

Table II.4.21 Areal Rainfall in Meki Basin

Year	Monthly Rainfall (mm)												Annual
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1979	94.1	35.5	167.5	46.7	140.6	96.4	208.5	196.3	134.1	53.3	0.0	3.5	1176.4
1980	18.6	15.4	29.3	77.1	63.9	103.6	160.2	154.2	106.6	27.1	7.3	0.0	763.3
1981	0.0	7.1	228.8	87.5	24.0	19.8	229.0	172.4	134.0	6.9	0.0	1.3	911.0
1982	39.3	69.1	52.9	116.1	142.0	65.8	116.1	189.3	63.8	114.8	31.7	10.1	1011.0
1983	36.6	55.0	161.0	157.6	199.1	120.6	193.8	295.6	113.3	26.7	0.0	0.9	1360.1
1984	0.0	1.7	23.4	4.8	189.7	160.2	177.6	152.5	89.5	0.0	0.4	0.0	799.7
1985	8.9	0.8	27.7	166.2	83.3	59.3	195.2	170.3	135.4	2.4	0.3	0.0	849.9
1986	13.7	122.5	24.8	160.5	73.6	125.8	123.6	111.8	143.3	26.5	0.0	2.9	928.9
1987	0.0	84.3	237.9	85.2	228.7	56.1	83.4	114.9	101.8	15.0	0.0	0.0	1007.4
1988	1.8	50.3	6.4	183.0	33.2	50.0	187.9	163.1	134.9	77.5	0.0	1.2	889.4
1989	2.0	97.0	149.5	116.8	16.0	106.4	188.6	162.2	115.2	33.5	0.0	23.9	1011.2
1990	0.8	262.3	87.9	153.3	72.9	74.6	193.6	172.6	94.0	10.0	0.0	0.0	1121.9
1991	16.6	97.0	158.0	14.4	14.3	70.4	237.6	211.4	114.1	5.2	0.0	19.8	958.8
1992	72.0	48.7	28.7	102.7	46.6	96.6	211.9	202.9	89.6	78.3	3.3	7.6	989.0
1993	22.3	79.3	6.4	193.8	129.7	90.5	228.9	236.1	112.9	135.2	0.0	0.0	1235.0
1994	0.1	1.9	67.5	50.9	55.3	190.6	219.9	134.7	113.0	0.9	8.9	6.2	850.0
1995	0.0	52.3	100.0	289.0	105.4	76.1	165.3	132.5	116.6	9.5	0.0	44.5	1091.2
1996	109.3	0.5	206.1	68.8	159.3	219.0	170.5	226.1	93.3	5.1	8.3	0.0	1266.4
1997	63.8	0.0	86.2	138.3	20.9	146.1	146.6	149.8	60.8	105.9	24.4	0.0	942.8
1998	74.0	72.3	127.4	73.2	140.4	95.6	209.6	192.0	92.5	65.2	0.0	0.0	1142.1
1999	2.0	9.7	82.4	31.9	26.7	118.7	183.0	123.9	90.4	161.3	0.0	0.0	830.0
Average	27.4	55.4	98.1	110.4	93.6	102.0	182.4	174.5	107.1	45.7	4.0	5.8	1006.5
Std	34.7	60.8	74.1	68.6	66.0	47.7	39.7	44.4	22.5	48.9	8.6	11.1	162.8

Table II.5.1 Sediment Analysis Data of the Meki River near Meki

Date	Gauge Height (m)	Q (m ³ /s)	Concentration (ppm)	Qs (Tons/day)
28-Jul-88	1.21	11.602	2,383.750	2,389.500
9-Sep-88	1.38	15.618	2,078.750	2,805.000
5-Feb-89	0.46	1.462	12,461.550	1,574.103
26-Jun-89	0.8	6.887	657.580	391.284
12-Jul-89	1.44	18.312	2,690.000	4,256.002
28-Aug-89	1.05	8.948	1,671.660	1,292.372
28-Aug-89	0.5	8.783	1,634.900	1,240.646
8-Dec-89	0.5	0.376	2,827.650	91.860
8-Dec-89	0.5	0.376	2,224.180	72.254
8-Dec-89	0.5	0.376	3,408.225	110.722
23-Feb-90	1.29	13.534	4,070.880	4,760.233
23-Feb-90	1.29	13.534	4,485.590	5,245.169
23-Feb-90	1.29	13.534	4,092.060	4,784.999
11-Apr-90	2.35	39.647	2,717.500	9,308.798
11-Apr-90	2.35	39.647	2,674.060	9,159.994
11-Apr-90	2.35	39.647	2,831.560	9,699.511
27-May-90	0.62	3.595	768.750	238.780
27-May-90	0.62	3.595	779.380	242.081
27-May-90	0.62	3.595	760.310	236.158
13-Aug-90	2.85	55.032	11,587.150	55,094.170
13-Aug-90	2.85	55.032	12,450.720	59,200.240
13-Aug-90	2.85	55.032	11,378.930	54,104.136

Source: Water Resources Studies on Utilization Desk (EVDSA)

