)
Terhathum, Bhojpur,Dhankuta	Radish, beans, cauliflower, pea

Source: Agricultural Input Corporation, Seed Division.

(3) Price of Inputs

AIC functions as a wholesaler to supply the inputs to cooperatives and individual dealers through the branch and sub-branch offices. Wholesale prices of inputs are regulated at same level throughout the country by subsidizing costs of transportation. The current prices of inputs of AIC are shown on Table D.1.1.

Cooperatives and individual dealers purchase inputs from AIC, and retail to farmers. Farmers purchase inputs from the above retailers, however, the retail prices of inputs are not fixed mainly because transportation cost depends on the locations. As the result, prices of inputs in the hill area is higher due to transportation from AIC wholesale points.

1.1.2 Input Supply in the Project Area

In the project area, the AIC Lumbini zonal office is located at Bhairahawa. This zonal office supervises procurement and supply of inputs. Under this zonal office, the branch offices and depot are located in districts. These offices have storage facilities in the project area as follows;

District	Location	Office	Purpose	No. of storage	Capacity (ton)
Rupandchi	Bhairahawa	zonal	fertilizer	3	5,000
			seed	3	1,400
Kapilvastu	Taulihawa	branch	fertilizer	1	1,000
			seed	1	250
Kapilvastu	Krishnanagar	branch	fertilizer	1	500
Gulmi	Tamghas	branch	fertilizer	1	250
	Majuwa	depot	seed	1	40
Arghakhanchi	Sandhikharkha	branch	fertilizer	1	150

Source: Agricultural Input Corporation, Annual Report, 1988.

(1) Fertilizers

It is estimated that about 10% of fertilizers imported to Nepal are supplied for the project area. Sales amount of AIC to retailers in 1987/88 is shown in the following table;

(Unit:ton)

Item	Rupandchi	Kapilvastu	Gulmi	Arghakhanchi	Total
Complex	1,537	1,524	86	73	3,220
Urea	4,064	2,463	272	190	6,989
D.A.P.	593	561	-	-	1,154
T.S.P.	1,126	585	118	59	1,888
Potash	52	68	6	9	135
Total	7,372	5,201	482	331	13,386

Source: Agricultural Input Corporation, Lumbini Zonal Office.

Sales amount of AIC in the past five years are shown in Table D.1.2. Supplied amount in the project area has been increasing during this periods, and 1,810 tons of nitrogen, 760 tons of phosphate and 80 tons of potassium were annually supplied on average in nutrient content base. Out of these amount of fertilizers, over 90% are supplied to Terai area, on the other hand the hill area received less than 10%.

According to the Lumbini zonal office of AIC, almost 60% of fertilizer is applied for wheat crop in winter season and other 40% is for paddy crops. Assuming that all the fertilizers sold by the AIC was used in the farmers field, the average dosage per ha of nitrogen and phosphate is estimated as follows;

Area	Crop	Cropped/1 area (ha)	Fertilizers/2 amount (ton)		Average dosage (kg/ha)
Terai area	Wheat	50,250	N	1,770	35.3
			P	800	15.9
	Paddy (Irrigated)	56,900	N	1,180	20.7
			P	540	9.5
Hill area	Wheat	6,930	N	130	18.8
			P	70	10.1
	Paddy	8,900	N	90	10.1
			P	45	5.0

/1 : Refer to Annex A.
/2 : Calculated the average sales based on of nutrient content as shown in Table D.1.2.

The average dosage of fertilizers indicated that 1) generally applied amount is very low in term of requirement of crop production, and 2) average dosage in the hill area is almost a half amount of the Terai area. These indicate that the present amount of fertilizer is not enough for increasing crop production, and short supply of fertilizer is one of the main reasons of stagnation of low crop yields.

When the price of fertilizer in India is higher than Nepal, some amount of fertilizer are sold to India through open border in the process of marketing to farmers. At that time, fertilizer supply to farmers in Nepal is seriously short.

(2) Certified Seeds

Certified seed of wheat, paddy, maize and vegetables are produced under the Lumbini zonal office under the Seed Production and Marketing Project under the assistance of

GTZ. These seeds are mainly multiplied in the contract farmers' fields. These contract farmers receive materials and technical assistance from AIC and to sell seeds to AIC. In 1987/88, AIC collected 505 tons of wheat seed and 15 tons of paddy seed through about 700 ha of contract seed growers' field. These seeds are supplied to the western region.

Sales amount of certified seed from AIC to retailers in 1988/89 are shown as follows;

Item	Rupandehi	Kapilvastu	Gulmi	Arghakhanchi	Total
Wheat	63 tons	23 tons	14 tons	13 tons	113 tons
Maize	0.6 tons	0.8 tons	0.6 tons	2 tons	4 tons
Paddy	19 tons	11 tons	0.5 tons	-	30.5 tons
Vegetable	146 kg	147 kg	283 kg	168 kg	744 kg

Source: Agricultural input Corporation, Lumbini Zonal Office.

It is estimated that these amount of seeds are covering only 1% and 3% of the cropped area of paddy and wheat in the project area, respectively.

(3) Retailers of Inputs

AIC Lumbini zonal office appoints 54 cooperatives and 56 individual dealers as retailers to distribute inputs as shown below;

District	Cooperative	Individual
Rupandehi	26	13
Kapilvastu	18	22
Gulmi	4	19
Arghakhanchi	6	2
Total	54	56

Source: Agricultural Input Corporation, Lumbini zonal office.

