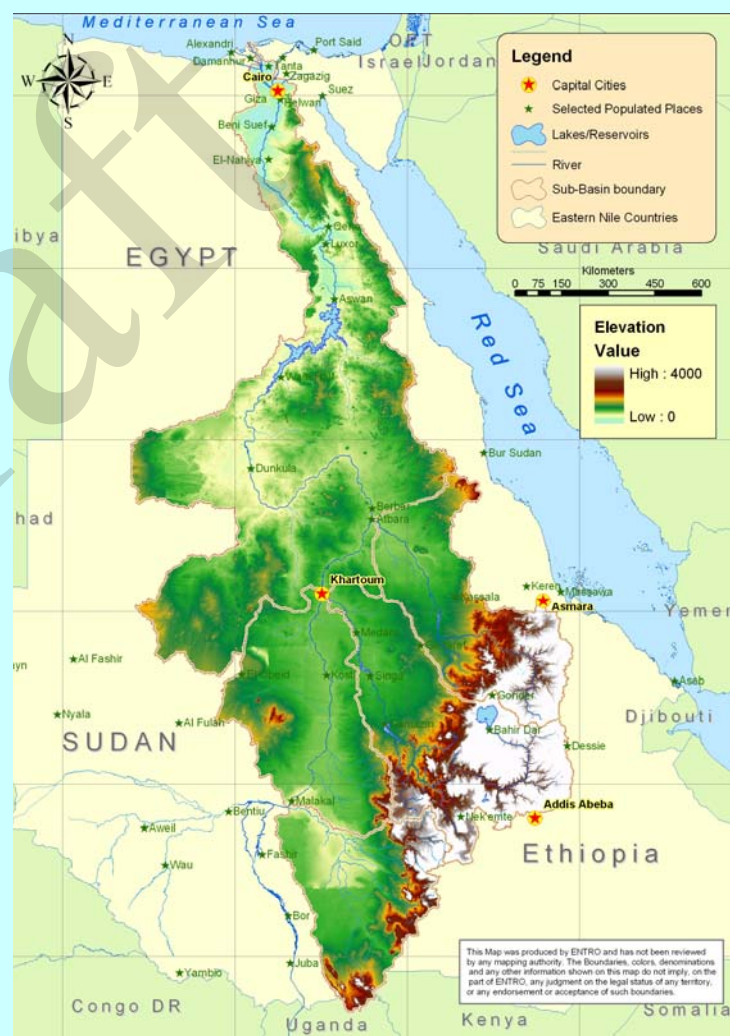


Multipurpose Development of the Eastern Nile, One-System inventory report on water resource related Data and information Ethiopia

ENTRO
(Eastern Nile Technical Regional Office)



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1 Introduction

The Eastern Nile countries (EN), namely Egypt, Sudan and Ethiopia with the main interest in the sub-basins Baro-Akobo-Sobat, Blue Nile, Tekeze-Settit-Atbara, portions of the White Nile in Sudan, and the Main Nile are pursuing cooperative development at the sub-basin level through an investment oriented Eastern Nile Subsidiary Action Program (ENSAP). The proper development and management of these resources calls for an integrated approach within the framework of multi-country joint development program, which will address the opportunities and challenges within the basin in a unified manner that benefits all riparian countries. To this end, the Eastern Nile Council of Ministers (ENCOM) agreed to launch the first phase of identification of a major program of multipurpose development of the Eastern Nile just a year ago and proposed to prepare inventories containing information on the Water Resources, Environmental and Socio-economic issues for the EN.

In order to compile the Water Resources data from the Ethiopian side, a consultancy agreement was signed on 10th November 2005 between the Eastern Nile Technical Regional Office (ENTRO) here in after called the Client and Mr. Mesfin Shenkut of MS Consultancy here in after called the Consultant. The objective of this consultancy agreement is to compile essential information on water and related resources of the Eastern Nile sub-basins that will be used to support analysis for the identification of multipurpose development opportunities under the EN Multipurpose Development Program. The work also includes the preparation of a report on the data/information gathered, including comments on data quality, and annotated list of references

Based on the above, this report is presented as per the consultancy services requirements set out in the Terms of Reference (TOR) provided by the Client to present the draft report of the task of the activities undertaken by the Consultant. The report briefly shows the data collected and the general assessment of the data availability and quality as well as the drawbacks of the accomplished tasks. The collected data are annexed with this report.

1.1 The Basins

Ethiopia has been divided into twelve river basins. Among the river basins, the three basins, namely Baro-Akobo, Abby and Tekeze are located along the west and northwestern part of Ethiopia (see fig 1). They cover

an area of 358,072 Km² in total. Abbay takes the largest share with an area of 199,810km².

The basins have different potentials for water resources development. Taking the land and water resources together; Baro –Akobo has the largest irrigation potential, while considering water resource and hydropower potential Abbay is the most important basin in the country and Tekeze has got an immense potential of hydropower generation.

These basins are studied at different period and have fairly detailed pre-feasibility studies with complete master plan documents. For all of them, the amount of water available, the water resource development potential and the problems related within the river reaches have been studied.

Given the potential and the level of the available studies done, these basins are the least utilized basins in the country. Considering the booming population pressure, recurring drought and hunger with the demands for developing economy immediate response is required. Therefore, implementation of the master plan becomes the countries key question.

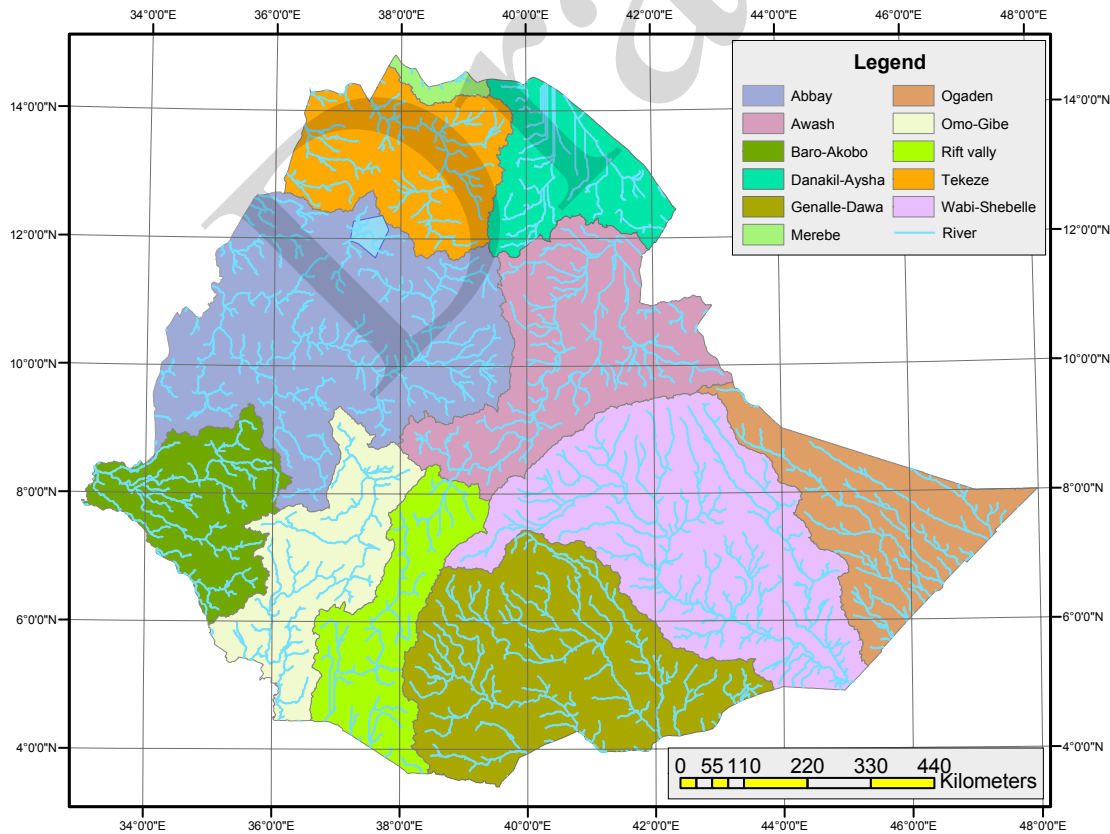


Fig. 1 Ethiopia's major river basins

1.2 Data Collection and Compilation

With the objective of compiling essential information on water and related resources of the Eastern Nile sub-basins that will be used to support analysis for the identification of multipurpose development opportunities under the EN Multipurpose Development Program, the data required have been categorized as per Table 1 of Annex 1. The Consultant has strictly adhered to the ToR provided by the Client and followed the format. The data categories are:

- Basin Physical features
- Hydrology and climate
- Features of water infrastructure
- Hydropower related
- Irrigation and Navigation related

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2 Data collected

Based on the format provided by the Consultant the following data have been collected and annexed in this report.

2.1 Basin Physical features

2.1.1 General

The data required here have been collected and processed to the required format. For these basins all the major features are prepared with both digital and paper format. It includes the main river network with the names labeled, identified projects i.e. irrigation and hydropower and location of infrastructures. There is also longitudinal profile for only the main stem Tekeze river but the quality of the data is not to the required level. The catchment delineated and the flow direction located in the map is comparable to the 1:2,000,000 scale map of the country.

The Consultant has concerns on the quality of these maps, because they have got considerable misalignment, especially the paper maps with the digital one. The state of art for collection of such kinds of data is new in Ethiopia. Data handling in general is poor. At the available data are mixed and in a few circumstances the accuracy of the data is not known even by the primary data holders.

2.1.2 Basin physical feature river network related

a. Major rivers, lakes and wetlands, and their basic features

All major rivers and lakes with their features have been indicated by the Ministry of Water Resources are attached in here. The consultant didn't find any previous study performed about wetlands.

b. River network maps (scale 1:2,000,000)

From all the riparian countries in eastern Nile, most of the tributaries are in Ethiopia. Since all the river basins, namely, Tekeze, Abbay and Baro-Akobo have got lots of rivers networked and attached with them. The consultant tried to show the entire river network as compared with the related map produced by the Ethiopian mapping agency (EMA).

Here the consultant recommends satellite imagery digital elevation models are helpful to get more detailed map for the basin. And they can be co-referenced with the maps of EMA.

c. Longitudinal profile of major river profile(scale 1:10)

The longitudinal profile for all the main stems is not prepared in an appropriate format. Only paper based profile is available for Tekeze River, here also the accuracy of the data is questionable.

As it is already known, the longitudinal profile of river is one of the major inputs for identification of proper hydropower site. Here the Consultant recommends digitally processed satellite imagery to extract the profile with fair accuracy as an alternative.

2.2 Climate and Hydrology

2.2.1 Climate

2.2.1.1 Introduction

Basic climatic features of the Abbay, Tekeze and Baro-Akobo river basins are dominated by the near equatorial location, high altitude and the global scale mechanisms. The influence of these factors determine the variability of local climates ranging from hot and nearly desert areas to cold mountain peaks.

Since, much of the yield for the Nile River is contributed from the Ethiopian highlands; accessibility of these data has got a major significance in the study of any development work within the riparian countries. In fact in this basin, there are many stations within Ethiopia which measure rainfall and evaporation. However, most of the stations either show lack of records or wide recording gaps noted on the available data. In some instances the stations are either abandoned or are being restructured and upgrade their standards.

2.2.1.2 Precipitation Anomalies and Droughts

The largest source of moisture to the three river basins is the tropical Atlantic, which results in the main July-September rainy season. A minor source of moisture is the Indian Ocean which causes the small April-May rains. Sometimes these rains are less abundant and a drought

situation can arise. There are two distinct precipitation types. The monomodal and the bimodal type. Both the amount of precipitation and the distribution of the precipitation over the year could occur to cause a drought situation. In the past 30 years, several severe droughts have occurred in all the three river basins.