Table II.6.1 Diversion Water Requirements for 105% Croppig Intensity

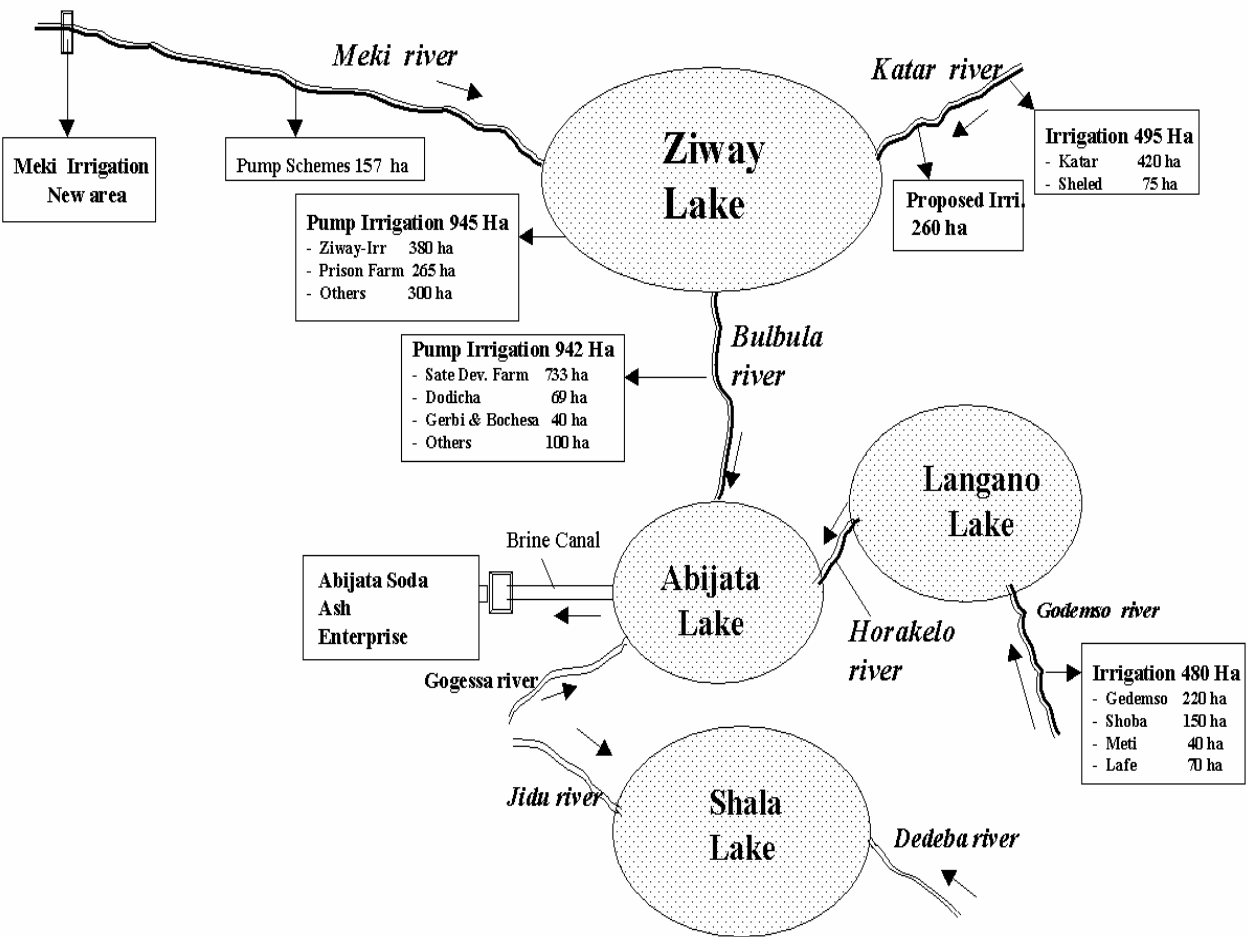
Year	Diversion Water Requirements (MCM/1000 ha)												Annual
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1979	0.12	0.13	0.14	0.19	0.12	0.53	0.92	1.91	2.18	1.05	0.08	0.05	7.43
1980	0.14	0.14	0.22	0.18	0.13	0.61	0.97	1.44	2.43	1.16	0.08	0.05	7.56
1981	0.15	0.14	0.11	0.18	0.14	0.80	0.86	0.75	1.90	1.12	0.08	0.05	6.29
1982	0.14	0.13	0.22	0.17	0.12	0.80	1.14	1.37	1.86	1.08	0.08	0.05	7.17
1983	0.14	0.11	0.19	0.13	0.07	0.60	1.06	0.97	2.06	1.23	0.08	0.05	6.69
1984	0.15	0.14	0.22	0.21	0.09	0.75	0.83	0.86	2.28	1.30	0.08	0.05	6.97
1985	0.15	0.14	0.22	0.17	0.11	0.76	0.67	1.04	1.86	1.30	0.08	0.05	6.58
1986	0.15	0.05	0.20	0.18	0.11	0.55	0.97	1.89	1.92	1.08	0.08	0.05	7.23
1987	0.15	0.13	0.15	0.17	0.06	0.78	1.13	1.24	2.34	1.29	0.08	0.05	7.58
1988	0.15	0.11	0.21	0.16	0.14	0.69	1.05	1.33	2.02	1.11	0.08	0.05	7.11
1989	0.15	0.12	0.15	0.16	0.14	0.53	1.06	1.03	1.99	1.21	0.08	0.05	6.69
1990	0.15	0.07	0.22	0.16	0.14	0.79	0.84	0.97	2.18	1.18	0.08	0.05	6.83
1991	0.15	0.11	0.12	0.21	0.14	0.79	1.34	1.24	2.70	1.25	0.08	0.05	8.19
1992	0.14	0.11	0.22	0.18	0.12	0.71	0.57	0.54	2.18	0.93	0.08	0.05	5.84
1993	0.14	0.12	0.22	0.15	0.12	0.74	0.72	1.25	2.48	1.07	0.08	0.05	7.15
1994	0.15	0.14	0.21	0.20	0.12	0.56	0.60	1.65	2.49	1.30	0.08	0.05	7.56
1995	0.15	0.14	0.20	0.17	0.13	0.75	1.22	2.11	2.83	1.30	0.08	0.05	9.14
1996	0.15	0.14	0.17	0.16	0.08	0.47	0.89	0.83	2.00	1.30	0.08	0.05	6.32
1997	0.14	0.14	0.17	0.11	0.14	0.56	0.86	1.66	2.49	1.06	0.08	0.05	7.45
1998	0.14	0.11	0.20	0.18	0.13	0.69	1.06	1.28	2.16	0.75	0.08	0.05	6.85
1999	0.15	0.14	0.18	0.21	0.15	0.62	0.70	1.45	2.35	0.60	0.08	0.05	6.68
Average	0.15	0.12	0.19	0.17	0.12	0.67	0.93	1.28	2.22	1.13	0.08	0.05	7.11

Table II.6.2 Diversion Water Requirements for 195% Croppig Intensity

Year	Diversion Water Requirements (MCM/1000 ha)												Annual
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1979	1.61	1.89	2.27	2.51	0.51	0.59	0.93	1.87	2.13	1.06	0.14	0.12	15.65
1980	1.88	1.97	3.54	2.38	0.60	0.68	0.99	1.40	2.38	1.19	0.14	0.12	17.26
1981	2.01	2.03	1.91	2.54	0.63	0.89	0.87	0.72	1.85	1.14	0.14	0.12	14.86
1982	1.90	1.87	3.48	2.30	0.58	0.89	1.15	1.33	1.82	1.09	0.13	0.12	16.66
1983	1.84	1.55	2.98	1.83	0.38	0.69	1.07	0.94	2.01	1.25	0.14	0.12	14.81
1984	2.01	1.96	3.56	2.82	0.44	0.81	0.85	0.83	2.23	1.33	0.14	0.12	17.11
1985	2.01	2.04	3.50	2.36	0.47	0.85	0.69	1.01	1.81	1.33	0.14	0.12	16.34
1986	1.98	0.70	3.24	2.40	0.52	0.59	0.98	1.85	1.87	1.10	0.14	0.12	15.49
1987	2.01	1.87	2.46	2.25	0.31	0.85	1.15	1.22	2.29	1.32	0.14	0.12	15.98
1988	2.01	1.57	3.41	2.26	0.63	0.71	1.06	1.29	1.97	1.13	0.14	0.12	16.30
1989	1.97	1.72	2.54	2.27	0.65	0.60	1.08	1.00	1.94	1.24	0.14	0.12	15.25
1990	2.00	0.89	3.43	2.12	0.65	0.87	0.86	0.94	2.13	1.21	0.14	0.12	15.34
1991	2.01	1.57	2.00	2.89	0.63	0.88	1.36	1.20	2.65	1.28	0.14	0.12	16.73
1992	1.88	1.55	3.55	2.46	0.57	0.79	0.59	0.52	2.13	0.95	0.14	0.11	15.24
1993	1.79	1.76	3.56	2.09	0.58	0.79	0.74	1.21	2.43	1.09	0.14	0.12	16.29
1994	2.01	2.04	3.32	2.77	0.51	0.63	0.62	1.61	2.44	1.33	0.14	0.12	17.54
1995	2.01	2.03	3.23	2.30	0.59	0.84	1.24	2.07	2.78	1.33	0.14	0.11	18.66
1996	1.94	1.97	2.79	2.24	0.35	0.52	0.91	0.80	1.96	1.33	0.13	0.12	15.05
1997	1.78	2.04	2.72	1.59	0.65	0.62	0.88	1.61	2.43	1.07	0.14	0.12	15.65
1998	1.92	1.56	3.22	2.48	0.60	0.78	1.08	1.25	2.11	0.78	0.14	0.12	16.02
1999	2.00	1.99	2.84	2.86	0.66	0.70	0.72	1.41	2.30	0.61	0.14	0.12	16.36
Average	1.93	1.74	3.03	2.37	0.55	0.74	0.94	1.24	2.17	1.15	0.14	0.12	16.12