These retailers own or hire the storage space for inputs. No data is available storage facilities utilized by cooperatives and individual dealers.

According to the interview survey on agricultural input supply, it is estimated that the existing storage facilities are mostly deteriorated, and the total capacity and the number of the warehouses of cooperatives and individual dealers are not enough to supply input to

farmers to conduct proper farming practices. Retailers and farmers in the hill area are suffered from high transportation cost. In addition to these, the number of cooperatives established in the hill area are limited to supply enough inputs.

1.2 Marketing of Agricultural Products

1.2.1 General

Marketing aspects of agricultural products are depending on the commodities and the geographical condition. In the hill area, production of food grains is not sufficient, and the supplemental food grains are transported from the Terai districts in large quantity to sustain the population. On the other hand, farmers in the Terai have marketable surplus in food grain production, and the surplus are conveyed to the hill area and outside the area such as Kathmandu, Pokhara and India.

Marketing channel of food grains is broadly divided into two categories, i.e. one is the private sector and the other is National Food Corporation (NFC), the government organization. Cooperatives have also marketing function of grains, but this channel is involved in the above two channels, and is not functioned well.

Vegetables, sugarcane, oil seeds,pulses and tropical fruits are the main cash crops in the Terai area, and are marketed in the local markets through private dealers. The main cash crops in the hill area are coffee cherries, soybeans, ginger, medicinal herbs and ghee and these are transported to the Terai area, however, these production is very low at present

At the village level, a number of small periodical (usually weekly) markets (so called as "Haat Bazar") are opened under the supervision of the marketing committees of the village panchayats. These small markets provide farmers with opportunities to purchase daily commodities and to generate cash income by selling their products.

1.2.2 Estimation of Marketable Surplus of Food Grains

The marketable surplus of the main food grains such paddy, wheat, maize in the Terai are estimated on the basis of the present production and per capita consumption. The results of estimation are shown in Table D.1.3, and summarized as follows;

(unit : ton)

District	Production	Seed and Waste	Consumption in the Area	Marketable Surplus
Kapilvastu	162,600	21,100	55,200	86,300
Rupandehi	172,400	22,400	84,000	66,000
Total	335,000	43,500	139,200	152,300

Out of the total production of 335,000 tons, 182,700 tons or about 55% are consumed by the local people in the average year. Accordingly, the annual marketable surplus of food grains is estimated at about 152,300 tons or 45% of the total production.

1.2.3 Marketing Channel of Food Grains

Most of the surplus of food grains are marketed and collected at Bhairahawa, Butwal, Taulihawa and Krishnanagar in the project area. From these locations, grains are transported outside the project area. Therefore these four places are functioned as marketing centers.

In order to identify the marketing systems of food grains, the interview survey was conducted for small agents (village middlemen), rice mill owners, wheat mill factory, dull mill factories, merchants in Bhairahawa, Butwal, Taulihawa and Krishnanagar. The results of interview survey are presented in Table D.1.4. General marketing flows of paddy and wheat are illustrated on Figs.D.1.1 and D.1.2 respectively, and summarized as follows.

Paddy and maize is purchased by merchants through small commission agents from farmers and rice mill operators in the villages. Small commission agents transport and handle grains to merchants in the above four marketing centers. Merchants sell grains to the wholesalers and middlemen of the other districts such as Gulmi and Arghakhanchi, Kathmandu, etc.

NFC also purchase paddy, rice and maize from cooperatives, individual merchants and rice mill operators. The amount procured by NFC is about 2,000 to 3,000 tons or less than 2% of marketable surplus in the project area.

Wheat is purchased by the Lumbini Wheat Flour Mill through their purchase depots located at Bhairahawa and Krishnanagar. Annually this flour mill purchases about 6,000 tons from the project area. Other wheat purchased by merchants is transported to flour mills located at Hetauda, Birganji and Kathmandu.

While the main market centers in the Terai area are the above four locations, these locations do not cover the area along the East-West highway except near Butwal. Since the location of Gorusinge is the center of this area, it is considered to establish to wholesale market in Gorusinge by establishing the committee organized by the Ministry of Agriculture.

1.2.4 Food Grains Transported to Hill Area

On the basis of the results of the interview survey with merchants and NFC, the amount of food grains transported to Gulmi and Arghakhanchi districts is roughly estimated at nearly 20,000 tons annually as follows;

Market center	Amount(tons)	Destination
Private merchants		
Butwal	6,000	Gulmi and Arghakhanchi
Taulihawa	2,000	Arghakhanchi
Bhairahawa	10,000	Gulmi and Arghakhanchi
Subtotal	18,000	
Nepal Food Corporation		
	500	Gulmi
	800	Arghakhanchi
Subtotal	1,300	
Grand total	19,300 (approximately 20,000 tons)	

Out of 2,000 tons of grains transported to Gulmi and Arghakhanchi, it is estimated that nearly 2,000 tons are transported to Baglun or other districts located north of the project area. Accordingly, about 18,000 tons is consumed in the hill area in the project area. On the basis of this estimation, the present food balance in the hill area is estimated in Table D.1.5

1.2.5 Marketing of Other Commodities

(1) Terai area

In the project area, marketable surplus of pulses such as pigeon peas, dull are traded to other districts. Two dull mills located at Bhairahawa purchase pulses through their purchasing depots or through middlemen.