2.2.1.3 Climatological Data

The meteorological data are generally collected from the National Meteorological Agency. Some additional data have been collected by other Agencies, including the Food and Agriculture Organization, the Ministry of Agriculture and rural development, institute of Agricultural research and others.

Rainfall data are available in several stations in the three basins. The number of available years could be 2-40 years. Other climatic parameters such as mean maximum and minimum, temperatures, relative humidity, wind speed, sunshine duration have also been collected. Whereas some areas within each river basin have intense data coverage others have very low station density. Another short coming of the available data is the lack of daily data series.

a. Rainfall

This includes the mean annual rainfall isohyets with the rainfall record for selected fifty seven (57) stations. The mean annual rainfall isohyets and other parameters exist for all the basins but the Consultant has not included them here because of the compatibility problems with the original data. Out of the requested meteorological records for selected fifty seven stations, thirty eight (38) of the stations have got mean monthly rainfall records in mm. The general overview of the acquired data is tabulated in the Table below.

Considering the isohyetal map for the areas, the Consultant has accessed paper based maps on the master plan studies for the basins. For presentation purpose the isohyets are shown for Abbay basin in Fig 2.

From the data it is shown that for Tekeze and Baro- Akobo basin do not have much data available and the available data are not covering the reaches of the river evenly. Hence they are hardly showing the rainfall distribution for the basins.

Another alternative, like cold cloud determination (CCD) method which is used in the master plan study of Tekeze basin, can be used.

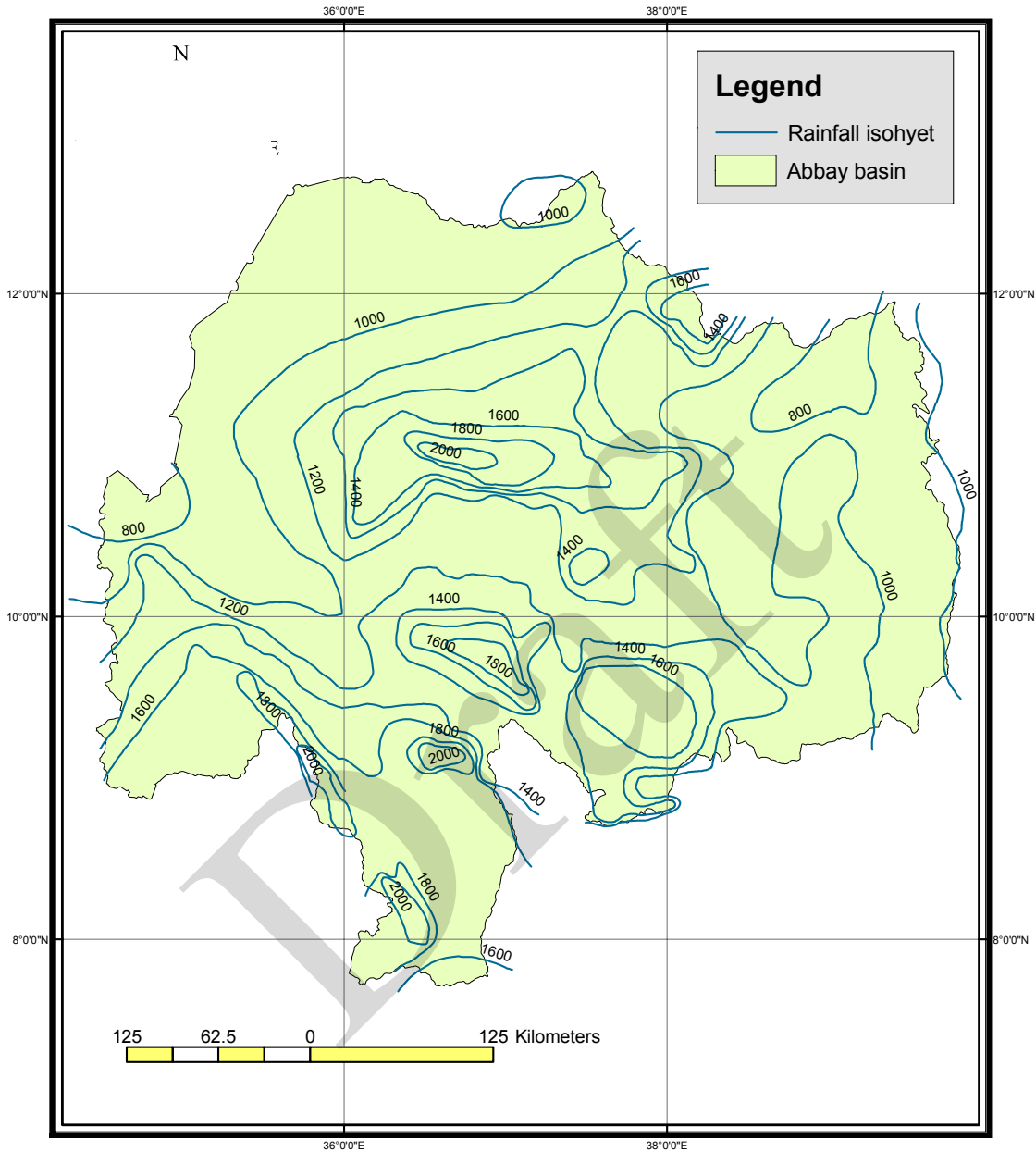


Fig. 2 isohyets for Abbay river basin basins

b. Evaporation

Though the expected data is to cover 57 stations and major reservoir sites, it is only 15 stations that the Consultant found information regarding direct measurement of mean monthly evaporation in mm. Other government documents and master plan studies use penman-month method to determine the evapo-transpiration of the areas. This is also an option to determine evaporation indirectly. There is no isoline

of evaporation done for all the basins. General overview of the data with regard to their location, years they cover, and remarks on the quality of the data is summarized in Table 2.

2.2.1.4 Climatic Classification

The presence of lowland and highland areas closely associated over the river basins exerts a considerable influence on the climatic conditions. Most of the eleven principal climatic types of Ethiopia are distinguished in the three river basins ranging from hot semi-arid climate to cool highland climate.

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Table 2. Overview of rainfall data quality and availability

Region	Station	Location		No. Years recorded	Recorded Period	Remarks
		Lat	Lon			
Abbay						
Gonder	Addis Zemen	12.07	37.52	21	1980-2000	Incomplete for the years 1983,1991,1992,1993,1997,1999
Shoa	Ambo	8.59	37.50	17	1984-200	All data are incomplete except for the year 2000
Gonder	Dabat	12.59	37.45	4	1988-2000	All data are incomplete
Gojam	DebreMarkos	10.20	37.40	21	1980-2000	Incomplete for the year 1991
Gonder	Ibnat	12.08	38.03	9	1980-1984 & 1997-2000	All data are incomplete except the years 1980 and 1984
Shoa	Gedo	9.02	37.27	21	1980-2000	Incomplete for the years 1990,1991,1992,1993,19994,1995,1997,1999,2000
Gojam	Kunzela	10.53	37.02	11	1980-1990	All data are incomplete except the years 1981 and 1984
Gojam	Merawi	11.25	37.09	15	1981-1995	Incomplete for the years 1981,1982,1983,1990,1991,1992,1993,1994
Gonder	Nefas Mewcha	11.45	38.27	15	1986-2000	Incomplete for the years 1986,1989,1990,1991,1994
Kefa	Agaro	7.51	36.36	21	1980-2000	Incomplete for the years 1980,1981,1982,1983,1984,1990,1991,1994,1995,1999
Gojam	B/Dar Synoptic	11.36	37.27	21	1980-200	Incomplete for the years 1991 & 1998
Gonder	Dabark	13.15	37.55	19	1980-1989 & 1992-2000	Incomplete for the years 1982, 1983,1984,1985,1986,1987,1988,1989,1992,1993,1996,1998
Gonder	DebreTabor	11.53	38.02	21	1980-200	Incomplete for the years 1986,1989,1990,1991
Shoa	Fiche	9.47	37.41	21	1980-2000	Incomplete for the years 1980,1982,1983,1984,1988
Gonder	Gonder	12.32	37.25	21	1980-2000	Incomplete for the years 1991 & 2000
Shoa	Mehal Meda	10.15	37.26	21	1980-2000	Incomplete for the years 1990 & 1991
Gonder	Metema	12.58	36.10	10	1987-1989 & 1994-2000	All data are incomplete except for the year 2000
Gojam	Pawe	11.09	36.03	14	1987-2000	Incomplete for the years 1990 & 1991
Shoa	Alem Ketema	10.05	39.02	21	1980-200	Incomplete for the years 1990,1991,1998
Gojam	Chagni	10.57	36.30	16	1980-1992 & 1998-2000	Incomplete for the years 1983,1984,1990,1991,1992,1998

Shoa	DebreBirhan	9.38	39.30	19	1982-2000	Incomplete for the years 1982,1983,1990,1994,1995,1997
Gojam	Dejen	10.08	38.09	21	1980-2000	Incomplete for the years 1982,1983,1986,1990,1999
Gojam	Finite Selam	10.41	37.16	18	1980-1997	Incomplete for the years 1980,1983,1985,1986,1990,1991,1992,1993
Gonder	Humera	14.17	36.34	14	1980-1988 &1996-2000	Incomplete for the years 1980,1984,1987,1988,1996,1997,1998,2000
Gojam	Motta	11.05	37.52	21	1980-2000	Incomplete for the years 1982,1983,1990,1991,2000
Welo	Wegel Tena	11.36	39.13	19	1980-1989 &1992-2000	Incomplete for the years 1982,1983,1988,1989,1992,1993,1996,1997
Baro-Akobo						
Illbabur	Abobo	7.51	34.25	21	1980-2000	Incomplete for the years 1980,1981,1982,1983,1984,1985,1989,1990,1991,1992,1995,1996,1997,1998,1999,2000
Illbabur	Gambela	8.14	34.34	17	1980-1993	Incomplete for the years 1983,1984,1985,1989,1990,1991,1993,1998,1999,2000
Illbabur	Tepi	6.59	35.15	21	1980-200	Incomplete for the years 1980,1981,1982,1983,1984,1988,1992,1993,1994,1998
Illbabur	Alge	8.32	35.40	21	1980-2000	Incomplete for the years 1980,1983,1984,1987,1989,1993,1997,1998
Illbabur	Masha	7.36	35.30	21	1980-2000	Incomplete for the years 1983,1984,1985,1988,1989,1990,1996,1997,2000
Illbabur	Bedelle	8.27	36.20	21	1980-2000	Incomplete for the years 1980,1981,1982,1983,1984,1997,1998
Illbabur	Metu	8.18	35.34	2	1999-2000	Incomplete data for years 1999
Tekeze						
Tigray	Abiaddi	13.37	39.38	10	1980 &1995-2003	Incomplete for the years 1980,1995,1996,1997,1999
Tigray	Endesilase	14.06	39.38	9	1992-2000	Incomplete for the years 1992 &1995
Wello	Lalibela	12.02	39.03	17	1981-1983,1985-1989 & 1992-2000	Incomplete for the years 1983,1985,1989,1992
Tigray	Mekele	13.30	39.29	21	1980-2000	Incomplete for the years 1980,1986,1989,1990,1991

Table 3. Overview of Meteorological Evaporation Data Quality and Availability

Region	Station	Location		No. Years	Duration	Remarks
		Lat	Lon			
Abbay						
Kefa	Agaro	7.51	36.36	9	1986-1994	Incomplete data for the year 1994
Shoa	Ambo	8.59	37.50	10	1983,1986-1991,1993,1999,2000	All datas are incomplete except for years 1987 &1993
Gojam	Chagni	10.57	36.30	12	1980-1988 &1998-2000	Incomplete data for the years 1988 &1998
Gojam	DebreMarkos	10.20	37.40	18	1980-1982 &1985-1999	Incomplete data for the years 1980,1981,1982,1986,1989,1990,1991,1992,1995,1999
Gojam	Finite Selam	10.41	37.16	7	1982-1988	Incomplete data for the years 1984,1985,1986,1988
Gojam	Motta	11.05	37.52	7	1990-1993 &1998-2000	Incomplete data for the years 1990,1991,1993,2000
Shoa	Alem Ketema	10.05	39.02	12	1989-2000	Incomplete data for the years 1990,1991,1998,1999
Gojam	B/Dar Synoptic	11.36	37.27	4	1997-2000	
Shoa	DebreBirhan	9.38	39.30	6	1985-1990	Incomplete data for the year 1990
Shoa	Fiche	9.47	37.41	4	1997-2000	
Shoa	Mehal Meda	10.15	37.26	4	1997-2000	
Gonder	Gonder	12.32	37.25	10	1980-1985 &1997-2000	Incomplete data for the years 1980,1981,1997,2000
Baro-Akobo						
Illbabur	Bedelle	8.27	36.20	7	1986-1988 & 1997-2000	All datas are incomplete except for the years 1999
Illbabur	Masha	7.36	35.30	5	1996-2000	Incomplete data for the years 1996,1997
Tekeze						
Wello	Lalibela	12.02	39.03	2	1999-2000	Incomplete data for the year 1999

2.2.2 Flow characteristic

a. Flow hydrographs

For the specified locations where data is required, most of the data are collected on monthly runoff volume basis with the exception of four of the sites. With a few exceptions these data are satisfactorily recorded. The general overview of the data quality is shown on table 3 below. The other data demanded such as river level and peak discharge in the basin could not be found.