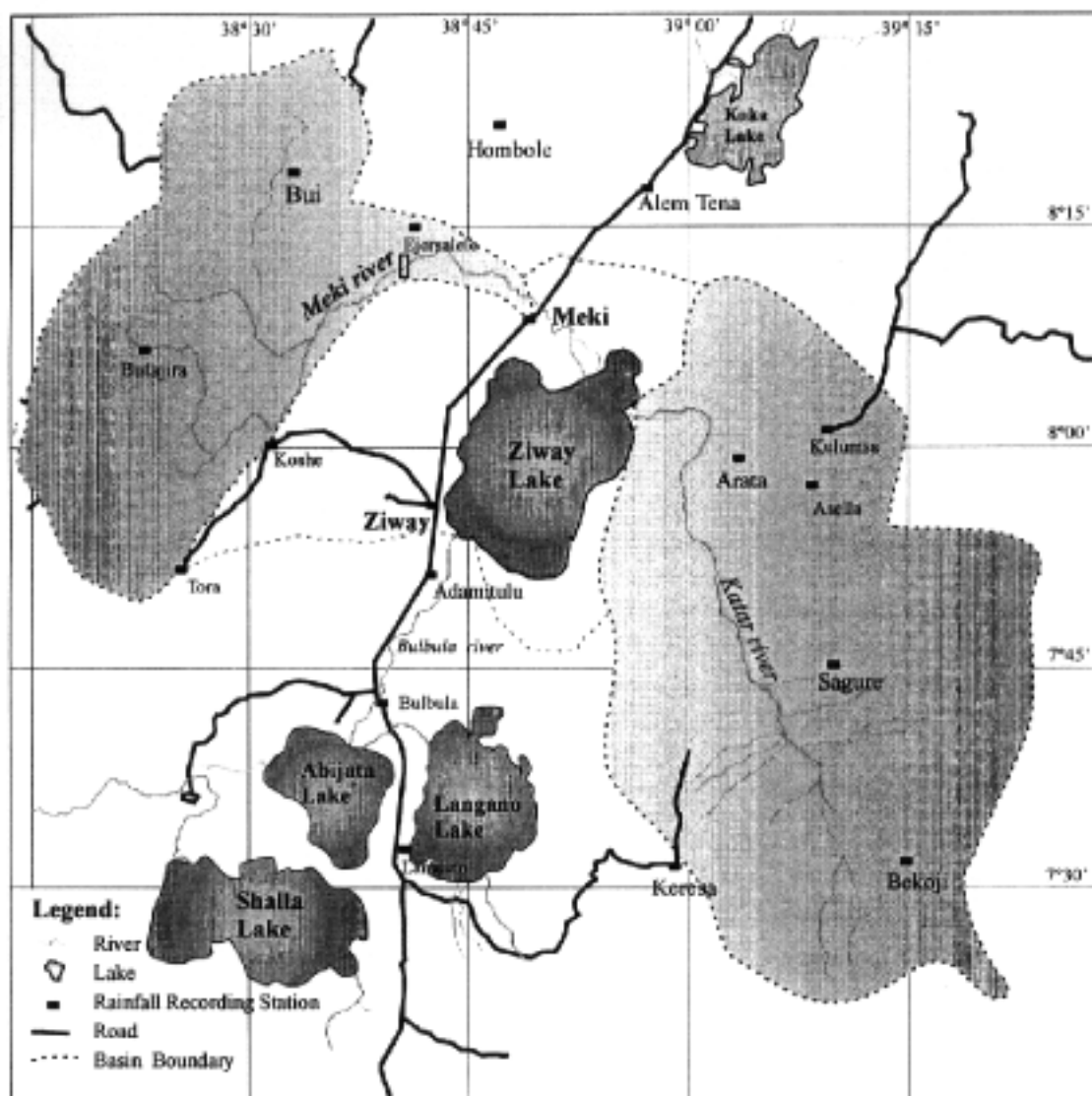
APPENDIX II
METEOROLOGY AND HYDROLOGY

Figures



The Study for
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Figure II.1.1
 Conceptual Diagram of Meki-Ziway-Abijata Water
 Resources System



List of Rainfall Recording Stations

S.N.	Station Name	Coordinates		S.N.	Station Name	Coordinates	
		Latitude	Longitude			Latitude	Longitude
1.	Alem Tena	8° 18' N	38° 56' E	10.	Hombole	8° 22' N	38° 46' E
2.	Adamitulu	7° 51' N	38° 42' E	11.	Kereba	7° 33' N	38° 58' E
3.	Arata	7° 59' N	39° 04' E	12.	Koshe	8° 01' N	38° 32' E
4.	Asella	7° 57' N	39° 08' E	13.	Kolumsa	8° 04' N	39° 08' E
5.	Bekoji	7° 32' N	39° 15' E	14.	Langano	7° 31' N	38° 48' E
6.	Bui	8° 21' N	38° 33' E	15.	Meki	8° 09' N	38° 49' E
7.	Bulbula	7° 43' N	38° 40' E	16.	Sagure	7° 45' N	39° 09' E
8.	Butajira	8° 09' N	38° 22' E	17.	Tora	7° 52' N	38° 25' E
9.	Ejersalele	8° 15' N	38° 41' E	18.	Ziway	7° 56' N	38° 43' E

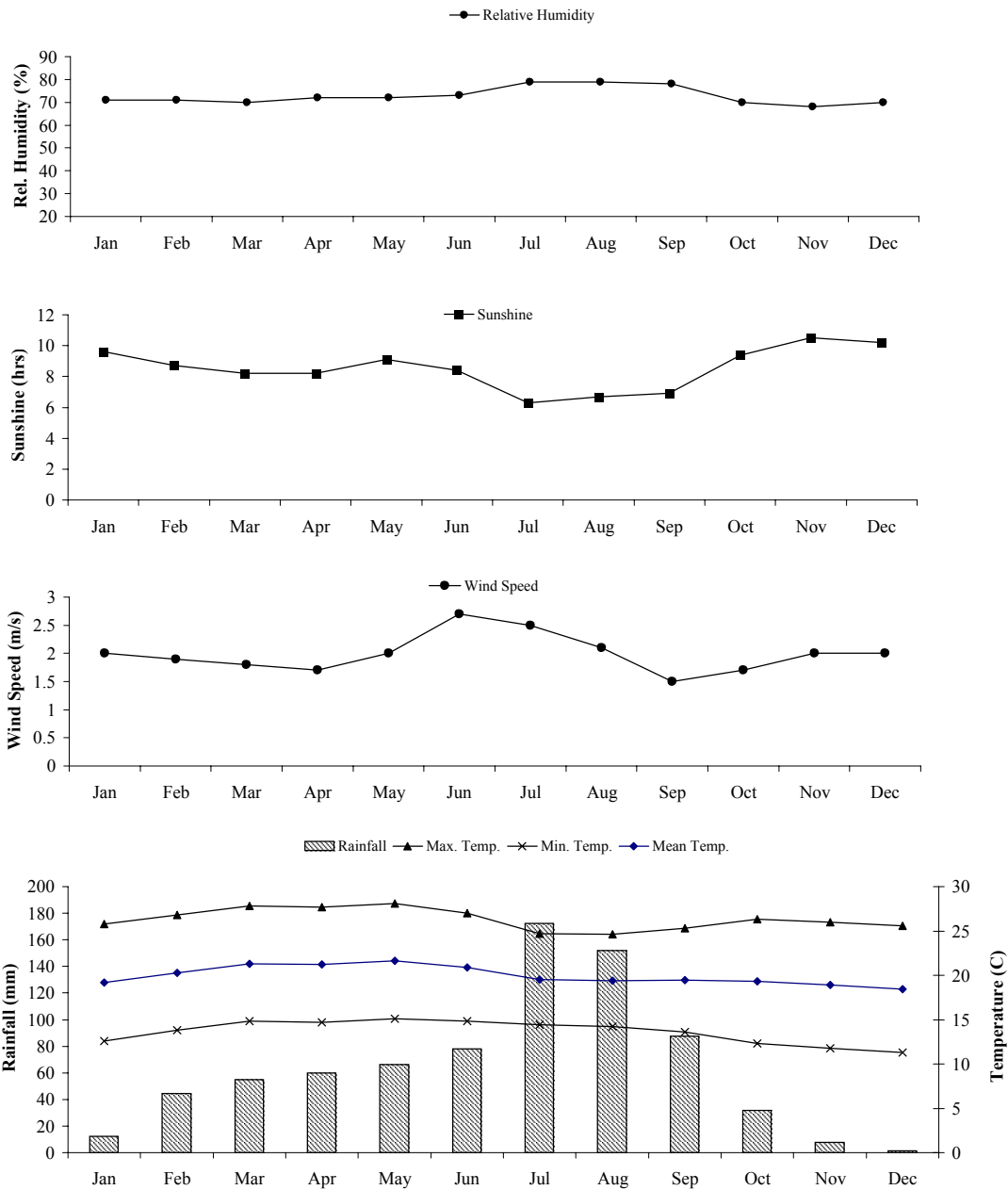
Figure II.2.1 Location Map of Meteorological Stations

