

APPENDICES

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Appendix 1(1) List of Township and Urban Population: 1990 Census

District		Township		
Code Name	Code Name	Population	Household	Social Amenities
11 Lusaka-Urban	111 Lusaka	769,353	148,609	All Available
12 Lusaka-Rural	121 Chôngwe	3,370	780	Market, Clinic, Rest House, Police, Post Office, Restaurant, Council Office, Shops
	122 Kafue	43,801	9,218	All Available
	123 Chilanga	9,126	1,763	All Available
	124 Rufunsa	2,217	440	Clinic, Shops, Tavern, Bars, Markets
13 Luangwa	131 Luangwa	1,606	332	Clinic, Government Offices, Police Post, Motel, Post Office, Schools, Churches, Market, Tap Water & Restaurant
21 Ndola-Urban	211 Ndola Township	334,531	60,679	All Available
22 Ndola-Rural	221 Massiti	2,140	488	Government Offices, ZCBC Shop, Co-op Market, Churches & Tap Water
	222 Mpongwe	10,837	2,717	Shops, Guest House, Market, Tavern, Air Strip, Tap Water
23 Chililabombwe	231 Chililabombwe	48,055	8,296	All Available
	232 Konkola	1,795	560	Mine Police Post, Post Office, Clinic, Schools, Council Offices, Churches, Market, Shops, Tap Water Clubs
24 Chingola	241 Chingola	142,379	24,679	All Available
25 Mufulira	251 Mufulira	124,746	21,908	All Available
26 Kalulushi	261 Kalulushi	31,474	5,829	All Available
	262 Chambishi	9,945	1,744	Police, Post Office, Clinic, Schools, Tap Water, Churches
27 Kitwe	271 Kitwe	288,592	47,222	All Available
28 Luanshya	281 Luanshya	118,143	21,974	All Available
31 Kabwe-Urban	311 Kabwe Township	161,456	33,849	All Available
32 Kabwe-Rural	321 Chibombo	4,058	744	Schools, Clinic, Government Offices, Churches, Opium Depot, Tap Water, Market
	322 Chisamba	2,972	720	Clinic, Post Office, Schools, Shops, Government Offices, Police Post, Bank Market, Restaurant, Churches, Council Offices, Tavern, Bars, Depot, Tap Water
	323 Kapiri Mposhi	13,540	2,810	Hospital, Police, Schools, Shops, Civic Centre, Bank, Restaurant, Market, Motel, Clinic, Agriculture Depot, Post Office, Tavern, Bars, Tap Water
33 Mumbwa	331 Mumbwa	11,015	2,341	Government Offices, Schools, Shops, Post Office, Police Post, Hotel, Resthouse, Tavern, Agriculture Depot, Tap Water
	332 Nampundwe	4,088	756	Guest House, Schools, Post Office, Police Post, Clinic, Churches, Tavern, Market, Tap Water, Grinding Mill
34 Mkushi	341 Mkushi	7,804	1,662	Schools, Hospital, Council Offices, Government Office, Police, Churches, Hotel, Bank, Post Office, Shops, Bars, Tavern, Air Strip, Depot Road Network
35 Serenje	351 Serenje	8,265	1,751	Churches, Government Offices, Hospital, Bank, Post Office, Police Post, Taverns & Bars, Clinic, Recreation Facilities, Motel, Resthouse, Council Office
41 Solwezi	411 Solwezi	26,223	5,579	All Available

(To be continued)

Appendix 1(2) List of Township and Urban Population: 1990 Census

(Continuation)

District		Township			
Code Name	Code Name	Population	Household	Social Amenities	
42	Mwinilunga	421 Mwinilunga	6,342	1,404	Government Offices, Post Office, Police Post, Schools, Market, Clinic, Shops, Tap Water
43	Zambezi	431 Zambezi	5,941	1,267	Government Office, Hospital, Post Office, Police Post, Market, Shops, Schools, Tap Water, Churches, Clinic
		432 Chavuma	1,798	283	
44	Kabompo	441 Kabompo	5,005	971	Police Post, Post Office, Clinic, Civic Centre, Hospital, Schools, Churches, Tap Water, Government Offices, Council Offices
45	Mfumbwe	451 Mfumbwe	4,860	1,116	Government Offices, Post Office, Police Post, Schools, Clinic, Shops, Market, Churches, Tap Water, Resthouse
46	Kasempa	461 Kasempa	4,151	932	Bank, Clinic, Resthouse, Schools, Churches, Shops, Police Post, Post Office, Restaurant, Market, Tap Water
51	Mongu	511 Mongu	29,302	5,679	All Available
		512 Limulunga	5,764	1,367	Police Post, Post Office, Resthouse, Butchery, Court, Palace, Museum, Schools, Clinic, Court, Tap Water
		513 Namushakande	1,771	421	Rural Health Centre, Shops, Council Market, Police Post, Church, Tap Water
52	Lukulu	521 Lukulu	3,129	706	All Available
53	Kalabo	531 Kalabo	7,209	1,680	All Available
		532 Sikongo	1,659	425	Police Post, NIEC Shops, Clinic, Sub-boma
54	Kaoma	541 Kaoma	9,165	2,092	All Available
55	Senanga	551 Senanga	7,727	1,651	All Available
		552 Shangombo	1,599	279	Schools, Court, Churches, Customs Office
56	Sesheke	561 Sesheke	5,390	1,060	All Available
		562 Mulobezi	2,009	470	Co-op Shop, Guest House, Schools, Hospital, Police Post, Government Offices, Post Office, Railway Network
		563 Katima-Mulilo	1,017	245	Schools, Churches, Court, Custom Border Post
61	Livingstone	611 Livingstone	76,875	15,404	All Available
62	Namwala	621 Namwala	3,772	757	All Available
		622 Itzhi-Tezhi	5,027	1,086	All Available
63	Mazabuka	631 Mazabuka	24,596	4,848	All Available
		632 Magoye	2,331	498	ZR Police Post, Council Office, Clinic, Post Office, School, Shops
		633 Nakambala	7,503	1,390	Guest House, Clinic, Police, Market, Postal Agency, Churches
		634 Nega-nega	1,836	445	Shops, Market, Churches, Schools, SPCMU Depot, Post Office
		635 Kafue-gorge	2,813	713	Namulundu Hospital, Shops, Schools, Police Post, Clinic, Market, Tap Water
		636 Chikankata	3,912	662	
64	Monze	641 Monze	15,910	3,440	All Available
		642 Chisekesi	1,675	283	Government Offices, Schools, Churches, Groceries, Market, Tap Water

(To be continued)

Appendix 1(3) List of Township and Urban Population: 1990 Census

(Continuation)

District		Township		Social Amenities
Code Name	Code Name	Population	Household	
65 Choma	651 Choma	30,143	6,382	All Available
	652 Batoka	1,445	297	Schools, Council Offices, Shops, Churches, Tap Water
	653 Pemba	2,170	475	Council Offices, Resthouse, Restaurant, SPCMU Depot, Police Post, Shopping Centre, Schools, Churches, Tavern, Tap Water, Clinic
	654 Mbabala	1,762	386	Schools, Churches, Clinic, Groceries
66 Kalomo	661 Kalomo	8,386	1,920	All Available
	662 Zimba	1,351	304	Mission Hospital, Schools, Shops, Police Post, Council Offices, Churches, Resthouse, Tap Water
67 Siavonga	671 Siavonga	5,569	1,300	All Available
	672 Chirundu	2,072	390	Government Offices, Schools, Churches, Shops, Market, Tap Water
68 Gwembe	681 Gwembe	2,013	406	Hospital, Police Post, Market, Tap Water, Churches, Government Offices, Council Offices
69 Sinazongwe	691 Sinazongwe	2,006	456	Hospital, Schools, Government Offices, Resthouse, Shops, Churches, Police Post, Post Office, Tap Water
	692 Maamba	8,817	1,726	All Available
71 Mansa	711 Mansa	39,051	8,694	Government Offices, Council Offices, Post Office, Police Post, Banks, Shops, Schools, Hospital, Bars, Tavern, Market
72 Nchelenge	721 Nchelenge	14,498	3,504	All Available
	722 Chiengi	1,900	519	
73 Kawambwa	731 Kawambwa	3,882	909	All Available
	732 Mvansabombwe	7,382	1,970	Post Office, Market, Schools, Churches, Restaurant, Shops, Government Offices
74 Mwense	741 Mwense	3,695	847	All Available
75 Samfya	751 Samfya	12,718	3,185	All Available
81 Kasama	811 Kasama	48,045	10,422	All Available
82 Kaputa	821 Kaputa	2,936	636	Schools, Government Offices, Shops, Churches, Police Post, Clinic, Council Offices, Electricity, Tap Water
	822 Kaputa			
83 Mbala	831 Mbala	12,185	2,633	All Available
	832 Mpulungu	2,739	647	Shops, Schools, Churches, Post Office, Clinic, Police Post, Tap Water, Market, Bank, Ports
84 Mporokoso	841 Mporokoso	4,818	1,051	Schools, Churches, Government Offices, Post Office, Agriculture Depot, Tap Water, Resthouse, Restaurant, Market, Bars, Tavern
85 Luwingu	851 Luwingu	4,664	999	Shops, Schools, Churches, Post Office, Clinic, Police Post, Tap Water, Council Offices, Government Offices
86 Chilubi	861 Chilubi	1,366	371	Hospital, Market, Police Post, Government Offices, Post Office, School, Bars, Taverns

(To be continued)

Appendix 1(4) List of Township and Urban Population: 1990 Census

(Conclusion)

District		Township		
Code Name	Code Name	Population	Household	Social Amenities
87 Isoka	871 Isoka	8,596	1,895	All Available
	872 Nakonde	4,493	905	Government Offices, Post Office, Shops, Restaurant, Agriculture Depot, Police Post, Schools, Churches, Clinic, Tap Water
88 Chinsali	881 Chinsali	7,509	1,663	All Available
89 Mpika	891 Mpika	20,950	4,094	All Available
91 Chipata	911 Chipata Township	52,213	10,270	All Available
92 Chama	921 Chama Township	3,474	764	Hospital, Schools, Council Offices, Government Offices, Post Office, Tap Water, Shops, Police Posts, Market, Agriculture Depot
	931 Lundazi	5,590	1,200	Government Offices, Bank, Market, Restaurant, Churches, Police Post, Post Office, Schools, Shops, Co-op Depot, Air Strip, Tap Water
94 Chadiza	941 Chadiza Township	3,031	746	Government Offices, Police Post, Schools, Tap Water, Post Office, Resthouse, Tavern, Hospital, Churches, Shops, Bank, Council Offices
95 Katete	951 Katete Township	7,165	1,633	Tavern, Bars, Shops, Government Offices, Police Post, Bank, Post Office, Co-op Depot, Motel, Market, Load Network, Tap Water
96 Petauke	961 Petauke	8,148	1,723	Hospital, Government Offices, Resthouse, Schools, Shops, Motel, Clinic, Police Post, Post Office, Council Offices, ECU Depot, Tap Water
	962 Nyimba	1,684	305	Council Offices, Police Post, Hostel, Hotel, School, Air Strip, Hospital, Churches, Tap Water
	963 Kacholola	1,445	377	Hotel, Police Post, Market, Restaurant, Tap Water
Total of Zambia		2,781,530	535,028	

Source: Data by Cartography Division of CSO

Appendix 2: Input-Output Table of Domestic Intermediate Sectors: 1985

Table 2-1(1) Input-Output Table

Delivering Sector	Receiving Sector							
	1	2	3	4	5	6	7	8
1	26,526	11,729	0	108,109	19,751	71,964	4,505	1,767
2	0	0	0	0	0	0	0	0
3	0	62,579	310	269	0	0	0	0
4	25,263	0	15	5,896	4,943	0	0	0
5	0	0	0	0	0	0	0	0
6	3	22,861	38	1,439	0	193,512	4,842	35
7	0	41,959	67	2,504	79	0	21,826	0
8	4,667	252	73	8,616	3,207	7,775	610	5,941
9	21,234	237,599	9,565	5,381	4,143	9,094	19,551	3,301
10	0	18,320	107	3,813	0	6,145	4,871	649
11	0	43,859	1,021	0	0	0	0	0
12	1,012	2,120	0	0	0	0	0	0
13	8,331	407,070	11,036	2,891	57	4,177	3,853	1,245
14	0	78,226	372	0	0	14,803	0	457
15	5,289	77,100	46	3,781	477	2,136	1,228	1,100
16	23	1,253	11	971	183	538	305	439
17	7,896	37,976	33	2,788	243	3,323	3,664	1,012
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	6,255	1,417	0	13,992	2,979	14,860	4,365	5,968
21	0	11,279	3,369	0	0	0	725	0
22	364	4,250	0	0	0	0	0	0
23	8,600	5,555	39	781	511	8,651	664	3,191
24	684	3,084	156	9,508	525	41,396	3,088	1,071
25	1,672	5,632	5	2,388	348	4,805	1,270	2,081
26	4,310	49,734	359	10,385	1,012	3,477	1,385	2,493
27	0	0	255	2,420	0	0	0	0
28	9	0	0	0	0	0	31	0
29	0	0	0	0	0	0	0	0
30	13,985	18,807	0	0	0	0	0	0
31	136,123	1,142,661	26,875	185,931	38,455	386,657	76,781	30,747
32	99,426	610,200	24,408	99,359	11,114	119,023	4,510	13,105
33	464,478	1,174,456	56,057	56,724	52,146	87,296	25,469	81,930
34	29,319	290,000	11,600	14,976	1,240	16,499	6,362	1,751
35	27,105	351,500	14,060	32,071	41,655	3,067	1,371	2,375
36	620,328	2,426,156	106,125	203,129	106,155	225,885	37,713	99,161
37	120,255	35,315	65	32,341	12,555	111,609	4,882	26,847
38	876,706	3,604,132	133,065	421,401	157,165	724,151	119,377	156,755

Source: CSO

(To be continued)

Note:	Sector No.	Description of Sector
	1	Agriculture, Fishing and Forestry
	2	Metal Mining
	3	Other Mining (Quarrying, Clay, etc.)
	4	Food Manufacturing
	5	Beverages and Tobacco Manufacturing
	6	Textiles and Wearing Apparel Manufacturing
	7	Wood and Wood Products Manufacturing
	8	Paper and Paper Products Manufacturing
	9	Chemicals Manufacturing
	10	Rubber Products Manufacturing
	11	Non-Metallic Products Manufacturing
	12	Basic Metal Products Manufacturing
	13	Fabricated Metal Products Manufacturing
	14	Other Manufacturing (Jewelry and Related Articles Musical Instruments, Sports goods, Games and Toys, Pens, Pencils, Brooms etc.)
	15	Electricity and Gas
	16	Water

Appendix 2 Input-Output Table of Domestic Intermediate Sectors: 1985
Table 2-1(2) Input-Output Table

(Continuation)

Delivering Sector	Receiving Sector							
	9	10	11	12	13	14	15	16
1	0	5,867	0	0	4,001	0	0	0
2	0	0	0	8,266	9,336	0	0	0
3	0	0	728	604	1,802	53	0	0
4	0	0	0	0	0	50	0	0
5	0	0	0	0	0	0	0	0
6	0	1,480	468	0	7,530	96	0	126
7	321	0	0	0	341	0	0	14
8	1,397	2,272	1,994	0	2,911	894	16	298
9	18,066	9,236	42,276	2,826	37,177	173	57,867	566
10	0	96	0	0	24,566	226	0	0
11	0	0	263	0	6	763	0	0
12	0	0	0	27,326	27,241	0	0	0
13	3,449	6,852	6,122	4,609	355,312	24	41,054	2,697
14	19	0	0	0	0	0	0	0
15	16,970	1,232	114,955	465	4,790	92	0	2,940
16	5,657	210	49,261	155	1,203	24	0	372
17	1,430	633	42	392	2,495	260	12,330	311
18	0	0	0	238	68,116	0	0	0
19	0	376	0	0	0	0	0	0
20	10,395	9,002	4,056	919	10,407	1,447	1,435	0
21	0	0	0	0	2,015	0	7,653	0
22	0	0	0	0	126	0	478	0
23	1,164	745	349	765	7,615	121	1,234	38
24	3,196	3,509	618	2,215	18,233	123	1,760	2,947
25	731	1,692	8,952	0	3,055	92	0	8
26	15,788	5,574	8,117	0	7,899	110	10,423	16
27	0	0	332	0	0	0	0	0
28	0	906	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0
31	78,583	49,679	238,533	48,778	596,175	4,546	134,249	10,562
32	60,062	16,551	12,896	1,671	145,152	1,829	32,908	4,718
33	155,280	23,876	19,278	1,350	186,345	2,265	84,928	60,558
34	26,400	3,252	5,894	152	101,548	446	3,703	0
35	4,612	1,714	3,460	554	3,894	21	0	0
36	246,353	45,393	41,528	3,726	436,940	4,561	121,539	65,276
37	609,713	65,883	9,191	7,950	112,846	83,722	6,305	3,587
38	934,649	160,956	289,251	60,454	1,145,960	92,829	262,093	79,425

Source: CSO

(To be continued)

Note:

Sector No.	Description of Sector
17	Construction
18	Wholesale and Retail Trade
19	Bars, Hotels and Restaurants
20	Rail Transport
21	Road Transport
22	Other Transport (Air Transport, Water Transport, Forwarding and Travel Agents other services incidental to transport which are not included elsewhere).
23	Posts and Telecommunications
24	Financial Institutions and Insurance
25	Real Estate (includes activities connected to ownership and use of dwelling and renting of other buildings)
26	Business services (Legal, Technical Engineering, Accounting, etc., services)
27	Education (Activities of Private and Government owned institutions whose main purpose is dissemination of knowledge and Research while Education of employees at places of work is classified under the same institutions which they serve.
28	Health
29	Recreation and cultural services (includes Religious and Welfare Organisations)

Appendix 2 Input-Output Table of Domestic Intermediate Sectors: 1985

Table 2-1(3) Input-Output Table

(Continuation)

Delivering Sector	Receiving Sector							
	17	18	19	20	21	22	23	24
1	0	6	3,963	0	4,765	0	0	0
2	0	0	0	0	0	0	0	0
3	12,388	0	0	0	0	0	0	0
4	0	0	18,637	0	0	0	0	0
5	0	0	18,950	0	0	0	0	0
6	2,996	27,412	933	3,407	8,766	11,401	724	6,867
7	2,840	3	192	0	2,582	0	0	0
8	1,568	26,607	1,122	429	9,625	4,084	3,457	11,150
9	9,524	109,815	2,554	64,214	56,839	82,352	4,666	14,497
10	554	0	0	281	0	16,161	0	0
11	4,953	0	0	0	16,265	0	0	0
12	0	0	0	0	2,756	0	0	0
13	1,295	18,418	2,424	1,652	53,886	21,888	98	2,289
14	41	0	0	0	0	0	0	0
15	965	7,371	780	224	1,162	888	340	1,886
16	2,573	2,510	326	75	388	296	113	629
17	15,266	35,134	1,006	1,430	1,088	3,299	1,714	2,233
18	0	0	0	0	0	0	0	0
19	0	0	0	538	950	8,745	0	0
20	2,676	10,482	1,520	10,195	1,598	5,946	1,445	15,210
21	669	90,951	0	0	13,867	0	0	0
22	1,199	1,336	0	0	204	17,837	0	0
23	722	17,138	245	1,492	1,882	9,710	3,431	5,097
24	9,509	82,208	2,269	9,757	22,403	29,458	1,849	21,340
25	4,103	36,970	423	718	492	2,678	948	22,081
26	10,571	155,329	2,786	16,235	30,350	104,389	13,080	38,874
27	0	0	0	1,066	575	1,763	569	1,910
28	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0
30	267	40,724	463	22,392	24,379	9,167	0	17,464
31	84,677	662,415	58,662	134,104	254,821	330,060	32,434	161,527
32	22,783	568,381	602,062	28,236	48,634	230,717	44,625	125,101
33	1,845	227,296	13,237	15,718	28,978	540	7,265	404,753
34	1,288	98,116	60,595	15,741	8,696	39,091	10,942	15,987
35	10	283,077	39	306	2,571	738	0	37
36	25,927	1,176,870	675,933	60,001	88,878	271,087	62,832	545,877
37	139,166	771	0	19,033	1,843	2,324	8,245	0
38	249,769	1,840,056	734,594	213,138	345,542	603,471	103,511	707,404

Source: CSO

(To be continued)

Note:

Sector No.	Description of Sector
30	Public Administration and Personal Services (General Central and Local Government, Domestic Servants, Laundries, Commercial photographic studios,
31	Intermediate Demand
32	Compensation of Employees
33	Operational Surplus
34	Cons. of Fixed Capital
35	Net Indirect Taxes
36	Value Added
37	Total Imports
38	Total Demand

Appendix 2 Input-Output Table of Domestic Intermediate Sectors: 1985

Table 2-1(4) Input-Output Table

(Conclusion) Delivering Sector	Receiving Sector						Total Intermediate Use
	25	26	27	28	29	30	
1	0	0	0	0	83	5	263,039
2	0	0	0	0	0	0	17,602
3	0	0	0	0	0	0	78,732
4	0	0	5,191	576	33	82	60,734
5	0	0	0	0	41	0	18,992
6	348	52,004	284	463	240	2,396	350,691
7	0	8	1	0	67	294	73,097
8	77	63	1,499	843	100	3,708	105,254
9	1,858	7,048	1,421	1,577	783	17,542	852,744
10	0	0	0	7	0	4,574	80,369
11	0	0	0	0	0	0	67,129
12	0	0	0	0	0	0	60,454
13	116	16,900	193	528	0	26,571	1,005,033
14	0	0	0	6	0	0	93,923
15	2,120	2,042	1,014	624	175	2,733	254,923
16	707	681	350	50	53	921	70,277
17	9,481	7,981	1,457	841	764	5,893	162,615
18	0	0	0	0	0	0	68,354
19	0	0	0	0	0	82	10,690
20	3,600	33,547	663	731	1,441	2,573	179,123
21	0	11,182	0	0	0	0	141,710
22	0	67,094	0	0	0	70	92,958
23	3,445	13,520	180	626	126	1,472	99,106
24	890	132,866	752	433	162	7,330	413,338
25	2,594	17,504	43	549	247	2,615	124,695
26	7,083	170,346	800	354	370	11,546	683,224
27	0	0	880	0	0	51	9,822
28	0	0	0	0	0	451	1,396
29	0	0	898	0	3	1,422	2,323
30	1,548	10,961	0	70	109	12,657	172,991
31	33,869	543,745	15,624	8,278	4,797	104,986	5,615,334
32	22,881	178,805	16,645	2,864	5,834	894,929	4,049,429
33	49,393	85,283	1,681	5,444	61	34,538	3,408,468
34	12,426	9,689	1	7,748	289	94,861	888,611
35	112,643	1,948	62	117	55	0	889,060
36	197,343	275,725	18,389	16,172	6,239	1,024,328	9,235,567
37	0	497	0	3,414	2,516	1,787	1,422,661
38	231,212	819,967	34,013	27,861	13,552	1,131,100	16,273,562

Source: CSO

Appendix 2 Input-Output Table of Domestic Intermediate Sectors: 1985
Table 2-2(1) Input Coefficient Table

Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	0.0303	0.0033	0.0000	0.2565	0.1257	0.0994	0.0377	0.0113	0.0000	0.0364	0.0000	0.0000	0.0035	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1367	0.0081	0.0000	0.0000
3	0.0000	0.0174	0.0023	0.0006	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0025	0.0100	0.0016	0.0006	0.0000
4	0.0288	0.0000	0.0001	0.0140	0.0314	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0005	0.0000
5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
6	0.0000	0.0063	0.0003	0.0034	0.0000	0.2672	0.0406	0.0002	0.0000	0.0092	0.0016	0.0000	0.0066	0.0010	0.0000
7	0.0000	0.0116	0.0005	0.0059	0.0005	0.0000	0.1828	0.0000	0.0003	0.0000	0.0000	0.0000	0.0003	0.0000	0.0000
8	0.0053	0.0001	0.0005	0.0204	0.0204	0.0107	0.0051	0.0379	0.0015	0.0141	0.0069	0.0000	0.0025	0.0096	0.0001
9	0.0242	0.0659	0.0719	0.0128	0.0264	0.0126	0.1638	0.0211	0.0193	0.0574	0.1462	0.0467	0.0324	0.0019	0.2208
10	0.0000	0.0051	0.0008	0.0090	0.0000	0.0085	0.0408	0.0041	0.0000	0.0006	0.0000	0.0000	0.0214	0.0024	0.0000
11	0.0000	0.0122	0.0077	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0009	0.0000	0.0000	0.0082	0.0000
12	0.0012	0.0006	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.4520	0.0238	0.0000	0.0000
13	0.0095	0.1129	0.0829	0.0069	0.0004	0.0058	0.0323	0.0079	0.0037	0.0426	0.0212	0.0762	0.3101	0.0003	0.1566
14	0.0000	0.0217	0.0028	0.0000	0.0000	0.0204	0.0000	0.0029	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
15	0.0060	0.0214	0.0003	0.0090	0.0030	0.0030	0.0103	0.0070	0.0182	0.0077	0.3974	0.0077	0.0042	0.0010	0.0000
16	0.0000	0.0003	0.0001	0.0023	0.0012	0.0007	0.0026	0.0028	0.0061	0.0013	0.1703	0.0026	0.0010	0.0003	0.0000
17	0.0090	0.0105	0.0002	0.0066	0.0015	0.0046	0.0307	0.0065	0.0015	0.0039	0.0001	0.0065	0.0022	0.0028	0.0470
18	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0039	0.0594	0.0000	0.0000
19	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0023	0.0000	0.0000	0.0000	0.0000	0.0000
20	0.0071	0.0004	0.0000	0.0332	0.0190	0.0205	0.0366	0.0381	0.0111	0.0559	0.0140	0.0152	0.0091	0.0156	0.0055
21	0.0000	0.0031	0.0253	0.0000	0.0000	0.0000	0.0061	0.0000	0.0000	0.0000	0.0000	0.0000	0.0018	0.0000	0.0292
22	0.0004	0.0012	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0018
23	0.0098	0.0015	0.0003	0.0019	0.0032	0.0119	0.0056	0.0204	0.0012	0.0046	0.0012	0.0127	0.0066	0.0013	0.0047
24	0.0008	0.0009	0.0012	0.0226	0.0033	0.0572	0.0259	0.0068	0.0034	0.0218	0.0021	0.0366	0.0159	0.0013	0.0067
25	0.0019	0.0016	0.0000	0.0057	0.0022	0.0066	0.0106	0.0133	0.0008	0.0105	0.0309	0.0000	0.0027	0.0010	0.0000
26	0.0049	0.0138	0.0027	0.0246	0.0064	0.0048	0.0116	0.0159	0.0159	0.0346	0.0281	0.0000	0.0069	0.0012	0.0398
27	0.0000	0.0000	0.0019	0.0057	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0011	0.0000	0.0000	0.0000	0.0000
28	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003	0.0000	0.0000	0.0056	0.0000	0.0000	0.0000	0.0000	0.0000
29	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
30	0.0160	0.0052	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	0.1553	0.3170	0.2020	0.4412	0.2447	0.5339	0.6432	0.1961	0.0841	0.3087	0.8247	0.8069	0.5202	0.0490	0.5122

(To be continued)

Appendix 2 Input-Output Table of Domestic Intermediate Sectors: 1985
Table 2-2(2) Input Coefficient Table

(Conclusion) Sector	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	0.0000	0.0000	0.0000	0.0054	0.0000	0.0138	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0062	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0496	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4	0.0000	0.0000	0.0000	0.0254	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1526	0.0207	0.0024	0.0001
5	0.0000	0.0000	0.0000	0.0258	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0030	0.0000
6	0.0016	0.0120	0.0149	0.0013	0.0160	0.0254	0.0189	0.0070	0.0097	0.0015	0.0634	0.0083	0.0166	0.0177	0.0021
7	0.0002	0.0114	0.0000	0.0003	0.0000	0.0075	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0049	0.0003
8	0.0037	0.0063	0.0145	0.0015	0.0020	0.0279	0.0068	0.0334	0.0158	0.0003	0.0001	0.0441	0.0303	0.0074	0.0033
9	0.0071	0.0381	0.0597	0.0035	0.3013	0.1645	0.1365	0.0451	0.0205	0.0080	0.0086	0.0418	0.0566	0.0578	0.0155
10	0.0000	0.0022	0.0000	0.0000	0.0013	0.0000	0.0268	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003	0.0000	0.0040
11	0.0000	0.0198	0.0000	0.0000	0.0000	0.0471	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
12	0.0000	0.0000	0.0000	0.0000	0.0000	0.0080	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
13	0.0340	0.0052	0.0100	0.0033	0.0078	0.1559	0.0363	0.0009	0.0032	0.0005	0.0206	0.0057	0.0189	0.0000	0.0235
14	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000	0.0000
15	0.0370	0.0039	0.0040	0.0011	0.0011	0.0034	0.0015	0.0033	0.0027	0.0092	0.0025	0.0298	0.0224	0.0129	0.0024
16	0.0047	0.0103	0.0014	0.0004	0.0004	0.0011	0.0005	0.0011	0.0009	0.0031	0.0008	0.0103	0.0018	0.0039	0.0008
17	0.0039	0.0611	0.0191	0.0014	0.0067	0.0031	0.0055	0.0166	0.0032	0.0410	0.0097	0.0428	0.0302	0.0564	0.0052
18	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
19	0.0000	0.0000	0.0000	0.0000	0.0025	0.0027	0.0145	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
20	0.0000	0.0107	0.0057	0.0021	0.0478	0.0046	0.0099	0.0140	0.0215	0.0156	0.0409	0.0195	0.0262	0.1063	0.0023
21	0.0000	0.0027	0.0494	0.0000	0.0000	0.0401	0.0000	0.0000	0.0000	0.0000	0.0136	0.0000	0.0000	0.0000	0.0000
22	0.0000	0.0048	0.0007	0.0000	0.0000	0.0006	0.0296	0.0000	0.0000	0.0000	0.0818	0.0000	0.0000	0.0000	0.0001
23	0.0005	0.0029	0.0093	0.0003	0.0070	0.0054	0.0161	0.0331	0.0072	0.0149	0.0165	0.0053	0.0225	0.0093	0.0013
24	0.0371	0.0381	0.0447	0.0031	0.0458	0.0648	0.0488	0.0179	0.0302	0.0038	0.1620	0.0221	0.0155	0.0119	0.0065
25	0.0001	0.0164	0.0201	0.0006	0.0034	0.0014	0.0044	0.0092	0.0312	0.0112	0.0213	0.0013	0.0197	0.0182	0.0023
26	0.0002	0.0423	0.0844	0.0038	0.0762	0.0878	0.1730	0.1264	0.0550	0.0306	0.2077	0.0235	0.0127	0.0273	0.0102
27	0.0000	0.0000	0.0000	0.0000	0.0050	0.0017	0.0029	0.0055	0.0027	0.0000	0.0000	0.0259	0.0000	0.0000	0.0000
28	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0004
29	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0264	0.0000	0.0002	0.0013
30	0.0000	0.0011	0.0221	0.0006	0.1051	0.0706	0.0152	0.0000	0.0247	0.0067	0.0134	0.0000	0.0025	0.0080	0.0112
	0.1301	0.3390	0.3600	0.0799	0.6292	0.7375	0.5469	0.3133	0.2283	0.1465	0.6631	0.4594	0.2971	0.3540	0.0928