There are general data gaps on records at border locations. Considering the importance these data for flood mitigation, determination of peak discharges and river level measurements is of immense importance.

b. Sedimentation

There are numerous gauging stations in the Baro-Akobo, Tekeze and Abbay river basins. The measurements have been taken over large range of discharges, and include measurements at high flows. Some of the measurements were taken at the beginning of the rainy season, when soil erosion and sediment transport are expected to be the highest due to the higher erodibility of the dry soil often deprived of vegetative cover. Estimates of soil erosion and land degradation are both difficult to achieve and are site specific. The situation is, however serious, especially in the cultivated areas. In such areas, losses of 1cm or more of soil each year could occur. This is well in excess of rates of soil formation.

The distribution of erosion potential in the maps prepared by the Abbay and Tekeze Master Plan Studies indicate the following:

None to Slight	<15 tons/ha/y
Moderate erosion	16-50 tons/ha/y
High erosion potential	51-200 tons/ha/y
Very high erosion potential	>200 tons/ha/y

A problem unique to the highlands of Ethiopia where the three basins are part occurs as a result of the widespread growing of teff, the staple cereal. The seed is tiny, about pin-head size, and so requires an extremely fine and level seed bed. This is accomplished by much cultivation which has an adverse effect on the soil structure.

For most of the stations selected, there are no data available and the Consultant collected the required information from alternative stations than those specified. This include sediment concentration, sediment load and sediment loss per day. The general overview of the collected data is shown in the following Table.

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Table 4. Overview of monthly runoff volume data quality and availability

Station	Location		No. Years	Period	Remarks
	Lat	Lon			
BARO-AKOBO					
Baro nr Gambella	8.15	34.34	21	1976-1985, 1990-200	Incomplete for years 1976,1985,1990,1991,1992,1993,1996,1998,1999
Gilo nr Pignudo	7.37	34.14	20	1977-1990,1994- 1996	Incomplete for years 1980, 1984, 1985, 1986,1988,1989, 1990,1995,1996,1999.
Alwero nr Abobo	7.84	34.55		X	X
Sor nr Metu	8.19	35.36	21	1980-2000	incomplete for years 1992-1993
Gebba nr Suppe	8.29	35.39	25	1976-1977,1979- 1983, 1986-1991,1993- 2000	incomplete for years 1976,1977,1979,1980,1981,1982,1983,1988,1991,1993,1994,1996,1997, 1998,2001,2002,2003
ABBAY					
Abbay nr Bahidar	11.36	37.25	21	1980-2000	incomplete for year 1991
Abbay nr kessie	11.04	38.11	21	1980-2000	incomplete for years 1981,1985,1986,1991
Wechit nr Alem Ketema	10.05	38.47		X	X
Jemma nr Lemi	9.55	38.54	2	1996-1997	
Debis nr Guder	9.01	37.46	4	1997-2000	
Didessa nr Arjo	8.41	36.25	22	1981-1997,2000- 2004	incomplete for years 1981,1984,1986,1987,1988,1989,1990,1991,1992,1996,1997,2003,2004
Dabana nr Abasina	9.02	36.03	24	1961-1984	incomplete for years 1961,1962,1964,1966,1970,1973,1975,1977,1978,1980,1981,1982,1983,1984
Anger nr Nekemet	9.26	36.31	12	1980-1985,1994- 1999	incomplete for years 1985,1994,1995,1996,1999
Bogena nr Lumame	10.15	37.57	8	1996-2003	incomplete for years 1998,1999,2000,2001,2002,2003
Aleltu nr Muka	9.39	38.57	19	1980-1991,1194-	incomplete for years 1980,1989,1991,1996

				2000	
Birr nr Jiga	10.39	37.23	16	1985-2000	incomplete for years 1985,1887
Dura nr Metekel	10.59	36.29		X	X
Dabus nr Assosa	9.52	34.54	24	1963,1968-1980	incomplete for years 1963,1976,1977,1978,1979,1980
Muger nr Chancho	9.18	38.44	20	1980-2000	incomplete for years 1985,1986
Abbay nr border	11.14	34.59		X	X
TEKEZE					
Tekeze nr Yechi	13.21	38.45	8	1996-2003	incomplete for years 1996,1997
Tekeze nr Humera	14.17	36.37	4	1981-1984	
Tekeze nr Embamaderre	13.44	38.12	17	1967-1976,1995-2000	incomplete for years 1970,1994,1998,1999
Zerem at Zerem	12.25	38.02	4	1973-1976	incomplete for year 1973

Table 5. Overview of sedimentation data quality and availability

LOCATION	No. of Years	Record years	Remark(More than one recorded per year)
ABBAY			
Addis zeman(ribb)	16	1960,1964,1968,1980,1983,1985-1990,1992-1996	1968,1980,1986-1988,1990,1992,1993,1996
Addis zeman(Bure)	1	1968	1968
Amanual(gaziginit)	2	1989,1994	
Ambera(yeda)	6	1988,1989,1992-1995	1988,1989,1995
Ambessema(yelda)	10	1983-1988,1990,1994-1996	1986,1988,1996
Assosa(hoffa)	5	1989,1990,1993,1995,1996	1990,1996.
Barhir dar	12	1961,1964,1968,1983,1985,1986,1988,1990,1993,1995,1996	1961,1964,1968,1983,1986,1987,1888,1990
Bambasi(mutusa)	3	1988-1990	
Bichena (Muga)	10	1983-1989,1993-1995	1983-1989,1995
Bichena (suha)	8	1985-1989,1992,1994,1995	1985-1989,1992,1995
Debere Birhan(beressa)	10	1968,1989,1990,1992,1994-1998,2002	1968,1992,1995-1998
Debere Markos	3	1989,1992,1995	1985,1995
Debere Zeite	4	1988.1989,1992.1993,	1988,1989,1992
Dimbecha (gudla)	12	1960,1964,1968.1982,1985-1989,1992,1993,1995	1968,1982,1985-1989,1995
Dimbecha(temech)	8	1968,1969,1985-1989,1992,1993	1968,1985-1989,1992
Esteachena(chena)	5	1985-1988,1996	1985-1988,1996
Estey2(wanka)	4	1987-1988,1996	1987-1988,1996
Fincha(Neshe)	7	1968,1988-1991,1995,1996	1968,1988-1991,1995
Togeda(Arrbgebega)	6	1985-1987,1994-1996	1995,1996
Galebr mariam(fettan)	4	1986-1987	1986-1989
Gori(komise)	6	19988-1990,1993-1995	1988,1993,1995
Guder(bello)	8	1972,1988-1991,1994-1996	1977.1988,1989,1990,1995,1996.
Guder (Guder)	11	1968,1988-1992,1995,1996	1968,18989-1992
Gundeweian(Tigor)	11	1983-1989,1992-1995	1983,1984-1989,1992,1995
Gutin(Tota)	7	1988-1992,1995,1996	1988-1990,1992,1995,1996
Kabie(Mechela)	3	1985,1986,1989	1988,1989
Kosober(Ayo)	5	1986-1989,1993	1986-1989
Lumami(Bogene)	2	1993,1995	1995
Mankusa(Debohila)	2	1968,1994	1668
Mehalemeda(Wizer)	1	1998	1998

Mehalemeda(Shag)	4	1989,1996-1998	1989,1996-1998
Mendel(Tis abbay)	8	1987-1990,1993-1996	1988,1990,1996
Merawi(Bered)	5	1988,1990,1994-1996	1986,1995,1996
Merawi (Gilegel Abbay)	10	1968,1983,1985-1988,1990,1993,1995,1996	1968,1986-1988
Metekel(Mandura)	1	1995	1995
Metekel(Ardi)	10	1977,1984-1989,1993-1995	1977,1984,1985-1989,1995
Motta(Azuari)	9	1985-1989,1992-1995	1985-1989,1995
Motta(sede)	6	1987-1989,1992-1995	1987-1989,1992,1995
Motta(Teme)	8	1985-1989,1993-1995	1985-1989,1995
Muketuri(Robi-Jida)	8	1985,1988-1990,1992,1994-1996	1985,1988-1989,1992,1995,1996
Nedjo (Dila)	7	1985,1986,1988-1990,1994,1995	1986,1988,1989,1990,1995
Werello(Tamelle)	1	1985	1985
Yehereka(Chreka)	1	1995	
TEKEZE			
Adikumsi	1	1995	1995
Adwa	3	1992,1993,1994	1992
Aitowedeko(Maidunger)	2	1992,1993	1992
Altowedeko(Mairam Shewito)	3	1992-1994	1992,1993,1994
Aquale	2	1994,1995	1994
Aynalem(Metere)	1	1992	1992
Dansha(Raza)	1	1996	1996
Debark(Asera)	2	1995,1996	1996
Embamadre	1	1995	1995
Hawzien-suluh	2	1994,1995	1994,1995
Maiknetal(Weree)	3	1994-1996	1994,1995
Mekelle(Ghiba)	3	1994-1996	1994-1996
Mekelle(illala)	1	1992	1992
Quba(Dollo)	2	1992,1994	1992,1994
Rama(Endesa)	2	1992,1994	1994
Wokro(Genfel)	3	1994-1996	1994-1996
BARO-AKOBO			
Gore	4	1988-1990,1996	1988-1990

3 Features of water infrastructure

The location of storage zones and other related reservoir and dam data are collected for all the basins. For most of the data collected, the infrastructures are studied on pre-feasibility stage or more including information on the purpose of the dams when they form part of the infrastructure. Both digital and hard copy data are available.

3.1 Hydropower related

Installed capacity and energy production and in some cases cost of production when available is collected for existing and planned hydropower schemes for the entire basin. In Abbay basin, only the Fincha-Amerti dam and the Chara – Chara high weir are exploited for hydropower purpose. In tekeze river basin, the first hydropower dam is under construction at Tk-5. In Baro-Akobo basin, small amount energy is being generated. The dams for this purpose are designed and have preliminary cost estimates in the master plan studies (see Fig 3).

