ETHIO-ITALIAN CO-OPERATION
ARSI-BALE RURAL DEVELOPMENT PROJECT

CLIMATE, HYDROLOGY AND WATER RESOURCES OF ARSI AND BALE ZONES

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PREFACE

This report was prepared to serve as a reference for Managers, Planners, Scientists and Engineers of the Ethio-Italian Co-operation, Arsi-Bale Rural Development Project who seek data and general information on the climate, hydrology and water resources of the Arsi and Bale zones.

The report was prepared as part of the Consultancy Service for ETH-94-R51. Out of the total period of assignment of the Hydrologist in the first term, which was one month, only three weeks was allocated for the preparation of this report. Even then, a lot of data and information have been included from previous studies in order to enrich the report.

This report is intended to serve as a starting point for other similar studies which may have to be carried out in the future. The report should be updated based on up-to-date data and information in order to maintain its usefulness in the future.

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ETH-94-R51

CLIMATE, HYDROLOGY AND WATER RESOURCES of ARSI & BALE ZONES

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1.0 INTRODUCTION

1.1 Content of Report

This report covers the Climate, Hydrology and Water Resources of Arsi and Bale Zones.

The report is divided in to five major sections described in the following.

Section 1: Introduction

This section presents the introduction to the report and provides general information about the project area such as its location, physiography and agro-climatic zonation

Section 2: Climate

The section deals with the climate of the project area. It provides pertinent climatic data at key stations in Arsi and Bale Zones and statistical analysis of the same with illustrations on important results to serve as background information for the study area

Section 3: Hydrology

This section presents the hydrological analysis and establishes hydrological design criteria for hydraulic structures. It also provides some information on major rivers flowing through the study area.

Section 4 Surface Water Resources

The section deals with the surface water resources of the study area

Section 5: Conclusion and Recommendations

This section summarizes the findings and provides the Conclusion and Recommendations of the study.

1.2 Project Area

Arsi and Bale which are among the most important zones of Oromia extend from the center to the south and east of the country(Fig. 1.2-1) The project area includes the whole Arsi Zone and the northern part of Bale Zone. The portion of the project area which lies in the northern part of Bale, according to the former administrative boundary, includes the ex-woredas of Dodola and Adaba in the Genale Awraja, all the ex-woredas in the Mendeyou Awraja (for the woreda of Goro, only half the territorial area) and the ex-woredas of Ginir and Gololcha in the Wabe Awraja of these tow latter woredas, the area includes the portion bounded on the east by a line passing through Oda (southern Ginir), Mount Sera and Legehida (northern Gololcha) Fig.(1.2-2)

These zones are traversed by the Nazareth – Assela – Dodola highway which is about 200 km long and by the Shashemene – Goba highway which is also about 200 km long. These highways connect the agriculturally productive hinterlands of the Oromia Regional State which have their major centers at Assela, Dodola and Goba to the Town of Nazareth which is located on one of the major highways of the country, namely: Addis Ababa – Assab highway and the Town of Shashemene which lies on another major highway of the country, namely: Addis Ababa – Awasa highway

1.3 Physiography

1.3.1 Altitude

The range of altitudes in the project area include the lowlands which occupy the northern and north-western fringes of Arsi Zone as well as the eastern lowlands of Bale zone which have altitudes less than 1500 masl to the mountains in the Galama and Bale Mountain ranges which have altitudes exceeding well over 4000 masl. The major portion of the project area is dominated by plateau which have altitudes exceeding 1800 masl

In order to provide some insight on the physiography of the project area, altitudes have been provided at key points along the Nazareth – Assela – Dodola highway in Table 1.3-1 and Figure 1.3-1; and, at key points along the Shashemene – Goba in Table 1.3-2 and Figure 1.3-2.

1.3.2 General Drainage Pattern

There are four main drainage patterns in the project area. The northern part of the project drains to the Awash River, the western part to the Rift Valley Lakes. The middle and larger portion of the project area which extends from west to east drains to the Wabi Shebelle River; and, the southern part drains to the Genale River. Details on this topic have been provided in Section 4 of this report.

1.3.3 Geomorphology

The northern part of the project area is dominated by step faulted plain and low plateau complex of the Ethiopian Rift, and piedmonts of extinct central volcanoes and other related forms. The middle portion of the area is dominated by dissected sideslopes and piedmonts of extinct central volcanoes and volcanic complexes of dramatic mountainous relief. The southern part of the project area is dominated by undulating high plateaux formed predominantly on pyroclastic deposits and dissected sideslopes of extinct central volcanoes and other relic volcanic forms.

1.3.4 Land Use / Cover

Most of the northern and central portion of the project area is moderately to intensively cultivated land except the piedmonts and steep mountain slopes where there is some remnant forest cover

The southern part of the project area is interspersed with moderately cultivated land and open woodlands, dense coniferous high forests, Afro-Alpine vegetation and distributed high forest

Fig. 1.2-1 Key Map

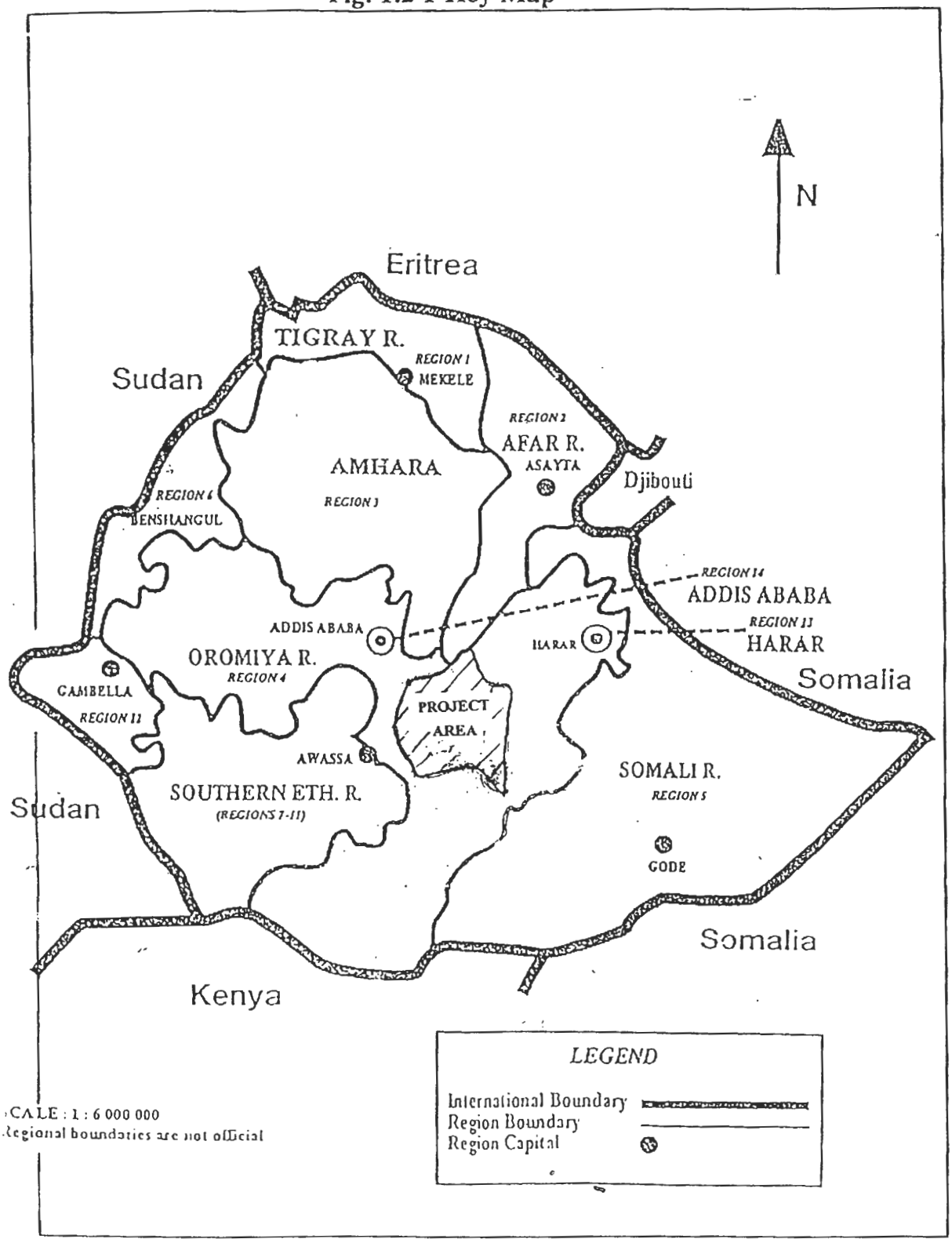


FIGURE 1.2-2 PROJECT AREA

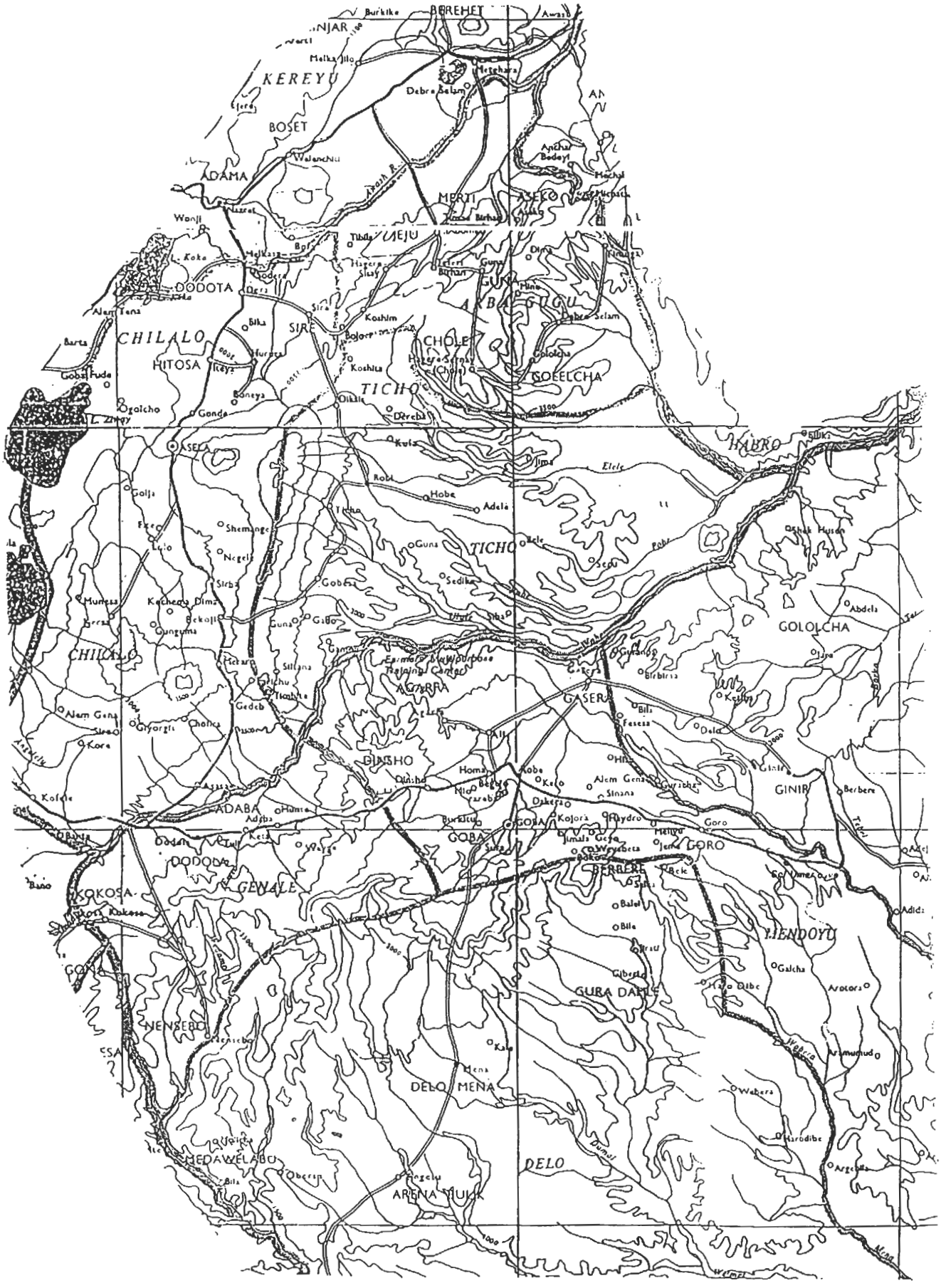


Table 1.3-1 Altitudes at Key Points along Nazareth - Assela - Dodola Road

Ser. No.	Location	Station (Km)	Elevation (masl)	Distance (metres)	Elev. Diff. (metres)	Av. Gradient (%)
1	Nazareth	0	1620	0		
2	Awash Melk.	15	1540	15	-80	-0.5
3	Dera	24	1680	9	140	1.6
4	Iteya	50	2200	26	520	2.0
5	Gonde	63	2280	13	80	0.6
6	Kulumsa	66	2200	3	-80	-2.7
7	Assela	75	2400	9	200	2.2
8	Sagure	100	2520	25	120	0.5
9	Lemu Sirba	120	2530	20	10	0.1
10	Bekoji	130	2780	10	250	2.5
11	Meraro	145	2980	15	200	1.3
12	Sirbo	153	2920	8	-60	-0.8
13	Negele	163	2580	10	-340	-3.4
14	Asasa	183	2360	20	-220	-1.1
15	Dodola	200	2480	17	120	0.7

Table 1.3-2 Altitudes at Key Points along Shashemene - Goba Road

Ser. No.	Location	Station (Km)	Elevation (masl)	Distance (metres)	Elev. Diff. (metres)	Av. Gradient (%)
1	Shashemene	0	2020	0		
2	Kofele	25	2670	25	650	2.6
3	Totolamo R.	37	2540	12	-130	-1.1
4	Wabe R.	55	2480	18	-60	-0.3
5	Ukuma R.	59	2460	4	-20	-0.5
6	Dodola	73	2480	14	20	0.1
7	Herero	88	2390	15	-90	-0.6
8	Adaba	97	2400	9	10	0.1
9	Wesha	105	2480	8	80	1.0
10	Zetegn Melka R.	108	2500	3	20	0.7
11	Sebsibe Washa	128	3600	20	1100	5.5
12	Dinsho	153	3080	25	-520	-2.1
13	Homa	168	2600	15	-480	-3.2
14	Shaya R	177	2390	9	-210	-2.3
15	Robe	183	2490	6	100	1.7
16	Goba	197	2700	14	210	1.5

Figure 1.3-1 Altitude at Key Points along Nazareth - Assela - Dodola Road

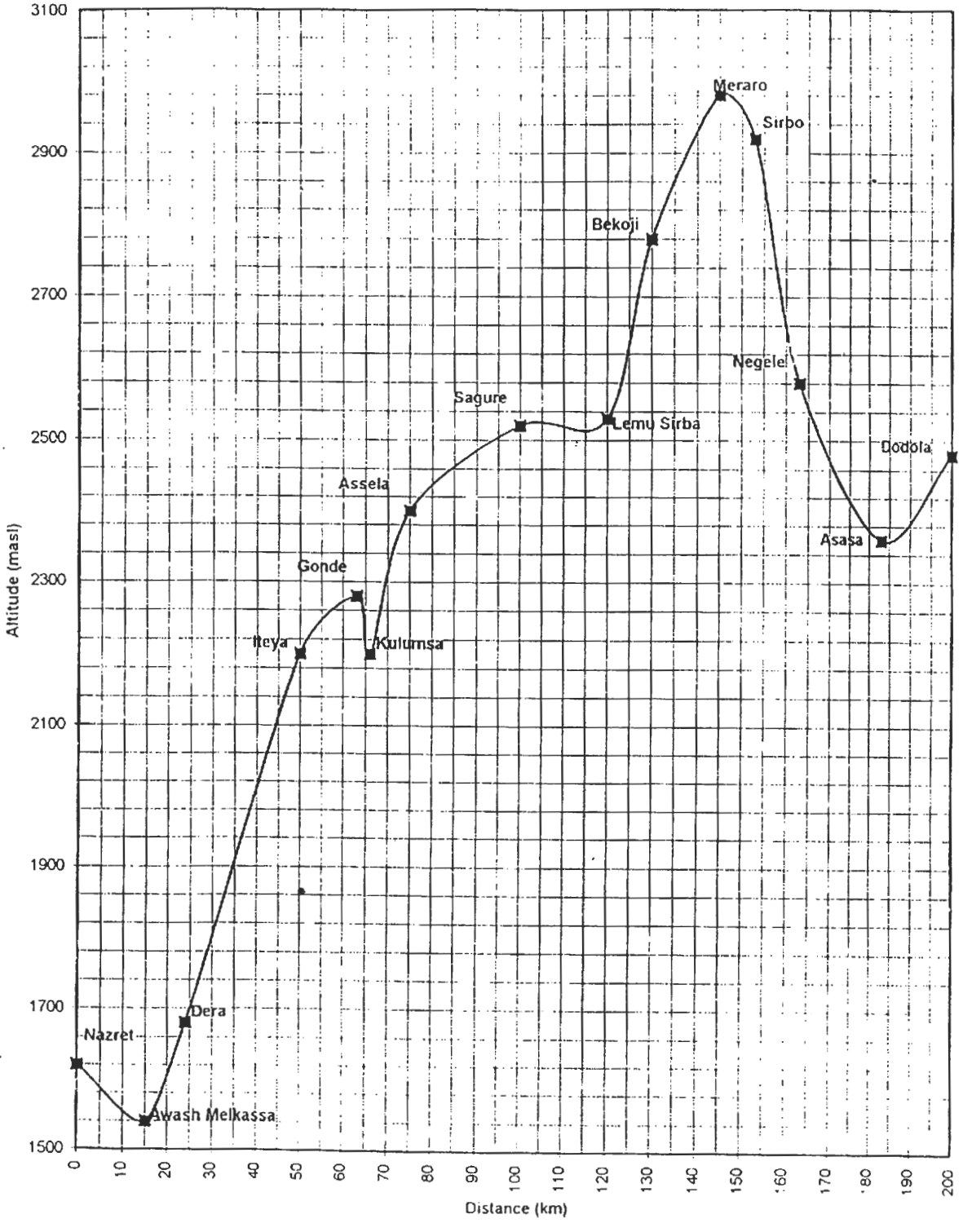
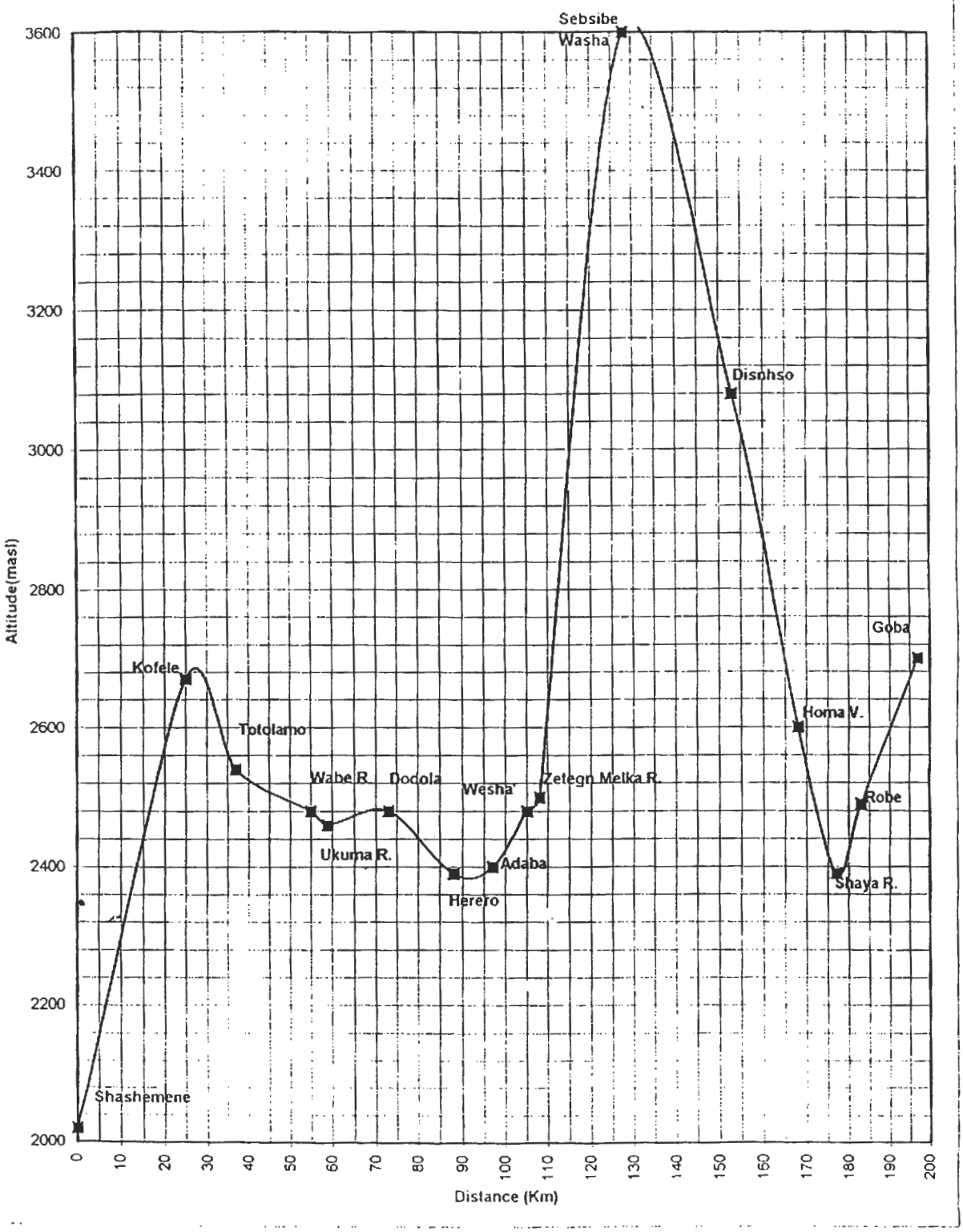


Fig. 1.3-2 Altitude of Key Points Along Shashemene - Goba Road



1.4 Agro-Climatological Zonation

The agro-climatological zonation is shown in Fig. 1 4-1 Zone-wise water related problems and potentials have been presented in Table 1.4-1. Only water related problems and potentials have been presented in the table and others have been deliberately omitted since they do not have direct relevance in this report

Fig. 1.4-1 Agro-climatological Zonation

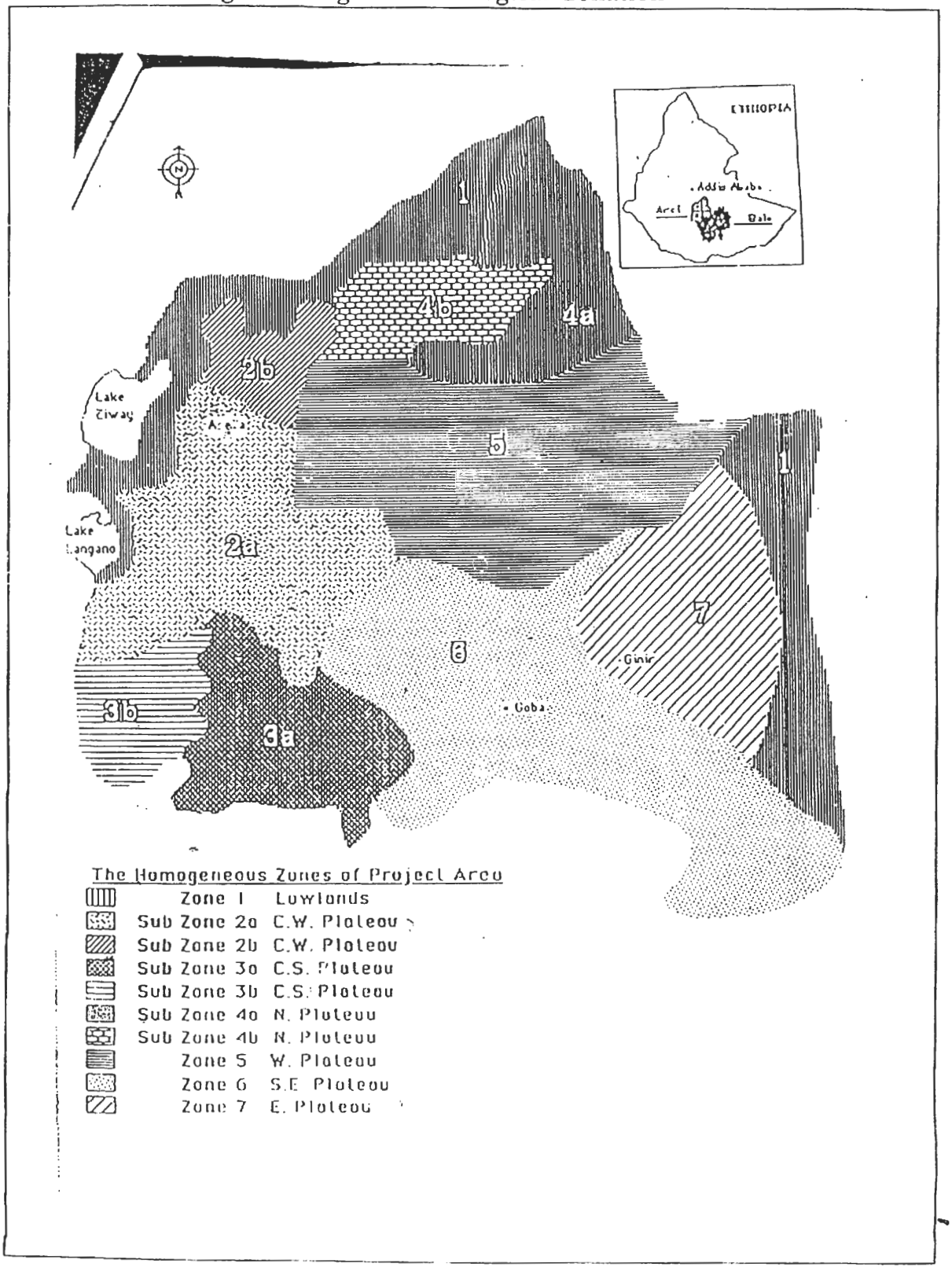


Table 1.4-1 Water Related Problems and Potentials

Zone No.	Zone Description	Average Altitude (masl)	Annual Rainfall	Problems	Potentials
1	Lowlands	Below 1800	< 700 mm July - September	- scarcity of water for human use and for livestock - frequent drought - erratic rainfall	- Availability of ground and surface waters - favourable temperature - irrigation know how
2	Central Western Plateau	>1800	< 1,100 mm March - September		- favourable climatic conditions
3	Central Southern Plateau	> 1900	< 900 May - September	- fairly frequent drought and frost	- existence of sources of water supply for irrigation
4	Northern Plateau	> 1600	< 1200 April - October	- no serious drought problems - wide spread environmental degradation (erosion, floods)	- presence of numerous sources of water supply - improvement of existing plants and development of new irrigation schemes
5	Eastern Plateau	> 1800	> 1200 March - October	- scarcity of water for human use and for livestock (in some areas)	- development of low-cost irrigation
6	South-Eastern Plateau	> 1600	< 900 April - October	- drought	- rainfall well distributed throughout the year
7	Eastern Plateau	> 1800	900 -1000 March - October	- problems of drinking water supply - drought	- rainfall distributed over over a long period of time

2.0 CLIMATE

2.1 General

The project area includes moderately varied climate. It is warmer in the lowlands and cool in the highlands. There is a strong correlation of temperature with altitude. The temperature occasionally falls below zero in the high mountain peaks with altitudes exceeding 3800 masl.

Also, as in most other parts of Ethiopia, there is a strong correlation of rainfall with altitude, in general, somewhat modified by orographic effects in some localities such as Assela and Goba. Thus, the areas lying at higher altitude receive relatively higher rainfall amounts than those situated at lower altitude.

The rainfall distribution in the northern part of the Project Area is unimodal with a peak in July or August, and, further south it gradually changes to a bimodal pattern with two peaks, one in August or September and the other in April. The rainfall regimes in the Project Area are shown in Figure 2.1-1.

2.2 Availability of Data

Pertinent meteorological data were collected for representative stations located in the project area from the following sources:

1. Previous studies: i) Original ABRDP project document ii) monthly climatic data for over 100 stations in Ethiopia prepared by AGAR-UND HYDROTECHNIK GMBH

2. National Meteorological Services Authority (NMSA), where secondary data were not available.

The availability of meteorological data has been presented in Table 2.2-1. It should be noted that due to limitations in budget and the shortage of time for data processing, the data collection was very limited.

Readily available secondary data has been used as much as possible. Where secondary data were not available, primary data were obtained from the National Meteorological Services Authority as follows:

- Rainfall: monthly data of the most recent ten years

- Temperature: monthly data of the most recent five years.

Fig. 2.1-1 Rainfall Regime

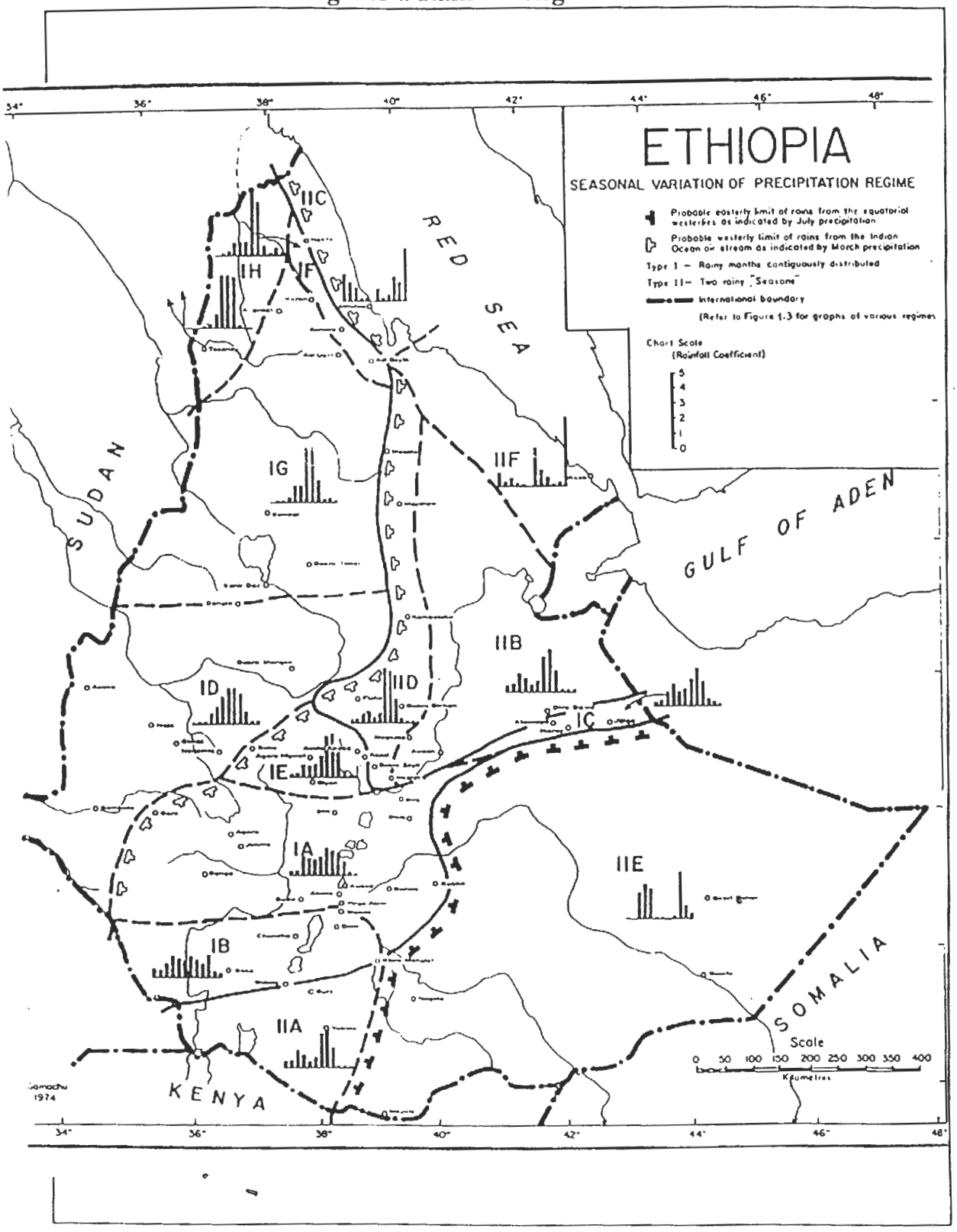


Table 2.2-1 Availability of Meteorological Data

Ser No.	Element	Station	Period of Observation	Record Length (Years)	Remarks
1.	Monthly Mean Maximum and Mean Minimum Air Temperature	Assela	1966 – 96	31	missing
		Dodola	1954 - 96	21	gaps & missing
		Goba	1962 - 84	23	missing
		Diksis			most recent 5 ye
		Ginir			most recent 5 ye
		Goro			most recent 5 ye
		Asasa			most recent 5 yea
		Kofele			most recent 5 yea
		Bekoji			most recent 5 yea
		Meraro			most recent 5 yea
2.	Monthly Rainfall	Assela	1966 – 96	31	missing
		Dodola	1954 – 96	27	gaps & missing
		Goba	1969 – 96	27	gaps & missing
		Diksis			most recent 10 ye
		Eteya			most recent 10 ye.
		Goro			most recent 10 ye.
		Adaba			most recent 10 ye
		Asasa			most recent 10 ye
		Kofele			most recent 10 ye
		Bekoji			most recent 10 ye
		Meraro			most recent 10 ye
3	Rainfall Intensity	Asasa	1971 – 93	24	missing

Rainfall intensity records were obtained from a representative station located in the project area, namely: Asasa. It is only this station which has the longest rainfall intensity records.

It may be noted from Table 2.2-1 that there are some gaps in the records in some cases Missing data were filled in using appropriate methods.

2.3 Air Temperature

Average monthly mean maximum and mean minimum air temperature computed using the available observed data for selected stations in the project area are given in Table 2.3-1 and shown in Figure 2.3-1. The observed data have been provided in Appendix 1.1.2.

In general, the maximum air temperature is highest in the months March – May and the minimum air temperature is lowest in the months November – January

A Correlation of mean temperature with altitude has been attempted using data from selected stations in the project area. The stations along with their altitudes and mean temperatures have been given in Table 2.3-2. The correlation is shown in Fig. 2.3-2. It may be noted from Fig. 2.3-2 that a strong correlation exists between mean temperature and altitude as indicated by the high value for the Coefficient of Determination ($R^2 = 0.872$). Thus, the equation given in Fig. 2.3-2 could be used in estimating the mean temperature of a locality in the project area given its altitude.

Table 2.3-1 Average Monthly Mean Maximum and Mean Minimum Air Temperature

Station: Asela
Lat.: 7°57' N Long.: 39°08' E Alt.: 2450 masl

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Tmax(0C)	21.59	21.95	22.62	22.3	22.28	21.13	19.25	19.01	19.22	20.8	20.84	20.93	21
Tmin(0C)	6.063	7.419	8.705	9.627	10.16	9.786	9.359	9.818	9.302	8.555	6.483	5.585	8
Tmean(0C)	13.3	14.2	15.1	15.7	15.7	14.7	13.8	13.7	13.7	14.2	13.2	12.7	14

Station: Bekoji
Lat.: 7°19' N Long.: 39°09' E Alt.: 2850 masl

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Tmax(0C)	20.78	21.36	21.64	20.6	20.98	19.54	17.36	17.3	18.24	19.06	20.1	20.28	20
Tmin(0C)	8.48	9.24	9.66	10.3	9.92	9.04	8.94	8.74	8.6	8.2	7.86	8.24	9
Tmean(0C)	14.63	15.3	15.65	15.45	15.45	14.29	13.15	13.02	13.42	13.63	13.98	14.26	14

Station: Degaga
Lat.: 7°26' N Long.: 39°50' E Alt.: 2040 masl

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Tmax(0C)	24	25	25	25	24	22	21	21	21	23	23	23	23
Tmin(0C)	6	7	8	10	10	10	10	10	11	9	7	5	9
Tmean(0C)	15	16	16.5	17.5	17	16	15.5	15.5	16	16	15	14	16

Station: D'era
Lat.: 8°20' N Long.: 39°19' E Alt.: 1680 masl

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Tmax(0C)	26	27	28	29	30	30	27	27	27	28	27	27	28
Tmin(0C)	12	13	15	16	15	15	15	15	14	13	13	12	14
Tmean(0C)	19	20	21.5	22.5	22.5	22.5	21	21	20.5	20.5	20	19.5	21

Station: Diksis
Lat.: 8°05' N Long.: 39°21' E Alt.: 2600 masl

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Tmax(0C)	20.22	20.84	21.32	20.64	20.38	20.4	18.48	18.33	18.44	18.54	19.04	19.88	20
Tmin(0C)	5.58	6.54	7.1	8.14	8.3	8.86	8.38	8.775	8.5	7.35	5.825	5.45	7
Tmean(0C)	12.9	13.69	14.21	14.39	14.34	14.63	13.43	13.55	13.47	12.95	12.43	12.66	14

Table 2.3-1 Average Monthly Mean Maximum and Mean Minimum Air Temperature
(cont'd)

Station: Kofele
Lat.: 7°02' N Long.: 38°28' E Alt.: 2680masl

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Tmax(°C)	20.9	21.6	22.2	20.4	20.1	19.0	18.0	18.4	18.8	19.1	20.1	20.7	20.0
Tmin(°C)	6.7	7.6	7.2	8.6	8.2	8.6	8.6	9.3	8.7	7.6	6.1	6.2	7.8
Tmean(°C)	13.8	14.6	14.7	14.5	14.2	13.8	13.3	13.8	13.8	13.4	13.1	13.4	13.9

Station: Kulumsa
Lat.: 7°58' N Long.: 39°08' E Alt.: 2600 masl

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Tmax(°C)	23	24	25	25	24	23	21	21	21	23	22	23	23
Tmin(°C)	8	9	11	12	12	11	11	11	11	11	9	8	10
Tmean(°C)	15.5	16.5	18	18.5	18	17	16	16	16	17	15.5	15.5	17

Station: Ogolcho
Lat.: 8°02' N Long.: 39°01' E Alt.: 1800 masl

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Tmax(°C)	26	27	27	29	29	27	25	24	24	26	26	26	26
Tmin(°C)	10	12	13	13	13	13	14	14	13	12	10	9	12
Tmean(°C)	18	19.5	20	21	21	20	19.5	19	18.5	19	18	17.5	19

Station: Ticho
Lat.: 7°29' N Long.: 39°19' E Alt.: 2800 masl

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Tmax(°C)	21	22	21	20	21	21	20	19	19	19	19	19	20
Tmin(°C)	6	7	8	9	9	8	8	8	8	8	6	5	8
Tmean(°C)	13.5	14.5	14.5	14.5	15	14.5	14	13.5	13.5	13.5	12.5	12	14

Table 2.3-1 Average Monthly Mean Maximum and Mean Minimum Air Temperature (cont'd)

Station: Adaba
Lat.: 7°01' N Long.: 39°14' E **Alt.: 2485mas**

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Tmax(°C)	24	25	25	24	25	25	21	21	22	22	22	24	23
Tmin(°C)	5	5	7	8	7	8	9	8	7	6	4	4	7
Tmean(°C)	14.5	15	16	16	16	16.5	15	14.5	14.5	14	13	14	15

Station: Asasa
Lat.: 7°09' N Long.:39°11' E **Alt.: 2400masl**

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Tmax(°C)	25.0	25.0	25.8	25.2	25.6	25.3	21.6	21.3	22.6	23.0	24.2	24.1	24.2
Tmin(°C)	1.5	3.1	6.3	8.0	8.1	9.3	9.7	9.4	7.3	3.8	1.6	0.3	5.4
Tmean(°C)	13.2	15.1	16.0	16.6	16.8	17.3	15.6	15.3	14.9	13.4	12.9	12.2	14.8

Station: Meraro
Lat.: 7°25' N Long.: 39°15' E **Alt.: 2980masl**

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Tmax(°C)	18.6	18.6	19.4	18.5	18.3	18.4	15.8	15.9	16.3	16.2	17.0	17.7	17.7
Tmin(°C)	4.6	5.0	5.8	7.3	7.2	6.0	6.7	6.5	5.8	5.1	4.0	3.7	5.6
Tmean(°C)	11.6	11.8	12.6	12.9	12.7	12.2	11.3	11.2	11.1	10.7	10.5	10.7	11.7

Station: Dodola
Lat.: 6°58' N Long.: 39°11' E **Alt.: 2540masl**

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Tmax(°C)	22.9	22.5	23.8	23.4	24.1	23.2	20.8	20.9	20.7	21.5	23.3	22.6	22.5
Tmin(°C)	3.5	4.1	5.0	6.6	5.7	5.5	6.5	6.5	5.9	4.2	2.5	2.5	4.9
Tmean(°C)	13.2	13.3	14.4	15.0	14.9	14.4	13.6	13.7	13.3	12.9	12.9	12.6	13.7

Station: Ginir
Lat.: 7°08' N Long.: 40°43' E **Alt.: 1950masl**

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Tmax(°C)	24.7	25.8	24.3	23.9	23.3	22.9	22.7	23.2	24.1	22.3	22.0	23.4	23.5
Tmin(°C)	12.8	13.1	14.8	14.4	14.4	13.4	12.8	12.8	13.0	13.1	11.9	12.0	13.2
Tmean(°C)	18.7	19.5	19.6	19.2	18.9	18.1	17.7	18.0	18.5	17.7	16.9	17.7	18.3

Table 2.3-1 Average Monthly Mean Maximum and Mean Minimum Air Temperature (cont'd)

Station: Goba
Lat.: 7°01' N Long.:39°58' E Alt.: 2700masl

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Tmax(°C)	20.2	20.8	20.9	19.8	20.1	20.7	19.9	19.5	19.1	17.6	18.2	19.4	19.7
Tmin(°C)	4.2	5.1	6.5	8.0	8.0	7.4	7.4	7.2	7.5	7.2	5.3	3.9	6.5
Tmean(°C)	12.2	12.9	13.7	13.9	14.0	14.1	13.7	13.4	13.3	12.4	11.7	11.7	13.1

Station: Goro
Lat.: 7°00' N Long.: 40°29' E Alt.: 1780masl

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Tmax(°C)	26.5	28.2	28.2	28.6	29.0	27.4	26.7	27.5	27.0	28.1	26.8	26.9	27.1
Tmin(°C)	6.2	7.4	8.2	8.9	9.9	9.7	9.6	8.5	9.2	7.2	6.4	6.1	8.3
Tmean(°C)	17.4	17.8	18.2	18.8	19.5	18.5	18.1	18.0	18.1	17.6	16.6	16.5	17.7

Fig. 2.3-1 Mean Maximum and Minimum Air Temperature

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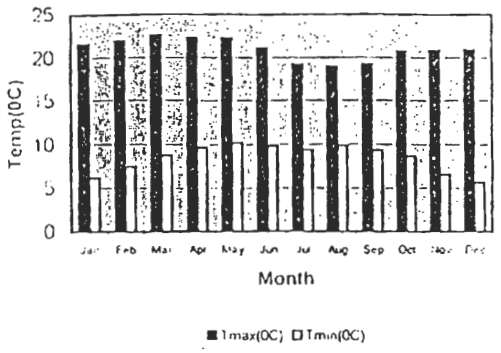
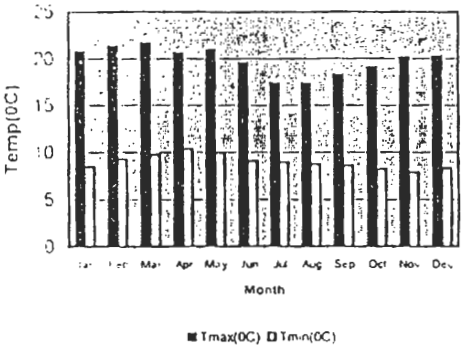


BEKOJI



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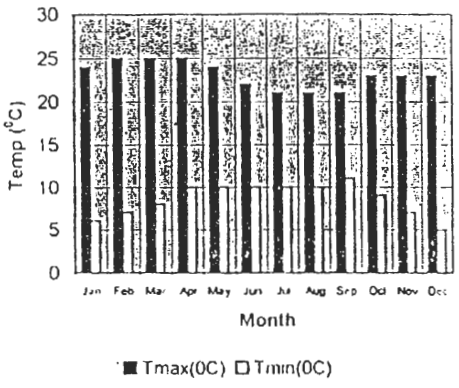

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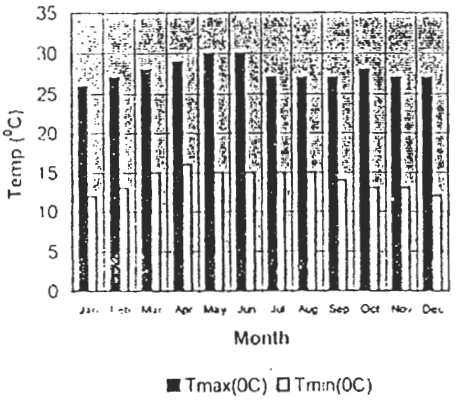

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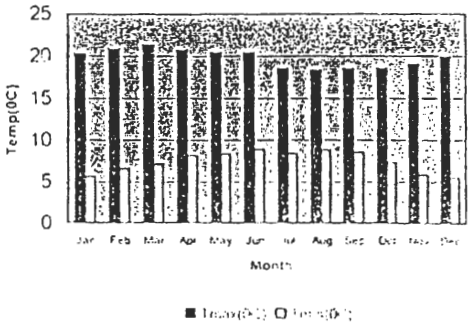

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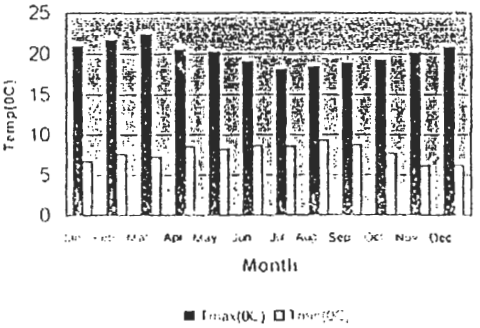
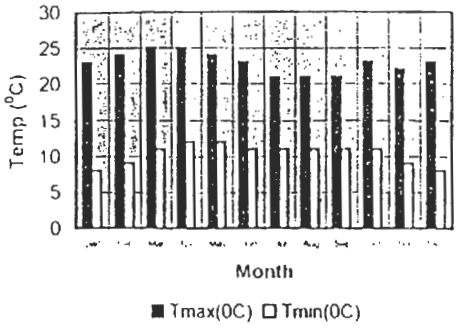


Fig. 2.3-1 Mean Maximum and Minimum Air Temperature (cont'd)

KULUMSA



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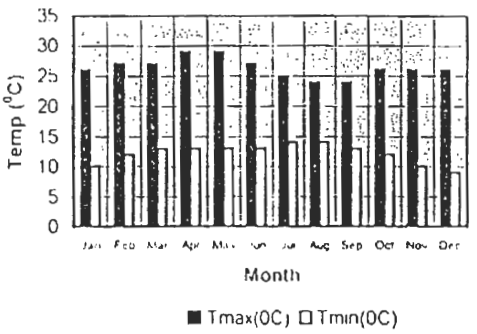

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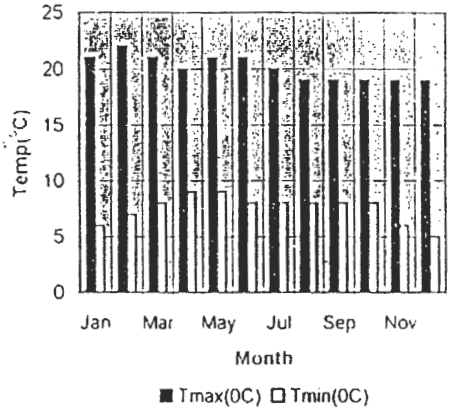

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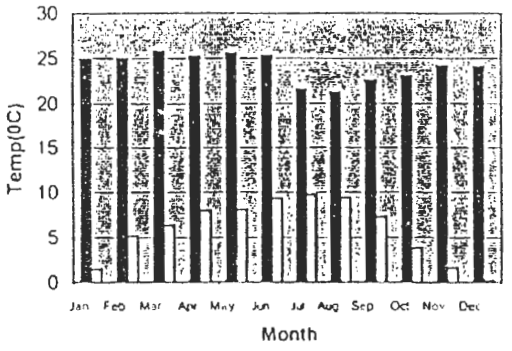

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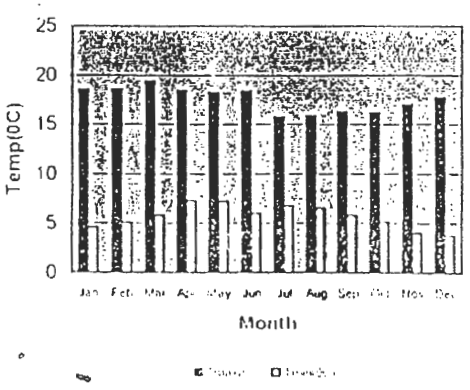

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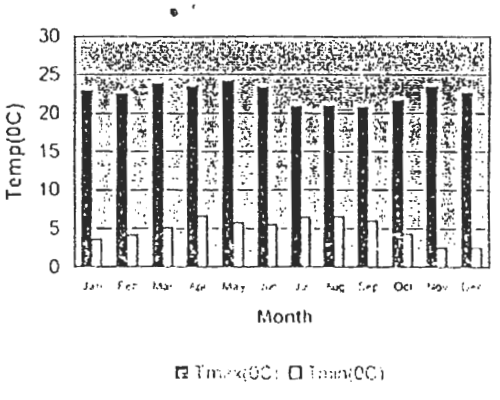
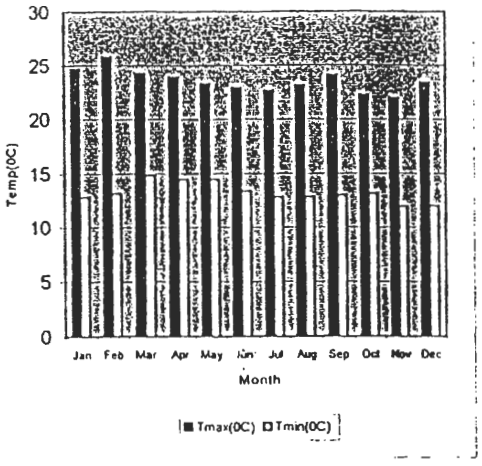


Fig. 2.3-1 Mean Maximum and Minimum Air Temperature (cont'd)

GINIR



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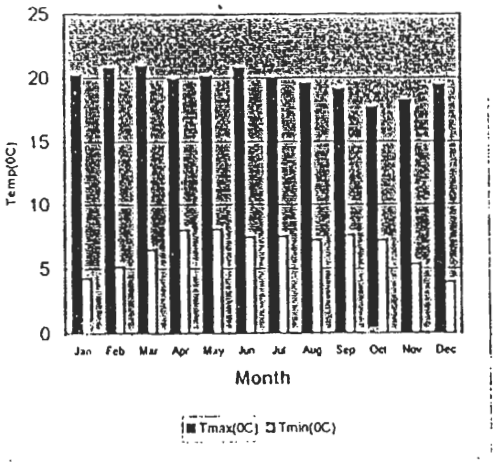


GORO

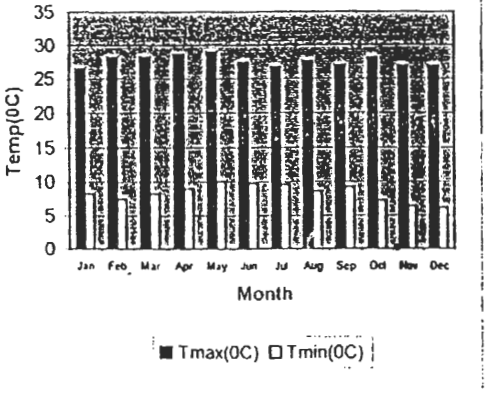
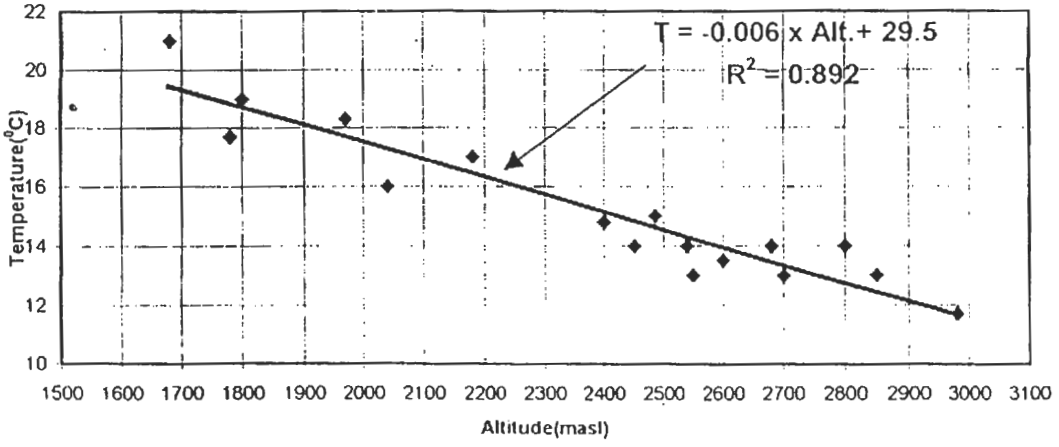


Table 2.3-2 Mean Air Temperature and Altitude of Selected Stations

Ser.No	Name of Station	Altitude(masl)	Temp(^{0}C)
1	Adaba	2485	15
2	Asasa	2400	15
3	Asela	2450	14
4	Bekoji	2850	13
5	Degaga	2040	16
6	D'era	1680	21
7	Diksis	2600	14
8	Dodola	2540	14
9	Ginir	1970	18
10	Goba	2700	13
11	Goro	1780	18
12	Kofele	2680	14
13	Kulumsa	2180	17
14	Meraro	2980	12
15	Munesa	2550	13
16	Ogolcho	1800	19
17	Ticho	2800	14

Fig. 2.3-2 Correlation of Mean Air Temperatue on Altitude



2.4 Rainfall

2.4.1 Rainfall Classification

To compare the monthly distribution of rainfall at various stations which differ in rainfall amount, the method described Daniel Gamachu (1977) has been employed. This involves the calculation of "Rainfall Coefficient" for each month for selected stations in the project area, the coefficient being the ratio between the mean monthly rainfall and one-twelfth of the annual mean (the latter referred to as "Rainfall Module"). To distinguish between a "rainy" month and a "dry" month, a month is designated "rainy" when the monthly Rainfall Coefficient reaches 0.6 (60% of the Rainfall Module), and distinctly rainy when it exceeds 0.8. Extremely rainy months have a coefficient of more than 1 (that is, the rainfall exceeds the module value.

A month is designated "rainy" if the Rainfall Coefficient is 0.6 or more. The term "small rains" is employed to refer to those months with a rainfall coefficient of 0.6 to 0.9; and the term "big rains" to those months where the coefficient is 1.0 and above. The "big" rainy months are further classified into three groups: those with "moderate concentration" of rainfall (coefficient of 1.0 to 1.9); those with "high concentration" of rainfall (coefficient. of 2.0 to 2.9); and those with "very high concentration" of rainfall (coefficient of 3.0 and above). This classification scheme is presented in Table 2.4-1.

Table 2.4-1 Classification Scheme of Monthly Rainfall

Ser No.	Designation	Rainfall Coefficient
I	Dry Month	Less than 0.6
II	Rainy Month	0.6 and over
	1. Small Rains	
	2. Big Rains	
	2.1 Moderate Concentration	
	2.2 High Concentration	
	2.3 Very High Concentration	

Mean monthly rainfall and values of Rainfall Coefficient for selected stations in the project area have been given in Tables 2.4-2 & 2.4-3

Table 2.4-2 Mean Monthly Rainfall for Selected Stations
(in Millimeters)

Ser.No.	Name of Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MARF	RM
1	Adaba	10	40	58	108	56	71	184	204	75	29	6	18	858	71
2	Asasa	17	40	47	74	50	72	161	162	63	24	7	12	729	61
3	Asela	30	55	102	107	116	147	238	245	171	61	20	6	1298	108
4	Bekoji	27	65	95	126	88	106	170	223	94	56	14	20	1084	90
5	Degaga	10	32	48	71	121	104	204	191	177	67	21	11	1057	88
6	D'era	18	26	44	45	77	55	138	149	75	64	28	14	733	61
7	Diksis	14	28	48	75	87	130	163	240	138	57	10	14	1002	83
8	Dodola	33	33	51	86	41	75	193	179	118	62	23	21	915	76
9	Eteya	11	34	55	81	82	69	194	199	116	22	0	3	866	72
10	Ginir	0	26	89	228	157	23	25	36	95	109	44	20	852	71
11	Goba	22	41	63	131	113	63	96	118	122	107	66	16	958	80
12	Goro	13	34	85	231	156	41	29	54	81	143	46	23	935	78
13	Kofele	57	57	127	183	147	107	163	169	163	74	46	48	1340	112
14	Kulumsa	17	57	84	109	84	90	126	136	103	27	8	17	858	72
15	Meraro	22	50	58	71	60	72	136	165	82	28	10	17	771	64
16	Munesa	41	82	108	146	131	130	191	187	189	84	30	14	1333	111
17	Ogolcho	12	47	44	85	41	72	132	118	89	32	11	6	689	57
18	Ticho	46	87	135	155	101	95	157	165	144	103	54	23	1265	105

Note

MARF: Mean Annual Rainfall

RM: Rainfall Module

Table 2.4-3 Values of the Rainfall Coefficient for Selected Stations

Ser No.	Name of Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MARF	RM
1	Adaba	0 1	0.6	0.8	1.5	0.8	1 0	2.6	2.8	1 1	0.4	0.1	0.3	858	71
2	Asasa	0.3	0.7	0.8	1.2	0.8	1.2	2.7	2.7	1.0	0.4	0.1	0.2	729	61
3	Asela	0.3	0.5	0.9	1 0	1.1	1 4	2.2	2.3	1.6	0.6	0.2	0 1	1298	108
4	Bekoji	0.3	0.7	1.1	1.4	1 0	1.2	1.9	2.5	1.0	0.6	0.2	0.2	1084	90
5	Degaga	0.1	0.4	0.5	0.8	1.4	1 2	2.3	2.2	2.0	0.8	0.2	0.1	1057	88
6	D'era	0.3	0.4	0 7	0.7	1.3	0.9	2.3	2.4	1.2	1 0	0.5	0.2	733	61
7	Diksis	0.2	0.3	0.6	0.9	1.0	1 6	2.0	2.9	1.7	0.7	0 1	0.2	1002	83
8	Dodola	0.4	0.4	0.7	1.1	0.5	1.0	2.5	2.3	1 5	0.8	0.3	0.3	915	76
9	Eteya	0.2	0.5	0.8	1.1	1.1	1.0	2.7	2.8	1.6	0.3	0.0	0.0	866	72
10	Ginir	0.0	0.4	1.3	3.2	2.2	0.3	0.4	0.5	1.3	1.5	0.6	0.3	852	71
11	Goba	0.3	0.5	0.8	1.6	1.4	0.8	1.2	1.5	1.5	1.3	0.8	0.2	958	80
12	Gorc	0.2	0.4	1.1	3.0	2.0	0.5	0.4	0.7	1.0	1.8	0.6	0.3	935	78
13	Kofele	0.5	0.5	1.1	1.6	1.3	1.0	1.5	1.5	1.5	0.7	0.4	0.4	1340	112
14	Kulumsa	0.2	0.8	1.2	1.5	1.2	1.3	1.8	1.9	1.4	0.4	0 1	0.2	858	72
15	Meraro	0.3	0.8	0.9	1.1	0.9	1.1	2.1	2.6	1.3	0.4	0.2	0.3	771	64
16	Munesa	0.4	0.7	1.0	1 3	1.2	1.2	1.7	1 7	1 7	0.8	0.3	0 1	1333	111
17	Ogolcho	0.2	0.8	0.8	1.5	0.7	1.3	2.3	2.1	1.6	0.6	0.2	0 1	689	57
18	Ticho	0.4	0.8	1.3	1.5	1.0	0.9	1.5	1.6	1 4	1.0	0.5	0.2	1265	105

Note

MARF: Mean Annual Rainfall

RM: Rainfall Module

2.4.2 Monthly Rainfall

Monthly rainfall statistics for selected stations in the project area have been provided in Table 2.4-4 and the annual distribution shown in Fig. 2.4-1. Among the statistics given in Table 2.4-4 is the Coefficient of Variation(Cv) which serves as a measure for the variability of rainfall. Thus, a high value of Cv for a month indicates a high variability of rainfall and a low value of Cv indicates a low variability. Thus, it should be possible to classify the rainfall as less or highly variable or erratic based on the value of Cv. In general, a month which has Cv of over 0.5 may be classified as highly variable and that with a Cv value of less than 0.5 as less variable as far as monthly rainfall is concerned. The higher the variability of rainfall in a month the less dependable is the amount of rainfall given as the mean or otherwise. That is, the chances of getting that amount in a particular month are less; in other words, the amount of rainfall varies too much. Therefore, it should be noted that the value of Cv could be used as a very good guide in determining the dependability of rainfall at any given station in any given month.