Appendix 2 Input-Output Table of Domestic Intermediate Sectors: 1985
Table 2-3(1) Leontief Inverse Matrix

Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1.0397	0.0067	0.0017	0.2730	0.1398	0.1423	0.0585	0.0130	0.0004	0.0408	0.0025	0.0035	0.0090	0.0007	0.0030
2	0.0006	1.0027	0.0019	0.0004	0.0001	0.0003	0.0011	0.0003	0.0002	0.0010	0.0020	0.2532	0.0207	0.0000	0.0035
3	0.0007	0.0186	1.0028	0.0014	0.0003	0.0006	0.0024	0.0005	0.0002	0.0006	0.0041	0.0242	0.0037	0.0008	0.0032
4	0.0304	0.0002	0.0005	1.0232	0.0360	0.0043	0.0018	0.0005	0.0000	0.0015	0.0003	0.0002	0.0003	0.0006	0.0001
5	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
6	0.0023	0.0151	0.0043	0.0117	0.0027	1.3700	0.0766	0.0053	0.0031	0.0212	0.0132	0.0109	0.0205	0.0025	0.0123
7	0.0004	0.0147	0.0010	0.0077	0.0010	0.0002	1.2246	0.0002	0.0005	0.0002	0.0007	0.0041	0.0011	0.0001	0.0013
8	0.0073	0.0024	0.0026	0.0252	0.0234	0.0192	0.0113	1.0412	0.0021	0.0171	0.0107	0.0045	0.0077	0.0104	0.0039
9	0.0344	0.0935	0.0889	0.0437	0.0420	0.0405	0.2434	0.0429	1.0303	0.0900	0.2653	0.1418	0.0749	0.0108	0.2543
10	0.0009	0.0100	0.0038	0.0105	0.0007	0.0124	0.0527	0.0049	0.0004	1.0027	0.0036	0.0074	0.0321	0.0026	0.0058
11	0.0003	0.0131	0.0091	0.0003	0.0001	0.0005	0.0014	0.0003	0.0001	0.0003	1.0022	0.0039	0.0008	0.0083	0.0027
12	0.0030	0.0090	0.0061	0.0016	0.0006	0.0011	0.0035	0.0008	0.0005	0.0032	0.0064	1.8364	0.0640	0.0001	0.0111
13	0.0188	0.1800	0.1313	0.0222	0.0061	0.0190	0.0747	0.0175	0.0119	0.0706	0.1432	0.2590	1.4707	0.0029	0.2446
14	0.0001	0.0221	0.0029	0.0003	0.0001	0.0281	0.0016	0.0032	0.0001	0.0005	0.0004	0.0058	0.0009	1.0001	0.0004
15	0.0077	0.0300	0.0067	0.0130	0.0055	0.0069	0.0200	0.0090	0.0192	0.0110	0.4113	0.0260	0.0101	0.0048	1.0079
16	0.0006	0.0037	0.0025	0.0032	0.0017	0.0018	0.0058	0.0035	0.0064	0.0023	0.1738	0.0071	0.0028	0.0019	0.0031
17	0.0115	0.0152	0.0019	0.0131	0.0046	0.0108	0.0453	0.0099	0.0033	0.0082	0.0257	0.0202	0.0083	0.0037	0.0537
18	0.0011	0.0107	0.0078	0.0013	0.0004	0.0011	0.0045	0.0010	0.0007	0.0042	0.0085	0.0226	0.0877	0.0002	0.0146
19	0.0001	0.0001	0.0001	0.0002	0.0001	0.0002	0.0004	0.0002	0.0001	0.0026	0.0002	0.0002	0.0002	0.0001	0.0003
20	0.0111	0.0078	0.0042	0.0443	0.0251	0.0373	0.0609	0.0456	0.0140	0.0666	0.0280	0.0391	0.0223	0.0178	0.0173
21	0.0006	0.0061	0.0275	0.0013	0.0005	0.0007	0.0096	0.0009	0.0010	0.0016	0.0145	0.0044	0.0082	0.0003	0.0332
22	0.0017	0.0039	0.0012	0.0042	0.0015	0.0024	0.0042	0.0030	0.0023	0.0053	0.0074	0.0031	0.0034	0.0005	0.0085
23	0.0116	0.0047	0.0022	0.0075	0.0062	0.0208	0.0123	0.0238	0.0023	0.0089	0.0079	0.0288	0.0140	0.0020	0.0097
24	0.0062	0.0137	0.0093	0.0374	0.0096	0.0894	0.0548	0.0175	0.0100	0.0404	0.0335	0.0858	0.0416	0.0039	0.0323
25	0.0033	0.0047	0.0017	0.0098	0.0040	0.0140	0.0189	0.0161	0.0020	0.0147	0.0358	0.0062	0.0090	0.0019	0.0052
26	0.0138	0.0302	0.0133	0.0471	0.0168	0.0268	0.0457	0.0343	0.0265	0.0614	0.0769	0.0311	0.0362	0.0054	0.0745
27	0.0003	0.0002	0.0021	0.0064	0.0004	0.0006	0.0006	0.0004	0.0001	0.0005	0.0015	0.0007	0.0003	0.0001	0.0003
28	0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	0.0006	0.0000	0.0000	0.0056	0.0000	0.0000	0.0002	0.0000	0.0000
29	0.0000	0.0000	0.0001	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
30	0.0184	0.0078	0.0031	0.0109	0.0055	0.0091	0.0104	0.0062	0.0022	0.0100	0.0065	0.0090	0.0068	0.0021	0.0066
Total	1.2270	1.5271	1.3405	1.6211	1.3348	1.8605	2.0476	1.3020	1.1401	1.4929	2.2863	2.8395	1.9577	1.0844	1.8136

(To be continued)

Appendix 2 Input-Output Table of Domestic Intermediate Sectors: 1985
Table 2-3(2) Leontief Inverse Matrix

(Conclusion) Sector	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	0.0008	0.0039	0.0050	0.0165	0.0044	0.0229	0.0075	0.0038	0.0028	0.0010	0.0138	0.0457	0.0092	0.0116	0.0010
2	0.0008	0.0004	0.0006	0.0001	0.0004	0.0058	0.0010	0.0002	0.0002	0.0001	0.0009	0.0004	0.0005	0.0002	0.0005
3	0.0005	0.0533	0.0014	0.0001	0.0007	0.0015	0.0008	0.0012	0.0004	0.0023	0.0011	0.0029	0.0019	0.0033	0.0004
4	0.0000	0.0002	0.0002	0.0271	0.0011	0.0011	0.0012	0.0011	0.0006	0.0001	0.0007	0.1605	0.0213	0.0031	0.0001
5	0.0000	0.0000	0.0000	0.0258	0.0001	0.0001	0.0004	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0031	0.0000
6	0.0044	0.0270	0.0365	0.0029	0.0364	0.0555	0.0531	0.0282	0.0226	0.0083	0.1244	0.0210	0.0285	0.0346	0.0054
7	0.0004	0.0150	0.0009	0.0006	0.0004	0.0100	0.0003	0.0004	0.0002	0.0007	0.0005	0.0022	0.0007	0.0070	0.0005
8	0.0051	0.0095	0.0196	0.0031	0.0060	0.0359	0.0122	0.0383	0.0185	0.0019	0.0089	0.0532	0.0345	0.0105	0.0042
9	0.0214	0.0683	0.0877	0.0079	0.3388	0.2213	0.1712	0.0669	0.0374	0.0225	0.0670	0.0774	0.0827	0.1090	0.0216
10	0.0014	0.0042	0.0018	0.0005	0.0031	0.0074	0.0304	0.0012	0.0009	0.0006	0.0056	0.0028	0.0019	0.0015	0.0050
11	0.0002	0.0219	0.0031	0.0001	0.0004	0.0496	0.0005	0.0006	0.0002	0.0010	0.0014	0.0012	0.0008	0.0014	0.0002
12	0.0026	0.0012	0.0024	0.0003	0.0012	0.0267	0.0032	0.0006	0.0005	0.0003	0.0028	0.0012	0.0017	0.0006	0.0016
13	0.0600	0.0264	0.0372	0.0065	0.0262	0.2621	0.0718	0.0124	0.0116	0.0071	0.0578	0.0254	0.0383	0.0116	0.0371
14	0.0001	0.0009	0.0008	0.0001	0.0008	0.0014	0.0011	0.0007	0.0005	0.0002	0.0026	0.0006	0.0009	0.0008	0.0001
15	0.0383	0.0158	0.0087	0.0018	0.0091	0.0311	0.0073	0.0065	0.0047	0.0108	0.0076	0.0363	0.0258	0.0171	0.0034
16	1.0051	0.0156	0.0032	0.0007	0.0031	0.0121	0.0024	0.0024	0.0016	0.0040	0.0027	0.0127	0.0032	0.0059	0.0012
17	0.0069	1.0693	0.0252	0.0023	0.0122	0.0113	0.0123	0.0227	0.0074	0.0462	0.0199	0.0544	0.0367	0.0649	0.0066
18	0.0036	0.0016	1.0022	0.0004	0.0016	0.0157	0.0043	0.0007	0.0007	0.0004	0.0034	0.0015	0.0023	0.0007	0.0022
19	0.0000	0.0002	0.0004	1.0000	0.0029	0.0032	0.0154	0.0003	0.0002	0.0001	0.0019	0.0002	0.0001	0.0004	0.0001
20	0.0030	0.0205	0.0181	0.0047	1.0639	0.0250	0.0315	0.0284	0.0303	0.0207	0.0701	0.0386	0.0355	0.1199	0.0051
21	0.0016	0.0061	0.0539	0.0002	0.0022	1.0463	0.0042	0.0029	0.0014	0.0013	0.0194	0.0023	0.0016	0.0018	0.0006
22	0.0008	0.0115	0.0120	0.0007	0.0105	0.0132	1.0519	0.0154	0.0071	0.0045	0.1118	0.0050	0.0032	0.0055	0.0016
23	0.0019	0.0067	0.0150	0.0011	0.0123	0.0146	0.0252	1.0401	0.0111	0.0173	0.0301	0.0105	0.0266	0.0136	0.0024
24	0.0424	0.0602	0.0783	0.0061	0.0774	0.1094	0.1046	0.0556	1.0498	0.0169	0.2424	0.0447	0.0298	0.0350	0.0117
25	0.0021	0.0228	0.0273	0.0014	0.0102	0.0127	0.0154	0.0167	0.0359	1.0142	0.0391	0.0077	0.0237	0.0232	0.0036
26	0.0081	0.0729	0.1313	0.0078	0.1236	0.1473	0.2533	0.1813	0.0833	0.0502	1.3243	0.0551	0.0350	0.0609	0.0173
27	0.0002	0.0005	0.0005	0.0002	0.0058	0.0024	0.0038	0.0062	0.0032	0.0003	0.0016	1.0279	0.0006	0.0008	0.0001
28	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0004
29	0.0000	0.0000	0.0001	0.0000	0.0003	0.0002	0.0001	0.0002	0.0001	0.0000	0.0001	0.0272	0.0000	1.0003	0.0013
30	0.0017	0.0067	0.0324	0.0017	0.1172	0.0831	0.0262	0.0075	0.0311	0.0104	0.0351	0.0073	0.0081	0.0232	1.0126
	1.2135	1.5427	1.6060	1.1206	1.8721	2.2289	1.9129	1.5427	1.3641	1.2433	2.1971	1.7259	1.4557	1.5711	1.1481

Appendix 3(1) Capital Expenditure for Water Projects of Central Government: 1989-1993

Item	(Unit: K' Million)					
	1989 Actual	1990 Actual	1991 Actual	1992 Actual	1993 Approved Est.	1994 Estimate
1. Department of Water Affairs	9.3	14.5	14.3	67.4	1,312.3	13,021.0
001 Provincial Water Works (All Provinces)	4.1	6.1	3.1	35.8	62.2	300.0
002 Western Province Water Supply (2)	0.0	0.0	0.0	0.0	192.0	1,121.4
003 Township Water Programme Northern Sec.	3.3	2.4	0.9	1.4	34.6	44.7
006 Office/Service Building	0.9	0.6	0.8	2.1	8.6	27.2
007 Canal Development	0.0	0.0	1.0	5.8	8.6	568.3
008 Purchase of Houses	-	0.0	0.0	0.0	0.0	120.0
009 Central Province Water Supply (3)	0.0	0.0	0.0	0.0	240.0	1,232.0
010 Operational Training Course	0.0	0.2	0.3	0.1	4.3	7.4
011 International Drinking Water & San. Decade	0.0	0.3	0.5	0.0	0.0	0.0
012 Zambezi River System	0.1	0.2	0.2	0.0	0.5	3.7
013 Rural Water Supply Programme (4) (Northern Province)	0.0	0.0	0.0	0.0	76.0	33.4
014 Ground Water Supply Development (5) Central, Lusaka & Copperbelt	0.0	2.4	3.4	0.3	74.3	3,290.8
015 Pipe Supplies for Small Community	0.0	0.1	0.0	0.0	0.0	0.0
016 Hydrological Assessment & Strengthening of Network	0.8	2.2	3.6	2.0	6.0	7.4
017 Integration of Women in Water & San. Act.	0.0	0.0	0.4	0.0	0.0	0.0
018 Advisers to DWA	0.0	0.1	0.0	0.0	0.0	0.0
019 Rural Water for Health Project (6) North-Western Province	-	0.0	0.0	0.0	186.0	291.1
020 Rehabilitation of Wells & Boreholes	-	-	-	20.0	0.0	870.0
021 Six Township Water Supplies (7) Southern Province	-	-	-	-	74.0	178.1
022 Rehabilitation/Construction Earth Dams	-	-	-	-	0.0	700.0
023 Six Township Water Supplies (8) North-Western Province	-	-	-	-	345.0	742.2
024 Procurement of Rigs	-	-	-	-	0.0	450.0
025 National Water Resources Master Plan (9)	-	-	-	-	0.0	717.5
026 Kafue Basin Action Plan (10)	-	-	-	-	0.0	83.5
027 Community Management & Monitoring Unit (11)	-	-	-	-	0.0	314.7
028 Programme Coordinating Unit (12)	-	-	-	-	0.0	242.5
030 Institutional & Capacity Building Programme (13)	-	-	-	-	0.0	1,567.5
031 Borehole for Rural Areas (14) Lusaka Province	-	-	-	-	0.0	107.5
2. Energy Department	-	-	-	3.5	10.4	157.6
032 Hydro Electric Hydrological Assistance (1)	-	-	-	3.5	10.4	157.6
3. MOH	0.0	0.3	1.0	3.0	583.0	558.5
034 Community Water Supply & Sanitation (15)	0.0	0.3	1.0	3.0	583.0	558.5
4. MOWS *1	-	0.4	1.8	7.5	13.0	11.2
002 Urban Water & Sewerage Scheme	-	0.4	1.8	7.5	13.0	11.2

(To be continued)

Appendix 3(2) Capital Expenditure for Water Projects of Central Government: 1989-1993

Item	(Unit: K' Million)					
	1989 Actual	1990 Actual	1991 Actual	1992 Actual	1993 Approved Est.	1994 Estimate
5. MAFF - Fisheries Department	5.9	25.1	35.7	75.1	255.2	511.2
003 Fish Culture Development Project (16)	0.4	1.2	0.4	0.6	23.5	32.4
004 Northern Province Agricultural Project	1.1	3.2	0.5	1.3	0.0	0.0
006 Fish Culture Adaptive Research (17)	1.7	11.5	14.8	18.7	14.8	31.5
007 Restocking of Itezhi Tezhi Dam	0.1	4.1	0.7	0.9	4.1	10.0
008 Lake Kariba SADCC Project (18)	-	0.5	6.0	31.0	85.4	211.7
009 Fish Hatchery Project (19)	-	1.0	11.5	15.1	19.5	65.5
010 Aquaculture Project for North Western (20)	-	0.1	0.0	0.0	17.2	39.4
011 Lake Tanganyika Research (21)	-	-	0.0	1.1	34.5	51.8
012 Lake Kariba Small Fisheries Development Project (22)	-	-	0.0	0.0	47.6	56.0
020 Fisheries Development Project	2.5	3.4	1.8	6.6	8.6	12.8
5. MLGH - Loans & Investments	64.2	75.1	127.4	89.8	3,579.2	19,650.8
003 Ndola Water Supply & Sewerage Project (23) (Kanini & Lubuto)	7.5	29.0	78.3	76.3	537.2	550.0
004 Livingstone Water Supply & Sewerage Services (24)	3.2	14.1	19.3	5.0	129.4	380.0
005 Chipata Water Supply	0.3	0.0	0.5	0.0	0.0	0.0
006 Kabwe Underground Water Supply & Sewerage Treatment Plant	6.0	0.0	0.0	0.0	0.0	0.0
007 Choma Water Supply	0.7	0.0	1.1	0.0	0.0	0.0
008 Kalomo Water Supply	0.9	0.0	0.7	7.6	0.0	0.0
009 Monze Water Supply	0.2	0.0	0.4	0.0	0.0	0.0
010 Kabwe Surface Water Supply	33.0	25.3	5.8	0.0	0.0	0.0
016 Copperbelt Water Supply	0.0	0.0	0.0	0.0	0.0	0.0
017 IRDP Mpika Phase II	1.2	2.0	1.0	0.0	0.0	0.0
022 Lusaka Water Supply Scheme (25) (Rehabilitation of Distribution System)	3.1	1.6	8.0	0.0	2,412.0	10,790.8
025 Chama Water Supply Scheme	0.3	0.5	0.3	0.0	0.0	0.0
026 Chipata Water Distribution Scheme	1.6	0.0	0.0	0.0	0.0	0.0
027 Chongwe/Lusaka Rural Water Scheme	1.2	0.0	0.0	0.0	0.0	0.0
028 Mongu Water Supply Scheme	0.8	0.0	0.0	0.0	0.0	0.0
029 Lundazi Water Supply Scheme	0.3	0.0	0.0	0.0	0.0	0.0
030 Livingstone Water Distribution System	2.0	0.0	0.0	0.0	0.0	0.0
031 Kitwe Water Supply Scheme (26)	-	0.0	3.2	0.9	30.6	3,200.0
033 Mbala Water Supply Scheme	-	1.1	2.0	0.0	0.0	0.0
034 Mansa Water Supply Scheme	-	1.0	5.5	0.0	0.0	0.0
035 Mpika Water Supply Scheme	-	0.5	0.5	0.0	0.0	0.0
037 Kafue Sewerage Treatment Plant	1.9	0.0	0.8	0.0	0.0	0.0
045 Urban Infrastructure Engineering Credit - Water Supply / Sewerage (27)	-	-	0.0	0.0	0.0	200.0
046 District Centres Water Supply & Sewerage Rehab. Project - Southern Sector (28)	-	-	0.0	0.0	470.0	2,075.0

(To be continued)

Appendix 3(3) Capital Expenditure for Water Projects of Central Government: 1989-1993

(Conclusion)		(Unit: K' Million)					
Item	1989	1990	1991	1992	1993	1994	
	Actual	Actual	Actual	Actual	Approved Est.	Estimate	
5. MLGH - Loans & Investments (Continuation)							
047 Rehab. of Water Supply & Sewerage Systems in Cities, Municipalities & Urban Centres	-	-	0.0	0.0	0.0	1,908.0	
048 Providing Adequate Water Supply & Sanitation Facilities for Peri Urban Areas	-	-	0.0	0.0	0.0	547.0	
4. Total	79.4	115.3	180.3	246.3	5,753.0	33,910.2	

Source: (1) Estimates of Revenue & Expenditure 1994, Volume I, II & III, MOF (Ref.C19-C21)
 (2) Financial Report for the Year Ended 31st December 1992, 1994, MOF (Ref.C26)
 (3) Financial Report for the Year Ended 31st December 1991, 1993, MOF (Ref.C12)
 (4) Financial Report for the Year Ended 31st December 1990, 1992, MOF (Ref.C11)
 (5) Financial Report for the Year Ended 31st December 1989, 1991, MOF (Ref.C11)

Remark: *1 Before 1989, MOWS did not exist.

*2 Foreign Assistance of Grant

		(Unit: K' Million)					
Donor Country / International Agency	1989	1990	1991	1992	1993	1994	
(1) CIDA	-	-	-	-	-	139.0	
(2) NORAD	-	-	-	-	-	1,031.4	
(3) German Government	-	-	-	-	-	1,232.0	
(4) Irish Government	-	-	-	-	-	33.4	
(5) Japanese Government	-	-	-	-	-	3,290.8	
(6) Netherlands	-	-	-	-	-	275.1	
(7) German Government	-	-	-	-	-	178.1	
(8) German Government	-	-	-	-	-	742.2	
(9) Japanese Government	-	-	-	-	-	712.5	
(10) UNDP	-	-	-	-	-	70.5	
(11) NORAD	-	-	-	-	-	314.7	
(12) NORAD/GTZ	-	-	-	-	-	237.5	
(13) NORAD	-	-	-	-	-	1,567.5	
(14) Chinese	-	-	-	-	-	47.5	
(15) WHO	-	-	-	-	-	32.0	
EEC	-	-	-	-	-	526.5	
(16) Netherlands	-	-	-	-	-	19.3	
(17) NORAD	-	-	-	-	-	20.4	
(18) DANIDA/NORAD	-	-	-	-	-	184.1	
(19) JICA	-	-	-	-	-	47.5	
(20) AFRICARE/UNDP	-	-	-	-	-	32.7	
(21) FINNIDA	-	-	-	-	-	38.0	
(22) GTZ	-	-	-	-	-	47.5	
(23) ADB	-	-	-	-	-	410.0	
(24) ADB	-	-	-	-	-	75.0	
(25) ADB	-	-	-	-	-	7,074.4	
ADF	-	-	-	-	-	2,754.1	
(26) ADB/ADF, NORDIC Fund	-	-	-	-	-	2,825.0	
(27) IDA	-	-	-	-	-	176.0	
(28) ADB	-	-	-	-	-	1,678.8	
Total	-	-	-	-	-	25,813.5	

Appendix 4(1) Estimate of Total Urban and Rural Population: 1995-2015

I. Medium Projection								
Item	Actual			Projection				
	1980	1990	1993	1995	2000	2005	2010	2015
1. GDP *1	At Current Prices (K' Million)			At 1993 Constant Prices (Kwacha Billion)*1				
GDP Total	3,064	113,340	1,423,187	1,554	1,975	2,343	2,760	3,229
Rural Sector *2	467	20,631	393,930	443	592	687	796	923
Urban Sector	2,597	92,709	1,029,257	1,112	1,383	1,656	1,964	2,306
2. Population (1000)	Census Population			Projected Population				
Total Population	5,662	7,383	7,954 *	8,359	9,388	10,465	11,584	12,738
Rural Population	3,403	4,602	5,010 *					
Urban Population	2,259	2,782	2,944 *					
3. GDP per Capita (Kwacha)								
Rural Sector	137	4,483	78,636 *					
Urban Sector	1,150	33,330	349,553 *					
4. G (Gradient)	8.39	7.43						
G (Gradient: Assumption)*3			4.45 *	4.30	4.25	4.20	4.15	4.10
5. Population Estimated applying "G"				8,359	9,388	10,465	11,584	12,738
Urban Sector				3,082	3,329	3,818	4,318	4,824
Rural Sector				5,276	6,059	6,647	7,263	7,914
Percentage Share (%)								
Urban Sector	40	38	37	37	35	36	37	38
Rural Sector	60	62	63	63	65	64	63	62

Remark: * Estimated on the basis of the census figures

*1 Refer to Table 3-12.

*2 Only agricultural sectors are assumed to contribute rural activity product.

*3 Economic disparity between urban and rural areas is assumed to shrink quickly among the three projections.

Appendix 4(2) Estimate of Total Urban and Rural Population: 1995-2015

II. High Projection		Actual			Projection			
Item	1980	1990	1993	1995	2000	2005	2010	2015
1. GDP *1		At Current Prices (K' Million)			At 1993 Constant Prices (Kwacha Billion)*1			
GDP Total	3,064	113,340	1,423,187	1,568	2,026	2,461	2,991	3,634
Rural Sector *2	467	20,631	393,930	418	483	559	647	748
Urban Sector	2,597	92,709	1,029,257	1,150	1,543	1,902	2,344	2,886
2. Population (1000)		Census Population			Projected Population			
Total Population	5,662	7,383	7,995 *	8,431	9,628	10,994	12,555	14,336
Rural Population	3,403	4,602	5,035 *					
Urban Population	2,259	2,782	2,960 *					
3. GDP per Capita (Kwacha)								
Rural Sector	137	4,483	78,232 *					
Urban Sector	1,150	33,330	347,758 *					
4. G (Gradient)		8.39	7.43					
G (Gradient: Assumption)*3				4.45 *	4.30	4.25	4.20	4.15
5. Population Estimated applying "G"				8,431	9,628	10,994	12,555	14,336
Urban Sector				3,292	4,130	4,921	5,853	6,950
Rural Sector				5,139	5,498	6,073	6,701	7,387
• Percentage Share (%)								
Urban Sector	40	38	37	39	43	45	47	48
Rural Sector	60	62	63	61	57	55	53	52

Remark: * Estimated on the basis of the census figures

*1 Refer to Table 3-12.

*2 Only agricultural sectors are assumed to contribute rural activity product.

*3 Economic disparity between urban and rural areas is assumed to shrink slowly among the three projections.

Appendix 4(3) Estimate of Total Urban and Rural Population: 1995-2015

III. Low Projection

Item	Actual			Projection				
	1980	1990	1993	1993	2000	2005	2010	2015
1. GDP *1	At Current Prices (K' Million)			At 1993 Constant Prices (Kwacha Billion)*1				
GDP Total	3,064	113,340	1,423,187	1,492	1,677	1,846	2,009	2,166
Rural Sector *2	467	20,631	393,930	415	463	511	556	599
Urban Sector	2,597	92,709	1,029,257	1,078	1,213	1,335	1,453	1,567
2. Population (1000)	Census Population			Projected Population				
Total Population	5,662	7,383	7,915 *	8,291	9,176	10,025	10,832	11,589
Rural Population	3,403	4,602	4,985 *					
Urban Population	2,259	2,782	2,930 *					
3. GDP per Capita (Kwacha)								
Rural Sector	137	4,483	79,021 *					
Urban Sector	1,150	33,330	351,264 *					
4. G (Gradient)	8.39	7.43						
G (Gradient: Assumption)*3			4.45 *	4.30	4.25	4.20	4.15	4.10
5. Population Estimated applying "G"								
Urban Sector				3,291	3,498	3,846	4,185	4,514
Rural Sector				5,167	5,678	6,180	6,647	7,075
Percentage Share (%)								
Urban Sector	40	38	37	38	38	38	39	39
Rural Sector	60	62	63	62	62	62	61	61

Remark: * Estimated on the basis of the census figures

*1 Refer to Table 3-12.

*2 Only agricultural sectors are assumed to contribute rural activity product.

*3 Economic disparity between urban and rural areas is assumed to shrink modestly among the three projections.