Although farmers have marketable surplus of mustard in the Terai area, mustard is traded and consumed only in the local area. Supply of mustard in the Bhairahawa market is not enough for local consumption, therefore mustard is brought from Dan and Citwan districts.

Sugarcane is also cash crop, and all the sugarcane is purchased by the the Mahendra Sugar Mill located at Bhairahawa. Other sugar mill factory located at Nawalparasi is going to be opened in 1990, and this mill will purchase sugarcane from the project area.

(2) Hill Area

Although the agricultural products in the hill area are consumed by local people, only small amount of soybeans, ginger, medicinal herbs, ghee and coffee is marketed as cash crops and transported to the Terai and other areas. Out of these cash crops, soybeans, ginger, medicinal herbs and ghee are purchased by the traders who may be wholesalers to bring food grains from Terai area to the hill area.

The cropped area of coffee is expanding and production of coffee is increasing gradually, because the government has been encouraging farmers to produce coffee and marketing channel has been arranged by the Nepal Coffee Company (NECCO). NECCO established the coffee processing plant in Rupandehi districts, and collects and processes the coffee cherries. NECCO establishes the seasonal purchasing depots at Ampchaur, Majuwa, Ulhi Khola and Baletakshar in the Gulmi district. Farmers in Arghakhanchi and Gulmi bring coffee cherries to these depots and sell to NECCO. The price of coffee cherries is regulated by the Coffee Committee which organized by the Coffee Development Center and the district Panchayat.

1.2.6 Small Market (Haat Bazar)

Periodical small markets called as Haat Bazar are established and operated by the Haat Bazar Operating and Developing Committee under the supervision of the Village Panchayat administration. The members of this committee are selected from the representatives of village panchayats, businessman (merchants), farmers and departments concerned such as Department of Food and Agricultural Marketing Services. The committee consists of sub-committees of advisory, marketing, advertising. Usually, facilities such as stoles and water supply are constructed through the people's participation.

Main function of Haat Bazar is to provide farmers with the opportunities to sell their products and to purchase daily commodities. Although a number of Haat Bazars are established and operated in the Terai area, while Haat Bazars in the hill area are established in the limited locations along the main road sides. This is because of that it is difficult to transport commodities due to the topographic condition, and farmers in the hill area has little marketable surplus.

The following Haat Bazars has been established in the study area at present;

District	No.	Locations
Gulmi	8	Ridi, Uli Khola, Shreenga, Biswash, Tamitaxsar, Jwang, Dhurkot, Purkot Daha
Arghakhanchi	3	Patharkot, Balkot, Thada
Kapilvastu		not available
Rupandchi	31	Semara, Mangalapur, Bhaluwari, Makrahar, Madhauliya, Gangoliya, Hati Farsatikar, Shankarnagar, Devdaha, Keruwani, Chhipagadha, Pokharbhindi, Dhakadhai, Majhagawa, Barsauli, Semari, Baitkuiya, Asuraina, Khurdabagar, Lumbini, Bhagawanpur, Jogeda, Suryapur, Dayanagar, Kamhariya, P. Amuwa, Sau. Farsatikar, Manpakadi, Saljhandi, Parroha, Gajedi

Source : District Profile, 1988.

These markets have no facilities such as rain shades, cemented floors and water supply, sanitation, and is inconvenient for farmers and dealers.

1.2.7 Price of Products

Although the price of agricultural products is principally determined by the balance of demand and supply, Nepal Food Corporation sets the minimum supporting prices for food grains. The minimum support prices are listed as follows;

Commodity	Price (Rs/ton)	Commodity	Price (Rs/ton)
Paddy (coarse)	2,400	Wheat (hill)	3,000
Paddy (fine)	2,500	Wheat (Terai)	2,450

Source : Agricultural Marketing Information Bulletin, 1988, Marketing Service Division, Department of Food and Agricultural Marketing Services.

The farmgate prices, wholesale prices and retail prices are different depending on the locations and seasons. Generally, prices in the hill area are higher than those in the Terai area in the same season, and in harvest season is lower than off season. The average prices of agricultural commodities are listed in Annex A.

1.3 Processing of Agricultural Products

1.3.1 Processing of Paddy, Wheat and Mustard

(1) Small Rice Mill

According to the Department of Cottage and Small Industry, there are about 1,568 small scale mills for cereals and oil seeds in the project area, consists of 246 mills in the hill area and 1,322 mills in the Terai area. In the hill area, 30% of mills or 73 mills are driven by water turbine, and another 70% of mill are driven by the diesel engines. In the Terai area, main power source of mills are electric motor and diesel engines. The milling recovery rate of these mills are about 60%.

According to the field interview and the socio-economic survey, it is estimated that the average capacity of the mills are about 0.2 ton/ha for water turbine mills and 0.25 ton/hr for diesel engine mills in the hill areas and 0.5 ton/hr in the Terai area. On the basis on these mill capacity, the total milling capacity is estimated as follows;

District	Number of mills	Processing capacity (ton/hr/unit)	Total capacity (ton/month)
Gulmi			
Water turbine	30	0.2	1,050
Diesel	96	0.25	4,200
Arghakhanchi			
Water turbine	43	0.2	1,510
Diesel	77	0.25	3,370
Total in hill	246		10,130
Kapilvastu	461	0.5	40,340
Rupandchi/1	861	0.5	75,340
(Marchawar)	(24)	(0.5)	(2,100)
Total in Terai	1,322	-	115,680

/1 : Rupandchi includes Marchawar area.
Source: Department of Cottage and Small Industries.