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Figure II.2.1

Location Map of Meteorological Stations

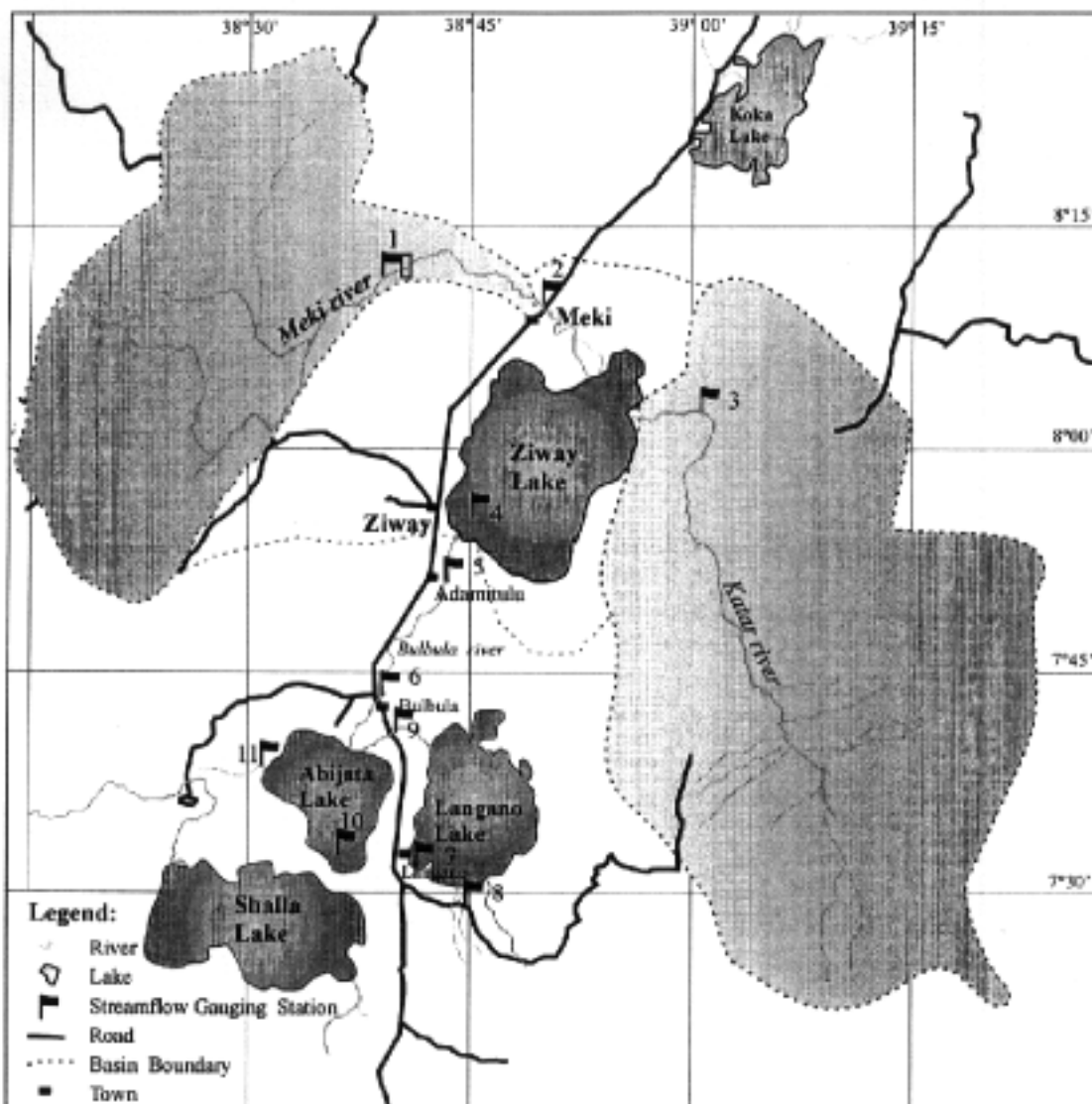


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Figure II.2.3

Monthly Climatic Parameters at Ziway



List of Hydrological Gauging Stations

S.N	River/Lake	Station	Coordinates		Drainage Area (Km ²)	Remarks
			Latitude	Longitude		
1.	Meki	Dugda	8°12'N	38°42'E	2,040	Abandon
2.	Meki	Meki Village	8°09'N	38°50'E	2,433	
3.	Katar	Abura	8°04'N	39°03'E	3,350	
4.	Lake Ziway	Bochessa	7°54'N	38°45'E	7,380	
5.	Kekersitu	Adamtitulu	7°51'N	38°43'E	7,488	
6.	Bulbula	Bulbula	7°43'N	38°38'E	8,155	Abandon
7.	Lake Langano	Near Hotel	7°32'N	38°41'E	2,006	
8.	Gedemso	Near Langano	7°28'N	38°44'E	213	Abandon
9.	Horakelo	Near Bulbula	7°41'N	38°40'E	2,050	
10.	Lake Abijata	Aroressa	7°33'N	38°36'E	10,744	
11.	Gogessa	Near Judu	7°38'N	38°32'E		

Figure II.2.4 Location Map of Hydrological Stations

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Figure II.2.4

Location Map of Hydrological Stations

S.N.	River	Station	Coordinates		Drainage Area (km ²)	Year																																												
			Latitude	Longitude		1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999										
1	Meki	Dugda	8° 12' N	38° 42' E	2040																																													
2	Meki	Meki Village	8° 09' N	38° 50' E	2433																																													
3	Katar	Abura	8° 04' N	39° 03' E	3350																																													
4	Ziway Lake	Bochessa	7° 54' N	38° 45' E	7736																																													
5	Kekersitu	Adamitulu	7° 28' N	38° 43' E	7488																																													
6	Bulbula	Bulbula	7° 28' N	38° 52' E	8155																																													
7	Horakelo	Langano Outlet	7° 41' N	38° 40' E	2050																																													
8	Godemso	Near Langano	7° 28' N	38° 44' E	213																																													
9	Langano Lake	Near Hotel	7° 32' N	38° 41' E	2006																																													
10	Gogessa	Jidu	7° 38' N	38° 32' E																																														
11	Abjata Lake	Aroressa	7° 33' N	38° 36' E	10744																																													

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Figure II.2.5
Available Stream Flow Records

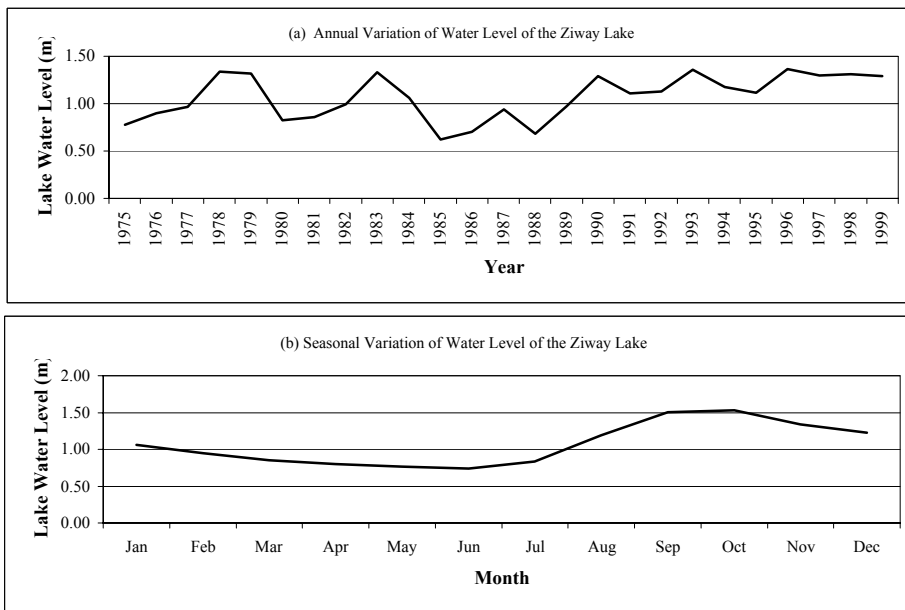


Figure II.3.1 Water Level of the Ziway Lake

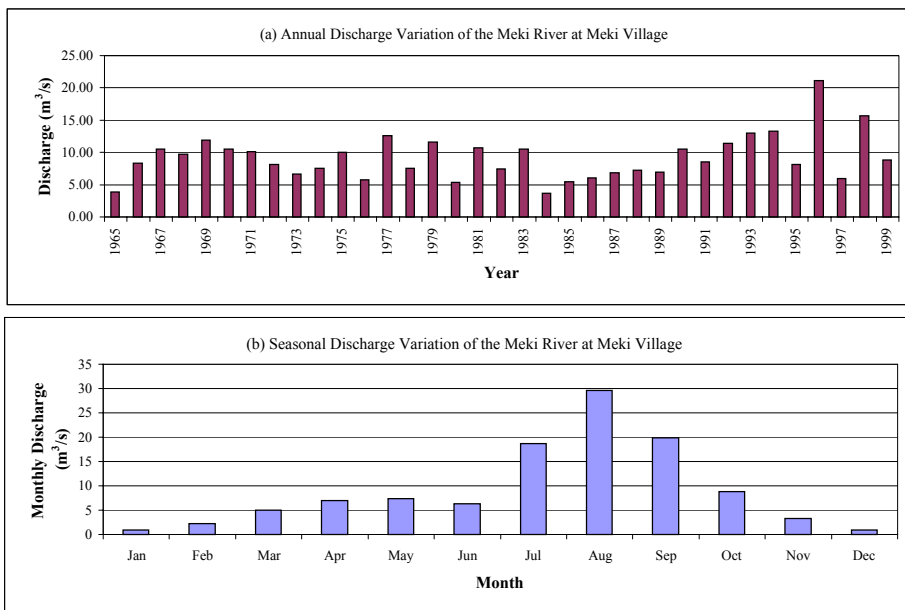


Figure II.3.2 Meki River Discharge at Meki Village

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Figure II.3.1, Figure II.3.2