Appendix 5(1) Basic Urban Population by Township: 1990

District		Township		Group 1	Group 2	Group 3
Code	Name	Code	Name			
11	Lusaka-Urban	111	Lusaka	769,353		
12	Lusaka-Rural	121	Chóngwe		3,370	
		122	Kafue		43,801	
		123	Chilanga			9,126
		124	Rufunsa			2,217
13	Luangwa	131	Luangwa		1,606	
21	Ndola-Urban	211	Ndola Township	334,531		
22	Ndola-Rural	221	Masaiti		2,140	
		222	Mpongwe			10,837
23	Chililabombwe	231	Chililabombwe	48,055		
		232	Konkola		1,795	
24	Chingola	241	Chingola	142,379		
25	Mufulira	251	Mufulira	124,746		
26	Kalulushi	261	Kalulushi	31,474		
		262	Chambishi		9,945	
27	Kitwe	271	Kitwe	288,592		
28	Luanshya	281	Luanshya	118,143		
31	Kabwe-Urban	311	Kabwe Township	161,456		
32	Kabwe-Rural	321	Chibombo		4,058	
		322	Chisamba			2,972
		323	Kapiri Mposhi		13,540	
33	Mumbwa	331	Mumbwa		11,015	
		332	Nampundwe			4,088
34	Mkushi	341	Mkushi		7,804	
35	Serenje	351	Serenje		8,265	
41	Solwezi	411	Solwezi		26,223	
42	Mwinilunga	421	Mwinilunga		6,342	
43	Zambezi	431	Zambezi		5,941	
		432	Chavuma			1,798
44	Kabompo	441	Kabompo		5,005	
45	Mfumbwe	451	Mfumbwe		4,860	
46	Kasempa	461	Kasempa		4,151	
51	Mongu	511	Mongu		29,302	
		512	Limulunga			5,764
		513	Namushakande			1,771
52	Lukulu	521	Lukulu		3,129	
53	Kalabo	531	Kalabo		7,209	
		532	Sikongo			1,659
54	Kaoma	541	Kaoma		9,165	
55	Senanga	551	Senanga		7,727	
		552	Shangombo			1,599
56	Sesheke	561	Sesheke		5,390	
		562	Mulobezi			2,009
		563	Katima-Mulilo			1,017
61	Livingstone	611	Livingstone	76,875		
62	Namwala	621	Namwala		3,772	
		622	Itezhi-Tezhi			5,027

(To be continued)

Appendix 5(2) Basic Urban Population by Township: 1990

(Conclusion)						
District		Township				
Code	Name	Code	Name	Group 2	Group 3	Group 4
63	Mazabuka	631	Mazabuka		24,596	
		632	Magoye			2,331
		633	Nakambala			7,503
		634	Nega-nega			1,836
		635	Kafue-gorge			2,813
		636	Chikankata			3,912
64	Monze	641	Monze		15,910	
		642	Chisekesi			1,675
65	Choma	651	Choma		30,143	
		652	Batoka			1,445
		653	Pemba			2,170
		654	Mbabala			1,762
66	Kalomo	661	Kalomo		8,386	
		662	Zimba			1,351
67	Siavonga	671	Siavonga		5,569	
		672	Chirundu			2,072
68	Gwembe	681	Gwembe		2,013	
69	Sinazongwe	691	Sinazongwe		2,006	
		692	Maamba			8,817
71	Mansa	711	Mansa		39,051	
72	Nchelenge	721	Nchelenge		14,498	
		722	Chiengi			1,900
73	Kawambwa	731	Kawambwa		3,882	
		732	Mwansabombwe			7,382
74	Mwense	741	Mwense		3,695	
75	Samfya	751	Samfya		12,718	
81	Kasama	811	Kasama		48,045	
82	Kaputa	821	Kaputa		2,936	
83	Mbala	831	Mbala		12,185	
		832	Mpulungu			2,739
84	Mporokoso	841	Mporokoso		4,818	
85	Luwingu	851	Luwingu		4,664	
86	Chilubi	861	Chilubi		1,366	
87	Isoka	871	Isoka		8,596	
		872	Nakonde		4,493	
88	Chinsali	881	Chinsali		7,509	
89	Mpika	891	Mpika		20,950	
91	Chipata	911	Chipata Township		52,213	
92	Chama	921	Chama Township		3,474	
93	Lundazi	931	Lundazi		5,590	
94	Chadiza	941	Chadiza Township		3,031	
95	Katete	951	Katete Township		7,165	
96	Petauke	961	Petauke		8,148	
		962	Nyimba		1,684	
		963	Kacholola			1,445
Total				2,095,604	584,889	101,037

Note: Types of Township are classified in principle as follows:

Group 1: Large urban areas

Group 2: District capital towns and small urban areas in the districts having large urban areas

Group 3: Other rural centres

Appendix 6(1) Projected Urban Population by Township: 1990-2015

I. Medium Projection

District		Township					
Code	Name	Code	Name	1990	1995	2005	2015
11	Lusaka-Urban	111	Lusaka	769,353	967,970	1,483,197	2,180,740
12	Lusaka-Rural	121	Chongwe	3,370	4,047	5,649	7,569
		122	Kafue	43,801	52,602	73,415	98,377
		123	Chilanga	9,126	10,960	15,297	20,496
		124	Rufunsa	2,217	2,662	3,716	4,979
13	Luangwa	131	Luangwa	1,606	1,855	2,397	2,974
21	Ndola-Urban	211	Ndola Township	334,531	388,375	506,943	635,129
22	Ndola-Rural	221	Masaiti	2,140	2,537	3,451	4,509
		222	Mpongwe	10,837	12,846	17,473	22,832
23	Chililabombwe	231	Chililabombwe	48,055	50,656	54,479	56,247
		232	Konkola	1,795	1,892	2,035	2,101
24	Chingola	241	Chingola	142,379	154,140	174,784	190,314
25	Mufulira	251	Mufulira	124,746	130,658	138,776	141,511
26	Kalulushi	261	Kalulushi	31,474	36,628	48,020	60,457
		262	Chambishi	9,945	11,574	15,173	19,103
27	Kitwe	271	Kitwe	288,592	320,666	383,289	439,808
28	Luanshya	281	Luanshya	118,143	126,214	139,345	147,713
31	Kabwe-Urban	311	Kabwe Township	161,456	194,556	273,376	368,824
32	Kabwe-Rural	321	Chibombo	4,058	4,540	5,496	6,391
		322	Chisambo	2,972	3,325	4,025	4,681
		323	Kapiri Mposhi	13,540	15,148	18,339	21,325
33	Mumbwa	331	Mumbwa	11,015	12,838	16,872	21,304
		332	Nampundwe	4,088	4,765	6,261	7,907
34	Mkushi	341	Mkushi	7,804	8,860	11,046	13,229
35	Serenje	351	Serenje	8,265	9,438	11,917	14,443
41	Solwezi	411	Solwezi	26,223	31,310	43,195	57,209
42	Mwinilunga	421	Mwinilunga	6,342	6,893	7,877	8,647
43	Zambezi	431	Zambezi	5,941	6,575	7,798	8,877
		432	Chavuma	1,798	1,990	2,360	2,687
44	Kabompo	441	Kabompo	5,005	5,540	6,570	7,479
45	Mfumbwe	451	Mfumbwe	4,860	5,379	6,379	7,262
46	Kasempa	461	Kasempa	4,151	4,594	5,449	6,203
51	Mongu	511	Mongu	29,302	32,685	39,357	45,498
		512	Limulunga	5,764	6,430	7,742	8,950
		513	Namushakande	1,771	1,976	2,379	2,750
52	Lukulu	521	Lukulu	3,129	3,491	4,203	4,859
53	Kalabo	531	Kalabo	7,209	7,505	7,877	7,981
		532	Sikongo	1,659	1,727	1,813	1,837
54	Kaoma	541	Kaoma	9,165	10,507	13,370	16,330
55	Senanga	551	Senanga	7,727	8,361	9,471	10,298
		552	Shangombo	1,599	1,730	1,960	2,131
		553	Mulobezi	2,009	2,092	2,195	2,224
56	Sesheke	561	Sesheke	5,390	5,612	5,890	5,967
		562	Mulobezi	2,009	2,092	2,195	2,224
		563	Katima-Mulilo	1,017	1,059	1,111	1,126
61	Livingstone	611	Livingstone	76,875	84,833	99,967	113,134
62	Nanwala	621	Nanwala	3,772	4,465	6,053	7,882
		622	Itezhi-Tezhi	5,027	5,950	8,067	10,504

(To be continued)

Appendix 6(2) Projected Urban Population by Township: 1990-2015

L Medium Projection (Conclusion)

District		Township					
Code	Name	Code	Name	1990	1995	2005	2015
63	Mazabuka	631	Mazabuka	24,596	27,423	33,005	38,134
		632	Magoye	2,331	2,599	3,128	3,614
		633	Nakambala	7,503	8,365	10,068	11,633
		634	Nega-nega	1,836	2,047	2,464	2,847
		635	Kafue-gorge	2,813	3,136	3,775	4,361
		636	Chikankata	3,912	4,362	5,249	6,065
64	Monze	641	Monze	15,910	17,739	21,349	24,666
		642	Chisekesi	1,675	1,868	2,248	2,597
65	Choma	651	Choma	30,143	33,134	38,758	43,538
		652	Batoka	1,445	1,588	1,858	2,087
		653	Pemba	2,170	2,385	2,790	3,134
		654	Mbabala	1,762	1,937	2,266	2,545
66	Kalomo	661	Kalomo	8,386	9,774	12,845	16,203
		662	Zimba	1,351	1,575	2,069	2,610
67	Siavonga	671	Siavonga	5,569	6,197	7,429	8,550
		672	Chirundu	2,072	2,306	2,764	3,181
68	Gwembe	681	Gwembe	2,013	2,240	2,685	3,090
69	Sinazongwe	691	Sinazongwe	2,006	2,232	2,676	3,080
		692	Maamba	8,817	9,812	11,762	13,535
71	Mansa	711	Mansa	39,051	43,581	52,555	60,843
72	Nchelenge	721	Nchelenge	14,498	16,603	21,070	25,669
		722	Chiengi	1,900	2,176	2,761	3,364
73	Kawambwa	731	Kawambwa	3,882	4,171	4,664	5,005
		732	Mvansabombwe	7,382	7,933	8,868	9,520
74	Mwense	741	Mwense	3,695	3,974	4,450	4,783
75	Samfya	751	Samfya	12,718	12,891	12,941	12,957
81	Kasama	811	Kasama	48,045	53,513	64,219	74,015
82	Kaputa	821	Kaputa	2,936	3,159	3,541	3,810
83	Mbala	831	Mbala	12,185	12,908	14,014	14,613
		832	Mpulungu	2,739	2,902	3,150	3,285
84	Mporokoso	841	Mporokoso	4,818	5,185	5,811	6,252
85	Luwingu	851	Luwingu	4,664	4,876	5,156	5,236
86	Chilubi	861	Chilubi	1,366	1,428	1,510	1,533
87	Isoka	871	Isoka	8,596	9,320	10,599	11,576
		872	Nakonde	4,493	4,871	5,540	6,050
88	Chinsali	881	Chinsali	7,509	7,979	8,717	9,146
89	Mpika	891	Mpika	20,950	23,889	30,045	36,304
91	Chipata	911	Chipata Township	52,213	59,711	75,543	91,815
92	Chama	921	Chama Township	3,474	3,826	4,491	5,062
93	Lundazi	931	Lundazi	5,590	6,313	7,786	9,224
94	Chadiza	941	Chadiza Township	3,031	3,466	4,390	5,335
95	Katete	951	Katete Township	7,165	7,942	9,437	10,769
96	Petauke	961	Petauke	8,148	9,349	11,910	14,575
		962	Nyimba	1,684	1,932	2,462	3,012
		963	Kacholola	1,445	1,658	2,112	2,585
Total				2,781,530	3,226,731	4,252,784	5,464,606

Appendix 6(3) Projected Urban Population by Township: 1990-2015

II. High Projection

District		Township					
Code	Name	Code	Name	1990	1995	2005	2015
11	Lusaka-Urban	111	Lusaka	769,353	976,307	1,558,053	2,455,730
12	Lusaka-Rural	121	Chongwe	3,370	4,911	10,234	20,820
		122	Kafue	43,801	63,822	133,020	270,604
		123	Chilanga	9,126	12,134	21,155	36,204
		124	Rufunsa	2,217	2,948	5,139	8,795
13	Luangwa	131	Luangwa	1,606	2,172	3,896	6,828
21	Ndola-Urban	211	Ndola Township	334,531	391,783	532,432	714,849
22	Ndola-Rural	221	Massiti	2,140	3,041	6,032	11,690
		222	Mpongwe	10,837	14,136	23,733	39,139
23	Chililabombwe	231	Chililabombwe	48,055	51,110	57,244	63,328
		232	Konkola	1,795	2,029	2,542	3,108
24	Chingola	241	Chingola	142,379	155,430	183,612	214,138
25	Mufulira	251	Mufulira	124,746	131,824	145,834	159,342
26	Kalulushi	261	Kalulushi	31,474	36,950	50,458	68,043
		262	Chambishi	9,945	13,639	25,196	45,419
27	Kitwe	271	Kitwe	288,592	323,504	402,540	494,797
28	Luanshya	281	Luanshya	118,143	127,273	146,402	166,259
31	Kabwe-Urban	311	Kabwe Township	161,456	196,243	287,304	415,359
32	Kabwe-Rural	321	Chibombo	4,058	5,150	8,151	12,586
		322	Chisamba	2,972	3,557	5,030	6,979
		323	Kapiri Mposhi	13,540	17,183	27,199	41,997
33	Mumbwa	331	Mumbwa	11,015	15,148	28,143	51,021
		332	Nampundwe	4,088	5,201	8,307	13,021
34	Mkushi	341	Mkushi	7,804	10,190	17,079	27,925
35	Serenje	351	Serenje	8,265	10,926	18,751	31,427
41	Solwezi	411	Solwezi	26,223	37,787	77,015	153,207
42	Mwinilunga	421	Mwinilunga	6,342	7,605	10,748	14,829
43	Zambezi	431	Zambezi	5,941	7,389	11,225	16,648
		432	Chavuma	1,798	2,120	2,905	3,910
44	Kabompo	441	Kabompo	5,005	6,225	9,457	14,025
45	Mfumbwe	451	Mfumbwe	4,860	6,045	9,183	13,619
46	Kasempa	461	Kasempa	4,151	5,163	7,843	11,632
51	Mongu	511	Mongu	29,302	37,006	57,912	88,485
		512	Limulunga	5,764	6,874	9,635	13,264
		513	Namushakande	1,771	2,112	2,961	4,075
52	Lukulu	521	Lukulu	3,129	3,952	6,184	9,449
53	Kalabo	531	Kalabo	7,209	7,952	9,487	11,052
		532	Sikongo	1,659	1,786	2,039	2,287
54	Kaoma	541	Kaoma	9,165	12,207	21,270	36,195
55	Senanga	551	Senanga	7,727	9,186	12,747	17,264
		552	Shangombo	1,599	1,822	2,331	2,929
56	Sesheke	561	Sesheke	5,390	5,945	7,093	8,263
		562	Mulobezi	2,009	2,163	2,469	2,770
		563	Katima-Mulilo	1,017	1,095	1,250	1,402
61	Livingstone	611	Livingstone	76,875	85,585	105,047	127,363
62	Namwala	621	Namwala	3,772	5,345	10,544	20,300
		622	Itzhi-Tezhi	5,027	6,544	10,939	17,950

(To be continued)

Appendix 6(4) Projected Urban Population by Township: 1990-2015

II. High Projection		(Conclusion)					
District		Township					
Code	Name	Code	Name	1990	1995	2005	2015
63	Mazabuka	631	Mazabuka	24,596	31,036	48,519	74,059
		632	Magoye	2,331	2,778	3,891	5,352
		633	Nakambala	7,503	8,942	12,524	17,228
		634	Nega-nega	1,836	2,188	3,065	4,216
		635	Kefue-gorge	2,813	3,352	4,696	6,459
		636	Chikankata	3,912	4,662	6,530	8,983
64	Monze	641	Monze	15,910	20,074	31,385	47,905
		642	Chisekesi	1,675	1,996	2,796	3,846
65	Choma	651	Choma	30,143	36,990	54,704	78,973
		652	Batoka	1,445	1,686	2,264	2,986
		653	Pemba	2,170	2,532	3,401	4,484
		654	Mbabala	1,762	2,056	2,761	3,641
66	Kalomo	661	Kalomo	8,386	11,522	21,386	38,734
		662	Zimba	1,351	1,718	2,741	4,294
67	Siavonga	671	Siavonga	5,569	7,000	10,860	16,450
		672	Chirundu	2,072	2,462	3,429	4,689
68	Gwembe	681	Gwembe	2,013	2,530	3,926	5,946
69	Sinazongwe	691	Sinazongwe	2,006	2,521	3,912	5,926
		692	Maamba	8,817	10,476	14,591	19,955
71	Mansa	711	Mansa	39,051	49,367	77,477	118,715
72	Nchelenge	721	Nchelenge	14,498	19,255	33,394	56,503
		722	Chiengi	1,900	2,354	3,568	5,307
73	Kawambwa	731	Kawambwa	3,882	4,557	6,166	8,143
		732	Mwansabombwe	7,382	8,330	10,459	12,893
74	Mwense	741	Mwense	3,695	4,342	5,887	7,789
75	Samfya	751	Samfya	12,718	13,301	14,262	14,931
81	Kasama	811	Kasama	48,045	60,450	94,054	142,740
82	Kaputa	821	Kaputa	2,936	3,454	4,696	6,225
83	Mbala	831	Mbala	12,185	13,894	17,752	22,110
		832	Mpulungu	2,739	3,023	3,635	4,288
84	Mporokoso	841	Mporokoso	4,818	5,667	7,706	10,215
85	Luwingu	851	Luwingu	4,664	5,179	6,277	7,423
86	Chilubi	861	Chilubi	1,366	1,517	1,838	2,174
87	Isoka	871	Isoka	8,596	10,259	14,360	19,600
		872	Nakonde	4,493	5,362	7,506	10,245
88	Chinsali	881	Chinsali	7,509	8,621	11,143	14,057
89	Mpika	891	Mpika	20,950	27,615	47,083	78,312
91	Chipata	911	Chipata Township	52,213	69,218	119,359	200,996
92	Chama	921	Chama Township	3,474	4,276	6,366	9,252
93	Lundazi	931	Lundazi	5,590	7,224	11,856	18,984
94	Chadiza	941	Chadiza Township	3,031	4,018	6,935	11,690
95	Katete	951	Katete Township	7,165	8,929	13,629	20,291
96	Petauke	961	Petauke	8,148	10,874	19,000	32,392
		962	Nyimba	1,684	2,247	3,927	6,695
		963	Kacholola	1,445	1,797	2,739	4,097
Total				2,781,530	3,350,170	4,886,225	7,170,519

Appendix 6(5) Projected Urban Population by Township: 1990-2015

III Low Projection		Township					
District							
Code	Name	Code	Name	1990	1995	2005	2015
11	Lusaka-Urban	111	Lusaka	769,353	960,128	1,420,524	1,984,501
12	Lusaka-Rural	121	Chongwe	3,370	4,014	5,408	6,882
		122	Kafue	43,801	52,172	70,287	89,445
		123	Chilanga	9,126	10,871	14,644	18,636
		124	Rufunsa	2,217	2,641	3,558	4,527
13	Luangwa	131	Luangwa	1,606	1,840	2,297	2,705
21	Ndola-Urban	211	Ndola Township	334,531	385,372	485,657	577,936
22	Ndola-Rural	221	Masaiti	2,140	2,517	3,306	4,103
		222	Mpongwe	10,837	12,748	16,745	20,773
23	Chililabombwe	231	Chililabombwe	48,055	50,256	52,198	52,644
		232	Konkola	1,795	1,877	1,950	1,966
24	Chingola	241	Chingola	142,379	152,858	167,347	173,122
25	Mufulira	251	Mufulira	124,746	129,626	132,968	133,432
26	Kalulushi	261	Kalulushi	31,474	36,329	46,006	54,989
		262	Chambishi	9,945	11,479	14,537	17,376
27	Kitwe	271	Kitwe	288,592	318,161	367,236	400,065
28	Luanshya	281	Luanshya	118,143	125,158	133,398	135,414
31	Kabwe-Urban	311	Kabwe Township	161,456	192,965	261,982	335,846
32	Kabwe-Rural	321	Chibombo	4,058	4,502	5,267	5,818
		322	Chisamba	2,972	3,297	3,857	4,261
		323	Kapiri Mposhi	13,540	15,022	17,572	19,410
33	Mumbwa	331	Mumbwa	11,015	12,733	16,164	19,377
		332	Nampundwe	4,088	4,726	5,999	7,191
34	Mkushi	341	Mkushi	7,804	8,787	10,580	12,027
35	Serenje	351	Serenje	8,265	9,365	11,416	13,143
41	Solwezi	411	Solwezi	26,223	31,053	41,372	52,034
42	Mwinilunga	421	Mwinilunga	6,342	6,836	7,548	7,870
43	Zambezi	431	Zambezi	5,941	6,524	7,471	8,083
		432	Chavuma	1,798	1,974	2,261	2,446
44	Kabompo	441	Kabompo	5,005	5,496	6,294	6,810
45	Mfumbwe	451	Mfumbwe	4,860	5,337	6,112	6,612
46	Kasempa	461	Kasempa	4,151	4,558	5,220	5,647
51	Mongu	511	Mongu	29,302	32,416	37,694	41,388
		512	Limulunga	5,764	6,376	7,415	8,141
		513	Namushakande	1,771	1,959	2,278	2,502
52	Lukulu	521	Lukulu	3,129	3,461	4,025	4,419
53	Kalabo	531	Kalabo	7,209	7,447	7,612	7,654
		532	Sikongo	1,659	1,714	1,752	1,761
54	Kaoma	541	Kaoma	9,165	10,424	12,808	14,864
55	Senanga	551	Senanga	7,727	8,291	9,069	9,363
		552	Shangombo	1,599	1,716	1,877	1,938
56	Sesheke	561	Sesheke	5,390	5,568	5,691	5,722
		562	Mulobezi	2,009	2,075	2,121	2,133
		563	Katima-Mulilo	1,017	1,050	1,074	1,080
61	Livingstone	611	Livingstone	76,875	84,174	95,824	102,950
62	Namwala	621	Namwala	3,772	4,428	5,800	7,175
		622	Itezhi-Tezhi	5,027	5,902	7,729	9,562

(To be continued)

Appendix 6(6) Projected Urban Population by Township: 1990-2015

III. Low Projection		(Conclusion)					
District		Township					
Code	Name	Code	Name	1990	1995	2005	2015
63	Mazabuka	631	Mazabuka	24,596	27,207	31,624	34,691
		632	Magoye	2,331	2,579	2,997	3,288
		633	Nakambala	7,503	8,300	9,647	10,583
		634	Nega-nega	1,836	2,031	2,361	2,590
		635	Kafue-gorge	2,813	3,112	3,617	3,968
		636	Chikankata	3,912	4,328	5,030	5,518
64	Monze	641	Monze	15,910	17,601	20,456	22,439
		642	Chisekesi	1,675	1,853	2,154	2,362
65	Choma	651	Choma	30,143	32,873	37,150	39,635
		652	Batoka	1,445	1,576	1,781	1,900
		653	Pemba	2,170	2,367	2,674	2,853
		654	Mbabala	1,762	1,922	2,172	2,317
66	Kalomo	661	Kalomo	8,386	9,693	12,299	14,738
		662	Zimba	1,351	1,562	1,982	2,374
67	Siavonga	671	Siavonga	5,569	6,149	7,118	7,777
		672	Chirundu	2,072	2,288	2,648	2,894
68	Gwembe	681	Gwembe	2,013	2,223	2,573	2,811
69	Sinazongwe	691	Sinazongwe	2,006	2,215	2,564	2,802
		692	Maamba	8,817	9,735	11,270	12,314
71	Mansa	711	Mansa	39,051	43,243	50,358	55,350
72	Nchelenge	721	Nchelenge	14,498	16,467	20,182	23,353
		722	Chiengi	1,900	2,158	2,645	3,060
73	Kawambwa	731	Kawambwa	3,882	4,139	4,469	4,554
		732	Mwansabombwe	7,382	7,869	8,496	8,661
74	Mwense	741	Mwense	3,695	3,941	4,260	4,348
75	Samfya	751	Samfya	12,718	12,788	12,846	12,858
81	Kasama	811	Kasama	48,045	53,073	61,529	67,362
82	Kaputa	821	Kaputa	2,936	3,134	3,392	3,467
83	Mbala	831	Mbala	12,185	12,801	13,429	13,454
		832	Mpulungu	2,739	2,877	3,018	3,024
84	Mporokoso	841	Mporokoso	4,818	5,142	5,566	5,689
85	Luwingu	851	Luwingu	4,664	4,837	4,939	4,950
86	Chilubi	861	Chilubi	1,366	1,417	1,447	1,450
87	Isoka	871	Isoka	8,596	9,242	10,148	10,525
		872	Nakonde	4,493	4,831	5,304	5,501
88	Chinsali	881	Chinsali	7,509	7,915	8,353	8,412
89	Mpika	891	Mpika	20,950	23,691	28,781	33,009
91	Chipata	911	Chipata Township	52,213	59,219	72,399	83,526
92	Chama	921	Chama Township	3,474	3,794	4,300	4,602
93	Lundazi	931	Lundazi	5,590	6,260	7,457	8,385
94	Chadiza	941	Chadiza Township	3,031	3,439	4,205	4,856
95	Katete	951	Katete Township	7,165	7,876	9,042	9,802
96	Petauke	961	Petauke	8,148	9,272	11,410	13,254
		962	Nyimba	1,684	1,916	2,358	2,739
		963	Kacholola	1,445	1,644	2,023	2,350
Total				2,781,530	3,200,822	4,074,423	4,982,138

Appendix 7(1) Projected Population by District: 1995-2015

(Unit: 1000)

I. Medium Projection			1995			2005			2015		
District	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural		
11 Lusaka-Urban	968	968	0	1,483	1,483	0	2,181	2,181	0		
12 Lusaka-Rural	242	70	172	338	98	240	452	131	321		
13 Luangwa	19	2	17	24	2	22	30	3	27		
21 Ndola-Urban	388	388	0	507	507	0	635	635	0		
22 Ndola-Rural	196	15	180	266	21	245	348	27	320		
23 Chililabombwe	66	53	13	71	57	14	73	58	15		
24 Chingola	174	154	20	198	175	23	215	190	25		
25 Mufulira	153	131	23	163	139	24	166	142	25		
26 Kalulushi	79	48	31	104	63	41	131	80	51		
27 Kitwe	386	321	66	462	383	79	530	440	90		
28 Luanshya	152	126	25	167	139	28	177	143	30		
31 Kabwe-Urban	193	193	0	274	273	0	369	369	0		
32 Kabwe-Rural	245	23	222	297	28	269	345	32	313		
33 Mumbwa	149	18	131	196	23	173	247	29	218		
34 Mkwashi	123	9	114	154	11	142	184	13	171		
35 Serenje	118	9	109	149	12	137	181	14	166		
41 Solwezi	149	31	117	205	43	162	272	57	215		
42 Mwinilunga	89	7	82	101	8	93	111	9	102		
43 Zambesi	68	9	60	66	10	56	61	12	50		
44 Kabompo	59	6	53	70	7	63	80	7	72		
45 Mfumbwe	25	5	20	30	6	24	34	7	27		
46 Kasempa	41	5	36	48	5	43	55	6	49		
51 Mongu	159	41	118	192	49	142	222	57	165		
52 Lukulu	58	3	54	70	4	66	81	5	76		
53 Kalabo	93	9	84	82	10	72	69	10	60		
54 Naoma	128	11	118	163	13	150	200	16	183		
55 Senanga	149	10	139	169	11	157	184	12	171		
56 Sesheke	68	9	59	71	9	62	71	9	62		
61 Livingstone	92	85	7	108	100	8	122	113	9		
62 Naniwala	98	10	88	133	14	119	174	18	155		
63 Mazabuka	173	48	125	209	58	151	241	67	174		
64 Monze	141	20	121	169	24	146	195	27	168		
65 Choma	179	39	140	210	46	164	236	51	184		
66 Kalomo	190	11	178	249	15	234	314	19	295		
67 Siavonga	39	9	30	47	10	36	54	12	42		
68 Gwembe	39	2	37	47	3	45	54	3	51		
69 Sinazongwe	71	12	59	85	14	70	98	17	81		
71 Mansa	159	44	115	192	53	139	222	61	161		
72 Nchelenge	128	19	110	163	24	139	198	29	169		
73 Kawambwa	89	12	77	99	14	86	107	15	92		
74 Mwense	86	4	82	97	4	92	104	5	99		
75 Samfya	109	13	96	108	13	95	104	13	91		
81 Kasama	211	54	157	253	64	189	292	74	218		
82 Kaputa	54	3	51	60	4	57	65	4	61		
83 Mbala	144	16	128	157	17	139	163	18	145		
84 Mporokoso	57	5	51	63	6	58	68	6	62		
85 Luwingu	70	5	65	74	5	69	75	5	70		
86 Chilubi	42	1	40	44	2	43	45	2	43		
87 Isoka	132	14	118	150	16	134	164	18	146		
88 Chinsali	89	8	81	97	9	88	102	9	93		
89 Mpika	131	24	107	165	30	135	199	36	163		
91 Chipata	333	60	273	422	76	346	512	92	421		
92 Chama	57	4	53	67	4	62	75	5	70		
93 Lundazi	194	6	187	239	8	231	283	9	274		
94 Chadiza	72	3	69	92	4	87	111	5	106		
95 Katete	153	8	146	182	9	173	208	11	197		
96 Petauke	286	13	273	365	16	348	446	20	426		
10 Lusaka	1,229	1,040	189	1,845	1,584	261	2,663	2,315	348		
20 Copperbelt	1,595	1,236	359	1,938	1,484	454	2,276	1,720	556		
30 Central	830	253	577	1,069	347	722	1,327	458	869		
40 Northwestern	431	62	369	521	80	441	613	98	515		
50 Western	655	83	572	747	97	649	826	110	717		
60 Southern	1,022	236	786	1,256	283	973	1,488	327	1,161		
70 Luapula	572	91	480	659	107	552	735	122	613		
80 Northern	929	130	799	1,064	152	911	1,173	172	1,001		
90 Eastern	1,096	94	1,002	1,366	118	1,248	1,637	142	1,494		
Zambia	8,359	3,227	5,132	10,465	4,253	6,212	12,738	5,465	7,273		