Total processing capacity for cereals in the project area is estimated at 10,130 tons/month in the hill area and 115,700 tons/month in the Terai area. The annual cereal production in the project area is estimated at 71,900 tons in the hill area and 335,100 tons in

the Terai area (refer to Annex A, Agriculture and Agro-economy). The milling capacity in the Terai area is enough to process all the cereals within three month. However, it takes more than seven month to process all the cereals in the hill area. This indicates that the farmers in the hill area process their products manually in their houses by the family members.

(2) Medium and Large Scale Rice Mill

In Taulihawa, there are two large scale rice mills and some medium scale rice mills. Large scale mills are Kapilvastu Rice Mill and Sarda Rice Mill, and both have the processing facilities of 1 ton/ hr. with 60 horse power. In Krishnanagar, there are two large scale rice mills, namely Krishna Rice Mill and Laxmi Rice Mill.

Merchants owns medium scale mills of which capacity is 200 to 300 kg/hr. with 20 to 30 horse power in the marketing centers such as Bhairahawa, Butwal, Krishnanagar and Taulihawa.

1.3.2 Coffee Processing Factory

The coffee processing factory of the Nepal Coffee Company is located at Manigram near Bhairahawa. This factory consists of one unit of huller (500 kg/hr.), one roaster machine (25 kg/hr.) and one grinder (25 kg/hr.), and has the capacity to process 200 kg of coffee cherry per shift (12 hours operation). The production amount of coffee cherry is small at present, and the procurement of coffee cherry is not enough for the factory. According to the company, about 16 tons of coffee was processed in this factory in 1987/88.

The Central Food Research Laboratory of the Ministry of Agriculture established a small coffee processing plant at Ampchaur village in Gulmi district in 1982. The purpose of this small plant is to demonstrate the processing process of coffee for the coffee farmers. This plant consists of one pulper (40 kg/hr.), one huller (20 kg/hr), one roaster (20 kg/hr.) and one grinder (1 kg/hr.). Presently, this plant is not operated because operator is not appointed and there is no power.

1.3.3 Sugar Mill

Mahendra Sugar Mill has been operated in Bhairahawa. This sugar mill is a private company and produces sugar and liquor. Although the installed capacity is 50 tons/day of sugarcane with the recovery rate of 8.5% and 6 klit../day of liquor, the production of sugar is less than 70% of the capacity owing to the shortage of supply of sugarcane, which is

brought in from the Rupandehi, Kapilvastu and Nawalparasi. In 1986/87, this factory employed about 800 persons, produced 5,400 tons of sugar and 259,000 lit. of alcohol.

1.3.4 Dull Mill

There are two large scale dull mills (Arpit Dull Mill and Durga Dull Mill) of the private sector located at Bhairahawa. The Arpit Dull Mill was established in 1986. Processing facility consists of huller and grinder, and 3 warehouses are equipped in this dull mill. The Durga Dull Mill was established in July 1989. Processing facility consists of huller (roller), brun (polisher) and grinder. Capacity of this mill is 12.5 tons per day.

1.4 Institutional Supporting System of Marketing and Processing

1.4.1 Marketing of Agricultural Products

(1) Department of Food and Agricultural Marketing Services (DFAMS)

Statistics and data on production, cropped area, unit yield, prices concerning to agriculture information and policies on marketing aspects of agricultural products are provided by Department of Food and Agricultural Marketing Services (DFAMS), under the Ministry of Agriculture

DFAMS consists of Agricultural Statistic Division and Marketing Services Division, and has the districts offices in Parsa, Dhanusha, Morang, Kaski, Rupandehi, Banke, Kailali and Doti districts. In other districts, some staff of DFAMS are appointed in the Agricultural Development Office. In the project area, DFAMS office is located at Bhairahawa.

DFAMS prepared the program to fulfil the basic needs of the country in terms of marketing aspects of vegetables and fruits. According to the program, wholesale markets will be established at Bhairahawa and Taulihawa by 1995 and at Butwal and Tansen by 2000.

(2) National Food Corporation (NFC)

National Food Corporation (NFC) is the government organization to market food cereals, and its functions are to stabilize the price of foods through purchasing at the minimum support prices and to store emergency stock.

In the Lumbini zone, the zonal office of NFC is located at Bhairahawa in Rupandehi District. Under the zonal office, there are one branch office at Tansen in Palpa district, one sub-branch at Tamghas in Gulmi district, and one sub-branch at Sandhikharkha in Arghakhanchi district. Two depots are located at Majuwa and Chaurasi Phant for distributing foods in Gulmi district.

In the project area, NFC procures food grains, mainly rice, through the cooperatives, the private merchants and rice mill owners in Rupandehi and Kapilvastu districts in Terai area, and transports to Gulmi and Arghakhanchi districts in the hill area. According to the zonal office of NFC, amount procured in Terai area and transported to hill area by NFC in 1984/85 to 1987/88 are as follows :

Fiscal year	Procured amount (ton)	Transported amount (ton)	Destination
1984/85	2,200	380 690	Gulmi Arghakhanchi
1985/86	3,660	830 930	Gulmi Arghakhanchi
1986/87	120	380 900	Gulmi Arghakhanchi
1987/88	2,960	470 540	Gulmi Arghakhanchi
Average	2,240	520 770	Gulmi Arghakhanchi

Source: Zonal office, Nepal Food Corporation, Bhairahawa.