Water Level of the Ziway Lake
Meki River Discharge at Meki

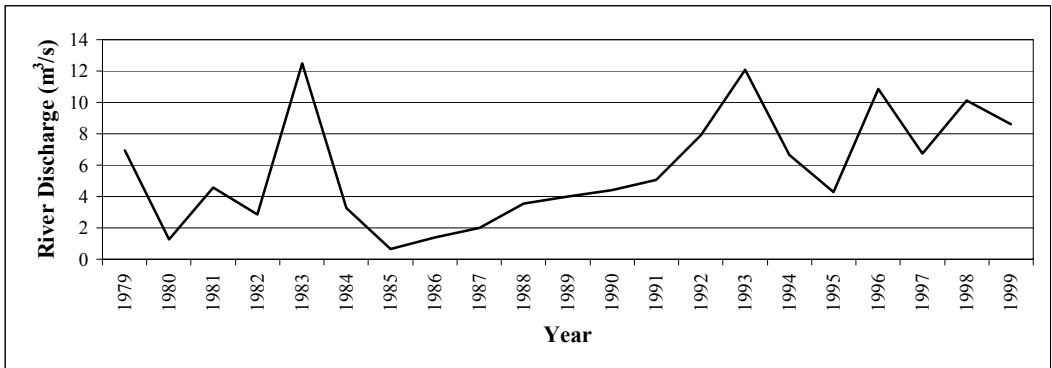


Figure II.3.3 Annual Variation of Bulbula River Discharge at Adamitulu

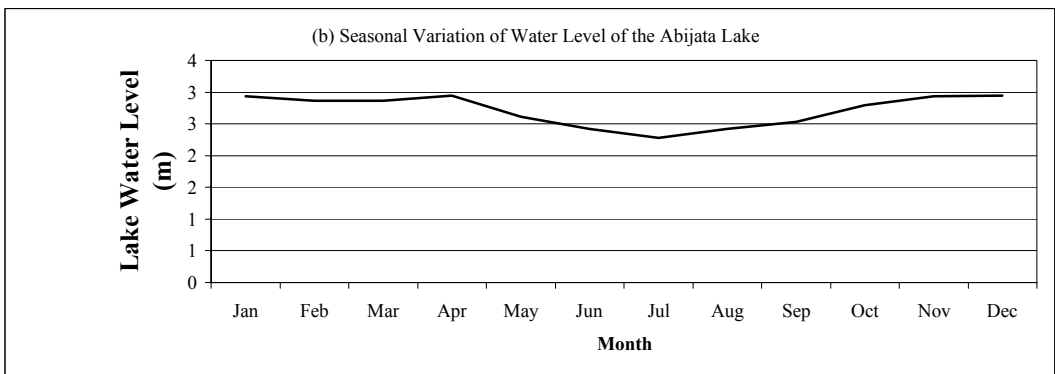
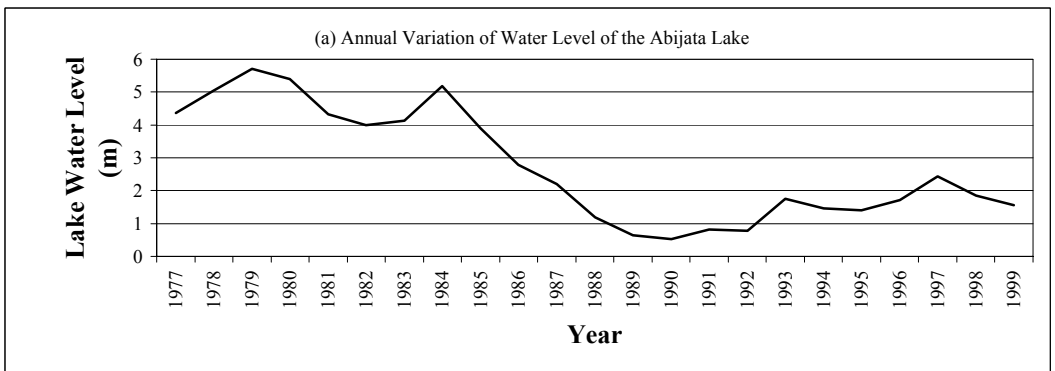


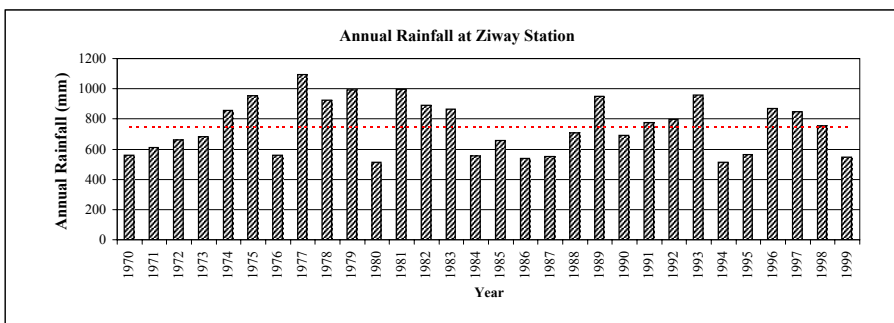
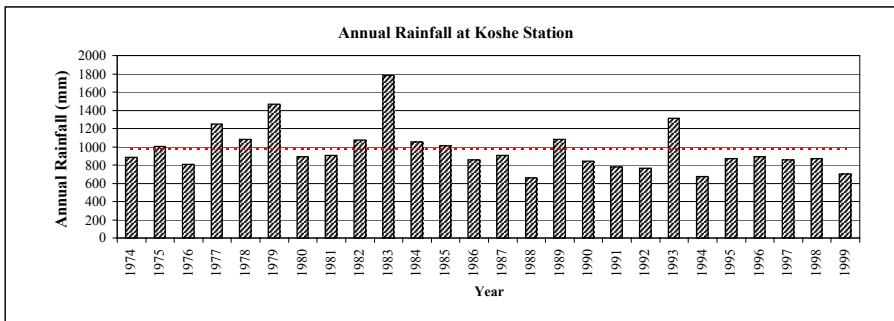
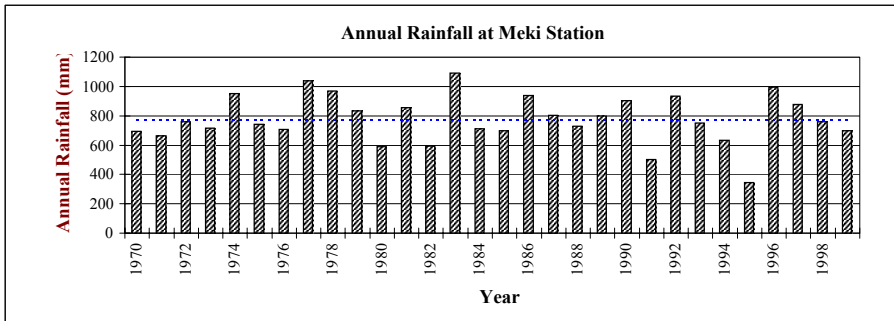
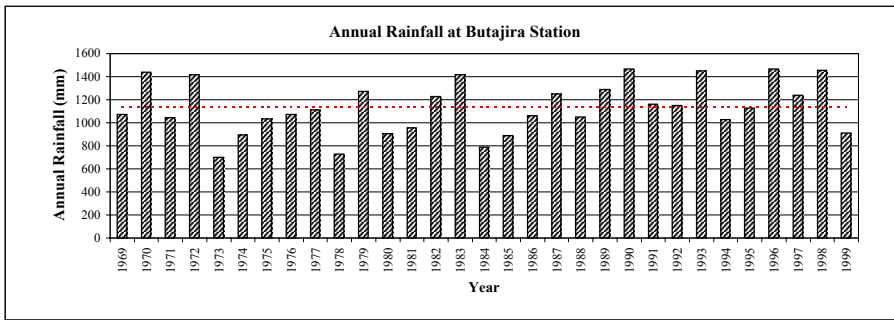
Figure II.3.4 Water Level Variation of the Abijata Lake