3.2 Irrigation

3.2.1 Introduction

Irrigation and drainage studies in the Baro-Akobo, Tekeze and Abbay river basins have been carried out at project specific and at regional levels. Irrigation sites have been identified. Some projects have been studied at feasibility level. The level of study in the remaining sites varies from identification to pre-feasibility level.

As stated in the master plan of the basins, Baro -Akobo has got the highest potential of irrigation while the Tekeze basin has little potentials for irrigation purpose (see Fig 4).

The basic scheme characteristics area and location are well presented in map and other relevant data are collected in spreadsheet format. Crop water requirement and cropping pattern is also collected as studied by government documents. The verification of the data to the actual condition has to be performed accordingly to present date.

3.2.2 Small Scale Irrigation

Small scale irrigation sites have conventionally been considered to be less than 200ha. The responsibility of small scale irrigation development has

recently been transferred from the Ministry of Water Resources to the Ministry of Agriculture and Rural Development. The problem with identifying and studying small scale irrigation projects is unavailability of suitable topographic maps.

Some studies however have been carried out in the Abbay and Tekeze river basins by the Tigray and Amhara Regional Governments. Estimates made by SAERT (Tigray Region) and SAERAR (Amhara Region). It has been considered that, spread over the entire Tekeze river basin, 1,500 reservoirs can be built over 30 years (May, 1998 estimate), providing a total storage of 1,500Mm³. Irrigation water demand calculations have been made to assess the size of irrigation development possible from a typical reservoir with a capacity 1Mm³ both in the Abbay and of Tekeze basins Master Plan Studies.

In the Abbay river basin, an estimated area of 100,000 to 150,000ha could be developed in small scale schemes. In the Tekeze river basin, in the year 2025, 450,000ha can be put under small scale supplementary irrigation. The small scale irrigation potential in the Baro-Akobo basin is restricted to the upper basin. Some 17 irrigation sites have been identified with a total area of about 120,000ha.

3.2.3 Large and Medium Scale Irrigation

Several large and medium scale irrigation sites have been identified in the Baro-Akobo, Tekeze and Abbay river basins. The total potential in the Baro-Akobo river basin exceeds 480,000ha. The potential in the Tekeze river basin is about 189,000ha. In the Abbay river basin, the potential is about 530,000ha for identified schemes.

Developing this potential would meet a number of constraints. Principal among these are lack of markets, lack of institutional capacity, limitation of private sector involvement and investment competition.

Rainfed cultivation area is difficult to estimate because the potential irrigable lands have existing rainfed farming or rainfed farming potential. Furthermore, the farming system requires large number of livestock and appropriate amounts of land need to be reserved for their maintenance.

3.3 Navigation

The Consultant has done different survey on this area and understands there is available data. But the data are not accessible one way or another.

Navigation however is limited to Baro Akobo basin while the other basins have steep slopes limiting any navigation activities.

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4 PROPOSED PROJECTS

4.1 Introduction

Studies are being carried out on some Irrigation, Watershed and Hydropower projects in the Baro-Akoba, Tekeze and Abbay river basins.

The status of the studies is at different level. It ranges between pre-feasibility and detailed design.

4.2 Project Description

4.2.2 Hydropower Projects

4.2.2.1 Baro-1 & 2 and Genji Multipurpose projects (feasibility study)

i) Project Location

The Baro 1 and 2 MPPs are located along the Baro River in the Baro-Akobo Basin between Gore and Bonga, by road approximately 600 km west of Addis Ababa. The projects form a hydropower cascade, the tail water of the upper scheme (Baro 1) will be the headwater for the lower plant (Baro 2).

Genji River is a tributary to Baro River, with confluence some 3 km downstream of the Baro 2 dam site.

ii) Previous Studies on Baro 1MPP, Baro 2MPP and Genji Diversion

The hydropower potential of Baro River was first studied by TAMS & ULG in the "Baro-Akobo River Basin Master Plan Report" in 1996. A Pre-feasibility study for the Baro 1 and 2 MPPs was worked out by the Norplan-Norconsult Joint Venture in 1999.

iii) Objective of the Study

Baro 1 and 2 were intended to provide income and improvements in the region and create win-win situations for the countries of the Eastern Nile (Ethiopia, Egypt and Sudan).

iv) Project Characteristics

A. Baro-1 Project

The Baro scheme includes a reservoir with capacity for seasonal flow regulation. The Baro reservoir inundates approx 38 km² of rainforest.

- Total out put from the two units =180MW
- Catchments area = 2,210 km²
- Concrete faced rock fill dam (CFRD)

B. Baro-2 project

- Total output= 500MW
- Catchments area = 2,332 km²
- Rock fill dam with clay core

C. Genji Diversion Project

- Total output= 216MW
- Catchments area = 1,380 km²

4.2.2.2 Karadobi Multipurpose Project

i. Project Location

The Karadobi dam is located on the Abbay (Blue Nile) River, about 3km upstream of its confluence with Gudar River.

ii. Previous Studies

The site was investigated by USBR in 1963/64. The Abbay Basin master plan Project had also studied the project by upgrading the USBR study.

iii. Objectives of the Study

The major objective of the study is to establish reliable key data for the Karadobi Project by assuring whether the project is environmentally feasible.

iv. Project Characteristics

The project includes a high dam and a reservoir with improved regulation of the Abbay River.

Total output= 1600MW

Catchments area = 66,910 km²

Roller compacted Concrete (RCC).

4.2.3 Irrigation Projects

4.2.3.1 RIBB IRRIGATION PROJECT (Feasibility level study is in Progress)

i) **General**

The Ribb Irrigation Site has a gross area of 21, 123 ha of which 15,045 ha will be irrigated from a reservoir on the Ribb River. The annual water requirement for the irrigation area is 148.0 million m³.

The project will build a 53m high compacted rock fill and clay core dam on the rib river about 30km upstream of the river mouth at Lake Tana.

The main crop is rice which represents 60% of the cultivated area. With improvement mainly of drainage, flood protection and irrigation agricultural practices will change drastically.

ii) **Project location**

The Project area is located in Amhara Region, south Gonder Zone. The irrigable area is situated both sides of the Addis-Zemen-Wereta road and begins at a point of the river, 20 km east of the shore of Lake Tana where Ribb River approaches the lake plain from the mountainous area.

iii) **Climate**

The climate of the study area is marked by a wet season from May to September, with monthly rainfalls varying from 65mm in May to 411 mm in July. The dry season, from October to April has a total rainfall of about 8% of the annual rainfall of 1,295 mm.

Temperature variations throughout the year are minor (19.0°C in December to 23.0°C in May), whereas humidity values vary between 70% in December and 88% in August.

Wind speeds are low, thus minimizing potential evapotranspiration values between 95 mm/month in December and 140 mm/month in April. Sunshine duration is reduced to 6.0-6.5 hours during July to August.

iv) **Accessibility**

The lower part of the project area is traversed by the main Bahir Dar-Gondar road, whereas the southern part on the left bank is partly accessible from the Wereta Weldia main

road. The northern part or the right bank could be accessed from the Addis Zemen Debre Tabor road.

v) Soil Condition

Most of the area is waterlogged during the rainy season.

Measured infiltration rates on the Vertisols are in the range of 0.3-26.45 cm/hour. The measurement of infiltration rates on Vertisols was complicated especially by the presence of wide subsurface cracks. As a result higher infiltration rates were obtained.

Electrical conductivity values are very low, having values of 0.1-0.9 dS/m: therefore, salinity would not impose any limitation on plant growth. The flood plain soils (mostly Vertisols) have high levels of base saturation indicating a high fertility level.

In some areas close to the lake, the water table was found at a depth of about or less than 1 meter. All low lying and depression areas are excluded from the proposed scheme. On the contrary, the soils of the steeper area are excessively drained.

vi) Hydrology

Irrigated agriculture in the valley would depend on water available from the Ribb River and on the possibility of drainage which is influenced by Lake Tana.

Without dam, average flows of Ribb River decrease from a maximum of 31m³/s in August to a low 0.39 m³/s in April. Dry season flows, exceeded 4 out 5 years reach minimum values 0.09m³/s.

Lake levels vary between +1784 and + 1787.5 and especially during flood flows and high lake levels the project areas in the lower reaches of the valley would face drainage problems.

vii) Irrigation and Drainage

The maximum duty would amount 0.6 and 1.1 l/s/ha, respectively for the non rice based cropping pattern and the rice based cropping pattern.

For preliminary design purposes, it has been assumed that 50% of the irrigated area would be covered by the rice based cropping pattern with the remainder for the no rice system. Hence the average duty that has been adopted for the calculations is 0.85 l/s/ha/

viii) Conveyance and Distribution Systems

Water would be diverted by a 70m long concrete weir, with its crest at 1801.0m into a sedimentation canal with a length of 800-900m. The capacity of the weir at free flow has been calculated at 180m³/s, equivalent to a water level of about +1801.8 in the river just downstream of the weir. Full bank flow just upstream of the weir amounts to about 400 m³/s.

Flood flows which overtop the embankment upstream of the weir would be diverted to the 150-200 m wide floodway to the north of the weir. In order to prevent erosion on downstream banks in the vicinity of the weir, the design of the weir has taken into account that once this floodway starts to operate the river downstream is at full bank.

4.2.3.2 MEGECH IRRIGATION PROJECT (Feasibility Level Study is in Progress)

i) General

The Megech irrigation area has a gross suitable area of 13,100 ha, of which 10,018 ha will be irrigated. The project will pump water from Lake Tana, thus there is no reservoir associated with the development. Annual water extracted will be 86.8mm³.

Water would be supplied via pumping stations at the eastern and western extremities of the project area with capacities of 4.6m³/s and 3.7m³/s respectively, at dynamic heads of 15.6m and 15m respectively.

ii) Project Location

The project area is located in Amhara Region South Gonder Zone. It is located in the northern portion of the Lake Tana sub-basin and has a catchment basin of about 700km². The river flows generally in a southerly direction towards Lake Tana. The main tributaries of the Megech are the West fork and the Angerb. The project area is on the lake plain south of the Gondar-Debre Tabor road and begins at a point about 15 km north of the lake where the river breaks out of the steep canyon area into the lake plain

iii) Climate

The climate of the project area of East and West Megech is marked by a wet season from June to September, with monthly rainfalls varying from 155mm in May via 271 mm in July to 115mm in September.

Data have been taken from Gorgora station. The dry season, from October to May has a total rainfall of about 14% of the annual rainfall of 906 mm.

Average daily temperature variations throughout the year are minor (19.0oC in December to 23.0oC in May), whereas humidity values vary between 77% in February and 88% in August. Wind speeds are low, thus minimizing potential evapotranspiration values between a low 95mm/month in December and a high of 141mm/month in April.

Sunshine duration is reduced to 6.0-6.5 hours during July/August.

iv) Accessibility

Access to East Megech is possible via a track departing from the main road Gondar-Bahir Dar, 1km south-west of the village Maksenyit. Access from kola Diba is impossible due to lack of bridges or drifts across the Megech River.

Access to the West Megech is possible from kola Diba and Gorgora. However, during the rainy season the area is inaccessible as most tracks are on Vertisols which are rendered impassable even after the slightest rain. Apart from Gorgora, there are no harbours or landing facilities.

v) Soil Condition

In some areas close to the lake, the water table was found at a depth of about or less than 1 meter. All low lying and depression areas are excluded from the proposed scheme. On the contrary, the soils of the steeper area are excessively drained.

Measured infiltration rates on the Vertisols are in the range of 1.6-3.8 cm/h, whereas the red soils show rates of 8.8-16.5cm/.hour.

Electrical conductivity values are very low, having values of 0.1-0.7 dS/m and therefore, salinity would not impose any limitation on plant growth. The flood plain soils (mostly Vertisols) have high levels of base saturation indicating a high fertility level.

vi) Hydrology

Development of irrigated agriculture in the valley would depend on water available from the lake and on the possibility of drainage which is influenced by Lake Tana. Drainage would have to be provided to prevent water

logging during the wet season. Lake levels vary between +1784 and +1787.5.