Procured amount of food grains is fluctuated year by year depending on the market prices of grains. When production of food grains in the Terai area was low because of flooding or drought, market price was high and farmers and private dealers didn't sell grains to NFC at the minimum support price.

NFC owns the storage facilities as listed below;

District	Number	Total Capacity (ton)
Gulmi	1	250
Arghakhanchi	1	250
Kapilvastu	1	1,000
Rupandehi	3	3,000
Total	6	4,500

Source : Lumbini zonal office, Nepal Food Corporation.

1.4.2 Processing

Processing of agricultural products is developed and extended by the Central Food Research Laboratory. Department of Cottage and Small Industry is regulating and encouraging to establish small processing industries such as rice mills, flour mills, oil mills, food industries through registration system. After registration, these processing industries can receive credits and loans from commercial banks and Agricultural Development Bank.

1.4.3 Credit

There are two main sources of credit and loans for agricultural production, marketing and processing. One is the Agricultural Development Bank of Nepal, and the other is the commercial banks such as Nepal Bank Ltd, Rastriya Banijya Bank and Nepal Arab Bank Ltd.

(1) Agricultural Development Bank (ADB/N)

ADB/N is the main source of institutional credit in agriculture, and extends short, medium and long-term loans to individual farmers, groups of farmers, cooperative societies and village-committees. In recent years, overall lending covers more than 25% of total agricultural credit needs. ADB/N's financial position is sound, and loan recovery has been under the satisfactory circumstances.

Repayment performance of cooperative societies, however, has been poor and a number of government programmes are underway to improve the functioning of these important groups. Loans are extended by ADB/N for a wide variety of purposes, including irrigation, ware-housing and marketing. Interest rates vary with loan purpose between 6 to 15 percent.

In the project area. ADB/N zonal office is located at Bhairahawa. Under the zonal office, there are 3 branch offices in the Terai area and 2 sub-branch offices in the hill area. These branches and sub-branches provide credit in two kind of mode, i.e. direct lending and indirect lending. Loan disbursement and repayment collection by ADB/N in 1986/87 are as follows:

District	Loan Disbursement		Repayment Collection	
	Target	Achievement	Target	Achievement
Rupandehi	10,233	13,602	8,688	10,790
Kapilvastu	7,449	5,423	3,178	2,368
Arghakhanchi*	1,796	2,322	1,428	1,875
Gulmi	5,377	5,956	4,264	4,051

*: Figures in 1985/86

ADB/N is implementing the Small Farmers Development Project (SFDP) to increase income of small farmers and to improve their living standards through providing loans and technical assistance. The following Small Farmers Development Project are implemented by ADB/N:

District	Branch office	Existing	Under process
Gulmi	Tamghas	-	3 projects
Arghakhanchi	Sandhikharkha	-	3 projects
Kapilvastu	Krishnanagar	1 project	-
	Taulihawa	4 projects	1 project
Rupandehi	Bhairahawa	2 projects	1 project
	Butwal	5 projects	-
Total		12 projects	8 projects

(2) Commercial Bank

There are 25 branches of the three commercial banks such as Nepal Bank Ltd, Rastriya Banijya Bank and Nepal Arab Bank Ltd in the project area as follows;

District	Nepal Bank Ltd	Rastriya Banijya Bank	Nepal Arab Bank Ltd	Total
Gulmi	0	3	0	3
Arghakhanchi	1	3	0	4
Kapilvastu	1	2	1	4
Rupandehi	7	5	2	14
Total	9	13	3	25

Source : Banking Operations Department, Nepal Rastra Bank.

Credit provided for the primary sectors such as agriculture, industry and service in 1985/86 is shown Table D.1.6, and summarized as follows;

(Unit : Rs 1,000)

District	Total	Agriculture	Industry	Service
Gulmi	1,093	350	553	3,190
Arghakhanchi	618	138	352	129
Kapilvastu	2,219	338	1,406	457
Rupandehi	52,197	4,849	44,373	2,972
Total	56,127	5,675	46,684	3,766

Source : Banking Operations Department, Nepal Rastra Bank.

In the project area, the total credit amount was Rs 56.1 million. Out of Rs 56.1 million, Rs 5.7 million or about 10% was provided for agriculture.

1.4.4 Cooperatives

Cooperatives has been developed to provide individual farmers with credits and marketing channel of inputs, products and essential goods. Farmers purchase farm inputs and consumer goods, and sell their products mainly wheat and rice through cooperatives. The following cooperatives have been established in the project area.

District	Number of Societies	Membership
Gulmi	6	Not available
Arghakhanchi	4	8,592
Kapilvastu	19	53,887
Rupandehi	26	47,740
(Marchawar)	(5)	10,704

Source : District cooperative offices in the study area.

The district cooperative office in each district is headed by the board of directors, who are elected by the cooperative members, and one cooperative officer is appointed from the government. In each cooperative, main staff consist of a cooperative manager, accountant and salesmen. The cooperative manager receives the periodical training by the government.

Some of cooperatives own the storage facilities for inputs mainly fertilizers to sell to farmers and to store the products purchased from farmers as follows;

District	No.	Total Capacity (tons)
Rupandehi	15	2,550
Kapilvastu	5	500
Gulmi	1	100
Arghakhanchi	0	0
Total	21	3,150

Source: District Profile, 1988.