Regarding the distribution of rainfall shown in Fig. 2.4-1, in general, two distinct distributions may be noted from the figure. The unimodal distribution in the northern and the central portion of the project area and the bi-modal distribution in the southern and the southeastern portion of the project area. Areas which have a unimodal rainfall distribution have only a single main rainy season and areas which have a bi-modal rainfall distribution have two main rainy seasons.

Table 2.4-4 Monthly Rainfall Statistics for Selected Stations

ASSELA

Station: Assela School(Assela Town)
Lat. 07°57' Long. 39°08' Alt. 2400 masl

Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	20.2	48.4	95.4	116.4	111.7	143.3	205.7	215.8	178.4	56.5	18.7	14.0	1224.5
Max.	112.0	152.6	275.0	278.5	327.2	293.5	367.0	391.8	302.3	212.0	100.5	88.5	1724.6
Min.	0.0	0.0	1.0	23.0	19.8	38.7	111.9	132.7	39.1	1.5	0.0	0.0	803.8
80% Dep.	0.0	0.0	15.5	57.8	29.4	39.0	184.5	157.1	82.5	0.0	0.0	1.8	853.8
St.Dev.	24.0	43.3	59.9	70.4	68.6	58.0	56.7	67.8	62.7	46.3	25.8	20.2	232.9
Cv	1.19	0.895	0.628	0.605	0.615	0.404	0.276	0.314	0.352	0.82	1.383	1.445	0.19

BEKOJI

Station: Bekoji
Lat. 7°19'N Long. 39°19'E Alt. 2850 masl

Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	27.2	65.1	94.9	126.3	87.8	106.1	170.2	223.4	93.6	55.6	13.9	19.5	1083.6
Max.	112.9	224.9	206.9	201.3	175.8	168.0	241.5	262.6	157.2	126.7	51.8	80.0	1197.1
Min.	0.0	0.0	2.7	30.9	38.0	50.1	67.4	155.0	36.2	6.3	0.9	3.2	963.7
80% Dep.	2.2	31.7	39.0	108.0	51.7	81.6	157.4	208.7	65.8	15.8	2.7	4.7	1023.9
St.Dev.	37.1	64.1	59.6	49.7	46.9	34.4	44.5	33.5	35.5	45.6	17.5	23.7	78.4
Cv	1.368	0.984	0.628	0.393	0.534	0.325	0.262	0.15	0.38	0.82	1.257	1.211	0.072

DEGAGA

Station: Degaga
Lat. 7°26'N Long. 39°50'E Alt. 2040 masl

Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	9.5	31.8	48.0	70.7	121.2	104.4	204.0	191.5	176.7	67.2	21.2	11.3	1057.4
Max.	28.0	113.0	141.0	114.0	150.0	159.0	273.0	319.0	251.0	178.0	90.0	28.0	1193.0
Min.	0.0	0.0	0.0	19.0	81.0	73.0	129.0	93.0	130.0	21.0	0.0	0.0	899.0
80% Dep.	0.0	12.0	12.0	48.0	112.0	95.0	174.0	140.0	138.0	29.0	0.0	0.0	968.0
St.Dev.	10.7	40.8	55.2	36.2	24.3	28.8	53.5	78.4	44.8	58.5	35.2	12.7	107.2
Cv	1.125	1.283	1.151	0.513	0.201	0.276	0.262	0.409	0.253	0.871	1.665	1.12	0.10

D'ERA

Station: D'era
Lat. 8°20'N Long. 39°19'E Alt. 1680 masl

Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	18.5	26.4	44.3	44.6	77.2	55.4	137.6	149.6	75.3	63.8	27.6	16.4	736.7
Max.	49.0	162.0	143.0	113.0	190.0	149.0	183.0	243.0	147.0	162.0	108.0	49.0	1097.4
Min.	0.0	0.0	0.0	0.0	5.0	5.0	80.0	76.0	8.0	0.0	0.0	0.0	539.5
80% Dep.	0.0	0.0	8.8	18.8	28.4	8.4	103.0	125.2	43.0	23.2	0.0	0.0	570.8
St.Dev.	18.8	51.9	51.1	37.2	58.1	46.3	38.1	44.8	44.3	54.8	43.5	17.5	203.5
Cv	1.019	1.967	1.153	0.835	0.752	0.835	0.277	0.299	0.588	0.86	1.576	1.068	0.276

Table 2.4-4 Monthly Rainfall Statistics for Selected Stations (cont'd)

DIKSIS

Station: Diksis
Lat. 8°05'N Long. 39°21'E Alt.2600 masl

Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	13.5	27.7	47.9	75.0	86.7	129.5	162.9	240.0	138.0	57.4	9.5	13.6	1001.8
Max.	77.4	127.9	137.9	110.6	155.9	219.7	265.1	392.8	196.7	127.5	46.3	36.0	1258.5
Min.	0.0	0.0	0.0	31.0	26.6	73.7	45.6	180.7	63.2	22.7	0.0	0.0	813.8
80% Dep.	0.0	0.0	11.8	52.8	53.4	96.1	137.1	211.8	134.0	40.3	0.0	5.8	900.6
St.Dev.	22.9	36.5	45.5	24.6	38.3	46.0	59.9	56.5	30.6	27.7	13.8	11.2	131.4
Cv	1.693	1.314	0.949	0.328	0.442	0.355	0.368	0.236	0.222	0.483	1.452	0.827	0.1311

ETEYA

Station: Eteya
Lat. 8°10'E Long. 39°14'E Alt. 2060 masl

Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	10.3	34.1	54.7	81.3	82.0	69.0	193.9	198.7	116.1	21.9	0.0	3.3	866.0
Max.	57.3	146.7	137.6	124.6	204.7	119.6	237.8	304.2	185.1	114.0	0.0	8.3	990.6
Min.	0.0	0.0	0.0	51.4	28.0	18.3	119.8	86.1	2.4	0.0	0.0	0.0	603.2
80% Dep.	0.0	0.0	15.5	57.8	29.4	39.0	184.5	157.1	82.5	0.0	0.0	1.8	853.8
St.Dev.	17.3	43.2	41.4	24.0	66.2	35.5	31.4	69.5	51.4	34.4	0.0	2.5	107.4
Cv	1.583	1.268	0.757	0.295	0.807	0.515	0.162	0.35	0.443	1.57	-	0.759	0.1241

KULUMSA

Station: Kulumsa
Lat.7°58'N Long. 39°05'E Alt. 2180 masl

Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	16.6	57.4	83.8	108.8	83.8	90.3	126.4	135.6	102.8	27.3	8.1	17.2	858.0
Max.	64.2	160.6	185.3	177.9	182.5	148.3	180.9	180.0	136.4	81.5	36.1	45.8	984.1
Min.	0.0	4.3	4.5	11.1	25.0	49.0	83.1	98.5	74.4	1.1	0.0	0.0	714.0
80% Dep.	0.0	19.9	22.6	64.3	30.2	59.9	111.7	114.8	87.3	2.0	0.0	0.8	798.0
St.Dev.	22.1	46.8	64.5	54.6	59.6	36.5	27.1	27.2	20.1	29.0	14.1	16.7	80.2
Cv	1.329	0.815	0.769	0.502	0.711	0.404	0.215	0.2	0.196	1.064	1.737	0.973	0.0934

MERARO

Station: Meraro
Lat. 7°25'N Long. 39°15'E Alt. 2980 masl

Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	22.2	50.2	58.1	70.5	59.7	71.6	136.3	165.4	81.9	28.3	9.8	17.4	771.4
Max.	52.3	301.7	138.5	130.4	107.4	117.9	183.5	252.3	133.1	65.2	45.8	100.7	881.3
Min.	0.0	0.0	4.0	16.2	33.4	16.6	112.4	101.9	47.0	1.9	0.0	0.0	655.8
80% Dep.	4.8	3.0	23.7	44.9	41.9	47.1	118.3	134.4	61.3	5.5	0.0	1.1	684.6
St.Dev.	21.2	91.1	43.6	35.7	23.0	30.2	25.4	43.7	29.1	23.4	14.6	30.1	84.5
Cv	0.953	1.815	0.751	0.506	0.385	0.422	0.187	0.264	0.355	0.828	1.488	1.737	0.1096

Table 2.4-4 Monthly Rainfall Statistics for Selected Stations (cont'd)

ADABA

Station: Adaba
Lat. 7°01'N Long. 39°14'E Alt. 2485 masl

Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	9.6	40.5	58.2	107.6	55.6	70.8	183.7	203.6	75.1	29.1	6 1	17.9	857.7
Max.	30.1	161.8	115.7	188.0	105.0	113.4	230.5	337.5	94.9	103.8	27.5	109.0	993.0
Min.	0.0	0.0	2.1	7.8	15.2	6.0	105.3	84.3	38.4	0.0	0.0	0.0	695.0
80%	0.0	2.7	16.3	80.7	24.2	52.6	173.6	165.3	67.0	4.2	0.5	0.1	784.6
St.Dev.	10.9	50.7	41.6	47.8	29.4	35.8	40.4	69.1	17.0	30.0	7.9	33.5	89.8
Cv	1.13	1.25	0.71	0.44	0.53	0.51	0.22	0.34	0.23	1.03	1.29	1.87	0.10

ASASA

Station: Asasa
Lat. 7°09'N Long. 39°11'E Alt. 2400 masl

Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	16.9	39.6	46.9	74.4	49.9	72.5	161.4	162.2	62.7	23.5	6.5	12.3	728.8
Max.	71.9	156.4	100.4	162.1	132.0	163.2	258.5	233.8	98.8	51.4	19.4	56.2	867.6
Min.	0.0	0.1	3.2	2.0	0.0	24.4	35.3	20.8	31.2	0.0	0.0	0.0	438.9
80% De	0.4	6.5	23.4	28.5	13.4	54.3	128.8	134.4	50.8	0.0	2.5	0.0	673.3
St.Dev.	22.7	45.6	28.1	50.6	46.9	38.4	61.8	62.1	20.3	20.7	6.9	19.5	124.2
Cv	1.34	1.15	0.60	0.68	0.94	0.53	0.38	0.38	0.32	0.88	1.05	1.58	0.17

DODOLA

Station: Dodola (Edo)
Lat. 06°59' Long. 39°11' Alt. 2500 masl

Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	30.5	42.4	57.3	90.0	49.9	86.5	144.8	159.5	101.3	46.8	25.1	19.7	853.8
Max.	135.3	164.9	138.6	212.4	145.3	148.8	247.0	227.0	227.0	131.0	79.0	64.8	1197.7
Min.	0.0	0.0	3.2	4.2	4.8	8.8	11.2	73.1	29.0	0.0	0.0	0.0	484.2
80% De	4.5	4.0	29.4	39.0	8.8	68.0	112.3	131.8	74.8	20.4	12.5	4.6	712.0
St.Dev.	32.7	46.1	33.8	59.4	37.6	30.5	52.3	40.1	38.5	29.1	18.2	14.3	168.0
Cv	1.072	1.089	0.59	0.66	0.754	0.353	0.361	0.252	0.38	0.622	0.724	0.724	0.197

GINIR

Station: Ginir
Lat. 7°08'N Long. 40°43'E Alt. 1950 masl

Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	0.6	26.0	89.0	228.0	157.0	23.5	24.6	36.4	94.9	109.3	44.7	20.3	854.2
Max.	3.0	65.0	265.0	328.0	275.0	47.0	43.0	127.0	185.0	212.0	84.0	51.0	1158.0
Min.	0.0	0.0	0.0	82.0	53.0	3.0	0.0	0.0	13.0	49.0	0.0	0.0	519.6
80% De	0	0.4	7.6	193.4	68	15.8	5.4	8.2	72.2	63	16.8	0	591.7
St.Dev.	1.1	27.9	104.8	81.0	84.2	14.0	17.5	46.5	52.8	57.6	33.5	23.6	251.9
Cv	1.826	1.074	1.178	0.355	0.536	0.596	0.711	1.275	0.556	0.527	0.75	1 161	0.29

Table 2.4-4 Monthly Rainfall Statistics for Selected Stations (cont'd)

GOBA

Station: Goba
Lat. 07°01' Long. 40°00'E Alt. 2700 masl

Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	22.4	39.0	60.6	140.7	112.3	59.2	91.2	118.9	124.1	105.7	63.8	17.7	955.8
Max.	78.4	106.3	169.4	248.6	235.7	115.5	151.9	232.6	186.9	263.6	226.7	119.3	1279.2
Min.	0.0	0.0	0.0	73.9	33.9	23.9	38.1	60.7	53.7	37.7	0.0	0.0	707.2
80% De	4.6	8.2	24.2	89.7	79.4	38.3	57.3	81.0	95.1	69.8	30.1	1.1	811.7
St.Dev.	24.0	35.0	45.9	51.5	42.5	24.6	35.6	40.1	33.9	50.2	52.0	27.8	160.6
Cv	1.068	0.897	0.757	0.366	0.378	0.415	0.39	0.337	0.273	0.475	0.815	1.564	0.1681

GORO

Station: Goro
Lat. 7°00'N Long. 40°29'E Alt. 1780 masl

Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	22.4	39.0	60.6	140.7	112.3	59.2	91.2	118.9	124.1	105.7	63.8	17.7	955.8
Max.	78.4	106.3	169.4	248.6	235.7	115.5	151.9	232.6	186.9	263.6	226.7	119.3	1279.2
Min.	0.0	0.0	0.0	73.9	33.9	23.9	38.1	60.7	53.7	37.7	0.0	0.0	707.2
80% De	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
St.Dev.	15.2	41.9	44.1	91.9	70.7	27.2	25.9	32.8	35.8	29.9	39.6	23.7	118.8
Cv	1.13	1.24	0.52	0.40	0.45	0.67	0.89	0.61	0.44	0.21	0.86	1.01	0.13

KOFELE

Station:Kofele
Lat. 7°02'N Long. 38°28'E Alt. 2680 masl

Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	56.9	57.0	127.1	183.4	146.7	106.9	163.0	168.6	162.7	74.5	46.0	47.8	1340.4
Max.	135.8	168.3	204.9	300.7	292.9	190.2	196.0	281.8	216.7	189.9	146.5	87.8	1800.1
Min.	0.0	0.6	64.3	64.3	75.2	72.0	105.6	130.3	104.6	11.7	7.8	0.8	879.9
80% De	15.6	10.3	82.6	127.1	109.0	80.3	149.8	133.6	117.3	24.0	13.3	22.4	1146.7
St.Dev.	48.4	61.2	53.2	78.3	69.8	39.7	29.7	53.6	43.6	59.7	47.0	32.7	305.6
Cv	0.852	1.074	0.419	0.427	0.476	0.372	0.182	0.318	0.268	0.801	1.022	0.685	0.228

2.4.3 Monthly Rainfall Distribution

The distribution of mean monthly rainfall obtained using the observed data for selected stations have been shown in Figure 2.4-1. It may be noted from the figure that the rainfall distribution gradually changes from a unimodal pattern in the north to a bimodal pattern in the south.

It may be noted from Figure 2.4-1 that in the case of the unimodal rainfall distribution, there is only a single main rainy season.

In the case of the bimodal pattern, there are two main rainy seasons. The first main rainy season occurs in the period March – May, and, the second rainy season during September – November.

An isohyetal map has been prepared for the project area based on the available data (Fig. 2.4-2)

2.4.2 Rainfall-Altitude Correlation

In general, rainfall appears to be directly correlated with Altitude except in very special cases where orographic effects dominate as in Assela and Goba. Mean monthly rainfall and altitude of selected stations in the project area have been provided in Table 2.4-5 Two correlations have been attempted, one for the northern part and the other for the southern part of the project area as shown in Figs. 2.4-3 & 2.4-4. Two different regression equations have been derived one for the northern part and the other for the southern part as indicated in these figures. The values of the Coefficient of Determination ($R^2 = 0.69$ & 0.57) indicate some correlation in both cases. The regression equations could be used for estimating the mean annual rainfall given the altitude of a station in the project area.

Fig. 2.4-1 Distribution of Monthly Rainfall at Selected Stations

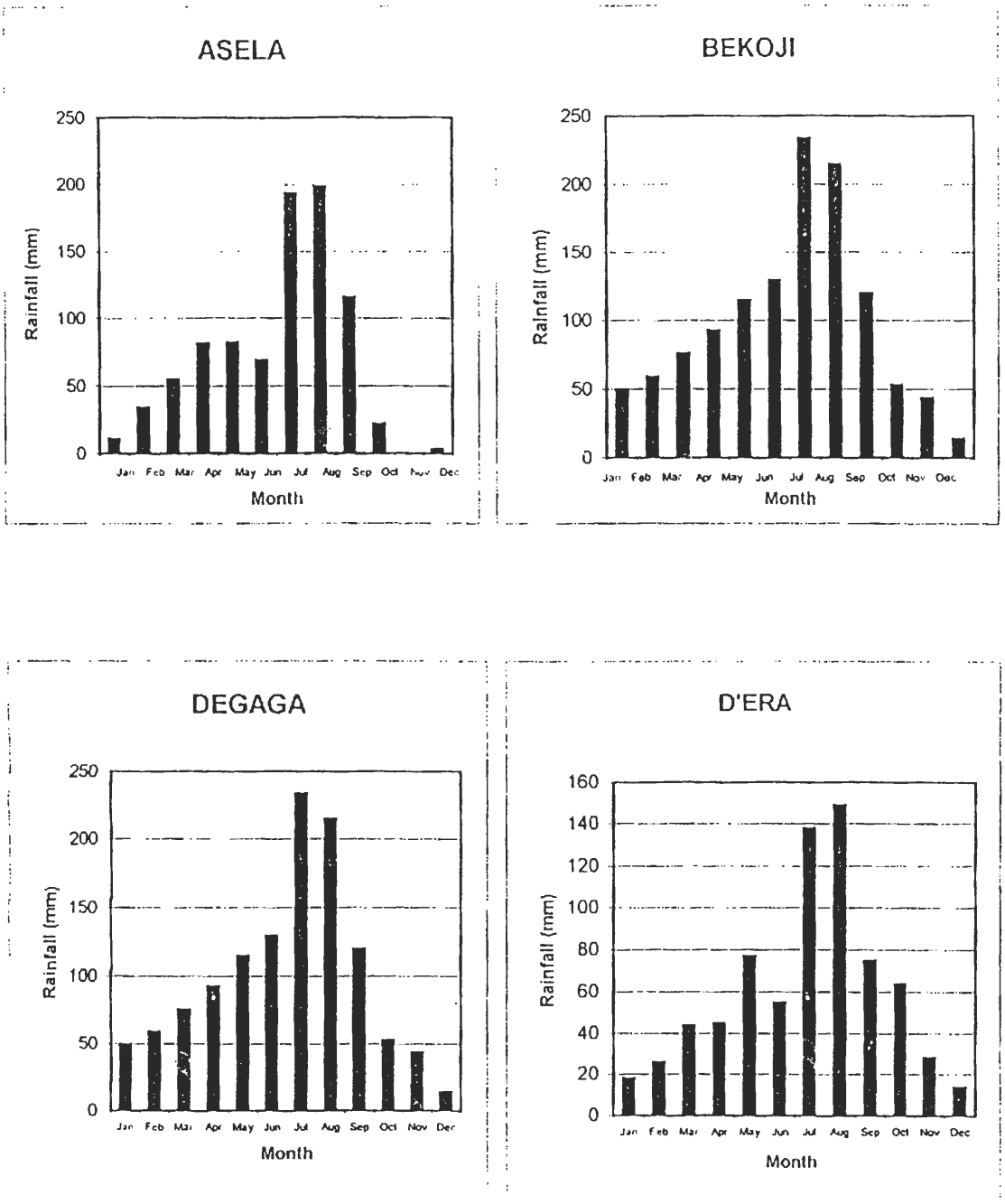
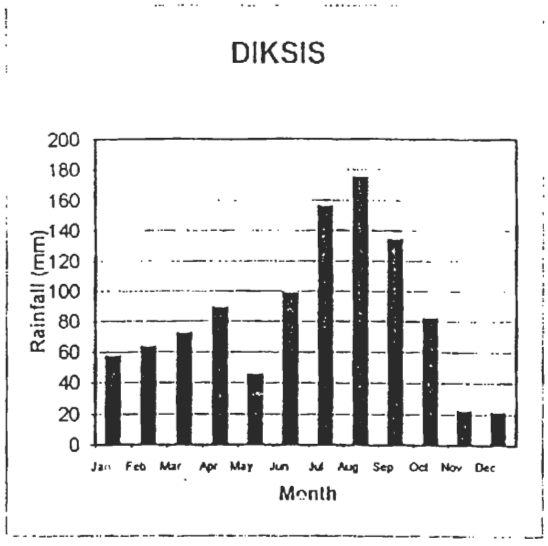
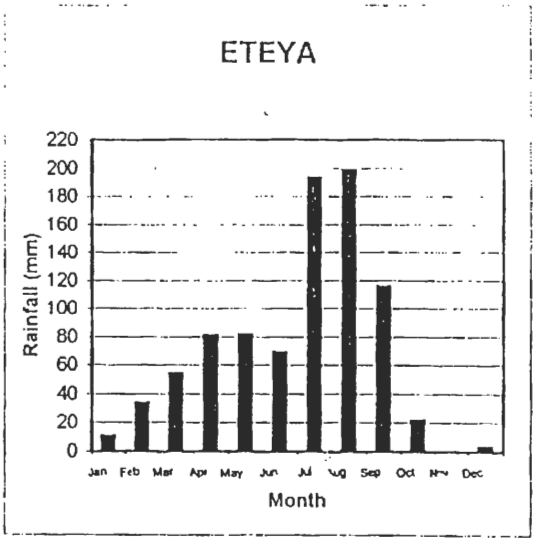
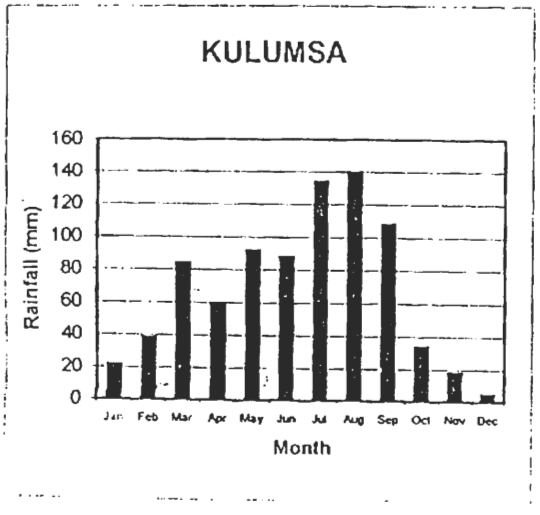


Fig. 2.4-1 Distribution of Monthly Rainfall at Selected Stations (cont'd)







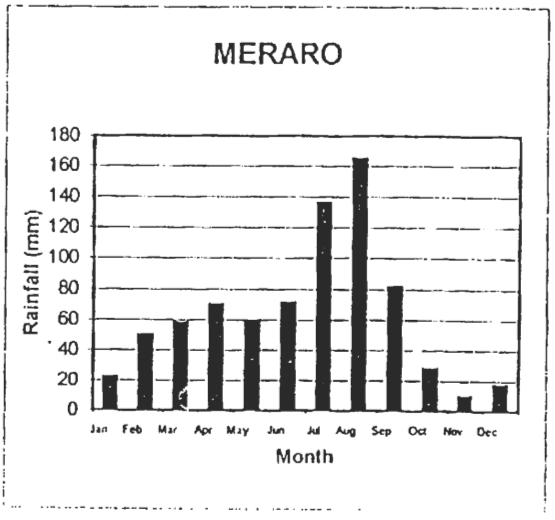
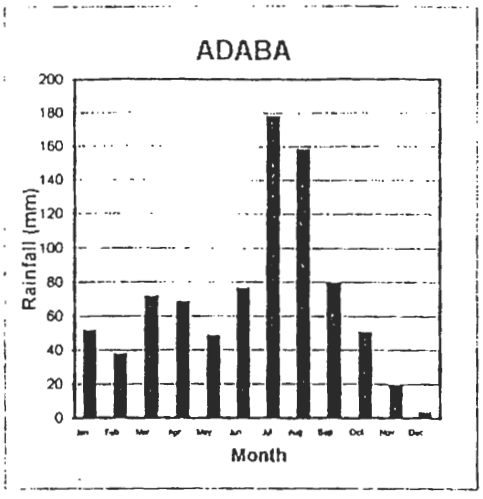
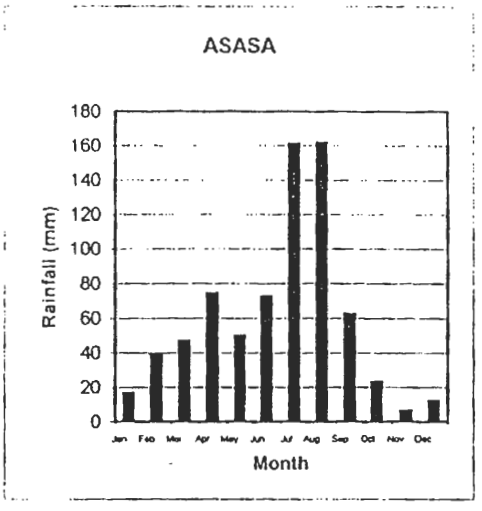
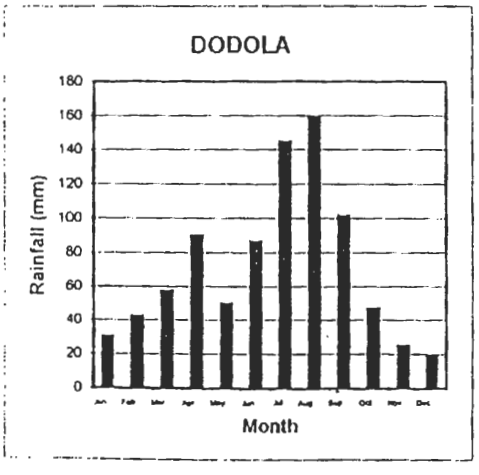


Fig. 2.4-1 Distribution of Monthly Rainfall at Selected Stations (cont'd)







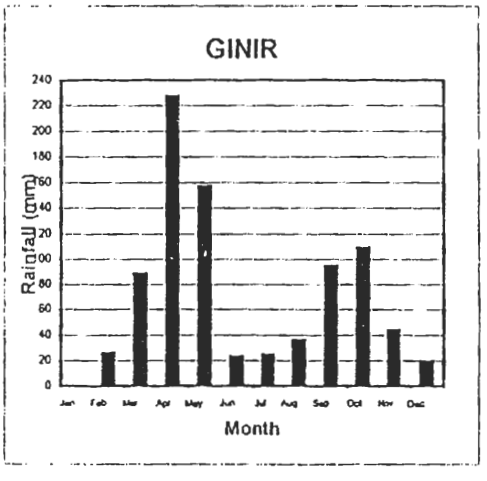
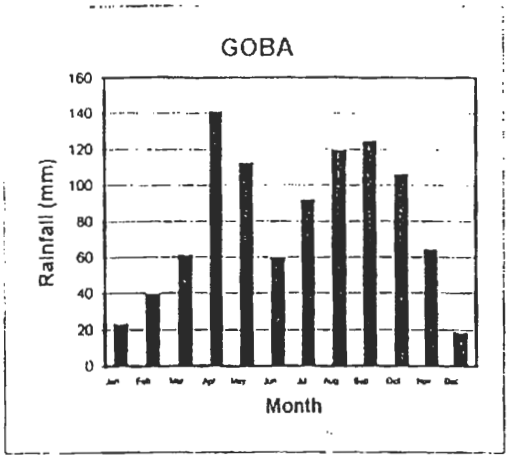
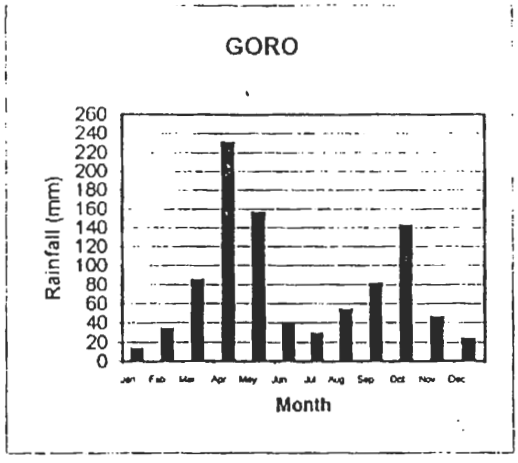


Fig. 2.4-1 Distribution of Monthly Rainfall at Selected Stations (cont'd)





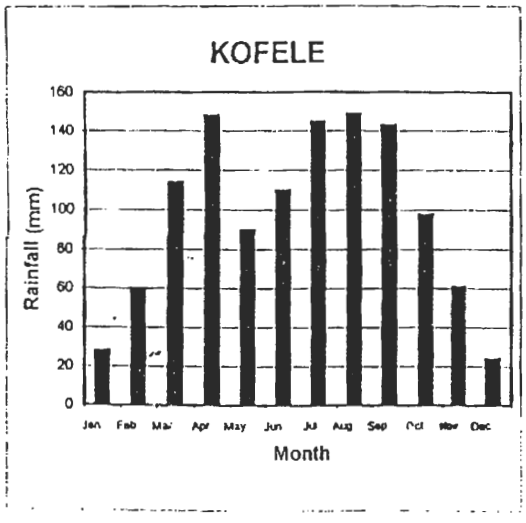


FIGURE 2.4-2 ISOHYETAL MAP OF PROJECT AREA

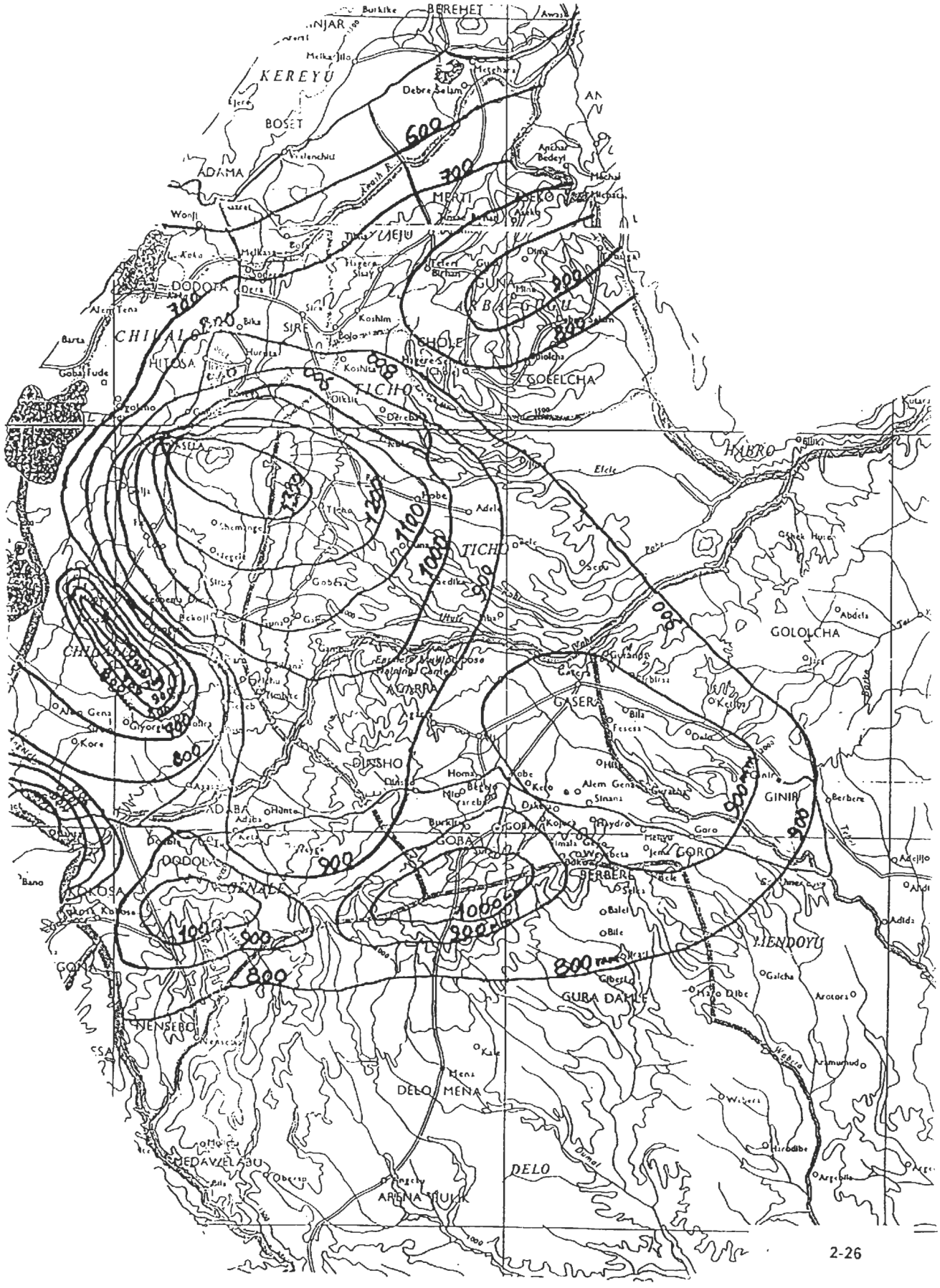


Table 2.4-5 Mean Annual Rainfall and Altitudes of Selected Stations

I. Northern Part of Project Area

Ser No.	Name of Station	Location			MARF
		Lat. (N)	Long.(E)	Altitude	(mm)
1	Asela	7°57'	39°08'	2450	1298
2	Bekoji	7°19'	39°09'	2850	1203
3	Degaga	7°26'	39°50'	2040	1057
4	D'era	8°20'	39°19'	1680	733
5	Diksis	8°05'	39°21'	2600	1002
6	Eteya	8°10'	39°14'	2060	860
7	Kulumsa	7°58'	39°05'	2180	858
8	Munesa	7°21'	38°32'	2550	1333
9	Ogolcho	8°02'	39°01'	1800	689
10	Ticho	7°29'	39°19'	2800	1265

Note: MARF: Mean Annual RainFall

II. Southern Part of Project Area

Ser. No.	Name of Station	Location			MARF
		Lat. (N)	Long.(E)	Altitude	(mm)
11	Adaba	7°01'	39°14'	2485	838
12	Bekoji	7°19'	39°09'	2850	1203
14	Dodola	6°35'	39°07'	2540	915
16	Ginir	7°08'	40°43'	1950	853
17	Kofele	7°02'	38°28'	2680	1170

Note: MARF: Mean Annual RainFall

Fig 2 4-3 Correlation of Mean Annual Rainfall with Altitude
Northern Part of Project Area

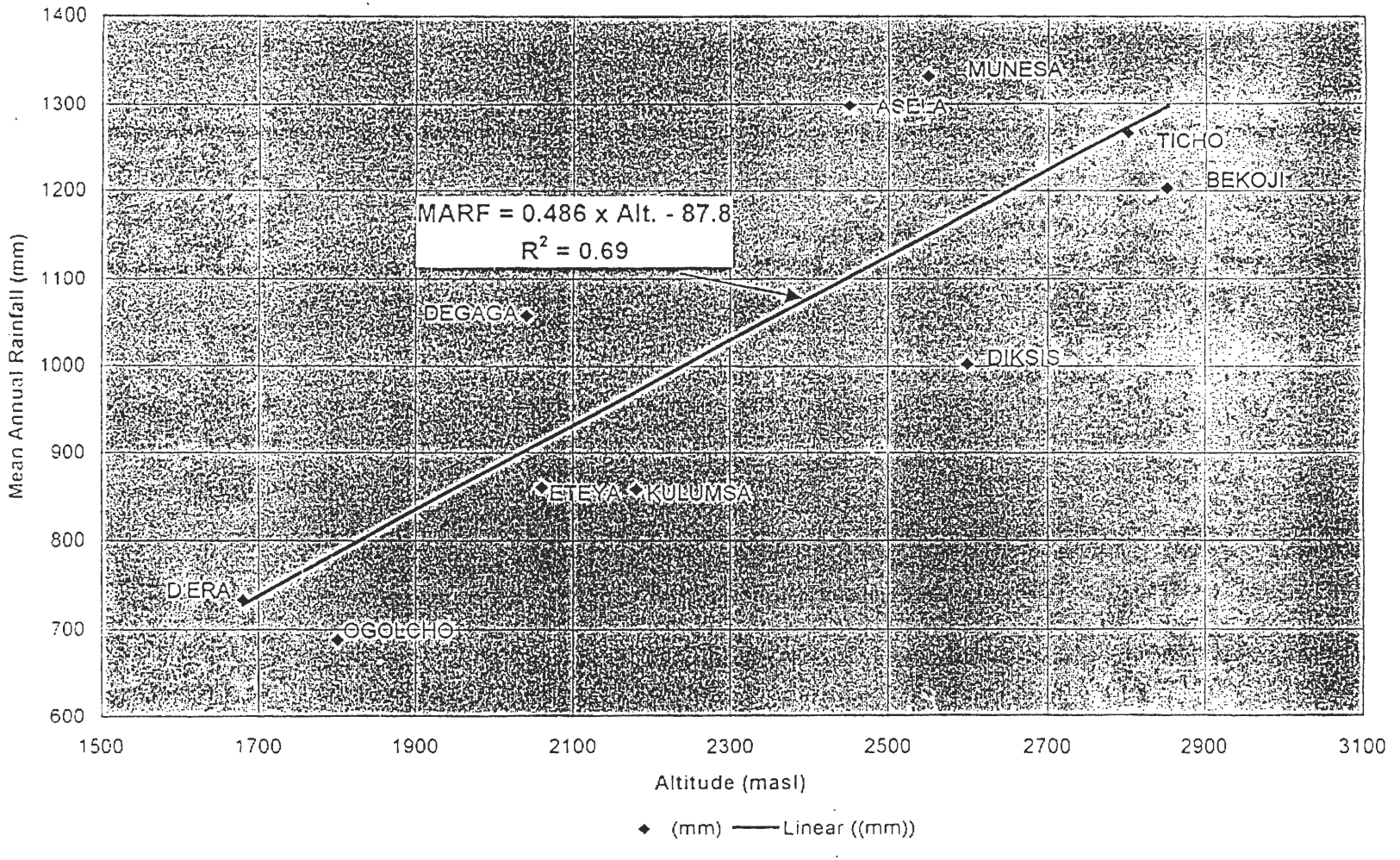
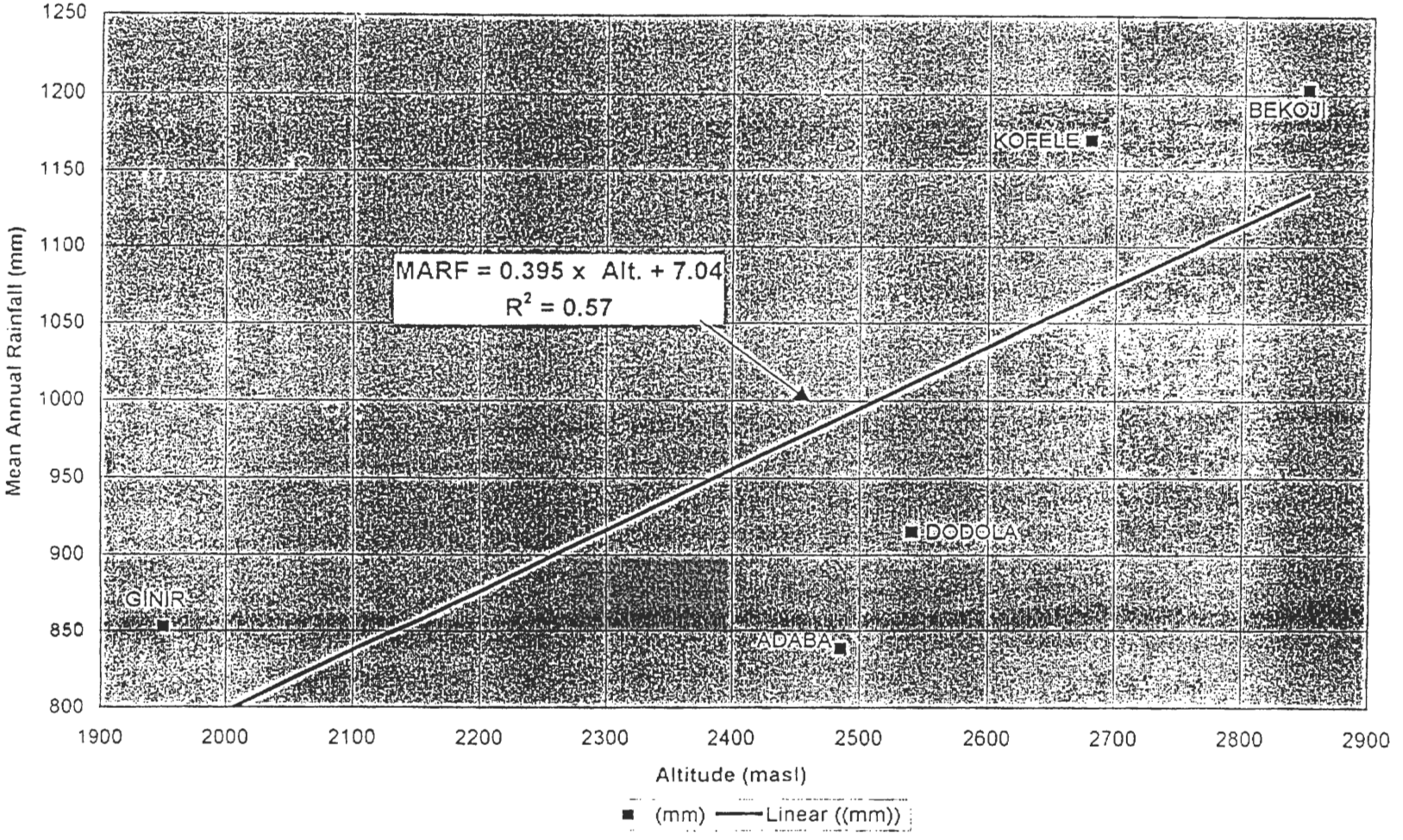


Fig 6 Correlation of Mean Annual Rainfall with Altitude
Southern Part of Project Area



2.5 Rainfall Intensity

2.5.1 Rainfall Intensity/Duration

Maximum rainfall intensities of 60 minimum duration observed at Asasa have been provided in Appendix I.3.2. In general, the highest rainfall intensities occur in the months April - September. The highest recorded rainfall intensity, 42.2 mm, occurred in June 1980.

There were missing data in some months. The missing data in a given month were filled in with the maximum observed value during the respective month. The maximum rainfall intensity data obtained after filling in the missing data have been provided in Table 2.5-1 Also, values of pertinent statistics such as the Mean, Standard Deviation and the Coefficient of Variation, (C_v), of annual maximum rainfall intensity values which are required for frequency analysis have been given in the table.

It should be noted that the observed maximum rainfall intensity are of 60 minute duration. However, maximum rainfall intensity values of various duration corresponding to the various time of concentrations of the watersheds under consideration are required. The following formula has been used for computing the maximum intensity values of various durations using the known maximum rainfall intensity of 1 hour or 60 minutes.

$$I_t = (2/(t+1)) \times I_0$$

Where:

I_t – Rainfall Intensity for rainfall of duration t

I_0 – Rainfall Intensity for 1 hour rainfall duration

t - Rainfall duration, taken equal to the time of concentration

In order to facilitate the frequency analysis, that part of the formula which appears in parentheses has been designated as the Intensity Factor The values of the Intensity Factor for various rainfall durations corresponding to the various values of the Time of Concentration have been computed explicitly and given in Tables 2.5-2 & 2.5-3.

2.5.2 Frequency and Regression Analyses of Rainfall Intensity

After filling in the missing data, the highest rainfall intensity amounts observed in each year of record were determined and as the result twenty four values of annual maximum rainfall intensity were available for frequency analysis.

The frequency analysis was carried out using two well known methods, namely i) Chow's Method and ii) Boldakov's Method as described in the following.

Table 2.5-1 Infilled Monthly Maximum Rainfall Intensity in 60 min. @ Asasa

Station: Asasa
Lat. 7°6.5'N Long. 39°11' E Alt. 2350 masl

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Maximum
1971	19.9	30.6	24.1	24.0	26.6	16.8	16.2	33.0	22.5	3.6	0.0	4.8	33.0
1972	19.9	15.9	24.1	24.0	2.8	7.9	10.1	4.4	22.5	3.2	0.8	1.0	24.1
1973	19.9	5.5	0.9	19.8	6.6	9.1	12.7	11.5	12.4	17.1	0.0	3.0	19.9
1974	0.7	2.0	1.8	15.6	26.6	42.2	28.0	37.4	14.4	0.4	0.0	0.2	42.2
1975	0.7	2.0	2.1	21.5	8.5	20.3	27.4	13.4	3.4	6.4	0.0	1.0	27.4
1976	1.2	0.2	3.3	22.9	6.9	12.3	5.0	14.1	11.3	1.1	7.2	4.5	22.9
1977	5.6	4.5	2.4	16.7	3.7	12.4	17.5	37.4	2.4	33.6	0.0	0.0	37.4
1978	3.3	17.9	4.9	8.0	6.4	7.8	3.9	16.3	5.5	31.7	0.0	3.0	31.7
1979	8.5	30.6	9.8	8.3	15.1	29.9	15.0	23.9	9.8	2.2	1.3	2.8	30.6
1980	19.9	2.3	2.3	10.0	9.6	42.2	28.0	25.5	7.7	0.8	0.0	0.0	42.2
1981	4.3	19.1	7.2	11.4	26.6	42.2	28.0	17.3	14.0	0.3	5.7	0.0	42.2
1982	19.9	30.6	24.1	15.3	9.6	6.9	11.0	17.6	22.5	7.6	3.9	3.8	30.6
1983	2.3	5.8	1.6	11.7	26.6	4.1	14.5	14.6	3.7	1.7	6.0	7.2	26.6
1984	19.9	30.6	24.1	24.0	26.6	20.4	28.0	11.6	13.9	33.6	7.2	7.2	33.6
1985	19.9	30.6	24.1	24.0	26.6	42.2	28.0	37.4	22.3	0.7	0.4	1.6	42.2
1986	0.0	0.0	5.2	10.7	10.6	11.0	14.5	4.7	12.3	20.5	0.8	2.6	20.5
1987	4.5	13.0	13.7	11.0	16.5	5.5	4.1	23.7	4.1	17.8	1.5	2.1	23.7
1988	0.0	0.0	0.0	15.4	3.0	18.5	20.5	23.0	21.6	16.0	0.0	0.0	23.0
1989	7.5	6.0	21.0	13.0	15.8	9.8	16.2	22.9	13.0	8.2	5.0	0.0	22.9
1990	2.4	30.6	24.1	24.0	11.3	3.5	19.5	7.2	7.9	2.3	7.2	1.2	30.6
1991	15.4	30.6	4.9	0.6	13.4	12.6	18.2	12.5	10.8	0.4	1.4	7.2	30.6
1992	0.0	0.0	1.5	10.0	0.0	0.0	1.2	25.0	21.2	5.8	0.0	0.0	25.0
1993	15.3	7.0	1.5	3.1	0.0	15.0	17.0	18.7	14.4	8.8	0.0	0.0	18.7
1994	0.0	0.0	6.8	24.0	4.4	11.2	28.0	23.4	16.5	33.6	7.2	7.2	33.6
Mean	8.8	13.1	9.8	15.4	12.7	16.8	17.2	19.9	12.9	10.7	2.3	2.5	29.8
Max.	19.9	30.6	24.1	24.0	26.6	42.2	28.0	37.4	22.5	33.6	7.2	7.2	42.2
Min.	0.0	0.0	0.0	0.6	0.0	0.0	1.2	4.4	2.4	0.3	0.0	0.0	18.7
St.Dev.	8.4	12.7	9.6	7.1	9.3	13.2	8.6	9.7	6.6	11.9	2.9	2.6	7.4
Cv	0.95	0.97	0.98	0.46	0.74	0.79	0.50	0.49	0.51	1.11	1.26	1.04	0.25

Chow's Method

The formula which has been used for computing rainfall intensity values of various return periods is given in the following.

$I(T) = I_{mean} + K(T) \times St.Dev.$

Where:

I(T) – Maximum Rainfall Intensity of Return Period T Years (mm/hr)

I_{mean} – Mean of observed annual maximum rainfall intensity values (mm/hr)

St.Dev. – Standard Deviation of observed annual maximum rainfall intensity values (mm/hr)

K(T) – Frequency Factor

The frequency analysis using Chow's Method has been done in Table 2.5-2. Maximum rainfall intensity values of rainfall duration from 5 – 120 minutes for 5, 10, 25 and 50 year return periods have been computed in Table 2.5-2 using Chow's Method.

Boldakov's Method

Boldakov's formula which has been used for computing rainfall intensity values of various duration is given in the following.

$I(T) = (I(T)/I_{mean}) \times I_{mean}$

Where.

I(T) – Maximum Rainfall Intensity of Return Period T Years (mm/hf)

I_{mean} – Mean of observed annual maximum rainfall intensity values (mm/hr)

Table 2.5-2 Maximum Rainfall Intensity of Different Rainfall Durations and Return Periods @ Asasa computed using Chow's Method

I_{mean} = 29.8 mm/hr

St.Dev. = 7.4 mm/hr

$I(T) = I_{mean} + K(T) \times St.Dev.$

Where:

$K(T) = -(0.4500 + 0.7797 \times \ln(\ln(T) - \ln(T-1)))$

Station: Asasa
Lat. 7°6.5'N
Long. 39°11' E

Alt. 2350 masl

Ser. No.	Duration (Minutes)	Tc (hrs)	Intensity Factor	Return Period, T (Years)			
				5	10	25	50
				Freq. Factor K(T)			
				0.720	1.305	2.044	2.592
1	5	0.0833	1.85	64.8	72.8	82.9	90.4
2	10	0.1667	1.71	60.2	67.6	77.0	84.0
3	15	0.2500	1.60	56.2	63.1	71.9	78.4
4	20	0.3333	1.50	52.7	59.2	67.4	73.5
5	25	0.4167	1.41	49.6	55.7	63.4	69.2
6	30	0.5000	1.33	46.8	52.6	59.9	65.3
7	35	0.5833	1.26	44.4	49.8	56.7	61.9
8	40	0.6667	1.20	42.1	47.3	53.9	58.8
9	45	0.7500	1.14	40.1	45.1	51.3	56.0
10	50	0.8333	1.09	38.3	43.0	49.0	53.4
11	55	0.9167	1.04	36.7	41.2	46.9	51.1
12	60	1.0000	1.00	35.1	39.5	44.9	49.0
13	65	1.0833	0.96	33.7	37.9	43.1	47.0
14	70	1.1667	0.92	32.4	36.4	41.5	45.2
15	75	1.2500	0.89	31.2	35.1	39.9	43.5
16	80	1.3333	0.86	30.1	33.8	38.5	42.0
17	85	1.4167	0.83	29.1	32.7	37.2	40.5
18	90	1.5000	0.80	28.1	31.6	35.9	39.2
19	95	1.5833	0.77	27.2	30.5	34.8	37.9
20	100	1.6667	0.75	26.3	29.6	33.7	36.7
21	105	1.7500	0.73	25.5	28.7	32.7	35.6
22	110	1.8333	0.71	24.8	27.8	31.7	34.6
23	115	1.9167	0.69	24.1	27.1	30.8	33.6
24	120	2.0000	0.67	23.4	26.3	29.9	32.7

The frequency analysis using Boldakov's Method has been done in Table 2.5-3. Values of $I(T)/I_{mean}$ for the value of C_v of 0.5 for various return periods were obtained from Figure 2.5-1. Maximum rainfall intensity values for 5 – 120 minutes rainfall duration and 5, 10, 25 and 50 year return periods have been computed in Table 2.5-3 using Boldakov's Method.

Closer examination of the rainfall intensity values of different return periods given in Tables 2.5-2 & 2.5-3 obtained using Chow's and Boldakov's Methods revealed that the rainfall intensity values for the 5 and 10 year return periods computed using Boldakov's Method are consistently higher than those obtained using Chow's Method. On the other hand, the rainfall intensity values for the 25 and 50 year return periods obtained using Chow's Method are consistently higher than the values obtained using Boldakov's Method. Consequently, the higher rainfall intensity values obtained using both methods have been selected. Accordingly, the values obtained using Boldakov's Method for the 5 and 10 year return periods and the values obtained using Chow's Method for the 25 and 50 year return periods have been selected for the design.

2.5.3 Rainfall Intensity/Duration/Frequency

The higher rainfall intensity values of various return periods obtained using Boldakov's and Chow's methods have been given in Table 2.5-4.

Regression analysis of the values of rainfall intensity given in Table 2.5-4 on the Time of Concentration was carried out for the various return periods. The regression equations obtained and the Coefficient of Determination (r^2) for the respective equations have been given alongside Table 2.5-4. It may be noted that the value of $r^2 = 0.93$ obtained for all the derived regression equations given there is high indicating that these equations are good enough for computing the values of the rainfall intensity for 5, 10, 25 and 50 year return periods.

Rainfall intensity values for different durations and 5, 10, 25 and 50 year return periods have been plotted in Figure 2.5-2.