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Figure II.3.3, Figure II.3.4

Annual Variation of Bulbula River Discharge at Adamitulu
Water Level Variation of the Abijata Lake

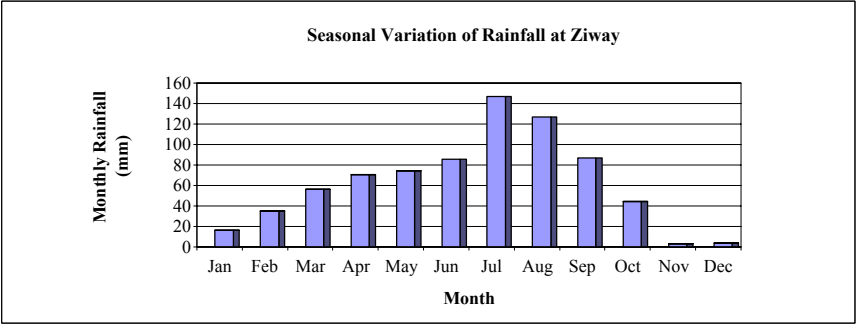
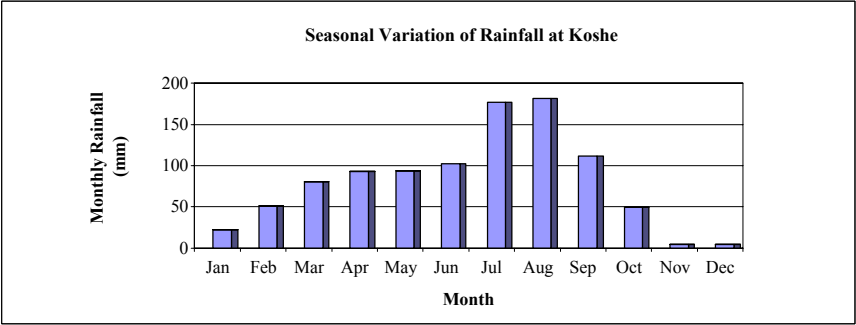
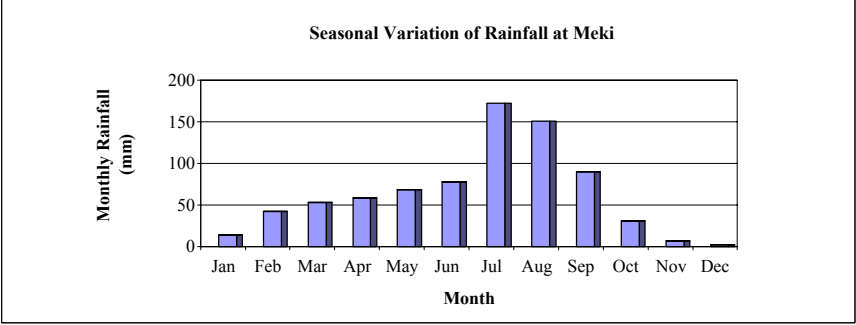
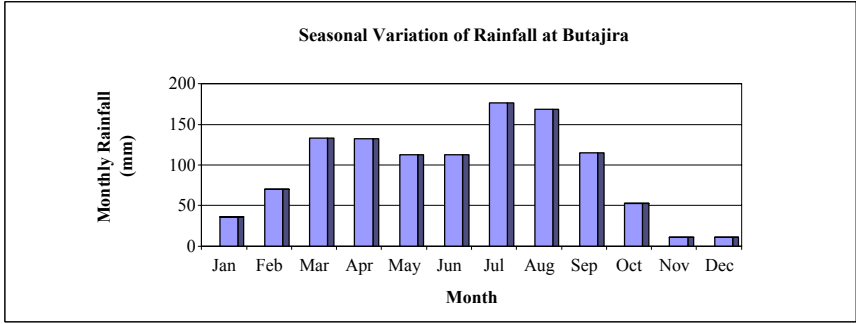