Over bank flow from Megech River tends to flood areas along the riverbed and therefore flood protection dykes have to be constructed. The present dykes are directly along the watercourse and have very steep banks. Therefore, they are not adequate.

vii) Irrigation And Drainage

The maximum duties amount to 0.74 l/s.ha for the cropping pattern without rice occurring in March and to 1.16 l/s.ha for the rice based cropping pattern, occurring in January during land preparation.

viii) Conveyance And Distribution systems

At full development, the pumping station would have a capacity of 4.6m³/s (0.7 l/s.ha), with an installed. Power of about 1.3 MW in 4 units, including 1 standby unit at East Megech. The number of 250KVA transformers would be 5. Water would be lifted over 13.5m. With 3 steel pipelines with 1.0m diameter and 260m long the dynamic head would be 15.6m at a velocity of 1.95 m/s. Annual operating hours would be 2, 906, whereas 2.7 GWh are required to lift 48 MCM during an average year.

At full development, the pumping station would have a capacity of 3.7 m³/s (0.7 l/s.ha), with an installed power of about 1 MW in 4 units, including 1 standby unit at west Megech. The number of 250 KVA transformers would be 4. Water would be lifted over 13.0m. With 3 steel pipelines with 1.0m diameter of 110m long the dynamic head would be 15.0m, at an average velocity of 1.60m Annual operating hours would be 2,906, whereas 2.1 GWh are required to lift 39 MCM during an average year.

4.2.3.3 NORTH EAST TANA LAKE IRRIGATION PROJECT (Feasibility Level Study Is In Progress)

1. General

This is a relatively small irrigation site of 5,000 ha. Development opportunities are good, because of the presence of ample water of good quality in Lake Tana, Soils with good fertility and a good topography, reasonable infrastructure, relatively good marketing facilities and the presence of a large farming community.

2. Project location

The project area is located in Amhara Region South Gonder Zone. The land areas considered are located on the lake plain on Northeast shore of Lake Tana, extending from Mitraa Island southwards to the edge of Ribb River valley. The area is about 14km in length and from 2 to 6 km in width. The main road from Gondar to Addis Zemen passes very near the North East limit of the project area.

3. Climate

The climate of the study area is marked by a wet season from June to September, with monthly rainfalls varying from 175mm in June via a maximum of 449 in August to 176 in September. The dry season, from October to May has a total rainfall of about 12% of the annual rainfall of 1,354mm.

Temperature variations throughout the year are minor (minimum of 18.70C in August to a maximum of 23.00C in April), whereas humidity values vary between 77% in May and 88% in August. Wind speeds are low, thus minimizing potential evapotranspiration values between 95mm/month in November/December and 140mm/month in March. Sunshine daily duration is reduced to 6.0-6.5 hours during July/August.

4. Accessibility

The northern area, can be reached via a track, taking-off from the main road Bahir Dar-Gondar just north-west of the crossing with the river of Arno garno. The 15km long track which has been used by trucks collecting sand from the lake shore is motorable during the dry season. There are many dry season tracks but numerous stream crossings render them impassable for most of the year.

5. Soil Condition

The majority of the soil can be classified as heavy clay soils, with impeded drainage. Ground water was found at a depth of more than 2.00m measured infiltration rates on the Vertisols are in the range of 1.0-17.7cm/hour.

Electrical conductivity values are low, having values of 0.1-1.2dS/m and therefore, salinity would not impose any limitation on plant growth. Most of the soils (Vertisols) in the study area have high levels of base saturation indicating a high fertility level.

6. Hydrology

Irrigation water would have to be pumped from Lake Tana, where levels vary between +1784 and +1787.5. During high water levels low areas along the coast line would be flooded whereas other areas might face drainage problems.

The lowest areas (classified as swamp and wet land) all along the lake shore which are presently used for grazing should be kept for this purpose: they are totally excluded from the scheme.

7. Irrigation and drainage

The maximum duty of the irrigation systems amount to 0.76 l/s.ha and 1.19 l/s.ha respectively for the without and with rice cropping patterns. Field irrigation methods include furrows for row crops and basins for rice and other crops. At this stage it is not appropriate to select alternatives but taking into account the presence of heavy soils, basins and furrows would be the preferred methods.

8. Conveyance and Distribution Systems

Water would be lifted by electrically driven pumping station from a minimum level of +1784 via a 1 km long rising main to the village of Gbeta Mewcha which is located at 1800-1810m, in a saddle in the hill range. The pumping station would have a capacity of 1.61m³/s against a dynamic head of 22m, requiring a minimum power requirement of 416 kW.

4.2.3.4 GILGEL IRRIGATION PROJECT (Feasibility Level Study Is In Progress)

1. General

The proposed irrigation system is made of two independent areas along the Gilgel River. The report is made separately for the two schemes Gilgel 2 and Gilgel 5. Either Gilgel 2 or Gilgel 5 could be implemented before the construction of the dam. Gilgel 2 would require a diversion weir while Gilgel 5 requires a pumping plant. The total command area is 5496ha.

2. Project Location

The project area is located in Amhara Region, West Gonder Zone. The right bank is part of Merawi Wereda, with Merawi as administrative centre.

3. Climate

The climate of the valley falls in the traditional Woina Dega climatic zone and is marked by a wet season from May to September, with monthly rainfalls varying from 123mm in May to 430mm in August. The dry season, from October to April has a total rainfall of about only 10% of the annual rainfall of 1,572mm.

Temperature variations throughout the year are minor (15.7°C in January to 18.2°C in May), whereas humidity values vary between 58% in May and 80% in August.

Wind speeds are low, thus minimizing potential evapotranspiration values between 95 mm/month in August and 144 mm/month in April. Sunshine duration is reduced to 3.6-5.2 hours daily during June to August; combined with low temperatures.

4. Accessibility

The Project Area is poorly served by roads and tracks. During the rainy season it is impossible to reach the projects sites by vehicle, apart from the site near Chimba.

5. Soil Condition

The soils are mainly Vertisols. Ground water in the floodplain is generally found at shallow depth; however, during surveys it has rarely been found at a depth less than one meter. On the contrary, soils of the steeper area are excessively drained. Measured infiltration rates on the Vertisols are in the range of 1.6-3.8cm/h, whereas the red soils show rates of 8.8-16.5cm/hour.

6. Hydrology

Development of irrigated agriculture in the valley would depend on water availability from Gilgel River and on the possibility of drainage which is influenced by Lake Tana.

Without dam, average flows of Gilgel River which has as catchment area of 1,980 km² at the gauging station just upstream of the main road crossing at Wetet Abbay would decrease from a maximum of 193 m³/s in August to as low as 3.1 m³/s in April. The dry season flows, exceeded 4 out 5 years reach minimum values 1.7m³/s.

7. Irrigation and Drainage

The maximum duty of the irrigation systems amount to 0.69l/s.ha and 1.18 l/s.ha respectively for the without and with rice cropping patterns. At this stage field irrigation methods are not appropriate to select appropriate alternatives but taking into account the presence of heavy soils, basins and furrows would be the preferred methods.

8. Conveyance and Distribution Systems

Piped off takes from the dam will supply by gravity water to the main canals in right and left bank, at elevation 1,860. The right bank canal is 16.8 kilometers long of which 44% must be lined;

A pumping plant with a capacity of 1.7m³/s for a dynamic head of 20 meters will be constructed.