The cooperatives not functioned well at present due to short of management training and operation fund. It is important to reinforce the activities of cooperatives for increase in income and improvement of living condition of farmers through providing inputs and daily essential commodities. Reinforcement could be made through management training, improvement of marketing facilities and financial assistance by the government.

1.5 Constraints for Development

(1) Input Supply

1) Input Supply by the AIC

- Quantity of inputs allocated by AIC in the project area are not enough for the requirement in the project area.

- In the hill area, capacity of storages is small and their locations are limited. This is resulted in the limited supply to the retailers.

2) Retailers

- Although the cooperatives should be the main distributors in the Terai area, only limited cooperatives have proper sales networks and enough facilities.

- In the hill area, poor transportation condition causes higher cost and limitation of quantity. Accordingly, farmers receive only small amount of inputs at higher prices. In addition to this, cooperatives have not established yet in some areas.

3) Farmers

- Financial capacity of individual farmers is not enough to purchase adequate amount of inputs necessary to proper farming.

(2) Marketing and Processing of Agricultural Products

1) Terai Area

- Bhairahawa, Butwal, Taulihawa and Krishnanagar function as the large wholesale markets of food grains and cash crops in the project area. Since the central part of the Terai area in the project area are far from these large markets, it is necessary to establish a public wholesale market in this area .

- Although the Haat Bazar system has been introduced, and this system provides farmers with important functions in marketing of products. However their facilities are still poor conditions and inconvenient for farmers and dealers.

- Farmers sell their products mainly to small commission agents at the road sides, and there are only limited facilities in these places. It is necessary to establish the marketing facilities in small scale along the farm roads.

- Only cooperative are the farmers' organization to market products, but not functioned well. There is no other farmers' organization to market products. These situations resulted in lower profit for farmers.

- Fish farming has been developing in the Terai area, and consumers purchase fish at the pond side. There is no regular marketing system for fish.

2) Hill Area

- It is estimated that about 20,000 tons of food grains is brought from the Terai area. The transportation conditions is poor and storage facilities is not enough for distribution of food grains.

- However Haat Bazar system has been introduced, the system is not functioned well owing to the small production and poor transportation condition. Besides, their facilities are still poor conditions and inconvenient for farmers and dealers.

- Cash crops in the hill area has not developed well, and the regular marketing system has not introduced yet. Only coffee is marketed through the regular collection system by the NECCO.

(3) Processing

1) Hill Area

- Capacity of grain mills and oil expellers are not enough in the hill area. Presently, most of the farmers process the grains and expel oil manually in their house. It is required to install small scale mills to cover the villages sporadically located in the hill area.

2. DEVELOPMENT PLAN

2.1 General

On the basis of the current situation and constraints, the following assumptions are considered to formulate development plan of marketing and processing aspects according to the agricultural development plan mentioned in Annex A;

1) Terai area

Agricultural production will be expanded, and marketable surplus of food grains and cash crops will be increased.

2) Hill area

Although agricultural production will be expanded and self-sufficiency in food will be improved, it is impossible to attain 100% of self-sufficiency. Therefore, cash crops will be introduced intensively to generate income to purchase foods from the Terai area.

According to the agricultural development plan, the future requirement in the target year of 2001 is estimated at 5,300 tons of fertilizers and 720 tons of certified seed of food grains in the hill area, and 21,200 tons of fertilizers and 3,500 tons of certified seed of food grains in the Terai area.

Agricultural production will be increased to 32,990 tons of paddy, 19,380 tons of wheat, 81,900 tons of maize, 5,000 tons of millet and 5,400 tons of pulses in the hill area, and 285,020 tons of paddy, 97,750 tons of wheat, 35,350 tons of maize, and 21,150 tons of pulses in the Terai area. Accordingly, about 7,800 tons of edible amount (about 16,000 tons in paddy base) of food will deficit in the hill area, and a considerable amount will be marketable surplus in the Terai area.

Cash crops will be introduced and expanded in both of Terai and hill areas. Main cash crops will be mustard, sugarcane, tropical fruits and vegetables in the Terai area. In the hill area, mustard, coffee, chest nuts, walnuts, temperate fruits,vegetables and spices will be the main cash crops.

Considering these conditions, the development plan is formulated in terms of the following components;

1) agricultural input supply,
2) marketing system of agricultural products, and
3) processing of agricultural products.

These components are classified into the central level and the district level projects in terms of main organization concerned to implement.

2.2 Master Plan of Development in Marketing and Processing Aspects

2.2.1 Agricultural Input Supply

Requirement of fertilizers, certified seed and agro-chemicals will increase by introduction and extension of improved farming practices in the project area as mentioned in the above section. Therefore, supply for the project area should be increased and expanded parallel to the extension of improved farming practices, improvement of transportation condition and other development activities. The input supply system is divided into three categories in terms of the marketing flow as follows :

1) Agricultural Input Corporation (AIC);
   Import of fertilizers and agro-chemicals, seed multiplication, distribution at the branch or sub-branch offices, sales to the retailers.

2) Retailers (cooperatives and individual dealers);
   Purchase from AIC and distribute to farmers.

3) Farmers;
   Final consumers and users.

In each category, the following development will be necessary to secure the input supply to farmers level:

(1) Central Level Project (AIC)

1) The allocation of Inputs for the Project area

The following amount of certified seed is estimated to be required by the improvement of farming practices in the project area;

(Unit : Tons)

Area	Paddy/1	Wheat/2	Maize/1	Millet/1	Total
Hill area	90	160	400	50	700
Terai area	860	920	150	-	1,930
Total	950	1,080	550	50	2,630

/1 : Requirement of certified seed is estimated at 20% of total requirement of seed.
/2 : Requirement of certified seed is estimated at 40% of total requirement of seed.