Fig. 2.5-1 Boldakov's Curves

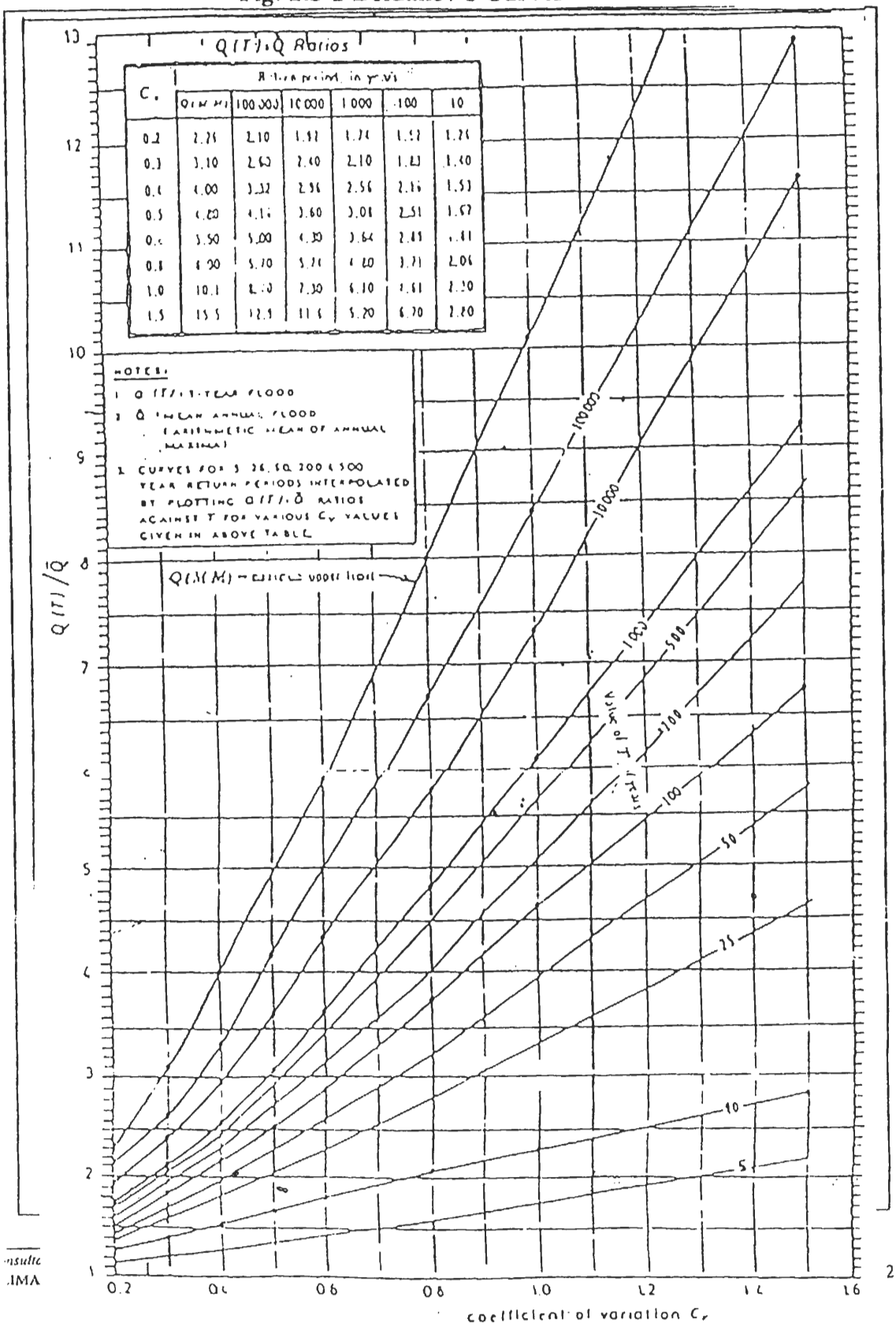


Table 2.5-3 Maximum Rainfall Intensity of Different Durations and Return Periods @ Asasa computed using Boldakov's Method

I_{mean} = 29.8 mm/hr

Computed Cv = 0.25, but assumed 0.5

$I(T) = (I(T) / I_{mean}) \times I_{mean}$

Station: Asasa
Lat. 7°6.5'N
Long. 39°11' E

Alt. 2350 masl

Ser No.	Duration Minutes	Tc (hrs)	Intensity Factor	Return Period (Years)			
				5	10	25	50
				$(I(T)/I_{mean})$			
				1.400	1.700	2.000	2.300
1	5	0.0833	1.85	74.1	78.2	82.3	86.4
2	10	0.1667	1.71	68.8	72.7	76.5	80.3
3	15	0.2500	1.60	64.3	67.8	71.4	74.9
4	20	0.3333	1.50	60.2	63.6	66.9	70.2
5	25	0.4167	1.41	56.7	59.8	63.0	66.1
6	30	0.5000	1.33	53.5	56.5	59.5	62.4
7	35	0.5833	1.26	50.7	53.5	56.3	59.1
8	40	0.6667	1.20	48.2	50.9	53.5	56.2
9	45	0.7500	1.14	45.9	48.4	51.0	53.5
10	50	0.8333	1.09	43.8	46.2	48.7	51.1
11	55	0.9167	1.04	41.9	44.2	46.5	48.9
12	60	1.0000	1.00	40.2	42.4	44.6	46.8
13	65	1.0833	0.96	38.6	40.7	42.8	44.9
14	70	1.1667	0.92	37.1	39.1	41.2	43.2
15	75	1.2500	0.89	35.7	37.7	39.6	41.6
16	80	1.3333	0.86	34.4	36.3	38.2	40.1
17	85	1.4167	0.83	33.2	35.1	36.9	38.7
18	90	1.5000	0.80	32.1	33.9	35.7	37.5
19	95	1.5833	0.77	31.1	32.8	34.5	36.2
20	100	1.6667	0.75	30.1	31.8	33.5	35.1
21	105	1.7500	0.73	29.2	30.8	32.4	34.1
22	110	1.8333	0.71	28.3	29.9	31.5	33.0
23	115	1.9167	0.69	27.5	29.1	30.6	32.1
24	120	2.0000	0.67	26.8	28.3	29.7	31.2

Table 2.5-4 Maximum Rainfall Intensities (mm/hr) of Various Return Periods and Rainfall Durations obtained using Boldakov's & Chow's Methods

Station: Asasa
Lat. 7°6.5'N Alt. 2700 masl
Long. 39°11' E

Ser. No.	Duration Minutes	Tc (hrs)	Intensity Factor	Return Period (Years) 5	10	25	50
1	5	0.0833	1.85	74.1	78.2	82.9	90.4
2	10	0.1667	1.71	68.8	72.7	77.0	84.0
3	15	0.2500	1.60	64.3	67.8	71.9	78.4
4	20	0.3333	1.50	60.2	63.6	67.4	73.5
5	25	0.4167	1.41	56.7	59.8	63.4	69.2
6	30	0.5000	1.33	53.5	56.5	59.9	65.3
7	35	0.5833	1.26	50.7	53.5	56.7	61.9
8	40	0.6667	1.20	48.2	50.9	53.9	58.8
9	45	0.7500	1.14	45.9	48.4	51.3	56.0
10	50	0.8333	1.09	43.8	46.2	49.0	53.4
11	55	0.9167	1.04	41.9	44.2	46.9	51.1
12	60	1.0000	1.00	40.2	42.4	44.9	49.0
13	65	1.0833	0.96	38.6	40.7	43.1	47.0
14	70	1.1667	0.92	37.1	39.1	41.5	45.2
15	75	1.2500	0.89	35.7	37.7	39.9	43.5
16	80	1.3333	0.86	34.4	36.3	38.5	42.0
17	85	1.4167	0.83	33.2	35.1	37.2	40.5
18	90	1.5000	0.80	32.1	33.9	35.9	39.2
19	95	1.5833	0.77	31.1	32.8	34.8	37.9
20	100	1.6667	0.75	30.1	31.8	33.7	36.7
21	105	1.7500	0.73	29.2	30.8	32.7	35.6
22	110	1.8333	0.71	28.3	29.8	31.7	34.6
23	115	1.9167	0.69	27.5	29.1	30.8	33.6
24	120	2.0000	0.67	26.8	28.3	29.9	32.7

REGRESSION OUTPUT

Return Period: 5 Years

m=	0.9914
b=	70.31
r^2 =	0.93
I_5 =	$70.31*0.99144^{TC}$

Return Period: 10 Years

m=	0.9914
b=	74.2
r^2 =	0.93
I_{10} =	$74.2*0.99144^{TC}$

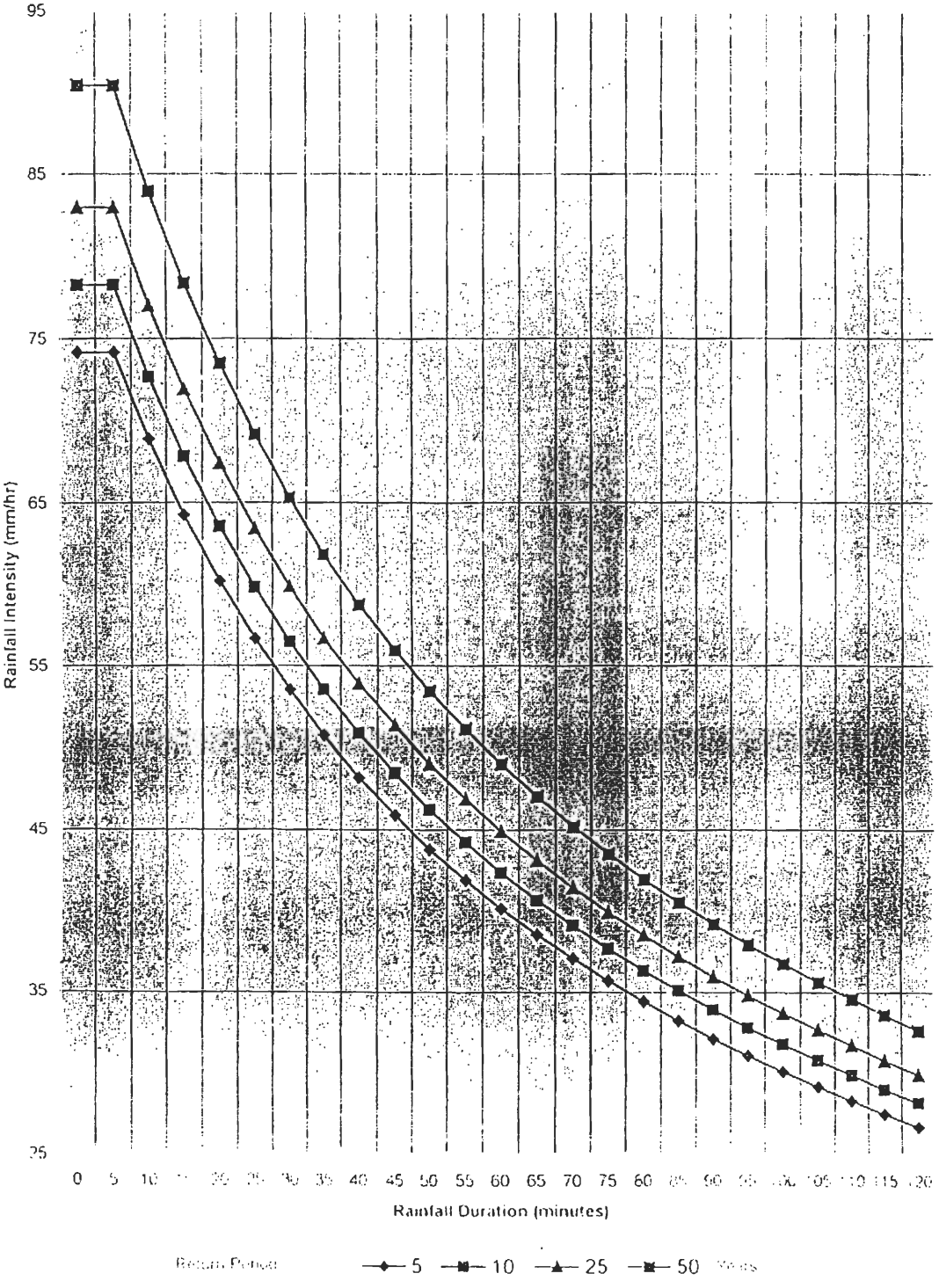
Return Period: 25 Years

m=	0.9914
b=	78.65
r^2 =	0.93
I_{25} =	$78.65*0.99144^{TC}$

Return Period: 50 Years

m=	0.9914
b=	85.754
r^2 =	0.93
I_{50} =	$85.754*0.99144^{TC}$

Fig. 2.5-2 Rainfall Intensity/Duration/Frequency for Asasa



Consultancy Services for ETH 94/K8

2.6 Potential Evapotranspiration

Monthly Potential EvapoTranspiration (PET) obtained from AGAR-UND HYDROTECHNIK GMBH for selected stations in the project area have been given in Table 2.6-1. Correlation of PET on Altitude has been made in Fig.2.6-1. It may be noted from Fig 2.6-1 that there is some correlation between PET and Altitude in the project area.

2.7 Moisture Regimes

The different moisture regions obtained from Daniel Gamachu (1977) have been given in Table 2.7-1. The value of the Moisture Index, Im , may be computed using the following formulae

$$Im = ((R/PET) - 1) \times 100$$

Where:

Im – Moisture Index
R - Annual Rainfall
PET- Annual Evapotranspiration

Table 2.7-1 Moisture Regimes

Im	Climatic (Moisture) Region
Over 100	Perhumid
20 to 100	Humid
0 to 20	Moist Subhumid
-33 to 0	Dry Subhumid
-67 to –33	Semi-arid
-100 – 67	Arid

Values of the moisture index for selected stations in the project area have been given in Tables 2.7-2.

2.8 Length of Growing Period

The Length of Growing Period (LGP) for selected stations in the project area have been shown in Fig. 2.8-1

Table 2.6-1 Monthly/Annual Potential EvapoTranspiration (in millimeters)

Station	Altitude	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Adaba	2485	126	124	139	128	132	124	103	104	109	117	118	127	1451
Asela	2450	127	124	139	137	132	118	98	101	100	123	123	122	1444
Bekoji	2850	125	115	132	118	116	99	80	83	91	104	111	118	1292
Degaga	2040	118	126	130	138	134	126	122	122	126	126	118	111	1500
D'era	1680	121	128	137	144	144	144	134	134	131	131	128	125	1600
Diksis	2600	132	121	137	130	128	121	101	106	105	121	121	127	1450
Dodola	2540	104	101	113	107	112	103	88	92	97	100	100	103	1220
Ginir	1950	130	135	136	133	131	126	123	125	129	123	118	123	1532
Goba	2700	113	112	133	107	109	107	100	101	95	83	90	105	1255
Kofele	2680	137	130	150	147	139	114	96	103	106	127	131	133	1513
Kulumsa	2180	129	125	140	133	140	134	105	109	97	125	133	126	1496
Munessa	2550	123	119	135	125	123	114	84	90	94	115	115	115	1352
Ogolcho	1800	150	141	161	150	150	145	116	119	109	140	143	134	1658
Ticho	2800	121	108	121	111	118	111	100	103	105	102	101	114	1315

Fig. 2.6-1 Correlation of Potential EvapoTranspiration (PET) with Altitude

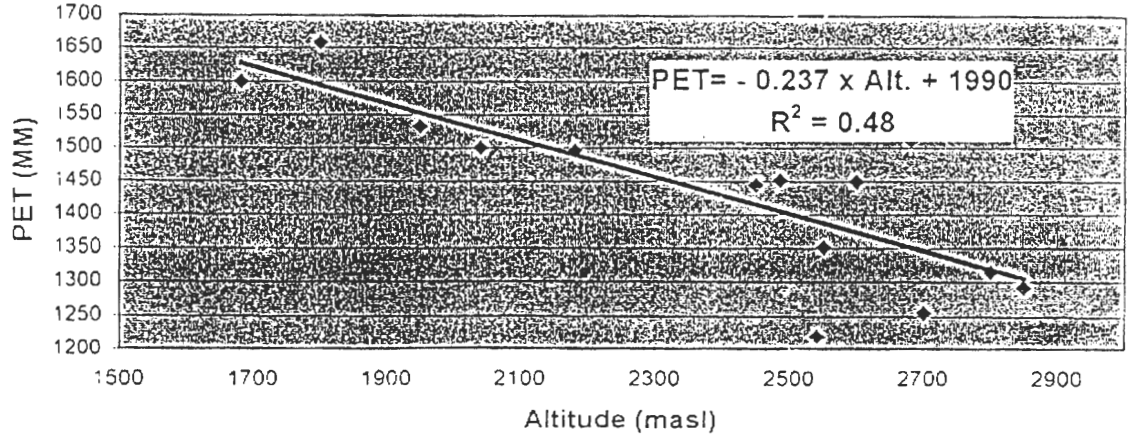


Table 2.7-1 Classified Moisture Regimes

Im. Value	Climatic (Moisture) Regimes
Over 100	Perhumid (A)
20 to 100	Humid (B)
0 to 20	Moist Subhumid
-33 to 0	Dry Subhumid
-67 to -33	Semi-arid
-100 to -67	Arid

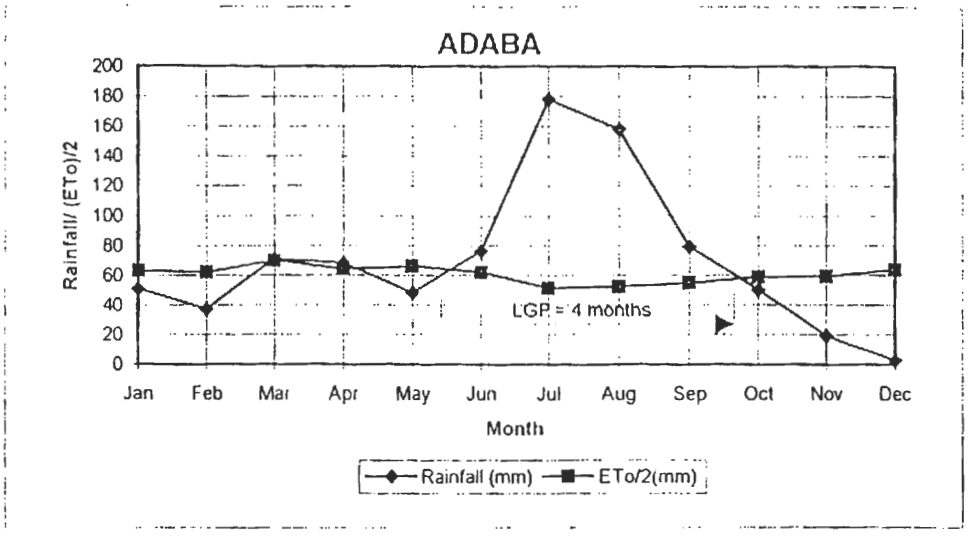
Source Daniel Gamachu(1977)

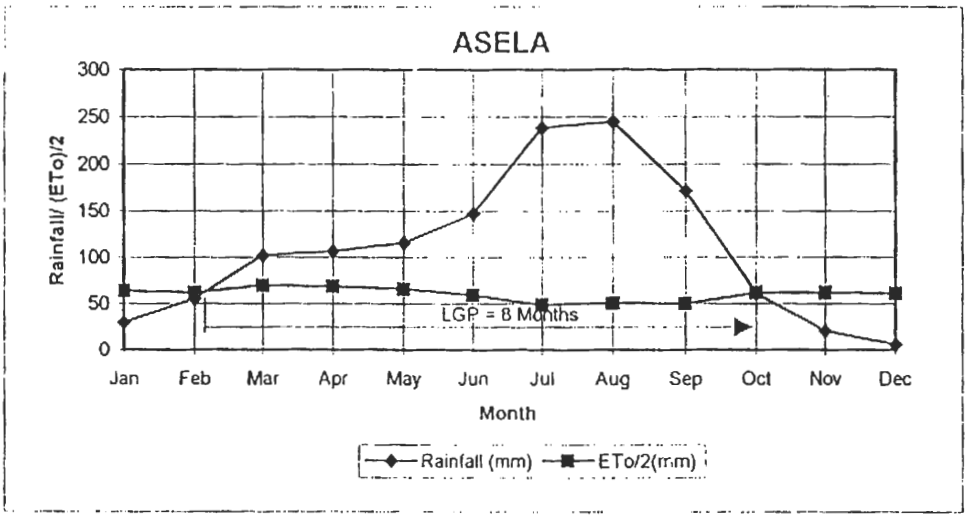
Table 2.7-2 Moisture Regimes for Selected Stations

Ser. No.	Name of Station	Annual Rainfall(mm)	ETo(mm)	Im	Regime
1	Adaba	858	1451	-41	Semi-arid *
2	Asela	1298	1444	-10	Dry Sub-humid
3	Bekoji	1084	1296	-16	Dry Sub-humid
4	Degaga	1057	1500	-30	Dry Sub-humid
5	D'era	733	1600	-54	Semi-arid
6	Diksis	1002	1450	-31	Dry Sub-humid
7	Dodola	915	1220	-25	Dry Sub-humid
8	Ginir	852	1532	-44	Semi-arid
9	Goba	958	1255	-24	Dry Sub-humid
10	Kofele	1340	1513	-11	Dry Sub-humid
11	Kulumsa	858	1496	-43	Semi-arid *
12	Munesa	1333	1352	-1	Dry Sub-humid
13	Ogolcho	689	1658	-58	Semi-arid
14	Ticho	1265	1315	-4	Dry Sub-humid

Note: * Adaba and Kulumsa are known to be Dry Sub-humid but the results obtained here based on scanty data indicate that they are Semi-arid; this needs to be checked using up-to-date data

Fig. 2.8-1 Length of Growing Period





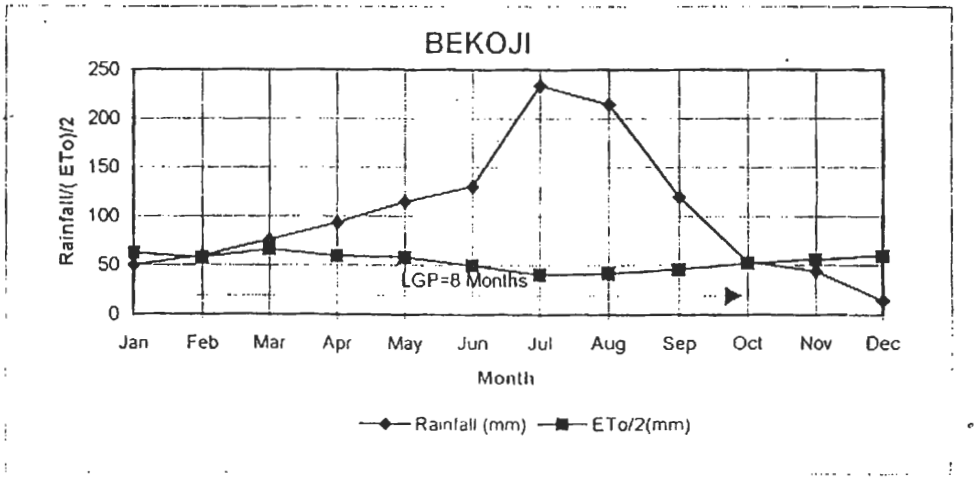
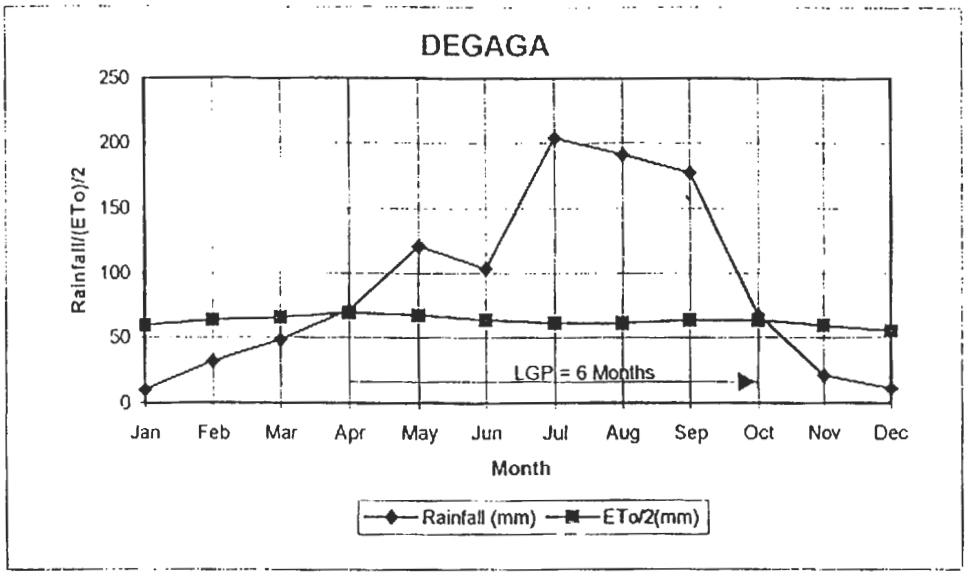
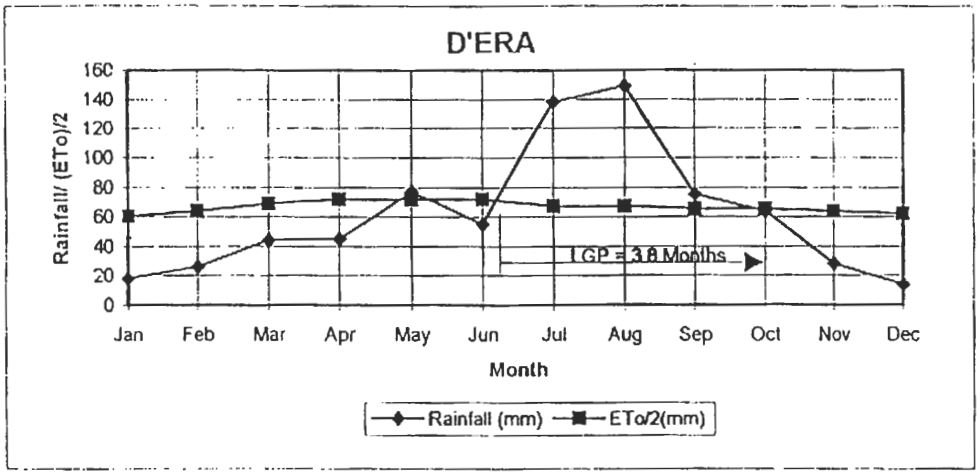
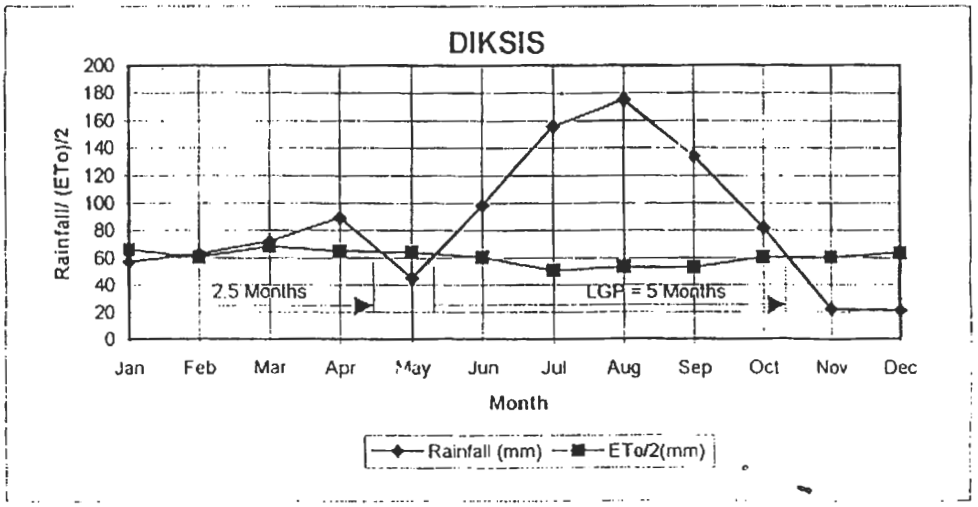


Fig. 2.8-1 Length of Growing Period (cont'd)







Element: Monthly Mean Minimum Temperature

Station: Assela School(Assela Town)

Lat. 07°57' Long. 39°08' Alt. 2400 masl

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1966	4.8	8.2	7.8	10.1	9.6	9.1	10.4	10.2	10.0	8.5	5.5	4.0	8.2
1967	4.1	6.3	8.6	9.2	9.8	9.8	10.3	9.8	9.4	7.4	7.4	5.5	8.1
1968	3.7	9.0	7.2	9.8	9.1	9.8	8.7	9.6	9.7	8.1	4.6	5.5	7.9
1969	5.8	8.4	9.7	10.1	10.9	10.3	10.4	10.0	9.7	8.4	6.6	4.8	8.8
1971	5.7	7.1	7.7	9.3	9.8	9.9	0.3	9.8	8.7	8.7	9.4	4.6	7.6
1972	4.8	5.1	7.6	10.3	10.3	10.2	10.6	10.3	9.3	7.0	4.9	3.1	7.8
1973	4.3	3.7	4.9	6.3	9.7	7.1	6.2	6.1	7.0	8.0	6.7	5.8	6.3
1974	5.5	6.8	10.4	9.4	11.3	10.1	9.2	9.9	9.9	8.0	4.6	4.7	8.3
1975	4.3	5.3	6.2	5.2	5.3	4.9	4.3	4.6	5.6	8.6	8.6	5.5	5.7
1976	5.6	6.9	8.0	8.8	9.6	9.0	9.6	8.7	8.0	7.5	5.7	4.3	7.6
1977	6.8	6.2	7.1	8.8	9.1	9.2	9.5	9.0	8.4	8.4	4.0	3.8	7.5
1978	6.3	5.4	8.4	9.2	9.3	10.5	10.6	10.0	9.6	8.7	8.7	6.4	8.6
1979	8.3	8.1	9.3	10.0	10.6	10.9	10.0	9.8	8.2	7.6	4.2	4.7	8.5
1980	6.0	6.2	8.8	7.9	8.3	8.0	7.7	9.8	8.9	7.2	4.5	2.6	7.2
1981	3.6	5.0	9.0	9.7	9.8	9.4	8.1	9.3	8.4	7.0	4.4	3.2	7.2
1982	5.3	7.0	6.6	8.4	9.4	9.0	9.4	9.4	8.3	6.9	6.0	7.9	7.8
1984	4.9	3.1	6.5	8.1	12.2	9.8	9.2	9.8	9.1	6.4	6.1	5.5	7.6
1985	5.1	6.1	7.4	9.6	9.3	8.6	9.3	9.2	9.3	7.8	5.2	4.4	7.6
1986	6.1	7.8	8.4	10.2	10.0	10.0	9.3	9.1	8.4	7.7	5.7	5.3	8.2
1987	5.6	7.1	9.2	8.7	10.6	9.7	9.9	11.2	10.0	10.3	8.0	8.0	9.0
1988	8.7	10.5	11.6	12.4	11.5	11.5	12.0	11.4	11.2	10.5	6.6	7.7	10.5
1989	6.9	8.6	10.4	10.6	10.8	10.9	11.0	11.2	10.7	10.3	9.6	9.1	10.0
1990	7.3	10.6	9.5	10.7	11.2	9.8	9.4	9.9	9.1	9.2	6.8	5.0	9.0
1991	8.5	10.3	10.8	11.4	11.9	11.8	11.2	11.5	11.0	10.5	7.2	7.1	10.3
1993	9.5	8.8	9.4	11.4	11.7	11.3	10.8	10.8	10.6	9.7	7.3	6.9	9.9
1994	6.7	13.1	11.5	11.8	11.4	11.1	11.8	11.8	10.9	11.1	8.2	6.2	10.5
1995	6.7	9.5	11.0	11.5	10.9	11.2	11.7	11.7	10.7	11.2	8.3	7.9	10.2
1996	8.8	7.5	10.8	10.6	11.0	11.1	11.2	11.0	10.4	8.9	6.8	6.8	9.6
Mean	6.1	7.4	8.7	9.6	10.2	9.8	9.4	9.8	9.3	8.6	6.5	5.6	8.4
Max.	9.5	13.1	11.6	12.4	12.2	11.8	12.0	11.8	11.2	11.2	9.6	9.1	10.5
Min.	3.6	3.1	4.9	5.2	5.3	4.9	0.3	4.6	5.6	6.4	4.0	2.6	5.7

Element: Monthly Mean Maximum Temperature

Station: Diksis State Farm
Lat. 8°05'N Long. 39°21'E Alt. 2600 masl

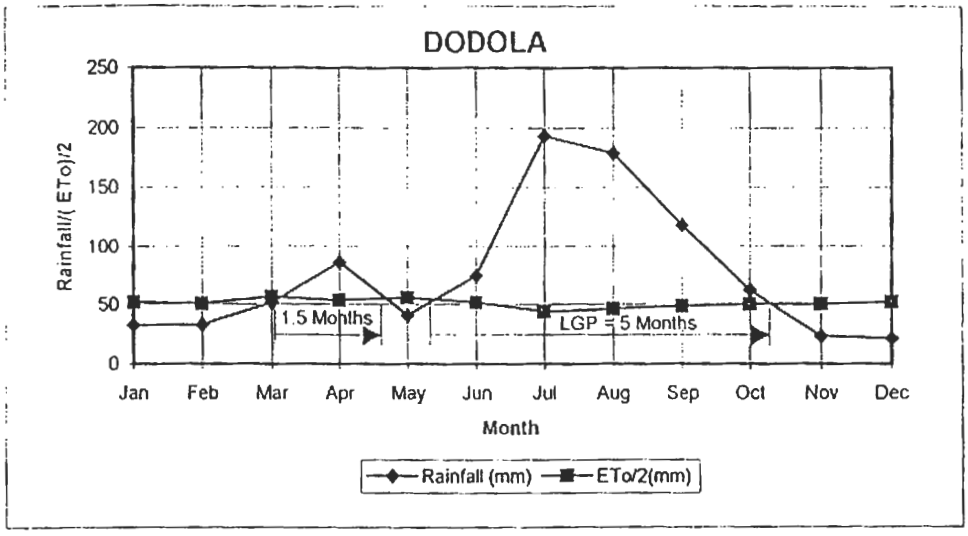
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1991	20.7	20.6	20.8	19.5	19.9	21.1	18.4	18.3	18.3	18.4	19.5	19.9	19.6
1992	19.6	20.8	22.4	21.1	20.3	20.3	18.1	17.7	17.2	18.2	18.1	19.0	19.4
1993	18.2	18.6	21.3	21.1	19.4	19.6	18.9	18.8	18.9	18.7	19.4	20.3	19.4
1994	21.4	22.5	22.0	21.8	21.4	19.8	18.3	17.9	18.5	18.6	18.5	19.9	20.1
1995	21.2	21.7	20.1	19.7	20.9	21.2	18.7	18.9	19.3	18.8	19.7	20.3	20.0
Mean	20.2	20.8	21.3	20.6	20.4	20.4	18.5	18.3	18.4	18.5	19.0	19.9	19.7
Max.	21.4	22.5	22.4	21.8	21.4	21.2	18.9	18.9	19.3	18.8	19.7	20.3	20.1
Min.	18.2	18.6	20.1	19.5	19.4	19.6	18.1	17.7	17.2	18.2	18.1	19.0	19.4

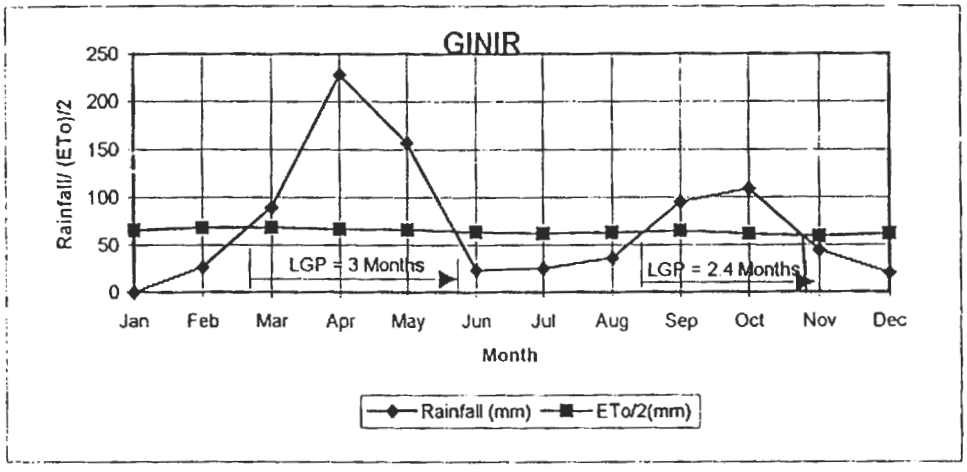
Element: Monthly Mean Minimum Temperature

Station: Diksis State Farm
Lat. 8°05'N Long. 39°21'E Alt. 2600 masl

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1992	6.2	7.2	7.1	8.7	8.9	8.5	8.4	9.4	8.2	6.8	5.9	7.4	7.7
1993	6.9	7.0	6.7	7.9	9.0	9.2	7.8	7.6	8.6	8.0	6.0	4.9	7.5
1994	3.6	6.0	6.8	8.2	8.5	9.4	9.2	8.7	8.6	6.8	6.5	4.1	7.2
1995	4.3	6.7	8.6	9.5	9.2	8.7	9.4	9.4	8.6	7.8	4.9	5.4	7.7
1996	6.9	5.8	6.3	6.4	5.9	8.5	7.1	8.8	8.5	7.4	5.8	5.5	6.9
Mean	5.6	6.5	7.1	8.1	8.3	8.9	8.4	8.8	8.5	7.4	5.8	5.5	7.4
Max	6.9	7.2	8.6	9.5	9.2	9.4	9.4	9.4	8.6	8.0	6.5	7.4	7.7
Min.	3.6	5.8	6.3	6.4	5.9	8.5	7.1	7.6	8.2	6.8	4.9	4.1	6.9

Fig. 2.8-1 Length of Growing Period (cont'd)





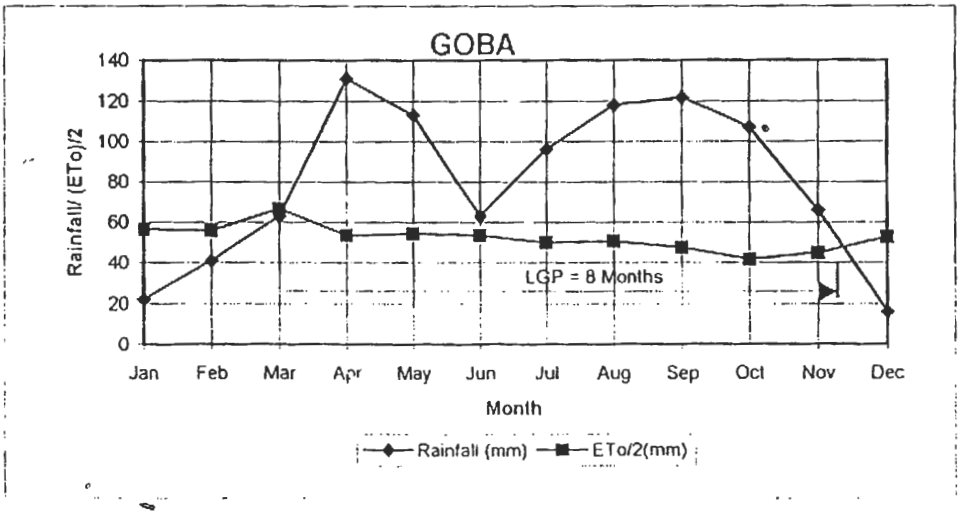
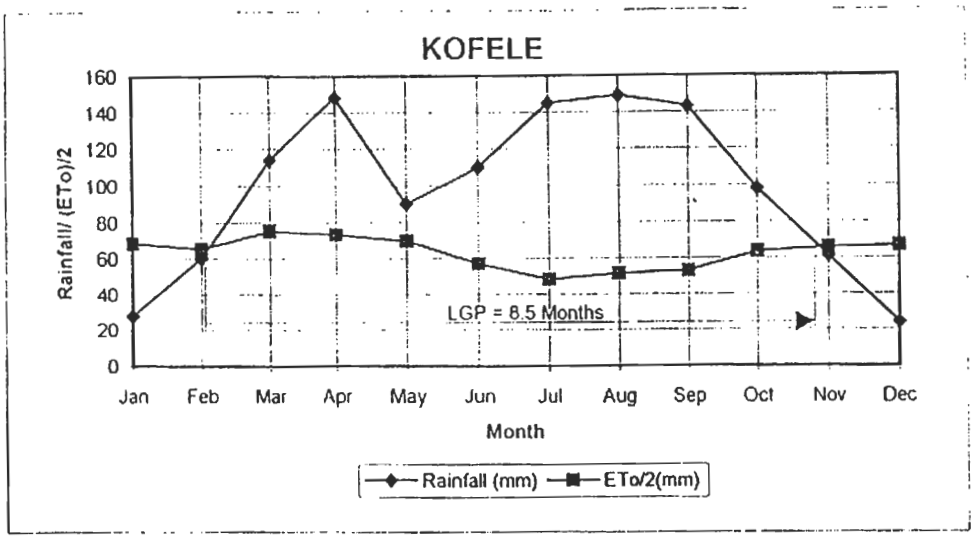
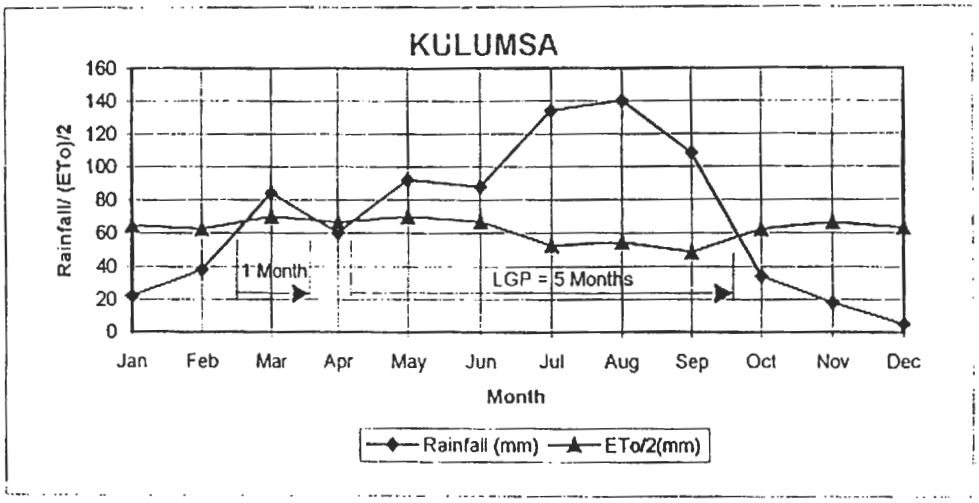


Fig. 2.8-1 Length of Growing Period (cont'd)





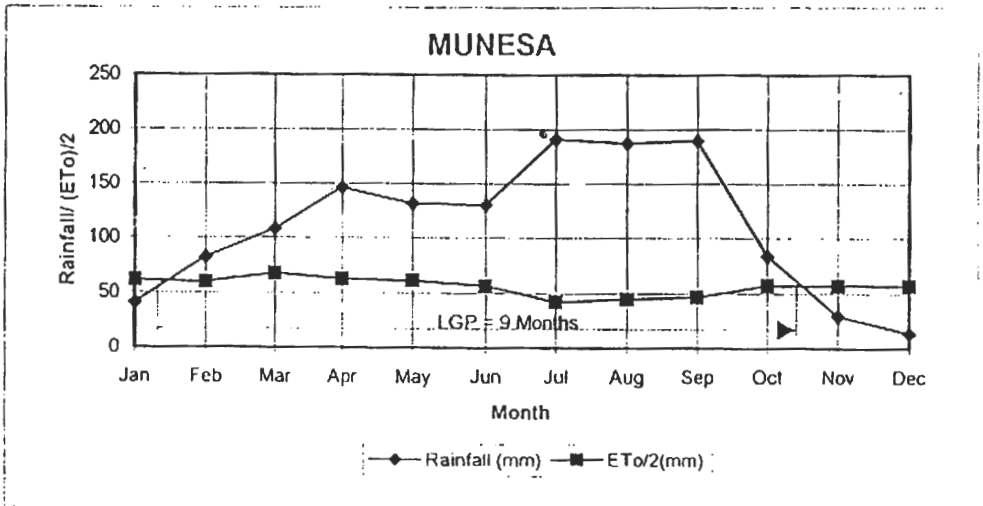
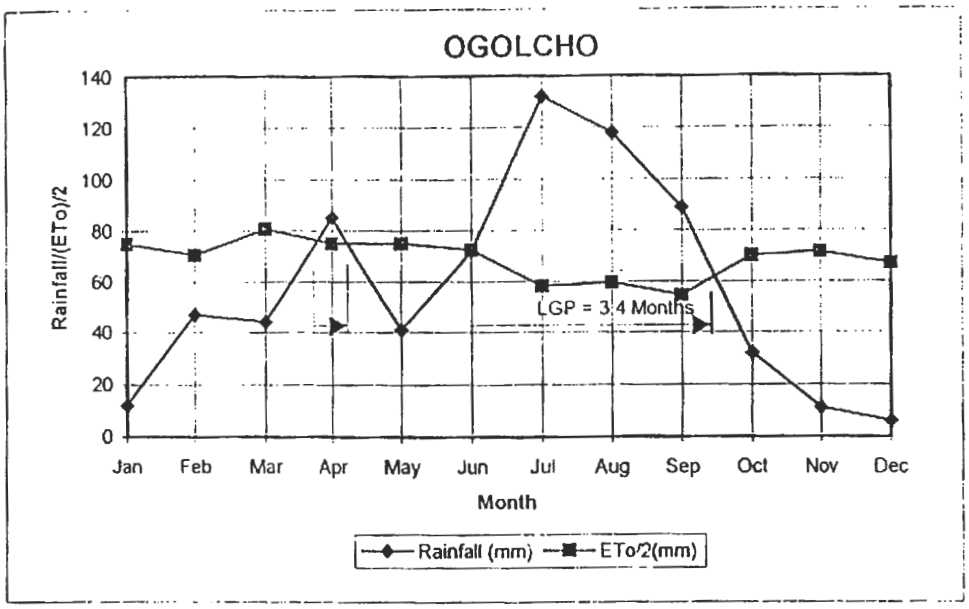
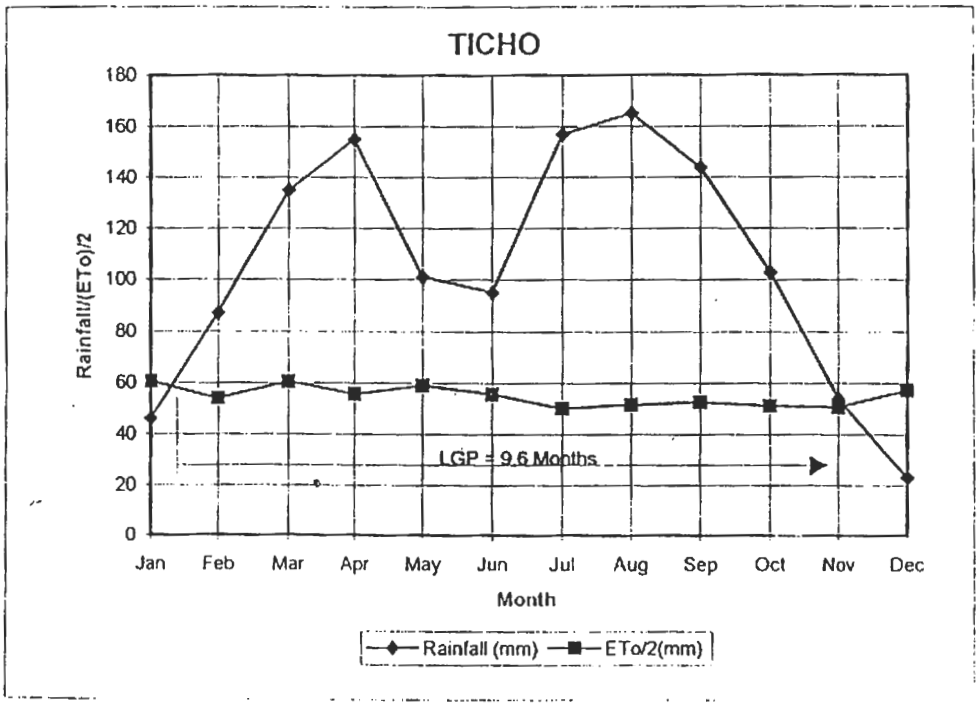


Fig. 2.8-1 Length of Growing Period (cont'd)





3.0 HYDROLOGY

3.1 *Availability of Data*

Flow and flood data for some of the gauged rivers in the project area were obtained from the Ministry of Water Resources, Hydrology Department. Relevant information on the availability of flow/flood data for the rivers in the project area have been given in Table 3.1-1. It should be noted that some of the data are only secondary data; therefore, they are not up to date The observed and infilled data tables have been provided in Appendix II.

Table 3.1-1 Availability of Flow/Flood Data

Ser No.	Element	Name of River	Period of Observation	Record Length (Years)	Remarks
1.	Monthly Flow	Ashebeka	1982 – 93	12	Some missing
		Ketar	1982 – 95	14	Some missing
		Wabe	1967 – 96	29	Some missing
		Weyib	1980 – 95	16	Some missing
		Robe	1979 – 93	15	Some missing
		Lelisso	1975 – 84	9	Some missing
		Keleta *	1962 - 87	25	Some missing
2.	Maximum Mean Daily Peak (MMD)	Ashebeka	1982 – 91	10	
		Ketar	1983 – 91	9	
		Wabe	1967 – 90	23	1 record missing
		Weyib	1981 – 92	12	
		Robe	1979 – 93	14	1 record missing
		Lelisso	1975 - 84	9	Some missing
		Keleta *	None	None	
3	Momentary Flood Peak	Ashebeka	None	None	
		Ketar	None	None	
		Wabe	None	None	
		Weyib	1981 – 92	6	Some missing
		Robe	None	None	
		Lelisso	None	None	
		Keleta	None	None	

* Source Awash Master Plan, 1989.

It may be noted from Table 3.1-1 that only Weyib River has some Momentary Flood Peak data and the remaining do not have such data.

Water quality samples were obtained from eight representative perennial rivers which cross the Nazret Assela – Dodola and Shashmene – Goba highways These are Ashebeka, Wabe, Herero, Zetegn Melka, Weyib, Shaya, Ukuma and Totolamo rivers.

3.2 Monthly Flow of Gauged Rivers in Arsi-Bale Zones

3.2.1 Introduction

Several rivers have been identified to be perennial based on the experience of the project area obtained from previous studies. Estimation of available flows in these rivers have been made using the observed flow data for representative gauged rivers obtained from the Ministry of Water Resources, Hydrology Department. These are given in Table 3.2-1.

Table 3.2-1 List of Representative Gauged Rivers

Name of River	Sub-basin
Keleta	Awash
Ashebeka	Rift Valley Lakes
Wabe & Lelisso	Wabi Shebelle
Weyib	Genale

The observed monthly flow data have been provided in Appendix II.1.2. The available flow data from the above mentioned gauged rivers have been used for estimating flow data for some perennial rivers flowing through the project area.

3.2.2 Monthly Flow Statistics of Gauged Rivers

Monthly flow statistics for the rivers mentioned above have been given in Table 3.2-2. The monthly flow distribution for these rivers have been shown in Figure 3.2-1.

Flow data obtained from the gauged rivers mentioned in Table 3.2-1 have been used in estimating the monthly flow distribution of other rivers in the project area.

Table 3.2-2 Monthly Flow Statistics of Gauged Rivers

(in Million Cubic Meters)

Ashebeka River nr. Sagure

WA = 236 Km²

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	1.60	1.68	2.05	3.05	2.78	2.44	5.86	16.41	6.72	3.26	1.86	1.79	49.5
Max.	1.99	2.79	3.92	6.09	6.80	4.38	18.94	47.85	9.14	5.18	2.33	2.06	91.65
Min.	0.90	1.03	0.93	1.27	1.40	1.61	2.69	3.36	3.24	1.90	1.48	1.28	32.2
St.Dev.	0.38	0.50	0.77	1.47	1.42	0.88	4.37	13.42	1.78	1.11	0.29	0.24	18.30
Cv	0.24	0.29	0.38	0.48	0.51	0.36	0.75	0.82	0.27	0.34	0.16	0.13	0.37
% of MAF	3.2	3.4	4.1	6.2	5.6	4.9	11.8	33.2	13.6	6.6	3.7	3.6	100

Wabe River d/s of Bridge Crossing nr. Dodola

WA = 1035 Km²

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	5.16	6.22	8.45	14.31	15.67	15.65	28.49	47.39	42.05	22.40	9.54	6.44	221.8
Max.	10.37	19.20	20.10	46.92	65.51	44.18	54.40	79.55	83.00	59.28	41.73	25.95	386.9
Min.	1.94	3.10	3.29	3.63	5.40	4.25	6.42	19.87	23.22	6.52	4.07	3.04	124.3
St.Dev.	2.04	4.066	4.95	11.57	12.88	10.09	13.7	16.34	13.02	13.29	7.939	4.932	60.5
Cv	0.40	0.65	0.59	0.81	0.82	0.64	0.48	0.34	0.31	0.59	0.83	0.77	0.27
% of MAF	2.3	2.8	3.8	6.5	7.1	7.1	12.8	21.4	19.0	10.1	4.3	2.9	100

Lelisso R. at Adaba

WA = 126.3 Km²

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	0.941	1.05	1.589	8.387	6.507	1.536	8.277	43.76	10.13	10.91	3.76	1.659	98.4978
Max.	2.62	2	3.75	29.61	26.52	3.79	15.15	116.4	23.89	28.8	15.28	5.65	206.52
Min.	0.49	0.45	0.51	0.81	0.64	0.6	1.98	6.42	4.81	1.9	0.77	0.55	26.23
St.Dev	0.689	0.603	1.245	11.15	8.772	0.969	4.391	39.75	5.854	10.15	4.516	1.555	56.5022
Cv	0.732	0.574	0.784	1.329	1.348	0.631	0.531	0.908	0.578	0.931	1.201	0.938	0.57364
% of MAF	0.955	1.066	1.613	8.515	6.606	1.559	8.403	44.43	10.28	11.07	3.817	1.684	100

Table 3.2-2 Monthly Flow Statistics of Gauged Rivers (cont'd)

Weyib River nr. Agarfa

WA=771.9 Km²

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	1.19	4.09	3.23	20.51	16.03	3.73	11.36	36.05	12.98	18.08	4.11	3.11	134.5
Max.	7.07	40.70	14.20	90.95	57.31	25.43	32.70	95.64	30.02	47.12	13.03	12.81	208.39
Min.	0.36	0.41	0.35	0.45	1.42	0.71	1.28	4.01	3.52	2.38	0.90	0.54	45.58
St.Dev.	1.64	10.08	4.35	24.82	16.35	6.06	9.33	28.49	8.43	14.75	3.69	4.04	45.85
Cv	1.37	2.46	1.35	1.21	1.02	1.62	0.82	0.79	0.65	0.82	0.90	1.30	0.34
% of MAF	0.9	3.0	2.4	15.3	11.9	2.8	8.5	26.8	9.6	13.4	3.1	2.3	100

Ketar River nr. Sagure

WA=1950 Km²

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	4.6	6.6	8.3	14.1	13.3	11.9	38.4	134.0	64.5	24.0	8.1	6.0	333.7
Max.	6.7	26.9	43.4	44.4	36.3	35.5	67.7	293.3	113.1	76.1	18.8	10.5	571.3
Min.	3.3	3.4	3.2	4.1	4.7	4.5	14.8	51.2	20.6	6.0	2.5	3.3	180.4
St.Dev.	1.17	6.23	10.28	12.68	9.70	9.36	17.44	66.14	24.51	19.96	4.68	2.25	111.02
Cv	0.25	0.95	1.24	0.90	0.73	0.79	0.45	0.49	0.38	0.83	0.57	0.38	0.33
% of MAF	1.4	2.0	2.5	4.2	4.0	3.6	11.5	40.2	19.3	7.2	2.4	1.8	100

Robe River nr. Robe

WA=171 Km²

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	1.20	2.45	0.95	3.11	4.21	0.93	4.14	8.42	5.01	4.05	1.78	0.51	36.77
Max.	12.54	17.23	4.96	10.79	13.80	2.19	19.34	19.52	13.68	10.67	13.65	2.32	73.91
Min.	0.03	0.01	0.00	0.02	0.02	0.03	0.95	2.31	0.94	0.57	0.23	0.10	16.70
St.Dev.	3.16	5.32	1.56	3.61	4.35	0.65	4.51	5.30	3.29	3.07	3.40	0.56	16.33
Cv	2.62	2.17	1.65	1.16	1.03	0.70	1.09	0.63	0.66	0.76	1.91	1.11	0.44
% of MAF	3.3	6.7	2.6	8.5	11.5	2.5	11.3	22.9	13.6	11.0	4.9	1.4	100.0

Fig. 3.2-1 Monthly Flow Distribution of Gauged Rivers

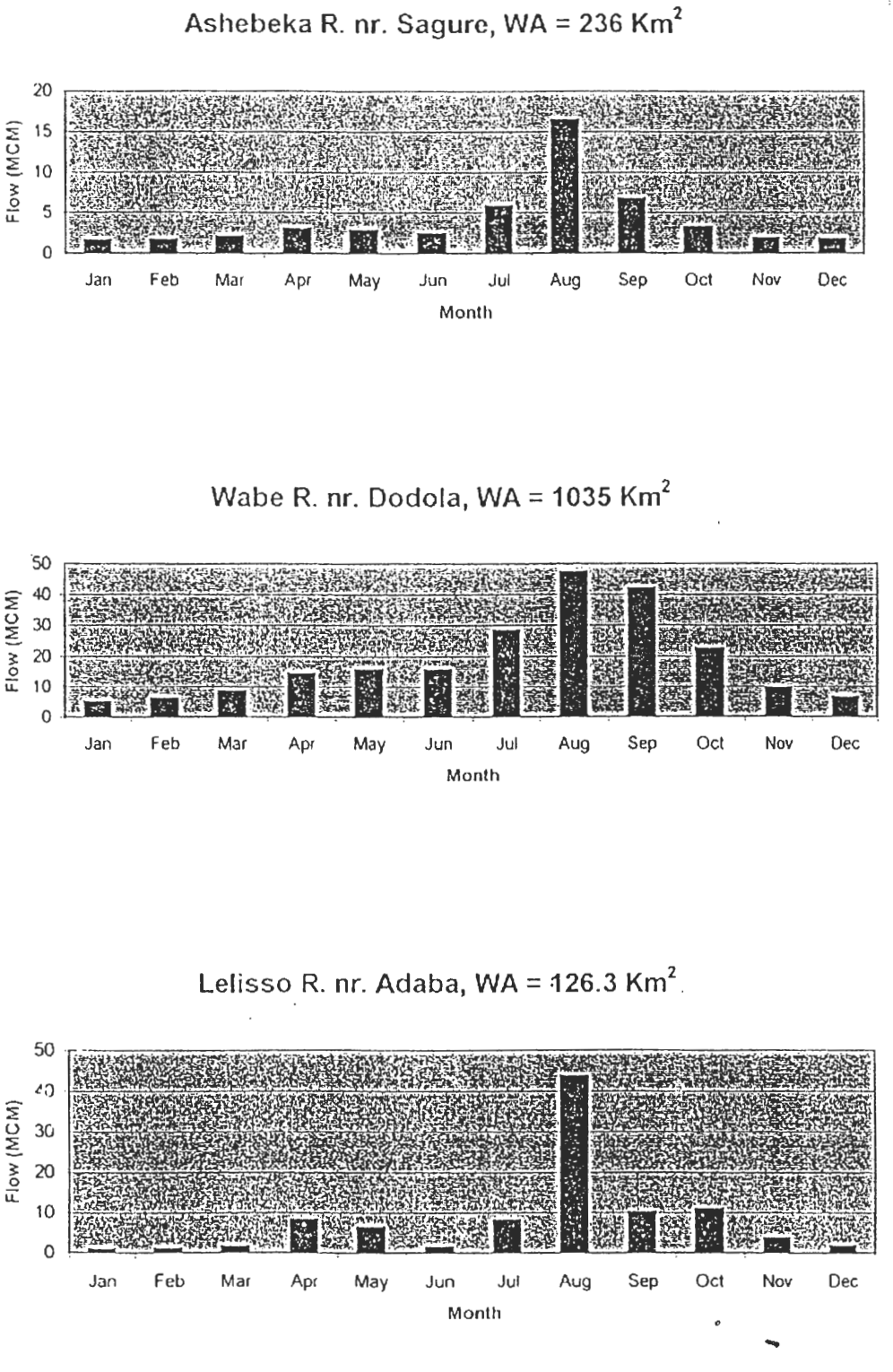
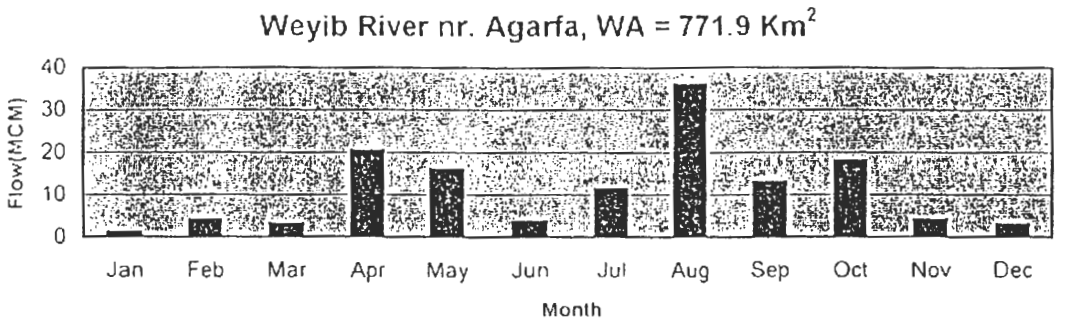
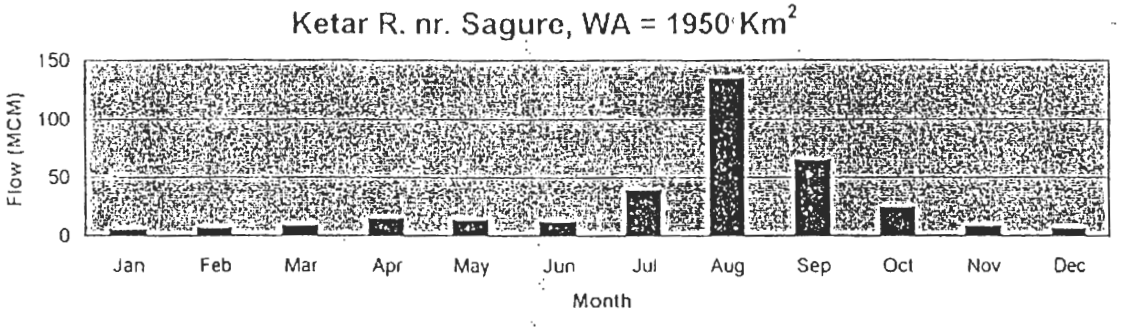
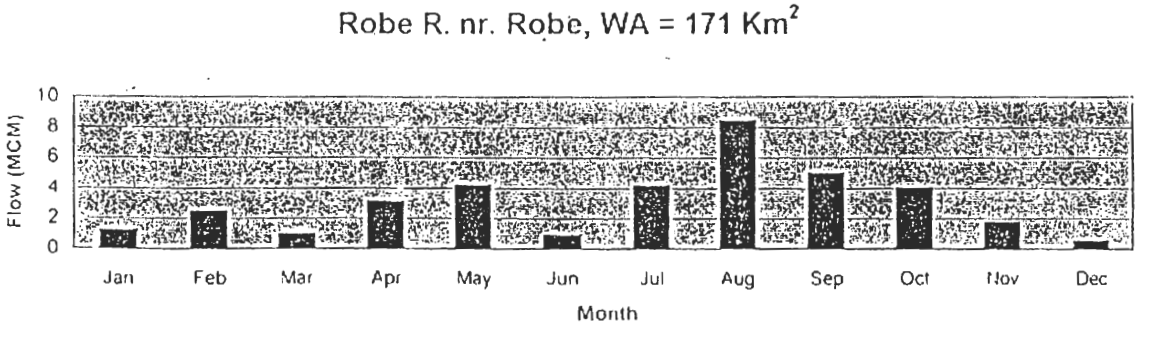


Fig. 3.2-1 Mean Monthly Flow for Representative Gauged Rivers (cont'd)







3.3 Flood Flows

3.3.1 Introduction

Observed Maximum Daily Peak (MMD) for the rivers listed in Table 3.1-1 abstracted from the original 'SUMMARY OF HYDROMETRIC DATA' records obtained from the Ministry of Water Resources, Hydrology Department have been provided in the tables given in Appendix II.2. Also, values of pertinent statistics which are required for regional analysis have been computed therein, these statistics are the Mean, Standard Deviation and the Coefficient of Variation (C_v).

3.3.2 Regional Flood Analysis

Values of pertinent statistics required for flood frequency analysis computed using the data provided in Appendix II.2 have been reproduced in Table 3.3-1. Specific Flood, i.e. values of flood per unit Km^2 area, obtained by dividing the average of the Maximum Mean Daily (MMD) peak values by their respective watershed areas have been provided in Table 3.3-1.