Fig 3. Irrigation

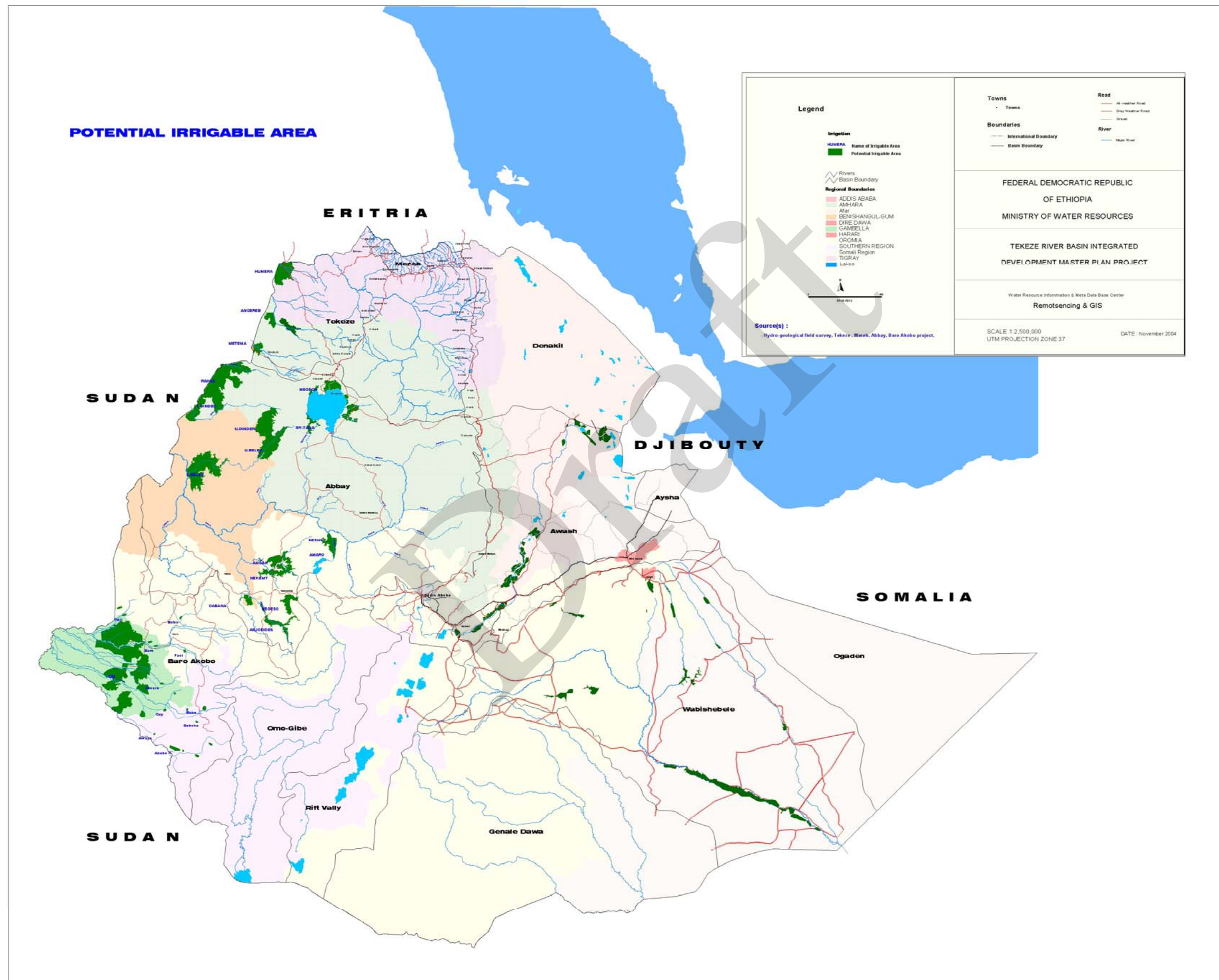


Fig 4 Hydropower

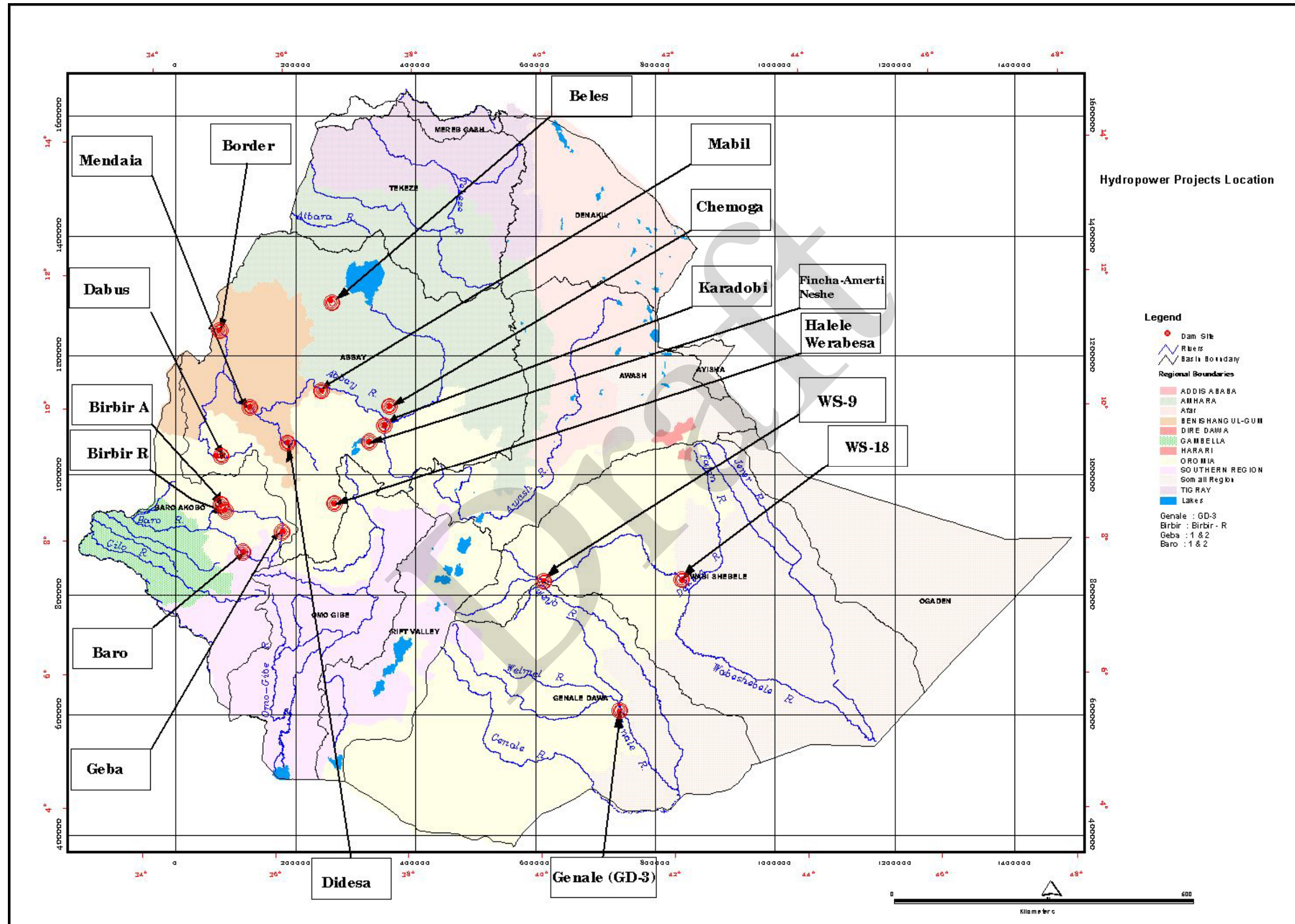


Table 4.1 Hydropower Plants in the Abay, Baro-Akobo and Tekeze river basins

No.	Name of the Power Plant	River Basin	Region	Year of Com.	Installed Capacity (MW)	Turbine types
1	Fincha'a	Abay	Oromia	1973	134	Pelton
2	Tis Abbay II	Abay	Amhara	2001	73	Francis
3	Tis Abbay I	Abay	Amhara	1964	11.4	Francis
4	Sor	Baro Akobo	Oromia	1992	5	Francis
Hydropower Plants under construction						
Item No.	Name of the Power Plant	River Basin	Region	Year of Com.	Installed Capacity (MW)	
1	Beles multipurpose Project	Abay	Amhara	2009	470	
2	Tekeze	Tekeze	Tigray	2008	300	

Table 4.2 Identified potential hydropower sites with their locations in the specified river basins

4.2.1 ABAY RIVER BASIN

MATER PLAN STUDIES	NAME OF THE HYDROPOWER PROJECTS	PROJECT COST USD	LOCATION	GENERATION CAPACITY
ABBAY MASTER PLAN				
Hydropower Scheme except Abay River	BELES DANGUR	233,000,000		455 GWh/yr
	FETTAM	126,000,000		410 GWh/yr
	LOWER DIDESSA	196,000,000	North latitude = 09 29'00" East longitude = 35 58' 30"	832 GWh/yr
	LOWER GUDER	50,000,000	North latitude = 09 25'20" East longitude = 37 39' 20"	131 GWh/yr
	LOWER DABUS	248,000,000		709 GWh/yr
	UPPER DABUS	219,000,000		666 GWh/yr
Abbay River Hydropower Development	-	-		
	KARADOBI	958,000,000	North latitude = 09 51'20" East longitude = 37 41' 30"	2890 GWh/yr

	MABIL	656,000,000	North latitude = 10 19'02"East longitude =36 40' 10"	2230 GWh/hr
	MENDAIA	885,000,000	North latitude = 10 04'00"East longitude =36 33' 50"	
	BORDER	786,000,000	North latitude = 11 12'50"East longitude =35 05' 40"	3285 GWh/yr
MULTI - PURPOSE PROJECTS	-	-		
Hydropower Projects	UPPER GUDER	20,000,000		10.4 MW
	NEKEMTE	18,600,000	North Latitude = 09 25 50"East longitude = 36 30' 00"	16 MW
	DABANA	36,700,000	North Latitude = 08 55' 05"East longitude = 36 00' 47"	41.6 MW
	UPPER DIDESSA	32,000,000	North Latitude = 08 12' 20"East longitude = 36 48' 20"	30 MW
	NESHE A	20,000,000	North Latitude = 37 15' 20"East longitude = 09 45' 10"	19.2 MW
	NESHE B	20,000,000	North Latitude = 37 15' 25"East longitude = 09 45' 40"	19.2 MW
	LOWER DINDIR	26,300,000	North latitude = 12 01'00"East longitude =35 52' 40"	26 MW
	UPPER DINDER		North latitude = 8 12'20"East longitude =36 48' 20"	31 MW
	GALEGU	4,200,000	North latitude = 12 10'30"East longitude =35 59' 45"	2 MW
	RAHAD	22,400,000	North latitude = 12 32' 30"East longitude =36 19' 30"	20.8 MW
TOTAL		4,557,200,000		216.2MW

Table 4.2.3 BARO-AKOBO RIVER BASIN

MATER PLAN STUDIES	NAME OF THE HYDROPOWER PROJECTS	PROJECT COST USD	LOCATION	GENERATION CAPACITY GWh/yr
BARO-AKOBO MASTER PLAN	1. BARO DAM	209,442,000	UPPER PART OF THE BASIN	1049
	2. GEBA-A DAM	180,627,000	60 KM EAST OF GORE	865.6
	3. BIRBIR-A DAM	130,417,000	70 KM ENE FROM DEMBIDOLO	492.3
	4. KASHU DAM	80,790,000	22 KM SSE OF MIZAN TEFERI	298.5
	5. GUMERO DAM	84,946,000	28 KM NORTHWEST OF GORE	255
	6. BIRBIR-R DAM	930,900,000	11 KM UPSTREAM OF THE CONFLUENCE OF THE GEBA RIVER	2503
	7. SOR DAM	127,566,000	10 KM NORTHWEST OF METU	542
	8. GILO-1 DAM	212,377,000	95 KM WNW FROM MIZAN TEFERI	425.7
	9. TAMS DAM	2,809,519,000	IS ON THE BARO RIVER 47 KM EAST OF GAMBELLA	5485
	10. GEBA-R DAM	1,011,422,000	75 KM FROM GAMBELLA	1574
TOTAL		5,778,006,000		13,490.10

Table 4.2.4 TEKEZE RIVER BASIN

MATER PLAN STUDIES	NAME OF THE HYDROPOWER PROJECTS	PROJECT COST USD	LOCATION	GENERATION CAPACITY MW
TEKEZE MASTER PLAN	1. TK03 DAM	193,080,646	NORTHING 1391027 EASTING 441042	69
	2. TK04 DAM	2,037,923,195	NORTHING 1424777 EASTING 483504	220.5
	3. TK07 DAM	1,036,591,000	NORTHING 1533176 EASTING 381974	671
	4. TK12 DAM	539,304,000	NORTHING1411239 EASTING 509256	91
	5. TK16 DAM	110,257,836	NORTHING1419512 EASTING 271468	3
	6. TK21 DAM	98,470,305	NORTHING 1463224 EASTING 274601	14.2
	7. TK22 DAM	89,768,562	NORTHING 1390525 EASTING 236113	3.7
	8. TK23 DAM	35,464,440	NORTHING 1492271 EASTING 558952	0.06
	9. TK25 DAM	78,883,375	NORTHING 1508248 EASTING 544946	6.4
TOTAL		4,219,743,359		1,078.86

5 Major issues in water resources development and management in Ethiopia

The three basins cover nearly one third of the total area of Ethiopia and accounts for 65 percent of the country's estimated annual water resources as well as affects 39% of its population. The flow from Ethiopia provides over 80% of the water for the two countries.

Frequently, the country is subjected to food shortage and recurrent drought. This coupled with the alarming population; there is the need to develop the irrigation potential. As part of Eastern Nile basin the country and the MDG goals, high priority should be given to mitigate the problem. Therefore, the implementation of the studied potential irrigable areas needs to be given immediate attention.

The three basins have immense and untouched potential of hydropower. This is believed to enhance economic growth. Despite these huge untapped resources, it is only 13% of the Ethiopian people with access to some sort of electricity. This is again area of big attention.

5.2 Flood Situation

5.2.2 Introduction

The flood studies in the Abbay, Tekeze and Baro Akobo river basins are mainly to establish values of design flood at the locations of various projects. Generally, dam spillways are designed to pass the 1,000 year or 10,000 year flood. The villages and towns are required to be protected against 10-year or 20-year flood. Irrigation projects are also protected against the 10-year or 20-year flood. Some enclaves and depressed areas are prone to flooding. In the highland parts of the three river basins, rivers cut their channel deep in to the volcanic cap and the underlying sedimentary rocks. Floods usually occur once the rivers reach the level land.

5.2.3 Flooded Areas

The Gambella plain in the Baro Akobo River Basin has been partly under flood.

There are two reasons for the flooding problem of the Gambela plains.

- Flooding resulting from overflows of river banks; and,
- Flooding resulting from rainfall and poor drainage.

The flooding resulting from the river overflow is stated as the consequences of two possible phenomena: a river bankfull capacity too small and the backwater effect from the Pibor River and the Sobat River.

Flooding in the Gambela Plain varies from year to year. For each flooding situation the Study has estimated the probability of the land flooding. The total area of the lower basin subject to repeated flooding is 9720 km².

5.2.4 The Proposed Flood Protection Measures

There are essentially two possible flood protection measures proposed by the Master Plan Study for the Gambela Plain.

These are:

- construction of dikes to prevent the over topping of river banks; and,
- Construction of reservoirs to store and control the runoff from the upper watershed.

The Master Plan Study proposes the construction of dikes, drains and pumping stations for the protection of the towns of Gambela and Itang. The protection of Gambela consists in building 2.4 km of dikes along the right bank of the Baro River and its right tributary the Jejebe River with a five-meter wide road on the crest.