Appendix 7(2) Projected Population by District: 1995-2015

II. High Projection			(Unit: 1000)								
District	1995			2005			2015				
	Code	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	
11	Lusaka-Urban	976	976	0	1,558	1,558	0	2,455	2,455	0	
12	Lusaka-Rural	244	84	160	355	170	185	509	336	173	
13	Luangwa	19	2	17	25	4	22	34	7	27	
21	Ndola-Urban	392	392	0	533	532	0	715	715	0	
22	Ndola-Rural	197	17	180	280	30	250	391	51	340	
23	Chililabombwe	67	53	13	75	60	15	82	66	16	
24	Chingola	176	155	20	208	184	24	242	214	28	
25	Mufulira	155	132	23	171	146	25	187	159	28	
26	Kalulushi	80	51	30	109	76	34	147	113	34	
27	Kitwe	390	324	66	485	403	83	596	495	102	
28	Luanshya	153	127	26	176	146	29	200	166	33	
31	Kabwe-Urban	196	196	0	287	287	0	415	415	0	
32	Kabwe-Rural	247	26	222	312	40	272	389	62	327	
33	Mumbwa	150	20	130	206	36	169	278	64	214	
34	Mkushi	124	10	114	161	17	144	207	28	179	
35	Serenje	119	11	108	157	19	138	204	31	172	
41	Solwezi	150	38	112	216	77	139	306	153	153	
42	Mwinilunga	89	8	82	106	11	96	125	15	110	
43	Zambezi	69	10	59	69	14	55	69	21	48	
44	Kabompo	59	6	53	73	9	64	89	14	75	
45	Mfumbwe	26	6	20	32	9	23	39	14	25	
46	Kasenpa	41	5	36	51	8	43	62	12	50	
51	Mongu	161	46	115	201	71	131	250	106	144	
52	Lukulu	58	4	55	73	6	67	91	9	81	
53	Kalabo	94	10	84	86	12	75	78	13	65	
54	Kaoma	130	12	117	172	21	150	225	36	189	
55	Senanga	150	11	139	177	15	162	207	20	186	
56	Sesheke	68	9	59	75	11	64	80	12	68	
61	Livingstone	92	86	7	113	105	8	137	127	10	
62	Namwala	99	12	87	140	21	119	195	38	157	
63	Mazabuka	175	53	122	219	79	140	271	116	155	
64	Monze	142	22	120	178	34	144	220	52	168	
65	Choma	181	43	138	220	63	157	265	90	175	
66	Kalomo	191	13	178	262	24	238	354	43	311	
67	Siavonga	39	9	30	49	14	35	60	21	39	
68	Gwembe	40	3	37	50	4	46	61	6	55	
69	Sinazongwe	71	13	58	89	19	71	110	26	84	
71	Mansa	160	49	111	201	77	124	250	119	131	
72	Nchelenge	129	22	108	171	37	134	223	62	161	
73	Kawambwa	90	13	77	105	17	88	120	21	99	
74	Mwense	87	4	83	102	6	96	117	8	109	
75	Samfya	110	13	97	114	14	100	116	15	102	
81	Kasama	213	60	152	266	94	172	328	143	186	
82	Kaputa	54	3	51	63	5	59	73	6	67	
83	Mbala	145	17	128	164	21	143	184	26	157	
84	Mporokoso	57	6	51	67	8	59	77	10	66	
85	Luwingu	70	5	65	77	6	71	84	7	77	
86	Chilubi	42	2	41	46	2	44	50	2	48	
87	Isoka	133	16	118	158	22	136	185	30	155	
88	Chinsali	90	9	81	102	11	91	115	14	101	
89	Mpika	132	28	105	173	47	126	225	78	146	
91	Chipata	336	69	267	443	119	324	577	201	376	
92	Chama	58	4	53	70	6	64	85	9	76	
93	Lundazi	195	7	188	251	12	239	319	19	300	
94	Chadiza	73	4	69	96	7	89	125	12	114	
95	Katele	155	9	146	192	14	178	234	20	214	
96	Petauke	289	15	274	383	26	358	502	43	459	
10	Lusaka	1,239	1,062	177	1,938	1,731	206	2,998	2,798	199	
20	Copperbelt	1,609	1,251	358	2,036	1,576	460	2,562	1,980	582	
30	Central	837	264	574	1,123	400	723	1,493	600	893	
40	Northwestern	435	72	362	547	128	419	690	228	462	
50	Western	661	92	569	784	135	649	930	197	733	
60	Southern	1,030	254	776	1,320	364	956	1,674	520	1,155	
70	Luapula	577	102	475	693	151	541	827	224	603	
80	Northern	937	145	792	1,117	216	901	1,320	317	1,003	
90	Eastern	1,106	109	997	1,435	184	1,252	1,842	304	1,538	
	Zambia	8,431	3,350	5,081	10,924	4,886	6,108	14,336	7,170	7,167	

Appendix 7(3) Projected Population by District: 1995-2015

(Unit: 1000)

III. Low Projection											
District		1995			2005			2015			
Code	Name	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	
11	Lusaka-Urban	960	960	0	1,420	1,421	0	1,984	1,985	0	
12	Lusaka-Rural	240	70	170	323	94	230	412	119	292	
13	Luangwa	19	2	17	23	2	21	27	3	23	
21	Ndola-Urban	385	385	0	486	486	0	578	578	0	
22	Ndola-Rural	194	15	179	255	20	235	316	25	291	
23	Chililabombwe	65	52	13	68	54	14	67	55	12	
24	Chingola	173	153	20	189	167	22	196	173	23	
25	Mufulira	152	130	23	156	133	23	151	133	18	
26	Kalulushi	79	48	31	100	61	39	119	72	47	
27	Kitwe	383	318	65	442	367	75	482	400	82	
28	Luanshya	150	125	25	160	133	27	161	135	26	
31	Kabwe-Urban	193	193	0	262	262	0	336	336	0	
32	Kabwe-Rural	243	23	221	285	27	258	314	29	285	
33	Mundwa	148	17	130	188	22	166	225	27	199	
34	Mkushi	122	9	113	147	11	137	167	12	155	
35	Serenje	117	9	108	143	11	132	165	13	151	
41	Solwezi	148	31	117	197	41	155	247	52	195	
42	Mwinilunga	88	7	81	97	8	89	101	8	93	
43	Zambezi	68	8	59	63	10	54	56	11	45	
44	Kabompo	58	5	53	67	6	61	72	7	66	
45	Mfumbwe	25	5	20	29	6	23	31	7	25	
46	Kasempa	41	5	36	46	5	41	50	6	45	
51	Mongu	158	41	117	184	47	136	202	52	150	
52	Lukulu	57	3	54	67	4	63	73	4	69	
53	Kalabo	92	9	83	78	9	69	63	9	54	
54	Kaoma	127	10	117	157	13	144	182	15	167	
55	Senanga	148	10	138	162	11	151	167	11	156	
56	Sesheke	67	9	58	68	9	59	65	9	56	
61	Livingstone	91	84	7	103	96	8	111	103	8	
62	Namwala	98	10	87	128	14	114	158	17	141	
63	Mazabuka	172	48	124	200	55	145	219	61	159	
64	Monze	139	19	120	162	23	139	178	25	153	
65	Choma	178	39	139	201	44	157	214	47	168	
66	Kalomo	188	11	177	239	14	224	286	17	269	
67	Siavonga	39	8	30	45	10	35	49	11	38	
68	Gwembe	39	2	37	45	3	43	50	3	47	
69	Sinazongwe	70	12	58	81	14	67	89	15	74	
71	Mansa	158	43	115	184	50	133	202	55	147	
72	Nchelenge	127	19	109	156	23	133	180	26	154	
73	Kawambwa	88	12	76	95	13	82	97	13	84	
74	Mwense	86	4	82	93	4	88	95	4	90	
75	Samfya	108	13	95	104	13	91	94	13	81	
81	Kasama	209	53	156	242	62	181	265	67	198	
82	Kaputa	53	3	50	58	3	54	59	3	56	
83	Mbala	143	16	127	150	16	133	148	16	132	
84	Mporokoso	56	5	51	61	6	55	62	6	56	
85	Luwingu	69	5	64	71	5	66	68	5	63	
86	Chitubi	41	1	40	42	1	41	41	1	39	
87	Isoka	131	14	117	144	15	128	149	16	133	
88	Chinsali	88	8	80	93	8	85	93	8	84	
89	Mpika	130	24	107	158	29	129	181	33	148	
91	Chipata	331	59	271	404	72	332	466	84	383	
92	Chama	57	4	53	64	4	60	69	5	64	
93	Lundazi	192	6	186	229	7	221	258	8	249	
94	Chadiza	72	3	68	88	4	83	101	5	96	
95	Katete	152	8	144	175	9	166	189	10	180	
96	Petauke	284	13	271	350	16	334	406	18	388	
10	Lusaka	1,219	1,032	187	1,767	1,517	250	2,423	2,107	316	
20	Copperbelt	1,582	1,226	356	1,857	1,421	435	2,071	1,572	499	
30	Central	824	251	572	1,024	333	692	1,207	417	790	
40	Northwestern	427	62	366	499	76	423	558	90	468	
50	Western	650	82	567	715	93	622	752	101	651	
60	Southern	1,013	234	779	1,204	271	932	1,354	298	1,056	
70	Luapula	567	91	476	631	103	528	668	112	556	
80	Northern	921	129	793	1,019	146	873	1,067	157	910	
90	Eastern	1,087	93	994	1,309	113	1,196	1,489	130	1,360	
	Zambia	8,291	3,201	5,090	10,025	4,074	5,951	11,589	4,982	6,607	

Appendix 8 Population by Drainage Area
Table 8-1 1990 Census Population by Drainage Area

No.	Drainage Area Basin / Sub-Basin	Census Population		
		Total	Urban	Rural
AZ-00	Zambezi River	1,699,062	507,815	1,191,247
AZ-01	Upper Zambezi	32,601	0	32,601
AZ-02	Chavuma to Zambezi Pump House.	30,479	1,798	28,681
AZ-03	Zambezi Pump house to Kabompo R.	18,692	5,941	12,751
AZ-04	Upper Kabompo R.	134,402	11,202	123,200
AZ-05	Middle Kabompo R.	12,797	5,005	7,792
AZ-06	Dongwe R.	33,811	0	33,811
AZ-07	Dongwe R. to Watopa Pontoon.	0	0	0
AZ-08	Mumbezi R. and Lutali R.	16,106	0	16,106
AZ-09	Lungwebungu R.	19,635	3,129	16,506
AZ-10	Luena R.	147,179	9,165	138,014
AZ-11	Upper Luanginga R.	37,838	1,659	36,179
AZ-12	Lower Luanginga R. (Luambimba R.)	37,311	7,209	30,102
AZ-13	Mongu to Senanga.	155,030	36,837	118,193
AZ-14	Senanga to Sesheke.	120,250	8,744	111,506
AZ-15	Sesheke to Confluence (Mambova.)	84,811	8,750	76,061
AZ-16	Chobe R.	34,365	1,599	32,766
AZ-17	Confluence (Mambova) to Livingstone.	12,887	0	12,887
AZ-18	Livingstone to Kariba Dam.	365,535	121,529	244,006
AZ-19	Kariba Dam to Confluence of Kafue R.	47,871	5,984	41,887
AZ-20	Confluence of Kafue R. to FERIA BOMA.	357,462	279,264	78,198
AK-00	Kafue River	2,864,334	1,801,410	1,062,924
AK-01	Upper Kafue R.	34,813	1,795	33,018
AK-02	Mwanbashi R.	13,389	0	13,389
AK-03	Mufulira	392,094	325,125	66,969
AK-04	Smith's Bridge to Mpatamatu.	486,089	423,095	62,994
AK-05	Kafulafuta R. and Lufwanyama R.	485,175	362,622	122,553
AK-06	Machiya Ferry to Confluence	7,322	0	7,322
AK-07	Luswishi R.	13,145	0	13,145
AK-08	Confluence to Chilenga	3,568	0	3,568
AK-09	Lukanga Swamp	89,495	13,790	75,705
AK-10	Upper Lunga R.	82,448	26,223	56,225
AK-11	Lower Lunga R.	0	0	0
AK-12	Lufupa R. and others.	21,566	4,151	17,415
AK-13	Itezhi-tezhi Reservoir	2,778	0	2,778
AK-14	Kafue Flats.	1,211,319	641,796	569,523
AK-15	Lower Kafue R.	21,133	2,813	18,320
AL-00	Luangwa River	1,310,998	273,367	1,037,631
AL-01	Upper Luangwa R.	683,317	82,227	601,090
AL-02	Middle Luangwa R.	152,964	8,148	144,816
AL-03	Ndevu Camp to Confluence of Lunsemfwa	39,180	1,445	37,735
AL-04	Upper Lunsemfwa R.	340,366	176,040	164,326
AL-05	Lukasashi R.	43,980	0	43,980
AL-06	Lower Lunsemfwa R.	1,221	0	1,221
AL-07	Confluence to Luangwa Road Bridge	1,432	0	1,432
AL-08	Lower Luangwa R.	48,538	5,507	43,031
AC-00	Chambeshi River and Luapula River	1,208,761	173,818	1,034,943
AC-01	Upper Chambeshi R.	276,312	31,070	245,242
AC-02	Upper Lukulu R.	72,784	21,455	51,329
AC-03	Lower Chambeshi R. and Lower Lukulu River	26,765	16,118	10,647
AP-01	Lake Bangweulu	299,736	18,748	280,988
AP-02	Luela R. and others	88,375	8,265	80,110
AP-03	Chembe Ferry to Kashiba.	119,591	39,051	80,540
AP-04	Upper Kalungwishi R.	62,615	4,818	57,797
AP-05	Lower Kalungwishi R. and Lake Mweru-Wantipa	46,849	2,936	43,913
AP-06	Rest of Lake Mweru	215,734	31,357	184,377
AT-00	Lake Tanganyika	80,725	14,924	65,801
AT-01	Lufubu R.	17,769	0	17,769
AT-02	Rest of Lake Tanganyika	62,956	14,924	48,032
	Outside of Basins	219,204	10,196	209,008

Appendix 8 Population by Drainage Area
Table 8-2 Projected Population by Drainage Area: 1995-2015

(Unit: 1000)

I. Medium Projection Basin	1995			2005			2015		
	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural
1. Zambezi River	1,917	604	1,313	2,396	836	1,560	2,929	1,130	1,799
2. Kafue River	3,296	2,083	1,213	4,265	2,730	1,534	5,365	3,490	1,875
3. Luangwa River	1,496	321	1,175	1,889	431	1,459	2,298	556	1,742
4. Chambesi and Luapula Rive	1,317	191	1,126	1,520	224	1,296	1,693	254	1,439
- Chambeshi River	410	76	335	474	89	385	527	101	426
- Luapula River	907	115	792	1,046	135	911	1,167	153	1,013
5. Lake Tanganyika	86	16	70	93	17	76	98	18	80
6. Outside of Basins	246	11	235	301	14	287	355	16	339
Total	8,359	3,227	5,132	10,465	4,253	6,212	12,738	5,465	7,273

(Unit: 1000)

II. High Projection Basin	1995			2005			2015		
	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural
1. Zambezi River	1,930	627	1,303	2,495	952	1,543	3,234	1,439	1,795
2. Kafue River	3,323	2,137	1,186	4,478	3,036	1,442	6,050	4,371	1,679
3. Luangwa River	1,512	344	1,168	1,995	539	1,457	2,608	834	1,775
4. Chambesi and Luapula Rive	1,334	213	1,121	1,617	318	1,300	1,949	468	1,481
- Chambeshi River	418	85	333	512	127	385	622	187	435
- Luapula River	916	128	788	1,105	190	915	1,328	282	1,046
5. Lake Tanganyika	86	17	69	98	21	76	108	26	82
6. Outside of Basins	247	13	234	311	21	290	386	32	354
Total	8,431	3,350	5,081	10,994	4,886	6,108	14,336	7,171	7,165

(Unit: 1000)

III. Low Projection Basin	1995			2005			2015		
	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural
1. Zambezi River	1,902	599	1,303	2,295	801	1,494	2,663	1,029	1,634
2. Kafue River	3,270	2,067	1,203	4,085	2,615	1,470	4,885	3,183	1,702
3. Luangwa River	1,484	319	1,165	1,810	413	1,397	2,089	506	1,582
4. Chambesi and Luapula Rive	1,307	190	1,117	1,457	215	1,241	1,541	233	1,308
- Chambeshi River	407	75	332	454	85	369	479	92	387
- Luapula River	900	115	785	1,003	130	873	1,062	141	921
5. Lake Tanganyika	85	16	69	89	16	73	89	16	72
6. Outside of Basins	244	11	233	289	13	275	323	15	308
Total	8,291	3,201	5,090	10,025	4,074	5,951	11,589	4,982	6,607

JAPAN INTERNATIONAL COOPERATION AGENCY
REPUBLIC OF ZAMBIA
MINISTRY OF ENERGY AND WATER DEVELOPMENT

THE STUDY
ON
THE NATIONAL WATER RESOURCES MASTER PLAN
IN
THE REPUBLIC OF ZAMBIA

FINAL REPORT
SUPPORTING REPORT [B]

METEOROLOGY

OCTOBER, 1995

YACHIYO ENGINEERING CO., LTD.
(YEC)

**THE STUDY ON NATIONAL WATER RESOURCES MASTER PLAN
IN THE REPUBLIC OF ZAMBIA**

**SUPPORTING REPORT (B)
METEOROLOGY**

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CHAPTER 1 GENERAL CLIMATIC CONDITIONS

For a land-locked tropical country, Zambia enjoys an enviably pleasant climate. Temperatures are remarkably moderate and this is mainly due to the altitude. The rainfall is not heavy and floods are rare. Winds are generally light and damage to life and property due to high winds is practically unknown. Cases of tropical cyclone storms from the Indian Ocean crossing the East Coast of Africa and reaching as far as Zambia are rare.

Lusaka, the capital city of Zambia, is located almost in the centre of the country at an elevation of 1,280 metres above sea level. The mean daily maximum temperature is 30.1°C in October which is the hottest month and the mean daily minimum temperature is 9.1°C in July which is the coldest month.

Over the continent of Africa, the rainfall is greatest over the equatorial belt and it decreases both northwards and southwards till it reaches a minimum value over the subtropical arid regions of the Sahara and the Kalahari deserts. The annual rainfall over the equatorial belt along 30°E, the mean longitude of Zambia, is around 2,000 mm. In Zambia the annual rainfall ranges from 700 mm in the extreme southwest to 1,400 mm in the north. Over Lusaka, the mean annual rainfall is 858 mm.

In general, a year in Zambia can be divided into two distinct halves, a dry half from May to October and a wet half from November to April. However, from the synoptic point of view it is more convenient to divide a year into 4 unequal seasons as follows :

- 1) Winter season : June to August
- 2) Pre-rainy season : September to October
- 3) Rainy season : November to March
- 4) Post rainy season : April and May

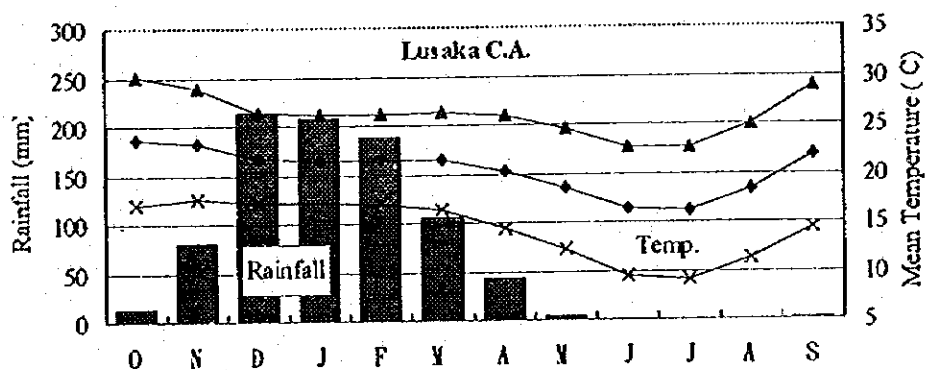


Figure 1-1 Monthly Climate at Lusaka City Airport

In general there is a belt of low pressure area at the surface over the equator. The northeast and southeast trade winds of the tropical areas of both hemispheres converge into this low pressure area. The trade winds do not confront over a sharp boundary. Instead the convergence takes place over an area or a zone with distinct north and south boundaries. This zone is known as the Inter Tropical Convergence Zone (ITCZ). The equatorial low and the ITCZ move north and south in the tropics, with the apparent movement of the sun in the different months of the year. The sun is overhead at the equator in March, reaches its

northernmost position in June, again comes down and crosses the equator in September and reaches its southernmost position in December. The positions of the ITCZ over Africa in July and January are shown in Figure 1-2. Whereas the ITCZ in July is almost a straight line extending from west to east at about 15° North, the ITCZ in the month of January takes a "Z" shape with 2 curvatures ABC and DEF. One end AB is at 7° North and the other end EF is at 17° South. Zambia is in the bend DE. It is this crooked shape of the ITCZ in January that explains and controls the rainfall over Zambia.

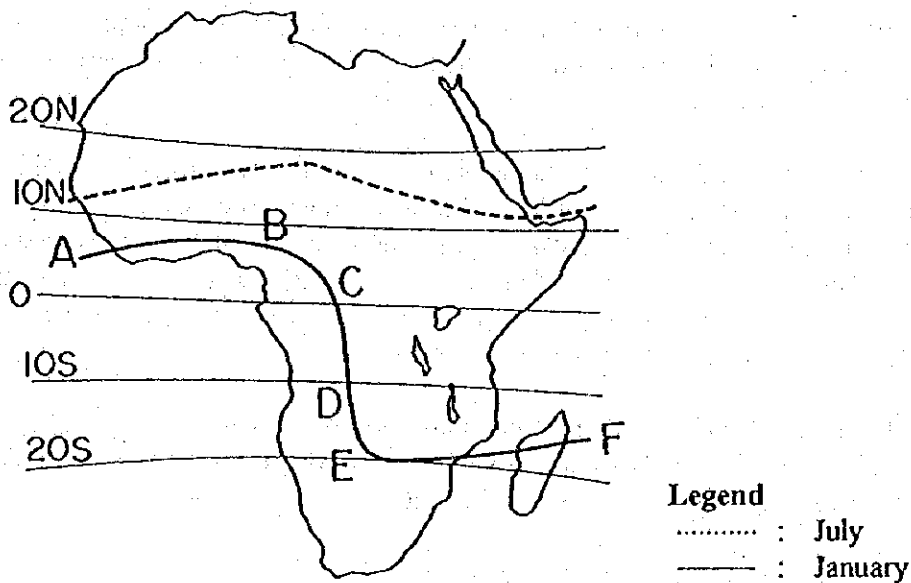


Figure 1-2 Inter Tropical Convergence Zone (ITCZ) in July and January

CHAPTER 2 NETWORK OF METEOROLOGICAL STATIONS

2.1 Meteorological Stations and Voluntary Rainfall Stations

Meteorological data in Zambia is observed, collected and archived mainly by the Department of Meteorology (DOM), Ministry of Transport and Communication (MOTC) and is available to the public.

There are currently 36 stations forming the meteorological station network of DOM. Such meteorological items as rainfall, temperature, relative humidity, pressure, daily weather, wind speed, sunshine hours, cloud cover and pan-evaporation are observed at these stations. In terms of rainfall only stations, there are 825 registered voluntary stations, operated by volunteers and various organisations. However the number of rainfall reporting stations has declined from 750 in 1976 to 340 in 1991. This was caused by the difficulty in obtaining measuring glasses for measuring rainfall due to foreign exchange constraints, and because of the fact that DOM could not inspect existing stations due to lack of transport resources.

The geographical information of the 36 meteorological stations are shown in Table 2-3 and the location of both meteorological and voluntary stations are shown in Figure 2-1. The number of meteorological stations and voluntary rainfall stations is presented in Table 2-1 by the basin and the province and Table 2-2 by the district. The registered total stations are numerous amounting to 861 stations but the operated number is 394 stations, only 46% of the total registered. The number of stations by record length are described as follows:

<u>Length of Record</u>	<u>Number of Stations</u>	<u>Length of Record</u>	<u>Number of Stations</u>
exceeding 10 years	402	exceeding 40 years	126
exceeding 20 years	320	exceeding 50 years	85
exceeding 30 years	205		

Table 2-1 Number of Meteorological and Voluntary Stations

Basin	Station Registered	Meteorological Station	Voluntary Station	Total	Province	Meteorological Station	Voluntary Station	Total
Zambezi	248	13	78	91	Lusaka	3	21	24
Kafue	190	7	109	116	Copperbelt	2	44	46
Luangwa	157	8	60	68	Central	4	44	48
Chambeshi	92	3	44	47	Northwestern	5	23	28
Luapula	149	4	60	64	Western	5	24	29
Lake Tanganyika	25	1	7	8	Southern	4	50	54
-	-	-	-	-	Luapula	3	34	37
-	-	-	-	-	Northern	6	85	91
-	-	-	-	-	Eastern	4	33	37
Total	861	36	358	394	Total	36	358	394

Table 2-2 Number of Meteorological Stations (Met.Stn.) and Main Voluntary Rainfall Stations (Vol.Stn.) by the district and the Province

Code	District	Met. Stn.	Met. & Vol. Stn.	Code	District	Met. Stn.	Met. & Vol. Stn.
Lusaka Province				Southern Province			
		3	24			4	54
11	Lusaka-Urban	1	6	61	Livingstone	1	2
12	Lusaka-Rural	2	16	62	Namwala	0	3
13	Luangwa	0	2	63	Mazabuka	1	12
Copperbelt Province				Luapula Province			
		2	46			3	37
21	Ndola-Urban	1	10	71	Mansa	1	7
22	Ndola-Rural	0	12	72	Nchelenge	0	10
23	Chililabombwe	0	2	73	Kawambwa	1	9
24	Chingola	0	5	74	Mwense	0	6
25	Mufulira	1	1	75	Samfya	1	5
26	Kalulushi	0	7	Northern Province			
27	Kitwe	0	6			6	91
28	Luanshya	0	3	81	Kasama	2	17
Central Province				Northern Province			
		4	48			6	91
31	Kabwe-Urban	1	5	82	Kaputa	0	4
32	Kabwe-Rural	1	18	83	Mbala	1	13
33	Mumbwa	1	10	84	Mporokoso	0	12
34	Mkushi	0	11	85	Luwingu	0	2
35	Serenje	1	4	86	Chilubi	0	2
Northwestern Province				Northern Province			
		5	28			6	91
41	Solwezi	1	6	87	Isoka	1	11
42	Mwinilunga	1	11	88	Chinsali	0	13
43	Zambezi	1	6	89	Mpika	2	17
44	Kabompo	1	2	Eastern Province			
45	Mfumbwe	0	0			4	37
46	Kasempa	1	3			4	37
Western Province				Eastern Province			
		5	29			4	37
51	Mongu	1	10	91	Chipata	2	13
52	Lukulu	0	7	92	Chama	0	5
53	Kalabo	1	1	93	Lundazi	1	3
54	Kaoma	1	2	94	Chadiza	0	3
55	Senanga	1	3	95	Katete	0	4
56	Sesheke	1	6	96	Petauke	1	9

* Based on the map of rainfall network published by the office of the Survey General, Ministry of Lands and Natural Resources, Lusaka, 1983

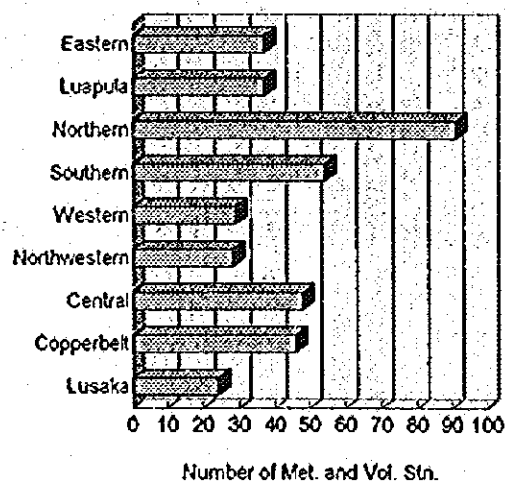
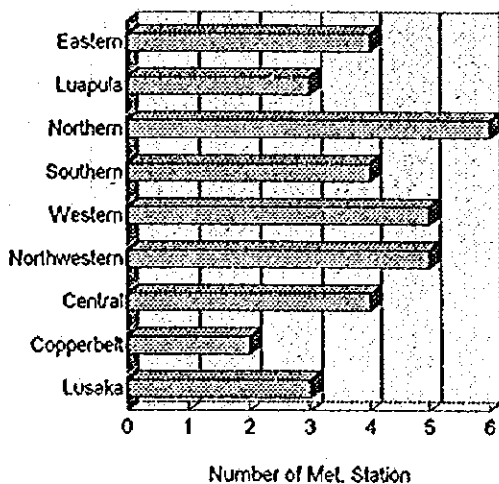


Table 2-3 Geographical Information of Meteorological Stations

Province	Station Name	Altitude (m)	Latitude		Longitude		Local No.	WMO No.
			Deg.	Min.	Deg.	Min.		
Lusaka	Lusaka C.A.	1,280	15	25	28	19	2193	666
	Lusaka I.A.	1,154	15	19	28	27	2150	665
	Mt. Makulu	1,213	15	33	28	15	2375	667
Copperbelt	Kafironda	1,242	12	36	28	7	4375	563
	Ndola	1,270	13	0	28	39	4100	561
Central	Kabwe	1,207	14	27	28	28	525	663
	Kabwe Agro.	1,165	14	24	28	30	500	662
	Mumbwa	1,218	14	59	27	4	2755	655
	Serenje	1,384	13	14	30	13	7850	571
Northwester	Kabompo	1,026	13	36	24	12	6415	543
	Kasempa	1,235	13	32	25	51	3180	541
	Mwinilunga	1,362	11	45	24	26	6525	441
	Solwezi	1,333	12	11	26	23	3570	551
	Zambezi	1,078	13	32	23	7	6840	531
Western	Kalabo	1,051	14	57	22	42	6053	625
	Kaoma	1,152	14	48	24	48	6210	641
	Mongu	1,053	15	15	23	9	6010	633
	Senanga	1,027	16	7	23	16	5979	731
	Sesheke	951	17	28	24	18	5800	741
Southern	Choma	1,267	16	51	27	4	5350	753
	Kafue Polder	978	15	46	27	55	2400	659
	Livingstone	987	17	49	25	49	5625	743
	Magoye	1,018	16	8	27	38	2525	751
Luapula	Kawambwa	1,324	9	48	29	5	7450	403
	Mansa	1,259	11	6	28	51	7650	461
	Samfya	1,172	11	21	29	32	8000	469
Northern	Isoka	1,360	10	10	32	40	9349	481
	Kasama	1,384	10	13	31	8	8700	475
	Mbala	1,672	8	51	31	20	9830	413
	Mfuwe	573	13	16	31	56	1310	585
	Misamfu	1,536	10	11	31	13	8705	563
	Mpika	1,402	11	54	31	26	8470	477
Eastern	Chipata	1,032	13	33	32	35	1470	581
	Lundazi	1,143	12	17	33	12	1630	583
	Msekera	1,025	13	39	32	34	1418	580
	Petauke	1,036	14	15	31	17	1085	673

2.2 Meteorological Data Availability

DOM received several micro-computers installed with the CLICOM (Climate Computing) system through the FINNIDA/SATCC/WMO Meteorology and UNDP/WMO Projects. This was a very significant achievement which offered the possibility of substantially improved services to the user community. Currently, DOM has the following quality controlled data on computer, referring to the report of "25 Years of Meteorological Services in Zambia (1962-1992), November 1992".