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Figure II.4.1

Variation of Annual Rainfall at Selected Stations in Meki Basin

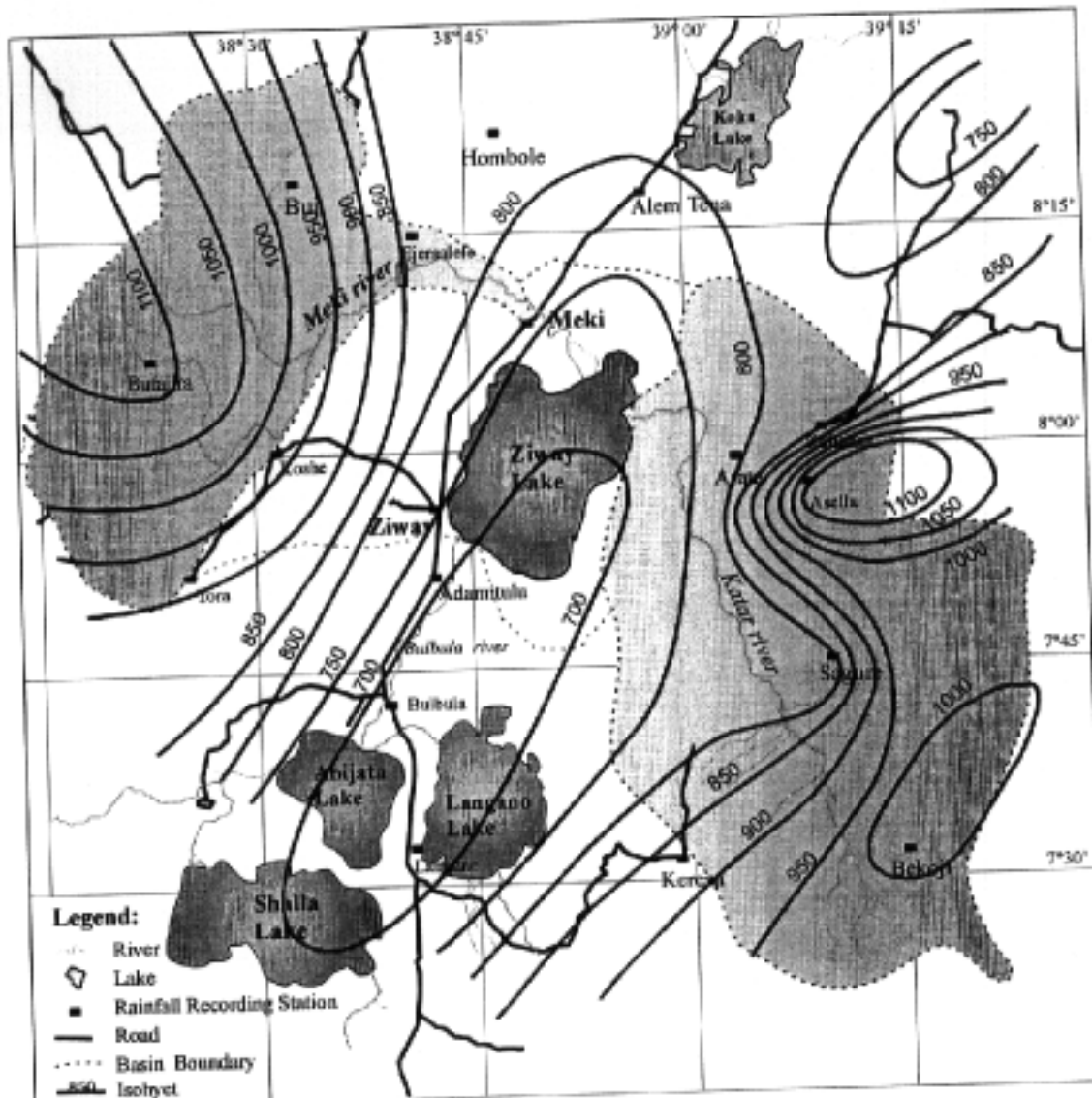


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Figure II.4.2

Seasonal Variation of Rainfall at Selected Stations in Meki Basin



List of Rainfall Recording Stations

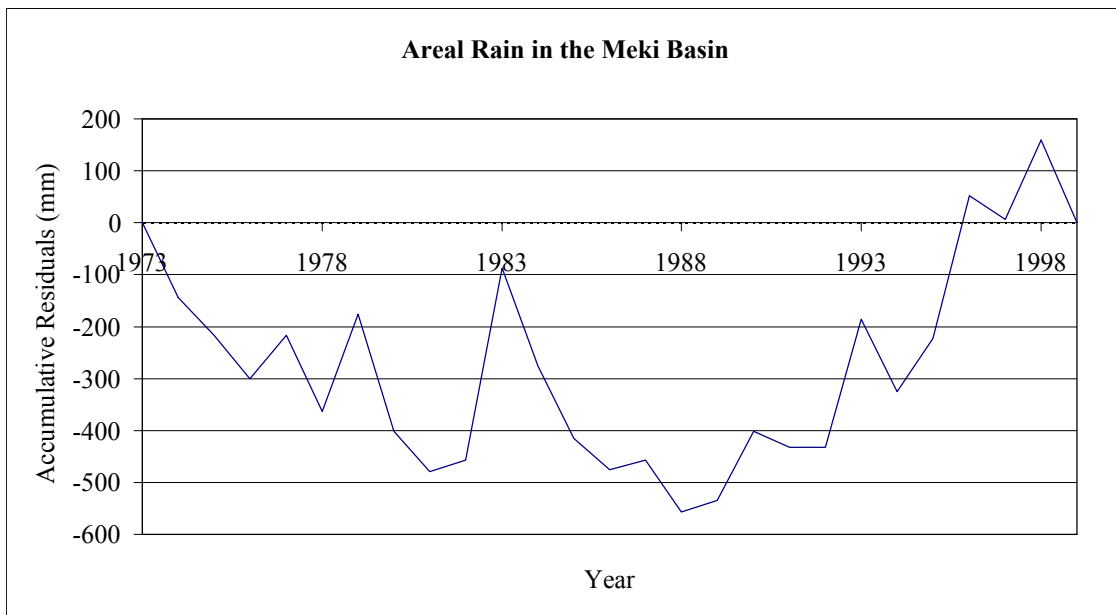
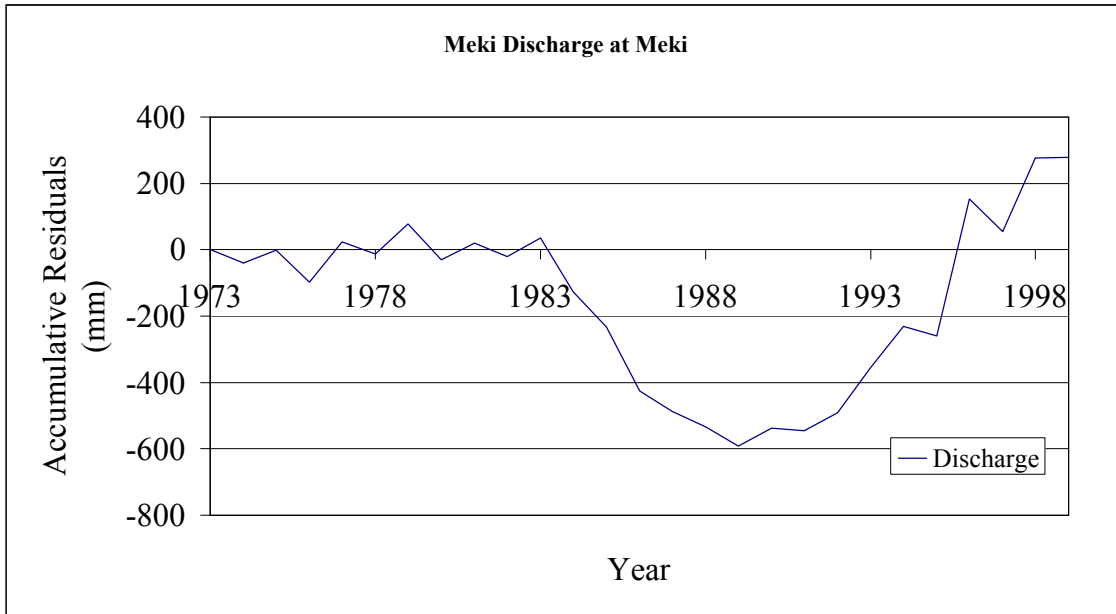
S.N.	Station Name	Coordinates		S.N.	Station Name	Coordinates	
		Latitude	Longitude			Latitude	Longitude
1.	Alem Tera	8° 18' N	38° 56' E	10.	Hombolo	8° 22' N	38° 46' E
2.	Adamitulu	7° 51' N	38° 42' E	11.	Koroja	7° 33' N	38° 58' E
3.	Arasa	7° 59' N	39° 04' E	12.	Koshe	8° 01' N	38° 32' E
4.	Asella	7° 57' N	39° 08' E	13.	Kulonsa	8° 04' N	39° 08' E
5.	Bekoji	7° 32' N	39° 15' E	14.	Langano	7° 31' N	38° 48' E
6.	Bui	8° 21' N	38° 33' E	15.	Meki	8° 09' N	38° 49' E
7.	Bulbula	7° 43' N	38° 40' E	16.	Sagure	7° 46' N	39° 09' E
8.	Butajira	8° 09' N	38° 22' E	17.	Tora	7° 52' N	38° 25' E
9.	Ejeratele	8° 15' N	38° 41' E	18.	Zeway	7° 56' N	38° 43' E