The second approach, which consists of providing flood control storage capacities at dams upstream of the considered developments, should also be evaluated on its economical merit. In the case of the Gambela plain due to the complexity of the flooding process and the large number of unknown factors, it is uncertain that this approach is practical.

The flooding of the plain is caused by a combination of events for which there are very few known facts, including the flooding of the Pibor river which forms the border with the Sudan and the limited capacity of the Sobat river downstream of the Pibor in the Sudan.

6 Drawbacks

The above data collection and compilation was seriously hampered due to the following problems:

- The data holders are not fully committed to give appropriate data and access to data sources. Lack of awareness and poor coordination among the data holders is prime cause for the problem.
- In some of the cases especially, maps and related information, the data are not fully dependable and
- Most of the available data is highly unstructured and the primary data and the secondary data are mixed or regenerated after the original data are completely destroyed.

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7 Annotated list of references

BCEOM ; 1998, Abbay River Basin Integrated Development Master Plan, Ministry of Water Resources Addis Ababa, Volume I - XVIII, Main Report, Executive Summary, Annexes and Master Plan (Volumes I-IV)

Basin Physical Features

7.2 River network related

The report discusses the surface water including the river network. The river network of the basin is dominated by the Abbay, which rises in the centre of the basin and develops its course in a clockwise spiral.

The river network data covers tributaries, catchment area, flow direction, average annual discharge, lakes, wetlands and their basic features. The spatial representation includes river network maps and longitudinal profile of major rivers.

The Abbay collects water from enormous tributaries before reaching the Sudan border above the Reseires dam. The Gilgel Abbay, the main river flows north from its source into Lake Tana. The lake receives tributaries from a catchment of 15,320 km². Tributaries are acquired on the right and left banks.

The text and the maps are well elaborated. The average annual discharge as well as their low flow and high flow months. The data has been to a large extent utilized. Most of the rivers are gaged and long years flow data are available.

7.3 Hydrology and Climate

7.3.2 Climate

Data are available until 1998. Hence the latest data from the National Meteorological Service Agency (NMSA) utilized.

7.3.3 Flow characteristics

Available hydrographs at selected points have been utilized.

7.3.4 Sediment transport measurements, sediment loads.

The report summarizes observations based on previous assessments (before 1998). The annual sediment discharge and sediment yield assuming a 10% delivery rate to the rivers. One of the Major sources of sediments is erosion of the intensively farmed high land areas in the central and eastern parts of the basin (about 100 t/ha/yr rate for the basin).

7.3.5 Flood peaks at selected points

Available from the Hydrology Department of the Ministry of water Resources.

7.3.6 Existing Water Infrastructure

This aspect has been discussed with minimum data because of the low economic development level of the basin.

7.3.7 Water Resources Opportunities

The report discusses the identified sites at reconnaissance and semi detailed level. The pre-feasibility studies have been documented in separate volumes. A good part of these data has been utilized. Only part of the identified sesames have been taken to the pre-feasibility level.

7.3.8 Major issues in water resources development and management in the EN.

Data for flood damage have not been well documented in the Master Plan reports.

**NEDECO, 1998, Tekeze River Basin Integrated Development
Master Plan, Ministry of Water Resources, Addis Ababa,
Volume I-XX and Executive Summary.**

**1. Basin Physical Features
River network related**

The report details basic features of the basin including the drainage system. The basin has an average elevation of 1850 masl and a catchment area of about 59,306 km². The basin includes the Angereb (area about 13,327 km²) and Guang (area about 6,694 km²) sub-basins.

2. Hydrology and Climate

2.1 Climate

The study discusses the general characteristics the climate of the basin, anomalies and variability of climate, precipitation, station network, missing data, rainfall from satellite data and evapotranspiration some 6 maps have also been provided attached to the report.

The study also provided analysis for drought. The consultant used patched rainfall series in and near the study area that had 20 or more years of observations. From each series the number of meteorological droughts were determined. Meteorological drought is defined as rainfall with an annual probability of 20% or less. It has been concluded that the number of drought to has been increased in the 1980-1994 period in comparison with the 1965-1979 period.

The report also discussed augmentation of rainfall data using satellite information. Since 1992, National Meteorological Service Agency (NMSA) has been publishing 10 day, monthly, seasonal and annual precipitation estimate maps of Ethiopia, based on Cold Cloud Duration (CCD) data. CCD data are temperature data of the cloud tops. Cold (high) clouds can be associated with rainfall, assuming that they are the tops of the active storms. CCD data can be obtained from satellite data. At present the satellite data required for rainfall estimation are obtained by NMSA from METEOSAT (the European geostationary satellite a Primary Data Users System (PDUS)).

The study further analyzed several climatic elements including temperature, wind speed, sunshine hours, radiation and relative humidity. They have a much smaller spatial variation, which means that fewer stations are required to obtain good regional estimated.

The climate data, however was largely obtained from the National Meteorological Service Agency (NMSA) were utilized for the present study. This is because the data contained in the report were collected before 1998.

This study provides the data required on river flows over time and at the specific locations in the basin. The master plan project has initiated improved monitoriver by assisting and procuriver materials for station upgrading, designing stilling wells, and procuriver new flow measuriver equipments.

The hydrometric network (1996) consists of 30 stations of which 14 have recorders. The report also discusses station operation and data processing by the Hydrology Department of the Ministry of Water Resources. The study states that the Regional Governments have staff and budget constraints, which affect the adequacy of flow gauging. It was stated that the historical flow data in the Tekeze basin have a very short record length (max. 10 years).

The flood studies indicate that high flows in the basin are the results of wet season high precipitation. They mainly occur July to September. Flood hydrographs related to the highest peaks have been prepared. Several flood calculation methods have been provided. Catchment yield for the basin has been determined after considerate factors influencing the flow rate and yield. The average specific sediment yield of the basin area is 900 t/km²/year.

The study annexed the following:

- Monthly discharge data
- Rating equation preparation and flow calculation
- Daily weighted average water levels and daily flows
- Monthly flows
- Hydrological stations
- Flow data used for verification of the generated flows
- Generated flows for dam sites
- Flood calculation methods
- Surface water quality data
- Sediment data

The maps included:

Hydrological map

Hydrometric stations

For optimal use of the surface water in the basin, hydrologic monitoriver will have to be considerably improved.

Available hydrographs at selected points have been utilized.

2.2 Sediment transport measurement sediment loads

The report discusses the erosion potential of the basin including sediment transport and loads. Trends are observed putting the basin area in a situation of accelerating deterioration of natural resources.

- population increase
- limited buffer capacity of many areas to withstand degradation
- ongoing depletion of vegetation and nutrient missing farming systems

Though the above information has been accessed the consultant collected primary data from the Ministry Water Resources. Refer to Table 5 above for details.

2.3 Flood peaks at selected points

Monthly runoff volume has been obtained from the Ministry of Water Resources; hence the flood peak could not be identified.

3. Water resources opportunities

Dams selected by the project for further study include TK04, and TK07 in the middle Tekeze River. TK21 in the Angereb River and TK22 in the Genda River. Potential Negative effects of the dams are related mainly to water borne and transmittable diseases and changing water regimes.

The potential for irrigated agriculture has been addressed in this document. Relatively detail study has been done in this document.

4. Major issues in water resources development and management

As there is no big threat as regards to flooding, no emphasis given in the document.

**TAMS - ULG, 1997, Baro Akobo River Basin Integrated
Development Master Plan, Ministry of Water Resources, Addis Ababa
Volumes I - V, and Annexes 1- 4**

**1. Basin Physical Features
- River network related**

The major rivers within the basin are the Baro and its tributaries (Birbir, Geba, Sor, Alwero and Akobo). The basic data used by the master plan study include monthly river discharges at various gauging stations and monthly precipitation. The general direction of the rivers is from the east to the west. The rivers originate in the highlands (2000-3400 masl). All the major rivers are gauged.

2. Hydrology and Climate

2.1 Climate

The meteorological data were collected and processed by NMSA. The data contained in the master plan were, however, not used because of their collection before 1997. Latest data from NMSA were used in this study.

2.2 Flow Characteristics

The observed monthly data by stations are provided in the Master plan report. The flow fluctuation of the observed monthly flow data are high: The coefficient of variation is close to one.

The data for the present study however were obtained from the Hydrology Department of the Ministry of Water Resources.

2.3 Sediment transport measurements, sediment loads

The amount of sediment that enters and accumulates in the reservoirs planned for the basin have been studied. Based on the estimates reservoir dead storage was selected.

2.4 Flood peaks at selected points

The magnitude and frequency of the floods in the rivers on the basin have been estimated in order to provide data for the design of spillways for hydropower and irrigation dams and of flood protection works for towns and villages, especially in the Gambella plain.

The flood studies in the basin are the most elaborate than the other master plan studies. The flood damage data however are not available also for this basin.

3. Water Resources Opportunities

The study concluded that the Baro-Akobo Basin contains a very high potential for both hydropower and large scale irrigation development. A number of hydropower and irrigation schemes have been studied to pre-feasibility level.

4. Major issues in water resources development and management in the EN.

The environmental issues include the location of the large scale irrigation projects in the wildlife habitats.

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ABBAY SUB-BASIN

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Element: Monthly Rain Fall in mm

Region: Gonder

Station: Debre Tabor

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	0.0	10.1	28.4	103.8	37.6	166.8	576.6	489.1	225.4	97.6	141.1	0.0
1981	0.0	0.0	0.0	7.2	26.0	136.5	462.7	464.9	247.3	155.7	58.0	0.0
1982	14.3	0.6	57.9	3.9	78.6	98.3	266.5	670.6	201.8	182.6	67.9	0.0
1983	0.0	0.0	0.0	20.8	89.6	51.0	474.0	516.7	186.4	50.6	46.6	0.0
1984	0.0	0.0	0.0	0.0	35.7	83.0		620.6	116.7	0.0	13.0	0.0
1985	5.0	10.0	14.6	54.8	100.9	177.3	338.2	259.4	143.7	9.0	15.7	11.0
1986	3.3	2.3	42.0	14.3	5.6	352.5	447.4	436.6	193.7	46.8	x	22.9
1987	16.1	0.3	58.3	21.4	172.3	127.8	273.8	371.4	60.3	65.1	27.2	0.0
1988	0.1	5.4		31.9	69.8	155.5	590.5	462.5	182.3	84.9	7.5	5.5
1989	6.2		84.4	45.8	94.8	84.7	304.5	425.5	139.3	103.6	12.4	x
1990	10.8	x	x	x	x	x	x	x	x	x	x	x
1991	x	x	x	x	x	x	x	x	x	1.7	38.1	2.2
1992	0.5	0.0	12.8	99.8	38.5	116.0	330.1	365.5	124.6	128.7	60.5	5.9
1993	0.8	2.0	86.3	74.8	199.0	136.5	429.8	289.9	208.8	118.6	23.3	0.0
1994	1.8	9.1	0.0	17.0	89.7	237.7	495.8	633.5	248.0	10.0	24.8	31.7
1995	0.0	0.0	22.7	34.6	100.4	73.0	399.7	403.6	184.9	5.0	23.4	25.3
1996	4.3	1.2	49.4	92.1	146.1	197.0	349.4	373.9	155.3	30.6	76.2	4.4
1997	3.4	0.0	73.7	43.1	197.6	225.1	449.7	359.0	197.0	314.0	12.3	82.5
1998	13.6	0.0	20.9	6.9	203.6	126.2	400.6	410.8	244.8	75.9	0.0	0.0
1999	34.5	0.0	0.0	18.1	41.2	181.4	476.5	345.7	244.8	250.6	11.2	19.5
2000	0.0	0.3	6.3	118.4	61.1	168.1	423.4	462.4	232.3	137.8	34.8	0.5