Correlation of the Mean Annual Specific Flood (q) with Watershed Area (WA) was carried out in Fig. 3.3-1. The regression equation obtained along with its Coefficient of Determination ($r^2 = 0.555$) indicate the existence of some correlation. Values of the Specific Flood computed using the observed data and those computed using the regression equation have been plotted in Figure 3.3-1 for comparison. It may be noted that the values computed using the equation fall midway between the observed values. Therefore, the regression equation appears to be reasonably good. Values of the Specific Flood computed using the equation for different watershed areas have been provided in Table 3.3-2 and shown in a log-log plot in Fig. 3.3-2 as a straight line. Design floods of different return return periods versus watershed area for the region have been plotted in Fig. 3.3-3

Table 3.3-1 Regional Flood Analysis

Ser. No.	Name of River	WA (km^2)	Q_{mean}* (m^3/s)	Cv	Sp. Flood $q_{obs.}$	Log. WA	Log. $q_{obs.}$	q (Eq.)
1	Ketar	1,975	120.7	0.64	0.06	3.2956	-1.214	0.05
2	Ashebek	236	19.6	0.98	0.08	2.3727	-1.080	0.14
3	Wabe	1,035	46.0	0.34	0.04	3.0149	-1.352	0.07
4	Weyib	772	82.3	0.63	0.11	2.8876	-0.972	0.08
5	Robie	171	42.5	0.60	0.25	2.2330	-0.605	0.16
* Mean Q_{mmdp}			Av. C_v =	0.64				

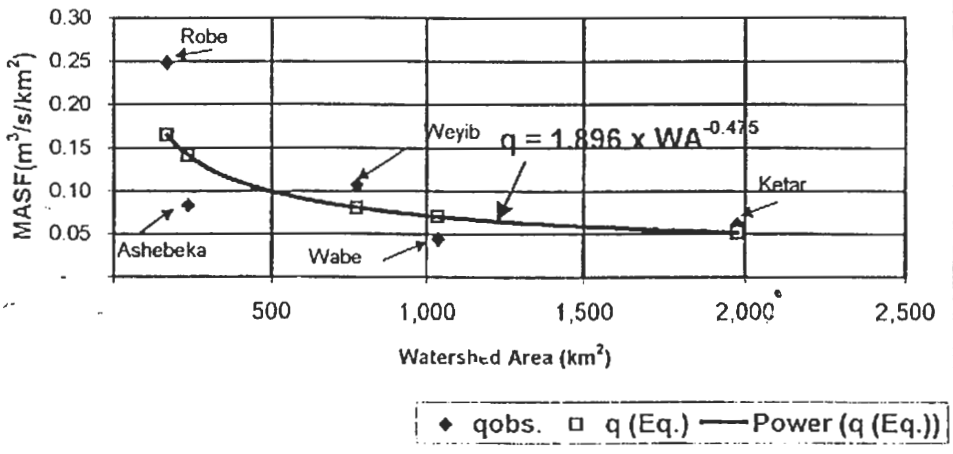
$q = a \times (WA)^b$

$\text{Log } q = \text{Log } a + b \times \text{Log}(WA)$

b = -0.47475	Log a = 0.265996		a = 1.896
r^2 = 0.554666			

$q = 1.896 \times WA^{-0.475}$

Fig. 3.3-1 Correlation of Mean Annual Specific Flood with Watershed Area

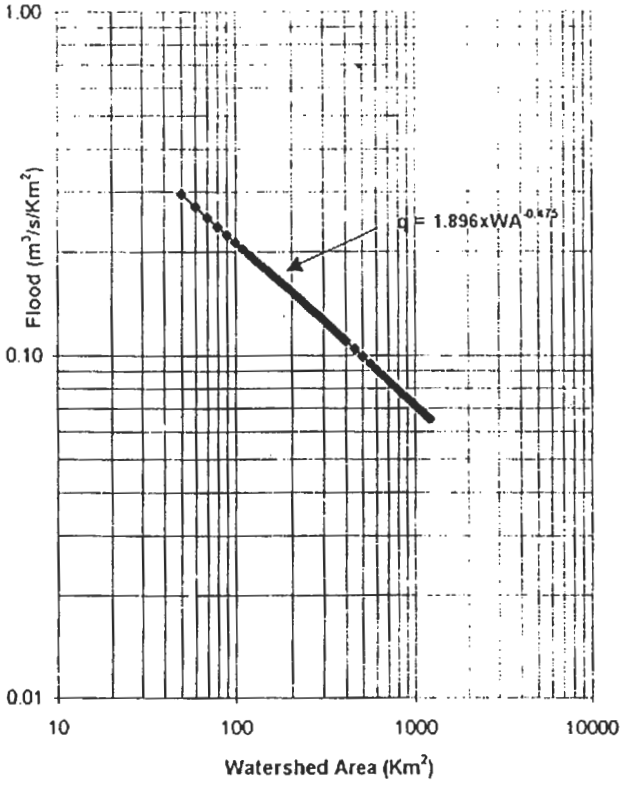


NOTE:
- MASF: Mean Annual Specific Flood

Table 3.3-2 Mean Annual Specific Flood Versus Watershed Area

WA (km^2)	MASF ($m^3/s/km^2$)
50	0.296
60	0.271
70	0.252
80	0.237
90	0.224
100	0.213
110	0.203
120	0.195
130	0.188
140	0.181
150	0.175
160	0.170
170	0.165
180	0.161
190	0.157
200	0.153
210	0.150
220	0.146
230	0.143
240	0.140
250	0.138
260	0.135
270	0.133
280	0.130
290	0.128
300	0.126
310	0.124
320	0.122
330	0.121
340	0.119
350	0.117
360	0.116
370	0.114
380	0.113
390	0.111
400	0.110
450	0.104
500	0.099
550	0.095
600	0.091
650	0.087
700	0.084
750	0.082
800	0.079
850	0.077
900	0.075
950	0.073
1000	0.071

Fig. 3.3-2 Mean Annual Specific Flood Versus Watershed Area



3.3.3 Flood Frequency Analysis

The analysis was carried out using the Specific Flood values computed in Section 3.2 along with Boldakov's Method which was employed in rainfall intensity frequency analysis in Section 2.5

Boldakov's formula has been reproduced in the following for estimating the magnitudes of floods of different return periods.

$$Q(T) = (Q(T)/Q_{mean}) \times Q_{mean}$$

Where:

Q(T) – Magnitude of flood of T year return period(m^3/s)

Q_{mean} – Mean of observed annual maximum floods(m^3/s)

The frequency analysis has been carried out using Boldakov's Method in Table 3-4 Values of $Q(T)/Q_{mean}$ for C_v of 0.64 for various return periods were obtained from Figure 2.5-1. Magnitudes of design floods for different watershed areas and return periods of 5, 10, 25, 50 and 100 years return periods have been computed in Table 3-4 using this method.

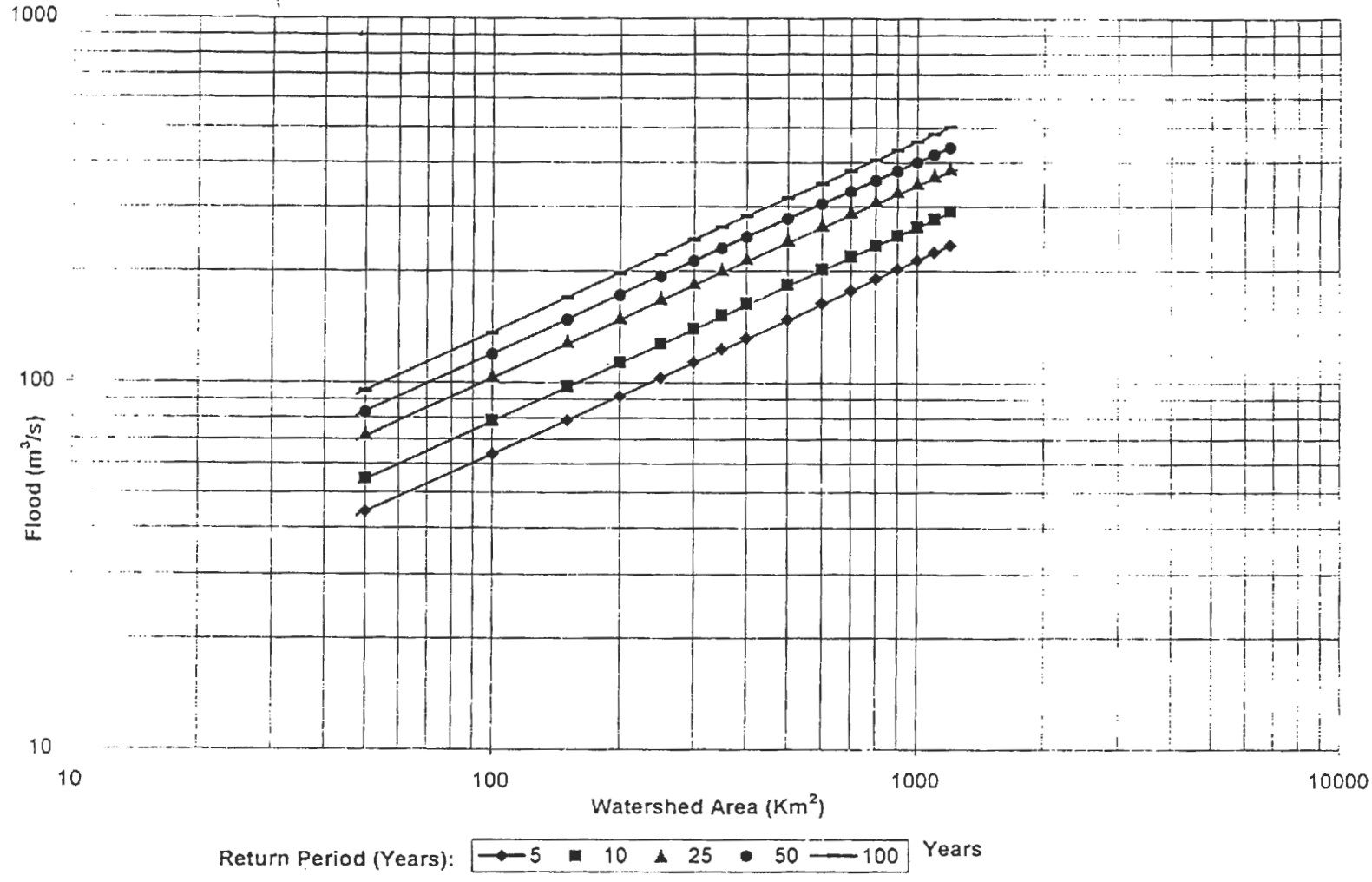
Flood regression equations were derived for various return periods based on the specific flood formula which was derived earlier incorporating the values of the multiplying factor for various return periods obtained from Bolkdakov's curves, Figure 2.5-1. The values of design floods of various return periods for different watershed areas computed using these regression equations have been shown in the log-log plot given in Figure 3.3-3. These values may be used for the design of hydraulic structures for watershed areas exceeding 50 km^2

Table 3.3-3 Design Floods of Different Return Periods for Various Watershed Areas

WA	MAF	Return Period (Years)				
		5	10	25	50	100
(km^2)	($m^3/s/km^2$)	1.500	1.850	2.450	2.800	3.200
50	0.296	44.4	54.7	72.4	82.8	94.6
60	0.271	48.8	60.2	79.7	91.1	104.1
70	0.252	52.9	65.3	86.4	98.8	112.9
80	0.237	56.8	70.0	92.7	106.0	121.1
90	0.224	60.4	74.5	98.6	112.7	128.8
100	0.213	63.8	78.7	104.2	119.1	136.2
110	0.203	67.1	82.8	109.6	125.2	143.1
120	0.195	70.2	86.6	114.7	131.1	149.8
130	0.188	73.2	90.3	119.6	136.7	156.3
140	0.181	76.2	93.9	124.4	142.1	162.5
150	0.175	79.0	97.4	129.0	147.4	168.4
160	0.170	81.7	100.7	133.4	152.5	174.3
170	0.165	84.3	104.0	137.7	157.4	179.9
180	0.161	86.9	107.2	141.9	162.2	185.4
190	0.157	89.4	110.3	146.0	166.9	190.7
200	0.153	91.8	113.3	150.0	171.4	195.9
210	0.150	94.2	116.2	153.9	175.9	201.0
220	0.146	96.5	119.1	157.7	180.2	206.0
230	0.143	98.8	121.9	161.4	184.5	210.8
240	0.140	101.1	124.6	165.1	188.6	215.6
250	0.138	103.2	127.3	168.6	192.7	220.3
260	0.135	105.4	130.0	172.1	196.7	224.8
270	0.133	107.5	132.6	175.6	200.7	229.3
280	0.130	109.6	135.1	179.0	204.5	233.8
290	0.128	111.6	137.7	182.3	208.3	238.1
300	0.126	113.6	140.1	185.6	212.1	242.4
310	0.124	115.6	142.6	188.8	215.8	246.6
320	0.122	117.5	145.0	192.0	219.4	250.7
330	0.121	119.4	147.3	195.1	223.0	254.8
340	0.119	121.3	149.6	198.2	226.5	258.8
350	0.117	123.2	151.9	201.2	230.0	262.8
360	0.116	125.0	154.2	204.2	233.4	266.7
370	0.114	126.8	156.4	207.2	236.8	270.6
380	0.113	128.6	158.6	210.1	240.1	274.4
390	0.111	130.4	160.8	213.0	243.4	278.2
400	0.110	132.1	163.0	215.8	246.7	281.9
450	0.104	140.6	173.4	229.6	262.4	299.9
500	0.099	148.6	183.2	242.7	277.3	316.9
550	0.095	156.2	192.6	255.1	291.6	333.2
600	0.091	163.5	201.6	267.0	305.2	348.8
650	0.087	170.5	210.3	278.5	318.3	363.7
700	0.084	177.3	218.6	289.5	330.9	378.2
750	0.082	183.8	226.7	300.2	343.1	392.1
800	0.079	190.1	234.5	310.6	354.9	405.6
850	0.077	196.3	242.1	320.6	366.4	418.8
900	0.075	202.3	249.5	330.4	377.6	431.5
950	0.073	208.1	256.7	339.9	388.4	443.9
1000	0.071	213.8	263.7	349.2	399.0	456.1
1050	0.070	219.3	270.5	358.2	409.4	467.9
1100	0.068	224.7	277.2	367.1	419.5	479.5
1150	0.067	230.1	283.7	375.8	429.4	490.8
1200	0.065	235.3	290.1	384.2	439.1	501.9

REGRESSION EQUATIONS
$Q_5 = 5.688 \cdot WA^{0.525}$
$Q_{10} = 7.015 \cdot WA^{0.525}$
$Q_{25} = 9.29 \cdot WA^{0.525}$
$Q_{50} = 10.62 \cdot WA^{0.525}$
$Q_{100} = 12.13 \cdot WA^{0.525}$

Fig. 3.3-3 Design Floods of Different Return Periods
Versus Watershed Area



3.3.4 Rational Method

General

The Rational Method may be used for computing magnitudes of design floods for watershed areas less than 50 km^2 The Rational Formula is given in the following.

$$Q = 0.28 \times A \times C \times I_C \times f$$

Where:

Q – Maximum runoff in m^3/s

A – Watershed Area in Km^2

C – Runoff Coefficient

I_C – Critical Rainfall Intensity in mm/hr

f – Watershed area reduction factor

The critical rainfall intensity for a given rainfall duration equal to the Time of Concentration (t_c) and return period may be estimated from Table 2.5-4 or Fig. 2.5-1.

The Time of Concentration has been computed using the following formula (Kadiyali, 1989):

$$t_c = (0.87 * L^3/H)^{0.385}$$

Where:

- t_c – Time of Concentration in hours
- L – Maximum Length of Travel of Water (MLTW) in Km
- H – Difference in elevation between the remotest point on the watershed and the outlet in meters.

The maximum length of travel of water and the difference in elevation between the remotest point on the watershed and the outlet for each watershed may be obtained from a suitable scale map of the project area.

Runoff Coefficient (C)

Values of the Runoff Coefficient (C) for various watershed land uses and slopes provided in ERA procedures given in Table 3.3-4 may be used. However, since the values for the land use 'Cultivated Area' were found to be too high, they have been reduced somewhat based on values given for these in other references (e.g. Mutreja, 1986; Kadiyali, 1989).

Watershed Area Reduction Factor (f)

Values of watershed area reduction factor for watershed area up to 200 Km^2 for use in the Rational Formula obtained from ERA procedures are given in Table 3.3-5.

Regression of watershed area reduction factor on watershed area has been made in Figure 3.3-4. The resulting trend-line equation is given in the following:

$f = -0.0932 \times Ln(WA) + 1.1539$

Where:

f – watershed area reduction factor

WA- Watershed Area in Km^2

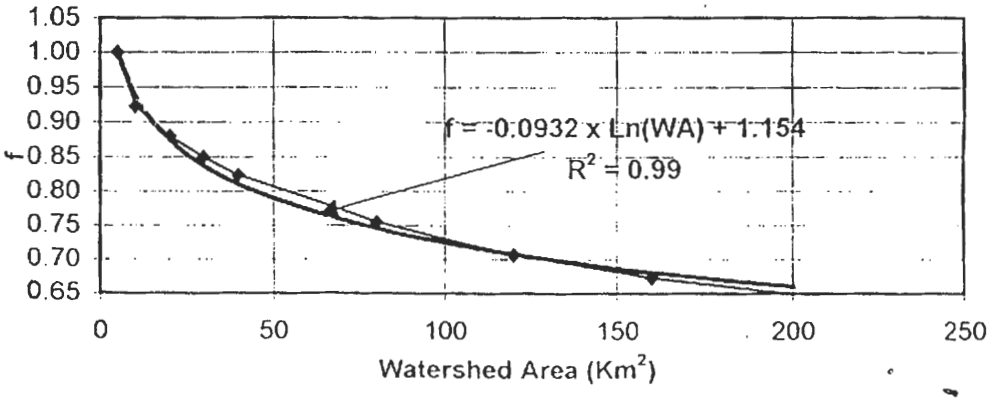
Table 3.3-4 Values of Runoff Coefficient in Rational Formula

Land Use	Slope			
	Flat 4 - 7%	Rolling 8 - 10%	Hilly 11 - 20%	Mountainous 21 - 30%
Paved Area	0.80	0.85	0.90	0.95
Bare Area	0.70	0.75	0.80	0.85
Cultivated Area	0.30	0.35	0.40	0.50
Grass Land	0.20	0.25	0.30	0.40
Forest	0.10	0.15	0.20	0.30

Table 3-6 Values of Watershed Area Reduction Factor in Rational Formula

Watershed Area (km^2)	Area Reduction factor (f)
5	1.000
10	0.923
20	0.880
30	0.850
40	0.823
80	0.755
120	0.707
160	0.673
200	0.649

Figure 3.3-4 Regression of Watershed Area Reduction Factor on Watershed Area



4.0 SURFACE WATER RESOURCES

4.1 Drainage Basins

4.1.1 Introduction

There are four drainage sub-basins in Arsi & Bale Zones (Fig. 4.1-1). They are:

- The Awash River Sub-basin
- The Rift Valley Lakes Sub-basin
- Wabi Shebelle Sub-basin
- The Genale Sub-basin

4.1.2 The Awash River Sub-basin

This sub-basin is situated in the northern part of the project area. It occupies only a small portion of the project area. The major rivers in this sub-basin are Keleta, Wererso and Arba.

4.1.3 The Rift Valley Lakes Sub-basin

This sub-basin is situated in the western part of the project area. It occupies a modest portion of the project area. The major rivers in this sub-basin are the Ketar, Melka Bedi and Awariftu which empty in to Lake Ziway, the Dedeba and Awade in to Lake Shala and the Kersa, Dalele & Metana, Jirma, Konkolata and Yebelo in to Lake Langeno. All of them flow to the west.

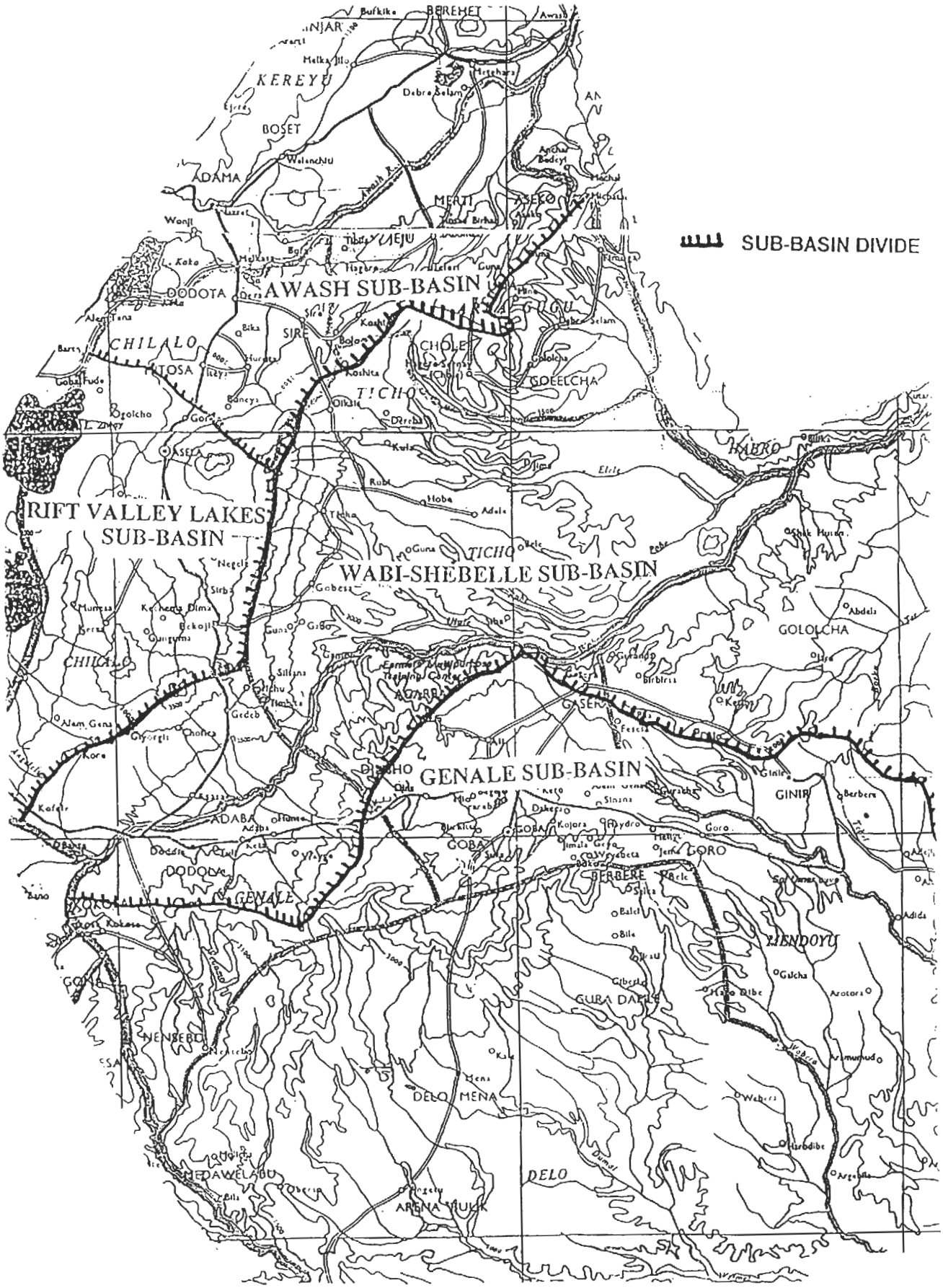
4.1.4 The Wabi Shebelle Sub-basin

This sub-basin extends from the western to the eastern part of the project. It occupies a very large portion of the project area. The major rivers in this sub-basin are the Wabe, Ulule, Robe, Pobe and Elele all of which flow to the east to join the Wabi Shebelle River.

4.1.5 The Genale Sub-basin

This sub-basin is situated in the southern part of the project area. It occupies a modest portion of the project area, but only a small portion of the whole Genale sub-basin. The major rivers in this sub-basin are the Weyib, Wabe Mena. Other rivers such as the Welmel

FIGURE 4.1-1 DRAINAGE SUB-BASINS IN THE PROJECT AREA



4.2 Estimation of River Flow

Flow data for representative gauged rivers were obtained from the Hydrology Department of the Ministry of Water Resources. The observed monthly and annual flow statistics in these rivers have been given in Table 3.2-2. The mean monthly flows in these rivers have been shown in Fig. 3-2-1 The observed monthly discharges presented by the Hydrology Department of the Ministry of Water Resources have been given in Appendix II.1.2.

A regression analysis of the mean annual flow of six gauged rivers on their respective watershed areas has been done using Table 4.2-1 and a regression equation established in Figure 4.2-1. The value of the Coefficient of Determination, $r^2 = 0.98$, obtained indicates a high correlation. Estimation of mean annual flow in the perennial rivers of the project area has been made using the equation given in Fig. 4.2-1 reproduced in the following.

$$MAF = 0.168 \times WA + 16$$

Where:

MAF – Mean Annual Flow (in Million Cubic Meters)

WA - Watershed Area (Km^2)

The estimation of the monthly flows using the above mentioned equation is described in the following:

- the mean annual flow for the given river is estimated using the regression equation given above;
- the percentage of the annual flow of the river for each month is determined using the mean monthly flow distribution of a gauged river located in the same sub-basin as the river under consideration;
- finally, the mean monthly flow of the given river is estimated by multiplying its estimated mean annual flow by the monthly flow percentage for the respective month.

Estimated mean monthly/annual flow of some of the perennial rivers flowing through the project area obtained using the procedure described above have been provided in Table 4.2-2.

Table 4.2-1 Observed Mean Monthly/Annual Flow
of Gauged Rivers in the Project Area

Ser. No.	Name of River	WA (Km^2)	MAF (MCM)	Month/Mean Monthly Flow(Million Cubic Meters)											
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Keleta nr. Sire	746.9	147.6	3.55	3.77	6.30	7.39	8.65	7.19	20.80	37.57	31.76	12.07	4.88	3.68
2	Robe nr. Robe	171.0	36.8	1.20	2.45	0.95	3.11	4.21	0.93	4.14	8.42	5.01	4.05	1.78	0.51
3	Ashebeka nr Sagure	235.9	49.5	1.60	1.68	2.05	3.05	2.78	2.44	5.86	16.41	6.72	3.26	1.86	1.79
4	Kelar nr Sagure	1975.0	333.7	3.55	3.77	6.30	7.39	8.65	7.19	20.80	37.57	31.76	12.07	4.88	3.68
5	Wabe nr Dodola	1035.0	221.8	5.16	6.22	8.45	14.31	15.67	15.65	28.49	47.39	42.05	22.40	9.54	6.44
6	Weyib nr Agarfa	771.9	134.5	1.19	4.09	3.23	20.51	16.03	3.73	11.36	36.05	12.98	18.08	4.11	3.11

Fig. 4.2-1 Correlation of Mean Annual Flow with Watershed Area

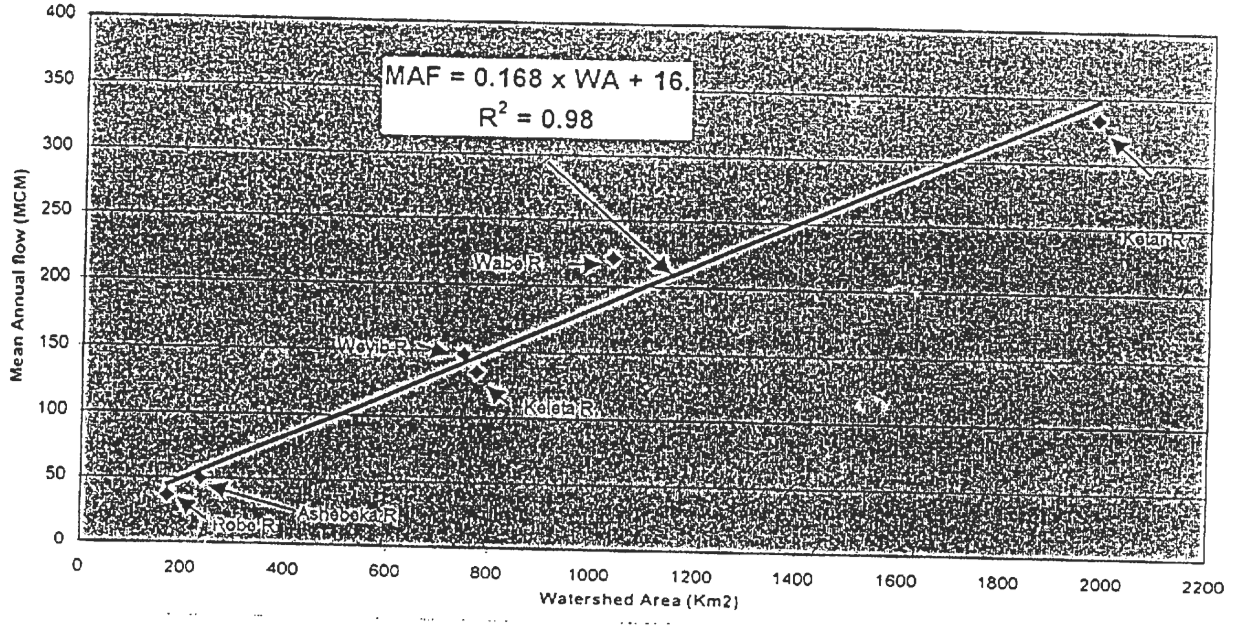


Table 4.2-2 Estimated Mean Monthly Flow of Some Perennial Rivers in the Project Area

Ser. No.	Name of River	WA (Km^2)	MAF (MCM)	Month/Mean Monthly Flow(Million Cubic Meters)											
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Keleta nr. Sire	746.9	147.6	3.55	3.77	6.30	7.39	8.65	7.19	20.80	37.57	31.76	12.07	4.88	3.68
2	Ashebeka nr. Sagure	235.9	49.5	1.60	1.68	2.05	3.05	2.78	2.44	5.86	16.41	6.72	3.26	1.86	1.79
3	Dergo @ Bridge Crossing	204.1	50.3	1.63	1.71	2.08	3.10	2.83	2.48	5.95	16.67	6.83	3.31	1.88	1.82
4	Ketar nr. Sagure	1975.0	333.7	4.61	6.59	8.29	14.07	13.25	11.86	38.41	134.02	64.46	24.01	8.15	5.99
5	Gosha Gobe-Lencha @ Bridge Crossing	89.0	31.0	1.00	1.05	1.28	1.91	1.74	1.52	3.67	10.26	4.20	2.04	1.16	1.12
6	Kela & Kersa @ Bridge Crossing	74.0	28.4	0.92	0.97	1.18	1.75	1.60	1.40	3.37	9.43	3.86	1.87	1.07	1.03
7	Wabe nr Dodola	1035.0	221.8	5.16	6.22	8.45	14.31	15.67	15.65	28.49	47.39	42.05	22.40	9.54	6.44
8	Alawanso @ Bridge Crossing	111.3	34.7	0.81	0.97	1.32	2.24	2.45	2.45	4.46	7.41	6.58	3.51	1.49	1.01
9	Kora @ Bridge Crossing	141.9	39.8	0.93	1.12	1.52	2.57	2.81	2.81	5.12	8.51	7.55	4.02	1.71	1.16
10	Herero @ Herero Village	118.8	36.0	0.84	1.01	1.37	2.32	2.54	2.54	4.62	7.68	6.82	3.63	1.55	1.04
11	Meribo @ Chata Village	204.4	50.3	1.17	1.41	1.92	3.25	3.56	3.55	6.47	10.76	9.55	5.09	2.16	1.46
12	Nanesha nr. Ejersa	68.8	27.6	0.64	0.77	1.05	1.78	1.95	1.94	3.54	5.89	5.23	2.78	1.18	0.80
13	Lelisso nr Adaba	126.3	98.5	0.94	1.05	1.59	8.39	6.51	1.54	8.28	43.76	10.13	10.91	3.76	1.66
14	Furunya @ Bridge Crossing	89.4	31.0	0.28	0.94	0.74	4.73	3.70	0.86	2.62	8.32	2.99	4.17	0.95	0.72
15	Weyib nr. Agarfa	771.9	134.5	1.19	4.09	3.23	20.51	16.03	3.73	11.36	36.05	12.98	18.08	4.11	3.11
16	Denka nr. Dinsho	79.4	29.3	0.26	0.89	0.70	4.47	3.50	0.81	2.48	7.87	2.83	3.94	0.90	0.68
17	Shaya nr. Robe	473.1	95.5	0.85	2.91	2.29	14.56	11.38	2.65	8.07	25.60	9.21	12.84	2.92	2.21
18	Ukuma nr. Edo Village	181.3	46.5	1.08	1.30	1.77	3.00	3.28	3.28	5.97	9.93	8.81	4.69	2.00	1.35
19	Wabe nr. Wabe Village	510.2	101.7	2.37	2.85	3.87	6.56	7.19	7.18	13.07	21.74	19.29	10.28	4.37	2.95
20	Ashoka @ Bridge Crossing	81.7	29.7	0.69	0.83	1.13	1.92	2.10	2.10	3.82	6.35	5.64	3.00	1.28	0.86
21	Totolamo nr. Kofele	104.1	33.5	0.78	0.94	1.28	2.16	2.37	2.36	4.30	7.16	6.35	3.38	1.44	0.97
22	Robe nr. Robe	171.0	36.8	1.20	2.45	0.95	3.11	4.21	0.93	4.14	8.42	5.01	4.05	1.78	0.51

Note

- WA: Watershed Area
- MAF: Mean Annual Flow

4.3 River Water Quality

4.3.1 Introduction

Water samples were collected for quality testing from eight representative rivers in the project area (Table 4.3-1). The samples were tested in the Ministry of Water Resources Laboratory The test results for selected physical and chemical water analysis for the eight river water samples have been provided in Appendix II.3. A summary of the results for the most important elements of concern have been provided in Table 4.3-1 along with the respective specified upper limits for drinking water.

4.3.2 Water Quality for Drinking Purpose

It may be noted from Table 4.3-1 that the concentration of the selected chemical constituents in the water samples obtained from all eight representative rivers are much smaller than the upper limits specified for drinking water. It can be inferred from the foregoing that the quality of water from the rivers in the project area is chemically good.

4.3.3 Water Quality for Irrigation

Todd (1959) explains that Sodium concentration is important in classifying an irrigation water because Sodium reacts with soil to reduce its permeability. Soils containing a large proportion of Sodium with Carbonate as the dominant anion are termed alkali soils; those with Chloride or Sulphate as the predominant anion, saline soils. Ordinarily, either type of sodium-saturated soil will support little or no plant growth. Sodium content is usually expressed in terms of percent Sodium (also known as Sodium percentage and soluble-sodium percentage), defined by:

$$\%\,Na = \frac{(Na + K)\,100}{Ca + Mg + Na + K}$$

Where: all ionic concentrations are expressed in milli-equivalents per litre.

The Sodium Adsorption Ratio (SAR) is defined by

$$SAR = \frac{Na}{((Ca + Mg)/2)^{0.5}}$$

The class of water against the SAR has been given in Table 4.3-2.

The Sodium percentage and the Sodium Adsorption Ratio (SAR) for all the samples have been computed in Table 4.3-1 It may be noted from Tables 4.3-1 & Table 4.3-2 that all the rivers have excellent quality water for irrigation.

Table 4.3-1 Selected Physical and Chemical Water Analysis Results

Ser. No.	Constituent	Name of River								
		Ashebeka	Wabe	Herero	Zetegn Melka	Weyib	Shaya	Ukuma	Totolamo	Upper * Limit (mg/l)
1	Electrical Conductivity(us/cm)	83	111	90	261	84	103	114	54	N.A.
2	Sodium(mg/l Na^{+})	4.8	10.4	4.7	14.4	7.3	9.5	6.9	5.5	N.A.
3	Total Hardness (mg/l $CaCO_3$)	32	32	36	108	29	30	40	14	N.A.
4	Calcium (mg/l Ca^{++})	8	8	8.8	20.8	7.2	7.6	10.8	3.2	N.A.
5	Magnesium (mg/l Mg^{++})	2.9	2.9	3.4	13.6	2.7	2.7	3.2	3.2	125
6	Chloride (mg/l Cl^{-})	1.6	1.1	2.1	6.3	2.1	4.2	2.1	1.6	250
7	Sulphate (mg/l SO_4^{--})	5	6	4	5	2	6	5	6	250
8	Potassium(mg/l K^{+})	1.8	4.3	2.1	4.5	2.6	2.2	4.9	3.2	N.A.
	% Na	28.5	46.9	26.4	25.6	39.8	43.8	34.7	43.2	
	SAR	0.4	0.8	0.3	0.6	0.6	0.8	0.5	0.5	
	Result for Irrigation Purpose	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	

Note

* Upper Limit Drinking Water Standards, Source: Todd, D.K., Ground Water Hydrology. 1959, p 185

N.A.: Not Available

Table 4.3-2 Recommended Irrigation Water Classification for SAR

Ser. No.	SAR	Water Class
1	<10	Excellent
2	10 - 18	Good
3	18 - 26	Fair
4	>26	Poor

Source: Todd, D.K . Ground Water Hydrology, 1959, p.192.

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

It has been tried in this brief study to show in perspective the major surface water resources potential of Arsi and Bale Zones. It may be deduced from this study that the two zones are endowed with enormous water resources potential. However, very little has been done in the past to exploit or harness the water resources potential. Perhaps, some of the reasons could be the following:

- favorable climate in these zones which has enabled production of crops under rainfed conditions from year to year round without much problem;
- the lack of incentives or motive to produce more due to the unavailability of markets for the agricultural produce;
- the low or subsistence level of agricultural production exercised in these zones.

It may be concluded that there is a lot that could be done in harnessing and putting to use the existing enormous water resources in irrigation, min-hydropower, fisheries, etc. development for enhancing the economic activities of these zones and thereby raising the standard of living of their people.

5.2 Recommendations

5.2.1 Integrated Water Resources Survey

An attempt has been made to divide these zones into four sub-basins as far as the development of the water resources potential of the zones in concerned. These are.

- The Awash Sub-basin
- The Rift Valley Lakes Sub-basin
- The Wabi-Shebelle Sub-basin
- The Genale Sub-basin.

It is recommended to plan in terms of developing the water resources of the sub-basins for developing the water resources potential of the zones. Each sub-basin should be studied as a whole. In order to gain more insight or refinement and experience from the studies, one perhaps should start with smallest sub-basin and gradually proceed to study the others turn by turn as more and more experience is gained in the studies. Each sub-basin should be

subjected to an integrated water resources survey through which a series of projects could be identified and ranked. An integrated survey with a multi-disciplinary team is necessary in order to relate the water resources with the other resources to be developed as an integral part of the water resources development. From the series of water resources development projects identified by the survey, each project could be picked up turn by turn and subjected to a feasibility study. Fortunately, most of the project area is covered by the 1:50,000 scale mapping and a lot could be done using the available maps.

In general, the rivers could be utilized for hydropower in the highlands wherever there are suitable dam and storage sites for river regulation and for irrigated agriculture and fisheries development in the lowlands where there are fertile alluvial soil soils.

5.2.2 Watershed Management & Land Use Planning

Extensive degradation of the environment by soil erosion has been observed to be prevalent in the two zones due to uncontrolled land use. Farming on steep slopes without resorting to appropriate cultivation practices is now very common in these zones as it is in other zones of the country. This has resulted in enormous soil losses due to runoff and considerable sedimentation of rivers and reservoirs; perhaps a typical example is the 'mud' flow in Zetegn Melka River during floods. This cultivation practice if continued without control could undermine the land and render it useless for agriculture in the near future. Also, it may jeopardize the use of water storage sites and pause serious restraints in water resources development. Therefore, it is essential to embark on planning and implementing appropriate land use and watershed management practices immediately

6.0 APPENDICES

APPENDIX I: METEOROLOGICAL DATA

I.1 MONTHLY MEAN MAX. AND MEAN MIN. TEMPERATURE

I.1.1 INFILLED

I.1.2 OBSERVED

1.1.1 INFILLED

1.1.2 OBSERVED

Element: Monthly Mean Maximum Temperature

Station: Dodola

Lat. 06°59' Long. 39°11' **Alt. 2500 masl**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1958	25.9	23.5	26.4	26.0	26.2	24.0	20.3	19.6	21.4	20.7	24.1	22.3	23.4
1959	24.8	25.1	25.7	24.1	24.8	23.8	21.5	20.1	18.7	22.4	26.0	26.5	23.6
1960	25.0	26.3	23.7	25.0	24.1	24.6	22.2	25.3	22.2	22.4	22.3	23.7	23.9
1961	25.0	26.3	27.2	26.6	27.1	25.3	22.2	19.2	19.6	21.8	23.6	19.0	23.6
1962	19.0	19.9	25.8	28.8	29.1	28.4	26.6	27.6	22.5	23.2	25.1	22.6	24.9
1965	24.4	24.1	25.4	24.0	25.1	25.8	24.6	23.5	22.7	23.4	23.4	23.3	24.1
1966	23.7	22.1	23.3	22.9	25.2	23.3	22.5	21.3	20.9	21.5	23.3	22.6	22.7
1968	21.7	21.8	23.1	22.6	23.3	21.8	20.2	20.5	20.5	21.9	22.0	22.3	21.8
1988	21.4	21.2	22.5	22.4	23.8	20.7	18.0	19.0	20.0	20.3	21.1	22.0	21.0
1989	21.2	15.6	22.5	20.6	22.6	27.1	18.1	19.4	19.6	20.0	29.6	21.3	21.5
1990	22.1	21.5	21.2	21.1	21.7	20.2	18.1	18.5	20.6	21.7	20.7	23.2	20.9
1993	22.2	20.6	23.2	22.2	21.3	20.8	20.2	20.3	20.0	20.6	22.3	22.6	21.4
1994	20.8	20.7	22.0	21.5	22.1	20.5	18.6	19.3	19.8	20.4	21.7	22.5	20.8
1995	23.8	23.9	22.2	22.0	23.3	22.2	19.3	19.3	20.5	20.7	22.4	22.7	21.9
1996	22.1	24.3	23.3	21.7	22.0	20.0	19.7	20.1	21.0	22.1	22.4	22.6	21.8
Mean	22.9	22.5	23.8	23.4	24.1	23.2	20.8	20.9	20.7	21.5	23.3	22.6	22.5
Max.	25.9	26.3	27.2	28.8	29.1	28.4	26.6	27.6	22.7	23.4	29.6	26.5	24.9
Min.	19.0	15.6	21.2	20.6	21.3	20.0	18.0	18.5	18.7	20.0	20.7	19.0	20.8

Element: Monthly Mean Maximum Temperature

Station: Bekoji
Lat. 7°19'N Long. 39°09'E Alt. 2850 masl

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1992	20.4	19.7	22.0	20.5	21.4	19.4	17.5	16.2	17.9	17.9	18.6	19.5	19.3
1993	19.4	19.1	21.5	20.0	19.3	18.5	16.7	17.4	18.0	18.9	19.5	19.5	19.0
1994	22.1	23.1	22.7	21.0	21.4	19.3	17.1	17.0	18.4	19.6	20.5	21.0	20.3
1995	22.1	22.4	21.1	20.1	21.9	21.2	17.5	17.9	18.9	19.3	21.2	20.6	20.4
1996	19.9	22.5	20.9	21.4	20.9	19.3	18.0	18.0	18.0	19.6	20.7	20.8	20.0
Mean	20.8	21.4	21.6	20.6	21.0	19.5	17.4	17.3	18.2	19.1	20.1	20.3	19.8
Max.	22.1	23.1	22.7	21.4	21.9	21.2	18.0	18.0	18.9	19.6	21.2	21.0	20.4
Min.	19.4	19.1	20.9	20.0	19.3	18.5	16.7	16.2	17.9	17.9	18.6	19.5	19.0

Element: Monthly Mean Minimum Temperature

Station: Bekoji
Lat. 7°19'N Long. 39°09'E Alt. 2850 masl

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1992	8.4	8.8	9.8	10.2	10.4	9.1	8.9	9.2	8.1	8.2	8.0	8.4	9.0
1993	8.6	8.5	9.3	10.2	9.8	8.8	8.9	8.6	8.5	8.4	8.2	8.3	8.8
1994	8.6	9.5	10.2	10.4	9.5	9.0	9.0	8.3	9.0	8.2	7.3	7.7	8.9
1995	7.7	9.5	9.8	10.4	9.9	9.2	9.1	9.2	8.5	8.7	7.9	9.0	9.1
1996	9.1	9.9	9.2	10.3	10.0	9.1	8.8	8.4	8.9	7.5	7.9	7.8	8.9
Mean	8.5	9.2	9.7	10.3	9.9	9.0	8.9	8.7	8.6	8.2	7.9	8.2	8.9
Max.	9.1	9.9	10.2	10.4	10.4	9.2	9.1	9.2	9.0	8.7	8.2	9.0	9.1
Min.	7.7	8.5	9.2	10.2	9.5	8.8	8.8	8.3	8.1	7.5	7.3	7.7	8.8

Element: Monthly Mean Maximum Temperature

Station: Assela School(Assela Town)

Lat. 07°57' Long. 39°08' Alt. 2400 masl

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1966	22.1	20.8	21.6.	21.2	23.6	20.4	19.1	18.9	18.9	20.6	20.9	21.4	20.7
1967	21.1	23.5	22.7	21.8	20.8	21.1	18.1	17.2	17.5	19.2	19.2	18.5	20.1
1968	21.7	20.0	21.2	19.8	21.8	19.8	18.7	19.1	19.5	20.6	20.3	20.7	20.3
1969	20.5	20.2	20.9	22.4	22.0	20.1	18.6	17.9	19.0	21.0	21.2	21.5	20.4
1971	20.8	21.2	22.4	22.1	20.3	19.4	18.3	18.0	19.0	21.0	19.6	19.1	20.1
1972	20.7	19.7	21.9	20.5	22.0	20.5	18.0	18.6	19.0	21.9	22.0	22.7	20.6
1973	22.8	26.0	28.9	28.7	23.5	24.4	20.7	19.0	18.5	20.9	22.0	20.3	23.0
1974	21.8	22.5	20.4	22.9	21.0	19.2	18.8	19.3	18.2	20.3	20.0	20.3	20.4
1975	20.8	22.0	23.3	21.2	21.9	18.8	17.6	17.4	18.4	20.0	19.4	20.1	20.1
1976	20.5	20.8	21.4	21.1	21.7	20.0	17.5	17.4	18.2	19.6	18.5	19.7	19.7
1977	19.1	19.7	21.2	20.7	20.4	18.7	17.5	17.4	17.5	18.7	18.8	19.2	19.1
1978	19.7	20.4	20.0	21.5	21.0	20.5	17.9	17.8	18.0	19.5	19.9	18.9	19.6
1979	21.9	20.1	21.1	21.9	21.5	20.3	18.8	18.1	17.9	19.7	20.4	21.0	20.2
1980	21.0	22.6	23.3	22.9	22.8	21.6	19.8	19.8	19.7	20.6	21.4	22.0	21.5
1981	21.9	22.3	20.5	20.0	21.9	21.6	18.5	18.0	17.8	19.4	20.0	20.0	20.2
1982	21.0	21.1	22.5	20.8	21.4	21.3	17.9	17.0	17.6	19.3	19.3	20.7	20.0
1984	20.5	22.2	21.5	23.7	20.3	18.9	18.1	17.8	18.2	21.0	20.2	20.3	20.2
1985	21.6	22.2	23.3	20.3	20.3	20.9	17.8	17.8	18.3	20.1	20.2	20.4	20.3
1986	21.1	21.3	21.7	20.1	21.8	20.0	19.2	20.3	18.7	20.4	20.6	20.5	20.5
1987	20.9	22.2	22.9	21.4	22.6	20.1	19.6	19.7	20.8	23.3	22.6	22.0	21.5
1988	22.0	21.7	24.0	23.6	24.2	22.0	20.9	20.2	20.7	21.7	21.1	21.0	21.9
1989	21.8	22.0	21.5	21.4	22.6	21.9	20.7	20.0	19.7	21.3	21.4	21.3	21.3
1990	21.9	21.5	21.5	22.8	24.4	24.0	20.9	20.1	20.4	21.8	22.5	21.8	22.0
1991	24.4	24.0	24.5	24.3	24.5	24.8	20.4	20.6	21.0	21.3	22.0	21.3	22.8
1993	23.3	21.6	23.6	24.2	24.2	23.3	21.9	21.5	21.8	22.4	22.3	23.3	22.8
1994	23.3	24.3	25.0	25.9	24.4	22.2	19.7	19.7	19.7	22.1	22.3	21.9	22.5
1995	24.0	25.2	24.4	23.1	24.1	24.4	22.5	21.7	21.9	21.9	21.1	22.9	23.1
1996	22.3	23.4	25.1	24.2	22.8	21.3	21.5	21.9	22.2	22.8	24.3	23.2	22.9
Mean	21.6	21.9	22.6	22.3	22.3	21.1	19.2	19.0	19.2	20.8	20.8	20.9	21.0
Max.	24.4	26.0	28.9	28.7	24.5	24.8	22.5	21.9	22.2	23.3	24.3	23.3	23.1
Min.	19.1	19.7	20.0	19.8	20.3	18.7	17.5	17.0	17.5	18.7	18.5	18.5	19.1

Element: Monthly Mean Maximum Temperature

Station: Asasa
Lat. 7°09'N Long. 39°11'E **Alt. 2400 masl**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1991	25.9	26.5	26.6	25.6	26.1	24.7	22.6	22.1	22.8	23.8	24.8	23.7	24.6
1992	24.9	25.0	25.8	25.7	26.1	26.1	21.6	20.1	22.2	22.4	24.0	23.9	24.0
1993	23.7	23.4	26.4	24.5	24.0	23.4	21.3	21.7	22.4	23.7	24.9	25.7	23.8
1994	25.0	25.0	25.8	25.2	25.6	25.3	21.0	21.1	21.8	21.1	23.4	23.1	23.6
1995	25.3	25.2	24.3	25.0	26.2	26.9	21.3	21.3	22.6	23.0	24.2	24.1	24.1
1996	25.0	25.0	25.8	25.2	25.6	25.3	21.6	21.3	23.6	24.1	23.8	24.1	24.2
Mean	25.0	25.0	25.8	25.2	25.6	25.3	21.6	21.3	22.6	23.0	24.2	24.1	24.0
Max.	25.9	26.5	26.6	25.7	26.2	26.9	22.6	22.1	23.6	24.1	24.9	25.7	24.6
Min.	23.7	23.4	24.3	24.5	24.0	23.4	21.0	20.1	21.8	21.1	23.4	23.1	23.6

Element: Monthly Mean Minimum Temperature

Station: Asasa
Lat. 7°09'N Long. 39°11'E **Alt. 2400 masl**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1991	-1.6	4.7	7.9	6.4	7.6	9.4	9.7	8.5	6.2	0.6	-0.6	1.6	5.0
1992	3.3	5.1	6.3	7.1	7.4	9.5	9.7	9.3	7.2	5.5	2.7	1.7	6.2
1993	4.8	5.6	2.9	8.0	9.1	9.6	9.7	7.7	6.8	5.7	1.2	-1.5	5.8
1994	1.9	5.1	6.3	8.0	8.1	9.3	8.9	12.2	7.8	4.1	2.9	-0.6	6.2
1995	-1.0	5.0	8.0	10.4	8.2	8.7	10.5	9.4	7.3	3.8	1.6	0.3	6.0
1996	1.5	5.1	6.3	8.0	8.1	9.3	9.7	9.4	8.4	3.1	1.7	6.3	6.4
Mean	1.5	5.1	6.3	8.0	8.1	9.3	9.7	9.4	7.3	3.8	1.6	1.3	5.9
Max.	4.8	5.6	8.0	10.4	9.1	9.6	10.5	12.2	8.4	5.7	2.9	6.3	6.4
Min.	-1.6	4.7	2.9	6.4	7.4	8.7	8.9	7.7	6.2	0.6	-0.6	-1.5	5.0

Element: Monthly Mean Maximum Temperature

Station: Ginir
Lat. 7°08'N Long. 40°43'E **Alt. 1950 masl**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1991	25.5	26.0	25.1	23.4	23.4	23.1	21.6	23.1	24.8	24.2	23.5	24.0	24.0
1992	24.1	25.2	26.4	24.1	23.3	22.6	22.9	22.9	23.3	21.7	21.5	22.5	23.4
1993	22.6	22.7	25.1	27.7	22.9	22.9	22.7	23.2	24.1	22.3	22.0	23.4	23.5
1994	24.7	25.8	24.3	23.9	23.3	24.5	23.0	23.8	25.1	22.4	21.8	23.3	23.8
1995	25.0	26.3	22.5	22.3	23.6	23.8	23.2	22.8	23.0	20.7	21.1	23.8	23.2
1996	24.6	26.5	25.4	24.1	24.9	21.2	22.7	23.2	23.9	22.3	22.0	23.4	23.7
1997	26.3	28.0	21.4	21.9	21.9	22.4	22.7	23.2	24.0	22.3	22.0	23.4	23.3
Mean	24.7	25.8	24.3	23.9	23.3	22.9	22.7	23.2	24.0	22.3	22.0	23.4	23.5
Max.	26.3	28.0	26.4	27.7	24.9	24.5	23.2	23.8	25.1	24.2	23.5	24.0	24.0
Min.	22.6	22.7	21.4	21.9	21.9	21.2	21.6	22.8	23.0	20.7	21.1	22.5	23.2

Element: Monthly Mean Minimum Temperature

Station: Ginir
Lat. 7°08'N Long. 40°43'E **Alt. 1950 masl**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1991	13.4	13.9	14.5	14.2	14.3	13.9	12.6	12.9	13.0	14.2	12.6	12.0	13.5
1992	12.8	14.2	14.3	15.0	14.7	13.8	12.7	12.7	13.1	13.2	11.9	12.8	13.4
1993	13.1	13.2	13.7	14.6	14.6	13.4	12.8	12.8	13.0	13.1	11.9	12.0	13.2
1994	12.8	13.1	14.8	14.4	14.4	13.6	13.1	13.4	13.5	13.0	12.2	11.4	13.3
1995	11.2	13.9	14.3	14.4	14.1	12.9	12.8	12.1	12.2	12.1	10.8	11.7	12.7
1996	13.0	13.7	16.0	15.8	16.4	14.4	12.8	12.8	13.0	13.1	11.9	12.0	13.7
1997	13.2	9.8	16.2	12.6	12.3	11.5	12.8	12.8	13.0	13.1	11.9	12.0	12.6
Mean	12.8	13.1	14.8	14.4	14.4	13.4	12.8	12.8	13.0	13.1	11.9	12.0	13.2
Max.	13.4	14.2	16.2	15.8	16.4	14.4	13.1	13.4	13.5	14.2	12.6	12.8	13.7
Min.	11.2	9.8	13.7	12.6	12.3	11.5	12.6	12.1	12.2	12.1	10.8	11.4	12.6

Element: Monthly Mean Maximum Temperature

Station: Goba

Lat. 07°01' Long. 40°00' **Alt. 2700 masl**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1962	20.7	21.3	21.5	20.3	20.7	21.4	20.2	19.3	19.6	18.7	18.5	20.0	20.2
1963	19.8	20.9	22.2	19.0	20.3	21.2	20.3	20.3	19.8	18.7	17.4	17.7	19.8
1965	18.9	19.0	20.1	18.4	19.3	20.5	19.3	18.0	17.6	16.4	16.2	17.7	18.4
1966	19.0	18.2	19.1	18.5	18.8	18.9	19.3	18.8	17.7	16.4	15.7	18.2	18.2
1967	18.7	20.4	20.2	18.2	18.0	19.1	17.6	16.8	17.0	15.7	15.7	17.4	17.9
1968	18.6	19.2	19.3	18.3	17.8	18.2	18.7	19.2	19.0	17.3	17.0	18.4	18.4
1969	18.9	18.4	18.2	19.8	20.1	20.0	19.2	19.1	18.7	18.2	18.2	19.4	19.0
1970	18.9	21.2	18.9	19.1	20.5	21.0	20.0	18.7	18.8	17.3	18.6	20.0	19.4
1971	20.5	21.7	20.5	19.7	19.8	20.4	19.7	20.0	18.9	17.2	17.6	19.1	19.6
1972	20.7	19.0	19.8	19.7	20.0	20.3	19.8	20.3	20.0	17.8	19.1	20.2	19.7
1973	22.2	23.4	24.8	22.3	21.0	22.1	20.9	20.0	20.0	18.3	20.5	20.0	21.3
1974	21.9	22.2	19.8	21.1	20.3	20.8	20.6	20.2	18.9	18.2	18.6	19.8	20.2
1975	20.8	21.6	22.5	19.5	20.5	20.5	19.4	18.6	18.9	17.0	17.6	19.4	19.7
1976	19.5	20.3	20.4	19.4	19.1	20.6	19.4	19.4	19.3	17.9	18.0	19.3	19.4
1977	19.3	20.0	20.4	19.9	20.4	21.1	20.4	19.6	18.8	17.1	18.0	19.8	19.6
1978	20.0	20.3	20.7	20.4	20.7	21.6	19.3	20.4	19.4	17.7	18.4	19.7	19.9
1979	18.3	20.5	21.5	20.1	21.1	21.3	21.2	20.3	20.3	18.8	20.2	21.8	20.5
1980	23.0	23.8	23.2	21.6	22.5	22.1	21.2	20.7	19.3	18.1	19.4	20.6	21.3
1981	21.7	21.2	19.9	18.8	20.0	21.9	20.4	19.8	19.0	17.9	18.5	19.9	19.9
1982	20.1	21.0	21.6	19.2	19.8	20.8	19.6	19.5	19.2	17.5	18.7	19.1	19.7
1983	20.3	20.5	22.5	20.8	20.4	21.2	20.8	19.5	19.2	17.5	18.7	19.6	20.1
1984	21.6	22.4	22.3	21.2	20.5	20.8	21.0	21.1	19.9	18.4	18.9	19.4	20.6
Mean	20.2	20.8	20.9	19.8	20.1	20.7	19.9	19.5	19.1	17.6	18.2	19.4	19.7
Max.	23.0	23.8	24.8	22.3	22.5	22.1	21.2	21.1	20.3	18.8	20.5	21.8	21.3
Min.	18.3	18.2	18.2	18.2	17.8	18.2	17.6	16.8	17.0	15.7	15.7	17.4	17.9

Element: Monthly Mean Minimum Temperature

Station: Goba

Lat. 07°01' Long. 40°00' Alt. 2700 masl

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1962	3.8	4.6	5.9	7.2	7.3	6.9	6.7	5.4	7.4	5.3	5.8	3.7	5.8
1963	4.2	6.0	5.6	8.0	8.0	6.8	7.1	7.3	6.8	6.5	7.3	6.7	6.7
1964	5.1	5.2	6.6	8.3	8.3	7.7	7.3	7.1	7.5	7.4	3.6	5.0	6.6
1965	3.9	2.2	4.4	7.1	6.9	7.3	7.3	6.8	7.8	7.1	7.1	3.8	6.0
1966	3.6	6.7	6.6	8.3	8.0	7.3	7.8	7.6	7.6	7.8	5.1	2.1	6.5
1967	4.2	5.1	6.8	7.6	7.5	7.6	7.9	7.6	7.8	8.1	7.6	2.9	6.7
1968	4.0	4.9	6.2	7.7	7.4	7.4	6.9	6.7	7.1	7.6	5.4	4.8	6.3
1969	5.6	6.4	8.2	8.1	8.7	7.7	7.6	6.8	7.7	6.8	5.0	3.9	6.9
1970	5.6	5.6	7.7	8.5	8.0	7.2	7.3	7.2	7.2	8.0	2.6	2.3	6.4
1971	3.7	3.4	5.6	7.1	7.5	7.4	6.9	6.6	7.8	7.8	5.0	3.1	6.0
1972	3.7	6.2	5.8	7.8	8.0	7.5	7.9	7.2	7.9	7.2	6.1	4.6	6.7
1973	4.2	4.7	5.5	8.5	8.2	7.9	7.7	8.0	8.0	7.4	4.6	2.5	6.4
1974	3.3	4.3	6.5	7.2	7.6	7.1	6.8	7.4	7.5	6.7	3.0	2.7	5.8
1975	2.2	4.3	6.0	7.8	8.1	7.2	7.6	7.2	7.4	6.8	4.5	2.8	6.0
1976	3.3	5.2	5.7	7.3	8.1	6.9	7.0	7.2	7.2	7.4	6.2	4.0	6.3
1977	6.5	5.4	6.6	8.6	7.9	7.6	7.9	6.9	7.6	8.9	5.8	4.1	7.0
1978	3.2	5.9	7.4	7.3	7.5	7.6	7.2	6.8	6.9	7.1	4.6	4.1	6.3
1979	5.7	5.7	5.9	7.3	7.7	7.2	6.6	6.3	6.9	6.6	4.2	4.1	6.2
1980	3.7	4.7	6.8	7.7	8.4	7.7	7.7	7.4	7.9	7.2	6.0	3.6	6.6
1981	4.1	5.5	8.1	9.4	8.8	7.8	8.5	7.7	7.7	7.4	4.7	3.6	6.9
1982	6.0	6.2	7.0	8.9	9.2	7.4	8.2	7.7	7.6	7.3	6.9	6.1	7.4
1983	4.6	6.0	7.7	8.9	8.9	8.3	8.4	8.7	8.8	8.0	6.3	4.9	7.5
1984	3.1	2.9	6.0	8.5	8.5	7.3	7.0	7.7	7.5	5.3	5.2	5.2	6.2
Mean	4.2	5.1	6.5	8.0	8.0	7.4	7.4	7.2	7.5	7.2	5.3	3.9	6.5
Max.	6.5	6.7	8.2	9.4	9.2	8.3	8.5	8.7	8.8	8.9	7.6	6.7	7.5
Min.	2.2	2.2	4.4	7.1	6.9	6.8	6.6	5.4	6.8	5.3	2.6	2.1	5.8