2) Facilities for distribution in the Hill Area

The present supply and distribution capacity of AIC in the hill area is not enough to ensure adequate supply of inputs, mainly due to short of capacity of warehouses and number of locations. Therefore, it is essential to increase storage capacity and number of locations of warehouses at the branch offices in the main marketing points along the road side in accordance with an improvement in the road conditions. The proposed locations and capacity of facilities are listed as follows;

District	Location	Facilities	Capacity
Gulmi	Tamghas/1	Office building and quarter	
		Storages for fertilizer x 3	300 tons x 3
		Storages for seed x 2	50 tons x 2
	Ridi Bazar	Office building and quarter	
		Storages for fertilizer x 3	300 tons x 3
		Storages for seed x 2	50 tons x 2
Arghakhanchi	Sandhikharkha/1	Office building and quarters	
		Storages for fertilizer x 3	300 tons x 3
		Storages for seed x 2	50 tons x 2

/1 : The existing facilities will be renovated in Tamghas and Sandhikharkha.

3) Training of AIC Staff

It is necessary to handle the adequate amount of inputs smoothly in proper time by proper manners under the proper management. In this regard, AIC staff of the zonal and branch offices will receive training on the marketing of the agricultural inputs.

(2) District Level Project

1) Establishment and Improvement of Cooperatives

Although fertilizers are distributed by the cooperatives in the Terai area, cooperatives not function well and their facilities for distribution are not adequate. In this respect, it is necessary to reinforce management of cooperatives and to improve their facilities such as storage, transportation and sales networks at the Ilaka or Panchayat level.

In the hill area, there are only 6 cooperatives in Gulmi and 4 cooperatives in Arghakhanchi. It is necessary to establish one cooperative in each Ilaka at least, and to install facilities. Proposed number of establishment of cooperatives and improvement of facilities are as follows;

District	Existing	To be established	Total	Facilities/1
Gulmi	6	3	9	Office, shop and storage (100 tons)
Arghakhanchi	4	5	9	Office, shop and storage (100 tons)
Kapilvastu	19	-	19	Office, shop and storage (200 tons)
Rupandehi/2	5	-	5	Office, shop and storage (200 tons)

/1 : The facilities will be 1 set of office, shop and storage.
/2 : Rupandehi district includes only Marchawar area.

2) Improvement of Financial Capacity and Training of Cooperative Staff

It is necessary to handle the adequate amount of inputs smoothly to farmers in proper time by proper manners under the proper management. In this regard, operational fund to handle inputs from AIC to farmers is required, and cooperative staff will be trained on management and accounting.

3) Establishment of Facilities for Input Supply in the District Panchayat

Private dealers should be encouraged to participate in retailing agricultural inputs for supplementing the activities of cooperatives, especially in the hill area. For this purpose, small storage facilities will be provided on rental base at the main marketing points by the district panchayats.

District	Number of locations	Facilities (Capacity)
Gulmi	9	Storages (100 tons x 9)
Arghakhanchi	9	Storages (100 tons x 9)

2.2.2 Marketing System of Agricultural Products

(1) Central Level Project

1) Establishment of Public Wholesale Market

While the main market centers in the Terai area are located in Bhairahawa, Butwal, Taulihawa and Krishnanagar, the central part of the Terai area in the project area is not covered by these locations.

Since Gorusinge is the center of the central part of the Terai area, and located along the East-West Highway convenient to trade with wholesalers of the other districts, it is necessary to establish a public wholesale market at Gorusinge to market products of this area.

Main commodities on the wholesale market will be food grains such as paddy, wheat and maize, vegetables, fruits and fish. Proposed facilities consists of multipurpose shades (food grains, vegetables and fruits, fish), cold storages, unloading yard, packing and loading yards, office building and utilities such as water supply. Area of wholesale market is estimated as 20,000 m^2 (100 m x 200 m).

This public wholesale market will be managed and operated by the committee organized by the Ministry of Agriculture, and the member of the committee will be the representatives of the district panchayat secretariat, wholesalers, farmers' organization and government organizations concerned to marketing.

2) Financial Capacity and Training of Staff of Wholesale Market

It is necessary to handle the commodities from farmers or producers smoothly by proper way under the proper management. In this regard, operational fund to handle commodities from farmers to wholesalers will be required, and staff of wholesale market will be trained on handling, management and accounting.

3) Reinforcement of Function of NFC

Only a limited amount of cereals is collected and supplied by NFC at present, and their storage facilities have only a small capacity. However, the cereal stock of NFC is functioning not only for price control but also as emergency stock for natural calamities such as landslides, floods etc, especially in the hill area. In this respect, it will be necessary to expand the storage points and to increase storage capacity in the hill area. Proposed sites and facilities are as follows;

District	Location	Facilities	Capacity
Gulmi	Tamghas/1	Office building and quarters Storages for fertilizer x 3	 300 tons x 3
	Ridi Bazar	Office building and quarters Storages for fertilizer x 3	 300 tons x 3
Arghakhanchi	Sandhikharkha/1	Office building and quarters Storages for fertilizer x 3	 300 tons x 3

/1 : The existing facilities will be renovated in Tamghas and Sandhikharkha.