- 1) Rainfall
 - Daily data : 30-40 years period, 36 stations in all, up to December 1991.
 - Monthly data : 11 years period, about 350 stations up to June 1991.
- 2) Maximum and Minimum Temperature
 - Daily data : 30-40 years period, 36 stations, up to December 1991.
- 3) Solar Radiation
 - Daily data : 10 years period, 6 stations, up to December 1990.
- 4) 25-Parameter Database
 - Parameter list : rainfall, temperature (air maximum, air minimum, air mean, dew point, ground minimum and, below ground level), relative humidity, pressure, daily weather, wind speed, sunshine hours, cloud cover, pan-evaporation.
 - Daily data : 33 years period, 25 stations, up to December 1988.
- 5) Based on the above data, the following information has been produced
 - Rainfall : 30 to 40 years of 10-day data, monthly mean values, long-term normals.
 - Temperature : 30 to 40 years of daily and monthly mean values, long-term normals.

Data availability of main meteorological items by each station is shown in Table 2-4 and Figure 2-2.

The data units and other remarks about the meteorological data are summarised as follows:

1) Meteorological data unit

<u>Item</u>	<u>Unit in this report</u>	<u>Unit in DOM</u>
Rainfall	mm	inch (until 1972/12), mm(after 1973/01)
Temperature	°C	°F (until 1972/12), °C (after 1973/01)
Relative humidity	%	%
Sunshine hours	hours	hours
Wind speed	m/sec	knot (nautical mile / hour)
Pan evaporation	mm	inch (until 1972/12), mm(after 1973/01)

- 2) An evaporimeter used in Zambia is the US Class A pan with 1.21 m in diameter.
- 3) Meteorological data is compiled based on the hydrological year (October-September) in this report, although the original meteorological data in DOM is stored based on the meteorological year (July - June).
- 4) Meteorological day is the day from 09:00 hours to 09:00 hours.
- 5) Monthly mean or total data is adopted for months that have more than 25 days observation data.
- 6) Annual mean or total data is adopted in case that all months a year have monthly mean data.

Table 2-4 Beginning of Data Observation

No.	Station Name	Rainfall	Temperature	Evaporation	Sunshine Hours	Relative Humidity	Wind Speed
1	Chipata	1945/01	1945/01	1968/09	1950/01	1973/01	N.A.
2	Choma	1950/01	1950/01	1967/01	1967/01	1973/01	1967/01
3	Isoka	1978/01	1978/01	N.A.	1977/06	1977/06	1977/06
4	Kabompo	1961/01	1950/01	1962/05	1968/06	1973/09	1962/01
5	Kabwe	1950/01	1950/01	1962/07	1958/10	1962/07	1966/01
6	Kabwe Agrb.	1977/01	1977/01	1977/06	1977/08	1983/05	1977/06
7	Kafironda	1967/01	1967/01	1973/01	1973/01	1973/01	1973/01
8	Kafue Polder	1957/06	1957/06	1962/07	1959/03	1973/01	1959/07
9	Kalabo	1987/07	1987/07	1992/01	1992/01	1992/01	1992/01
10	Kaoma	1961/01	1961/01	1967/01	1981/04	1973/08	1973/07
11	Kasama	1933/05	1933/05	1961/04	1959/01	1964/03	1959/01
12	Kasempa	1938/01	1952/07	1962/07	1959/06	1973/01	1959/06
13	Kawambwa	1956/08	1958/01	1991/10	1957/07	1982/01	1959/10
14	Livingstone	1932/04	1950/01	1953/06	1951/01	1964/11	1959/08
15	Lundazi	1956/01	1956/07	1973/01	1980/01	1980/01	1961/06
16	Lusaka C.A.	1950/01	1950/01	N.A.	1960/01	1964/03	N.A.
17	Lusaka I.A.	1967/01	1967/01	1973/01	1967/07	1967/05	1967/02
18	Magoye	1978/01	1978/01	1978/01	1988/07	1983/01	1978/01
19	Mansa	1960/01	1967/01	1973/01	1970/04	1973/01	1967/01
20	Mbala	1961/01	1952/07	1967/07	1967/01	1973/01	1967/01
21	Mfuwe	1979/07	1979/07	1979/10	1979/10	1979/10	1979/10
22	Misamfu	1973/07	1973/07	1973/07	1973/07	1973/07	1973/07
23	Mongu	1935/02	1955/07	1962/08	1955/01	1966/01	1962/07
24	Mpika	1932/04	1930/04	1962/05	1950/01	1973/01	1965/07
25	Msekera	1982/01	1982/10	1982/01	1982/01	1982/05	1982/01
26	Mt. Makulu	1961/01	1962/01	1967/01	1967/01	1973/01	1967/01
27	Mumbwa	1978/01	1978/01	1978/01	1989/03	1983/04	1983/05
28	Mwinilunga	1950/01	1950/01	1973/01	1956/09	1973/01	1960/11
29	Ndola	1940/01	1950/01	1962/07	1950/01	1964/01	1962/07
30	Petauke	1950/01	1950/01	1954/04	1972/06	N.A.	1960/03
31	Samfya (Closed in 1984/08)	1957/07	1957/07	1962/07	N.A.	1973/01	1973/01
32	Senanga	1979/10	1979/10	1982/07	1981/08	1984/04	1979/10
33	Serenje	1957/01	1957/01	1961/10	1963/06	1981/01	1961/07
34	Sesheke	1950/01	1950/01	1951/05	1984/12	1983/06	1959/10
35	Solwezi	1961/01	1961/01	1962/09	1973/01	1973/01	1961/04
36	Zambezi	1953/01	1955/01	1962/07	1959/08	1983/05	1959/07

[Note] N.A. : Not Available

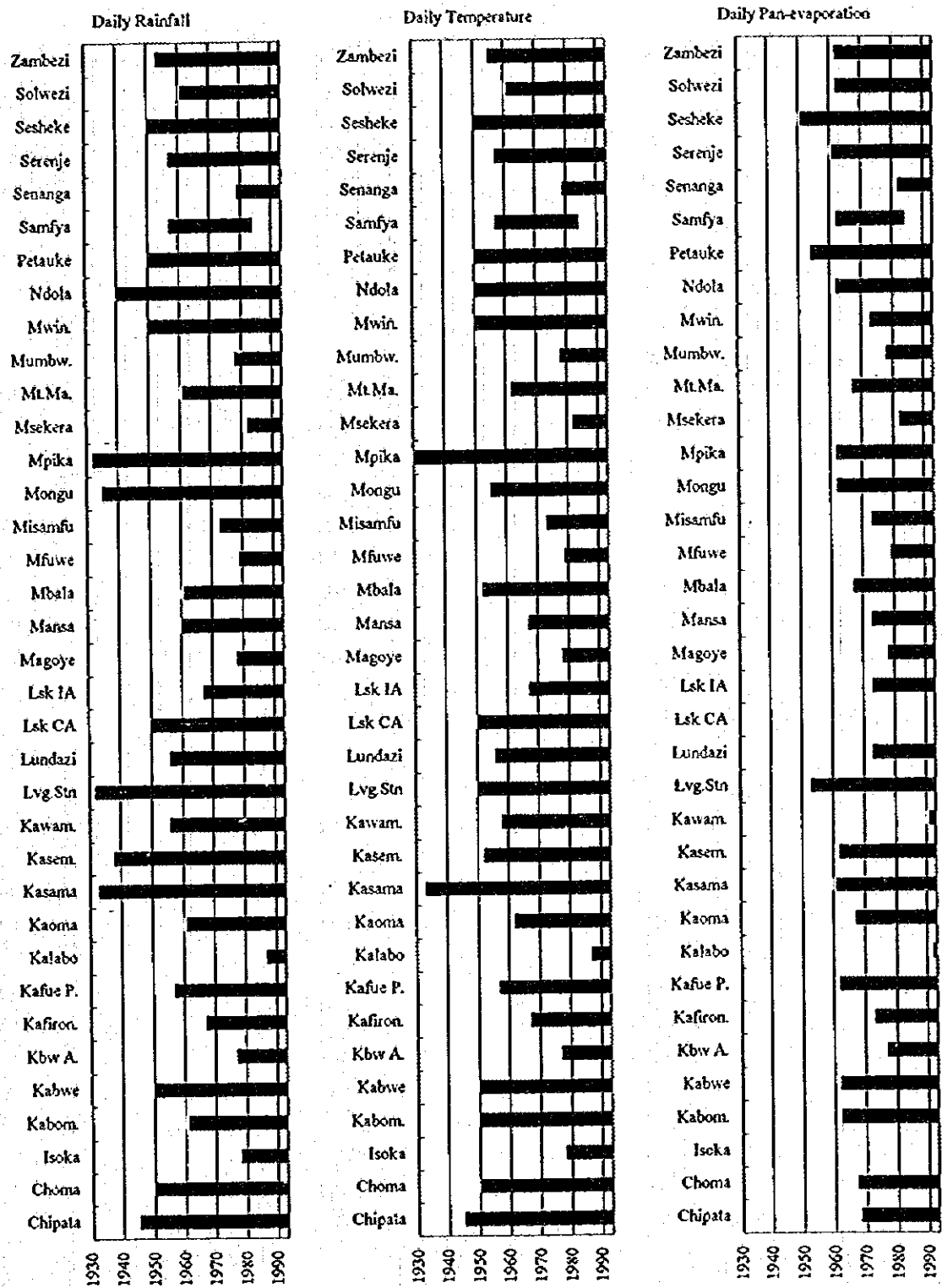


Figure 2-2 (1) Data Availability of Meteorological Stations

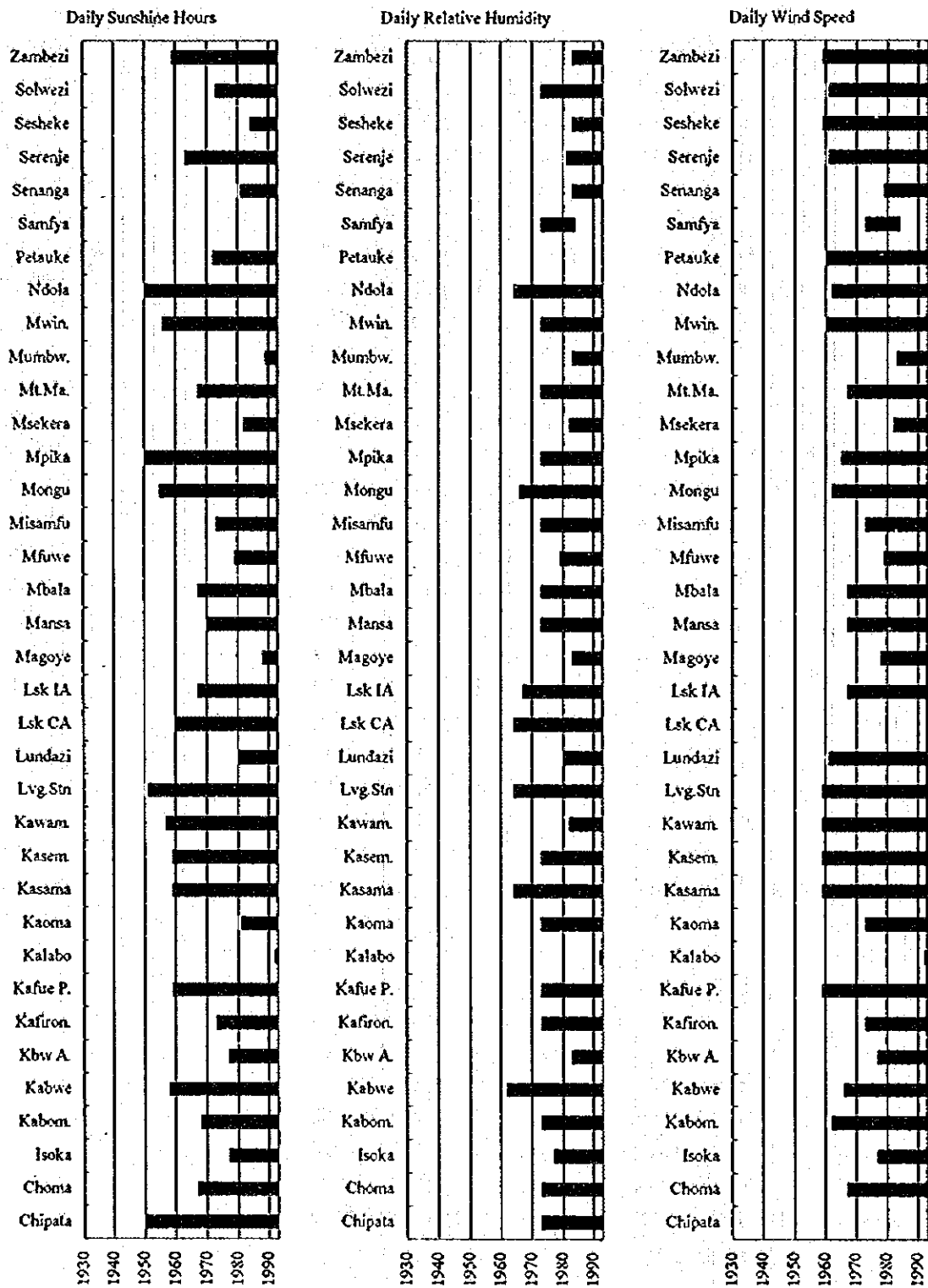


Figure 2-2 (2) Data Availability of Meteorological Stations

CHAPTER 3 RAINFALL

3.1 Rainfall Data Collection

Daily rainfall data at all the 36 meteorological stations from the beginning of observation to hydrological year 1992/93 were collected from Department of Meteorology, Ministry of Transport and Communication. In terms of rainfall data at the voluntary stations, monthly rainfall data were collected at about 370 voluntary stations over the last 11 meteorological years from 1980/81 to 1990/91.

3.2 Annual Rainfall and Monthly Rainfall

3.2.1 Average Annual Rainfall and Rainy Days

Based on the daily rainfall data, annual rainfall and annual number of rainy days for the 36 meteorological stations have been compiled and are summarised in Table 3-2. The 30 years averages of annual rainfall and rainy days in the all meteorological stations are graphically shown in Figure 3-1 (1) by the provinces, and in Figure 3-1 (2) in order of annual rainfall.

The annual rainy days are according to the annual rainfall. The figures of the annual rainy days are about one by ten of the annual rainfall figures. In terms of annual rainfall and annual rainy days at the provinces, Luapula Province has most annual rainfall, 1,259 mm and 123 days on an average, and Southern Province has least annual rainfall, 737 mm and 74 days on an average. The city with the most annual rainfall is Mwinilunga City in Northwestern Province amounting to 1,402 mm and 142 days, and the least is Sesheke City in Southern Province, amounting to 657 mm and 73 days. The 30 years averages of annual rainfall and annual rainy days in the each province are shown in Figure 3-1. The Zambian averages are 1,001 mm and 97 days.

Table 3-1 Provincial Average of Annual Rainfall and Rainy Days

Province	Annual Rainfall (mm)	Annual Rainy Days (day)
Lusaka	857	77
Copperbelt	1231	111
Central	947	86
Northwestern	1173	118
Western	808	87
Southern	737	74
Luapula	1259	123
Northern	1138	107
Eastern	961	93
Total Average in Zambia	1001	97

An isohyetal map of annual rainfall for Zambia was drawn based on the 36 meteorological stations with the 30 year period from October 1963 to September 1993 and is shown in Figure 3-2. Annual rainfall distribution in Zambia is summarised as follows :

- In the west of Zambia, isohyetal lines are almost parallel from west to east and annual rainfall of the northernmost area is about 1,400 mm and the southernmost area is about 700 mm.
- In the east of Zambia, isohyetal lines are more complicated. The trend that the north has much rain and the south has less is the same as the west side of Zambia.

However annual rainfall of Eastern Province ranges from 900 mm to 1,000 mm even in the north of the province.

- Northern Province and Northwestern Province have most rainfall in Zambia and the annual rainfall ranges from 1,100 mm to 1,400 mm.
- Southernmost area of Zambia, such as the area around Sesheke and Livingstone, is the least rainfall area and its annual rainfall is under 700 mm.

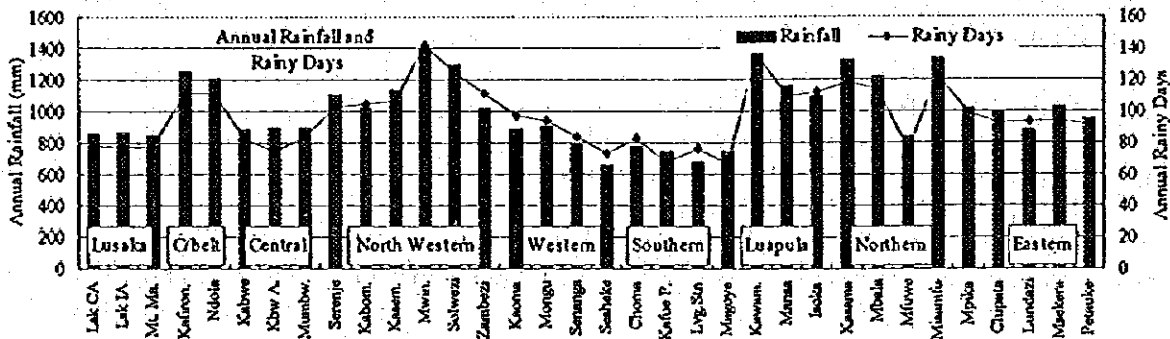


Figure 3-1 (1) Annual Rainfall and Rainy Days by Province

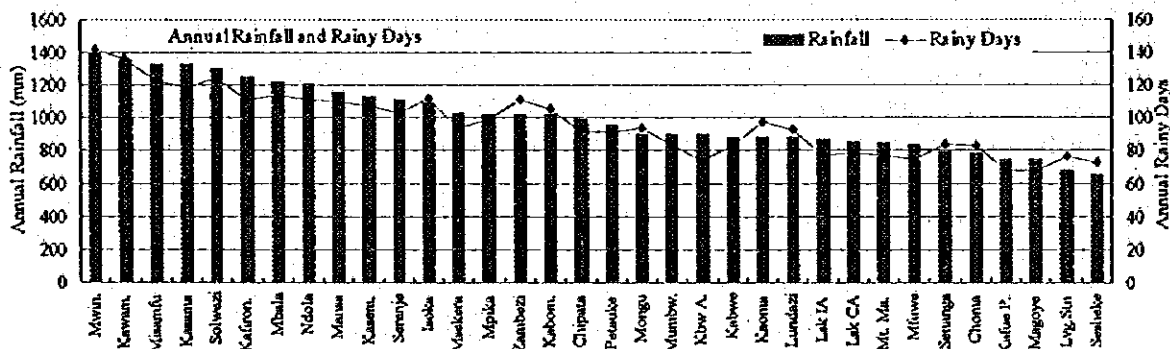


Figure 3-1 (2) Annual Rainfall and Rainy Days in Order

Table 3-2 Annual Rainfall and Annual Rainy Days

Unit ; RF:mm, RD:days

Province	Station Name	Altitude (EL.in)	Average Annual Rainfall (RF)			Average Annual Rainy Days (RD)			Maximum Annual		Minimum Annual	
			10yrs.	20yrs.	30yrs.	10yrs.	20yrs.	30yrs.	RF	RD	RF	RD
Lusaka	Lusaka C.A.	1280	832	887	858	74	79	78	1366	112	483	49
	Lusaka I.A.	1154	810	894	865	72	76	77	1299	109	530	49
	Mt. Makulu	1213	883	899	848	77	77	77	1288	102	569	45
	Average	1216	842	893	857	74	77	77	1318	108	527	48
Copperbelt	Kafironda	1242	1248	1282	1256	106	111	111	1748	139	895	89
	Ndola	1270	1183	1229	1205	109	111	111	1756	136	439	79
	Average	1256	1216	1256	1231	108	111	111	1752	138	667	84
Central	Kabwe	1207	823	891	886	81	84	83	1451	111	619	59
	Kabwe Agro.	1165	833	902	897	72	75	74	1313	110	499	50
	Mumbwa	1218	873	931	900	80	85	84	1324	98	438	60
	Serenje	1384	1114	1100	1105	106	105	103	1585	151	708	66
	Average	1244	911	956	947	85	87	86	1418	118	566	59
North-western	Kabompo	1026	1050	1028	1016	104	104	105	1338	125	593	74
	Kasempa	1235	1110	1151	1131	102	107	107	1559	136	654	76
	Mwinilunga	1362	1318	1375	1402	135	140	142	1761	167	1043	108
	Solwezi	1333	1263	1330	1300	124	127	125	1575	146	985	91
	Zambezi	1078	1026	1045	1017	110	112	111	1346	136	720	87
	Average	1207	1153	1186	1173	115	118	118	1516	142	799	87
Western	Kalabo (*1)	1051	877 (last 7 yrs.)			95 (last 7 yrs.)			1084	104	617	77
	Kaoma	1152	843	913	882	95	99	97	1311	118	240	71
	Mongu	1053	851	914	903	86	92	94	1357	117	382	43
	Senanga	1027	745	800	791	77	82	84	987	97	463	64
	Sesheke	951	630	692	657	72	76	73	1546	112	379	48
	Average	1046	767	830	808	83	87	87	1300	111	366	57
Southern	Choma	1267	744	800	779	82	86	83	1187	116	423	46
	Kafue Polder	978	694	753	744	63	66	68	1192	106	460	44
	Livingstone	987	617	688	679	67	75	76	1402	103	420	49
	Magoye	1018	694	753	744	62	65	67	935	76	461	49
	Average	1063	687	749	737	69	73	74	1179	100	441	47
Luapula	Kawambwa	1324	1277	1349	1358	136	135	136	1758	154	865	114
	Mansa	1259	1125	1162	1159	107	109	110	1573	131	800	81
	Samfya (*2)	1172	1490	1445	-	109	108	-	2065	128	937	79
	Average	1292	1201	1256	1259	122	122	123	1666	143	833	98
Northern	Isoka	1360	1062	1097	1094	109	109	112	1334	135	876	83
	Kasama	1384	1284	1337	1323	115	115	118	1888	146	801	92
	Mbala	1672	1190	1202	1219	105	109	114	1745	148	469	54
	Mfuwe	573	814	842	840	72	74	75	1062	89	495	42
	Misamfu	1536	1336	1345	1331	107	110	123	1751	127	1097	88
	Mpika	1402	1040	1054	1018	97	99	99	1498	127	644	71
Average	1321	1121	1146	1138	101	103	107	1546	129	730	72	
Eastern	Chipata	1032	959	992	990	88	90	92	1471	115	656	70
	Lundazi	1143	983	906	878	96	92	93	1415	120	495	68
	Msekera	1025	992	1026	1024	90	92	94	1179	101	753	76
	Petauke	1036	965	981	951	86	91	91	1381	120	597	71
	Average	1059	975	976	961	90	91	93	1362	114	625	71
Total Average		1187	977	1016	1001	93	96	97	1432	122	616	68

Remarks :

(*1), (*2) : These station are excluded in calculating the average.

[] : The data was calculated by using the record near the station

Average period : 10yrs.(1983-92), 20yrs.(1973-92), 30yrs.(1963-92)

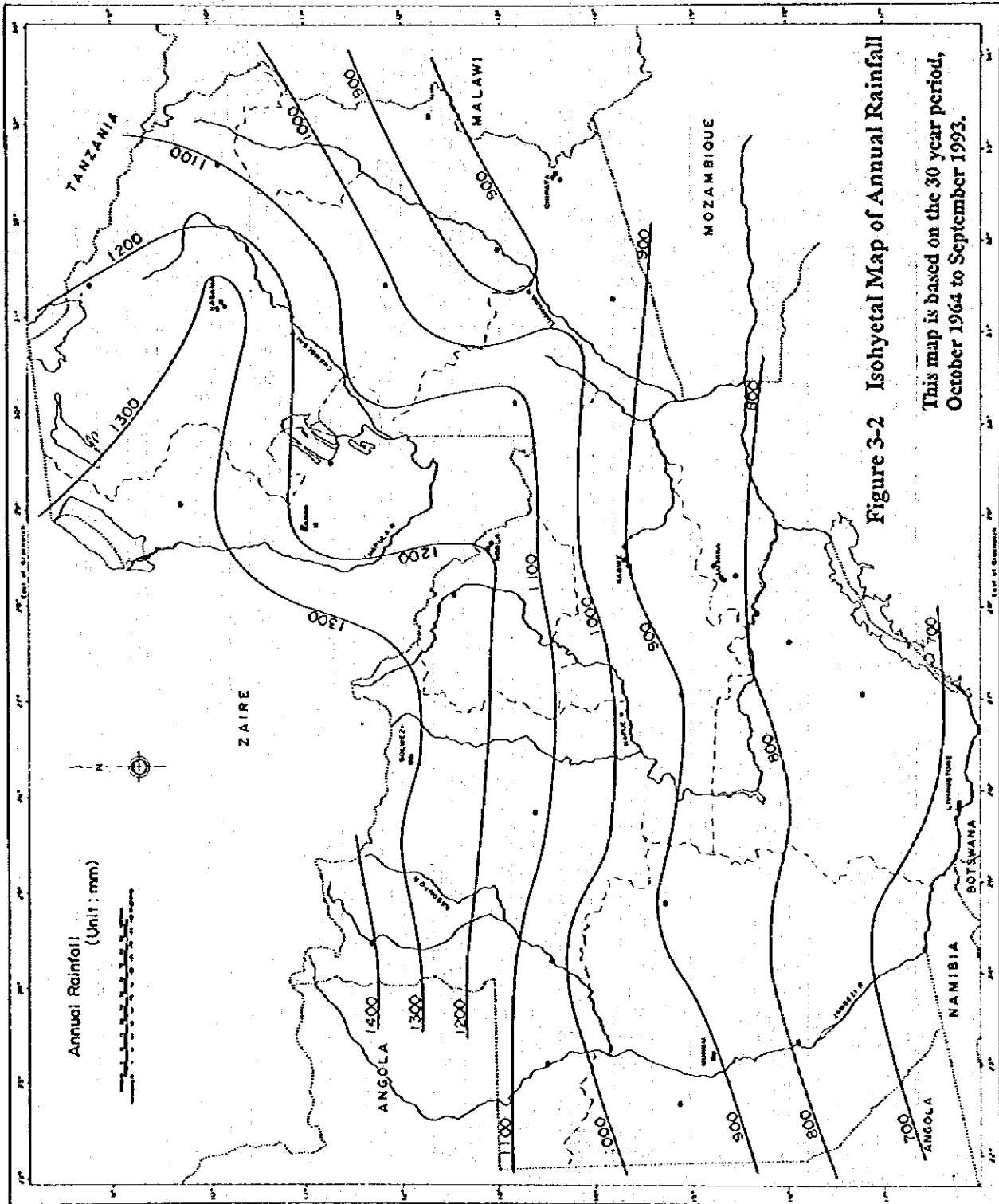


Figure 3-2 Isohyetal Map of Annual Rainfall
 This map is based on the 30 year period,
 October 1964 to September 1993.

3.2.2 Average Monthly Rainfall and Rainy Days

The annual variation of monthly rainfall and monthly rainy days in the all meteorological stations have been compiled and are shown in Figure 3-4. Average figures in each province are summarised in Table 3-3 and the annual variation of average monthly figures in Zambia is shown in Figure 3-3.

From May to September in Zambia it scarcely rains and from November to March, monthly rainfall ranges from 100 mm to 250 mm. More than 90 % of annual rainfall is concentrated in the rainy season from November to March. The 8 % of the residual 10 % of annual rainfall comes down on October and April, and the 2 % on September and May. There is definitely no rain from June to August in Zambia. The three months from December to February have about 65 % of annual rainfall.