Element: Monthly Mean Maximum Temperature

Station: Goro
Lat. 7°00'N Long. 40°29'E Alt. 1780 masl

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1990	27.2	27.3	26.6	26.8	27.3	27.1	27.5	26.8	26.9	26.7	26.9	27.2	27.0
1993	26.3	27.1	28.8	29.1	28.4	28.9	28.2	29.1	25.6	28.1	26.2	26.5	27.7
1994	23.1	26.9	27.4	27.0	26.4	26.3	25.9	26.5	27.8	30.9	25.5	26.0	26.6
1995	28.0	30.2	28.3	29.5	31.9	27.4	26.7	28.1	27.6	28.5	28.7	27.9	28.6
1996	28.1	29.5	29.8	30.6	30.8	27.1	25.2	27.2	27.0	26.2	26.8	26.9	27.9
Mean	26.5	28.2	28.2	28.6	29.0	27.4	26.7	27.5	27.0	28.1	26.8	26.9	27.6
Max.	28.1	30.2	29.8	30.6	31.9	28.9	28.2	29.1	27.8	30.9	28.7	27.9	28.6
Min.	23.1	26.9	26.6	26.8	26.4	26.3	25.2	26.5	25.6	26.2	25.5	26.0	26.6

Element: Monthly Mean Minimum Temperature

Station: Goro
Lat. 7°00'N Long. 40°29'E Alt. 1780 masl

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1990	3.4	5.6	5.4	5.8	6.3	6.7	5.8	5.6	6.2	5.2	5.0	6.0	5.6
1993	8.2	4.7	5.0	6.5	10.2	8.8	9.3	8.2	13.1	7.2	6.4	4.9	7.7
1994	7.9	9.6	11.9	13.3	12.7	12.2	11.7	10.8	9.9	9.1	8.6	6.0	10.3
1995	13.1	9.1	10.0	8.9	9.0	8.3	8.5	8.1	7.5	8.9	8.1	7.6	8.9
1996	8.5	8.1	8.9	10.0	11.5	12.6	12.6	10.0	9.2	5.5	3.9	6.1	8.9
Mean	8.2	7.4	8.2	8.9	9.9	9.7	9.6	8.5	9.2	7.2	6.4	6.1	8.3
Max.	13.1	9.6	11.9	13.3	12.7	12.6	12.6	10.8	13.1	9.1	8.6	7.6	10.3
Min.	3.4	4.7	5.0	5.8	6.3	6.7	5.8	5.6	6.2	5.2	3.9	4.9	5.6

Element: Monthly Mean Maximum Temperature

Station: Kofele
Lat. 7°02'N Long. 38°28'E **Alt. 2680 masl**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1992	21.1	20.8	22.4	21.1	20.6	19.3	18.3	18.4	18.9	18.2	19.4	20.2	19.9
1993	19.3	19.9	22.0	20.1	19.3	18.5	17.9	17.6	18.3	18.6	19.4	20.9	19.3
1994	22.2	23.2	22.8	21.1	19.8	18.8	17.7	18.6	19.0	19.5	19.9	20.9	20.3
1995	21.7	22.2	22.0	20.3	20.8	19.9	17.1	18.4	18.5	19.3	21.1	20.8	20.2
1996	20.2	22.0	22.0	19.4	20.2	18.3	19.0	18.9	19.5	20.1	20.5	20.8	20.1
Mean	20.9	21.6	22.2	20.4	20.1	19.0	18.0	18.4	18.8	19.1	20.1	20.7	20.0
Max.	22.2	23.2	22.8	21.1	20.8	19.9	19.0	18.9	19.5	20.1	21.1	20.9	20.3
Min.	19.3	19.9	22.0	19.4	19.3	18.3	17.1	17.6	18.3	18.2	19.4	20.2	19.3

Element: Monthly Mean Minimum Temperature

Station: Kofele
Lat. 7°02'N Long. 38°28'E **Alt. 2680 masl**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1992	7.5	8.4	8.1	9.0	8.9	8.4	9.0	9.2	8.5	8.1	6.8	7.1	8.3
1993	7.3	8.1	5.8	9.2	9.6	9.1	8.8	9.3	8.2	8.3	6.4	5.4	8.0
1994	5.4	7.1	8.6	9.1	8.6	9.7	9.1	9.5	8.8	6.6	6.8	5.1	7.9
1995	5.8	7.0	5.9	6.5	8.3	6.3	6.8	9.7	8.8	7.9	5.5	7.4	7.2
1996	7.4	7.2	7.6	9.1	5.7	9.7	9.1	8.8	9.1	7.3	5.0	5.8	7.7
Mean	6.7	7.6	7.2	8.6	8.2	8.6	8.6	9.3	8.7	7.6	6.1	6.2	7.8
Max.	7.5	8.4	8.6	9.2	9.6	9.7	9.1	9.7	9.1	8.3	6.8	7.4	8.3
Min.	5.4	7.0	5.8	6.5	5.7	6.3	6.8	8.8	8.2	6.6	5.0	5.1	7.2

Element: Monthly Mean Maximum Temperature

Station: Meraro
Lat. 7°25'N Long. 39°15'E Alt. 2980 masl

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1991	19.3	18.2	19	18	18.3	18.5	15.5	16	16.9	16.6	17.8	17.9	17.7
1992	18.0	18.3	20.8	19.6	18.9	18.7	15.8	15.0	15.9	15.6	16.3	16.6	17.5
1993	17.0	16.6	19.0	18.3	16.9	17.2	16.1	16.3	16.3	16.2	16.7	18.0	17.1
1994	19.4	20.2	20.2	19.3	18.7	18.0	15.7	16.4	16.1	16.4	17.3	18.3	18.0
1995	19.2	19.5	17.8	17.2	18.5	19.7	15.8	15.9	16.3	16.2	17.0	17.7	17.6
Mean	18.6	18.6	19.4	18.5	18.3	18.4	15.8	15.9	16.3	16.2	17.0	17.7	17.5
Max.	19.4	20.2	20.8	19.6	18.9	19.7	16.1	16.4	16.9	16.6	17.8	18.3	18.0
Min.	17.0	16.6	17.8	17.2	16.9	17.2	15.5	15.0	15.9	15.6	16.3	16.6	17.1

Element: Monthly Mean Minimum Temperature

Station: Meraro
Lat. 7°25'N Long. 39°15'E Alt. 2980 masl

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1991	4.9	6.1	6.9	7.7	8.2	6.0	7.1	6.3	5.6	3.7	3.6	2.6	5.7
1992	4.8	5.3	5.7	6.8	7.1	5.8	6.5	7.1	5.4	5.5	4.2	5.0	5.8
1993	5.5	5.0	4.1	6.8	6.9	6.0	6.1	5.8	5.3	6.1	4.1	3.6	5.4
1994	3.1	4.0	5.4	6.6	7.0	7.3	7.2	6.7	6.9	5.1	4.0	3.7	5.6
1995	4.6	4.7	7.0	8.4	6.7	4.8	6.7	6.5	5.8	5.1	4.0	3.7	5.7
Mean	4.6	5.0	5.8	7.3	7.2	6.0	6.7	6.5	5.8	5.1	4.0	3.7	5.6
Max.	5.5	6.1	7.0	8.4	8.2	7.3	7.2	7.1	6.9	6.1	4.2	5.0	5.8
Min.	3.1	4.0	4.1	6.6	6.7	4.8	6.1	5.8	5.3	3.7	3.6	2.6	5.4

Station Aasella School Region Arusi

Element Monthly Maximum Temperature

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1966	22.1	20.8	21.6	21.2	23.6	20.4	19.1	18.9	18.9	20.6	20.9	21.4
1967	21.1	23.5	22.7	21.8	20.8	21.1	18.1	17.2	17.5	19.2	19.2	18.5
1968	21.7	20.0	21.2	19.8	21.8	19.8	x	19.1	19.5	20.6	20.3	20.7
1969	20.5	20.2	20.9	22.4	22.0	20.1	18.6	17.9	19.0	21.0	21.2	21.5
1970	20.4	x	x	x	x	x	x	x	x	x	x	x
1971	x	x	22.4	22.1	20.3	19.4	18.3	18.0	19.0	21.0	19.6	19.1
1972	20.7	19.7	21.9	20.5	22.0	20.5	18.0	18.6	19.0	21.9	22.0	22.7
1973	22.8	26.0	28.9	28.7	23.5	24.4	20.7	19.0	18.5	20.9	22.0	20.3
1974	21.8	22.5	20.4	22.9	21.0	19.2	x	19.3	18.2	20.3	20.0	20.3
1975	20.8	22.0	23.3	21.2	21.9	18.8	17.6	17.4	18.4	20.0	19.4	x
1976	x	x	x	x	21.7	x	17.5	17.4	18.2	19.6	18.5	19.7
1977	19.1	19.7	21.2	20.7	20.4	18.7	17.5	17.4	17.5	18.7	18.8	19.2
1978	19.7	20.4	20.0	21.5	21.0	20.5	17.9	x	x	x	19.9	18.9
1979	21.9	20.1	21.1	21.9	21.5	20.3	18.8	18.1	17.9	19.7	20.4	21.0
1980	21.0	x	23.3	x	x	x	x	19.8	x	20.6	x	22.0
1981	21.9	22.3	20.5	20.0	21.9	21.6	x	18.0	17.8	19.4	20.0	20.0
1982	21.0	x	22.5	20.8	x	21.3	17.9	17.0	17.6	19.3	19.3	20.7
1983	19.6	20.5	21.7	21.2	20.9	20.4	x	x	x	x	x	x
1984	20.5	22.2	21.5	23.7	20.3	18.9	18.1	17.8	18.2	21.0	x	x
1985	21.6	22.2	23.3	20.3	20.3	20.9	17.8	17.8	18.3	20.1	x	x
1986	x	21.3	21.7	20.1	21.8	20.0	19.2	20.3	18.7	20.4	20.6	20.5
1987	20.9	22.2	x	21.4	x	20.1	x	19.7	20.8	23.3	22.6	22.0
1988	22.0	21.7	24.0	23.6	24.2	22.0	20.9	20.2	20.7	21.7	21.1	21.0
1989	21.8	22.0	21.5	21.4	22.6	21.9	20.7	20.0	19.7	21.3	21.4	21.3
1990	21.9	21.5	21.5	22.8	24.4	24.0	20.9	20.1	20.4	x	22.5	21.8
1991	24.4	24.0	x	24.3	24.5	24.8	20.4	20.6	21.0	21.3	22.0	21.3
1992	20.9	23.3	23.6	23.9	x	x	x	x	x	x	x	22.4
1993	23.3	21.6	23.6	24.2	x	23.3	21.9	21.5	21.8	22.4	22.3	23.3
1994	23.3	24.3	25.0	25.9	24.4	22.2	19.7	19.7	19.7	22.1	x	21.9
1995	24.0	25.2	24.4	23.1	24.1	24.4	22.5	21.7	21.9	21.9	21.1	22.9
1996	22.3	23.4	25.1	24.2	22.8	21.3	21.5	21.0	[illegible]	22.8	24.3	23.2

on Asella School Region Arsie

ent Monthly Minimum Temperature

ear	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
66	4.8	8.2	7.8	10.1	9.6	9.1	10.4	10.2	10.0	8.5	5.5	4.0
67	4.1	6.3	8.6	9.2	9.8	9.8	10.3	9.8	9.4	7.4	7.4	x
68	3.7	9.0	7.2	9.8	9.1	9.8	x	9.6	9.7	8.1	4.6	3.7
69	5.8	8.4	9.7	10.1	10.9	10.3	10.4	10.0	9.7	8.4	6.6	4.8
70	8.4	x	x	x	x	x	x	x	x	x	x	x
71	x	x	7.7	9.3	9.8	9.9	.3	9.8	8.7	8.7	9.4	4.6
72	4.8	5.1	7.6	10.3	10.3	10.2	10.6	10.3	9.3	7.0	4.9	3.1
73	4.3	3.7	4.9	6.3	9.7	7.1	6.2	6.1	x	8.0	6.7	5.8
4	5.5	6.8	10.4	x	11.3	10.1	x	9.9	9.9	8.0	4.6	4.7
5	x	x	x	5.2	5.3	4.9	4.3	4.6	5.6	8.6	8.6	x
6	x	x	x	x	9.6	x	9.6	8.7	8.0	7.5	5.7	4.3
7	6.8	6.2	7.1	8.8	9.1	9.2	9.5	9.0	8.4	8.4	4.0	3.8
	x	5.4	8.4	9.2	9.3	10.5	10.6	x	x	x	8.7	6.4
	8.3	8.1	9.3	10.0	10.6	10.9	10.0	9.8	8.2	7.6	4.2	4.7
	6.0	x	8.8	x	x	x	x	9.8	8.9	7.2	4.5	2.6
	3.6	5.0	9.0	9.7	9.8	9.4	x	9.3	8.4	7.0	4.4	3.2
	5.3	x	6.6	8.4	x	9.0	9.4	9.4	8.3	6.9	6.0	7.9
	4.5	7.3	8.6	10.0	10.3	9.4	x	x	x	x	x	x
	4.9	3.1	6.5	8.1	12.2	9.8	9.2	9.8	9.1	6.4	x	x
	5.1	6.1	7.4	9.6	9.3	8.6	9.3	9.2	9.3	7.8	5.2	4.4
	x	7.8	8.4	10.2	10.0	10.0	9.3	9.1	8.4	7.7	5.7	5.3
	5.6	7.1	x	8.7	x	9.7	x	11.2	10.0	10.3	8.0	8.0
	8.7	10.5	11.6	12.4	11.5	11.5	12.0	11.4	11.2	10.5	6.6	7.7
	6.9	8.6	10.4	10.6	10.8	10.9	11.0	11.2	10.7	10.3	9.6	9.1
	7.3	10.6	9.5	10.7	11.2	9.8	9.4	9.9	9.1	x	6.8	5.0
	8.5	10.3	10.8	11.4	11.9	11.8	11.2	11.5	11.0	10.5	7.2	7.1
	8.9	10.6	12.4	10.7	x	x	x	x	x	x	x	9.0
	9.5	8.8	9.4	11.4	x	11.3	10.8	10.8	10.6	9.7	7.3	6.9
	6.7	13.1	11.5	11.8	11.4	11.1	11.8	11.8	10.9	11.1	x	6.2
	6.7	9.5	11.0	11.5	10.9	11.2	11.7	11.7	10.7	11.2	8.3	7.9
	8.8	7.5	10.8	10.6	11.0	11.1	11.2	11.0	10.4	8.9	6.8	6.8

NATIONAL METEOROLOGICAL SERVICES AGENCY

C 29

Station: Assasa .... Wereda .... Awraja .... Region Arssi

Alt. .... Long. .... Lat. .... Element monthly maximum

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
1971	x	x	x	x	24.7	21.9	20.2	20.5	20.9	[illegible]	[illegible]	[illegible]		

Total														
1991	25.9	26.5	26.6	25.6	26.1	24.7	22.6	22.1	22.8	23.8	24.8	23.7		
1992	24.9	x	x	25.7	26.1	26.1	x	20.1	22.2	22.4	24.0	23.9		
1993	23.7	23.4	26.4	24.5	24.0	23.4	21.3	21.7	22.4	23.7	24.9	25.7		
1994	x	x	x	x	x	x	21.0	21.1	21.8	21.1	23.4	23.1		
1995	25.3	25.2	24.3	25.0	26.2	26.9	21.3	x	x	x	x	x		
1996	x	x	x	x	x	x	x	x	23.6	24.1	23.8	x		
19														
19														
19														
19														
Total														
Total	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
Ave.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		

NATIONAL METEOROLOGICAL SERVICES AGENCY C 42

Station: ASASSA Wereda ASASSA Awraja CHILALO Region ARSS

Alt. ..... Long ..... Lat. ..... Element MONTHLY MINT

ARITHMETIC MEANS FOR/

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Averag
19 91					6 8	9 2	9.6	9.9	9.1	6 9	4 -	2 . .		

Total 9														
19 91	-1.6	4.7	7.9	6.4	7.6	9.4	9.7	8.5	6.2	0.6	-0.6	1.6		
19 92	3.3	"	"	7.1	7.4	9.5	"	9.3	7.2	5.5	2.7	1.7		
19 93	4.8	5.6	2.9	8.0	9.1	9.6	9.7	7.7	6.8	5.7	1.2	-1.5		
19 94	1.9	"	"	"	"	"	8.9	12.2	7.8	4.1	2.9	-0.6		
19 95	-1.0	5.0	8.0	10.4	8.2	8.7	(10.5)	x	x	"	"	"		
19 96	"	"	"	"	"	"	"	"	8.4	3.1	1.7	"		
19 97														
19														
19														
19														
Total														
Total														
Ave.														

2 3 . 2 8

NATIONAL METEOROLOGICAL SERVICES AGENCY

Station: BEKOJI farm Wereda .... Awraja GALEMA Region Arsi

Alt. .... Long. .... Lat. .... Element monthly maximum Tem

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
1992	20.4	19.7	22.0	20.5	21.4	19.4	17.5	16.2	17.9	17.9	18.6	19.5		
1993	19.4	19.1	21.5	20.0	19.3	18.5	16.7	17.4	18.0	18.9	19.5	21.4		
1994	22.1	23.1	22.7	21.0	21.4	19.3	17.1	17.0	18.4	19.6	20.5	21.0		
1995	22.1	22.4	21.1	20.1	21.9	21.2	17.5	17.9	18.9	19.3	21.2	20.6		
1996	19.9	22.5	20.9	21.4	20.9	19.3	18.0	18.0	19.3	19.6	20.7	20.8		
19														
19														
19														
19														
19														
Total														
Total	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
Ave.	[illegible]	20.6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	16.4	17.5	[illegible]	19.3	[illegible]		
Total # of Yr.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	18	[illegible]	[illegible]	[illegible]	[illegible]		

NATIONAL METEOROLOGICAL SERVICES AGENCY

Station: BOKOJI FARM Wereda ..... Awraja ..... Region ARSSI

Alt. ..... Long. ..... Lat. ..... Element MONTHLY MEAN MIN TE

Year	I.	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
19 92	8·4	8·8	9·8	10·2	10·4	9·1	8·9	9·2	8·1	8·2	8·0	8·4		
19 93	8·6	8·5	9·3	10·2	9·8	8·8	8·9	8·6	8·5	8·4	8·2	8·3		
19 94	8·6	9·5	10·2	10·4	9·5	9·0	9·0	8·3	9·0	8·2	7·3	7·7		
19 95	7·7	9·5	9·8	10·4	9·9	9·2	9·1	9·2	8·5	8·7	7·9	9·C		
19 96	9·1	9·9	9·2	10·3	10·0	9·1	8·8	8·4	8·9	7·5	7·9	7·8		
19														
19														
19														
Total														
Total														
Ave.														
Total														

NATIONAL METEOROLOGICAL SERVICES AGENCY

D - K

ition: DODOLLA .... Wereda .... Awraja .... Region BALE

3ceP .... Long. 39 11 .... Lat. 06 59 .... Element Monthly Max. Temp. in

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
56	x	x	x	x	x	23.9	21.8	22.7	25.0	21.3	x	27.5		
57	28.5	x	x	23.7	24.6	x	x	x	x	x	x	x		
58	25.9	23.5	26.4	26.0	26.7	x	20.3	19.6	21.4	20.7	24.1	22.3		
59	24.8	25.1	25.7	x	x	x	x	20.1	18.7	22.4	26.0	26.5		
60	25.0	26.3	23.7	25.0	24.1	24.6	22.2	25.3	22.2	22.4	22.3	23.7		
61	25.0	26.3	27.2	26.6	27.1	25.3	22.2	19.2	19.6	x	x	19.0		
62	19.0	19.9	25.8	28.8	29.1	28.4	26.6	27.6	x	x	x	x		
55	x	24.1	25.4	24.0	25.1	25.8	24.6	23.5	22.7	23.4	23.4	23.3		
56	23.7	22.1	23.3	22.9	25.2	23.3	22.5	21.3	x	x	x	x		
58	21.7	x	x	x	x	21.8	x	20.5	20.5	21.9	22.0	22.3		
1														
6	x	x	x	x	x	x	x	x	x	x	x	23.0		
7	(22.2)	x	x	x	x	x	x	x	x	x	x	x		
8 7			N	O	-	D	A	T	A					
8	x	x	x	22.4	23.8	20.7	18.0	19.0	20.0	20.3	21.1	22.0		
9	x	15.6	22.5	20.6	22.6	27.1	18.1	19.4	19.6	20.0	29.6	21.3		
2	22.1	21.5	21.2	21.1	21.7	20.2	18.1	18.5	20.6	21.7	20.7	23.2		
1	24.2	23.2	22.3	22.9	24.2	x	x	x	x	x	x	x		
2	-	-	-	-	-	-	-	-	-	-	-	22.4		
3	22.2	20.6	23.2	22.2	21.3	20.8	x	x	x	x	x	x		
	x	-	-	-	x	20.5	18.6	19.3	19.8	20.4	21.7	22.5		
	23.8	23.9	22.2	22.0	23.3	22.2	19.3	19.3	20.5	20.7	22.4	22.7		
	22.1	24.3	23.3	21.7	22.0	20.0	19.7	20.1	21.0	22.1	22.4	22.6		

NATIONAL METEOROLOGICAL SERVICES AGENCY

Station: DODOLA Wereda Awraja Region BALE

Alt. 3000 Long. 39 11 Lat. 06 59 Element MINIMUM TEMP. in

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Avera
1954	"	"	"	"	"	"	"	9.2	9.7	7.5	4.2	4.8		
1955	6.0	7.4	7.1	8.0	8.0	7.5	7.8	8.2	8.4	"	"	5.5		
1956	6.3	5.4	5.9	"	"	(4.2)	7.0	7.0	4.8	"	"	3.0		
1957	3.9	"	"	8.2	8.1	8.1	7.8	7.9	7.5	5.1	6.0	"		
1958	7.5	7.1	7.6	8.4	8.8	"	9.9	8.8	8.7	7.1	4.6	6.2		
1959	6.5	5.8	6.7	"	"	"	"	3.9	4.0	2.5	0.4	0.2		
1960	-0.1	1.5	3.5	3.1	3.4	1.5	2.5	2.3	2.0	1.2	0.0	-0.1		
1961	-1.1	-0.9	0.5	2.3	2.2	1.4	1.5	2.4	0.5	"	"	0.5		
1962	-0.3	0.4	1.8	2.8	2.6	1.3	1.0	2.0	"	"	"	"		
1965	"	3.6	4.6	5.2	5.4	5.4	5.8	5.3	5.1	4.8	3.2	3.1		
Total														
1966	3.0	1.8	0.8	7.1	5.6	6.0	6.0	6.4	"	"	"	"		
1968	5.2	"	"	"	"	6.5	"	(7.8)	(6.6)	6.1	3.5	3.8		
1976	"	"	"	"	"	"	"	"	"	"	"	6.0		
1977	9.6	7.4	7.7	10.8	"	"	"	"	"	"	"	"		
1987			N	O	-	D	A	T	A					
1988	"	"	"	6.6	0.8	0.8	7.5	9.2	8.3	7.5	3.5	1.1		
89	"	4.9	8.9	8.9	7.4	8.4	9.4	8.8	8.2	6.2	5.2	7.6		
90	3.1	9.1	7.0	9.2	8.1	8.3	9.6	9.5	8.8	5.1	5.0	3.3		
91	4.6	7.3	8.4	"	"	"	"	"	"	"	"	"		
92	"	"	"	"	"	"	"	"	"	"	"	4.8		
al														
93	7.5	7.0	3.9	9.1	9.4	"	"	"	"	"	"	"		
94	"	"	"	"	"	4.6	4.4	4.3	3.5	-0.6	-1.1	-3.1		
95	5.9	5.5	6.6	10.4	7.9	8.8	9.9	10.0	8.1	6.8	2.9	3.8		
96	5.7	4.1	3.6	8.4	8.9	10.2	9.0	9.2	9.1	4.7	3.8	3.6		

12 × 5.82 = 67.84

DEGAGMTS.MET

DEGAGA STATION Co-ord 38 50'East 7 26'North

6 YEARS 2040 mt a.s.l.

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	TOTAL	YEAR
RAINFALL mm	13	113	29	114			129	319	130	39	11	4	1126	1972
	4	0	0	88	142	97	252	93	184	29	0	10	898	1973
	12	12	141	19	150	98	216	140	159	21	0	0	968	1974
	0	19	17	101	81	159	174	235	251	53	0	0	1089	1975
	0	28	12	54	112	73	273	179	138	83	90	26	1067	1976
	28	19	89	48	121	95	180	183	198	178	26	28	1192	1977
MONTH average	10	32	48	71	121	104	204	191	177	67	21	11	1057	

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	YEAR
MAX TEMP. 'C	23	22	25	23	25		21	21	23	24	23	23	1972
	25	27	28	26	23	23	22	21	21	22	24	23	1973
	24	25	23	25	24	23	21	22	21	24	23	24	1974
	24	25	26	26	24	21	19	20	20	23	22	23	1975
	23	25	26	25	23	23	21	20	21	22	22	22	1976
	22	23	24	24	24	22	20	21	21	22	23	23	1977
MONTH average	24	25	25	25	24	22	21	21	21	23	23	23	23.1

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	YEAR
MIN TEMP. 'C	6	9	8	10	10		6	11	11	8	6	5	1972
	6	7	8	10	11	10	11	9	11	9	5	3	1973
	5	6	9	9	10	10	10	11	10	7	5	4	1974
	2	6	8	10	10	10	10	11	11	10	5	4	1975
	5	7	8	9	11	9	11	10	10	11	12	11	1976
	10	8	10	11	10	10	11	10	10	10	8	6	1977
MONTH average	6	7	8	10	10	10	10	10	11	9	7	5	8.6°

MEAN TEMP. 'C 15 16 17 17 17 16 15 16 16 16 15 14 15.8

NOTE: The not available data (blank) have been substituded with mean data.
It has been done to have total and average data.

DHERAMTS.MET

DHERA METEO STATION Co-ord 39 19'East 8 20'North

10 YEARS 1680 at a.s.l.

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	TOTAL	YEAR
RAINFALL mm	49	0	13	113	89	149	145	145	115	148	107		1093	1977
	0	162	14	14	22	24	80	166	15	42	0	43	583	1978
	48	3	56	0	109	92	174	147	50	80	0	20	777	1979
	28	0	8	25	39	74	152	110	71	49	6	0	560	1980
	0	7	143	40	5	5	183	141	147			0	763	1981
	2	68	9	21	144	49	157	189	100	162	108	49	1055	1982
		16	23	94	190	9	95						426	1983
		0	51	20	74	78	105	129	61	0	0	5	538	1984
	21	0	0	45	70	6	180	243	8	0	0	0	572	1985
	0	0	126	74	30	68	105	76	111	29	0	0	619	1986
MONTH average	18	26	44	45	77	55	138	149	75	64	28	14	733	

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC		YEAR
MAX TEMP. °C	25	25	28	29	29	28	25	26	27	27	25			1977
	25	26	27	28	30	29	26	26	27	27	26	26		1978
	24	27	27	30	29	30	24	27	27		27	27		1979
	27	28	29	30	31	29	27	26	27	28	28	27		1980
	27	28	28	27	30	31	28	26	26			26		1981
	26	27	26	29	29	31	31	32	31	31	29	29		1982
		30	29	30	30	31	30							1983
		27	31	32	29	28	26	27	27	29	28	26		1984
	27	27	30	28	29	30	26	26	26	28	27	26		1985
	27	28	28	28	31	28	26	27	27	28	28			1986
MONTH average	26	27	28	29	30	30	27	27	27	28	27	27		27·8

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC		YEAR
MIN TEMP. °C	14	12	15	16	15	15	15	16	14	14	13			1977
	12	13	15	16	16	16	15	14	14	13	13	12		1978
	13	14	18	16	15	15	14	15	17		16	13		1979
	12	14	13	14			15	15	15					1980
	14	14	15	15	15	15	15	14	14			11		1981
	14	15	16	16	16	16	15	19	15	14	15	15		1982
		16	16	16	16	17	16							1983
		10	16	17	14	15	13	13	12	12	12	11		1984
	11	11	15	14	14	14	13	13	13	12	11	10		1985
	10	14	14	15	16	16	15	15	14	13	12			1986
MONTH average	12	13	15	16	15	15	15	15	14	13	13	12		12·8

MEAN TEMP. °C	19	20	22	22	22	22	21	21	21	21	20	19		20·8

NOTE: the not available data (blank) have been substituded with mean data.
It has been done to have total and average data.

NATIONAL METEOROLOGICAL SERVICES AGENCY

Station DIXIS STATE FARM Wereda ..... Awraja ..... Region ARSSI

Alt. ..... Long. ..... Lat. ..... Element MONTHLY MEAN MAX T

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
19 91	20·7	20·6	20·8	19·5	19·9	21·1	18·4	x	18·3	18·4	19·5	x		
19 92	19·6	20·8	22·4	21·1	20·3	20·3	18·1	17·7	17·2	18·2	18·1	19·0		
19 93	18·2	18·6	21·3	21·1	19·4	19·6	18·9	18·8	18·9	18·7	19·4	20·3		
19 94	21·4	22·5	22·0	21·8	21·4	19·8	18·3	17·9	18·5	18·6	18·5	19·9		
19 95	21·2	21·7	20·1	19·7	20·9	21·2	18·7	18·9	19·3	18·8	19·7	20·3		
19 96	19·9	^	^	^	^	^	^	^						
19 97		17·6	21·5	22·2	21·4									
19														
19														
Total														
19														
19														
19														
19														
19														
19														
19														
19														
19														
19														
Total														
Total														
Ave.														
Total														

NATIONAL METEOROLOGICAL SERVICES AGENCY

C 23

Station: Dixis State farm Wereda ..... Awraja ..... Region Arsi

Alt. ..... Long..... Lat. ..... Element monthly minimum

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
19 92	6.2	7.2	7.1	8.7	8.9	8.5	8.4	9.4	8.2	6.8	5.9	7.4		
19 93	6.9	7.0	6.7	7.9	9.0	9.2	7.8	7.6	8.6	8.0	6.0	4.9		
19 94	3.6	6.0	6.8	8.2	8.5	9.4	9.2	8.7	8.6	6.8	6.5	4.1		
19 95	4.3	6.7	8.6	9.5	9.2	8.7	9.4	5.4	8.6	7.8	4.9	5.4		
19 96	6.9	5.8	6.3	6.4	5.9	8.5	7.1	"	"	"	"	"		
19 97		6.3	8.2	8.7	8.6									
19														
Total														
19														
19														
19														
19														
19														
19														
19														
19														
19														
19														
Total														
Total														
Ave.														
Total of Yr.	6	7	6	7	7		8	8	8	8				

28: 61

Station: GINIR Wereda GINIR Awraja WABI Region BALE

Alt [illegible] Long Lat. Element Monthly MEAN MAX.

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
19 [illegible]								✓		✓				
19 [illegible]									✓					

Total														
19 91	25·5	26·6	25·1	23·4	23·4	23·1	21·6	23·1	24·8	24·3	23·5	24·6		
19 92	24·1	25·2	26·4	24·1	23·3	22·6	22·9	22·9	23·3	21·7	21·5	22·5		
19 93	22·6	23·2	25·1	23·1	22·9	x	x	x	x	x	x	x		
19 94	[illegible]					24·5	23·0	23·8	25·1	22·4	21·8	23·3		
19 95	25·0	26·3	25·5	22·3	23·6	23·8	23·2	22·8	23·0	20·7	21·1	23·8		
19 96	24·6	26·5	25·4	24·1	24·9	21·2								
19 97	26·3	28·0	24·4	21·9	21·9	22·4								
19														
19														
19														
Total														
Total														
Ave.														
Total of Yr.														
Ave. of Yr.														

[illegible]

NATIONAL METEOROLOGICAL SERVICES AGENCY

Station: GENNIR ..... Wereda GENNIR ..... Awraja WABE ..... Region BA

Alt. 1970 Long ..... Lat ..... Element Maximum Mean Mo

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Total													
19 91	13·2	13·9	14·5	14·2	14·3	13·9	12·6	12·9	13·0	13·2	12·6	12·0	
19 92	12·8	14·2	14·3	15·0	14·7	13·8	12·7	12·7	13·1	13·2	11·9	12·8	
19 93	13·1	13·2	13·7	14·5	14·6	x	x	x	x	x	x	x	
19 94	x	x	x	x	x	13·6	13·1	13·4	13·5	13·0	12·2	11·4	
19 95	11·2	13·9	14·3	14·4	14·1	12·9	12·8	12·1	12·2	12·1	10·8	11·7	
19 96	13·0	13·7	16·0	15·8	16·4	14·4							
19 97	13·2	9·8	16·2	12·6	12·3	11·5							
19													
19													
19													
Total													
Total													
Ave.													
Total of Yr.	11	11	11										29
Ave. of Yr.													

NATIONAL METEOROLOGICAL SERVICES AGENCY

Station: GOBA (N.M.S.A.) Wereda ..... Awraja ..... Region BALE

Alt. 2700 Long. 40 00 Lat. 07 01 Element MONTHLY MAX. TEMP. °

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
1962	x	x	x	x	x	21.4	20.2	19.3	19.6	18.7	18.5	20.0		
1963	19.8	20.9	22.2	19.0	20.3	21.2	20.3	20.3	19.8	18.7	17.4	17.7		
1964	20.1	21.3	22.0	x	x	x	x	x	x	x	x	x		
1965	x	19.0	20.1	18.4	19.3	20.5	19.3	18.0	17.6	16.4	16.2	17.7		
1966	19.0	18.2	19.1	18.5	18.8	18.9	19.3	18.8	17.7	16.4	15.7	18.2		
1967	18.7	20.4	20.2	18.2	18.0	19.1	17.6	16.8	17.0	15.7	15.7	17.4		
1968	x	x	x	x	17.8	18.2	18.7	19.2	19.0	17.3	17.0	18.4		
1969	18.9	18.4	18.7	19.8	20.1	20.0	19.2	19.1	18.7	18.2	18.2	x		
1970	18.9	21.2	18.9	19.1	20.5	21.0	20.0	18.7	18.8	17.3	18.6	20.0		
1971	20.5	21.7	20.5	19.7	19.8	20.4	19.7	20.0	18.9	17.2	17.6	19.1		
Total														
1972	20.7	19.0	19.8	19.7	20.0	20.3	19.8	20.3	20.0	17.8	19.1	20.2		
1973	22.2	23.4	24.8	22.3	21.0	22.1	20.9	20.0	20.0	18.3	20.5	20.0		
1974	21.9	22.2	19.8	21.1	20.3	20.8	20.6	20.2	18.9	18.2	18.6	19.8		
1975	20.8	21.6	22.5	19.5	20.5	20.5	19.4	18.6	18.9	17.0	17.6	19.4		
1976	19.5	x	x	x	(19.1)	20.6	19.4	19.4	19.3	17.9	18.0	19.3		
1977	19.3	20.0	20.4	19.9	20.4	21.1	20.4	19.6	18.8	17.1	18.0	19.8		
1978	20.0	20.3	20.7	20.4	20.7	21.6	19.3	20.4	19.4	17.7	18.4	19.7		
1979	18.3	20.5	21.5	20.1	21.1	21.3	21.2	20.3	20.3	18.8	20.2	21.8		
1980	23.0	(23.8)	23.2	21.6	22.5	22.1	21.2	20.7	19.3	18.1	19.4	20.6		
1981	21.7	21.2	19.9	18.8	20.0	21.9	20.4	19.8	19.0	17.9	18.5	19.9		
1982														
1983	20.1	21.0	21.6	19.2	19.8	20.8	19.6	19.5	19.2	17.5	18.7	19.1		
1984	20.3	20.5	22.5	20.8	20.4	21.2	20.3	19.5	19.2	17.5	18.7	19.6		
1985	21.6	22.4	22.3	21.2	20.5	20.8	21.0	21.1	19.9	X	X	X		

NATIONAL METEOROLOGICAL SERVICES AGENCY

Station: GOBA Wereda ..... Awraja ..... Region BALE

Alt. 2700 Long. 40 00 Lat. 07 07 Element monthly mean minimum

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Aver
19														
1962	"	"	"	"	"	6·9	6·7	5·4	7·4	5·3	5·8	3·7		
1963	4·2	6·0	5·6	8·0	8·0	6·8	7·1	7·3	6·8	6·5	7·3	6·7		
1964	5·1	5·2	6·6	8·3	8·3	7·7	7·3	7·1	7·5	7·4	3·6	5·0		
1965	3·9	2·2	4·4	7·1	6·9	7·3	7·3	6·8	7·8	7·1	7·1	3·8		
1966	3·6	6·7	6·6	8·3	8·0	7·3	7·8	7·6	7·6	7·8	5·1	2·1		
1967	2·2	4·5	6·8	7·6	7·5	7·6	7·9	7·6	7·8	8·1	7·6	2·9		
1968	"	"	"	"	7·4	7·4	6·9	6·7	7·1	7·6	5·4	4·8		
1969	5·6	6·4	8·2	8·1	8·7	7·7	7·6	6·8	7·7	6·8	5·0	x		
1970	5·6	5·6	7·7	8·5	8·0	7·2	7·3	7·2	7·2	8·0	2·6	2·3		
Total														
1971	3·7	3·4	5·6	7·1	7·5	7·4	6·9	6·6	7·8	7·8	5·0	3·1		
1972	3·7	6·2	5·8	7·8	8·0	7·5	7·9	7·2	7·9	7·2	6·1	4·6		
1973	4·2	4·7	5·5	8·5	8·2	7·9	7·7	8·0	8·0	7·4	4·6	2·5		
1974	3·3	4·3	6·5	7·2	7·6	7·1	6·8	7·4	7·5	6·7	3·0	2·7		
1975	2·2	4·3	6·0	7·8	8·1	7·2	7·6	7·2	7·4	6·8	4·5	2·8		
1976	3·3	5·2	5·7	7·3	8·1	6·9	7·0	7·2	7·2	7·4	6·2	4·0		
1977	6·5	5·4	6·6	8·6	7·9	7·6	7·9	6·9	7·6	8·9	5·8	4·1		
1978	3·2	5·9	7·4	7·3	7·5	7·6	7·2	6·8	6·9	7·1	4·6	4·1		
1979	5·7	5·7	5·9	7·3	7·7	7·2	6·6	6·3	6·9	6·6	4·2	4·1		
1980	3·7	4·7	6·8	7·7	8·4	7·7	7·7	7·4	7·9	7·2	6·0	3·6		
al														
1981	4·1	5·5	8·1	9·4	8·8	7·8	8·5	7·7	7·7	7·4	4·7	3·6		
1982	6·0	6·2	7·0	8·9	9·2	7·4	8·2	7·7	7·6	7·3	6·9	6·1		
1983	7·6	6·0	7·7	8·9	8·9	8·3	8·4	8·7	8·8	8·0	6·3	4·9		
1984	3·1	2·9	6·0	8·5	8·5	7·3	7·0	7·7	7·5	5·3	5·2	5·2		

NATIONAL METEOROLOGICAL SERVICES AGENCY

tation: GORO Wereda GORO Awraja Mendeyo Region Bale

lt. 1780 Long. Lat. Element monthly mean max ~~rainfall~~ ti

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
19														
19														
19														
19 93	26.9						32.2	29.1	35.6					
19 94					26.4	26.3	25.9	26.5	27.8	30.9				
19 95	27.8							22.1	27.6	28.5		27.9		
19 96	28.1					27.1	25.2	27.2		26.2	26.8			
9														
9														
9														
Total														
9														
9														
9														
9														
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NO DATA

NATIONAL METEOROLOGICAL SERVICES AGENCY

Station: GORO Wereda GORO Awraja Mendeyo Region Bale

Alt. 1780 Long. Lat. Element monthly mean min t

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
19														
Total														
19														
19 91														
19 92							ND				4·1	4·4		
19 93	×	4·7	5·0	6·5	10·2	9·9	9·3	8·2	13·1	(	13 2	11 9		
19 94	7·9	9·1	10·9	12·3	12·3	12·2	11·7	10·8	9·9	9·1	8·6	6·0		
19 95	13·1	9·1	6·6	8·9	9·6	8·3	8·5	8·1	7·5	8·9	8·4	7·6		
19 96	8·5	8·1	8·9	10·0	11·5	12·4	12·6	10·2	·	5·5	3·9	×		
19														
19														
19														
Total														
19														
19														
19														
19														
19														
19														
19														
19														
19														
Total														
Total														
Ave.														
Total 4 Yr.														
Ave. 4 Yr.														

NATIONAL METEOROLOGICAL SERVICES AGENCY

Station: KOFELE Wereda _____ Awraja _____ Region Arssi

Alt. _____ Long _____ Lat. _____ Element MONTHLY MAX TEMP

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
19 92	21·1	20·8	22·4	21·1	20·6	19·3	18·3	18·4	18·9	18·2	19·4	20·2		
19 93	19·3	19·9	22·0	20·1	19·3	18·5	17·9	17·6	18·3	18·6	19·4	20·9		
19 94	22·2	23·2	22·8	21·1	19·8	18·8	17·7	18·6	19·0	19·5	19·9	20·9		
19 95	21·7	22·2	22·0	20·3	20·8	19·9	17·1	18·4	18·5	19·3	21·1	20·8		
19 96	20·2	22·0	22·0	19·4	20·2	18·3	19·0	18·9	19·5	20·1	20·5	20·8		
Total														
19														
19														
19														
19														
19														
19														
19														
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19														
19														
Total														
19														
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19														
19														
19														
19														
19														
Total														
Total														
Ave.														

2

NATIONAL METEOROLOGICAL SERVICES AGENCY

Station: MERARO Wereda _____ Awraja _____ Region ARSI

Alt. _____ Long _____ Lat. _____ Element MEAN MIN Temp.

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
1991	4.9	6.1	6.9	7.7	8.2	6.0	7.1	6.3	5.6	3.7	3.6	2.6		
1992	4.3	5.3	5.7	6.8	7.1	5.8	6.5	7.1	5.4	5.5	4.2	5.0		
1993	5.5	5.0	4.1	6.8	6.9	6.0	6.1	5.8	5.3	6.1	4.1	3.6		
1994	3.1	4.0	5.4	6.6	7.0	7.3	7.2	6.7	6.9	"	"	"		
1995	"	(4.7)	7.0	8.4	6.7	4.8	"	"	"	"	"	"		
1996	"	"	"	"	"	"	"							
19														
19														
19														
19														
Total														
19														
19														
19														
19														
19														
19														
19														
19														
19														
19														
Total														
Total	31.7	40.6	50.3	59.4	51.5	48.2	53.4	50.5	43.9	41.6	29.5	25.5		
Ave.	4.5	5.7	6.4	7.4	7.4	6.5	6.8	6.7	6.3	5.2	4.2	4.3		

NATIONAL METEOROLOGICAL SERVICES AGENCY

Station. NAZARETH Mission Wereda ..... Awraja ..... Region SIDAMA

Alt 1622 Long. 39° 17' Lat. 08° 33' Element Monthly mean max

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
1983	x	28.1	30.F	25.5	30.4	29.8	2F.8	25.0	2F.5	28.6	28.5	2F.F		
1984	27.8	29.2	32.2	33.8	30.5	27.9	26.4	26.9	27.9	30.4	30.1	28.3		
1985	29.9	x	32.1	25.4	30.8	32.4	28.8	25.3	28.0	29.1	30.3	29.3		
1986	29.F	31.2	29.F	32.F	34.3	29.6	2F.5	28.4	30.8	2F.8	28.9	29.5		
1987	25.1	31.F	31.2	29.8	30.4	30.1	29.0	2F.0	29.8	31.1	30.F	30.6		
1988	31.0	32.9	32.3	33.1	33.1	31.F	25.2	2F.1	2F.5	2F.2	25.2	2F.3		
89	29.6	29.0	28.5	27.0	32.0	39.3	25.0	24.7	26.9	28.0	28.3	28.0		
90	25.9	27.5	26.1	26.8	30.3	29.1	25.6	27.5	26.1	31.4	26.6	25.9		
91	27.7	x	28.9	29.0	30.1	30.1	25.0	24.8	26.6	27.5	27.1	26.6		
92	25.8	26.1	29.7	29.7	30.7	30.1	25.3	24.3	25.3	25.9	26.4	25.9		
otal														
93	25.3	24.9	29.5	27.9	28.1	28.6	24.8	25.1	26.5	(27.5)	x	x		
94	x	x	x	34.5	31.2	25.6	26.4	25.2	25.9	27.1	25.5	25.1		
95	26.9	29.0	28.7	28.3	30.9	31.6	25.9	25.5	26.5	27.9	27.5	27.5		
96	26.8	29.6	29.5	29.0	29.2	27.5	26.2	25.5	26.9	27.9	27.5	26.2		

NATIONAL METEOROLOGICAL SERVICES AGENCY

NAZARETH MISSION Weroda _____ Awraja _____ Region SHOA

1622 Long 39 17 Lat. 08 33 Element MONTHLY MEAN MAX TEMP

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
	25.5	-	-	-	-	-	-	-	-	-	25.7	24.2		
	-	-	29.5	29.7	29.9	27.2	24.3	25.5	28.2	-	-	-		
	-	-	-	-	29.2	26.1	25.6	25.5	-	-	-	-		
	29.2	-	-	31.4	-	-	24.7	-	-	-	-	-		
	-	-	-	30.3	30.0	-	-	-	-	-	-	-		
	-	-	-	-	-	-	-	-	-	-	-	-		
	26.1	26.6	28.0	30.7	31.5	30.6	24.8	23.9	26.3	28.0	28.1	26.5		
	26.1	29.1	29.0	29.4	30.1	30.0	25.1	23.6	25.6	27.1	27.1	-		
	-	-	-	-	-	-	-	-	-	-	-	-		
	-	-	-	-	-	-	-	-	-	-	-	-		
	x	x	x	x	x	x	x	x	x	x	x	x		
	-	-	-	-	-	-	-	-	-	-	-	22.8		
	24.4	27.0	27.6	27.7	28.3	28.7	25.9	24.6	24.8	24.2	24.1	23.3		
	-	19.9	26.2	-	30.4	27.8	-	25.0	25.1	25.8	25.4	26.0		
	25.2	28.1	28.2	27.0	27.7	25.4	-	-	-	-	-	-		
	-	-	-	-	23.0	21.1	-	-	-	-	-	-		
	-	-	-	-	30.6	30.0	25.5	25.3	27.5	28.6	27.2	27.1		
	26.3	28.7	27.3	30.5	32.1	31.4	26.3	24.1	26.0	27.7	26.6	26.0		
	25.9	28.7	x	x	x	x	25.0	25.0	26.3	27.8	26.3	25.1		
	27.1	26.8	30.0	29.8	30.9	30.0	25.8	25.6	27.3	28.2	28.0	27.8		
	28.2	30.6	32.1	32.8	31.1	30.3	26.4	24.9	26.5	27.2	27.8	26.1		
	28.4	29.1	28.1	30.9	30.0	28.8	25.5	25.8	26.4	28.3	27.0	26.9		
	27.5	29.1	31.5	29.9	31.0	28.0	24.5	24.0	26.2	Y	26.9	X		
	27.5	x	29.8	29.6	x	30.0	25.3	25.6	27.9	28.6	27.5	27.6		
	26.4	26.3	29.9	29.3	29.5	28.9	25.0	25.8	27.0	27.5	25.4	26.4		
	27.6	27.7	29.4	32.1	32.5	30.2	25.4	26.1	27.3	27.5	x	27.2		
	26.0	27.5	30.0	31.7	30.2	29.3	25.8	28.3	29.3	29.8	x	x		
	x	x	x	x	x	x			28.2	29.1	25.7	26.1		
	29.6	29.6	28.4	27.6	x	33.0	28.3	25.7	25.8	27.9				
	28.2	29.1	31.3	30.4	30.3	31.5	27.3	25.2	27.2	25.3		26.5		

NATIONAL METEOROLOGICAL SERVICES AGENCY

ation: NAZRETH Mission Wereda ..... Awraja ..... Region SHOA

t. 1622 Long. 39 17 Lat. 08 33 Element Monthly mean min.

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
983	x	15.5	16.7	16.4	16.8	17.6	16.7	16.4	16.6	12.5	10.8	10.6		
984	9.6	10.0	13.7	15.6	16.0	16.9	15.5	15.9	13.6	10.9	12.3	11.3		
985	11.1	x	14.9	15.7	15.8	17.3	14.6	15.0	15.0	10.6	8.9	10.8		
986	11.5	14.7	13.3	13.5	14.8	16.1	15.7	14.2	15.8	11.2	10.7	16.2		
987	12.0	14.7	15.1	14.1	14.2	18.0	15.3	16.2	14.9	11.9	5.1	8.2		
988	11.5	15.1	12.7	12.6	14.8	16.2	11.0	14.4	15.0	10.0	7.6	8.2		
989	8.5	10.7	16.2	14.1	16.7	14.8	11.7	14.9	14.6	10.8	10.3	13.7		
990	12.7	15.1	14.5	14.4	16.5	17.8	15.7	15.6	15.1	14.1	12.0	11.6		
991	14.4	x	15.1	14.8	14.5	18.0	15.7	15.6	14.8	13.0	12.1	11.3		
992	13.6	15.4	16.1	16.0	15.9	17.0	15.4	15.5	13.5	11.8	12.2	13.4		
al														
993	13.7	13.6	13.8	15.1	15.6	16.4	15.4	14.9	14.8	(12.7)	x	x		
994	x	x	x	(35.6)	15.8	16.8	15.7	15.5	13.7	11.2	12.5	11.1		
995	10.5	14.3	14.4	14.8	13.2	15.3	15.6	16.2	13.5	12.9	12.7	14.1		
996	14.0	13.6	15.4	14.5	14.7	16.6	15.8	15.7	14.6	12.1	13.2	12.1		

I.2 MONTHLY RAINFALL

I.2.1 INFILLED

I.2.2 OBSERVED

1.2.1 INFILLED

Table I.2.1.2 Monthly Rainfall @ Adaba

Station: Adaba
Lat. 7°01'N Long. 39°14'E Alt. 2485 masl

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1984	0.0	0.0	4.4	7.8	105.0	86.6	199.1	84.3	93.0	2.8	3.0	109.0	695.0
1985	21.4	2.7	16.3	80.7	74.1	81.5	203.0	165.4	88.0	39.1	11.4	1.0	784.6
1986	0.0	66.1	23.0	86.1	64.4	109.7	190.0	183.2	71.7	15.0	8.1	0.0	817.3
1987	10.0	20.1	115.7	75.6	86.6	14.2	105.3	165.3	38.4	103.8	2.6	8.1	745.7
1988	0.0	98.3	2.1	128.1	24.2	106.8	179.7	252.6	67.0	56.2	0.0	0.0	915.0
1989	0.0	25.1	99.4	188.0	15.2	69.6	224.8	123.4	75.7	25.2	3.1	50.5	900.0
1990	10.6	161.8	100.4	151.6	46.0	6.0	118.5	337.5	56.3	4.2	0.0	0.1	993.0
1994	10.5	47.1	74.6	126.1	46.0	113.4	173.6	244.6	80.8	14.4	27.5	0.6	959.2
1995	0.4	10.0	86.7	131.4	19.1	52.6	219.0	227.0	88.5	26.8	0.5	5.8	867.8
1996	30.1	14.2	72.4	82.6	81.2	75.1	177.7	230.0	94.9	0.0	5.6	10.9	874.7
1997	22.5	0.0	45.2	125.5	49.4	62.8	230.5	225.8	71.7	32.9	5.6	10.9	882.8
Mean	9.6	40.5	58.2	107.6	55.6	70.8	183.7	203.6	75.1	29.1	6.1	17.9	857.7
Max.	30.1	161.8	115.7	188.0	105.0	113.4	230.5	337.5	94.9	103.8	27.5	109.0	993.0
Min.	0.0	0.0	2.1	7.8	15.2	6.0	105.3	84.3	38.4	0.0	0.0	0.0	695.0
80% Dep.	0	2.7	16.3	80.7	24.2	52.6	173.6	165.3	57	4.2	0.5	0.1	784.6
St.Dev.	10.9	50.7	41.6	47.8	29.4	35.8	40.4	69.1	17.0	30.0	7.9	33.5	89.8
Cv	1.13	1.25	0.71	0.44	0.53	0.51	0.22	0.34	0.23	1.03	1.29	1.87	0.10

Table I.2.1.2 Monthly Rainfall @ Asasa

Station: Asasa
Lat. 7°09'N Long. 39°11'E Alt. 2400 masl

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1987	20.0	46.9	55.6	55.0	95.2	24.4	35.3	20.8	31.2	45.8	3.0	5.7	438.9
1988	13.9	28.0	10.4	74.3	0.0	104.7	190.1	224.0	56.5	37.2	0.0	0.0	739.1
1989	7.8	6.1	100.4	162.1	33.1	67.9	131.7	161.4	62.5	51.4	5.1	39.8	829.3
1990	0.0	156.4	47.1	65.5	132.0	67.3	181.1	162.2	52.1	0.0	3.9	0.0	867.6
1991	0.5	11.0	63.5	2.0	17.7	73.5	224.6	174.9	58.2	0.0	1.3	56.2	683.4
1992	71.9	39.6	46.9	74.9	13.4	58.8	161.4	221.5	98.8	31.8	4.8	3.7	827.5
1993	38.1	55.3	3.2	130.6	57.8	60.5	135.1	123.9	93.3	29.7	6.3	0.0	733.8
1994	0.0	0.1	26.7	28.2	25.1	163.2	179.1	233.8	67.1	0.0	18.8	2.1	744.2
1995	2.4	45.9	53.0	122.4	13.3	36.2	117.0	137.0	61.9	37.3	2.8	3.6	632.8
1996	14.7	6.6	61.9	28.6	111.7	68.0	258.5	162.2	45.5	2.2	19.4	12.3	791.6
Mean	16.9	39.6	46.9	74.4	49.9	72.5	161.4	162.2	62.7	23.5	6.5	12.3	728.8
Max.	71.9	156.4	100.4	162.1	132.0	163.2	258.5	233.8	98.8	51.4	19.4	56.2	867.6
Min.	0.0	0.1	3.2	2.0	0.0	24.4	35.3	20.8	31.2	0.0	0.0	0.0	438.9
80% Dep.	0.4	6.5	23.4	28.5	13.4	54.3	128.8	134.4	50.8	0.0	2.5	0.0	673.3
St.Dev.	22.7	45.6	28.1	50.6	46.9	38.4	61.8	62.1	20.3	20.7	6.9	19.5	124.2
Cv	1.34	1.15	0.60	0.68	0.94	0.53	0.38	0.38	0.32	0.88	1.05	1.58	0.17

Table I.2.1.2 Monthly Rainfall @ Assela

Station: Assela School(Assela Town)
Lat. 07°57' Long. 39°08' Alt. 2400 masl

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	nnual
1966	17.0	112.5	52.5	111.5	27.5	146.5	231.5	221.5	139.0	82.5	1.5	0.0	1143.5
1967	2.5	0.0	139.5	71 5	180.5	112.5	367.0	281.0	211.5	212.0	100.5	14.0	1692.5
1968	10.0	125.5	50.0	278 5	111.0	199.0	266.9	267.5	267.5	20.0	15.0	17.0	1627.9
1969	46.0	131.0	134.0	74.0	84.0	149.0	249.5	247.0	182.0	39.0	14.0	5.0	1354.5
1970	112.0	35.0	275.0	72.0	77.0	92.0	285.0	225.5	187.0	65.0	0.0	0.0	1425.5
1971	29.0	2.0	98.0	153.0	185.0	164.0	191.0	200.0	171.0	38.5	25.5	27.0	1284.0
1972	23.0	43.0	88.5	256.0	75.5	134.0	160.5	341.0	117.0	2.0	6.5	9.0	1256.0
1973	2.0	0.0	1.0	40.5	194.5	172.5	127.3	195.0	135.0	53.0	0.0	0.0	920.8
1974	14.3	35.0	186.0	23.0	122.0	105.5	162.0	133.3	208.7	27.0	0.0	0.0	1016.8
1975	13.9	24.5	15.7	46.5	77.5	237.0	223.0	284.0	161 1	31.5	0.0	0.0	1114.7
1976	20.1	45.3	90.0	109 0	84.1	136.4	259.3	207.8	83.8	74.0	48 1	21.3	1179.2
1977	36.0	16.3	113.2	127.1	93.3	193.7	220.5	234.0	182.4	112.2	0.0	27.5	1356.2
1978	34.5	152.6	83.5	49.7	153.0	124.8	285.3	349.5	302.3	99.8	81.5	8.1	1724.6
1979	44.0	34.2	87.8	52.0	160.2	103.5	228.8	322.6	290.7	82.4	0.0	16.7	1422.9
1980	18.7	42.1	109.6	101.3	96.6	126.7	177.8	173.0	166.1	66.8	12.7	0.0	1091.4
1981	0.0	18.8	166.2	145.5	47.0	80.4	193.0	191.1	280.5	47.0	10.0	0.0	1179.5
1982	22.1	52.7	75.6	94.1	120.9	131.6	168.3	391.8	213.8	48.3	50.1	17.3	1386.6
1983	5.8	78.6	81.3	210 1	255.8	145.4	238.5	253.9	219.6	72.5	22.5	14.0	1597.9
1984	0.3	5.7	11.3	23.6	327.2	135.7	156.5	209.1	244.9	1.6	17.8	14.0	1147 7
1985	14.9	1.8	48.1	175.0	179.0	293.5	206.6	150.4	153.8	13.5	26.7	2.7	1266.0
1986	24.4	98.5	84.6	172.2	112.9	118.0	246.5	166.2	256.0	43.1	72.3	2.3	1397.0
1987	0.0	60.1	70.3	105.9	81.3	126.4	149.6	136.5	114.9	45.5	8.0	13.7	912.3
1988	14.1	52.0	8.4	75.3	51 1	279.5	219.3	168.2	148.1	66.5	0.0	0.0	1082.5
1989	1.7	26.7	126.6	268.2	40.2	132.3	111.9	169.3	130.0	53.2	13.2	88.5	1161.8
1990	0.0	111.5	93.0	92 1	19.8	87 1	197.8	186.4	153.7	49.2	11.2	0.0	1001.8
1991	0.0	42.4	162.1	34.4	57.6	117.6	178.8	149.1	39.1	1.5	1.2	20.0	803.8
1992	36.0	90.8	58.3	142.1	33.5	44.0	131.6	206.3	220.0	72.7	22.5	38.7	1096.5
1993	13.2	22.3	20.0	150.8	77.8	38.7	117.9	166.3	140.0	172.9	0.0	0.0	919.9
1994	0.0	0.0	132.9	44.9	83 8	203.8	249.7	164.5	178.1	5.5	16.6	3.5	1083.3
1995	0.0	23.2	122.4	153.8	96.7	118.9	212.0	164.2	97.6	22.0	0.0	69.5	1080.3
1996	69.8	16.0	171.7	155.9	156.5	193.9	163.5	132.7	133.9	31.5	1.9	4.3	1231 6
Mean	20.2	48.4	95.4	116.4	111.7	143.3	205.7	215.8	178.4	56.5	18.7	14.0	1224.5
Max.	112.0	152.6	275.0	278.5	327.2	293.5	367.0	391.8	302.3	212.0	100.5	88.5	1724.6
Min.	0.0	0.0	1.0	23.0	19.8	38.7	111.9	132.7	39.1	1.5	0 0	0.0	803 8
80% Dep.	0 3	16	50	49.7	57.6	105.5	160.5	164.5	133.9	22	0	0	1080.3
St.Dev.	24.0	43.3	59.9	70.4	68.6	58.0	56.7	67.8	62.7	46.3	25.8	20.2	232.9
Cv	1.19	0.89	0.63	0 60	0.61	0.40	0.28	0.31	0.35	0.82	1.38	1.44	0 19