In addition to these facilities, it is necessary to handle the adequate amount of grains smoothly in proper time by proper manners under the proper management. In this regard, NFC staff of the zonal and branch offices will be trained on the marketing of the food grains.

(2) District Level Project

1) Improvement and Reinforcement of Haat Bazars

Haat Bazars play an important role for the rural life of the people by providing local people with opportunities to sell the products and to purchase daily essential commodities. In addition to these functions, Haat Bazars will be utilized as the collection points of farm products. In this regard, facilities and management of Haat Bazars will be improved and reinforced.

Proposed facilities consists of permanent shades, cemented floor, water supply, small warehouse and office buildings. Estimated area of one Haat Bazar is about 2,500 m^2 (50 m x 50 m). One Haat Bazar should be established in one village Panchayat at least. The number of Haat Bazars to be established are tabulated as follows;

District	Number of locations
Gulmi	71
Arghakhanchi	41
Kapilvastu	79
Rupandehi/1	23
Total	214

/1 : Rupandehi district includes only Marchawar area.

In addition to these facilities, it is necessary to handle the commodities and products between farmers and merchants smoothly by proper way under the proper management. In this regard, operational fund to handle will be required as revolving fund, and staff of Haat Bazar will be trained on handling, management and accounting.

2) Formation of Producers' Groups and Associations

Merchants purchase food grains and cash crops from individual farmers through small agents and middlemen in the Terai area at present. Also, the marketing system of fish has not been established yet. By organizing individual farmers as producers' groups or associations like cooperatives and establishing small

marketing points, farmers will get more profit and information on market to sell their products to wholesale markets timely and directly.

In the hill area only limited quantities of cash crops are transported outside the project area at present, however, production of cash crops will increase under the project in future. In this connection, it is necessary to establish producers' groups or associations and marketing points along the main roads for smooth collection, grading and packing of products. Depending upon the improvement of road and transportation condition, the number of marketing points will be increased in the future as well. These marketing points should be equipped with temporary storage space.

The following producers' groups or associations are proposed in the project area;

Area	Crop	Number of Groups or Association
Hill area	Vegetables	2
	Citrus	2
	Apiculture	2
	Coffee	2
	Fruits	2
Terai area	Vegetables	2
	Fruits	2
	Fish	2

These producers' groups or associations will use the marketing facilities such as small collection points and offices. Operational fund to handle will be required, and staffs will be trained on handling, management and accounting.

3) Establishment of Small Marketing Groups

To market small amount of products from the home gardens such as eggs, vegetable, etc, it is necessary to establish small marketing groups. Members of these groups will consist of house keeping wives, and training and financial assistance will be needed.

To extend this system, it is proposed that the model small marketing groups will be established to demonstrate the activities. The proposed number of model small marketing groups are listed as follows;

Area	Number of Groups
Hill area	2
Terai area	2

4) Although only limited quantities of cash crops are transported to area outside the project area at present because of small amount of production, production will increase and new cash crops will be introduced under the project. In this connection, it will be necessary to establish marketing points along the main roads for smooth collection, grading and packing of products, and depending upon the improvement of road and transportation, increase the number of marketing points in the future as well. These marketing points should be equipped with temporary storage space.

5) Training of District Staff

There are many development activities of marketing and processing aspects in the district level. These activities should be integrated each other in terms of time sequence, location of areas, etc. In this connection, it is necessary for district staff concerning to marketing and processing to increase of capacity of planning and implementation through training.

2.2.3 Processing of Agricultural Products

Main surplus of products such as cereals, pulses and sugarcane in the Terai area are transported outside of the project area after processed by medium-scale rice mills of merchants, a large-scaled wheat flour mill, a sugarcane mill factory and dull mills. However, cereals, dull and oil seed for home consumption of the farmers in the Terai area are processed by small scale private mills located in the villages, and capacity of these mills are enough to process. Therefore, development of processing will not be necessary through the Lumbini IRDP.

In the hill area, most of cereal production is for home consumption only, and many small scale production points (cultivated lands) are sporadically located in a wide area. At the present time, small scale mills driven by water turbines of diesel engines are introduced only in the limited area, their milling capacities and number of locations are not enough.

Cash crops such as coffee are also transported outside in the form of raw materials. Also, new cash crops will be introduced and their production will be expanded by the project. It is necessary to introduce processing to increase value of cash crop products in total.

(a) Increase of Processing Capacity of Cereal Processing in the Hill Area

In the hill area, there still exists many areas where milling cereals and expelling oil are done manually. To reduce time consuming, it will be necessary to introduce small scale mills and expellers driven by water turbines or diesel engines in small production spots through the organization of farmers groups.

(b) Introduction of Simple Processing Facilities in the Hill Area

Simple processing machines such as pulper will be effective to reduce transportation cost and to increase value of cash crops at farmers level. For example, although farmers sell dried coffee cherry at present, farmers can sell pulped coffee beans at higher price and transportation cost will be reduced by pulping coffee cherry.

Along with promotion of cash crops, introduction of small scale processing and preserving facilities at farmers' level will be essential to increase farmers income. The envisaged facilities are pulper for coffee, juice or jam plant for citrus, refiner for honey, etc. These facilities will be operated both individual farmers or users association.

2.3 Implementation Program

Components of marketing and processing aspects will be implemented under the various agencies according to the necessity and progress of development of other sectors such as promotion of agricultural production, rural road, plan implementation capacity, etc. Implementation schedule of components are formulated taking into account 1) necessity for