Table 3-3 Average Monthly Rainfall and Rainy Days in Province
Unit : mm (Rain), days (Day)

Month	Zambia		Lusaka		C/belt		Central		N/western		Western		Southern		Luapula		Northern		Eastern	
	Rain	Day	Rain	Day	Rain	Day	Rain	Day	Rain	Day	Rain	Day	Rain	Day	Rain	Day	Rain	Day	Rain	Day
Oct.	32	5	17	3	34	5	24	4	57	8	37	6	24	4	67	8	20	3	15	2
Nov.	108	12	96	9	139	14	89	10	158	17	80	11	76	10	163	17	116	13	80	9
Dec.	221	19	204	17	289	23	233	18	237	22	175	17	186	16	258	23	236	21	211	19
Jan.	231	20	217	18	299	23	245	20	245	23	192	19	183	16	223	22	244	22	239	21
Feb.	196	18	183	16	230	20	199	17	201	20	165	16	151	14	204	19	226	19	208	18
Mar.	152	15	100	11	177	17	115	12	199	18	118	13	83	10	228	20	198	18	154	15
Apr.	30	6	33	3	55	6	32	4	61	7	34	4	21	3	91	11	83	9	45	6
May	7	1	4	1	5	1	4	1	6	1	2	1	5	1	15	2	12	2	7	1
Jun.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jul.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aug.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0
Sep.	3	1	1	0	3	1	1	0	8	1	3	1	1	1	9	2	2	0	1	0
Year	1001	97	857	77	1231	111	947	86	1173	118	808	87	737	74	1259	123	1138	107	961	93

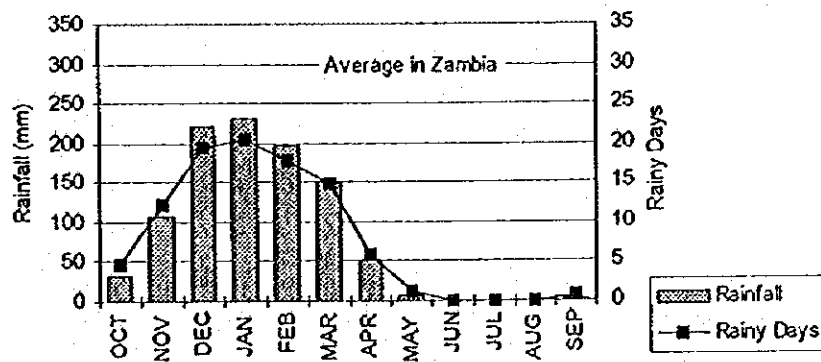


Figure 3-3 Annual Variation of Monthly Rainfall in Zambia

Isohyetal maps of monthly rainfall for Zambia were drawn based on the 36 meteorological stations with the 30 years period from October 1963 to September 1993 and are shown in Figure 3-5. Monthly rainfall distribution in Zambia is summarised as follows :

- September passing, it begins to rain in the north area of Zambia and monthly rainfall on October is 50 - 90 mm in these area. In the South area on October, monthly rainfall is less than the north, 20 - 40 mm. October rainfall is least around Lundazi in Eastern Province, and is about 10 mm.
- On November, monthly rainfall is 120 - 210 mm in the north area and is 70 - 110 mm in the south area.
- In the core of rainy season on December, January and February, monthly isohyetal line looks similar each other. Zambia could be divided into following four categories. The most rainfall area, Area I, is the north of Copperbelt Province, the south of Luapula Province, the next, Area II, is the northwest, northeast area and Central Province and Lusaka Province, then Area III is around Eastern Province, the least rainfall area, Area IV, is the south area of Zambia. The monthly rainfall in these area is as follows :

Month	Area I	Area II	Area III	Area IV
December	270 - 300 mm	200 - 260 mm	180 - 190 mm	140 - 190 mm
January	280 - 310 mm	210 - 270 mm	200 - 230 mm	150 - 200 mm
February	240 mm	180 - 230 mm	180 - 210 mm	140 - 170 mm

- On March the north area still has 170 - 250 mm of monthly rainfall, but the south area is starting to be less rainfall area, amounting to 90 - 160 mm.
- On April, monthly rainfall in the north area is also starting to be less, 50 - 120 mm, and is very little in the south area, amounting to 20 - 50 mm. May coming, dry season has started from the south area day by day to the north and finally rain stops in the whole Zambia at the beginning of June, and no rain until the end of August in Zambia.

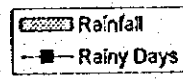
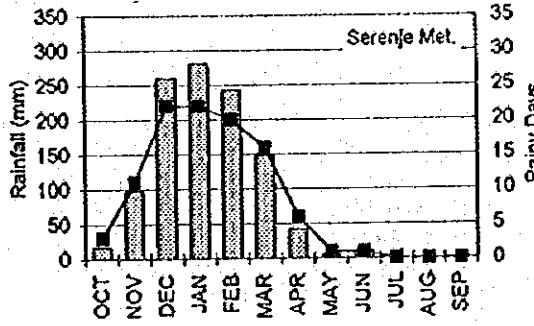
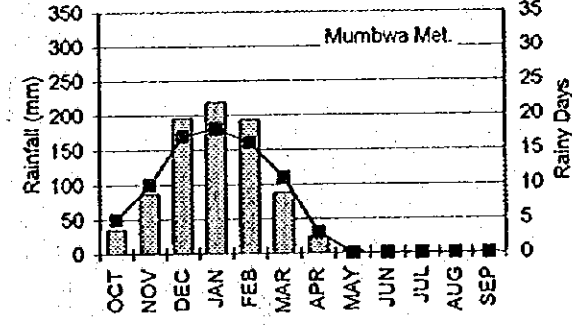
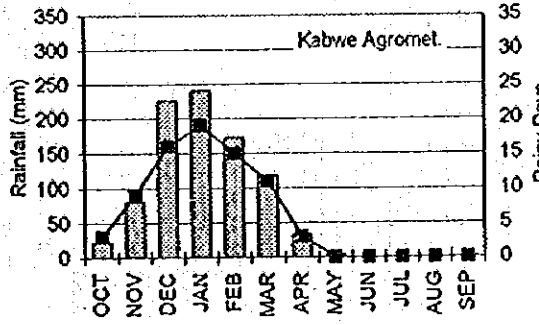
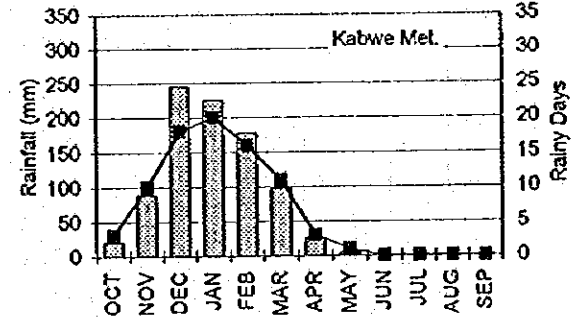
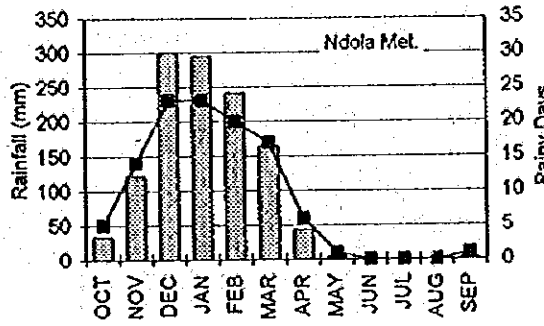
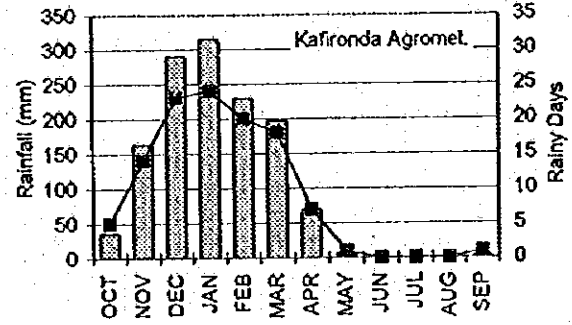
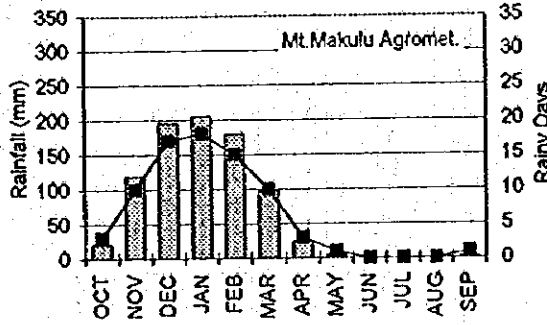
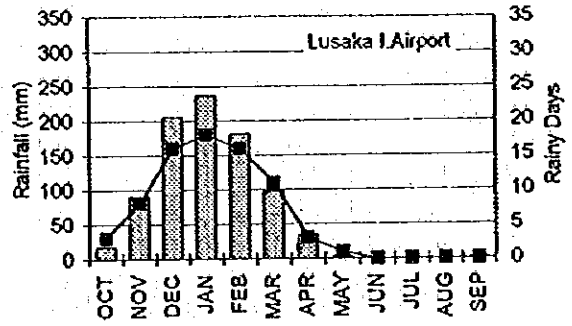
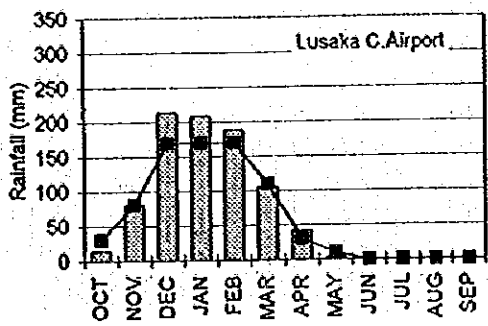


Figure 3-4 (1) Monthly Rainfall and Rainy Days

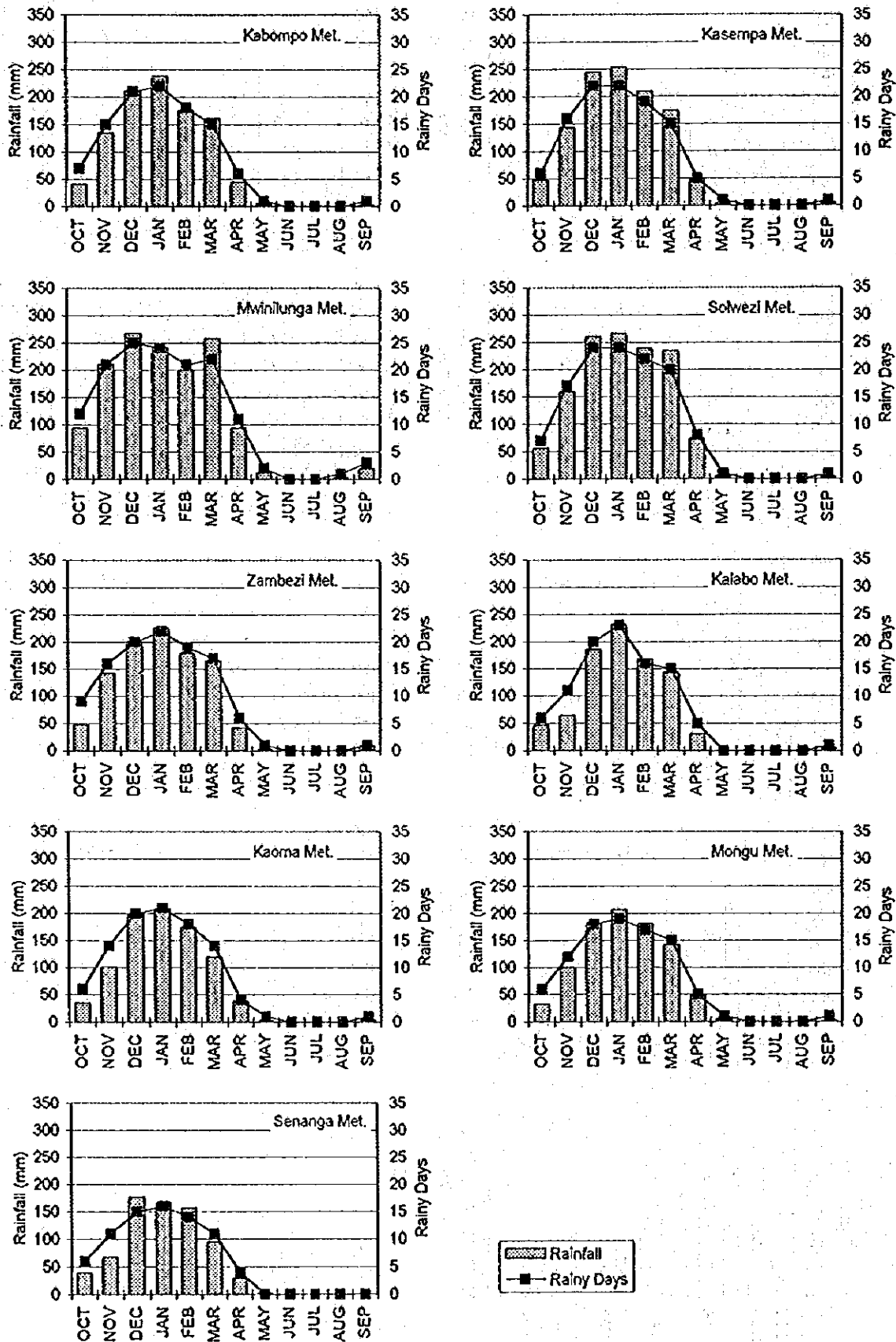


Figure 3-4 (2) Monthly Rainfall and Rainy Days

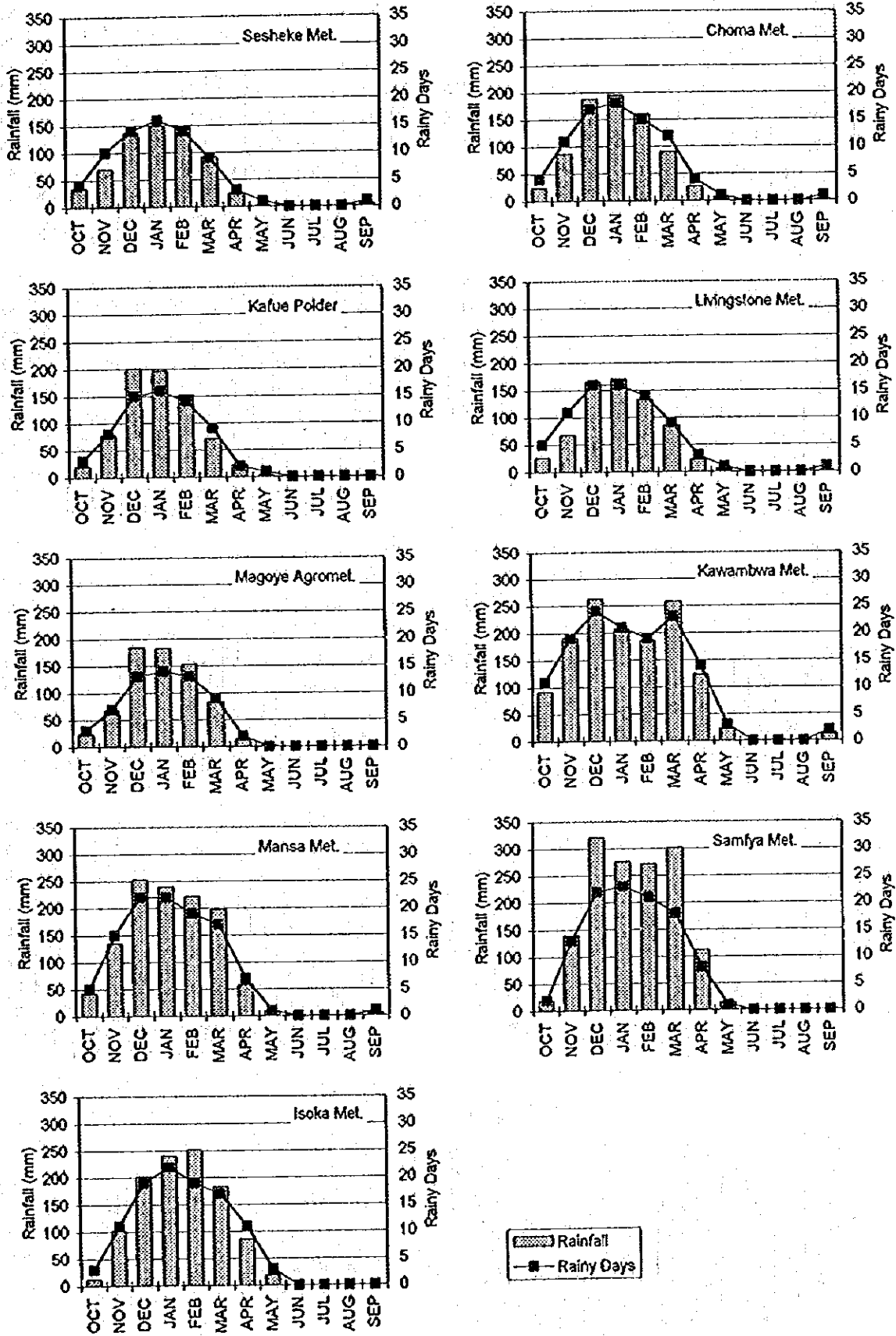


Figure 3-4 (3) Monthly Rainfall and Rainy Days

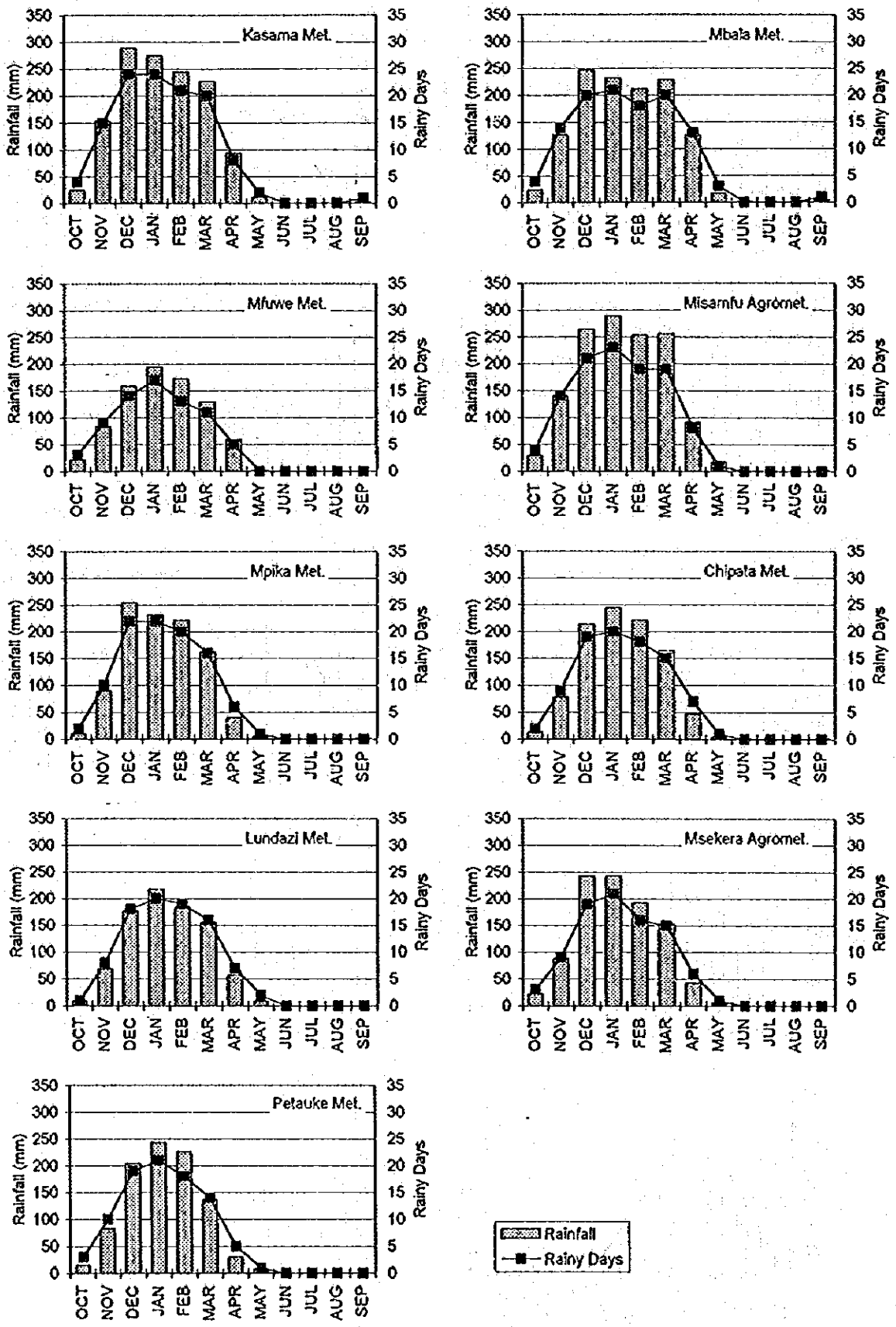
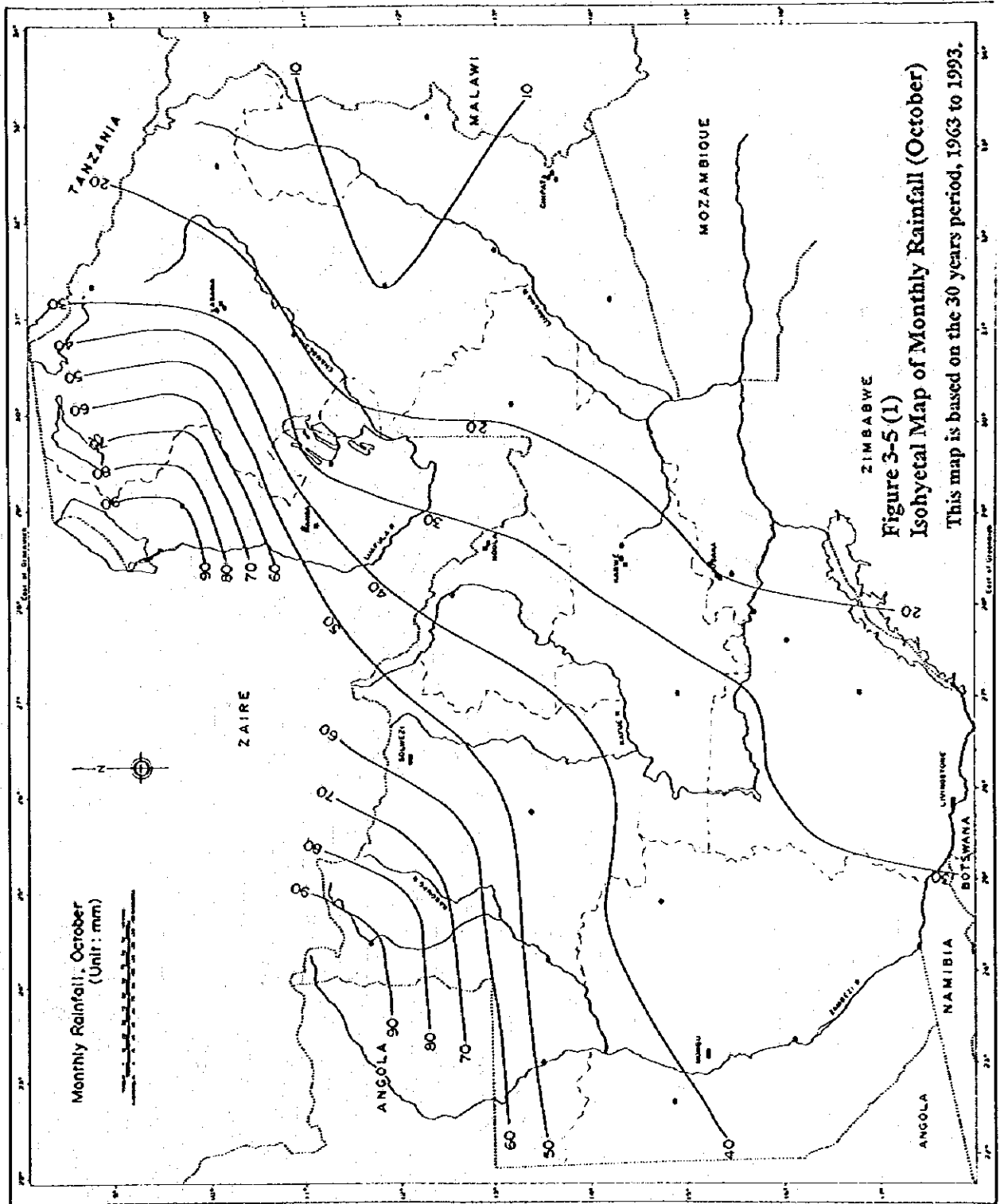


Figure 3-4 (4) Monthly Rainfall and Rainy Days



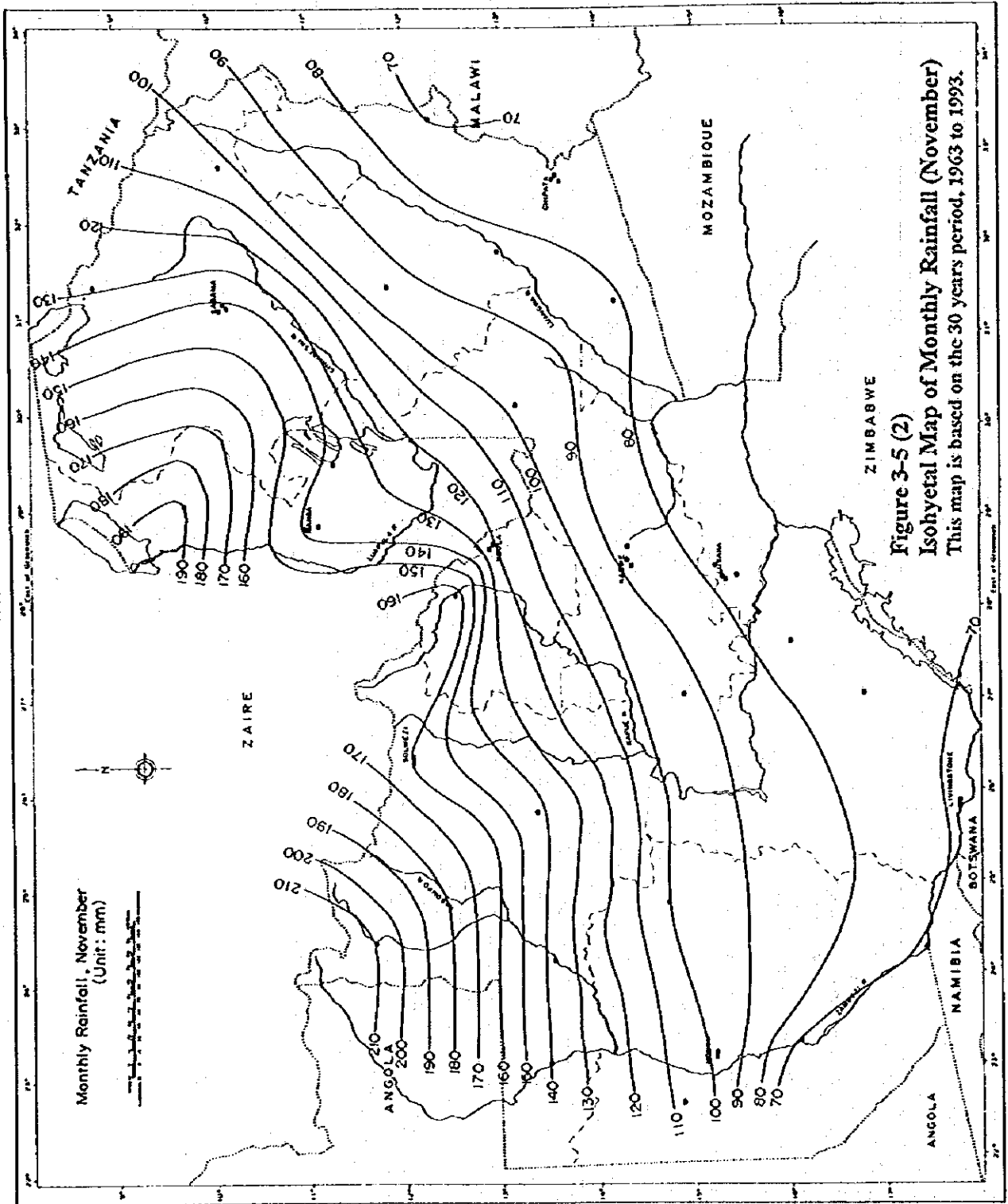


Figure 3-5 (2)
Isohyetal Map of Monthly Rainfall (November)
 This map is based on the 30 years period, 1963 to 1993.