Table I.2.1.2 Monthly Rainfall @ Bekoji

Station: Bekoji
Lat. 7°19'N Long. 39°09'E Alt. 2850 masl

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1987	2.5	37.5	206.9	123.1	117.5	97.7	67.4	179.6	60.3	44.8	3.2	23.2	963.7
1988	12.5	36.5	81.1	201.3	52.7	109.5	199.6	262.6	103.4	124.6	8.3	5.0	1197.1
1989	20.2	46.2	98.3	155.6	82.8	87.1	172.9	155.0	67.2	101.1	11.6	80.0	1078.0
1990	4.1	224.9	108.1	146.9	38.0	59.5	155.1	233.8	100.7	40.8	17.2	3.3	1132.4
1991	5.3	61.4	140.9	30.9	81.1	123.3	197.2	255.1	97.4	8.9	0.9	24.2	1026.6
1992	112.9	91.2	39.4	121.1	54.7	116.9	164.3	216.0	36.2	126.7	51.8	13.1	1144.3
1993	54.5	99.4	2.7	148.9	175.8	123.9	163.8	221.8	138.2	50.4	3.5	3.2	1186.1
1994	0.8	0.0	37.4	128.2	47.5	168.0	241.5	250.7	89.2	6.3	38.6	5.0	1013.2
1995	0.0	41.4	94.2	151.8	73.4	50.1	181.7	230.0	157.2	17.5	1.2	32.4	1030.9
1996	58.7	12.3	140.2	55.5	154.3	125.1	158.0	229.2	86.1	35.0	3.1	5.9	1063.4
Mean	27.2	65.1	94.9	126.3	87.8	106.1	170.2	223.4	93.6	55.6	13.9	19.5	1083.6
Max.	112.9	224.9	206.9	201.3	175.8	168.0	241.5	262.6	157.2	126.7	51.8	80.0	1197.1
Min.	0.0	0.0	2.7	30.9	38.0	50.1	67.4	155.0	36.2	6.3	0.9	3.2	963.7
80% Dep.	2.2	31.7	39.0	108.0	51.7	81.6	157.4	208.7	65.8	15.8	2.7	4.7	1023.9
St.Dev.	37.1	64.1	59.6	49.7	46.9	34.4	44.5	33.5	35.5	45.6	17.5	23.7	78.4
Cv	1.37	0.98	0.63	0.39	0.53	0.32	0.26	0.15	0.38	0.82	1.26	1.21	0.07

Table I.2.1.2 Monthly Rainfall @ Degaga

Station: Degaga
Lat. 7°26'N Long. 38°50'E Alt. 2040 masl

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1972	13.0	113.0	29.0	114.0	121.2	104.4	129.0	319.0	130.0	39.0	11.0	4.0	1126.6
1973	4.0	0.0	0.0	88.0	142.0	97.0	252.0	93.0	184.0	29.0	0.0	10.0	899.0
1974	12.0	12.0	141.0	19.0	150.0	98.0	216.0	140.0	159.0	21.0	0.0	0.0	968.0
1975	0.0	19.0	17.0	101.0	81.0	159.0	174.0	235.0	251.0	53.0	0.0	0.0	1090.0
1976	0.0	28.0	12.0	54.0	112.0	73.0	273.0	179.0	138.0	83.0	90.0	26.0	1068.0
1977	28.0	19.0	89.0	48.0	121.0	95.0	180.0	183.0	198.0	178.0	26.0	28.0	1193.0
Mean	9.5	31.8	48.0	70.7	121.2	104.4	204.0	191.5	176.7	67.2	21.2	11.3	1057.4
Max.	28.0	113.0	141.0	114.0	150.0	159.0	273.0	319.0	251.0	178.0	90.0	28.0	1193.0
Min.	0.0	0.0	0.0	19.0	81.0	73.0	129.0	93.0	130.0	21.0	0.0	0.0	899.0
80% Dep.	0	12	12	48	112	95	174	140	138	29	0	0	968
St.Dev.	10.7	40.8	55.2	36.2	24.3	28.8	53.5	78.4	44.8	58.5	35.2	12.7	107.2
Cv	1.13	1.28	1.15	0.51	0.20	0.28	0.26	0.41	0.25	0.87	1.66	1.12	0.10

Table I.2.1.2 Monthly Rainfall @ Diksis

Station: Diksis State Farm
Lat. 8°05'N Long. 39°21'E Alt. 2600 masl

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	nnual
1987	2.6	26.1	110.9	52.8	155.9	88.7	137.1	236.1	141.1	40.3	0.0	0.0	991.6
1988	4.8	16.3	47.9	87.7	39.3	96.8	98.9	218.4	138	57.4	2.4	5.9	813.8
1989	0.0	14.0	42.7	48.8	86.7	129.5	162.9	240.0	138.0	57.4	3.0	36.0	959.0
1990	2.7	127.9	23.0	110.6	26.6	96.1	265.1	259.1	132.0	52.0	14.5	5.8	1115.4
1991	7.0	21.9	137.9	65.8	108.5	73.7	168.0	240.0	151.6	22.7	0.0	13.6	1010.7
1992	29.7	19.2	28.8	61.6	102.2	132.1	168.3	392.8	196.7	80.5	18.6	28.0	1258.5
1993	77.4	50.4	0.0	91.1	132.6	131.2	186.2	181.3	134.0	127.5	0.7	11.6	1124.0
1994	0.0	0.0	11.8	82.9	76.9	219.7	241.9	180.7	147.6	45.5	46.3	0.0	1053.3
1995	0.0	29.4	87.6	93.4	84.6	120.8	155.4	211.8	63.2	33.3	0.0	21.1	900.6
1996	11.2	0.0	0.0	31.0	86.5	206.8	45.6	240.0	138.0	57.4	9.5	13.6	839.6
1997	13.5	0.0	36.5	99.2	53.4	129.5	162.9	240.0	138.0	57.4	9.5	13.6	953.5
Mean	13.5	27.7	47.9	75.0	86.7	129.5	162.9	240.0	138.0	57.4	9.5	13.6	1001.8
Max.	77.4	127.9	137.9	110.6	155.9	219.7	265.1	392.8	196.7	127.5	46.3	36.0	1258.5
Min.	0.0	0.0	0.0	31.0	26.6	73.7	45.6	180.7	63.2	22.7	0.0	0.0	813.8
80% Dep.	0	0	11.8	52.8	53.4	96.1	137.1	211.8	134	40.3	0	5.8	900.6
St.Dev.	22.9	36.5	45.5	24.6	38.3	46.0	59.9	56.5	30.6	27.7	13.8	11.2	131.4
Cv	1.69	1.31	0.95	0.33	0.44	0.36	0.37	0.24	0.22	0.48	1.45	0.83	0.13

Table I.2.1.2 Monthly Rainfall @ D'era

Station: D'era
Lat. 8°20'N Long. 39°19'E Alt. 1680 masl

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1977	49.0	8.0	13.0	113.0	89.0	149.0	145.0	145.0	115.0	148.0	107.0	16.4	1097.4
1978	0.0	162.0	14.0	14.0	22.0	24.0	80.0	166.0	15.0	42.0	0.0	43.0	582.0
1979	48.0	3.0	56.0	0.0	109.0	92.0	174.0	147.0	50.0	80.0	0.0	20.0	779.0
1980	28.0	0.0	8.0	25.0	39.0	74.0	152.0	110.0	71.0	49.0	6.0	0.0	562.0
1981	0.0	7.0	143.0	40.0	5.0	5.0	183.0	141.0	147.0	63.8	27.6	16.4	778.8
1982	2.0	68.0	9.0	21.0	144.0	49.0	157.0	189.0	100.0	162.0	108.0	49.0	1058.0
1983	18.5	16.0	23.0	94.0	190.0	9.0	95.0	149.6	75.3	63.8	27.6	16.4	778.2
1984	18.5	0.0	51.0	20.0	74.0	78.0	105.0	129.0	61.0	0.0	0.0	3.0	539.5
1985	21.0	0.0	0.0	45.0	70.0	6.0	180.0	243.0	8.0	0.0	0.0	0.0	573.0
1986	0.0	0.0	126.0	74.0	30.0	68.0	105.0	76.0	111.0	29.0	0.0	0.0	619.0
Mean	18.5	26.4	44.3	44.6	77.2	55.4	137.6	149.6	75.3	63.8	27.6	16.4	736.7
Max.	49.0	162.0	143.0	113.0	190.0	149.0	183.0	243.0	147.0	162.0	108.0	49.0	1097.4
Min.	0.0	0.0	0.0	0.0	5.0	5.0	80.0	76.0	8.0	0.0	0.0	0.0	539.5
80% Dep.	0	0	8.8	18.8	28.4	8.4	103	125.2	43	23.2	0	0	570.8
St.Dev.	18.8	51.9	51.1	37.2	58.1	46.3	38.1	44.8	44.3	54.8	43.5	17.5	203.5
Cv	1.02	1.97	1.15	0.83	0.75	0.84	0.28	0.30	0.59	0.86	1.58	1.07	0.28

Table I.2.1.3 Monthly Rainfall @ Dodola

Station: Dodola (Edo)
Lat. 06°59' Long. 39°11' Alt. 2500 masl

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1954	25.1	40.4	54.6	82.4	45.6	71.8	38 8	158.6	161.9	73.0	21.7	24.5	798.4
1955	33.1	2.0	29.7	39.0	38.0	81.2	138.0	149.7	125.2	45.1	24.6	38.0	743.6
1956	28.5	15.6	3.2	73.9	6.5	82.0	154.0	101.5	138.5	131.0	24.3	30.0	789.0
1957	5.0	48.9	66.1	212.2	85.0	60.0	132.0	109.0	29.0	38.0	32.0	3.0	820.2
1958	53.0	93.0	27.0	26.0	19.0	93.5	186.0	188.6	61.0	59.0	79.0	22.0	907.1
1959	74.0	23.0	24.0	127 1	70.4	121.4	201.8	227.0	227.0	57.0	31.5	13.5	1197.7
1960	4.0	18.0	119.0	33.0	115.0	68.0	166.0	222.0	103.0	0.0	12.5	23.0	883.5
1961	33.7	7.0	81.0	145.0	46.0	84.0	247.0	220.0	123.4	58.3	31.7	21.0	1098.3
1962	0.0	4.0	78.0	81.0	46.0	136.0	209.0	221.0	114.0	53.9	29.3	19.7	991.9
1965	21.6	0.0	41.4	28.8	5.7	8.8	172.5	177.7	98.8	79.7	25.9	31.3	692.2
1966	27.0	131.9	53.1	142.5	8.8	90.8	131.1	179.6	112.8	53.3	29.0	19.7	979.7
1968	14.1	34.6	46.8	70.7	39.2	98.7	112.3	101.4	60.0	15.9	5.6	4.6	603.9
1972	24.5	32.9	62.2	144.9	43.8	81.4	105.9	73.1	89.7	42.4	23.1	19.7	743.7
1975	22.2	0.0	20.2	48.0	31.5	98.6	156.1	158.0	118.9	38.1	0.0	19.7	711.3
1976	0.0	0.0	7.0	75.8	91.4	76.5	127.1	139.8	89.2	42.1	22.9	19.7	691.6
1977	135.3	111.1	40.4	127.0	81.1	79.5	191.2	135.3	99.7	98.5	66.0	0.8	1165.9
1978	11.1	63.4	46.9	7.3	4.8	37.8	11.2	129.2	99.5	54.4	6.4	12.2	484.2
1979	67.4	24.9	78.6	40.4	78.2	110.6	150.7	165.8	105.7	49.9	27.2	19.7	919.1
1988	24.3	39.1	52.8	71.9	6.3	125.6	114.1	196.4	74.8	55.1	0.0	3.2	763.7
1989	26.8	29.8	44.9	111.9	35.3	84.1	144.7	135.9	80.0	20.4	55.5	64.8	834.1
1990	5.0	164.9	87.4	189.9	44.1	47.5	198.7	166.5	58.8	4.1	19.5	4.2	990.6
1991	3.4	75.7	138.6	4.2	7.6	74.9	99.8	137.0	87.3	41.3	22.5	19.7	712.0
1993	99.5	117.3	29.4	123.6	145.3	65.1	128.8	181.8	81.7	49.1	13.8	0.0	1035.4
1994	4.5	1.5	53.8	58.2	98.9	148 8	197.8	165.8	105.3	3.5	19.2	8.6	865.9
1995	3.2	15.5	87.2	212.4	26.2	111.3	84.7	131.8	125.7	42.1	11 1	36.0	887.2
1996	46.4	7.1	115.5	63.6	76.6	112.3	165.3	174.8	63.0	11.4	19.0	34.1	889.1
Mean	30.5	42.4	57.3	90.0	49.9	86.5	144.8	159.5	101.3	46.8	25.1	19.7	853.8
Max.	135 3	164.9	138.6	212.4	145.3	148.8	247.0	227.0	227.0	131.0	79.0	64.8	1197.7
Min.	0.0	0.0	3.2	4.2	4.8	8.8	11.2	73.1	29.0	0.0	0.0	0.0	484.2
80% Dep.	4.5	4	29.4	39	8.8	68	112.3	131.8	74 8	20.4	12.5	4.6	712.0
St.Dev.	32.7	46.1	33.8	59.4	37.6	30.5	52 3	40.1	38.5	29 1	18.2	14.3	168.0
Cv	1.07	1.09	0.59	0.66	0.75	0.35	0.36	0.25	0 38	0.62	0.72	0.72	0.20

Table I.2.1.2 Monthly Rainfall @ Eteya

Station: Eteya
Lat. 8°10'N Long. 39°14'E Alt. 2060 masl

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1987	6.3	37.5	15.5	86.3	204.7	55.0	186.4	86.1	67.9	0.0	0.0	2.2	747.9
1988	9.3	69.0	16.9	80.6	28.0	42.8	232.4	157.1	164.7	49.5	0.0	6.5	856.8
1989	0.0	23.5	75.5	111.0	29.4	110.5	184.5	266.7	115.7	0.0	0.0	1.8	918.6
1990	0.0	146.7	55.2	93.1	33.0	29.2	237.8	188.8	82.5	0.0	0.0	4.2	870.5
1991	2.8	35.6	137.6	51.4	29.3	39.0	191.4	105.4	2.4	0.0	0.0	8.3	603.2
1992	20.5	0.0	14.6	58.6	40.5	79.1	180.8	294.4	185.1	114.0	0.0	3.0	990.6
1993	2.5	32.4	0.0	124.6	48.6	18.3	219.7	304.2	136.2	7.9	0.0	3.3	897.7
1994	0.0	0.0	64.0	56.8	135.1	64.0	193.9	198.7	116.1	21.9	0.0	3.3	853.8
1995	0.0	30.3	92.4	97.2	93.0	90.2	192.4	201.7	124.7	26.0	0.0	0.0	947.9
1996	21.5	0.0	81.8	57.8	191.2	111.8	119.8	184.2	165.8	0.0	0.0	0.0	933.9
1997	57.3	0.0	48.2	77.0	69.2	119.6	193.9	198.7	116.1	21.9	0.0	3.3	905.2
Mean	10.9	34.1	54.7	81.3	82.0	69.0	193.9	198.7	116.1	21.9	0.0	3.3	866.0
Max.	57.3	146.7	137.6	124.6	204.7	119.6	237.8	304.2	185.1	114.0	0.0	8.3	990.6
Min.	0.0	0.0	0.0	51.4	28.0	18.3	119.8	86.1	2.4	0.0	0.0	0.0	603.2
80% Dep.	0	0	15.5	57.8	29.4	39	184.5	157.1	82.5	0	0	1.8	853.8
St.Dev.	17.3	43.2	41.4	24.0	66.2	35.5	31.4	69.5	51.4	34.4	0.0	2.5	107.4
Cv	1.58	1.27	0.76	0.30	0.81	0.51	0.16	0.35	0.44	1.57	0.0	0.76	0.12

Table I.2.1.2 Monthly Rainfall @ Ginir

Station: Ginir
Lat. 7°08'N Long. 40°43'E Alt. 1950 masl

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1980	0.6	26.0	40.0	211.0	53.0	23.0	0.0	8.0	72.0	71.0	15.0	0.0	519.6
1981	0.6	65.0	265.0	328.0	53.0	3.0	36.0	72.0	124.0	95.0	0.0	0.0	1041.6
1982	0.0	28.0	204.0	224.0	222.0	34.0	27.0	9.0	73.0	212.0	79.0	46.0	1158.0
1983	3.0	61.0	0.0	189.0	275.0	47.0	31.0	127.0	101.0	134.0	84.0	0.0	1052.0
1984	0.0	0.0	3.0	82.0	128.0	19.0	0.0	16.0	185.0	49.0	24.0	38.0	544.0
1985	0.0	0.0	85.0	299.0	169.0	15.0	35.0	0.0	96.0	61.0	71.0	51.0	882.0
1986	0.0	2.0	26.0	263.0	199.0	23.5	43.0	23.0	13.0	143.0	40.0	7.0	782.5
Mean	0.6	26.0	89.0	228.0	157.0	23.5	24.6	36.4	94.9	109.3	44.7	20.3	854.2
Max.	3.0	65.0	265.0	328.0	275.0	47.0	43.0	127.0	185.0	212.0	84.0	51.0	1158.0
Min.	0.0	0.0	0.0	82.0	53.0	3.0	0.0	0.0	13.0	49.0	0.0	0.0	519.6
80% Dep.	0	0.4	7.6	193.4	68	15.8	5.4	8.2	72.2	63	16.8	0	591.7
St.Dev.	1.1	27.9	104.8	81.0	84.2	14.0	17.5	46.5	52.8	57.6	33.5	23.6	251.9
Cv	1.83	1.07	1.18	0.36	0.54	0.60	0.71	1.28	0.56	0.53	0.75	1.16	0.29

Table I.2.1.5 Monthly Rainfall @ Goba

Station: Goba
Lat. 07°01' **Long. 40°00'** **Alt. 2700 masl**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	nnual
1962	30.5	52.9	82.2	190.9	153.5	115.5	74.1	117.4	120.1	49.6	69.8	18.1	1074.6
1963	50.1	82.3	45.4	248.6	100.2	62.0	151.9	232.6	108.9	37.7	154.4	0.0	1274.1
1964	7.8	0.0	0.0	132.7	136.0	59.2	97.2	130.2	103.8	160.8	57.4	119.3	1004.4
1965	10.3	1.5	24.6	87.5	54.4	26.9	63.9	101.2	154.2	118.3	85.5	9.2	737.5
1966	18.1	81.9	23.9	179.8	100.2	51.4	90.1	132.0	101.0	110.7	64.4	0.0	953.5
1967	15.7	0.1	69.2	154.2	77.5	70.5	136.7	72.0	140.1	68.0	226.7	0.0	1030.7
1968	19.1	33.1	51.5	119.6	72.5	78.2	54.9	60.7	147.1	108.9	82.2	31.1	858.9
1969	24.1	91.3	155.0	80.5	127.0	90.9	108.1	121.3	159.1	56.6	56.7	17.7	1088.3
1970	77.5	19.4	169.4	162.1	33.9	34.0	61.0	106.8	87.0	129.4	0.0	0.0	880.5
1971	1.5	3.6	59.2	93.0	115.6	56.4	54.6	119.3	110.5	94.1	74.7	14.2	796.7
1972	14.2	102.6	54.8	185.7	82.3	105.6	52.4	119.6	91.1	177.1	44.4	2.6	1032.4
1973	7.9	9.0	0.0	73.9	142.2	39.1	129.9	134.0	136.8	117.2	6.2	38.1	834.3
1974	11.4	7.7	143.3	77.2	98.4	55.4	108.2	124.5	159.9	72.6	8.7	11.7	879.0
1975	2.4	13.1	30.8	127.0	143.6	79.6	131.4	116.7	121.6	97.1	44.7	3.3	911.3
1976	11.8	44.0	45.7	163.4	235.7	46.1	61.8	109.6	133.7	86.0	30.6	18.6	987.0
1977	66.1	78.6	56.8	118.9	129.4	51.9	140.5	75.1	169.1	263.6	126.6	2.6	1279.2
1978	10.6	106.3	51.8	119.1	146.0	37.8	142.8	172.0	71.3	129.1	102.3	2.0	1091.1
1979	78.4	20.0	78.7	83.7	108.0	75.0	83.5	77.5	77.0	83.7	1.2	7.1	773.8
1980	0.7	39.9	47.1	114.0	52.2	77.1	50.4	69.9	135.7	77.5	42.2	0.5	707.2
1981	0.0	23.8	99.0	242.9	91.2	23.9	81.7	142.3	133.2	42.9	29.7	12.7	923.3
1982	17.9	44.4	76.7	194.3	121.5	45.8	63.9	123.3	53.7	147.8	57.4	74.3	1021.0
1983	40.3	29.8	16.8	184.9	123.5	54.9	121.1	191.2	186.9	119.9	50.1	7.2	1126.6
1984	0.0	11.5	11.1	102.4	138.4	24.6	38.1	86.2	153.3	83.5	50.4	17.7	717.2
Mean	22.4	39.0	60.6	140.7	112.3	59.2	91.2	118.9	124.1	105.7	63.8	17.7	955.8
Max.	78.4	106.3	169.4	248.6	235.7	115.5	151.9	232.6	186.9	263.6	226.7	119.3	1279.2
Min.	0.0	0.0	0.0	73.9	33.9	23.9	38.1	60.7	53.7	37.7	0.0	0.0	707.2
80% Dep.	4.6	8.2	24.2	89.7	79.4	38.3	57.3	81.0	95.1	69.8	30.1	1.1	811.7
St.Dev.	24.0	35.0	45.9	51.5	42.5	24.6	35.6	40.1	33.9	50.2	52.0	27.8	160.6
Cv	1.07	0.90	0.76	0.37	0.38	0.42	0.39	0.34	0.27	0.47	0.82	1.56	0.17

Table I.2.1.2 Monthly Rainfall @ Goro

Station: Goro
Lat. 7°00'N Long. 40°29'E Alt. 1780 masl

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	nnual
1987	4.4	33.5	135.6	127.9	240.5	22.1	0.0	6.6	115.1	142.5	46.3	23.5	898.0
1988	1.7	48.8	69.4	178.8	99	16	82.8	105.6	78.5	118.5	24	0	823.1
1989	8.8	24.5	86.8	333.5	98.5	25.8	9.8	45.4	107.2	157.6	46.3	75.0	1019.2
1990	14.8	59.4	93.2	157.6	103.2	37.4	15.4	54.4	50.6	92.8	138.7	6.8	824.3
1991	49.6	11.0	137.9	230.6	155.9	40.5	29.1	53.8	81.0	142.5	46.3	23.5	1001.7
1992	13.5	33.8	95.4	168.8	144.3	90.9	39.6	96.0	139.4	161.7	79.4	59.0	1121.8
1993	33.0	144.8	0.0	303.6	204.0	21.6	0.0	0.0	0.0	142.5	0.0	0.0	849.5
1994	0.0	0.0	31.1	115.1	279.7	30.8	28.2	65.9	74.9	202.9	66.1	17.1	911.8
1995	0.0	16.0	118.7	306.0	113.5	13.8	42.0	32.9	82.1	159.0	2.4	6.5	892.9
1996	10.2	0.0	117.4	394.8	219.3	87.1	11.9	77.1	81.0	105.0	13.4	23.5	1140.7
1997	12.4	0.0	48.8	220.2	56.5	59.9	60.8	53.8	81.0	142.5	46.3	23.5	805.7
Mean	13.5	33.8	84.9	230.6	155.9	40.5	29.1	53.8	81.0	142.5	46.3	23.5	935.3
Max.	49.6	144.8	137.9	394.8	279.7	90.9	82.8	105.6	139.4	202.9	138.7	75.0	1140.7
Min.	0.0	0.0	0.0	115.1	56.5	13.8	0.0	0.0	0.0	92.8	0.0	0.0	805.7
80% Dep.	1.7	0	48.8	157.6	99	21.6	9.8	32.9	74.9	118.5	13.4	6.5	824.3
St.Dev.	15.2	41.9	44.1	91.9	70.7	27.2	25.9	32.8	35.8	29.9	39.6	23.7	118.8
Cv	1.13	1.24	0.52	0.40	0.45	0.67	0.89	0.61	0.44	0.21	0.86	1.01	0.13

Table I.2.1.2 Monthly Rainfall @ Kofele

Station: Kofele
Lat. 7°02'N Long. 38°28'E Alt. 2680 masl

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1991	14.4	107.0	174.5	64.3	161.2	72.0	105.6	183.3	167.9	11.7	29.3	61.0	1152.2
1992	79.4	168.3	113.4	203.5	127.4	106.3	178.6	281.8	216.7	92.7	146.5	85.5	1800.1
1993	87.9	61.6	64.3	164.2	292.9	106.2	196.0	131.4	203.6	189.9	37.6	0.8	1536.4
1994	0.0	0.6	91.6	117.8	132.0	110.4	146.5	130.3	106.0	15.3	9.3	20.1	879.9
1995	20.5	18.7	80.4	300.7	75.2	79.5	169.0	142.3	104.6	58.8	7.8	87.8	1145.3
1996	135.8	34.4	204.9	244.6	133.9	83.4	182.1	142.6	177.4	78.5	45.4	31.7	1494.7
1997	60.0	8.2	160.3	188.5	104.4	190.2	163.0	168.6	162.7	74.5	46.0	47.8	1374.2
Mean	56.9	57.0	127.1	183.4	146.7	106.9	163.0	168.6	162.7	74.5	46.0	47.8	1340.4
Max.	135.8	168.3	204.9	300.7	292.9	190.2	196.0	281.8	216.7	189.9	146.5	87.8	1800.1
Min.	0.0	0.6	64.3	64.3	75.2	72.0	105.6	130.3	104.6	11.7	7.8	0.8	879.9
80% Dep.	15.6	10.3	82.6	127.1	109.0	80.3	149.8	133.6	117.3	24.0	13.3	22.4	1146.7
St.Dev.	48.4	61.2	53.2	78.3	69.8	39.7	29.7	53.6	43.6	59.7	47.0	32.7	305.6
Cv	0.85	1.07	0.42	0.43	0.48	0.37	0.18	0.32	0.27	0.80	1.02	0.68	0.23

Table I.2.1.2 Monthly Rainfall @ Kulumsa

Station: Kulumsa
Lat. 7°58'N Long. 39°08'E Alt. 2600 masl

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1987	2.2	21.6	108.8	150.3	158.5	49.4	83.1	116.0	88.2	5.8	3.1	11.7	798.7
1988	64.2	79.3	25.0	113.6	60.4	82.7	133.9	122.5	136.4	56.3	0.0	0.2	874.5
1989	0.0	50.4	69.9	177.9	25.0	132.4	115.9	180.0	96.8	31.6	0.0	41.2	921.1
1990	0.0	160.6	100.6	155.2	30.5	97.1	180.9	109.8	120.3	22.7	5.5	0.9	984.1
1991	10.4	42.7	185.3	11.1	93.1	62.5	158.3	123.7	86.3	10.8	0.0	11.1	795.3
1992	26.5	96.0	4.5	65.6	28.8	68.0	109.1	174.3	104.6	81.5	36.1	14.5	809.5
1993	20.6	72.0	12.9	148.0	152.0	49.0	112.4	155.2	128.1	59.2	0.0	30.8	940.2
1994	0.0	13.0	34.5	66.7	42.8	148.3	120.1	133.6	105.6	1.1	32.9	15.4	714.0
1995	0.0	34.1	164.0	140.3	64.8	79.3	120.0	142.1	74.4	2.2	0.0	45.8	867.0
1996	42.1	4.3	132.4	58.9	182.5	134.6	130.4	98.5	87.5	1.3	3.4	0.0	875.9
Mean	16.6	57.4	83.8	108.8	83.8	90.3	126.4	135.6	102.8	27.3	8.1	17.2	858.0
Max.	64.2	160.6	185.3	177.9	182.5	148.3	180.9	180.0	136.4	81.5	36.1	45.8	984.1
Min.	0.0	4.3	4.5	11.1	25.0	49.0	83.1	98.5	74.4	1.1	0.0	0.0	714.0
80% Dep.	0.0	19.9	22.6	64.3	30.2	59.9	111.7	114.8	87.3	2.0	0.0	0.8	798.0
St.Dev.	22.1	46.8	64.5	54.6	59.6	36.5	27.1	27.2	20.1	29.0	14.1	16.7	80.2
Cv	1.33	0.82	0.77	0.50	0.71	0.40	0.21	0.20	0.20	1.06	1.74	0.97	0.09

I.2.2 OBSERVED

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Long　　Lat.　　Element monthly total Rain fa

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
984	0.0	0.0	4.4	7.8	105.0	26.6	149.1	224.3	93.0	2.8	3.0	x		
985	21.4	2.7	16.3	80.9	74.1	61.5	203.0	115.4	88.0	39.1	11.4	1.0		
986	0.0	66.1	23.0	86.1	64.4	109.7	190.0	183.2	-	15.0	7.1	0.0		
987	10.0	20.1	115.9	75.0	86.0	14.2	105.3	165.3	58.4	103.8	2.1	2.1		
al														
988	8.6	38.3	2.1	122.1	24.[illegible]	61.8	197.[illegible]	252.0	67.0	56.2	0.0	0.0		
989	0.0	25.1	99.4	188.0	15.2	15.[illegible]	224.[illegible]	123.4	25.7	25.2	3.1	56.5		
990	11.6	161.8	100.4	(115.0)	x	6.0	118.5	332.5	56.3	4.2	(0.0)	0.1		
991	0.0	x	x	x	x	x								
992														
993														
994						113.4	17.3	244.6	20.8	14.4	27.5	0.6		
995	0.4	10.0	86.7	131.4	19.1	52.6	219.0	227.0	88.5	36.8	0.5	5.8		
996	30.1	14.2	72.4	82.6	61.2	95.1	117.7	230.0	94.9	0.0				
[illegible]	[illegible]	10.0	45.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]							
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Aasella School
Monthly Total Rainfall

Region Arusi

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
17.0	112.5	52.5	111.5	27.5	146.5	231.5	221.5	139.0	82.5	1.5	0.0
2.5	0.0	139.5	71.5	180.5	112.5	367.0	281.0	211.5	212.0	100.5	x
10.0	125.5	50.0	278.5	111.0	199.0	x	267.5	267.5	20.0	15.0	17.0
46.0	131.0	134.0	74.0	84.0	149.0	249.5	247.0	182.0	39.0	14.0	5.0
112.0	35.0	275.0	72.0	77.0	92.0	285.0	225.5	187.0	65.0	0.0	0.0
29.0	2.0	98.0	153.0	185.0	164.0	191.0	200.0	171.0	38.5	25.5	27.0
23.0	43.0	88.5	256.0	75.5	134.0	160.5	341.0	117.0	2.0	6.5	9.0
2.0	0.0	1.0	40.5	194.5	172.5	127.3	195.0	135.0	53.0	0.0	0.0
14.3	35.0	186.0	23.0	122.0	105.5	x	133.3	208.7	27.0	0.0	0.0
13.9	24.5	15.7	46.5	77.5	237.0	223.0	284.0	161.1	31.5	0.0	0.0
x	x	x	x	84.1	x	259.3	207.8	83.8	74.0	48.1	21.3
36.0	16.3	113.2	127.1	93.3	193.7	220.5	234.0	182.4	112.2	0.0	27.5
x	152.6	83.5	49.7	153.0	124.8	285.3	x	x	x	81.5	8.1
44.0	34.2	87.8	52.0	160.2	103.5	228.8	322.6	290.7	82.4	0.0	16.7
18.7	x	109.6	x	x	x	x	173.0	166.1	66.8	12.7	0.0
0.0	18.8	166.2	145.5	47.0	80.4	x	191.1	280.5	47.0	10.0	0.0
22.1	x	75.6	94.1	x	131.6	168.3	391.8	213.8	48.3	50.1	17.3
5.8	78.6	81.3	210.1	255.8	145.4	x	x	x	x	x	x
0.3	5.7	11.3	23.6	327.2	135.7	156.5	209.1	244.9	1.6	x	x
14.9	1.8	48.1	175.0	179.0	293.5	206.6	150.4	153.8	13.5	26.7	2.7
x	98.5	84.6	172.2	112.9	118.0	246.5	166.2	256.0	43.1	72.3	2.3
0.0	60.1	x	105.9	x	126.4	x	136.5	114.9	x	8.0	13.7
14.1	52.0	8.4	75.3	51.1	279.5	210.3	168.2	148.1	66.5	0.0	0.0
1.7	26.7	126.6	268.2	40.2	132.3	111.9	169.3	130.0	53.2	13.2	88.5
0.0	111.5	93.0	92.1	19.8	87.1	197.8	186.4	153.7	x	11.2	0.0
0.0	42.4	162.1	34.4	57.6	117.6	178.8	149.1	39.1	1.5	1.2	20.0
36.0	90.8	58.3	142.1	33.5	44.0	131.6	206.3	x	x	x	38.7
13.2	22.3	20.0	150.8	x	38.7	117.9	166.3	140.0	172.9	0.0	0.0
0.0	0.0	132.9	44.9	83.8	203.8	249.7	164.5	178.1	5.5	x	3.5
0.0	23.2	122.4	153.8	96.7	118.9	212.0	164.2	97.6	22.0	0.0	69.5
9.8	16.0	171.7	155.9	156.5	193.9	163.5	132.7	133.9	31.5	1.9	4.3

NATIONAL METEOROLOGICAL SERVICE AGENCY

STATION Assasa
REGION Arsi
ELEMENT Monthly Total R.F

Year	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1987	20.0	46.9	55.6	55.0	95.2	24.4	35.3	20.8	31.2	45.8	3.0	5.7
1988	13.9	28.0	10.4	74.3	0.0	104.7	190.1	224.0	56.5	37.2	0.0	0.0
1989	7.8	6.1	100.4	162.1	33.1	67.9	131.7	161.4	62.5	51.4	5.1	39.8
1990	0.0	156.4	47.1	65.5	132	67.3	181.1	x	52.1	0.0	39	0.0
1991	0.5	11.0	63.5	2.0	17.7	73.5	224.6	174.9	58.2	0.0	1.3	56.2
1992	71.9	x	x	74.9	13.4	58.8	x	221.5	98.8	31.8	4.8	3.7
1993	38.1	55.3	3.2	130.6	57.8	60.5	135.1	123.9	93.3	29.7	6.3	0.0
1994	0.0	0.1	26.7	28.2	25.1	163.2	179.1	233.8	67.1	0.0	18.8	2.1
1995	2.4	45.9	53.0	122.4	13.3	36.2	117.0	137.0	64.9	37.3	2.8	3.6
1996	14.7	6.6	61.9	28.6	111.7	68.0	258.5	x	45.5	2.2	19.4	x

NATIONAL METEOROLOGICAL SERVICES AGENCY

Station: BOKOJI FARM Wereda ... Awraja ... Region ARSSI

lt. ... Long. ... Lat ... Element MONTHLY RAIN FALL

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
1987	[illegible]	37.5	206.9	123.1	111.5	31.7	61.4	171.6	96.3	44.5	3.2	23.2	[illegible]	
1988	12.5	36.5	81.1	201.3	52.1	109.5	149.6	266.6	103.4	124.6	8.3	5.0	[illegible]	
1989	20.2	46.2	98.3	155.6	82.5	81.1	[illegible]	[illegible]	67.2	101.1	11.6	80.0	[illegible]	
1990	4.1	224.9	108.1	146.9	38.0	59.5	155.1	x	x	x	17.2	3.3	[illegible]	
Total														
1991	5.3	61.4	140.9	30.9	31.1	123.3	197.2	255.1	97.4	8.9	0.9	24.2	[illegible]	
1992	112.9	91.2	39.4	121.1	54.7	116.9	164.3	216.0	36.2	126.7	51.8	13.1	[illegible]	
1993	54.5	99.4	2.7	148.5	175.8	123.5	163.2	221.8	138.2	50.4	3.5	3.2	1186.1	
1994	0.8	0.0	37.4	128.2	47.5	168.0	241.5	250.7	89.2	6.3	38.6	5.0	[illegible]	
1995	0.0	41.4	94.2	157.8	73.4	50.1	181.7	230.0	157.2	17.5	1.2	32.4	[illegible]	
1996	58.7	12.3	146.2	55.5	54.3	[illegible]	152.0	229.2	86.1	25.0	3.1	5.9		
1997														
19														
19														
19														
Total														
Total														
Ave.														

DEGAGMTS.MET

DEGAGA STATION Co-ord 38 50 East 7 26 North

6 YEARS 2040 at a.s.l.

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	TOTAL	YEAR
RAINFALL mm	13	113	29	114			129	319	130	39	11	4	1126	1972
	4	0	0	88	142	97	252	95	184	29	0	10	898	1973
	12	12	141	19	150	98	216	140	159	21	0	0	968	1974
	0	19	17	101	81	159	174	235	251	53	0	0	1089	1975
	0	28	12	54	112	73	273	179	138	83	90	26	1067	1976
	28	19	89	48	121	95	180	193	198	178	26	28	1192	1977
MONTH average	10	32	48	71	121	104	204	191	177	67	21	11	1057	

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC		YEAR
MAX TEMP. °C	23	22	25	23	25		21	21	23	24	23	23		1972
	25	27	28	26	23	23	22	21	21	22	24	23		1973
	24	25	23	25	24	23	21	22	21	24	23	24		1974
	24	25	26	26	24	21	19	20	20	23	22	23		1975
	23	25	26	25	23	23	21	20	21	22	22	22		1976
	22	23	24	24	24	22	20	21	21	22	23	23		1977
MONTH average	24	25	25	25	24	22	21	21	21	23	23	23		23.1

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC		YEAR
MIN TEMP. °C	6	9	8	10	10		6	11	11	8	6	5		1972
	6	7	8	10	11	10	11	9	11	9	5	3		1973
	5	6	9	9	10	10	10	11	10	7	5	4		1974
	2	6	8	10	10	10	10	11	11	10	5	4		1975
	5	7	8	9	11	9	11	10	10	11	12	11		1976
	10	8	10	11	10	10	11	10	10	10	8	6		1977
MONTH average	6	7	8	10	10	10	10	10	11	9	7	5		8.6

MEAN TEMP. °C	15	16	17	17	17	16	15	16	16	16	15	14		15.2

NOTE: The not available data (blank) have been substituded with mean data.
It has been done to have total and average data.

DHERA METEO STATION Co-ord 39 19'East 8 20'North

10 YEARS 1680 mt a.s.l.

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	TOTAL	YEAR
RAINFALL mm	49	6	13	113	89	149	145	145	115	149	107		1093	1977
	0	162	14	14	22	24	80	166	15	42	0	43	583	1978
	48	3	56	0	109	92	174	147	50	89	0	20	777	1979
	28	0	8	25	39	74	152	110	71	49	6	0	560	1980
	0	7	143	40	5	5	183	141	147			0	763	1981
	3	69	9	21	144	49	157	189	100	163	106	49	1055	1982
		16	23	94	190	9	95						426	1983
		0	51	29	74	78	105	129	61	0	0	3	530	1984
	21	0	0	45	70	6	180	243	8	0	0	0	572	1985
	0	0	126	74	30	68	105	76	111	29	0	0	619	1986
MONTH average	18	26	44	45	77	55	138	149	75	64	28	14	733	

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC		YEAR
MAX TEMP. °C	25	25	28	29	29	28	25	26	27	27	25			1977
	26	26	27	28	30	29	26	26	27	27	26	26		1978
	24	27	27	30	29	30	24	27	27	.	27	27		1979
	27	28	29	30	31	29	27	26	27	28	28	27		1980
	27	28	28	27	30	31	28	26	26			26		1981
	26	27	26	29	29	31	31	32	31	31	29	29		1982
		30	29	30	30	31	30							1983
		27	31	32	29	28	26	27	27	29	26	26		1984
	27	27	30	28	29	30	26	26	26	28	27	26		1985
	27	28	28	28	31	28	26	27	27	28	28			1986
MONTH average	26	27	28	29	30	30	27	27	27	28	27	27		27·8

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC		YEAR
MIN TEMP. °C	14	12	15	16	15	15	15	16	14	14	13			1977
	12	13	15	16	16	16	15	14	14	13	13	12		1978
	13	14	18	16	15	15	14	15	17		16	15		1979
	12	14	13	14			15	15	15					1980
	14	14	15	15	15	15	15	14	14			11		1981
	14	15	16	16	16	16	15	19	15	14	15	15		1982
		16	16	16	16	17	16							1983
		10	16	17	14	15	15	15	12	12	12	11		1984
	11	11	15	14	14	14	15	15	15	12	11	10		1985
	16	14	14	15	16	16	15	15	14	13	12			1986
MONTH average	13	13	15	16	15	15	15	15	14	13	13	12		12·8

MEAN TEMP. °C	19	20	22	22	22	22	21	21	21	21	20	19		20·8

NOTE: the not available data (blank) have been substituded with mean data.
It has been done to have total and average data.

NATIONAL METEOROLOGICAL SERVICES AGENCY

Station: DIRE S. FARM Wereda _____ Awraja _____ Region ARSSI

Alt. _____ Long _____ Lat. _____ Element Monthly total Rai

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
1978	XX	XX	XX	XX	32.0	5.2	58.4	198.2	111.2	32.0	2.1	5.2		
1987	2.6	26.1	110.9	52.8	155.9	88.7	137.1	236.5	141.1	40.3	0.0	0.0		
Total														
1988	4.8	16.3	XX	87.7	39.3	96.8	98.9	218.4	XX	XX	2.4	5.8		
1989	0.0	14.0	42.7	48.8	XX	XX	XX	XX	XX	XX	3.0	36.0		
1990	2.7	127.9	23.0	110.6	26.6	96.1	265.1	259.1	132.0	52.0	14.5	5.8		
1991	7.0	21.9	137.9	65.8	108.5	73.7	168.0	-	151.6	22.7	0.0	-		
1992	29.7	19.2	28.8	61.6	102.2	132.1	168.3	392.8	196.7	80.5	18.6	28.0		
1993	77.4	50.4	0.0	91.1	132.6	131.2	186.2	181.3	134.0	127.5	0.7	11.6		
1994	0.0	0.0	11.8	82.9	76.9	219.7	241.9	180.7	147.6	45.5	46.3	0.0		
1995	0.0	29.4	87.6	93.4	84.6	120.8	155.4	211.8	63.2	33.3	0.0	21.1		
1996	11.2	0.0	0.0	31.0	86.5	206.8	45.6	-			-	-		
1997		0.0	36.5	99.2	53.4									
Total														
19														
19														
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19														
19														
Total														
Total														
Ave.														
Total														

DHERAMET.MET

DHERA METEO STATION Co-ord 39 19'East 8 20'North

10 YEARS 1680 at a.s.l.

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	TOTAL	YEAR
RAINFALL mm	49	6	13	113	89	149	145	145	115	148	107		1093	1977
	0	162	14	14	22	24	80	166	15	42	0	43	583	1978
	48	3	56	0	109	92	174	147	50	80	0	20	777	1979
	28	0	8	25	39	74	152	110	71	49	6	0	560	1980
	0	7	143	40	5	5	183	141	147			0	763	1981
	2	69	9	21	144	49	157	189	100	162	108	49	1055	1982
		16	23	94	190	9	95						426	1983
		0	51	29	74	78	105	129	61	0	0	5	536	1984
	21	0	0	45	70	6	180	245	8	0	0	0	572	1985
	0	0	126	74	30	68	105	76	111	29	0	0	619	1986
MONTH average	18	26	44	45	77	55	138	149	75	64	28	14	733	

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC		YEAR
MAX TEMP. °C	25	25	28	29	29	28	25	26	27	27	25			1977
	26	26	27	28	30	29	26	26	27	27	26	26		1978
	24	27	27	30	29	30	24	27	27		27	27		1979
	27	28	29	30	31	29	27	28	27	28	28	27		1980
	27	28	28	27	30	31	28	26	26			26		1981
	26	27	26	29	29	31	31	32	31	31	29	29		1982
		30	29	30	30	31	30							1983
		27	31	32	29	28	26	27	27	29	25	26		1984
	27	27	30	28	29	30	28	26	26	28	27	26		1985
	27	28	28	28	31	28	26	27	27	28	28			1986
MONTH average	26	27	28	29	30	30	27	27	27	28	27	27		27.8

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC		YEAR
MIN TEMP. °C	14	12	15	16	15	15	15	16	14	14	13			1977
	12	13	15	16	16	16	15	14	14	13	13	12		1978
	13	14	18	16	15	15	14	15	17		16	13		1979
	12	14	13	14			15	15	15					1980
	14	14	15	15	15	15	15	14	14			11		1981
	14	15	16	16	16	16	15	19	15	14	15	15		1982
		16	16	16	16	17	16							1983
		10	16	17	14	15	13	13	12	12	12	11		1984
	11	11	15	14	14	14	13	13	13	12	11	10		1985
	10	14	14	15	16	16	15	15	14	13	12			1986
MONTH average	12	13	15	16	15	15	15	15	14	13	13	12		12.8

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	YEAR
MEAN TEMP. °C	19	20	22	22	22	22	21	21	21	21	20	19	20.8

NOTE: The not available data (blank) have been substituded with mean data.
It has been done to have total and average data.

NATIONAL METEOROLOGICAL SERVICES AGENCY

Station: DIRE S. FARM Wereda _____ Awraja _____ Region ARSSI

Alt. _____ Long _____ Lat. _____ Element Monthly total Rai

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
1978	XX	XX	XX	NA	33.0	5.2	58.4	196.2	141.1	22.0	2.1	5.2		
1987	2.6	26.1	110.9	52.8	155.9	88.7	137.1	236.1	141.1	40.3	0.0	0.0		
Total														
1988	4.8	16.3	XX	87.7	39.3	96.8	98.9	218.4	XX	XX	2.4	5.8		
1989	0.0	14.0	42.7	48.8	XX	XX	XX	XX	XX	XX	3.0	36.0		
1990	2.7	127.9	23.0	110.6	26.6	96.1	265.1	259.1	132.0	52.0	14.5	5.8		
1991	7.0	21.9	137.9	65.8	108.5	73.7	168.0	-	151.6	22.7	0.0	-		
1992	29.7	19.2	28.8	61.6	102.2	132.1	168.3	392.8	196.7	80.5	18.6	28.0		
1993	77.4	50.4	0.0	91.1	132.6	131.2	186.2	181.3	134.0	127.5	0.7	11.6		
1994	0.0	0.0	11.8	82.9	76.9	219.2	241.9	180.7	147.6	45.5	46.3	0.0		
1995	0.0	29.4	87.6	93.4	84.6	120.8	155.4	211.8	63.2	33.3	0.0	21.1		
1996	11.2	0.0	0.0	31.0	86.5	206.8	45.6	-	-	-	-	-		
1997		0.0	36.5	99.2	53.4									
Total														
19														
19														
19														
19														
19														
19														
19														
19														
19														
19														
Total														
Total														
Ave.														
Total														

NATIONAL METEOROLOGICAL SERVICES AGENCY

Station: ETEYA ..... Weroda HETOSSA ..... Awraja CHILLALO ..... Region ARSSI

Alt. 2060 M. Long ..... Lat. ..... Element MONTHLY TOTAL RAIN

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
1987	x	x	15.5	86.3	204.7	55.0	186.4	86.1	67.9	0.0	0.0	2.2		
1988	9.3	69.6	16.9	80.6	28.0	42.8	232.4	157.1	164.7	49.5	0.0	6.5		
1989	0.0	23.5	75.5	111.0	29.4	110.5	184.5	266.7	115.7	0.0	0.0	1.8		
1990	0.0	146.7	55.2	93.1	33.0	29.2	237.8	188.8	82.5	0.0	0.0	4.2		
1991	2.8	35.6	137.6	51.4	29.3	39.0	191.4	105.4	2.4	0.0	0.0	8.3		
1992	20.5	0.0	14.6	58.6	40.5	75.1	180.8	294.4	185.1	114.0	0.0	3.0		
1993	2.5	32.4	0.0	124.6	48.6	18.3	219.7	304.2	136.2	7.9	0.0	x		
1994	0.0	0.0	64.0	56.8	135.1	-	-	-	-	-	-	-		
1995	0.0	30.3	92.4	97.2	93.0	90.2	192.4	201.7	124.7	26.0	0.0	0.0		
1996	21.5	0.9	81.8	57.8	191.2	111.8	119.8	184.2	165.8	0.0	0.0	0.0		
Total														
1997	57.3	0.0	48.2	77.0	69.2	119.6								
19														
19														
19														
19														
19														
19														
19														
19														
19														
Total														
19														
19														
19														
19														
19														
19														
19														
19														
19														
19														
Total														
Total	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
Ave.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		

NATIONAL METEOROLOGICAL SERVICES AGENCY

on DODOLA EDO Wereda DODOLA Awraja GENALE Region BALE

Long. 39 11 Lat 06 57 Element TOTAL RAIN FALL IN M

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
84														
85														
86														
87														
88	-	-	-	71·9	6·3	125·6	114·1	196·9	74·8	55·1	0·0	3·2		
89	-	29·8	44·9	111·9	35·3	84·1	144·7	135·9	80·0	20·4	55·5	64·8		
90	5·0	164·9	87·4	189·9	44·1	117·5	198·7	166·5	58·8	41·1	19·5	41·2		
91	3·4	75·7	138·6	42·2	7·6	-	99·8							
92	-	-	-	-	-	-	-	-	-	-	-	87·9		
93	99·5	117·3	29·4	123·6	145·3	65·1	128·8	-	81·7	49·1	13·8	0·0		
94	4·5	1·5	53·8	58·2	98·9	148·8	197·8	165·8	105·3	3·5	19·2	8·6		
95	3·2	15·5	87·2	212·4	26·2	111·3	84·7	131·8	125·7	42·1	11·1	36·0		
96	46·4	7·1	116·5	63·6	76·6	112·3	165·3	174·8	63·0	11·4	19·0	34·1		

NATIONAL METEOROLOGICAL SERVICES AGENCY

Station: ETEYA Weroda: HETOSSA Awraja: CHILLALO Region: ARSSI

Alt.: 2060 M. Long: Lat: Element: MONTHLY TOTAL RAIN

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
1987	x	x	15.5	86.3	204.7	55.0	186.4	86.1	67.9	0.0	0.0	2.2		
1988	9.3	69.6	16.9	80.6	28.6	42.8	232.4	157.1	164.7	49.5	0.0	6.5		
1989	0.0	23.5	75.5	111.0	29.4	110.5	184.5	266.7	115.7	0.0	0.0	1.8		
1990	0.0	146.7	55.2	93.1	33.0	29.2	237.8	188.8	82.5	0.0	0.0	4.2		
1991	2.8	35.6	137.6	51.4	79.3	39.0	191.4	105.4	2.4	0.0	0.0	8.3		
1992	20.5	0.0	14.6	58.6	40.5	75.1	180.8	294.4	185.1	114.0	0.0	3.0		
1993	2.5	32.4	0.0	124.6	48.6	18.3	219.7	304.2	136.2	7.9	0.0	x		
1994	0.0	0.0	64.0	56.8	135.1	-	-	-	-	-	-	-		
1995	0.0	30.3	92.4	97.2	93.0	90.2	192.4	201.7	124.7	26.0	0.0	0.0		
1996	21.5	0.9	81.8	57.8	191.2	111.8	119.8	184.2	165.8	0.0	0.0	0.0		
Total														
1997	57.3	0.0	48.2	77.0	69.2	119.6								
19														
19														
19														
19														
19														
19														
19														
19														
19														
Total														
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19														
19														
19														
19														
Total														
Total	9.3	[illegible]	101.5	[illegible]	[illegible]	208.3	[illegible]	[illegible]	348.2	[illegible]	[illegible]	[illegible]		
Ave.	4.7	[illegible]	[illegible]	92.6	[illegible]	51.4	[illegible]	175.0	115.1	[illegible]	[illegible]	[illegible]		

GINIRMTS.MET

GINIR STATION Co-ord 40 45'East 7 08'North

7 YEARS 1950 at a.s.l.

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	TOTAL	YEAR
RAINFALL mm			40	211	53	23	0	8	72	71	15	0	517	1980
		65	265	328	53	3	36	72	124	95	0	0	1040	1981
	0	28	204	224	222	34	27	9	73	212	79	46	1158	1982
	3	61	0	189	275	47	31	127	101	134	84	0	1052	1983
	0	0	3	82	128	19	0	16	185	49	24	38	544	1984
	0	0	85	299	169	15	35	0	96	61	71	51	881	1985
	0	2	26	263	199		43	23	13	143	40	7	780	1986
MONTH average	0	26	89	228	157	23	25	36	95	109	44	20	853	

NOTE: The not available data (blank) have been substituded with mean data.
It has been done to have total and average data.

NATIONAL METEOROLOGICAL SERVICES AGENCY

on: GOBA Wereda _____ Awraja _____ Region BALE

2900 Long 40 00 Lat. 07 01 Element MONTHLY TOTAL-RAINF

ear	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
61	x	x	x	x	x	x	x	x	x	x	x	x		
62	x	x	x	x	x	115·5	74·1	117·4	120·1	49·6	69·8	18·1		
63	50·1	52·3	45·4	245·6	100·2	62·0	151·7	232·6	108·9	37·7	154·4	0·0		
64	7·8	0·0	0·0	132·7	136·0	59·2	97·2	130·2	103·8	160·8	57·4	119·3		
65	10·3	1·5	24·6	87·5	54·4	26·9	63·9	101·2	154·2	118·3	85·5	9·2		
66	18·1	81·9	23·9	179·8	100·2	51·4	90·1	132·0	101·0	110·7	64·4	0·0		
67	15·7	0·1	69·2	154·2	77·5	70·5	136·7	72·0	140·1	68·0	226·7	0·0		
68	x	x	x	x	72·5	78·2	54·9	60·7	147·1	108·9	82·2	31·1		
69	24·1	91·3	155·0	80·5	127·0	90·9	108·1	121·3	159·1	56·6	56·7	x		
70	77·5	19·4	169·4	162·1	33·9	34·0	61·0	106·8	87·0	129·4	0·0	0·0		
	203·6													
71	1·5	3·6	59·2	93·0	115·6	56·4	54·6	119·3	110·5	94·1	74·7	14·2		
72	14·2	102·6	54·8	185·7	82·3	105·6	52·4	119·6	91·1	177·1	44·4	2·6		
73	7·9	9·0	0·0	73·9	142·2	39·1	129·9	154·0	136·8	117·2	6·2	35·1		
74	11·4	7·7	143·3	77·2	98·4	55·4	108·2	124·5	159·9	72·6	8·7	11·7		
75	2·4	13·1	30·8	127·0	143·6	79·6	131·4	116·7	121·6	97·1	44·7	3·3		
76	11·8	44·0	45·7	163·4	235·7	46·1	61·8	109·6	133·7	86·0	30·6	18·6		
77	66·1	78·6	56·8	118·9	129·4	51·9	140·5	75·1	169·1	263·6	126·6	2·6		
78	10·6	106·3	51·8	119·1	146·0	37·8	142·8	172·0	71·3	129·1	102·3	2·0		
79	78·4	20·0	78·7	83·7	108·0	75·0	83·3	77·5	77·0	83·7	1·2	7·1		
80	0·7	39·9	47·1	114·0	52·2	77·1	50·4	69·9	135·7	77·5	42·2	0·5		
	265·0													
	0·0	23·8	99·0	242·9	91·2	23·9	81·7	142·3	133·2	42·9	29·7	12·7		
2	17·9	44·4	76·7	194·3	121·5	45·8	63·9	123·3	53·7	147·5	57·4	74·3		
3	40·3	29·8	16·8	184·9	123·5	54·9	121·1	191·2	186·9	119·9	50·1	7·2		
	0·0	11·5	11·1	102·4	138·4	24·6	38·1	86·2	153·3	x	x	x		

METEOROLOGICAL SERVICES AGENCY

Station: GORO Wereda: GORO Awraja: Mendeyo Region: Bale

Alt. 1750 Long. 40.28 Lat. 7.0 Element: monthly rainfall

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
1987	4.4	33.5	135.6	127.9	240.5	22.1	0.0	6.6	115.1	[illegible]	[illegible]	[illegible]		
1988	1.7	48.8	69.4	118.8	59.0	16.0	[illegible]	[illegible]	18.5	118.0	[illegible]	0.0		
1989	8.8	24.5	86.8	333.5	98.5	25.8	7.8	45.4	107.2	157.6	[illegible]	75.0		
1990	14.8	59.4	93.2	157.6	103.2	37.4	15.4	54.4	50.6	92.8	138.7	6.5		
1991	49.3	11.0	137.9											
1992	[illegible]	[illegible]	95.4	118.8	[illegible]	[illegible]	[illegible]	76.0	[illegible]	161.7	79.4	59.0		
1993	33.0	[illegible]	[illegible]	303.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	x	[illegible]	0.0		
Total														
1994	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	65.9	34.[illegible]	[illegible]	61.1	[illegible]		
1995	[illegible]	[illegible]	[illegible]	306.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.4	6.5		
1996	[illegible]	[illegible]	[illegible]	394.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		165.0	13.4	X		
1997	[illegible]	[illegible]	[illegible]	220.[illegible]	[illegible]	[illegible]	[illegible]							

NATIONAL METEOROLOGICAL SERVICES AGENCY

Station. KOFFLE Wereda .. Awraja Region ARSSI

Alt . Long. Lat Element Monthly Total R.