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Figure II.4.3

Annual Isohyetal Map

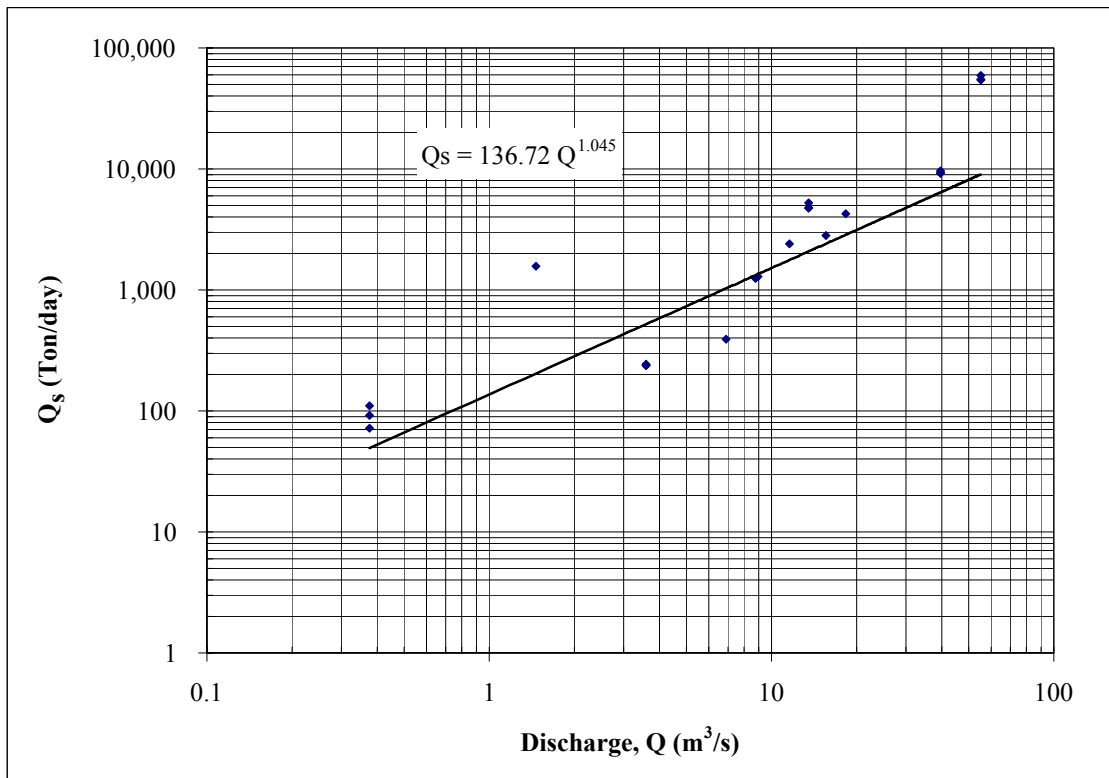


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Figure II.5.1

Residual Mass Curve of Meki River Discharge and Basin
Rainfall



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Figure II.5.2

Sediment Rating Curve of the Meki River Near Meki

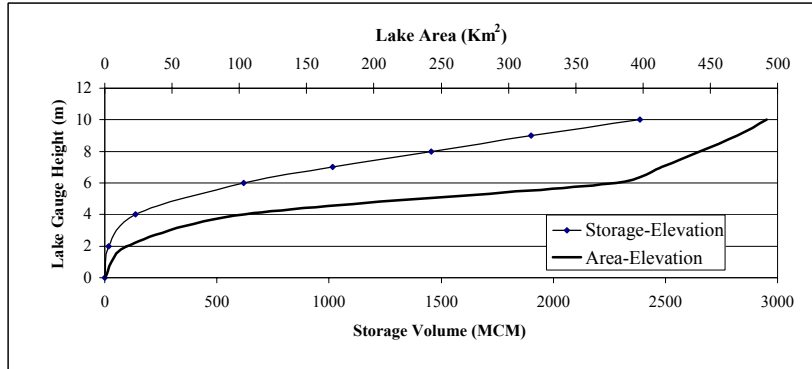


Figure II.6.1 Storage Characteristics of the Ziway Lake

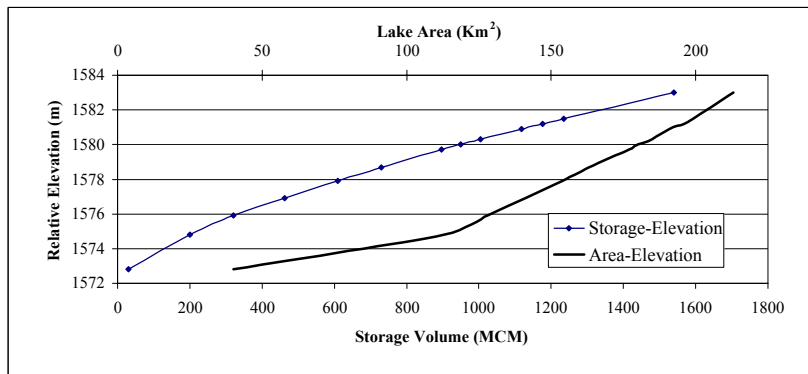


Figure II.6.2 Storage Characteristics Curve of the Abijata Lake

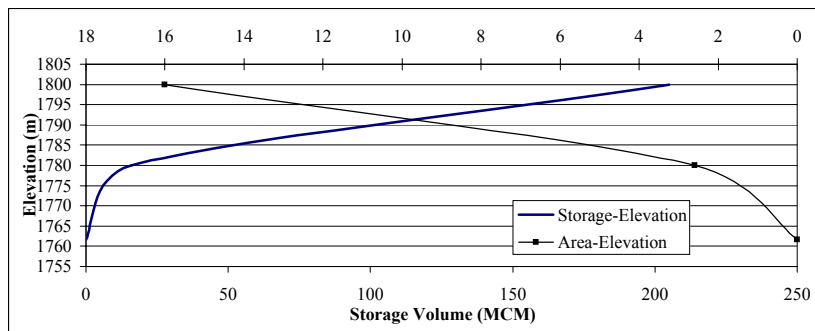


Figure II.6.3 Storage Characteristics Curve of the Proposed Dam

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Figure II.6.1, Figure II.6.2, Figure II.6.3

Storage Characteristics of the Ziway Lake
Storage Characteristics of the Abijata Lake
Storage Characteristics of the Proposed Dam

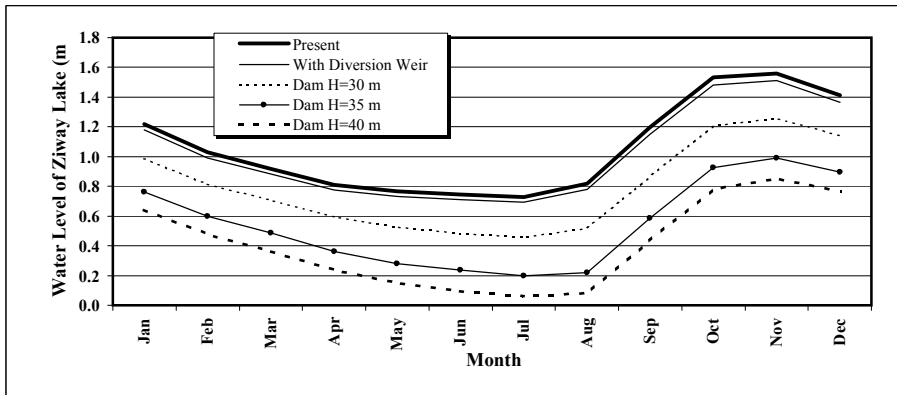


Figure II.6.4 Seasonal Reduction of Water Level of Ziway Lake Under Different Cases

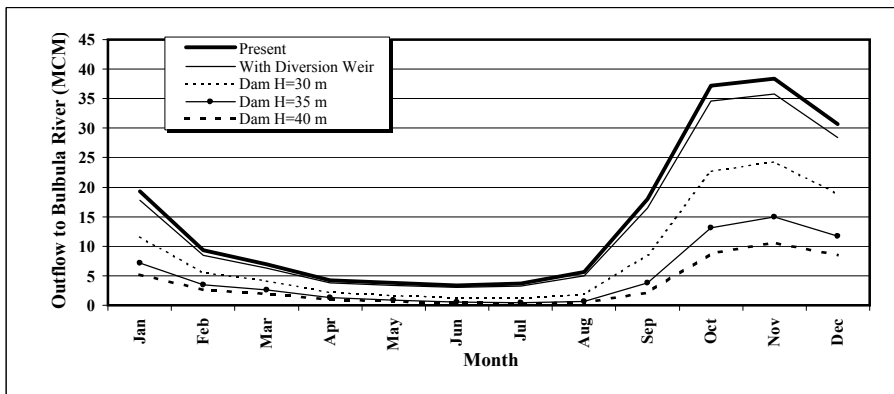


Figure II.6.5 Seasonal Reduction of Flow of Bulbula River Under Different Cases

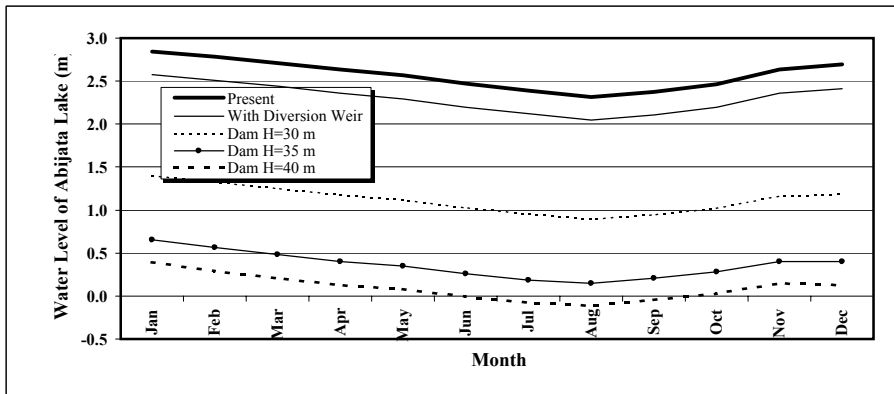


Figure II.6.6 Seasonal Reduction of Water Level of Abijata Lake Under Different Cases

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Figure II.6.4, Figure II.6.5, Figure II.6.6

Seasonal Reduction of Water Level of Ziway Lake Under Different Cases
Seasonal Reduction of Flow of Bulbula Under Different Cases
Seasonal Reduction of Water Level of Abijata Lake Under Different Cases