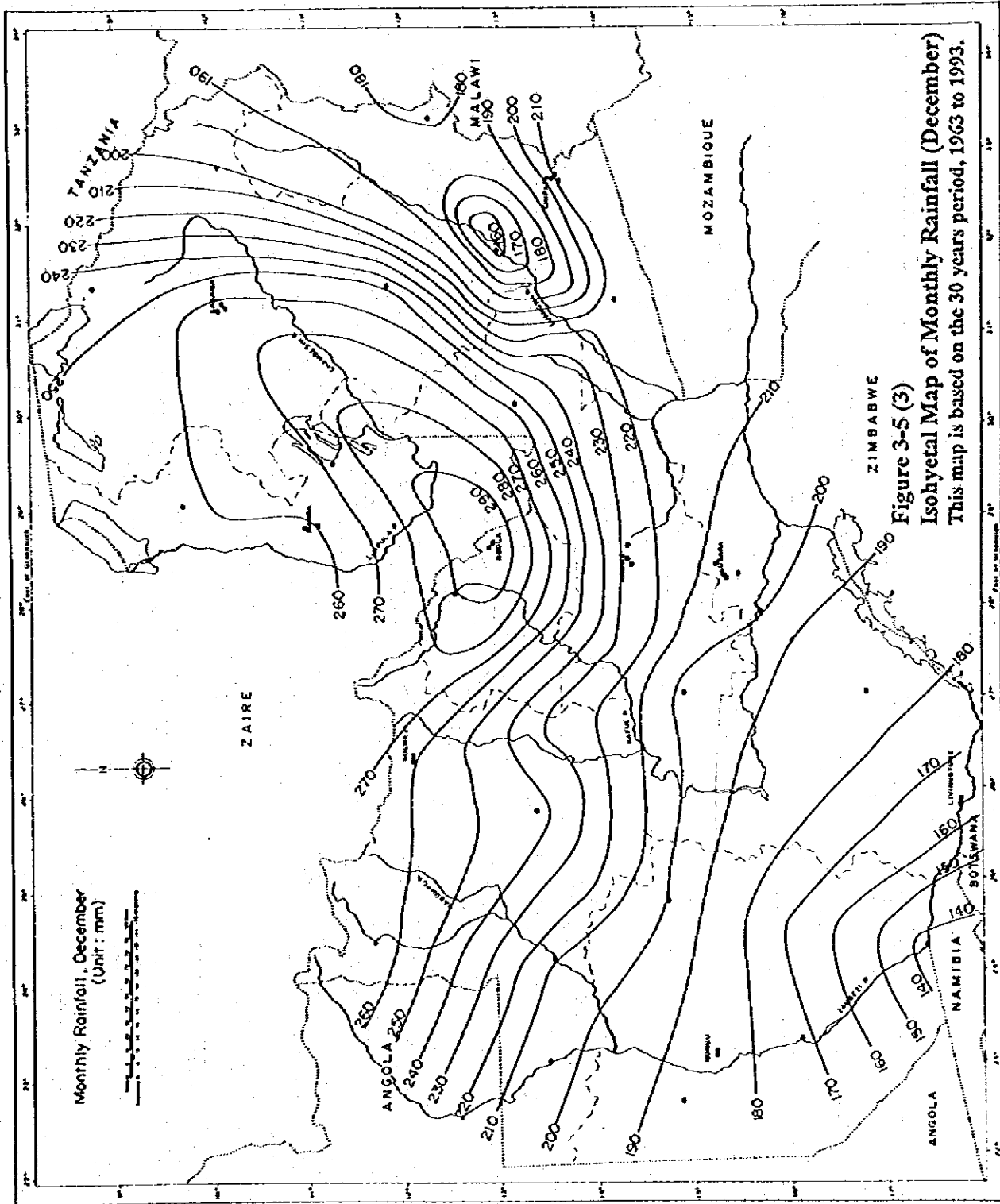


Figure 3-5 (3)
 Isohyetal Map of Monthly Rainfall (December)
 This map is based on the 30 years period, 1963 to 1993.

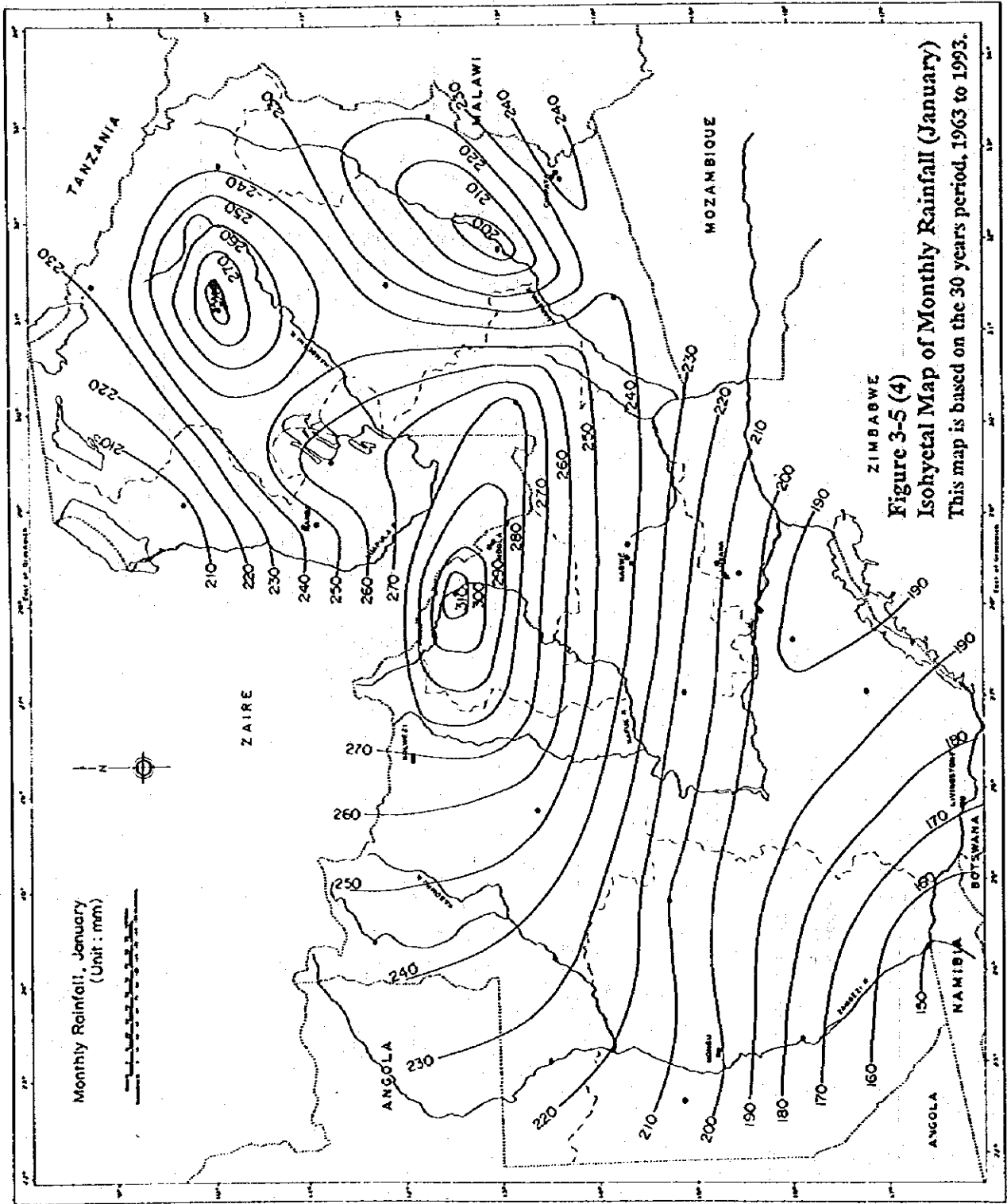


Figure 3-5 (4)
Isohyetal Map of Monthly Rainfall (January)
 This map is based on the 30 years period, 1963 to 1993.

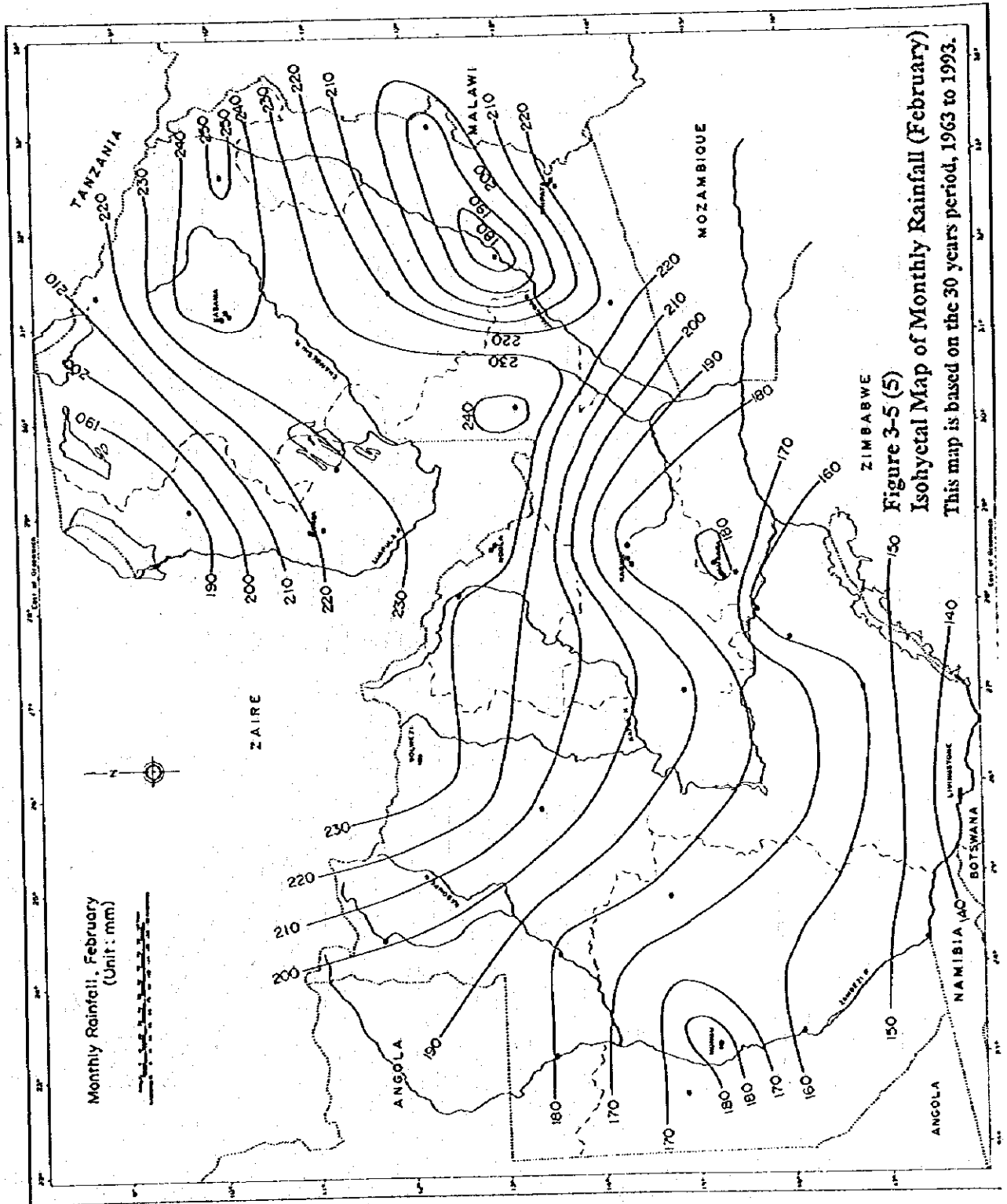
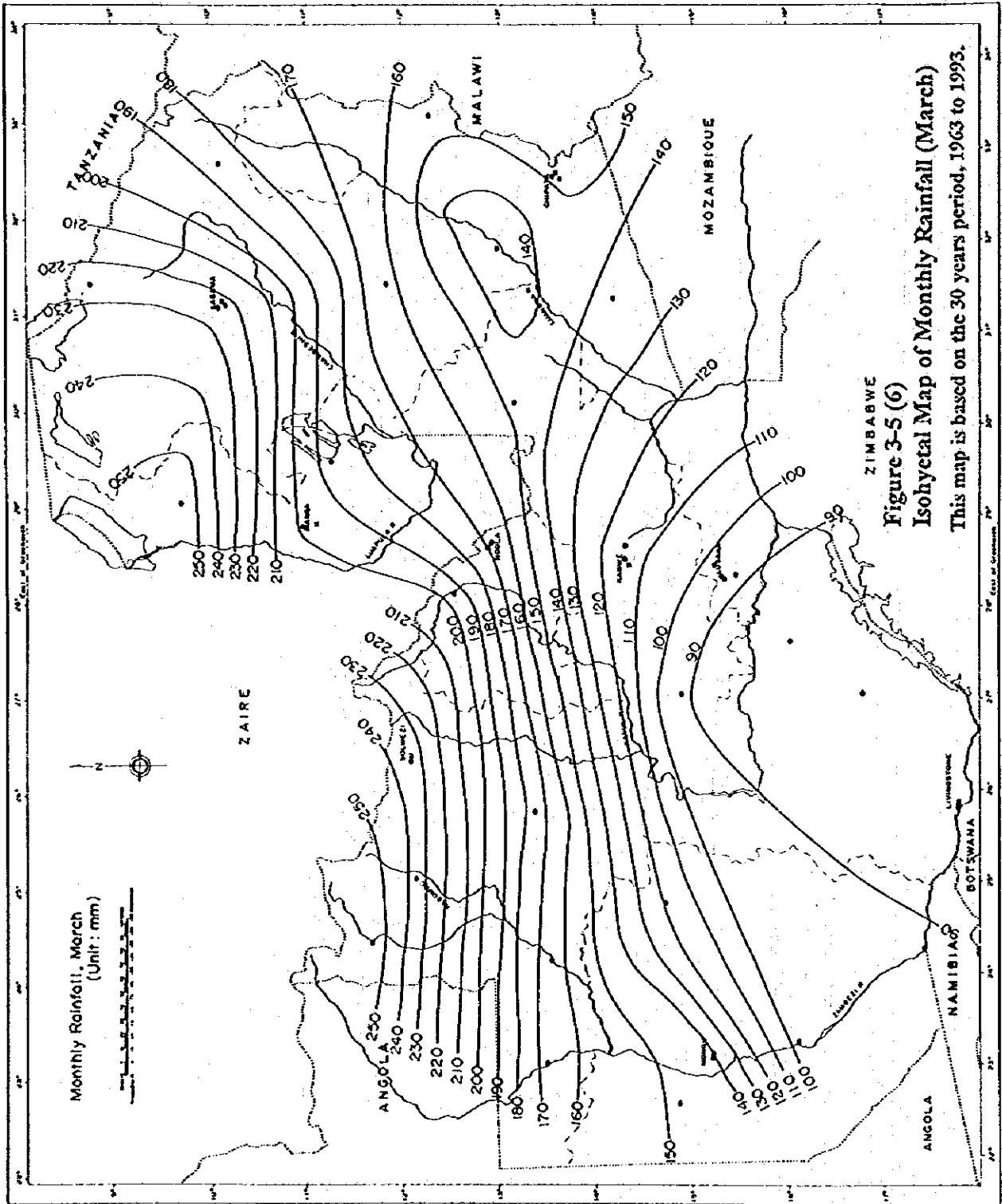


Figure 3-5 (5)
 Isohyetal Map of Monthly Rainfall (February)
 This map is based on the 30 years period, 1963 to 1993.



ZIMBABWE
Figure 3-5 (6)
Isohyetal Map of Monthly Rainfall (March)
 This map is based on the 30 years period, 1963 to 1993.

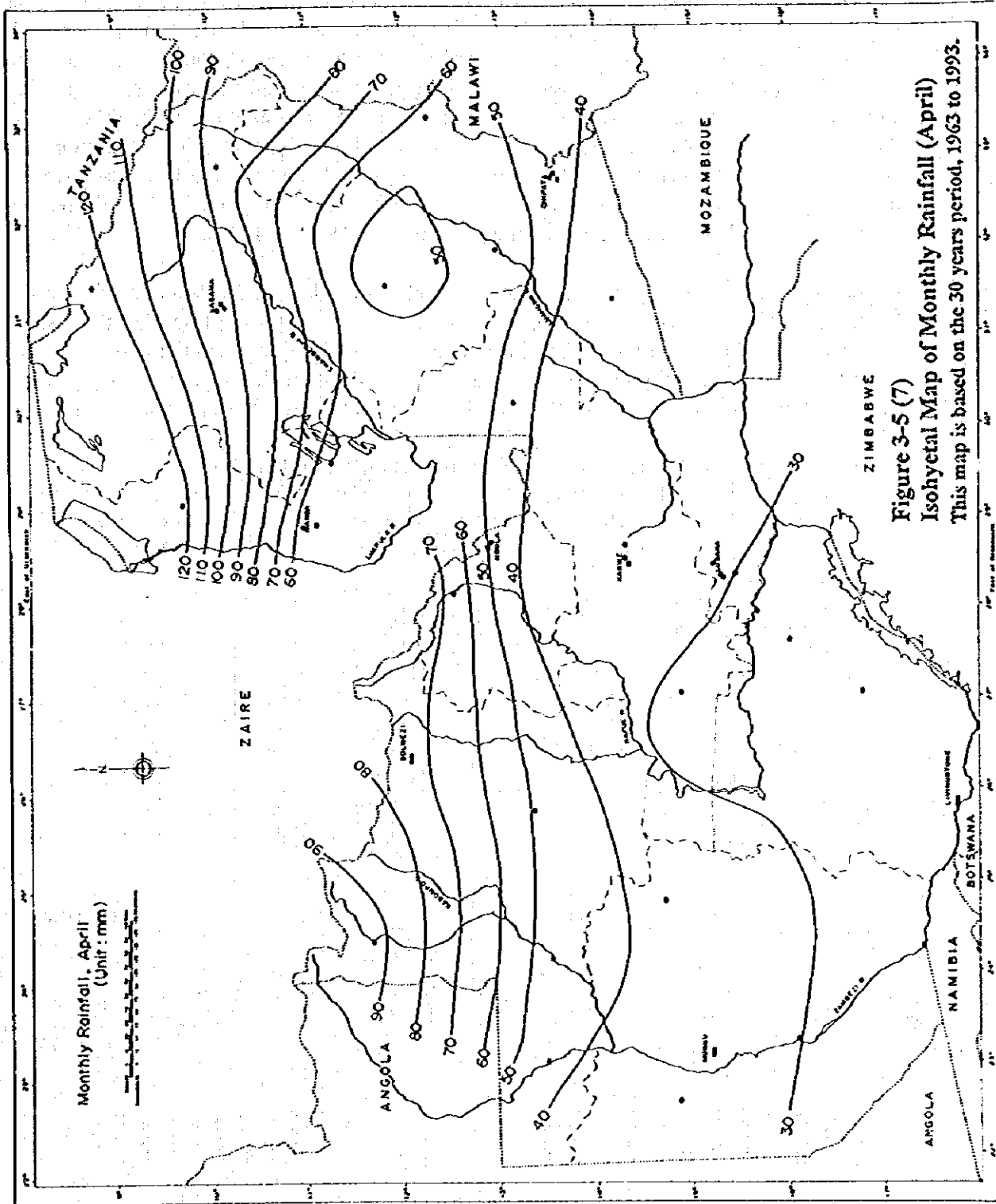


Figure 3-5 (7)
Isohyetal Map of Monthly Rainfall (April)
 This map is based on the 30 years period, 1963 to 1993.

3.2.3 Secular Variation of Annual Rainfall

In order to investigate secular variation of annual rainfall in Zambia, trend analysis was carried out. Based on annual rainfall of each year in the 36 meteorological stations, linear regression equations presenting secular variation trend were calculated using the least square method. The variation of annual rainfall and the linear regression line are shown in Appendix 3 and Figure 3-6 for Lusaka and Livingstone. The gradients of linear regression equations, which express the secular trend of annual rainfall, are summarised in Table 3-4 by the Province. This table indicates that annual rainfall has been becoming less by 2.4 mm per year on an Zambian average, and that the 8 provinces excluding Lusaka Province have the trend that annual rainfall has been becoming less by 0.7 - 5.8 mm per year. The decreasing trend is remarkable especially in Copperbelt, Central and Western Province.

In addition, comparing the average annual rainfall during the last 10 years and during the last 30 years, as shown in Table 3-4, the last 10 years averages are less than the last 30 years average. The former on an Zambian average is less by 27 mm than the latter and is 97 % of the latter. Especially in Luapula, Southern and Western Province, the last 10 years average of annual rainfalls are 93 - 95 % of the last 30 years average of annual rainfall.

Table 3-4 Trend of Annual Rainfall by Province

Province	Trend of Annual Rainfall (Gradient of Linear Equation) (mm/year)	Annual Rainfall (mm)		Balance R10-R30 (mm)	Ratio R10/R30 (%)
		10 years Average :R10	30 years Average :R30		
Lusaka	+1.8	842	857	- 15	98
Copperbelt	- 4.0	1216	1231	-15	99
Central	- 5.8	911	947	- 36	96
North-western	- 1.6	1153	1173	- 20	98
Western	- 4.1	767	808	- 41	95
Southern	- 3.0	687	737	- 50	93
Luapula	- 2.6	1201	1259	- 58	95
Northern	- 3.2	1121	1138	- 17	99
Eastern	- 0.7	975	961	+ 14	101
Whole Zambia	- 2.4	974	1001	- 27	97

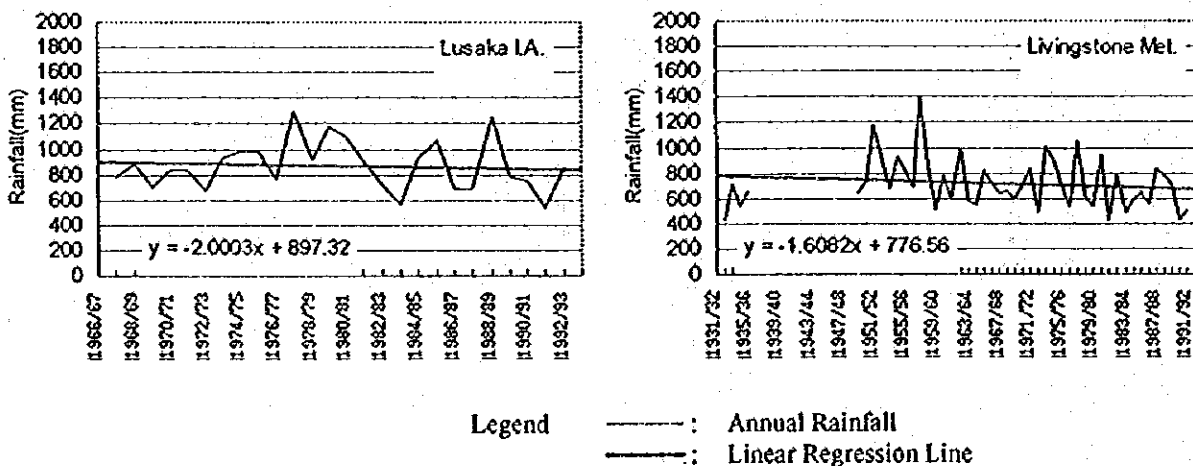


Figure 3-6 Secular Variation of Annual Rainfall

3.3 Rainfall Frequency

Considerable differences in rainfall quantities and the pattern of their occurrence are experienced in different climatic regimes. In general, the greater the annual rainfall amounts the less variable they are from one year to the next. In the semi-arid regions of the world with very limited amounts, the rainfall is irregular and unreliable. In UK or Japan, the pattern of occurrence of rainfall quantities for the month and the year are shown in Figure 3-7 for an imaginary rainfall station.

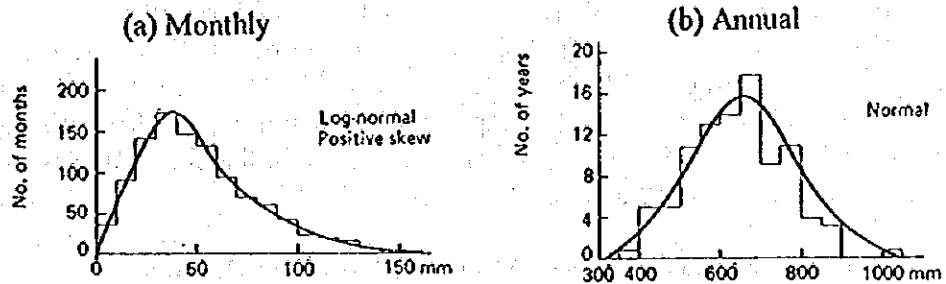


Figure 3-7 Rainfall Frequency in UK or Japan

In Zambia, the frequency of occurrence of rainfall quantities for the month and the year were compiled and are shown in Appendix 4 as a histogram for all the meteorological stations. Figure 3-8 shows the typical pattern of occurrence of monthly and annual rainfall in Lusaka City Airport as a representative for reference.

The monthly histogram shows the number of months with rainfalls grouped in under the 25 mm class and it will be noted at once that the maximum frequency of occurrence is in the first interval from 0 mm to 25 mm. This reflects the large number of (about half of) months without rain, which gives the characteristic shape of the J-distribution. Zambian climate can be obviously divided into a dry season and a rainy season differing from UK or Japan. This fact explains the difference between log-normal distribution in the monthly histogram of Figure 3-7 (a), and the J-distribution in the monthly histogram of Figure 3-8.

Annual rainfall totals in Zambia tend to reach maximum frequencies near the middle of range of values and approach the normal distribution. The normal distribution curves to be supposed in Appendix 4, seem not to correspond too well to the histograms with less years of the records. However the curves approximately correspond to the histograms with many years (more than 30 or 40 years) of the records.

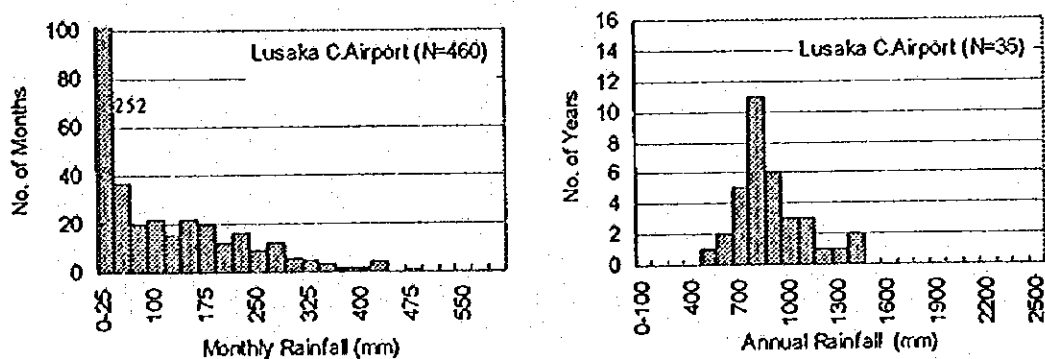


Figure 3-8 Rainfall Frequencies in Lusaka City Airport

3.4 Extreme Value of Rainfall

3.4.1 Rainfall Maxima and Minima

The highest recorded rainfalls in each meteorological station for a wide range of durations were abstracted and are shown in Table 3-6. The Figure 3-11 shows log-log plots of rainfall maxima in each station against durations from 1 day to 1 year. The Zambian highest three recorded rainfall for a wide range of durations are shown in Table 3-5. The first, second and third maximum rainfalls in Zambia are graphically shown in Figure 3-9. The Zambian rainfall maxima could be compared with the World's and the UK's rainfall maxima, based on the world's and UK's highest recorded rainfalls for a wide range of durations refereed from 'Hydrology in Practice, Elizabeth M. Shaw, Chapman & Hall'. Figure 3-10 shows the world's and UK's highest rainfall, and comparable maximum values have also been abstracted for Zambia. It is noted that the similarly drawn straight line for Zambia is smaller than the others and has a little small gradient.