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
1991	14·4	107·0	174·5	64·3	161·2	72·0	105·6	183·3	167·9	11·7	29·3	61·0		
1992	79·4	168·3	113·4	203·5	127·4	106·3	178·6	281·8	216·7	92·7	146·5	85·5		
1993	87·9	61·6	64·3	164·2	282·9	106·2	196·0	131·4	203·6	189·9	37·6	0·8		
1994	0·0	0·6	91·6	117·8	132·0	110·4	146·5	130·3	141·0	15·3	9·3	20·1		
1995	20·5	18·7	80·4	300·7	75·2	79·5	169·0	142·3	104·6	58·2	7·8	87·8		
1996	135·8	34·4	204·9	244·6	133·9	83·4	182·1	142·6	177·4	78·5	45·4	31·7		
1997	60·0	0·2	160·3	188·5	104·4	190·2								
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NATIONAL METEOROLOGICAL SERVICES AGENCY

Station: KULUMSA Weroda MERTI Awraja Region ARSI

Alt Long Lat. Element TOTAL RAINFALL

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
19														
19														
19														
19 87	2·2	21.6	108·8	150·3	158·5	42·4	83·1	116·0	88·2	5·8	3·1	11·7		
19 88	64·2	79·3	25·0	113·6	60·4	82·7	133·9	122·5	136·4	56·3	0·0	0·2		
19 89	0·0	50·4	69·9	177·9	25·0	132·4	115·9	180·0	96·5	31·6	0·0	41·2		
19 90	0·0	160·6	100·6	155·2	30·5	97·1	180·4	109·8	120·3	22·7	5·5	0·9		
19 91	10·4	42·7	185·3	11·1	93·1	62·5	158·3	122·7	88·3	10·8	0·0	11·1		
19 92	26·5	96·0	4·5	65·6	28·1	68·0	109·1	174·3	104·6	81·5	36·1	14·5		
19 93	20·6	72·0	12·9	148·0	152·0	47·0	112·4	155·2	128·1	57·2	0·0	30·8		
Total														
19 94	0·0	13·0	34·5	66·7	42·8	148·3	120·1	133·6	105·6	1·1	32·9	15·4		
19 95	0·0	34·1	164·6	140·3	64·8	79·3	120·0	142·1	74·4	2·2	0·0	45·8		
19 96	42·1	4·3	132·4	58·9	182·5	134·6	130·4	98·5	87·5	1·3	8·4	0·0		
19 97	6·4	0·0	218·2	112·7	35·3	115·5	134·5							
19														
19														
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Total														
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NATIONAL METEOROLOGICAL SERVICES AGENCY

Station: MARARO Wereda Awraja Region ARSSI

Alt. 2940 Long. 39 22 Lat. 07 21 Element MONTHLY TOTAL RAIN

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
Total														
1988	7.1	6.5	25.3	130.4	42.1	61.9	123.5	252.3	105.4	-	0.0	4.3	758.2	
1989	18.8	23.8	63.1	119.9	33.4	89.5	186.7	185.6	65.9	41.5	10.0	100.7	679.3	
1990	7.8	301.7	60.5	82.8	^	16.6	118.5	138.3	64.7	9.8	2.6	1.4	804.7	
1991	6.0	50.9	138.5	16.2	62.5	117.9	174.9	182.9	80.3	3.3	0.0	4.4	837.8	
1992	43.4	15.2	4.0	57.9	46.1	74.6	117.6	150.4	73.3	65.2	23.3	19.0	690	
1993	49.9	65.7	17.2	47.3	107.4	48.4	112.4	199.9	119.3	62.8	3.4	0.0	833.7	
1994	0.0	0.0	34.5	84.2	61.4	76.3	155.4	178.7	133.1	1.9	45.8	13.4	784.7	
1995	0.0	34.7	105.2	78.1	53.5	41.9	125.3	118.6	47.0	35.6	2.9	13.0	655.8	
1996	52.3	3.7	97.1	45.4	90.0	102.9	125.1	145.8	47.6	6.1	0.0	0.0	716.0	
1997	36.8	0.0	33.3	42.8	41.2	85.9	183.5	101.9						
Total														
Total														
Ave.														
Total														

NATIONAL METEOROLOGICAL SERVICES AGENCY

NAZARETH MISSION Wereda Adama Awraja Yerer kereyu Region Shoa

1622 Long. 39° 17' Lat 08° 53' Element Monthly RAIN Fall

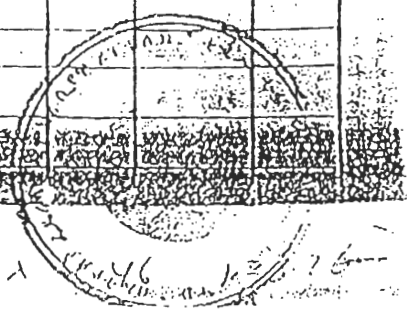
I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
0.0		80.1								0.0	413		
x		0.0	0.0	0.0	80.0	92.5	239.0	134.0	40.5	0.0			
			26.0	38.0	42.5	234.0	150.0	180.0	40.5	0.0			
0.0	0.0	5.0	78.0		40.0	138.0			0.0				
			18.0	19.0	96.0	285.0	199.0				0.0		
0.0	0.0	153.0	90.0		62.0	223.4	193.0	153.0	8.5				
0.0	58.8	0.0	0.0	0.0	17.0	132.0	191.0	54.0	3.0	0.0	0.0		
0.0	0.0	0.0	23.0	66.0	27.0	136.0	54.0	60.0	0.0	0.0	x		
x	x	x	x	x	x	x	x	x	x	x	x		
x	x	x	x	x	x	x	x	x	x	x	x		
x	x	x	x	x	x	x	x	x	x	x	x		
x	x	x	x	x	x	x	x	x	x	x	27.8		
18.1	0.0	15.9	29.8	0.0	121.7	103.2	187.9	44.8	47.5	11.3	0.0		
x	86.2	34.7		44.5	111.3		209.6	116.4	12.4	0.7	0.0		
0.0	0.0	65.6	37.8	59.2	91.5			x		x	0.0		
x	39.4	45.0	50.6	3.5	113.1								
	x			65.6	18.5	268.3	256.7	62.1	0.4	7.2	0.0		
51.1	27.9	81.1	25.4	18.4	11.5	155.1	305.7	112.1	4.4	0.0	0.0		
1.3	0.0					192.5	325.8	147.7	1.0	10.2	33.8		
1.3	10.5	96.2	86.3	28.0	130.3	273.5	249.2	85.7	6.5	0.0	0.0		
0.0	0.0	0.0	0.1	94.2	30.3	[illegible]	300.2	107.7	78.4	0.0	0.0		
0.6	7.3	[illegible]	0.0	77.2	118.5	150.5	161.7	171.0	1.5	0.0	0.0		
.9	8.5	1.1	102.2	42.0	202.3	469.5	165.5	90.7	x	0.0			
0.0		67.5	64.6		[illegible]	[illegible]	212.2	108.2	0.2	30.6	7.0		
8.2	[illegible]	[illegible]	[illegible]	61.6	[illegible]	[illegible]	172.0	83.5	163.0	63.7	0.0		
1.2	[illegible]	2.1	16.3	15.1	59.1	[illegible]	199.3	82.3	68.3		5.5		
14.3	[illegible]	[illegible]	[illegible]	127.4	115.6	[illegible]	128.6	21.8	17.4				
								120.7	39.4	4.3	0.0		
0.0	[illegible]	156	37.5		2.4	246.3	308.9	137.9	4.7	0.0	0.0		
.5	41.6	54.9	[illegible]	75.1	31.7	[illegible]	259.8	47.6	104.5	31.3	[illegible]		

NATIONAL METEOROLOGICAL SERVICES AGENCY

ion: NAZERETH Mission Wereda ..... Awraja ..... Region SHOA

1622 ..... Long. 39° 17' Lat. 08° 33' Element MONTHLY RAIN FAL

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
83	x	43·4	33·8	79·3	158·0	24·7	214·4	221·3	76·4	14·3	0·0	0·0		
84	0·0	0·0	4·3	0·4	173·1	84·6	202·7	148·3	66·9	0·0	0·0	19·8		
85	3·0	^	23·1	183·4	67·3	8·0	405·4	327·1	169·0	0·0	0·0	0·0		
86	0·0	96·5	41·0	6·2	54·4	152·4	263·3	95·0	20·4	0·0	0·0	0·0		
87	0·0	11·2	80·2	61·1	259·6	0·0	161·6	243·4	30·8	0·0	0·0	0·0		
88	34·0	31·3	6·5	50·9	9·4	50·3	155·4	171·4	186·9	52·9	0·0	0·0		
89	0·0	89·9	21·7	95·4	0·0	54·7	182·5	251·2	80·3	5·7	0·0	3·5		
90	0·7	169·0	83·0	114·7	13·3	12·0	337·8	187·9	153·7	10·8	0·0	0·0		
91	0·0	x	84·2	13·5	22·3	74·4	322·0	232·8	89·0	13·1	x	1·7		
92	44·2	27·8	0·0	46·3	8·6	65·9	232·8	210·0	160·3	43·9	0·0	3·5		
93	45·4	51·9	0·0	102·6	72·7	64·1	345·2	142·4	79·3	20·0	x	x		
94	0·0	0·0	2·6	49·1	26·5	70·1	229·6	171·5	173·8	13·8	35·6	51·0		
95	0·0	36·5	46·9	127·2	33·0	46·5	203·1	251·4	88·2	14·7	0·0	1·8		
96	27·8	0·0	111·5	65·1	115·2	120·2	220·2	246·8	93·9	0·0	7·9	0·0		



NATIONAL METEOROLOGICAL SERVICES AGENCY 4th

ion: SHASHEMENE ..... Wereda ________ Awraja Haickochaa Butajira Region SHOA

2080 Long 3836 . Lat. 0712 . Element MONTHLY TOTAL RAI

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average
69	x	x	x	x	x	x	x	x	x	x	(0.0)	0.0		
70	52.7	44.3	128.1	174.6	56.5	107.9	66.0	245.8	340.8	133.7	(0.0)	0.0	1350.4	
71	0.1	2.8	38.2	81.2	94.0	83.7	67.3	185.9	108.7	121.5	x	88.5	871.9	
72	26.2	110.8	66.8	132.0	76.7	88.0	144.6	100.2	174.5	57.9	7.0	3.4	988.1	[illegible]
73	8.0	0.0	0.0	99.4	142.1	51.9	125.0	86.2	80.2	61.0	4.0	7.0	668.8	1[illegible]
74	15.0	15.0	191.4	21.0	146.1	47.0	137.2	105.5	124.9	48.9	0.0	(0.0)	852.0	12
75	x	x	x	x	x	x	x	x	(87.3)	77.6	2.7	0.0	167.6	4
76	9.3	22.1	88.6	73.7	117.2	59.0	109.4	121.5	142.2	134.9	75.4	16.5	969.8	[illegible]
77	86.2	25.3	59.1	55.6	132.9	69.2	117.9	91.9	133.6	258.8	37.3	24.1	1096.9	12
78	3.5	123.0	29.6	63.0	157.4	62.0	87.9	215.1	119.7	54.0	35.3	3.6	954.1	12
[illegible]	201.0	343.3	601.8	700.5	927.9	568.7	859.3	1152.1	1311.9	948.3	161.7	143.1	7919.6	12
79	68.7	60.2	64.2	57.1	144.1	59.8	86.2	165.2	126.6	58.5	32.6	57.7	980.9	12
80	66.1	71.0	49.9	136.0	101.4	123.7	82.0	71.4	90.7	61.6	7.8	0.0	861.6	12
81	0.0	15.1	175.9	109.0	61.8	50.1	107.8	138.7	135.3	67.4	13.0	9.9	954.0	12
82	3.2	112.1	125.5	167.7	120.5	127.8	99.4	149.4	106.5	108.8	101.2	22.7	1245.1	12
83	63.7	33.9	78.3	231.1	37.1	73.5	92.1	121.4	139.7	40.5	26.6	1.2	941.1	12
4	0.0	0.0	46.7	37.4	160.4	75.6	80.6	110.7	112.3	12.6	18.6	19.4	674.3	12
5	3.5	0.0	98.4	142.3	203.8	96.3	126.6	90.0	84.6	35.7	1.3	28.7	911.2	12
6	0.0	16.9	75.0	132.9	148.9	70.3	x	x	x	78.2	2.7	0.3		9
7	8.1	68.9	143.7	71.8	237.4	62.1	101.5	113.6	88.2	153.0	0.2	2.9		12
8	35.1	60.0	34.5	131.1	75.4	80.7	102.6	99.9	128.8	158.7	0.0	6.4		12
[illegible]	31.6	58.4	126.1	261.5	26.5	94.9	52.2	107.5	154.6	58.2	11.6	107.3		12
[illegible]	x	x	x	x	x	x	x	x	0.0	x	18.5	4.2		3
[illegible]	4.1	76.7	101.9	24.6	42.8	50.3	92.3	88.1	102.2	11.9	0.0	9.1		12
[illegible]	55.1	44.3	29.3	114.3	47.6	125.6	26.1	99.9	174.6	27.4	35.6	44.5		[illegible]
[illegible]	63.2	43.7	0.0	137.0	75.8	23.0	112.8	112.8	242.8	131.5	0.0	0.0		[illegible]
1	0.0	0.0	59.5	112.6	65.8	40.5	192.0	64.2	185.9	3.9	20.9	9.3		12
[illegible]	0.0	23.0	135.8	184.8	76.2	66.5	65.1	102.9	130.1	35.8	5.2	21.9		[illegible]
[illegible]	16.0	0.0	108.5	155.9	187.2	101.6	99.2	132.8	140.1	69.[illegible]	33.7	7.7		

I.3 RAINFALL INTENSITY (@ ASASA)

I.3.1 INFILLED

I.3.2 OBSERVED

I.3.1 INFILLED

Infilled Monthly Maximum Rainfall Intensity in 60 min. @ Asasa

Station: Asasa
Lat. 7°6.5'N Long. 39°11' E Alt. 2350 masl

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Maximum
1971	19.9	30.6	24.1	24.0	26.6	16.8	16.2	33.0	22.5	3.6	0.0	4.8	33.0
1972	19.9	15.9	24.1	24.0	2.8	7.9	10.1	4.4	22.5	3.2	0.8	1.0	24.1
1973	19.9	5.5	0.9	19.8	6.6	9.1	12.7	11.5	12.4	17.1	0.0	3.0	19.9
1974	0.7	2.0	1.8	15.6	26.6	42.2	28.0	37.4	14.4	0.4	0.0	0.2	42.2
1975	0.7	2.0	2.1	21.5	8.5	20.3	27.4	13.4	3.4	6.4	0.0	1.0	27.4
1976	1.2	0.2	3.3	22.9	6.9	12.3	5.0	14.1	11.3	1.1	7.2	4.5	22.9
1977	5.6	4.5	2.4	16.7	3.7	12.4	17.5	37.4	2.4	33.6	0.0	0.0	37.4
1978	3.3	17.9	4.9	8.0	6.4	7.8	3.9	16.3	5.5	31.7	0.0	3.0	31.7
1979	8.5	30.6	9.8	8.3	15.1	29.9	15.0	23.9	9.8	2.2	1.3	2.8	30.6
1980	19.9	2.3	2.3	10.0	9.6	42.2	28.0	25.5	7.7	0.8	0.0	0.0	42.2
1981	4.3	19.1	7.2	11.4	26.6	42.2	28.0	17.3	14.0	0.3	5.7	0.0	42.2
1982	19.9	30.6	24.1	15.3	9.6	6.9	11.0	17.6	22.5	7.6	3.9	3.8	30.6
1983	2.3	5.8	1.6	11.7	26.6	4.1	14.5	14.6	3.7	1.7	6.0	7.2	26.6
1984	19.9	30.6	24.1	24.0	26.6	20.4	28.0	11.6	13.9	33.6	7.2	7.2	33.6
1985	19.9	30.6	24.1	24.0	26.6	42.2	28.0	37.4	22.3	0.7	0.4	1.6	42.2
1986	0.0	0.0	5.2	10.7	10.6	11.0	14.5	4.7	12.3	20.5	0.8	2.6	20.5
1987	4.5	13.0	13.7	11.0	16.5	5.5	4.1	23.7	4.1	17.8	1.5	2.1	23.7
1988	0.0	0.0	0.0	15.4	3.0	18.5	20.5	23.0	21.6	16.0	0.0	0.0	23.0
1989	7.5	6.0	21.0	13.0	15.8	9.8	16.2	22.9	13.0	8.2	5.0	0.0	22.9
1990	2.4	30.6	24.1	24.0	11.3	3.5	19.5	7.2	7.9	2.3	7.2	1.2	30.6
1991	15.4	30.6	4.9	0.6	13.4	12.6	18.2	12.5	10.8	0.4	1.4	7.2	30.6
1992	0.0	0.0	1.5	10.0	0.0	0.0	1.2	25.0	21.2	5.8	0.0	0.0	25.0
1993	15.3	7.0	1.5	3.1	0.0	15.0	17.0	18.7	14.4	8.8	0.0	0.0	18.7
1994	0.0	0.0	6.8	24.0	4.4	11.2	28.0	23.4	16.5	33.6	7.2	7.2	33.6
Mean	8.8	13.1	9.8	15.4	12.7	16.8	17.2	19.9	12.9	10.7	2.3	2.5	29.8
Max.	19.9	30.6	24.1	24.0	26.6	42.2	28.0	37.4	22.5	33.6	7.2	7.2	42.2
Min.	0.0	0.0	0.0	0.6	0.0	0.0	1.2	4.4	2.4	0.3	0.0	0.0	18.7
St.Dev	8.4	12.7	9.6	7.1	9.3	13.2	8.6	9.7	6.6	11.9	2.9	2.6	7.4
Cv	0.95	0.97	0.98	0.46	0.74	0.79	0.50	0.49	0.51	1.11	1.26	1.04	0.25

I.3.2 OBSERVED

in Assosa Region Arusi

ent Monthly Rainfall Intensity in 60 min

ear	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
71	NO DATA					16.8	16.2	33.0	X	3.6	0.0	4.8
72	X	15.9	NO DATA		2.8	7.9	10.1	4.4	X	3.2	0.8	1.0
73	Y	5.5	0.9	19.8	6.6	9.1	12.7	11.5	12.4	17.1	0.0	3.0
74	0.7	2.0	1.8	15.6	NO DATA			X	14.4	0.4	0.0	0.2
75	0.7	2.0	2.1	21.5	8.5	20.3	27.4	13.4	3.4	6.4	0.0	1.0
76	1.2	0.2	3.3	22.9	6.9	12.3	5.0	14.1	11.3	1.1	7.2	4.5
77	5.6	4.5	2.4	16.7	3.7	12.4	17.5	37.4	2.4	33.6	0.0	0.0
78	3.3	17.9	4.9	8.0	6.4	7.8	3.9	16.3	5.5	31.7	0.0	3.0
79	8.5		9.8	8.3	15.1	29.9	15.0	23.9	9.8	2.2	1.3	2.8
80	19.9	2.3	2.3	10.0	9.6	42.2	28.0	25.5	7.7	0.8	0.0	0.0
81	4.3	19.1	7.2	11.4	NO DATA			17.3	14.0	0.3	5.7	0.0
82	NO DATA			15.3	9.6	6.9	11.0	17.6	22.5	7.6	3.9	3.8
83	2.3	5.8	1.6	11.7	26.6	4.1	14.5	14.6	3.7	1.7	6.0	X
84	NO DATA					20.4	X	11.6	13.9	X	X	X
85	NO DATA								22.3	0.7	0.4	1.6
	0.0	0.0	5.2	10.7	10.6	11.0	14.5	4.7	12.3	20.5	0.8	2.6
	4.5	13.0	13.7	11.0	16.5	5.5	4.1	23.7	4.1	17.8	1.5	2.1
	0.0	0.0	0.0	15.4	3.0	18.5	20.5	23.0	21.6	16.0	0.0	0.0
	7.5	6.0	21.0	13.0	15.8	9.8	16.2	22.9	13.0	8.2	5.0	0.0
	2.4	30.6	24.1	24.0	11.3	3.5	19.5	7.2	7.9	2.3	X	1.2
	15.4	X	4.9	0.6	13.4	12.6	18.2	12.5	10.8	0.4	1.4	7.2
	0.0	0.0	1.5	10.0	0.0	0.0	1.2	25.0	21.2	5.8	0.0	0.0
	15.3	7.0	1.5	3.1	0.0	15.0	17.0	18.7	14.4	8.8	0.0	0.0
	0.0	0.0	6.8	X	4.1	11.2	-	23.4	16.5	X	X	

APPENDIX II: HYDROLOGICAL AND WATER QUALITY DATA

II.1 FLOW DATA

II.1.1 INFILLED

II.1.2 OBSERVED

II.1.1 INFILLED

Table II.2.1.1 Monthly Flow of Ketar River nr Sagure

(in Million Cubic Meters)

CA=1975Km^2

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1982	3.90	5 57	7 02	11 91	11 22	10 04	32 27	111.31	21.58	6.66	14 53	10 53	246 5
1983	3.84	4 27	5 27	12 39	36 28	35 51	27 32	293 29	90.51	45 58	10 16	6 85	571 3
1984	5.78	4 78	4 50	4 08	5 49	9 88	40 17	51.24	39.46	5.99	4 66	4 36	180 4
1985	3.84	3 41	3 86	5 17	13 01	5 76	67.66	92 69	61.66	10 59	4 38	3 90	275 9
1986	3.30	3.46	4 05	6 87	7 14	4 47	59 73	119.79	64.92	19.95	4.67	4 05	302 4
1987	3.71	3 47	9 42	35 61	23 95	21 10	15 00	56.95	20.58	10 46	4 10	4.04	208 4
1988	3.93	4.44	4 35	5.40	5 60	6 10	67 50	219.76	71.55	76.12	12.71	8.27	485 7
1989	6.73	6.03	6.04	14 00	9.63	9 47	33.35	62.40	63.57	14.86	7 90	9.13	243.1
1990	6.20	26.89	43 42	44 35	13 55	8.41	27.72	116.86	63.54	11.92	5.14	4.29	372.3
1991	3.88	4.37	7.55	8.02	4.85	5 27	22 43	122.39	73.11	7.29	2.49	3.31	265.0
1992	3.41	4.09	3 19	5 61	4 67	4 74	14.82	167.19	76.95	36.98	18.77	5.58	346 0
1993	4.73	11.99	4.37	10 64	28.46	27 15	37.98	179.94	71.45	41.53	10.01	5.10	423 4
1994	5.23	3.97	4.81	4.97	7 83	9.12	42.44	146.37	70.39	26.23	8 90	6.59	336.8
1995	0.11	5.45	8 22	27 94	13.85	9 01	49 29	136.16	113.10	22.03	5.64	7.88	404.7
Mean	4.6	6.6	8 3	14 1	12 3	11 9	38.4	134.0	64.5	24.0	8.1	6.0	333.7
Max.	6.7	26.9	43.4	44 4	36.3	35.5	67 7	293.3	113.1	76.1	18.8	10 5	571 3
Min.	3.3	3.4	3 2	4 1	4.7	4.5	14.8	51.2	20.6	6.0	2.5	3.3	180 4
St.Dev.	1.1663	6.2318	10.276	12 678	9 7017	9 3566	17.441	66.136	24.508	19.962	4.6798	2.2526	111.02
Cv	0.2528	0 9463	1.2395	0 9012	0 7321	0 789	0 4541	0.4935	0.3802	0.8313	0.5744	0.376	0 33
% of MAF	1.4	2.0	2 5	4 2	4 0	3 6	11 5	40.2	19.3	7.2	2.4	1 8	100

Fig. II.2.1.1 Ketar River: Mean Monthly Flow

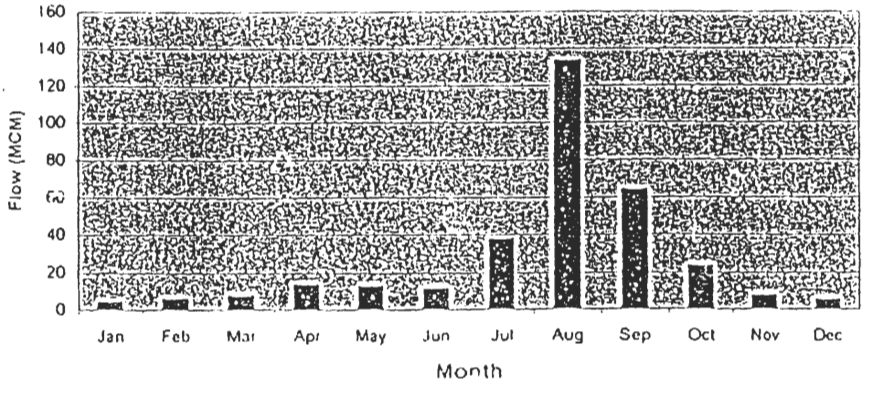


Table II.2.1.2 Monthly Flow of Ashebeka River nr. Sagure

(in Million Cubic Meters)

CA = 236 Km^2

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1982	1.70	1.57	1 72	2 49	2 57	1 91	3 38	14 31	4.29	4.15	2.04	2.02	42 2
1983	1.93	1 73	2.01	2 76	6 80	4.38	5 78	47 85	8.84	5.18	2 33	2.06	91 7
1984	1.99	1.71	1 78	1 68	1 97	2 10	4 13	5 86	6.36	2.12	1.73	1.81	33 2
1985	1 77	1.54	1.71	1 82	2 28	2 03	4 30	8.71	6.82	2.71	1.94	1.92	37 6
1986	1.76	1 58	2.05	2 78	3 08	3.82	8.33	18.73	7.91	5.14	2.15	2.01	59 3
1987	1.95	1.92	3.01	6.09	3 52	3 12	2 69	3.36	3.24	2.75	2.06	2.03	35 7
1988	0.92	1.03	0.93	1.27	1 40	1.67	18.94	34.72	6.29	3.50	1.48	1.28	73.4
1989	1.28	1.22	1.46	3.16	1 58	1.61	4.89	6.24	5.24	2.27	1.52	1.70	32.2
1990	1.57	2.79	3.92	5.13	2 08	2.05	4 29	8.26	8.18	2.61	1.59	1.57	44.0
1991	0.90	1.08	2.31	2.13	2 12	2.18	5.77	12.61	6.95	1.90	1.49	1.60	41.0
1992	1.63	1.73	1.98	4.51	2 74	2.57	4 39	25.78	9.14	3.06	1.83	1.79	61.2
1993	1.84	2.29	1.71	2 78	3 27	1.82	3.46	10.54	7.39	3.75	2.11	1.66	42.6
Mean	1.60	1.68	2 05	3.05	2.78	2.44	5.86	16.41	6.72	3.26	1.86	1.79	49.5
Max.	1.99	2.79	3.92	6.09	6.80	4.38	18.94	47.85	9.14	5.18	2.33	2.06	91.65
Min.	0.90	1.03	0.93	1.27	1.40	1 61	2.69	3.36	3.24	1.90	1.48	1.28	32.2
St.Dev.	0.38	0.50	0.77	1.47	1 42	0.88	4.37	13.42	1.78	1.11	0.29	0.24	18.30
Cv	0.24	0.29	0.38	0 48	0.51	0 36	0 75	0.82	0.27	0.34	0.16	0.13	0.37
% of MAF	3.2	3.4	4.1	6.2	5 6	4 9	11.8	33.2	13.6	6.6	3.7	3.6	100

Fig. II.2.1.2 Ashebeka River: Mean Monthly Flow

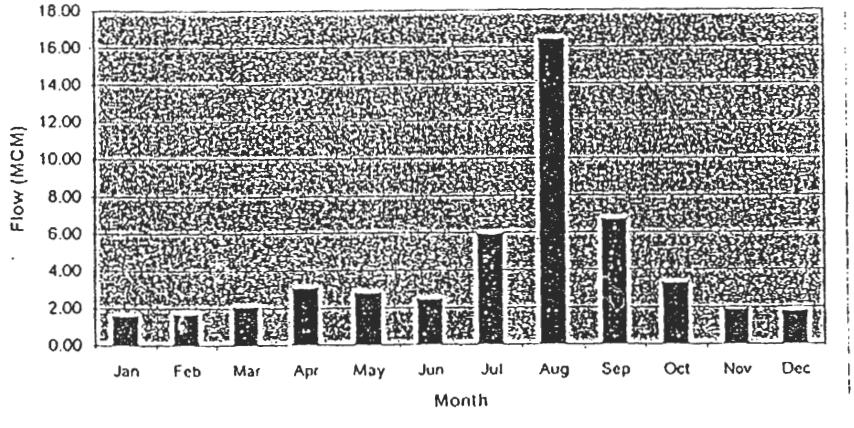


Table II.2.1.3 Monthly Flow of Wabe River d/s of Bridge Crossing

(in Million Cubic Meters)

CA = 1035 Km^2

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1967	2 73	3 24	3 29	4.95	6 59	4 95	27 32	49 28	63 76	56.25	41 73	6.27	270.4
1968	3 72	6 41	9 35	46.92	25.07	22.26	21.02	31 60	44 84	19 20	4.98	4.39	239.8
1969	8 94	10 62	18.08	8 89	12.72	10 52	38 30	79 55	42 51	9.54	4.92	4.02	248.6
1970	6.62	4 45	19.31	20 40	15.27	7.08	20.49	69.91	58 06	22.34	5.81	3.83	253.6
1971	4 39	3 31	4 58	8.11	19.93	23.54	54.37	79.01	38.10	30.53	9.12	6.75	281.7
1972	6.20	19 20	13.80	40.70	19.20	8.50	35 00	34.90	36.20	6.90	6.00	5.40	232.0
1973	5.20	4.40	4.70	4.50	7.40	7.90	16.90	48.30	34.30	15.70	5.10	5.30	159.7
1974	5.10	4.60	8.90	6 10	5.40	6.50	23.40	20.30	27.80	8.80	5.70	5 10	127.8
1975	1 94	3 24	4.08	7.47	6.82	18.10	39.62	47.70	52.02	13.45	7.13	5.94	207.5
1976	4.52	3 10	4.13	4.59	7.56	8.93	16.59	40.03	32.50	8.35	11.51	4.83	146.6
1977	9 96	9.02	5.46	10.84	9.34	16.97	45.38	50.88	59.58	28.50	15.65	5.29	266.9
1978	3.78	5.61	14.93	7 72	13.09	10.37	22.75	51 15	40.70	32 20	5.16	5.81	213.3
1979	6.17	8 52	10.05	12.74	6.60	9.57	15.85	19.87	34 37	15.27	5.06	3.95	148.0
1980	4.04	3 20	4.60	7 32	13.42	10.37	45 16	33.62	23.22	14.70	4.28	3.55	167.5
1981	3 43	3.34	9.68	25.06	5.54	4.25	13.29	50.07	47 45	14 40	5.73	4.60	186.8
1982	4 71	5 10	4.65	7.28	10.05	11 02	31.87	61.69	44 41	33.35	25.25	22 07	261.5
1983	8 29	3 62	11.32	35 85	65.51	15.18	15.61	61.85	83.00	59.28	22.43	4.92	386.9
1984	3 72	3 21	3.62	3.63	6.14	20.28	41.17	42.94	27 68	6.52	7.27	5.90	172.1
1985	4 13	3 42	4.35	10.18	23.55	24.06	34.71	49.00	50.74	17 34	5.74	4.67	231.9
1986	3 74	5 24	4.78	13.29	15.29	21 81	26 57	43.56	46 94	23 53	5.03	5.40	215.2
1987	4 81	5 52	14 23	18 61	39.82	29.55	16 42	51 27	35 39	35.32	13.28	6.04	270.3
1988	5 19	7 87	4.47	7 99	7.26	15.07	33.76	74.88	52.28	37.25	7.08	4.58	257.7
1989	4 30	5.39	4.83	8.86	6.70	6.23	11 36	30.57	33 30	19.41	7 36	25.95	164.3
1990	6.50	18 19	20.10	32.44	10.39	9.65	12.25	38 82	31 61	16 61	5.14	5 40	207 1
1991	4.21	8 79	9.92	7.98	8 71	5.01	6 42	24.46	34 36	9.37	4.31	4.07	127 6
1992	5 77	9.65	8.30	24.12	16.98	21.88	37.27	44.49	55 05	26 10	10.30	8 61	268.5
1993	5 51	7.70	8.06	9.39	35.60	33.98	51.80	49.27	30.14	35 93	11 82	4 60	283.8
1994	4 15	3 50	5.36	5.09	15.95	33.78	54.40	55.28	29 76	22.41	9.54	6.44	245.7
1995	2 64	3.13	4.26	7.21	7.89	7.89	14.35	23.48	35.20	11 17	4.07	3.04	124.3
1996	10.37	3.98	10.26	21.09	26.18	44.18	31.29	63.95	36.34	22.41	9.54	6.44	286.0
Mean	5 16	6.22	8.45	14 31	15.67	15.65	28.49	47.39	42 05	22.40	9.54	6.44	221.9
Max.	10 37	19.20	20.10	46.92	65.51	44 18	54.40	79.55	83 00	59.28	41.73	25.95	386 9
Min.	1 94	3 10	3.29	3 63	5.40	4 25	6.42	19 87	23.22	6.52	4.07	3.04	124.3
St.Dev.	2 04	4 066	4 95	11.57	12.88	10.09	13.7	16.34	13.02	13 29	7.939	4 932	60.5
Cv	0 40	0 65	0.59	0 81	0.82	0 64	0 48	0.34	0 31	0 59	0.83	0.77	0.27
% of MAF	2 3	2 8	3.8	6 5	7.1	7.1	12.8	21.4	19 0	10 1	4 3	2.9	100

Fig.___ Mean Monthly Flow of Keleta R. nr. Sire

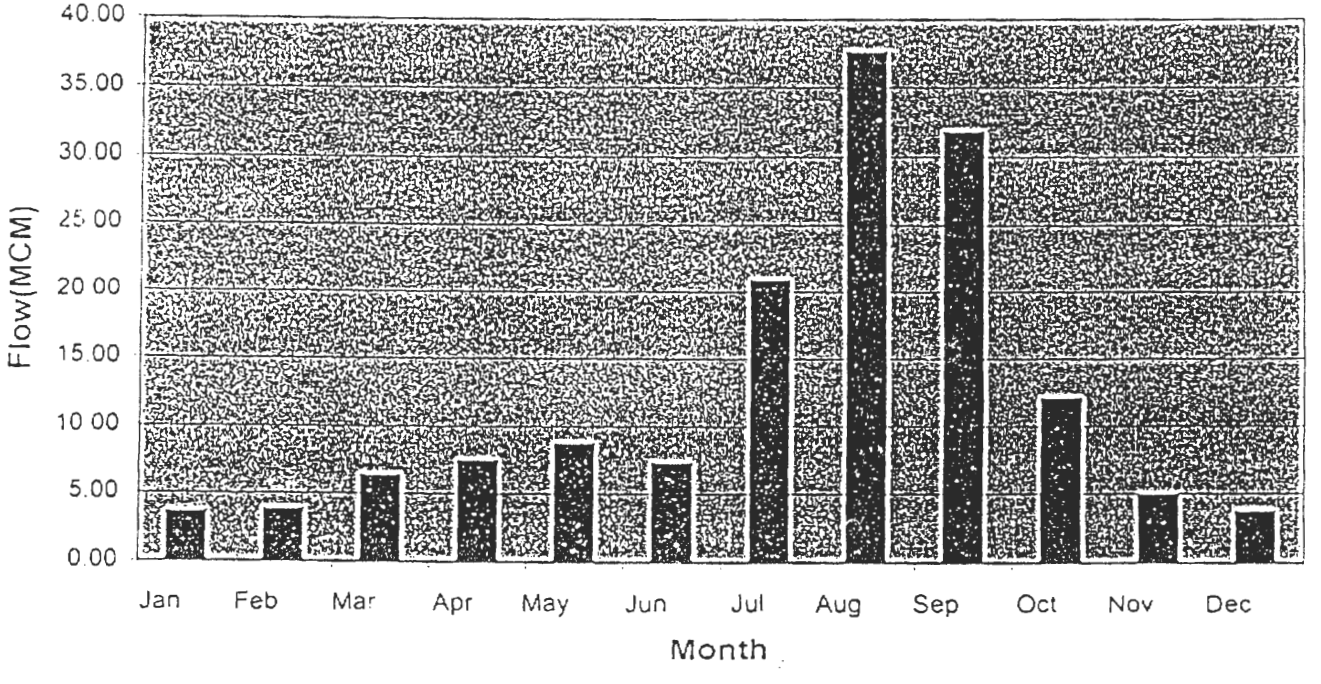


Fig. II.2.1 3 Wabe River: Mean Monthly Flow

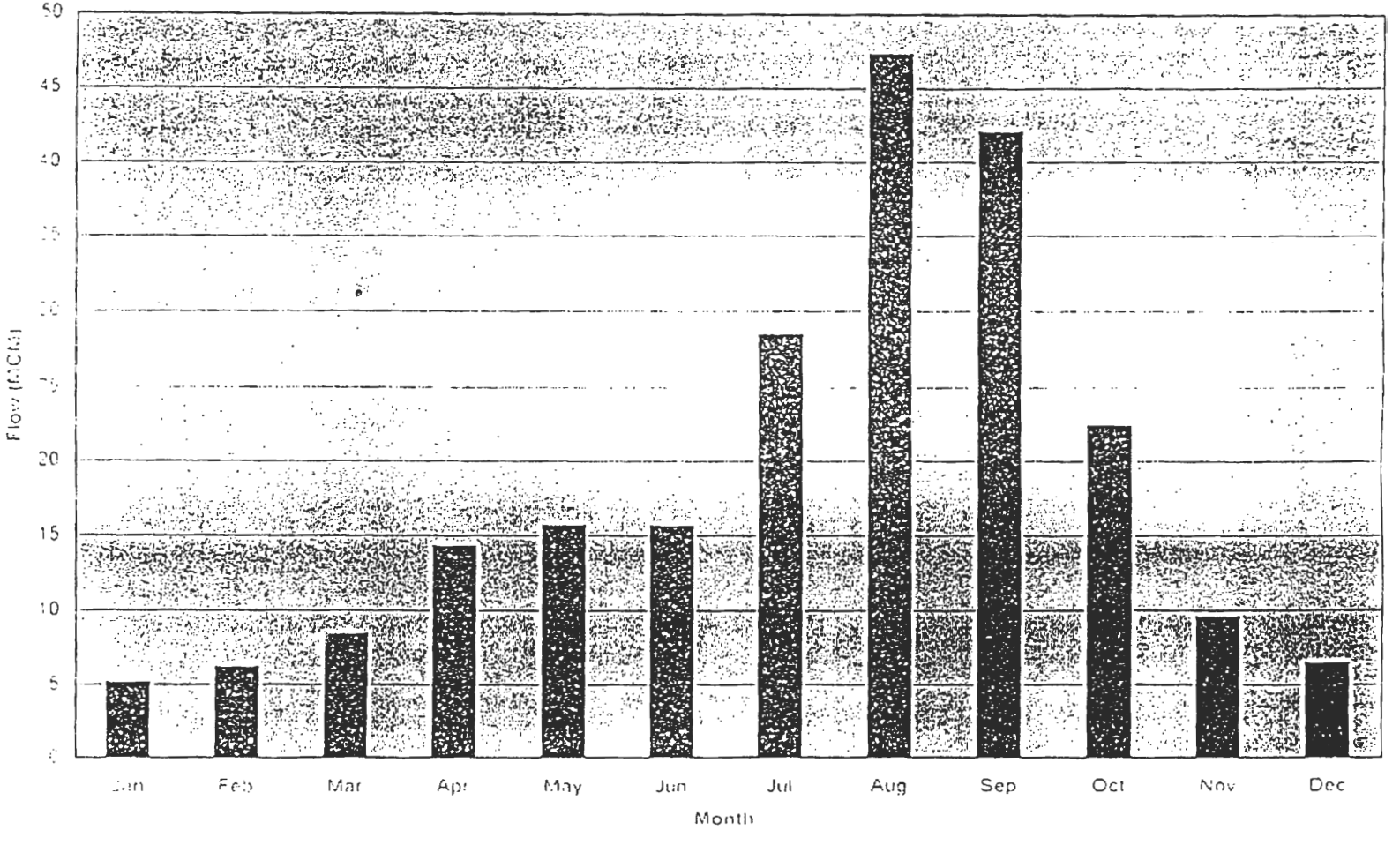


Table II.2.1.4 Monthly Flow of Weyib River nr. Agarfa

(in Million Cubic Meters)

CA=771.9 Km²

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1980	0 578	1 888	1 490	9 460	7 397	1 721	5 242	16 631	5 986	8 050	1 690	0.690	60 8
1981	0 463	0 557	13.140	90.950	6 080	0 706	7.240	49 250	30 020	7 870	1.430	0 683	208 4
1982	0 761	0 716	0.552	12 580	24 260	3 865	4 360	19 820	3 520	15 690	5 730	9.890	101 7
1983	1 540	1 920	1 200	9.510	30 660	7 130	5.590	65 490	26 140	39 780	5 580	1 360	195 9
1984	0 628	0 408	0 350	0 452	1 424	1 614	6.480	11 290	19.090	2 380	0.898	0.564	45 6
1985	0 430	0 420	1 710	9.920	24 160	1 050	8.860	34 780	10.370	7 560	2.100	0.770	102 1
1986	0 490	0 530	1 100	12.260	23 280	25.430	18.240	42 110	22.430	13 620	2.350	1 480	163 3
1987	0.586	0 648	3.690	23 180	57.310	5 780	1.280	4 200	6.440	10 080	3 250	0.976	117 4
1988	0 580	0.600	0.960	6.980	2 730	1 710	29.590	52 140	20.790	39 000	2.600	0.863	158 5
1989	0.630	0 580	1.280	53.330	9 690	1.270	32.700	10.160	9 950	12.310	5.170	10.350	147 4
1990	2 220	10 790	14.200	35.680	3.320	1 120	2.790	30.340	5.450	5.430	1.720	1.540	114 6
1991	0.990	1.050	6.620	47.950	41 790	2.280	4.990	4.010	4.260	2.660	1 180	1.010	118.8
1992	0 860	2 720	0.790	1.480	2 390	1.300	6.730	90.840	12.150	47 120	13.030	12.810	192 2
1993	7.070	40 700	2.230	3.250	12 650	1 756	14.380	29.743	4 190	21.032	12 396	0.535	149 9
1994	0 909	0 794	0.866	1 459	1 430	1.296	17 685	95.640	11.440	18.085	4 111	3.110	156 8
1995	0.356	1 162	1.496	9.689	7 980	1.656	15.659	20.410	15.386	38.585	2.521	3 110	118 0
Mean	1.19	4 09	3.23	20.51	16.03	3.73	11.36	36.05	12.92	18.08	4.11	3 11	134 5
Max.	7 07	40.70	14.20	90.95	57.31	25 43	32 70	95.64	30.02	47.12	13 03	12.81	208 39
Min.	0.36	0 41	0 35	0 45	1 42	0 71	1.28	4.01	3.52	2 38	0.90	0 54	45.58
St.Dev.	1 64	10 08	4.35	24.82	16 35	6.06	9.33	28.49	8.43	14 75	3 69	4.04	45.85
Cv	1.37	2 46	1.35	1.21	1 02	1.62	0.82	0.79	0.65	0.82	0.90	1 3	0 34
% of MAF	0 9	3 0	2.4	15 3	11 9	2 8	8.5	26.8	9.6	13 4	3.1	2 3	100

Fig. II.2.1.4 Weyib River: Mean Monthly Flow

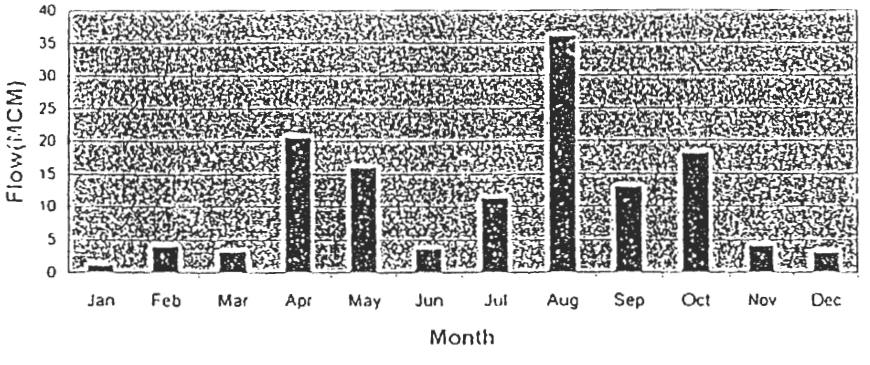


Table___ Monthly Flow: Lelisso River at Adaba (Drainage Area = 126.3 Km²)

Ser No	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	1975	0 52	0 76	0.51	2.09	0 89	1 17	4 07	103 99	23 89	2 59	0 85	0.55	141.88
2	1976	0 49	0 45	0 70	1.38	15 43	0 68	11 23	30 04	6.08	9 82	4 02	1 11	81.43
3	1977	2 62	1 95	1 18	2 13	3 56	1 59	15 15	33 18	11.51	28 80	15 28	0.79	117.74
4	1978	0 50	2 00	3.55	2.26	2 58	1 28	8 28	12 34	12 36	7 70	1 01	1.66	55.52
5	1980	0 68	0 49	0.52	0.81	0 64	0 60	1 98	12 31	4 89	1 90	0 77	0.64	26.23
6	1981	0 56	0 50	3.75	24.34	1 66	1 54	8 28	43 76	10.13	10.91	3 76	1.66	110.85
7	1982	1 02	0 86	1.05	11 83	5 28	1 03	12 83	35 40	9 74	27 03	3.20	1.44	110.71
8	1983	0.75	1 36	1.92	29 61	26.52	2 14	8.85	116 38	7 75	6 39	3 42	1.43	206.52
9	1984	1.33	1 08	1.12	1.03	2 00	3 79	3.82	6 42	4.81	3.02	1.53	5.65	35.6
	Mean	0 94	1.05	1.59	8.39	6.51	1.54	8.28	43 76	10.13	10.91	3.76	1.66	98.50
	Max.	2.62	2.00	3.75	29.61	26.52	3.79	15 15	116 38	23.89	28.80	15.28	5.65	206.52
	Min.	0.49	0.45	0.51	0.81	0.64	0.60	1.98	6 42	4.81	1.90	0.77	0.55	26.23
	St.Dev.	0.69	0.60	1.24	11.15	8.77	0.97	4 39	39 75	5.85	10.15	4.52	1.56	56.50
	Cv	0.73	0.57	0.78	1.33	1.35	0.63	0 53	0 91	0.58	0.93	1.20	0.94	0.57
	% of MAF	1.0	1.1	1.6	8.5	6.6	1.6	8 4	44 4	10 3	11.1	3.8	1.7	100.0

Fig.___ Mean Monthly Flow of Lelisso River at Adaba

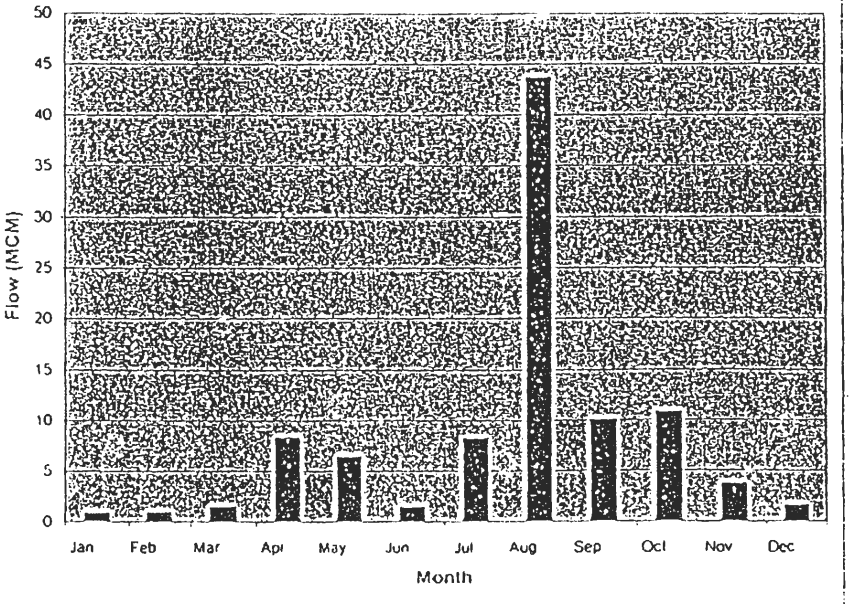


Table___ Monthly Flow: Robie River at robie (Drainage Area = 171 Km^2)

Ser No	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	1979	12 540	0 768	0 838	1 050	13 800	1 870	4 330	5 080	1 820	4 460	0 355	0 099	47 01
2	1980	0 028	0 009	0 003	0 020	0 015	0 031	19 340	2 310	0 943	1 200	0 234	0 146	24 279
3	1981	0 077	0 148	4 960	7 130	0 855	0 218	0 947	4 890	5 010	4 050	1 780	0 510	30 575
4	1982	0 230	0 260	0 240	2 040	3 560	0 540	4 600	5 580	2 460	5 860	0 730	1 170	27 27
5	1983	0 308	0 287	0 231	1 660	6 980	1 690	3 680	10 790	7 020	10 670	0 824	0 206	44 346
6	1984	0 090	0 070	0 060	0 150	0 520	0 630	3 040	3 860	6 960	0 570	0 360	0 390	16 70
7	1985	0 317	0 241	0 210	0 449	3 741	0 266	1 208	6 628	5 301	1 115	0 295	0 222	19 993
8	1986	0 191	0 155	0 351	2 130	4 210	0 930	4 140	8 420	0 945	1 530	0 395	0 230	23 627
9	1987	1 200	2 450	0 950	6 430	12 150	2 190	1 890	2 670	4 670	2 470	0 450	0 283	37 80
10	1988	0 219	0 192	0 170	1 310	1 050	0.559	1 680	8 420	5 010	5 200	1 030	0 414	25 254
11	1989	0 358	0 589	0 194	2 010	2 200	0 346	1 850	4 960	13.680	9 510	13 650	2 320	51 667
12	1990	0 617	17 230	4 500	9 980	1 100	1 080	2 550	15 460	5.010	4 050	0 650	0 440	62 667
13	1991	0 270	0 410	0 680	1 280	2 620	1 520	4.140	16 810	2 140	1 050	2 030	0 280	33 23
14	1992	0 392	0 416	0 173	0 295	1 245	1 114	7.080	10 860	8.020	2 760	0 412	0 414	33 181
15	1993	1 210	13.460	0 680	10 790	9.140	1.030	1.680	19.520	6.130	6 240	3 560	0 470	73 91
	Mean	1 20	2 45	0 95	3 11	4 21	0.93	4 14	8 42	5 01	4 05	1 78	0 51	36 77
	Max.	12 54	17 23	4 96	10 79	13.80	2.19	19.34	19.52	13.68	10 67	13 65	2 32	73 91
	Min.	0 03	0 01	0 00	0 02	0 02	0.03	0.95	2 31	0.94	0 57	0 23	0 10	16 70
	St.Dev.	3 16	5 32	1 56	3 61	4.35	0.65	4.51	5.30	3 29	3 07	3 40	0 56	16 33
	Cv	2 62	2 17	1 65	1 16	1 03	0.70	1 09	0 63	0.66	0 76	1 91	1 11	0 44
	% of MAF	3 3	6 7	2 6	8 5	11 5	2.5	11.3	22 9	13 6	11 0	4 9	1 4	100.0

Fig.___ Mean Monthly Flow of Robie River at Robie

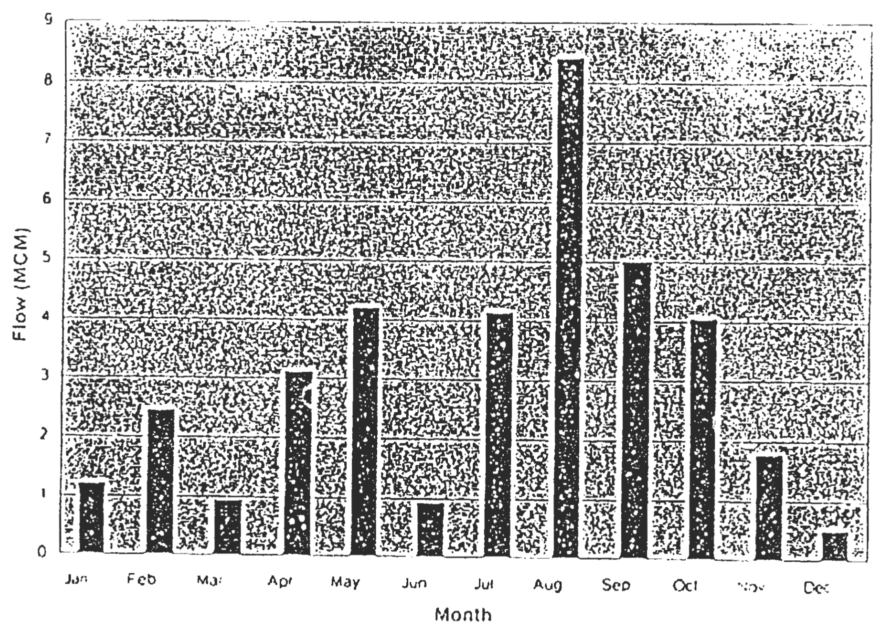


Table II.2.1.3 Monthly Flow of Keleta R. nr. Sire

(in Million Cubic Meters)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	
1962	3 55	3 77	6.30	7.39	8 65	7 19	20.80	31 33	28.09	8.21	2 33	10
1963	1.89	1 66	1.76	3.52	12 56	2.71	18.91	53 11	15.11	4.97	3 84	8
1964	2.44	1 73	2.26	2 52	2 45	3 77	16.25	56.03	42.36	13 35	4.88	
1966	3.55	3 77	6.30	7.39	1 54	3.03	13.02	19.16	56.78	10.66	4.03	
1967	2 31	1 96	2 21	4 55	7 06	3.98	20.44	46.22	57.26	49.01	15.77	4
1968	3.35	7 28	5.65	29 48	7 77	6.48	17.39	21.42	31.76	13.92	4 21	5
1969	3.74	6 94	24 61	5.91	6 68	6.82	35.22	84.06	27 23	4.89	2 74	
1970	3.10	2 63	10.85	6.38	7 92	3.50	26.36	75.70	29.99	6.15	1 93	1
1971	1.40	1.22	1.42	3 39	5 45	10.48	13.91	19.61	14.53	2.00	1.08	0 3
1972	0.72	1 46	1.61	4.84	1 77	2.08	10.64	30.33	15.94	0.64	0 18	0
1973	1 98	1.52	1.80	1.82	5 23	4 12	9.96	24.87	17.21	7 27	2 08	1
1974	1.60	1.36	2.80	1.99	1 51	2 09	8.02	44.56	46.68	14.16	7 85	7
1975	6 93	6 16	6 56	8.24	8 14	9.84	22.60	43.56	39.04	12.96	6 28	5
1976	5.21	4 37	5.20	6.05	8 63	6 00	15.39	31.62	22.16	6.80	7 14	4
1977	5.56	5.81	6.23	8.30	7 91	8 62	18.99	29.99	15.93	30.52	11 31	5
1978	4 38	5.89	6.32	4.13	4 19	4 95	16.47	26.54	15.73	10.73	1 32	0
1979	1.47	1 60	2 07	3.19	4 36	4 55	11.46	31.56	21.00	7 74	4 55	4.
1980	4.03	4.09	4.91	3.72	4 06	4 68	12.34	13.09	9.72	7.26	3.52	3
1981	3 17	3.03	10.17	15.90	4 10	2 24	10.54	37 46	106 09	15 05	10 16	9
1982	9 96	9 87	9 39	14 89	18 65	17 66	31 54	46.64	22.31	21 73	10.92	10.
1983	5.75	5.59	10.34	10.34	40.34	22.36	42.14	52.61	43.54	8.75	1 70	1
1984	3 16	2.73	3.36	3.13	5 76	6 01	14.03	20 85	28.33	3 88	2 86	2
1985	2 56	2 36	2.64	4 29	5 12	3.26	12.45	21 56	21.96	4.23	2 45	2
1986	3.55	3.77	6 30	6.76	10 03	10 55	83 28	49.78	26.51	12.89	4 02	3
1987	3 38	3.53	16 38	16.62	26 44	22.78	17.73	27.67	38.71	23 88	4 88	3
Mean	3.55	3 77	6.30	7.39	8.65	7 19	20.80	37.57	31.76	12 07	4.88	3
Max.	9.96	9.87	24.61	29.48	40.34	22 78	83.28	84 06	106.09	49.01	15 77	10
Min.	0.72	1.22	1.42	1.82	1 51	2 08	8.02	13.09	9.72	0.64	0.18	0.1
St Dev.	1 994	2 254	5.3	6.179	8 556	5.811	15.39	17.65	20.285	10.36	3.775	2.6
Cv	0.56	0.60	0.84	0 84	0 99	0 81	0.74	0.47	0 64	0.86	0 77	0 7
% of MAF	2.4	2 6	4.3	5.0	5 9	4 9	14.1	25 5	21 5	8 2	3.3	2

Fig.___ Mean Monthly Flow of Keleta R. nr. Sire

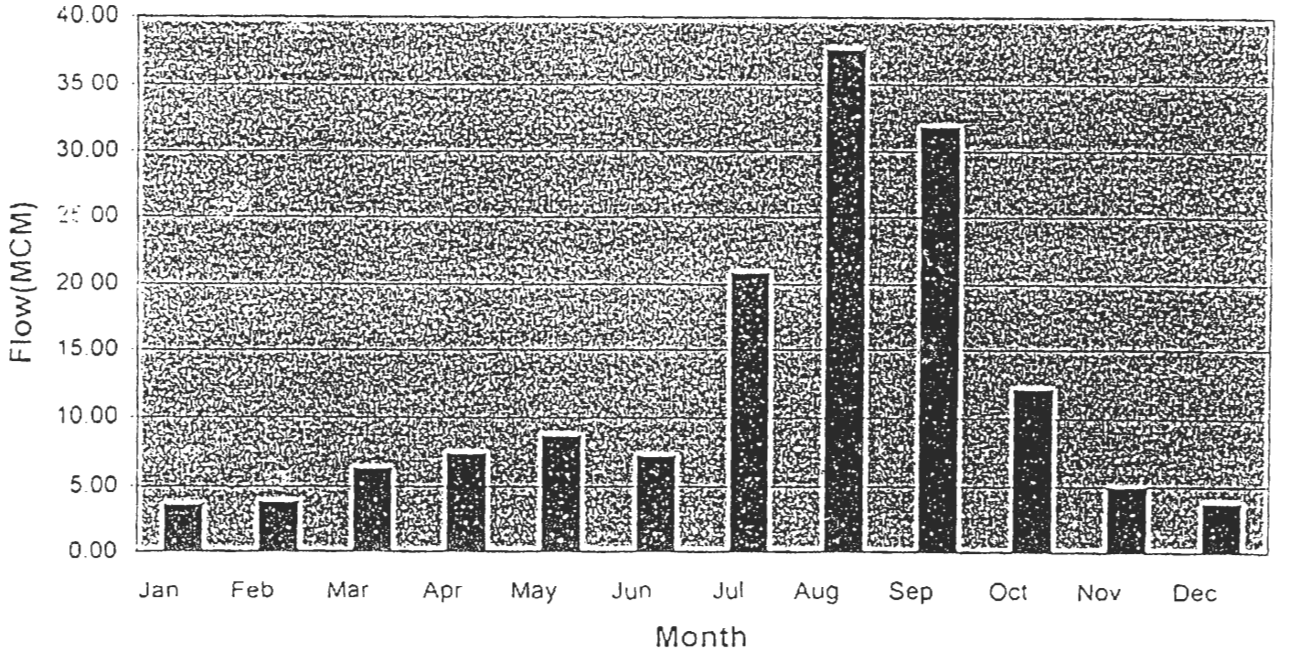
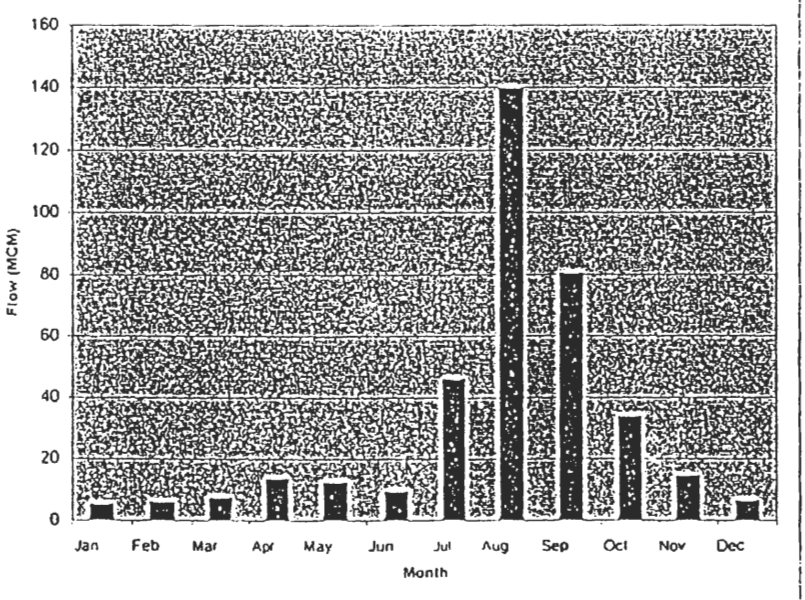


Table___ Monthly Flow: Katar River at Abura (Drainage Area = 3350 Km²)
(in Million Cubic Meters)

Ser No	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	1975	4.46	3.75	3.50	4.64	4.77	9.87	61.26	269.22	182.57	33.39	6.95	5.67	590.05
2	1976	3.60	2.82	2.90	4.53	9.31	5.00	27.82	110.46	62.57	11.64	10.77	4.17	255.59
3	1977	6.96	6.25	5.00	13.66	12.67	11.60	46.21	121.47	100.56	63.92	55.40	9.54	453.24
4	1978	5.27	5.50	14.46	5.26	7.97	7.86	81.47	140.67	42.73	35.86	10.40	6.74	364.19
5	1979	10.49	19.23	16.82	20.29	29.91	19.81	48.54	108.04	45.31	27.81	9.90	6.32	362.47
6	1980	4.77	4.53	4.09	4.26	4.52	8.81	45.11	90.45	35.77	19.28	5.38	4.39	231.36
7	1981	3.81	3.35	9.22	43.96	18.62	5.37	28.91	155.24	133.96	44.52	7.76	5.33	460.05
8	1982	5.25	4.42	4.49	13.11	13.16	8.89	28.29	122.00	40.42	33.69	10.95	10.55	295.22
	Mean	5.58	6.23	7.56	13.71	12.62	9.65	45.95	139.69	80.49	33.76	14.69	6.59	376.52
	Max.	10.49	19.23	16.82	43.96	29.91	19.81	81.47	269.22	182.57	63.92	55.40	10.55	590.05
	Min.	3.60	2.82	2.90	4.26	4.52	5.00	27.82	90.45	35.77	11.64	5.38	4.17	231.36
	St.Dev.	2.24	5.37	5.38	13.55	8.41	4.65	18.65	55.99	53.81	15.88	16.57	2.32	120.19
	Cv	0.40	0.86	0.71	0.99	0.67	0.48	0.41	0.40	0.67	0.47	1.13	0.35	0.32
	% of MAF	1.5	1.7	2.0	3.6	3.4	2.6	12.2	37.1	21.4	9.0	3.9	1.7	100.0

Fig.___ Mean Monthly Flow of Katar River at Abura



II.1.2 OBSERVED

SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION Aihebike ... [illegible] BASIN K.U DRAINAGE AREA ________ SQ.KM.