Table 3-5 Maximum and Minimum Observed Rainfall

1 day Rainfall Maxima				2 day Rainfall Maxima			
Order	Station	Date	Rainfall (mm)	Order	Station	Date	Rainfall (mm)
1	Sesheke	1958/02/22	308	1	Sesheke	1958/02/22	351
2	Mt. Makulu	1972/11/05	292	2	Samfya	1959/03/30	336
3	Kasempa	1949/12/29	253	3	Mt. Makulu	1972/11/04	292
3 day Rainfall Maxima				5 day Rainfall Maxima			
Order	Station	Date	Rainfall (mm)	Order	Station	Date	Rainfall (mm)
1	Sesheke	1958/02/22	397	1	Sesheke	1958/02/22	523
2	Samfya	1959/03/29	353	2	Kafironda	1991/01/25	405
3	Kafironda	1991/01/25	316	3	Mt. Makulu	1990/11/21	389
10 day Rainfall Maxima				1 month Rainfall Maxima			
Order	Station	Date	Rainfall (mm)	Order	Station	Date	Rainfall (mm)
1	Sesheke	1958/02/18	590	1	Sesheke	1958/02	523
2	Kasempa	1949/12/26	495	2	Kafironda	1991/01	660
3	Kafironda	1991/01/20	485	3	Samfya	1976/03	621
1 year Rainfall Maxima				1 year Rainfall Minima			
Order	Station	Date	Rainfall (mm)	Order	Station	Date	Rainfall (mm)
1	Samfya	1961/62	2065	1	Kaoma	1972/73	240
2	Kasama	1961/62	1888	2	Sesheke	1972/73	379
3	Mwinilunga	1975/76	1761	3	Mongu	1991/92	382

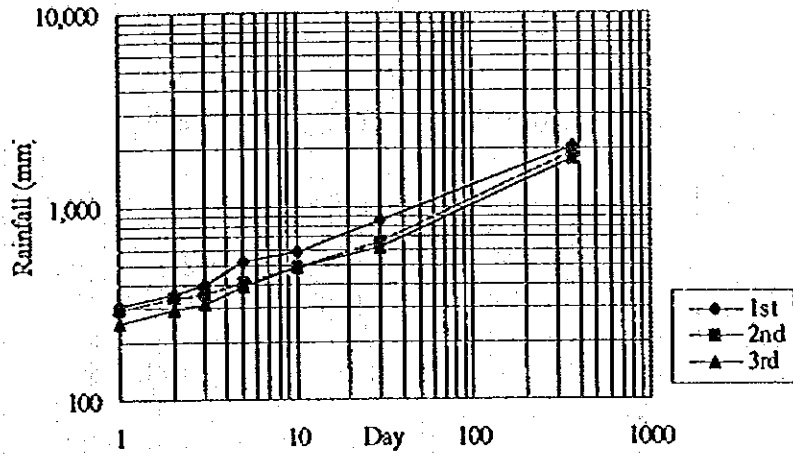


Figure 3-9 First, Second and Third Maximum Rainfall in Zambia

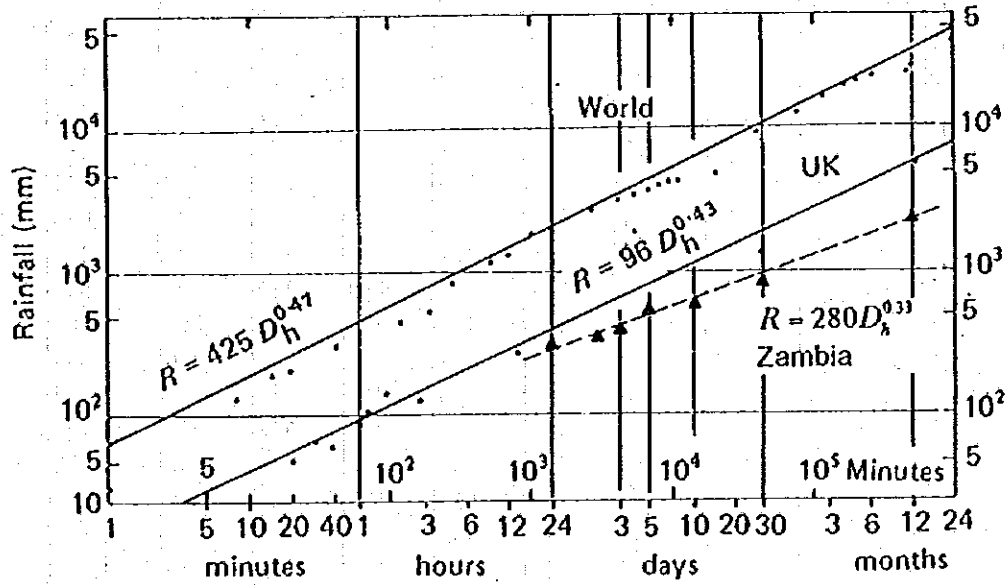


Figure 3-10 Highest Recorded Rainfall in Zambia, World and UK

Table 3-6 Maxima and Minima of Rainfall in each Station

Unit : mm

Province	Station Name	Altitude (EL.m)	Maximum Rainfall							Minimum Rainfall
			1-day	2-day	3-day	5-day	10-day	1-month	1-year	1-year
Lusaka	Lusaka C.A.	1,280	190	190	208	251	365	452	1,366	483
	Lusaka I.A.	1,154	105	150	170	236	378	528	1,299	530
	Mt. Makulu	1,213	292	292	292	389	456	559	1,288	569
Copperbelt	Kafironda	1,242	180	286	316	405	485	660	1,748	895
	Ndola	1,270	119	151	182	220	315	561	1,756	439
Central	Kabwe	1,207	122	143	161	208	305	460	1,451	619
	Kabwe Agro.	1,165	87	101	148	177	263	443	1,313	499
	Muinbwa	1,218	133	172	188	206	285	457	1,324	438
	Serenje	1,384	142	185	232	294	357	582	1,585	708
North-western	Kabompo	1,026	99	122	133	238	304	443	1,338	593
	Kasempa	1,235	253	270	275	308	495	529	1,559	654
	Mwinilunga	1,362	123	136	154	201	291	519	1,761	1,043
	Solwezi	1,333	130	167	179	235	277	575	1,575	985
	Zambezi	1,078	110	147	150	176	251	408	1,346	720
Western	Kalabo	1,051	101	201	203	268	279	389	1,084	617
	Kaoma	1,152	167	169	191	250	296	390	1,311	240
	Mongu	1,053	237	251	267	289	365	491	1,357	382
	Senanga	1,027	98	140	188	245	347	399	987	463
	Sesheke	951	308	351	397	523	590	856	1,546	379
Southern	Choma	1,267	116	145	170	217	277	502	1,187	423
	Kafue Polder	978	147	155	186	240	352	579	1,192	460
	Livingstone	987	148	213	267	289	331	498	1,402	420
	Magoye	1,018	94	115	127	177	287	369	935	461
Luapula	Kawambwa	1,324	81	121	142	165	229	438	1,758	865
	Mansa	1,259	95	113	126	156	255	416	1,573	800
	Samfya	1,172	227	336	353	376	408	621	2,065	937
Northern	Isoka	1,360	84	106	121	148	238	384	1,334	876
	Kasama	1,384	95	151	155	215	277	510	1,888	801
	Mbala	1,672	115	118	154	187	290	500	1,745	469
	Mfuwe	573	91	107	147	166	228	371	1,062	495
	Misamfu	1,536	140	173	188	191	290	517	1,751	1,097
	Mpika	1,402	180	232	271	331	358	543	1,498	644
Eastern	Chipata	1,032	139	151	187	211	318	583	1,471	656
	Lundazi	1,143	122	128	143	198	230	449	1,415	495
	Msekera	1,025	95	109	133	173	245	429	1,179	753
	Petauke	1,036	118	180	248	266	308	512	1,381	597
1st Maxima or Minima		-	308	351	397	523	590	856	2,065	240
2nd Maxima or Minima		-	292	336	353	405	495	660	1,888	379
3rd Maxima and Minima		-	253	292	316	389	485	621	1,761	382

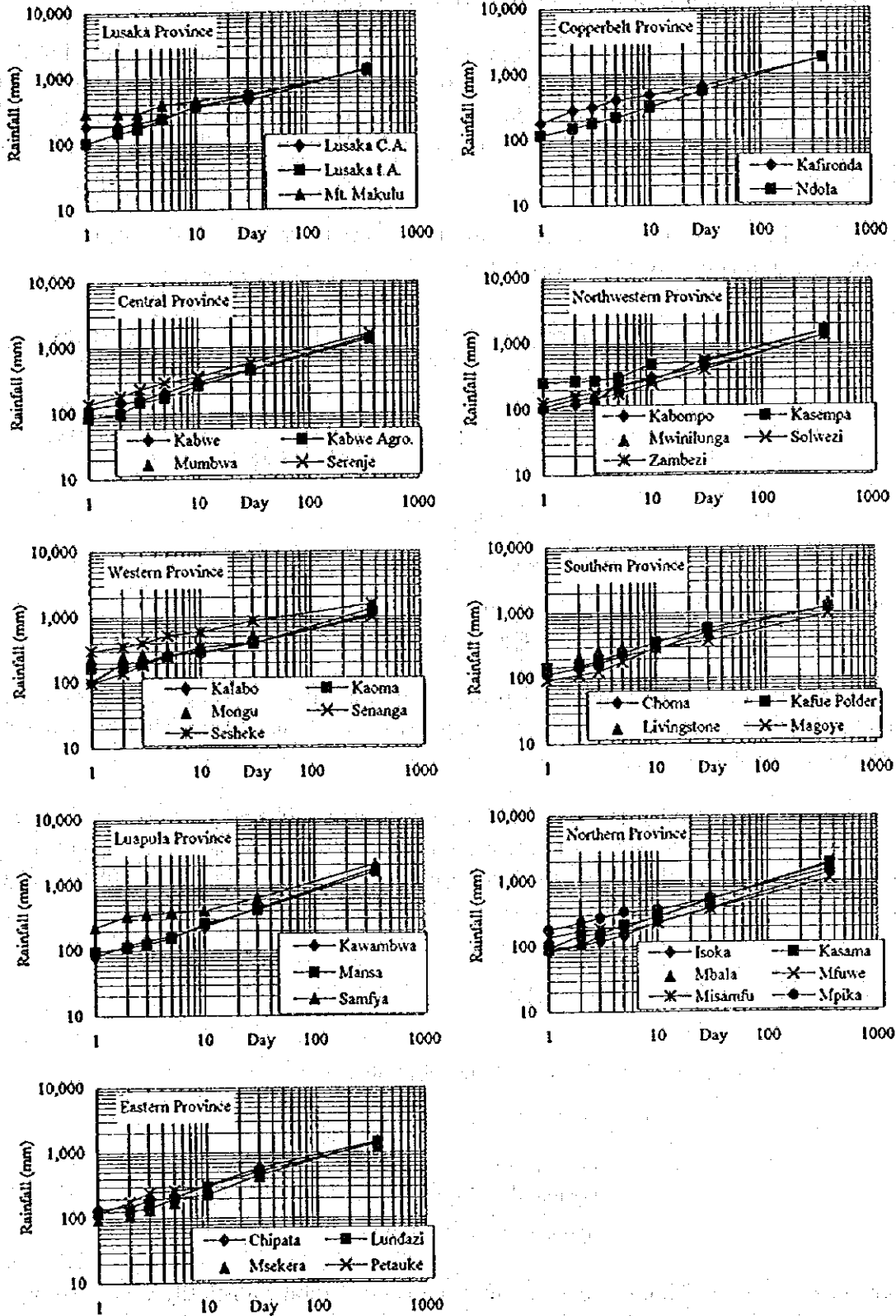


Figure 3-11 Maximum Rainfall at Meteorological Stations

3.4.2 Maximum and Minimum Probable Annual Rainfall

It was found in Section "3.3" that the normal distribution was approximately applied to the pattern of occurrence of annual rainfalls at the stations with many years (more than 30 or 40 years) of records. Assuming that the normal distribution was applied to the pattern of occurrence of annual rainfalls at all the stations, probable annual rainfall was estimated as follows.

Return period (or probability of exceedance) of each annual rainfall is calculated by using the following four equations of order statistics :

$$W = \frac{(2i-1)}{2N} : \text{Hazen (1930)} \qquad W = \frac{i}{(N+1)} : \text{Thomas (1938)}$$

$$W = \frac{i-0.3}{N+0.4} : \text{Chegodayov (1955)} \qquad W = \frac{i-0.31}{N+0.38} : \text{Jankinson (1969)}$$

Where, W : probability of exceedance

T : return period ($T = \frac{1}{W}$)

i : order from maximum or minimum

N : sample size (number of observation years)

In these four equation, Hazen equation has the largest value under a same return period, the second is Jankinson equation, the third is Chegodayov equation, and the Thomas equation has the smallest value.

Each annual rainfall (order statistics) and corresponding probability of exceedance are plotted on a normal curve paper, and the most suitable linear regression line is decided by using the least square method. Thus assuming a normal distribution against the frequency of occurrence of annual rainfall, a linear regression equation is presented as follows:

$$X_0 = \frac{1}{\alpha} \xi + A \qquad \frac{1}{\alpha} = \frac{\overline{X\xi}}{\xi^2} \qquad A = \overline{X}$$

Where, X_0 : theoretical annual rainfall

$\frac{1}{\alpha}, A$: constant

X : observational annual rainfall

ξ : normal deviation

$\overline{\quad}$: mark meaning average

A probable annual rainfall corresponding to a normal deviation statistically calculated by a return period will be obtained by using this equation. The probable annual rainfalls at all the meteorological stations were calculated and are presented in Appendix 6. In this section, maximum and minimum probable annual rainfall corresponding to return period, 5, 10, 30, 50 and 100 years are shown in Table 3-8. These figures in the table were estimated by using the Jankinson equation which is adopted by WMO.

As an instance, return period corresponding to annual rainfall in 1991/92 when a severer drought attached at Zambia is shown in Table 3-7. This table indicates that the drought corresponds once in 20 years in whole Zambia. The drought in the south area with less rain was severer and the return period was 73 years in Western Province, 38 years in Central Province and 21 years in Southern Province. Especially the return period of annual rainfall in Mongu was 270 years and was the severest drought in Zambia in 1991/92. Besides in the northward provinces, Northwestern, Luapula and Northern Province, the return period was 3 - 4 years and the drought was not so severe.

Table 3-7 Return Period of Annual Rainfall in 1991/1992

Province	Station Name	Rainfall 1991/92 (mm)	Return Period (yrs.)	Province	Station Name	Rainfall 1991/92 (mm)	Return Period (yrs.)
Lusaka	Lusaka C.A.	595.2	9	Southern	Choma	482.5	48
	Lusaka I.A.	529.6	17		Kafue Polder	509.2	12
	Mt. Makulu	625.1	6		Livingstone	511.3	14
	Average	583.3	11		Magoye	461.1	8
Copperbelt	Kafironda	1027.5	4		Average	491.0	21
	Ndola	708.1	22		Luapula	Kawambwa	1221.5
	Average	867.7	13	Mansa		946.7	4
Central	Kabwe	618.9	10	Samfya(*1)		-	-
	Kabwe Agro.	498.8	77	Average	1084.1	4	
	Mumbwa	438.4	55	Northern	Isoka	1125.0	2
	Serenje	768.7	10		Kasama	1282.6	2
	Average	581.2	38		Mbala	1278.5	2
North-western	Kabompo	847.4	4		Mfuwe	771.1	2
	Kasempa	1039.2	3		Misamfu	1256.3	2
	Mwinilunga	1103.7	4		Mpika	768.5	6
	Solwezi	1141.8	3	Average	1080.3	3	
	Zambezi	974.8	3	Eastern	Chipata	655.6	10
	Average	1021.4	3		Lundazi	841.3	2
Western	Kalabo	537.3	11		Msekera	825.8	3
	Kaoma	645.6	10		Petauke	596.6	16
	Mongu	382.2	270		Average	729.8	8
	Senanga	741.2	2	Total Average		787.0	20
	Sesheke	-	-				
	Average	576.6	73				

Table 3-8 Maximum and Minimum Probable Annual Rainfall

Unit : mm

Province	Station Name	Maximum Probable Annual Rainfall					Minimum Probable Annual Rainfall				
		Return Period					Return Period				
		5yrs.	10yrs.	30yrs.	50yrs.	100yrs.	5yrs.	10yrs.	30yrs.	50yrs.	100yrs.
Lusaka	Lusaka C.A.	1,424	1,729	2,112	2,264	2,453	671	582	470	426	370
	Lusaka I.A.	1,456	1,763	2,148	2,301	2,492	685	589	468	420	361
	Mt. Makulu	1,415	1,712	2,086	2,234	2,419	650	547	419	368	304
Copperbelt	Kafironda	2,109	2,526	3,049	3,258	3,516	959	774	543	451	336
	Ndola	1,965	2,363	2,862	3,061	3,308	956	827	665	600	520
Central	Kabwe	1,538	1,856	2,255	2,414	2,611	725	618	483	429	363
	Kabwe Agro.	1,556	1,900	2,332	2,504	2,718	747	668	569	530	481
	Mumbwa	1,454	1,772	2,172	2,331	2,529	681	595	488	455	392
	Serenje	1,878	2,263	2,746	2,938	3,177	891	761	597	532	450
North-western	Kabompo	1,641	1,962	2,364	2,524	2,723	761	621	446	376	289
	Kasempa	1,838	2,197	2,647	2,827	3,049	871	724	539	466	374
	Mwinilunga	2,198	2,614	3,138	3,346	3,604	998	788	524	420	289
	Solwezi	2,035	2,416	2,894	3,084	3,321	922	722	470	370	246
	Zambezi	1,676	2,004	2,415	2,579	2,782	776	633	455	383	295
Western	Kalabo	1,518	1,854	2,275	2,443	2,651	665	554	415	359	290
	Kaoma	1,483	1,791	2,178	2,332	2,523	729	642	533	490	436
	Mongu	1,555	1,873	2,273	2,432	2,629	768	676	559	513	455
	Senanga	1,216	1,466	1,780	1,905	2,060	574	488	382	339	286
	Sesheke	1,246	1,526	1,877	2,016	2,190	593	530	452	421	382
Southern	Choma	1,361	1,648	2,008	2,151	2,330	675	604	514	479	435
	Kafue Polder	1,280	1,547	1,882	2,015	2,181	608	523	417	375	322
	Livingstone	1,240	1,514	1,857	1,994	2,164	597	535	456	425	386
	Magoye	1,168	1,406	1,705	1,824	1,972	530	434	314	267	207
Luapula	Kawambwa	2,096	2,483	2,969	3,162	3,402	939	721	448	339	204
	Mansa	1,854	2,209	2,656	2,883	3,054	837	661	440	352	243
	Samfya(*1)	2,397	2,889	3,507	3,753	4,059	1,112	933	708	618	507
Northern	Isoka	1,703	2,021	2,420	2,578	2,776	722	527	282	185	64
	Kasama	2,037	2,426	2,914	3,108	3,349	938	752	519	427	312
	Mbala	1,972	2,357	2,840	3,032	3,271	920	755	548	466	364
	Mfuwe	1,348	1,624	1,969	2,107	2,278	625	522	393	342	279
	Misamfu	2,112	2,514	3,018	3,218	3,467	910	682	397	283	142
	Mpika	1,685	2,025	2,451	2,620	2,831	802	680	527	466	390
Eastern	Chipata	1,655	1,989	2,410	2,577	2,785	790	673	525	467	394
	Lundazi	1,490	1,805	2,201	2,358	2,554	704	609	489	442	382
	Msekera	1,595	1,909	2,304	2,461	2,655	697	542	348	271	174
	Petauke	1,604	1,930	2,339	2,502	2,705	767	657	517	462	393

[Note] The calculation results in the table are based on the Jankinson equation.

3.5 Drought Analysis

A drought is usually considered to be a period in which the rainfall consistently falls short of the climatically expected amount, such that the natural vegetation does not flourish and agricultural crops fail. Low rainfalls more seriously affect water supplies for industry and domestic purposes.

“The technique for the evaluation of drought from rainfall data” was proposed by Herbst in 1966 in South Africa. Refer to Appendix 8. This method confines the definition of droughts specifically to periods in which rainfall deficits were in excess of average deficits. Thus sequences of months with extremely dry conditions are identified beyond the shortfalls in monthly rainfall amounts that are normally experienced in some months of each year. This definition of a drought is given in Figure 3-12. In addition, an average monthly drought intensity and severity over the period of drought can be calculated from the following expression :

$$Y = \frac{\sum_{i=1}^D [(E_i - M_i) - (MMD)_i]}{\sum_{i=1}^D (MMD)_i} \quad (MMD)_i = \frac{\sum_{t=1}^n (E_t - R_t)}{n}$$

$$\begin{aligned} [(E_i - M_i) - (MMD)_i] &= 0, \text{ while } [(E_i - M_i) - (MMD)_i] > 0 \\ (E_i - R_i) &= 0, \text{ while } (E_i - R_i) > 0 \end{aligned}$$

A severity Index is given by $Y \times D$.

- Where, E_t : effective rainfall $E_t = (E_{t-1} - M_{t-1})W_t + R_t$
 M_t : monthly mean rainfall
 R_t : actual monthly rainfall
 W_t : carry-over factor ($t = 1, 2, \dots, 12$)
 $(MMD)_t$: monthly mean deficit ($t = 1, 2, \dots, 12$)
 D : drought duration in month
 Y : drought intensity

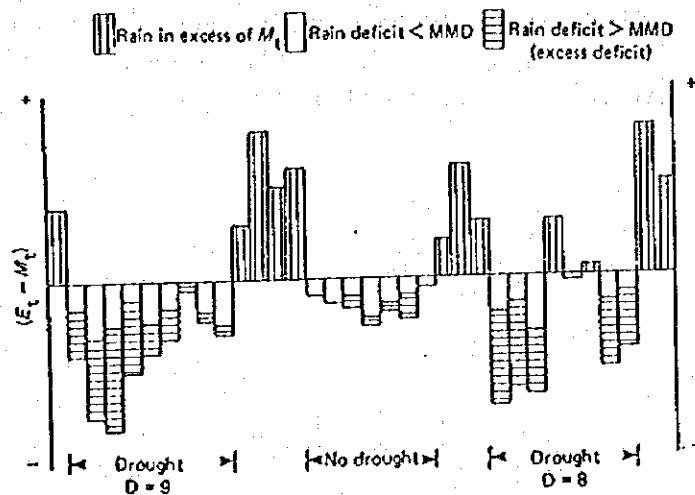


Figure 3-12 Beginning and Ending of Droughts

The Herbst method was applied to the long-rainfall record at all the meteorological stations in Zambia. The results are shown in Table 3-10 and Figure 3-13. The detail is referred to Appendix 7. The top ten droughts ranked according to their severity index are shown in Table 3-9. The drought severity is the highest at Livingstone over the 107 month period from January 1979 to November 1987, but the drought intensity is not so high comparing to the others. The drought intensity is the highest at Mbala in Northern Province, and this high intensity reflects the low percentage, 42%, of average rainfall for the 19 months of drought.

Table 3-9 Ten Maximum Droughts in Zambia

No.	Station Name	Province	Period	Duration (month)	Intensity	Severity	% of Mean Rain
1	Livingstone	Southern	79/01-87/11	107	1.54	165.3	84.4
2	Kasama	Northern	48/11-55/10	84	1.64	137.4	83.2
3	Mongu	Western	81/04-88/12	93	1.26	117.5	81.6
4	Lundazi	Eastern	69/01-77/11	107	1.02	108.6	80.6
5	Mpika	Northern	89/06-94/09	64	1.54	98.7	77.5
6	Kasempa	N/western	80/12-85/12	61	1.40	85.7	82.6
7	Zambezi	N/western	81/04-87/08	77	1.09	83.7	82.8
8	Kabwe	Central	86/11-92/10	72	1.13	81.6	77.5
9	Kasama	Northern	56/05-61/10	66	1.10	72.6	89.1
10	Kafironda	Copperbelt	85/03-90/12	70	1.01	70.4	85.4

The regional variations of droughts in Zambia were investigated by applying the Herbst method to 24 meteorological stations with records from 1963/64 to 1992/93. The Zambian average of the severest droughts at each station during 1963/63-1992/93 is obtained as follows :

- Drought Duration : 58 month
- Drought Intensity : 1.36
- Drought Severity : 68.7
- Percentage of Mean Rainfall during Drought : 78.2 %

Based on the results, drought severity index map was drawn and is shown in Figure 3-14. Drought severity is very high in the southwest area from Mongu to Livingstone, amounting to 80 - 160 and is also high near Lundazi, amounting to more than 100. On the centre belt of Zambia from east to west, drought severity is middle, amounting to 60 - 80, and in the northward drought severity is low, amounting to less than 60.

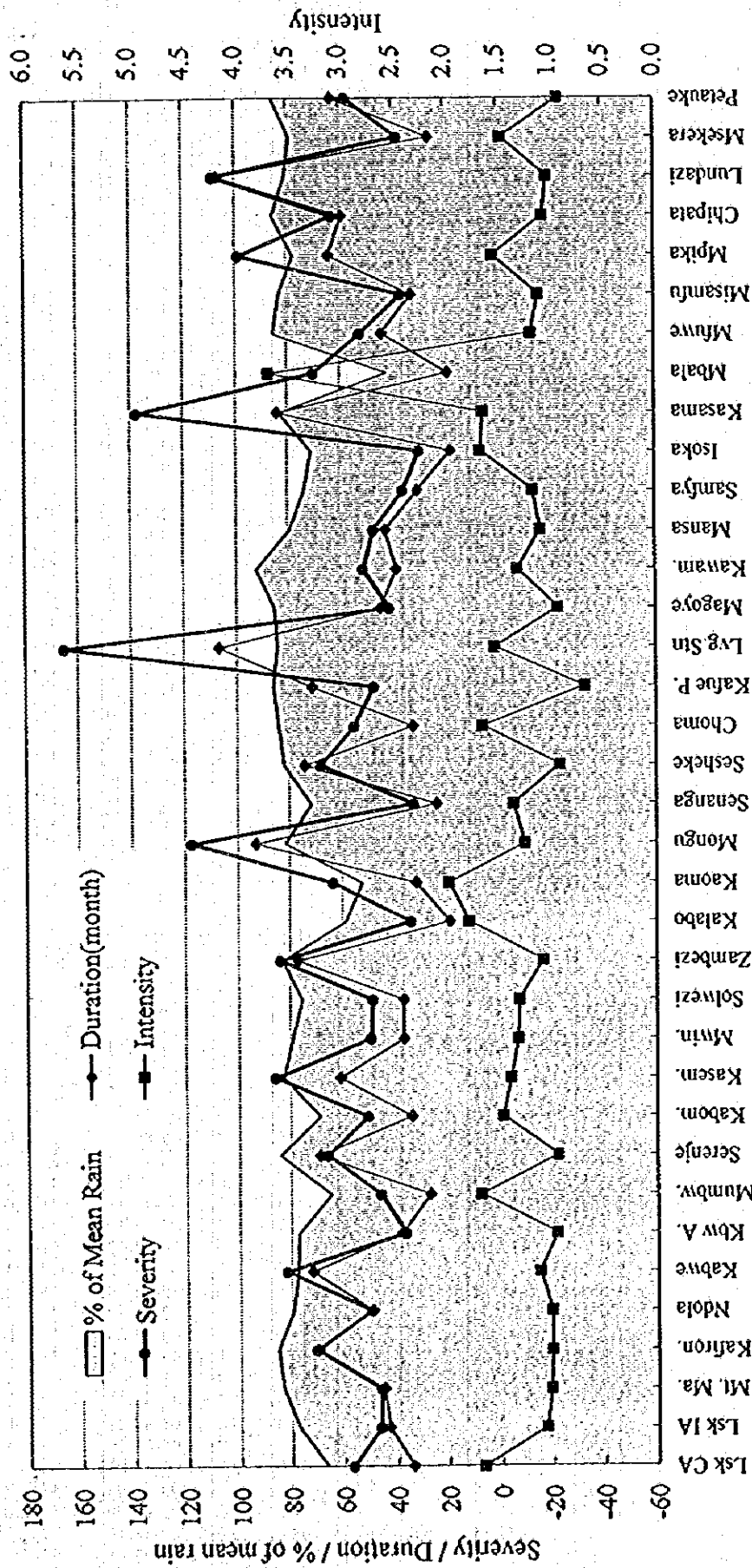


Figure 3-13 Severest Droughts in the Meteorological Stations

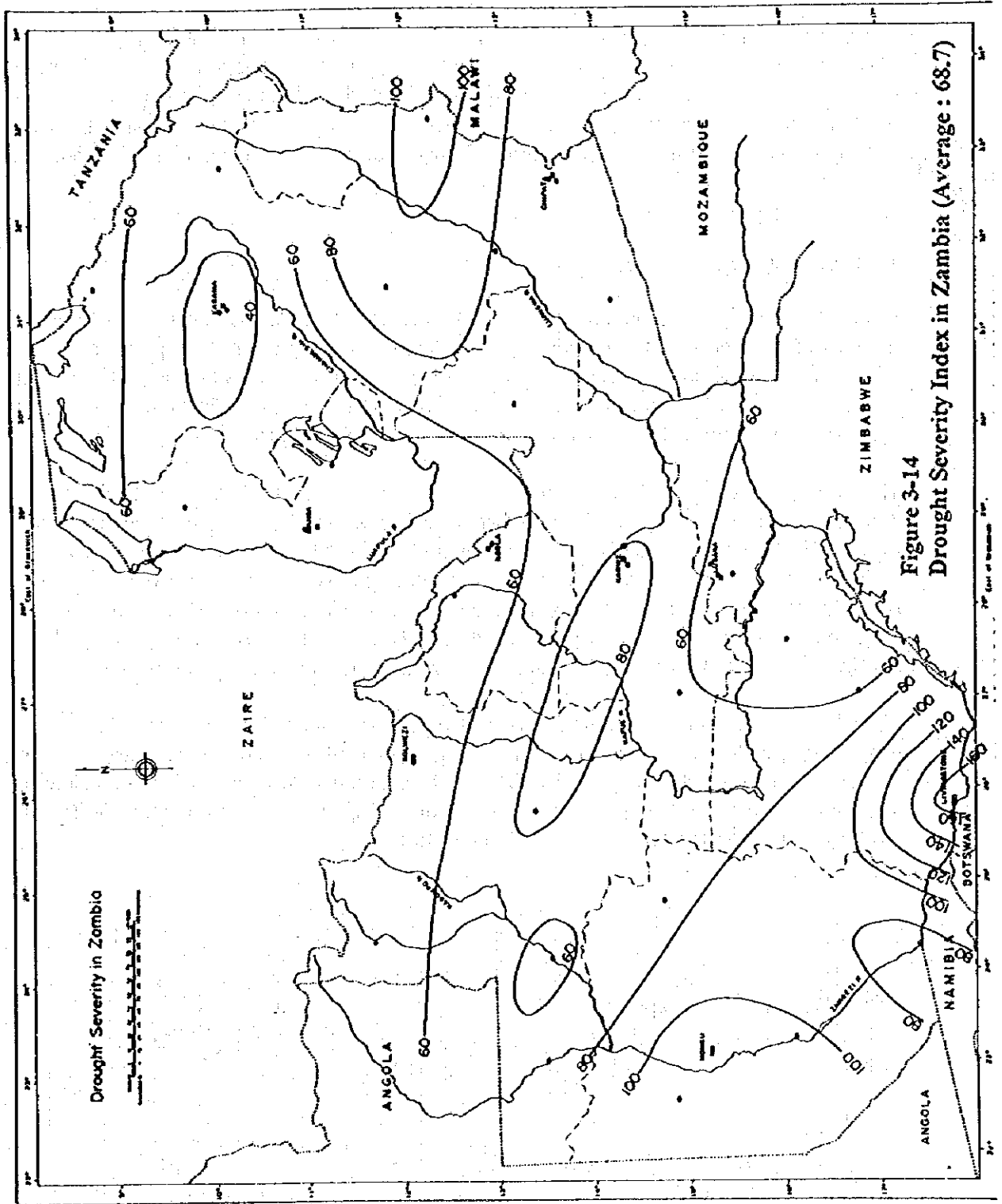


Figure 3-14
Drought Severity Index in Zambia (Average : 68.7)