YEAR	*	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	MP	MMD
1982	I	1.70	1.57	1.72	2.48	2.57	1.91	3.38	14.31	4.29	4.15	2.64	2.02	42.15		11
	II	.722	.803	.765	1.14	1.71	1.01	2.92	11.95	2.84	3.14	0.882	.922			
	III	.623	.590	.692	.723	.728	.728	.882	2.93	1.01	0.883	.728	.692			
1983	I	1.93	1.73	2.01	2.76	6.80	4.38	[illegible]	47.81	5.84	[illegible]	2.33	2.06	91.65		60
	II	.228	.922	1.28	1.77	5.81	4.19	9.014	60.91	10.08	10.23	1.01	.803			
	III	.692	.657	.657	.803	.882	1.01	.882	4.96	2.20	.964	.803	.765			
1984	I	1.95	1.71	1.78	1.68	1.97	2.10	4.13	5.86	6.36	2.12	1.73	1.81	33.24		9
	II	.765	.728	.728	.692	1.01	1.28	3.49	3.82	9.35	1.14	.803	.728			
	III	.728	.617	.657	.623	.623	.692	.842	1.44	1.18	.657	.657	.657			
1985	I	1.22	1.54	1.71	1.82	2.28	2.03	4.35	8.71	6.82	2.71	1.94	1.92	37.[illegible]		6
	II	.692	.612	.922	1.14	2.14	2.54	6.73	5.92	4.57	2.24	.803	.728			
	III	.657	.623	.50	.623	.657	.657	.803	2.14	1.14	.203	.692	.657			
1986	I	1.76	1.18	2.05	2.78	3.08	3.82	8.33	18.22	7.91	5.14	2.15	2.01	19.31		31
	II	.657	.728	2.20	2.14	3.92	6.73	9.937	21.81	5.81	6.10	.964	.803			
	III	.657	.623	0.612	.803	.842	.922	1.33	2.19	1.71	.922	.765	.728			
1987	I	1.95	1.52	3.01	6.09	3.52	3.12	2.69	3.36	3.24	2.71	2.26	2.03	35.74		3
	II	.228	1.33	2.20	4.17	3.31	2.34	1.66	3.48	1.44	1.44	.882	.803			
	III	.728	.728	.728	.964	.842	.552	.842	1.01	1.01	.352	.765	.728			

* I. MONTHLY RUNOFF IN MILLION M^3

II. MAXIMUM DISCHARGE IN M^3/S

III. MINIMUM DISCHARGE IN M^3/S

MP - MOMENTARY PEAK IN M^3/S

MMD - MAX. MEAN DAILY PEAK IN M^3/S

TABLE 08101

SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION Ashebeka & Ni Sagure BASIN Rift DRAINAGE AREA ______ SQ.KM.

YEAR	*	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	MP	MMD
1988	I	.919	1.03	.934	1.272	1.40	1.674	18.54	34.72	6.28	3.10	1.445	1.28	73.44		[illegible]
	II	.344	1.37	.540	.784	.605	1.034	30.26	47.5	4.68	4.68	.723	.429			
	III	.320	.320	.320	.344	.429	.505	.784	2.80	1.65	.746	.429	.429			
1989	I	1.225	1.215	1.417	3.16	1.53	1.603	4.84	6.24	5.24	2.27	1.52	1.695	32.15		
	II	.474	.705	.638	2.28	1.37	.784	4.68	10.10	3.37	1.54	.709	.823			10.[illegible]
	III	.418	.450	.344	.540	.45	.475	.572	1.27	1.32	.638	.540	.572			
1990	I	1.12	2.79	3.92	5.13	2.09	2.05	4.25	8.22	8.18	2.61	1.19	1.17	44.04		
	II	.638	3.22	2.98	4.90	1.13	3.63	3.14	5.00	13.12	2.22	.638	.638			13.[illegible]
	III	.572	.572	.784	1.034	.638	.635	.823	1.65	1.43	.638	.605	.572			
1991	I	.90	1.05	2.31	2.13	2.12	2.18	5.77	12.61	6.95	1.92	1.49	1.60	41.04		
	II	.635	1.08	2.88	1.14	.947	1.034	4.48	11.06	8.18	1.03	.605	.705			11.[illegible]
	III	.522	.572	.14	.635	.638	.705	.905	3.12	1.123	.605	.572	.572			
1992	I	1.63	1.73	1.98	4.51	2.74	2.52	4.35	21.78	9.14	3.06	1.83				
	II	1.034	.947	.709	2.72	2.02	2.02	11.89	29.14	7.10	1.22	.784				
	III	.572	.638	.633	.823	.863	.863	.99	1.71	1.32	.784	.638				
1993	I	1.84	2.29	1.71	2.78	3.27	1.82	3.46	10.54	7.35	3.75	2.107	1.66			
	II	1.126	1.48	.673	1.89	4.00	.863	2.55	9.99	7.29	2.15	1.37	.638			
	III	.638	.673	.638	.639	.709	.638	.709	2.15	1.43	.947	.638	.605			

* I. MONTHLY RUNOFF IN MILLION M^3

II. MAXIMUM DISCHARGE IN M^3/S

III. MINIMUM DISCHARGE IN M^3/S

MP - MOMENTARY PEAK IN M^3/S

MMD - MAX. MEAN DAILY PEAK IN M^3/S

TABLE	
STRe	081019

BASIN Rift valley DRAINAGE AREA 122 SQ.KM.

YEAR	*	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	MP	MMD
1989	I	6.73	6.03	6.04	14.00	9.63	9.47	33.35	62.40	63.52	4.86	1.90	9.13	242.11		
	II	2.67	3.33	3.33	14.52	9.75	6.37	34.65	53.58	21.48	14.12	4.54	4.54			77.98
	III	2.31	2.13	2.13	2.69	2.50	3.50	2.90	11.37	8.62	1.20	2.50	2.69			
1990	I	6.20	26.89	43.42	44.35	13.55	8.41	27.72	116.86	63.54	11.92	5.14	4.29	372.29		
	II	3.79	42.13	27.48	38.33	12.67	5.68	41.16	78.62	58.33	11.80	2.13	1.79			78.62
	III	1.34	1.34	4.54	6.57	3.79	1.79	3.11	23.86	10.95	2.13	1.79	1.48			
1991	I	3.88	4.32	7.55	8.02	4.85	5.27	22.43	122.39	73.71	7.25	3.49	3.31	266.56		
	II	1.48	4.28	5.36	7.90	3.33	2.50	29.02	139.30	79.78	5.36	1.48	1.34			139.30
	III	1.34	1.34	1.13	1.34	1.20	1.34	2.13	23.25	5.65	1.48	1.34	1.20			
1992	I	3.41	4.09	3.19	5.61	4.62	4.74	14.82	162.19	76.95	36.98	18.27	5.58	346.0		
	II	2.13	2.13	1.48	7.22	3.50	2.60	18.62	181.40	20.78	5.52	3.55	2.13			
	III	1.20	1.34	0.96	1.20	1.34	1.48	2.31	18.62	5.95	3.79	1.96	1.79			
1993	I	4.72	11.99	4.37	10.64	28.46	27.15	32.98	179.94	71.45	41.53	10.04	5.70	429.35		
	II	3.33	9.36	2.31	10.95	25.11	4.99	36.38	155.20	60.32	102.8	9.36	2.13			
	III	1.48	2.31	1.08	1.08	3.33	4.81	5.65	20.87	9.75	4.28	2.13	2.13			
1994	I	5.23	3.97	4.81	4.92	7.85	9.12	---	---	---	---	---	6.59			
	II	2.13	1.79	2.50	2.67	5.36	5.36	---	---	---	---	---	2.99			
	III	1.79	1.63	1.63	1.63	2.13	2.13						1.96			
1995	I	6.11	5.45	8.22	27.84	13.85	9.01	49.27	136.16	113.10	20.03	5.64	7.88	404.73		
	II	2.50	2.02	3.79	12.08	18.08	5.36	75.21	128.7	148.8	12.67	3.55	3.55			
	III	2.13	1.96	1.96	3.11	3.11	2.90	3.79	26.41	11.80	1.48	1.55	1.34			

* I. MONTHLY RUNOFF IN MILLION M^3
II. MAXIMUM DISCHARGE IN M^3/S
II MINIMUM DISCHARGE IN M^3/S

MP = MOMENTARY PEAK IN M^3/S
MMD = MAX. MEAN DAILY PEAK IN M^3/S

TABLE 2
ST NO 081011

SUMMARY OF HYDROMETRIC DISCHARGE DATA

TION KATAR RIVER @ ABURA . . . . . BASIN BIFT VALLEY . . . . . DRAINAGE AREA 335 . . SQ.KM.

R	*	JAN	FEB	MAR	APR	MAY	JUNE	JULY	ALIG	SEPT	OCT	NOV	DEC	TOTAL	MP	MMD
5	I	4·46	3·75	3·50	4·64	4·FF	9·87	61·26	269·22	182·5F	33·31	6·25	5·6F	595·95		162·50
5	II	1·86	1·80	1·50	3·00	3·10	9·F0	55·00	162·50	143·00	35·20	3·F8	2·30	+ -		
	III	1·62	1·50	1·08	1·32	1·20	2·10	5·14	45·00	21·45	2·F0	2·20	1·98			
6	I	3·60	2·82	2·90	4·53	1·31	5·00	2F·82	110·46	62·5F	11·64	10·FF	4·17	255·50		F4·00
	II	1·60	1·29	2·45	5·18	F·32	3·42	38·13	F4·80	56·00	8·58	6·28	2·00	+ -		
	III	1·09	0·99	0·6F	0·88	1·F0	1·09	2·3C	20·80	9·56	2·00	2·00	1·29			
F	I	6·96	6·25	5·00	13·66	12·6F	11·60	46·2L	120·4F	100·56	63·72	55·40	9·54	453·24		200·00
	II	6·0E	5·18	F·85	9·0F	F·60	F·38	45·3C	87·20	63·00	200·00	9F·03	6·38	+ -		
	III	1·39	1·49	0·FF	2·00	2·60	2·80	6·06	22·F0	10·16	8·34	5·84	2·45			
	I	5·2F	5·50	14·46	5·26	F·9I	E·8E	8·4F	140·67	42·F3	35·86	10·4E	6·F4	364·19		F8·00
	II	3·60	5·84	9·56	2·45	5·8F	F·3E	51·60	F8·00	35·52	43·90	6·50	4·96	+ -		
	III	1·50	1·50	2·60	1·39	1·39	1·60	8·52	42·50	8·09	6·94	10·26	2·00			
	I	10·4F	19·23	16·22	20·29	29·91	19·81	48·54	108·04	45·3L	2F·81	9·90	6·32	362·4F		63·00
	II	10·02	10·26	10·44	10·F6	18·40	10·05	39·F0	63·00	22·F0	20·50	F·16	3·20	+ -		
	III	1·F0	4·52	2·30	3·20	2·8C	6·28	9·0F	20·FE	10·F2	6·06	2·30	1·85			
	I	4·FE	4·53	4·02	4·26	4·52	8·81	45·11	90·45	35·FI	19·28	5·38	4·39	231·26		30·19
	II	2·45	2·60	2·60	2·90	4·F4	F·60	28·40	61·00	23·95	10·40	2·FE	1·F0	+ -		
	III	1·50	1·39	1·19	1·09	0·99	1·6a	4·3c	21·E5	10·26	2·90	1·F0	1·50			
	I	3·81	3·35	9·22	43·96	12·62	5·3F	22·91	155·24	133·96	44·52	FF6	5·33	46·0·05	84·4	83·20
	II	1·50	1·60	9·85	32·04	2c·60	2·60	60·00	F1·00	83·2c	48·40	4·52	2·15	+ -	20·17	
81	III	1·39	1·19	1·19	10·44	2·60	1·F0	2·15	41·30	38·13	4·F4	2·30	1·85			

MONTHLY RUNOFF IN MILLION M³
MAXIMUM DISCHARGE IN M³/S.
MINIMUM DISCHARGE IN M³/S.

MP = MOMENTARY PEAK IN M³/S.
MMD = MAX MEAN DAILY PEAK IN M³/S

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TABLE 2
02/10/19

SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION KATAR RIVER @ ABURA BASIN RIFT VALLEY DRAINAGE AREA

YEAR	*	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	MF	MMD
1982	I	5.25	4.48	4.49	13.16	15.16	3.82	38.32	122.60	40.42	35.69	10.35	10.55	[illegible]	72	
	II	2.30	3.60	3.60	7.24	10.48	5.12	30.50	61.00	33.58	20.60	5.84	7.16		51	
	III	1.31	1.29	1.08	2.15	1.85	2.13	4.52	23.70	10.26	5.24	2.83	2.40			
1983	I															
	II															
	III															
	I															
	II															
	III															
	I															
	II															
	III															
	I															
	II															
	III															
	I															
	II															
	III															
	I															
	II															
	III															

* I. MONTHLY RUNOFF IN MILLION M^3
II. MAXIMUM DISCHARGE IN M^3/s
III. MINIMUM DISCHARGE IN M^3/s

MF = MOMENTARY PEAK IN M^3/s
MMD = MAX MEAN DAILY PEAK IN M^3/s

3.13.15 TABLE

– – – [illegible] – – – – – DRAINAGE AREA 1975 SQ.KM.

YEAR	*	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	MP	MMD
1982	I	–	–	–	–	–	–	–	14.31	21.58	6.66	14.53	14.53			
	II	–	–	–	–	–	–	–	77.48	20.29	5.36	4.54	4.54			
	III								16.00	2.69	2.50	1.96	1.63			
1983	I	3.84	4.27	5.27	12.39	36.28	35.51	27.32	293.29	90.51	45.58	10.16	6.85	571.27		310.50
	II	1.63	2.90	4.81	10.95	52.58	80.54	60.32	310.50	56.38	62.34	5.65	2.90			
	III	1.34	1.34	1.34	2.13	2.13	2.90	2.90	32.63	17.55	4.54	2.90	2.31			
1984	I	5.78	4.78	4.50	4.08	5.49	9.88	40.17	51.24	39.40	5.91	4.06	4.36	179.79		63.34
	II	2.50	2.13	1.96	1.96	2.90	8.58	62.34	31.90	51.65	3.29	1.79	1.79			
	III	2.13	1.79	1.48	1.48	1.48	2.13	4.28	10.14	3.55	1.79	1.48	1.48			
1985	I	3.64	3.41	3.86	5.17	13.04	5.76	67.66	92.69	61.66	10.59	4.38	3.50	271.93		112.90
	II	1.79	1.48	1.79	3.33	12.67	3.11	99.45	112.90	49.81	9.36	1.96	1.48			
	III	1.34	1.34	1.20	1.48	2.13	1.79	2.50	19.55	5.65	1.96	1.48	1.34			
1986	I	3.30	3.46	4.05	6.87	7.14	4.47	59.73	119.79	64.92	19.95	4.67	4.05	302.40		89.63
	II	1.34	2.13	2.90	5.65	5.36	3.33	89.63	78.62	35.21	34.85	2.31	1.63	–		
	III	1.20	1.20	1.20	1.20	1.63	1.34	2.90	22.64	8.62	2.65	1.63	1.34			
1987	I	3.71	3.47	9.42	34.61	23.95	21.10	15.00	56.95	20.58	10.46	4.10	4.04	208.35		65.44
	II	1.48	1.79	24.05	47.13	33.36	18.62	15.01	65.44	31.90	25.11	1.96	1.79			
	III	1.34	1.20	1.48	2.69	1.96	3.11	2.90	3.55	3.33	1.96	1.48	1.48			
1988	I	3.93	4.47	4.35	5.40	5.60	6.16	67.50	219.76	71.55	26.18	12.71	8.27	455.73		148.80
	II	1.48	3.55	2.19	3.29	2.90	2.90	82.11	148.8	19.33	104.7	7.90	3.11			
	III	1.34	1.34	1.48	1.48	1.79	1.79	3.33	22.04	10.95	7.90	3.11	2.69			

* I MONTHLY RUNOFF IN MILLION M^3
II. MAXIMUM DISCHARGE IN M^3/S
II. MINIMUM DISCHARGE IN M^3/S

MP = MOMENTARY PEAK IN M^3/S
MMD = MAX. MEAN DAILY PEAK IN M^3/S

TABLE 1
081011

SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION _ KAIAR RIVER @ ABURA _ _ _ BASIN _ RIFT _ VALLEY _ _ _ _ _ _ DRAINAGE AREA _ _ _ _

YEAR	*	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	MP	
1982	I	5.25	4.48	4.49	13.06	6.16	8.89	38.32	122.00	40.42	35.69	10.35	10.55	[illegible]	72	
	II	2.30	3.60	3.60	7.24	10.48	5.12	20.50	71.00	33.58	20.60	5.84	7.16		[illegible]	
	III	1.39	1.29	1.08	2.15	1.85	2.15	4.52	22.70	10.26	5.84	2.75	2.45			
1983	I															
	II															
	III															
	I															
	II															
	III															
	I															
	II															
	III															
	I															
	II															
	III															
	I															
	II															
	III															
	I															
	II															
	III															

* I. MONTHLY RUNOFF IN MILLION M^3
II. MAXIMUM DISCHARGE IN M^3/s
III. MINIMUM DISCHARGE IN M^3/s

MP = MOMENTARY PEAK IN M^3/s
MMD = MAX MEAN DAILY PEAK IN M^3/s

3.3.12

TABLE

SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION Le Lièvre River in Asfaba BASIN Wabi Shebelle DRAINAGE AREA _____ SQ.KM.

YEAR	*	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	MP	MMD
1982	I	1.02	0.86	1.05	11.83	5.28	1.03	12.83	35.41	9.74	27.03	3.20	1.44			
	II	0.97	0.56	0.74	24.50	12.60	0.56	2.85	29.46	17.40	32.60	2.70	0.97			
	III	0.28	0.234	0.28	0.67	0.42	0.28	0.28	2.25	0.97	1.12	0.56	0.28			
1983	I	0.75	1.36	1.42	24.61	21.52	2.14	8.85	116.33	7.75	6.39	3.42	1.43			
	II	0.67	1.27	7.56	36.10	48.80	3.15	51.00	47.49	10.45	9.87	8.40	1.27			
	III	0.172	0.234	0.28	1.27	0.59	0.234	0.188	3.74	0.56	0.28	0.42	0.234			
1984	I	1.33	1.08	1.13	1.02	2.00	3.79	3.82	6.42	4.81	3.02	1.53	5.65			
	II	0.52	0.45	0.45	0.45	1.50	3.45	2.95	8.72	3.45	2.70	0.89	0.67			
	III	0.45	0.42	0.39	0.39	0.42	0.56	0.89	0.92	0.82	0.49	0.45	0.49			
	I															
	II															
	III															
	I															
	II															
	III															
	I															
	II															
	III															
	I															
	II															
	III															

* I. MONTHLY RUNOFF IN MILLION M^3
II. MAXIMUM DISCHARGE IN M^3/s.
III. MINIMUM DISCHARGE IN M^3/s.

MP = MOMENTARY PEAK IN M^3/s.
MMD = MAX. MEAN DAILY PEAK IN M^3/s.

TABLE 8
06 1001

...E HYDROMETRIC DISCHARGE DATA

STATION Kobie - River @ Kobie - BASIN Wabi Shebelle - - - - DRAINAGE AREA 1710 SQ.KM.

YEAR	*	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	MP	MMD
1979	I	12.54	0.768	0.838	1.05	13.80	1.87	4.33	5.08	1.82	11.46	0.355	0.099	47.01		
	II	43.40	1.81	2.43	2.76	52.45	2.43	23.42	17.29	2.56	12.77	0.414	0.083			
	III	0.01	0.05	0.00	0.083	0.083	0.164	0.107	0.164	0.197	0.234	0.030	0.010			
1980	I	0.028	0.027	0.003	0.020	0.015	0.031	19.34	2.31	0.943	1.20	0.234	0.146	94.279		
	II	0.019	0.004	0.004	0.083	0.045	0.045	141.57	2.43	0.864	1.39	0.164	0.083			
	III	0.010	0.001	0.000	0.000	0.000	0.000	0.030	0.164	0.164	0.107	0.062	0.019			
1981	I	0.077	0.148	4.96	7.13	0.855	0.218	0.947	4.89	---	---	---	---			
	II	0.045	0.134	83.42	16.55	0.864	0.107	0.864	6.75	---	---	---	---			
	III	0.019	0.030	0.062	0.525	0.107	0.062	0.062	0.468							
1982	I	0.23	0.26	0.244	2.04	3.56	0.54	4.60	5.58	2.46	5.86	0.73	1.17	27.27		
	II	0.107	0.317	0.234	2.43	8.70	0.789	4.12	9.78	5.87	13.14	0.65	8.70			
	III	0.062	0.062	0.107	0.147	0.134	0.134	0.414	0.650	0.317	0.317	0.164	0.164			
1983	I	0.208	0.287	0.231	1.66	6.98	1.69	3.68	10.79	7.02	10.67	0.824	0.206	44.346		
	II	0.164	0.234	0.274	6.52	16.18	4.30	9.50	22.54	14.08	60.91	0.942	0.107			
	III	0.083	0.083	0.062	0.164	0.274	0.197	0.134	0.942	0.942	0.274	0.107	0.045			
1984	I	0.090	0.070	0.060	0.150	0.520	0.630	3.04	3.86	6.96	0.570	0.360	0.390	16.70		
	II	0.045	0.030	0.062	0.062	0.650	0.525	3.29	2.70	8.70	0.414	0.234	0.164			
	III	0.030	0.019	0.004	0.032	0.030	0.107	0.317	0.414	0.585	0.107	0.107	0.134			
1985	I	0.310	0.241	0.210	0.449	3.741	0.266	1.208	6.628	5.301	1.115	0.295	0.222	19.79		
	II	0.164	0.107	0.164	0.468	14.76	0.164	0.864	12.27	15.460	0.864	0.164	0.083			
	III	0.107	0.062	0.062	0.062	0.164	0.062	0.164	0.650	0.784	0.197	0.083	*			

* I MONTHLY RUNOFF IN MILLION M^3
II MAXIMUM DISCHARGE IN M^3/s
III MINIMUM DISCHARGE IN M^3/s

MP = MOMENTARY PEAK IN M^3/s.
MMD = MAX. MEAN DAILY PEAK IN M^3/s

TABLE 1
061212

SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION Lelisso River nr. Adaba BASIN Wabi Shebelle DRAINAGE AREA _____ SQ.KM.

YEAR	*	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	MP	MMD
1975	I	0.58	0.76	0.51	3.09	0.89	1.17	4.07	103.99	23.89	2.59	0.85	0.55	141.88		
	II	0.234	0.470	0.219	4.04	0.970	1.27	4.64	272.40	32.40	2.40	0.49	0.230			
	III	0.172	0.203	0.172	0.230	0.220	0.20	0.35	1.85	1.30	0.42	0.23	0.188			
1976	I	0.49	0.45	0.70	1.38	15.43	0.68	11.23	30.04	6.08	9.82	4.02	1.11			
	II	0.219	0.219	0.67	1.27	09.40	0.42	44.20	73.20	6.41	0.47	4.34	0.39			
	III	0.156	0.156	0.172	0.234	0.35	0.203	0.28	2.10	0.56	0.25	0.39	0.203			
1977	I	2.62	1.45	1.13	2.13	3.56	1.59	15.15	33.18	11.51	23.80	15.25	0.79			
	II	2.70	2.10	1.12	8.40	8.72	1.27	20.20	44.20	12.40	102.00	77.10	0.45			
	III	0.28	0.39	0.219	0.28	0.35	0.35	0.82	2.70	1.12	1.12	0.39	0.219			
1978	I	0.50	0.00	3.55	2.26	2.58	1.28	[illegible]	12.34	12.36	7.70	1.01				
	II	0.234	0.98	3.74	2.10	2.10	1.65	[illegible]	12.40	14.50	4.40	0.97				
	III	0.156	0.156	0.35	0.25	0.219	0.141	[illegible]	1.50	0.56	0.59	0.28				
1979	I															
	II															
	III															
1980	I	0.68	0.49	0.52	0.81	0.64	0.60	1.48	12.31	4.89	1.40	0.77	0.64			
	II	0.35	0.234	0.234	0.52	0.32	0.42	2.10	20.20	6.41	1.27	0.49	0.28			
	III	0.203	0.156	0.156	0.203	0.203	0.172	0.28	1.12	0.56	0.42	0.172	0.203			
1981	I	0.56	0.50	3.75	24.34	1.66										
	II	0.234	0.234	5.83	31.00	2.55										
	III	0.203	0.188	0.203	1.12	0.25										

* I. MONTHLY RUNOFF IN MILLION M^3
II. MAXIMUM DISCHARGE IN M^3/s.
III. MINIMUM DISCHARGE IN M^3/s.

MP = MOMENTARY PEAK IN M^3/s.
MMD = MAX. MEAN DAILY PEAK IN M^3/s.

TABLE 1

Year		[illegible]	[illegible]	[illegible]	[illegible]	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	MP	MMD
1986	I	[illegible]	[illegible]	[illegible]	2.13	—	—	—	—	0.945	1.53	0.395	0.230			
	II	0.083	0.062	0.050	3.20	—	—	—	—	2.84	1.20	0.234	0.104			
	III	0.062	0.062	[illegible]	0.083	—	—	—	—	0.274	0.274	0.107	0.062			
1987	I	—	—	—	6.43	12.15	2.17	1.59	2.67	4.67	2.47	0.450	0.283			
	II	—	—	—	12.77	13.13	5.05	3.25	2.99	4.48	1.73	0.317	0.197			
	III	—	—	—	0.234	0.134	0.231	0.234	0.274	0.525	0.274	0.106	0.083			
1988	I	0.219	0.192	0.170	1.31	1.05	0.557	1.68	—	—	5.20	1.03	0.414			
	II	2.07	[illegible]	0.053	1.43	1.11	0.525	1.45	—	—	11.52	1.11	0.177			
	III	0.062	0.062	0.045	0.030	0.134	0.134	0.197	—	—	[illegible]	0.197	0.134			
1989	I	0.316	0.359	0.197	2.01	2.20	0.346	1.15	4.46	13.68	4.51	13.65	2.32	51.67		
	II	0.164	0.218	0.134	3.78	3.95	0.164	1.59	10.65	37.67	25.68	1.39	2.99			
	III	0.134	0.107	0.045	0.107	0.134	0.134	0.107	0.234	0.942	0.466	0.274	0.197			
1990	I	0.612	17.23	4.10	9.98	1.10	1.08	2.05	11.46	—	—	0.65	.440			
	II	0.414	21.63	8.70	62.38	0.942	.65	2.16	32.08	—	—	0.312	.164			
	III	0.164	0.364	0.125	0.125	0.164	.234	.197	1.39			0.197	.164			
1991	I	.27	.41	0.68	1.28	2.62	1.12	—	16.81	2.14	1.01	2.03	.28			
	II	.164	.164	1.11	.942	3.29	2.17	—	64.63	2.56	.364	.164	.164			
	III	.062	.107	0.134	.317	.197	.197		1.11	.414	.164	.134	.062			
1992	I	.342	.416	.173	.295	1.242	1.114	2.08	10.86	8.02	2.26	.412	.414			
	II	.274	.317	.085	.234	.610	9.43	6.30	7.69	7.21	2.19	.274	.414			
	III	.107	.062	.030	.083	.317	.193	1.29	2.17	1.29	.197	.107	.083			

* I. MONTHLY RUNOFF IN MILLION M^3
II. MAXIMUM DISCHARGE IN M^3/S
III. MINIMUM DISCHARGE IN M^3/S

MP = MOMENTARY PEAK IN M^3/S
MMD = MAX. MEAN DAILY PEAK IN M^3/S

TABLE 2
061012

[illegible] DATA

[illegible] @ Robe — BASIN Wabi Shebelle — DRAINAGE AREA 1710 SQ.KM.

YEAR	*	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	MP	MMD
1979	I	12.54	0.768	0.838	1.05	13.80	1.87	4.33	5.08	1.82	11.46	0.355	0.099	47.01		
	II	43.40	1.81	2.43	2.70	52.45	2.43	23.42	17.29	2.56	12.77	0.414	0.083			
	III	0.01	0.019	0.00	0.083	0.083	0.164	0.107	0.164	0.197	0.234	0.030	0.010			
1980	I	0.028	0.002	0.003	0.020	0.015	0.031	19.34	2.31	0.943	1.20	0.234	0.146	24.279		
	II	0.019	0.004	0.004	0.083	0.045	0.045	141.57	2.43	0.864	1.39	0.164	0.083			
	III	0.010	0.001	0.000	0.000	0.000	0.000	0.030	0.164	0.164	0.107	0.062	0.019			
1981	I	0.077	0.148	4.96	7.13	0.355	0.218	0.947	4.89	---	---	---	---			
	II	0.045	0.134	23.42	16.55	0.864	0.107	0.864	4.75	---	---	---	---			
	III	0.019	0.030	0.062	0.585	0.107	0.062	0.062	0.468							
1982	I	0.23	0.26	0.24	2.04	3.56	0.54	4.60	5.58	2.46	5.86	0.73	1.17	27.27		
	II	0.107	0.317	0.834	2.43	8.70	0.789	4.12	9.78	5.87	12.14	0.65	8.70			
	III	0.062	0.062	0.107	0.197	0.134	0.134	0.414	0.650	0.317	0.317	0.164	0.164			
1983	I	0.208	0.287	0.231	1.66	6.98	1.69	3.68	10.79	7.02	10.67	0.824	0.206	44.346		
	II	0.164	0.234	0.274	9.52	16.18	4.30	9.50	22.54	14.08	60.91	0.942	0.107			
	III	0.083	0.083	0.062	0.164	0.274	0.197	0.134	0.942	0.942	0.274	0.107	0.045			
1984	I	0.090	0.070	0.060	0.150	0.580	0.630	3.04	3.86	6.98	0.570	0.360	0.390	16.70		
	II	0.045	0.030	0.062	0.062	0.650	0.585	3.29	2.70	8.70	0.414	0.234	0.164			
	III	0.030	0.019	0.004	0.032	0.032	0.107	0.317	0.414	0.585	0.107	0.107	0.134			
1985	I	0.313	0.241	0.210	0.449	3.341	0.266	1.203	6.628	5.301	1.115	0.295	0.222	19.29		
	II	0.164	0.107	0.164	0.468	14.76	0.164	0.864	12.27	15.460	0.864	0.164	0.083			
	III	0.107	0.062	0.062	0.062	0.164	0.062	0.164	0.650	0.384	0.197	0.083				

* I MONTHLY RUNOFF IN MILLION M^3
II MAXIMUM DISCHARGE IN M^3/s
III MINIMUM DISCHARGE IN M^3/s

MP = MOMENTARY PEAK IN M^3/s
MMD = MAX MEAN DAILY PEAK IN M^3/s

TABLE 1
061012

SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION Robie River @ Robie BASIN Wabi Shebelle DRAINAGE AREA 171,00 SQ.KM.

YEAR	*	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	MP	MMD
1993	I	1.21	13.46	0.68	10.79	9.14	1.03	1.68	49.59	6.13	6.24	3.56	0.47	73.91		
	II	2.70	33.13	0.414	49.78	27.09	1.02	1.70	41.60	3.14	6.98	7.69	0.197			
	III	0.019	0.274	0.045	0.134	0.650	0.234	0.414	1.81	1.49	0.234	0.234	0.134			
	I															
	II															
	III															
	I															
	II															
	III															
	I															
	II															
	III															
	I															
	II															
	III															
	I															
	II															
	III															

* I. MONTHLY RUNOFF IN MILLION M^3

II. MAXIMUM DISCHARGE IN M^3/S

III. MINIMUM DISCHARGE IN M^3/S

MP = MOMENTARY PEAK IN M^3/S

MMD = MAX. MEAN DAILY PEAK IN M^3/S

TABLE 3

#Nº 061013

SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION Wabe at Dodolla Bridge BASIN Wabe Shebelle DRAINAGE AREA 1035 SQ KM

YEAR	*	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	MP	MMD
1967	I	---	3.24	3.29	4.95	6.59	4.95	27.32	47.28	63.76	56.25	41.13	6.27			81.90
	II		1.96	1.81	3.54	5.67	4.19	30.0	36.3	46.1	81.9	45.5	2.61			
	III		1.10	1.10	1.10	1.31	1.24	3.50	4.38	14.4	2.42	1.56	1.52			
1968	I	3.22	6.41	7.20	46.92	25.07	22.26	21.02	31.60	44.84	19.20	4.48	4.37	237.76		48,70
	II	1.52	4.52	2.68	50.9	31.3	29.2	23.2	23.1	48.7	25.5	3.63	2.92			
	III	1.24	1.66	1.52	1.38	2.50	3.53	3.50	4.09	4.38	2.11	1.52	1.36			
1969	I	8.94	10.62	18.08	8.89	14.72	10.52	36.30	29.55	42.51	9.54	4.92	4.02	248.67		59.00
	II	8.63	14.7	10.8	9.5	16.1	7.21	45.3	59.0	37.6	7.32	3.62	1.96			
	III	1.31	1.52	3.81	1.66	1.46	2.11	4.27	13.4	6.61	1.66	1.38	1.40			
1970	I	6.62	4.45	19.31	20.40	15.27	7.08	20.49	69.91	58.06	22.34	5.81	3.65	253.57		74.70
	II	5.49	3.61	11.5	14.4	12.2	4.95	14.1	24.7	41.1	28.1	4.47	1.61			
	III	1.38	1.24	1.66	4.28	2.56	1.81	3.36	8.39	9.76	3.62	1.52	1.38			
1971	I	4.37	3.31	4.58	8.11	19.93	23.54	54.37	39.61	38.10	30.53	9.12	6.75	281.12		66.00
	II	2.25	2.11	2.76	7.67	14.2	17.3	39.2	66.0	30.1	49.7	11.3	6.76			
	III	1.38	1.10	1.10	1.38	1.52	4.28	11.5	15.6	5.82	2.92	2.11	1.66			
1972	I	4.2	19.2	13.8	40.7	19.2	6.5	35.0	34.9	36.2	6.9	6.0	5.4	232.0		49.80
	II	4.4	29.0	15.9	42.2	35.2	7.2	23.6	31.7	31.0	4.2	4.6	3.3			
	III	1.7	2.1	2.1	2.0	2.2	2.1	6.0	5.4	4.3	2.0	1.7	1.8			
1973	I	5.2	4.4	4.7	4.5	7.4	7.9	16.9	48.3	34.3	15.7	5.1	5.3	157.7		49.8
	II	2.6	2.0	1.8	2.0	6.3	5.8	12.4	42.9	30.6	12.7	2.3	3.0			
	III	1.6	1.6	1.7	1.7	1.9	1.9	2.4	2.8	6.0	2.0	1.7	1.8			

* I MONTHLY RUNOFF IN MILLION M³
II MAXIMUM DISCHARGE IN M³/S
III MINIMUM DISCHARGE IN M³/S

MP = MOMENTARY PEAK IN M³/S
MMD = MAX MEAN DAILY PEAK IN M³/S

TABLE 1
06100.4

SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION Wabe at Dodolla Bridge BASIN Wabe Shebelle DRAINAGE AREA 1035 SQ.KM.

YEAR	*	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	MP	MMD
1974	I	5.1	4.6	8.9	6.1	5.4	6.6	23.4	20.3	27.8	8.8	5.7	5.1	127.8		80.30
	II	2.1	2.6	10.0	7.3	2.4	5.6	16.3	13.7	20.3	8.2	5.6	1.9			
	III	1.8	1.8	1.9	1.7	1.7	1.9	3.8	3.3	6.1	2.0	1.9	1.9			
1975	I	1.94	3.24	4.08	7.47	6.82	18.10	37.62	47.70	52.02 e	13.45	7.16 c	5.94 e	207.54		
	II	0.77	1.74	2.50	4.86	4.86	14.88	35.70	33.68	-	-	-	-			
	III	1.62	0.77	1.34	1.63	1.34	1.95	4.02	9.00	-	-	-	-			
1976	I	4.52	3.10	4.13	4.59	2.56	2.93	16.59	40.03	32.50	8.35	11.51	4.83	146.64		36.80
	II	5.3	1.95	3.22	3.39	6.76	6.54	10.92	34.95	36.90	4.70	12.57	5.50			
	III	1.16	1.16	1.28	1.16	1.28	0.93	2.40	4.70	3.93	1.67	1.31	1.28			
1977	I	9.96	9.02	5.46	16.84	4.34	16.47	45.38	50.88	59.52	28.50	15.65	5.29	266.81		45.00
	II	3.89	1.70	1.98	12.77	9.65	15.09	32.22	4.31	45.00	35.24	29.49	2.56			
	III	1.46	1.40	1.16	1.28	1.40	1.40	9.15	8.16	4.12	2.56	1.95	1.40			
1978	I	3.78	5.61	14.93	7.72	13.01	10.37	22.75	51.15	40.70	32.20	5.16	5.81	213.27		36.12
	II	1.67	6.32	34.10	6.76	13.89	13.04	21.90	31.05	26.85	36.12	3.05	4.50			
	III	1.16	1.16	1.53	1.67	1.95	1.67	1.45	11.13	6.32	2.35	1.28	1.40			
1979	I	6.17	8.52	10.05	12.74	6.60	9.57	15.85	19.87	34.37	15.27	5.06	3.95	148.02		10.24
	II	4.31	8.90	7.92	12.77	3.39	6.98	13.89	17.64	20.24	13.04	3.05	2.10			
	III	1.16	1.81	1.40	1.40	1.28	2.25	2.25	3.22	6.76	2.25	1.40	1.28			
1980	I	4.05	3.20	4.60	3.32	13.42	10.37	45.16	33.62	23.22	14.70	4.28	3.55	167.48		33.00
	II	3.05	1.81	4.70	13.32	11.18	13.89	33.00	27.22	20.24	20.24	2.56	1.67			
	III	1.28	1.04	1.16	1.16	1.51	1.53	7.21	3.05	3.57	1.63	1.40	1.16			

* I. MONTHLY RUNOFF IN MILLION M^3
II. MAXIMUM DISCHARGE IN M^3/s
III. MINIMUM DISCHARGE IN M^3/s.

MP = MOMENTARY PEAK IN M^3/s.
MMD = MAX MEAN DAILY PEAK IN M^3/s

TABLE 2

SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION Lake of Dolette Bridge . BASIN Lake Shebelle . . . DRAINAGE AREA 1635 . SQ.K.

YEAR	*	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	MP	MMD
1981	I	3.43	3.34	9.68	25.06	5.54	4.25	13.29	50.07	47.45	14.40	5.73	4.60	186.84		40,10,40,50
	II	1.53	1.81	14.48	20.90	3.57	3.57	12.77	34.95	40.50	17.00	3.05	2.10			
	III	1.16	1.16	1.40	2.88	1.53	1.40	1.67	7.92	5.30	1.67	1.67	1.28			
1982	I	4.71	5.16	4.65	7.28	14.05	11.02	31.87	61.69	44.41	33.35	25.25	22.07	261.45		
	II	2.82	3.57	3.25	5.10	20.24	5.18	27.22	39.76	40.10	24.33	29.10	14.48			
	III	1.46	1.53	1.40	1.53	1.40	1.40	5.50	14.18	6.77	3.93	3.93	5.50			
										54 17.37						
										40 14.24						
										55 1.91						
1983	I	8.29	3.62	11.32	35.55	65.51	15.18	15.61	61.85	83.00	59.28	22.43	4.92	386.86		56,15
	II	6.32	2.25	15.40	24.33	47.00	13.99	20.24	61.41	56.15	55.68	24.68	3.22			
	III	1.28	1.28	1.28	7.21	10.15	1.40	2.40	10.15	7.21	4.31	1.53	1.28			
1984	I	3.72	3.21	3.62	3.63	6.14	20.28	41.17	42.94	27.68	6.52	7.27	5.90	172.08		82.22
	II	1.81	1.28	1.67	1.95	4.12	18.28	32.22	27.96	31.38	6.54	5.10	4.50			
	III	1.28	1.28	1.28	1.28	1.28	1.93	8.90	7.67	3.22	1.67	1.81	1.67			
1985	I	4.13	3.42	4.35	10.18	23.55	24.06	34.71	49.00	50.14	17.34	5.74	4.67	231.9		40.50
	II	1.95	1.63	2.80	16.36	28.72	16.68	26.48	36.12	40.50	22.33	3.22	2.56			
	III	1.40	1.28	1.28	1.40	2.88	3.51	3.93	9.65	8.40	2.25	1.67	1.40			
1986	I	3.74	5.24	4.78	13.29	15.24	21.81	26.57	43.56	46.94	23.53	5.03	5.40	215.18		54.27
	II	1.42	5.12	4.73	16.42	12.40	22.96	21.56	34.02	54.27	34.02	2.90	3.95			
	III	1.29	1.24	1.29	1.68	2.58	3.24	3.07	6.30	4.72	2.26	1.68	1.55			

* I MONTHLY MEAN DISCHARGE IN M³/S

II MAX. MEAN DISCHARGE IN M³/S

III MINIMUM DISCHARGE IN M³/S

MP : MOMENTARY PEAK IN M³/S

MMD: MAX MEAN DAILY PEAK IN M³/S

TABLE 3

CC 1204

STATION Wabi River @ Dodola Bridge BASIN Wabi-Shebelle ___ DRAINAGE AREA 1035.0 SQ.KM.

YEAR	*	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	MP	MMD
1987	I	4.21	5.52	14.23	18.61	39.82	29.55	16.42	51.27	35.39	35.32	13.28	6.04	269.66		88.52
	II	8.26	5.74	20.89	15.82	46.13	30.53	14.04	59.48	32.45	57.09	34.02	4.92			
	III	1.42	1.42	1.68	2.58	2.11	5.12	3.59	4.72	5.32	3.07	2.11	1.55			
1988	I	5.14	7.57	4.47	7.99	7.26	15.07	23.76	24.88	52.28	37.25	7.68	4.55	257.68		84.48
	II	3.01	12.90	2.11	7.51	4.42	15.82	21.56	44.38	49.24	31.29	5.12	2.55			
	III	1.55	1.55	1.42	1.29	1.55	2.58	6.30	16.57	10.73	5.53	1.68	1.55			
1989	I	4.30	5.39	4.83	8.86	6.70	6.23	11.36	30.57	33.30	19.41	7.36	25.95	164.26		81.36
	II	1.97	11.92	3.59	8.70	5.12	4.14	9.19	23.61	31.68	17.98	5.74	17.98			
	III	1.42	1.42	1.42	1.68	1.68	1.55	1.82	3.59	5.32	2.74	1.55	3.77			
1990	I	6.50	18.19	20.10	32.44	10.39	9.65	12.25	38.82	31.61	16.61	5.14	5.40	207.10		41.91
	II	5.12	25.73	24.31	46.12	7.28	6.60	10.21	24.31	22.92	20.56	3.95	3.24			
	III	1.55	1.55	2.58	3.84	2.26	2.26	2.26	9.44	5.12	1.68	1.68	1.55			
1991	I	4.81	8.79	9.92	7.98	8.71	5.01	6.42	24.46	34.36	9.37	4.31	4.07	127.61		
	II	1.97	7.05	7.74	4.72	7.98	4.78	3.95	22.96	19.90	15.82	1.68	1.68			
	III	1.42	1.42	1.68	1.68	1.55	1.55	1.68	2.11	3.95	1.68	1.55	1.42			
1992	I	5.77	9.65	8.30	24.12	16.98	21.88	37.27	44.49	55.05	26.10	10.30	8.61	268.52		
	II	6.30	9.19	8.22	47.45	32.45	16.73	27.54	39.70	55.21	24.31	8.22	7.05			
	III	1.42	1.82	1.68	3.77	2.58	3.41	7.28	6.60	4.33	3.95	1.97	1.97			
1993	I	5.51	7.70	8.06	9.39	35.60	33.98	51.80	49.27	30.14	35.93	11.82	4.60	283.80		
	II	3.95	6.60	17.04	9.19	27.17	25.73	27.91	38.87	21.56	31.68	15.82	2.11			
	III	1.39	1.42	1.42	1.42	5.12	3.95	7.98	8.46	5.12	4.52	2.11	1.42			

* I. MONTHLY RUNOFF IN MILLION M^3
II. MAXIMUM DISCHARGE IN M^3/S
III. MINIMUM DISCHARGE IN M^3/S

MP = MOMENTARY PEAK IN M^3/S
MMD = MAX. MEAN DAILY PEAK IN M^3/S

TABLE 4
061004

STATION Wabe River Below the Bridge BASIN Wabi Shebelle DRAINAGE AREA 1035.0 SQ.KM.

YEAR	*	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	MP	MMD
1994	I	4.15	3.50	5.36	5.09	15.95	33.78	54.40	55.28	29.76						
	II	1.55	1.55	6.16	4.72	13.47	19.58	32.45	43.08	28.65						
	III	1.55	1.42	1.42	1.42	1.82	7.74	12.90	5.32	4.52						
995	I								23.476	35.197	11.173	4.070	3.039			
	II								18.43	36.41	11.26	2.11	1.68			
	III								3.41	3.95	1.82	1.41	1.42			
996	I	10.368	3.475	10.262	21.093	26.184	44.183	31.286	63.951	36.336						
	II	7.51	2.26	7.28	19.25	19.25	35.61	62.39	41.38	35.21						
	III	1.55	1.42	1.42	3.95	3.24	6.82	5.32	13.19	4.41						
	I															
	II															
	III															
	I															
	II															
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	I															
	II															
	III															

I. MONTHLY RUNOFF IN MILLION M^3
II. MAXIMUM DISCHARGE IN M^3/S
III. MINIMUM DISCHARGE IN M^3/S

MP = MOMENTARY PEAK IN M^3/S
MMD = MAX. MEAN DAILY PEAK IN M^3/S

TABLE

DISCHARGE DATA

LAKE Awassa BASIN Genale-Dawa DRAINAGE AREA 7769 SQ.KM

YEAR		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL	MP	MMD
1980	I										8.05	1.69	0.690			
	II										7.94	1.45	.505			
	III										1.07	.402	.173			
1981	I	0.463	0.557	13.14		6.08	0.706	7.24	49.25	30.02	1.87	1.43	0.683	208.349	147.C	
	II	.173	.356	25.93		7.38	.356	19.63	41.15	23.30	8.23	1.90	.356		Apr. 26,	
	III	.173	.173	0.173		402	.237	.273	5.14	3.20	0.562	.313	.204			
1982	I	0.761	0.716	0.552	12.58	24.26	3.965	4.360	19.820	3.520	15.690	5.730	9.990	101.19	1	49,35
	II	.452	.828	.356	19.63	49.35	5.831	5.360	13.390	3.540	14.20	20.64	21.150		=	
	III	.204	.173	.121	0.562	0.756	0.505	0.687	3.540	0.623	.828	0.562	0.904			
1983	I	1.54	1.92	1.20	9.51	30.66	7.13	5.59	65.49	26.14	39.78	5.58	1.36	195.90	117.3	57,98
	II	1.78	1.55	1.01	11.15	47.64	16.78	10.80	51.98	24.98	62.37	6.01	0.904		Aug. 25	
	III	.273	.273	.273	.687	1.45	.402	0.402	4.70	3.91	3.72	0.687	0.313			
1984	I	0.628	0.405	0.350	0.452	1.424	1.614	6.488	11.29	19.09 35.88	2.38	0.898	0.564	115.56	23.30	18,17
	II	0.313	0.204	0.173	0.313	1.78	1.28	8.53	11.50	18.13	2.15	0.452	0.402		Sep. 9	
	III	0.204	0.121	0.121	0.121	0.146	0.273	0.562	1.45	1.90	0.356	0.204	0.173			
1985	I	0.43	0.42	1.71	9.92	24.16	1.05	8.86	34.78	10.37	7.56	2.10	0.77	102.13	41.15	30,48
	II	0.402	0.313	2.43	16.33	30.48	0.562	17.70	30.48	9.79	7.10	1.45	0.452		Aug. 8	
	III	0.121	0.121	0.099	0.505	0.622	0.273	0.356	6.07	1.07	0.904	0.356	0.204			
1986	I	0.49	0.53	1.10	12.26	83.28	25.43	18.24	42.11	32.43	13.62	2.32	1.48	163.32	69.53	51,98
	II	0.204	0.505	0.828	19.63	41.15	29.84	24.41	51.98	18.17	10.45	1.66	1.66		Aug. 13	
	III	0.173	0.146	0.237	0.237	1.07	2.42	1.66	3.72	3.20	1.90	0.687	0.237			

I. MONTHLY RUNOFF IN MILLION M³
II. MAXIMUM DISCHARGE IN M³/S
III. MINIMUM DISCHARGE IN M³/S

MP = MOMENTARY PEAK IN M³/S
MMD = MAX MEAN DAILY PEAK IN M³/S

TABLE 1
DF3003

															MP	MMD
1987	II	0.237	0.505	3.41	38.86	164.20	10.45	0.623	6.58	9.46	11.15	4.92	0.868	117.42		164.2
	III	0.204	0.204	0.273	0.984	0.687	0.505	0.402	0.353	1.07	1.25	0.356	0.237			
1988	I	0.58	0.60	0.96	6.98	2.73	1.71	29.59	52.14	20.79	39.07	2.60	0.563	158.543		55.63
	II	0.373	0.623	0.828	13.40	2.87	1.16	33.14	55.63	30.48	50.22	3.20	0.452			
	III	0.173	0.146	0.204	0.204	0.402	0.402	0.756	5.36	3.20	2.57	0.402	0.273			
1989	I	0.63	0.58	1.28	53.33	9.69	1.27	32.70	10.16	9.95	12.31	5.17	10.35	147.48		171.4
	II	0.273	0.356	2.02	171.4	24.98	0.756	68.52	9.14	8.83	14.20	4.29	13.39			
	III	0.237	0.173	0.146	0.756	0.402	0.313	0.402	1.90	2.15	1.16	0.756	0.904			
1990	I	2.22	10.79	14.20	35.68	3.32	1.12	2.74	30.34	5.45	5.43	1.72	1.54	114.60	123.23 April 9	104.6
	II	1.78	11.50	30.48	104.6	3.37	0.623	2.15	25.16	6.32	5.36	1.16	0.984			
	III	0.356	0.356	1.35	2.15	0.505	0.356	0.313	2.20	1.16	0.756	0.452	0.402			
1991	I	0.99	1.05	6.62	49.95	41.79	2.28	4.99	4.01	4.26	2.66	1.18	1.01	118.79		53.72
	II	0.402	1.16	12.62	53.79	42.35	2.87	15.84	4.10	4.92	2.15	0.952	0.852			
	III	0.313	0.313	0.273	3.72	3.72	0.237	0.356	0.505	0.402	0.505	0.402	0.356			
1992	I	0.86	2.72	0.79	1.48	2.39	1.30	6.73	90.84	12.15	47.12	13.03	2.81	192.22		137.2
	II	2.29	4.84	0.402	1.45	1.66	1.45	6.84	137.2	7.94	75.02	11.50	28.58			
	III	0.356	0.356	0.313	0.356	0.562	0.402	0.505	7.65	2.43	2.43	1.55	1.55			
1993	I	7.07	40.10	2.23	3.25	12.65	1.756	14.38	29.743	4.19	21.032	12.396	0.535	149.932		
	II	8.17	138.8	1.90	4.50	26.15	4.29	12.24	48.41	10.12	31.13	24.41	0.756			
	III	0.904	1.78	0.505	0.505	1.55	0.904	1.45	4.29	2.02	1.55	0.828	0.358			

1. MONTHLY RUNOFF IN MILLION M^3
1. MAXIMUM DISCHARGE IN M^3/S
1. MINIMUM DISCHARGE IN M^3/S

MP = MOMENTARY PEAK IN M^3/S
MMD = MAX MEAN DAILY PEAK IN M^3/S

TABLE 2
073003

EAR	*	Jan	Feb	March	April	May	June	July	Aug	Sept.	Oct	Nov.	Dec.	TOTAL	MP	MMD
194	I	0.909	0.794	0.866	1.459	1.43	1.296	27.685	95.64	11.44						
	II	0.356	0.356	0.505	1.16	0.687	0.623	24.98	56.56	15.46						
	III	0.313	0.313	0.273	0.356	0.402	0.402	0.756	6.84	2.57						
15	I		1.1624	1.496	9.689	7.98	1.656	15.659	20.41	15.386	38.585	2.521				
	II		0.687	4.50	35.22	24.98	1.45	47.64	75.02	24.98	49.35	2.29				
	III		0.313	0.313	0.505	0.623	0.356	0.452	5.36	1.66	3.03	0.687				
	I															
	II															
	III															
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	II															
	III															
	I															
	II															
	III															

* I. MONTHLY RUNOFF IN MILLION M^3
II. MAXIMUM DISCHARGE IN M^3/S
III. MINIMUM DISCHARGE IN M^3/S

MP = MOMENTARY PEAK IN M^3/S
MMD = MAX. MEAN DAILY PEAK [illegible]

TABLE 2

II.2 OBSERVED FLOOD DATA

Table II.1.1 Ketar River near Sagure: Observed Floods
Catchment Area = 1975km^2

Ser No.	Year	Month	Q_{mmdp} (m^3/s)	Q_{mp} (m^3/s)
1	1983	August	310.5	N.A.
2	1984	July	63.34	N.A.
3	1985	August	112.9	N.A.
4	1986	July	89.63	N.A.
5	1987	August	65.44	N.A.
6	1988	August	148.8	N.A.
7	1989	September	77.48	N.A.
8	1990	August	78.62	N.A.
9	1991	August	139.3	N.A.
		Mean	120.7	
		St. Dev.	77.6	
		C_v	0.64	

Table II.1.2 Ashebeka River near Sagure: Observed Floods
Catchment Area = 236 km^2

Ser No.	Year	Month	Q_{mmdp} (m^3/s)	Q_{mp} (m^3/s)
1	1982	August	11.95	N.A
2	1983	August	60.91	N.A.
3	1984	September	9.35	N.A.
4	1985	July	6.73	N.A.
5	1986	August	21.81	N.A.
6	1987	August	3.48	N.A.
7	1988	August	47.8	N.A.
8	1989	August	10.1	N.A.
9	1990	September	13.12	N.A.
10	1991	August	11.06	N.A.
		Mean	19.6	
		St. Dev.	19.2	
		Cv	0.98	

Notes

Q_{mmdp}: Max Mean Daily Peak
Q_{mp} Momentary Peak
F_{mp}: Momentary Peak Factor
N.A Not Available

Table II.1.3 Wabe River at Dodola Bridge: Observed Flood Peaks
Catchment Area = 1035km^2

Ser. No.	Year	Month	Q_{mmdp} (m^3	Q_{mp} (m^3/s)
1	1967	October	81.90	N.A.
2	1968	September	48.70	N.A.
3	1969	August	59.00	N.A.
4	1970	August	74.70	N.A.
5	1971	August	66.00	N.A.
6	1972	April	42.20	N.A.
7	1973	August	42.90	N.A.
8	1974	September	20.30	N.A.
9	1976	September	36.90	N.A.
10	1977	September	45.00	N.A.
11	1978	October	36.12	N.A.
12	1979	September	20.24	N.A.
13	1980	July	33.00	N.A.
14	1981	September	40.50	N.A.
15	1982	September	40.10	N.A.
16	1983	September	56.15	N.A.
17	1984	July	32.22	N.A.
18	1985	September	40.50	N.A.
19	1986	September	54.27	N.A
20	1987	August	59.48	N.A
21	1988	September	49.24	N.A
22	1989	September	31.68	N.A
23	1990	April	46.12	N.A
		Mean	46.0	
		St. Dev.	15.4	
		C_v	0.34	

Notes

Q_{mmdp}: Max. Mean Daily Peak
Q_{mp}: Momentary Peak
F_{mp} Momentary Peak Factor
N.A. Not Available

Table II.1.4 Weyib River at Agarfa: Observed Flood Peaks
Catchment Area = 772 km^2

Ser. No.	Year	Month	Q_{mmdp} (m^3/s)	Q_{mp} (m^3/s)	F_{mp}
1	1981	April	99.30	147.0	1.5
2	1982	May	49.35	N.A	-
3	1983	August	51.98	117.3	2.3
4	1984	September	18.17	23.3	1.3
5	1985	August	30.48	41 15	1.4
6	1986	August	51.98	69.58	1 3
7	1987	May	164.20	N.A.	-
8	1988	August	55.63	N.A.	-
9	1989	April	171.40	N.A.	-
10	1990	April	104.60	123.3	1.2
11	1991	April	53.79	N.A.	-
12	1992	August	137.20	N.A.	-
		Mean	82.3	86.9	1.5
		St. Dev.	52.0	49.6	0.4
		Cv	0.63	0.57	0.26

Table II.1.5 Robie River at Robie: Observed Flood Peaks
Catchment Area = 171 km^2

Ser. No.	Year	Month	Q_{mmdp} (m^3/s)	Q_{mp} (m^3/s)	F_{mp}
1	1979	May	52.45	N.A	
2	1980	July	141.57	N.A.	
3	1981	August	6.75	N.A	
4	1982	October	12.14	N.A.	
5	1983	October	60.91	N.A.	
6	1984	September	8.70	N.A	
7	1985	September	15.46	N.A.	
8	1987	May	53.30	N.A	
9	1988	October	11.52	N.A.	
10	1989	September	38.67	N.A.	
11	1990	February	71.63	N.A.	
12	1991	August	64.63	N.A.	
13	1992	August	7.69	N.A.	
14	1993	April	49.78	N.A.	
		Mean	42.5		
		St. Dev.	25.4		
		C_v	0.60		

Notes

Q_{mmdp}: Max. Mean Daily Peak
Q_{mp}: Momentary Peak
F_{mp}: Momentary Peak Factor
N.A Not Available

II.3 WATER QUALITY DATA

MINISTRY OF WATER RESOURCE
LABORATORY

SELECTED PHYSICAL AND CHEMICAL WATER ANALYSIS RESULTS

'E OF SAMPLE	River	River	River	River	River	River	River	River
F COLLECTION								
RECEIVED	All samples received on 15/04/89							
T'S ID. NO.	Ashebeka	Wube	HERERO	Teten	Wuyub	Shaya	Likuaki	Tetelu
). NO.	1	2	3	4	5	6	7	8
pp)								
(NTU)								
ids, 105 °C (mg/l)								
s Solids, 105 °C (mg/l)								
Conductivity (µs/cm)	83	111	90	261	84	113	114	54
(mg/l NH_4^+)								
mg/l Na^+)	4.8	10.4	4.7	14.4	7.3	9.5	6.9	5.5
dness (mg/l $CaCO_3$)	32	32	36	105	24	30	40	14
(mg/l Ca2+)	8	8	5.8	20.8	7.2	7.6	10.8	3.2
m (mg/l Mg^{2+})	2.9	2.9	3.4	13.6	2.7	2.7	3.2	3.2
(mg/l Fe)								
e (mg/l Mn)								
mg/l F^-)								
mg/l Cl^-)	1.6	1.1	2.1	6.3	2.1	4.2	2.1	1.6
g/l NO_2^-)								
g/l NO_3^-)								
(mg/l $CaCO_3$)								
(mg/l CO_3^{2-})								
e (mg/l HCO_3^-)								
mg/l SO_4^{2-})	5.0	6.0	4.0	5.6	2.0	6.0	5.0	6.0
(mg/l PO_4^{3-})								
/l B)								
g/l SiO_2)								
ssium	1.5	4.3	2.1	4.5	2.6	2.2	4.9	3.2

KS Among the requested parameters pH and alkalinity are not indicated here since they are better performed during the time of sample collection.
- Moreover, the organic content of the samples is not also indicated here since this laboratory doesn't at the moment carry out this determination.
- The turbidity method was used for the determination of SO_4^{2-} and the values should be used confidently for turbid samples.

) BY [signature] Nesuma ?
? 90

APPROVED BY [signature]
22/09/89

- TDS may be approx. from EC values.

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