Element: Monthly Rain Fall in mm

Region: Gojam

Station: Dejen

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980		42.9	71.0	158.6	67.1	112.0	262.0	360.0	132.0	76.8	0.0	0.0
1981	0.0	0.0	64.8	47.0	52.6	99.7	424.4	306.7	156.4	37.8	11.1	4.7
1982	3.4	14.1	x	x	x	x	x	x	x	x	x	x
1983	x	x	x	x	x	x	282.2	377.6	94.4	102.6	62.7	0.0
1984	0.0	0.1	20.7	16.2	118.9	203.1	271.8	234.6	166.8	0.0	7.1	1.1
1985	10.1	0.0	25.3	119.3	17.9	40.4	250.1	282.1	166.0	67.9	0.4	3.4
1986	0.0	53.0	75.6	124.3	51.4	159.8	334.4	220.3	254.5	75.3		0.0
1987	0.0	21.4	126.8	34.5	115.4	89.3	249.0	215.0	95.9	62.1	0.0	2.0
1988	1.3	41.9	0.0	26.3	11.4	98.9	382.4	432.9	216.3	113.5	0.0	0.0
1989	0.0	18.7	160.1	117.5	43.1	103.2	216.2	429.7	215.2	69.5	0.0	65.3
1990	0.8	19.6	109.3	57.9		133.9	348.0	304.9	214.9	20.8	x	x
1991	2.7	3.4	8.8	11.6	37.1	199.0	276.8	343.6	189.0	18.5	0.0	10.9
1992	40.4	32.9	32.7	77.5	69.5	154.3	185.1	230.2	186.2	98.6	27.2	0.0
1993	8.8	11.7	35.7	171.9	164.5	171.3	283.7	239.7	212.3	122.9	0.0	0.0
1994	0.0	0.0	60.6	14.2	116.8	96.9	401.9	364.0	259.0	0.0	1.4	0.0
1995	0.0	0.0	15.2	56.3	87.4	120.8	329.5	388.0	193.1	6.0	4.7	39.1
1996	5.2	2.3	86.5	139.5	195.8	152.7	491.7	356.8	98.3	18.3	31.8	7.2
1997	54.8	0.0	65.9	173.3	96.1	310.9	376.3	335.0	53.6	200.7	198.7	13.9
1998	0.4	13.0	62.1	3.6	188.1	166.7	384.2	472.1	193.3	254.5	0.0	0.0
1999	4.9	0.0	0.0	28.8		161.0	637.4	595.3	128.7	296.1	2.1	5.5
2000	0.0	0.0	0.0	178.1	101.9	156.9	491.7	558.8	288.0	158.8	65.8	3.2

Element: Monthly Rain Fall in mm

Region: Gonder

Station:Ebinat

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	0.0	10.3	10.2	28.7	16.7	59.8	357.9	233.9	128.9	22.1	18.1	21.0
1981	4.7	0.0	1.5	47.8	54.6	59.1	293.7	308.8	82.0	60.2	17.7	0.0
1982	2.3	0.0	41.0	25.7	72.1	52.8	150.2	275.8	56.0	x	x	x
1983		x	x	x	x	x	249.2	324.4	60.2	22.1	16.1	0.0
1984	0.0	0.0	0.0	0.0	96.0	207.0	156.7	63.3	0.0	0.0	0.0	0.0
1997	x	x	0.0	33.3	162.2	146.0	276.9	223.7	47.7	149.6	33.8	1.1
1998	1.7	0.0	12.2	1.1	137.6	134.6	360.0	295.2	126.7	x	x	0.0
1999	39.0	0.0	0.0	10.1	x	47.7	407.2	403.0	168.6	162.3	0.0	x
2000	0.0	0.0	x	0.0	39.3	87.4	290.2	261.0	26.5	101.1	29.4	0.0

Element: Monthly Rain Fall in mm

Region: SHOA

Station:Fiche

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	x	x	x	x	10.8	52.2	127.9	167.1	32.7	4.9	0.8	0.0
1981	1.2	8.8	109.0	86.0	32.5	21.0	452.7	257.0	120.3	0.0	1.7	12.7
1982		36.8	84.3	60.4	35.6	15.1	141.7	x	x	x	x	x
1983	x	x	x	x	48.9	81.7	99.0	80.6	75.7	7.5	9.5	0.0
1984	0.0	0.1	0.3	0.1	2.9	4.4	8.9	x	3.4	0.0	0.0	0.0
1985	0.0	0.0	42.1	93.4	69.2	9.5	336.4		66.0	3.5	25.0	0.0
1986	12.2	75.6	19.5	109.3	113.2	57.5	234.1	367.7	72.0	24.0	10.0	3.0
1987	0.0	25.6	269.0	107.1	151.4	36.0	107.1	270.7	39.9	3.8	0.0	7.6
1988	23.5	91.1	8.9	80.6	16.9	41.1	339.5	369.6	163.3	10.3	x	x
1989	19.4	45.2	66.8	117.7	35.4	45.6	260.0	386.0	93.9	33.6	1.0	30.4
1990	2.0	106.4	56.5	70.0	11.2	12.9	398.0	281.9	216.8	11.8	0.0	0.6
1991	21.6	53.8	80.5	1.9	32.1	94.7	256.7	365.7	143.4	8.5	0.0	1.4
1992	48.1	100.9	63.5	35.9	40.8	70.4	251.0	336.4	9.3	49.0	16.5	18.3
1993	21.4	5.1	20.8	133.0	94.6	78.2	377.5	285.9	12.0	144.0	0.0	0.0
1994	1.6	2.1	70.2	55.1	18.8	98.4	307.1	634.4	128.0	0.1	10.6	0.0
1995	0.0	52.3	45.2	123.2	53.0	52.6	329.2	331.7	130.1	0.0	0.0	35.5
1996	29.5	11.5	102.3	79.8	80.1	209.6	393.0	397.9	198.9	7.2	18.1	1.8
1997	43.3	0.1	72.0	45.1	29.0	149.8	347.7	276.8	51.1	62.6	20.1	1.8
1998	11.2	19.0	49.1	53.8	45.8	87.8	266.9	383.8	181.1	40.5	0.2	0.0
1999	42.6	0.0	3.6	12.3	21.5	64.2	422.4	496.0	57.1	79.9	6.6	9.0
2000	0.0	0.0	24.0	88.3	35.5	52.5	442.7	381.8	91.7	10.9	8.3	4.3

Element: Monthly Rain Fall in mm

Region: Gojam

Station: Finote Selam

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	x	10.0	31.3	82.9	135.1	160.5	354.2	203.4	111.8	17.2	34.7	0.0
1981	0.7	0.1	20.6	45.0	66.7	72.2	305.9	194.9	152.0	54.6	16.2	1.5
1982	6.0	0.0	46.5	33.9	90.2	106.1	274.3	151.5	81.5	34.3	52.2	0.0
1983	0.0	16.3	0.0				194.6	342.2	156.0	81.0	49.8	0.0
1984	0.0	0.0	4.8	7.2	92.4	204.2	198.9	122.5	154.9	0.0	10.2	32.0
1985	5.7	0.0	8.5			138.6	252.4	332.6	86.1	63.6	8.6	14.5
1986	1.3	5.6	21.8	38.3	25.5	277.2	210.2	177.4		41.5	27.8	2.0
1987	6.5	1.8	41.2	54.0	164.4	133.9	175.5	217.7	126.5	160.7	11.8	0.0
1988	28.2	23.5	0.0	3.2	114.9	202.9	455.8	264.0	132.9	178.0	0.0	0.2
1989	0.0	4.4	24.1	26.4	103.3	181.5	318.9	175.9	117.1	81.4	0.6	49.4
1990	16.8	29.1	19.7	52.1	50.3	99.9	291.9	274.6	163.6			
1991	0.0						521.7	197.8	130.9	38.4	13.7	17.9
1992	16.1		25.9	35.8	86.7	41.0						
1993				60.4	128.9		356.0	200.8	207.5	134.9	57.0	0.0
1994	4.8	6.5	3.8	43.1	128.9	225.5	305.4	309.1	118.2	19.2	21.7	5.0
1995	0.0	6.4	53.3	74.8	103.5	214.6	340.6	226.3	122.6	30.7	15.8	19.5
1996	16.0	7.6	76.1	65.3	151.5	233.8	312.4	161.0	121.1	16.7	66.9	16.0
1997	0.0	1.0	55.4	80.6	114.2	281.2	282.3	289.0	277.2	151.4	54.8	21.3

Element: Monthly Rain Fall in mm

Region: SHOA

Station:Gedo

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	21.7	52.0	115.9	222.2	142.3	228.0	247.9	270.7	145.4	31.4	1.3	0.0
1981	5.8	3.3	131.2	136.0	142.8	191.0	346.9	301.0	89.7	8.1	34.3	20.0
1982	20.9	44.0	88.5	39.2	85.6	146.3	147.4	243.7	103.2	103.0	28.0	0.0
1983	3.6	32.3	93.3	85.5	189.1	111.7	211.4	305.4	229.1	79.3	31.3	0.0
1984	0.4	1.0	5.6	0.0	132.0	157.8	247.5	119.1	125.2	0.0	24.5	6.6
1985	15.0	0.0	21.1	70.3	247.2	161.5	269.1	263.0	90.5	46.6	4.1	0.0
1986	0.0	90.2	37.1	60.6	53.2	154.6	166.1	71.0	164.1	41.9	0.0	4.2
1987	7.0	52.5	123.8	47.4	149.5	114.3	113.1	251.2	159.1	59.7	7.2	25.4
1988	45.9	50.6	6.7	19.1	119.1	179.3	311.7	150.2	124.9	79.5	0.0	4.8
1989	0.0	16.9	166.4	103.0	1136.6	163.1	241.9	149.9	74.2	34.9	24.6	115.4
1990	15.4	57.7	88.4	25.6	127.2	149.8	114.6	181.4	55.4	17.6	0.0	x
1991	x	x	33.6			x	209.5	223.6	106.0	0.0	2.3	x
1992	48.1	47.9	67.5	44.4	66.2	202.3	199.3	205.6	114.4	x	42.1	6.3
1993	14.4	24.3	31.0	115.0	177.5	x	218.9	99.1	61.6	7.8	0.0	0.0
1994	8.2	2.7	40.6	62.3	89.3	x	187.0	103.2	157.7	9.1	6.0	0.0
1995	0.0	x	12.2	102.0	89.2	x	99.6	95.8	83.9	15.9	15.9	29.9
1996	1.5	0.0	46.4	60.1	129.0	36.3	69.3	92.0	35.1	0.0	73.5	3.0
1997	29.3	2.2	12.4	26.3	61.8	x	53.9	100.6	19.7	60.9	82.5	7.2
1998	17.0	22.1	41.7	41.9	63.7	112.1	181.1	98.5	42.8	63.9	11.6	1.8
1999	x	0.0	10.0	29.3	57.5	82.2	175.7	64.7	59.8	53.5	10.9	2.8
2000	0.0	0.0	5.8	36.7	64.2	x	74.6	x	75.6	82.6	26.7	0.0

Element: Monthly Rain Fall in mm

Region: Gonder

Station:Gonder

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	0.0	5.2	29.8	130.2	47.9	179.3	352.0	298.5	128.6	89.1	57.3	0.0
1981	4.0	0.0	11.4	30.9	96.2	74.7	265.6	212.1	96.2	26.4	5.5	0.5
1982	14.6	0.0	20.3	21.8	41.9	50.6	214.2	218.2	70.3	36.4	23.5	0.0
1983	0.0	0.0	0.0	5.3	99.7	148.7	271.6	194.5	92.1	69.0	19.3	0.0
1984	0.0	0.0	4.6	7.0	92.9	214.3	264.1	238.3	151.5	13.2	25.1	21.7
1985	0.0	0.0	56.4	61.8	81.3	79.7	179.7	334.0	103.2	64.4	40.4	16.0
1986	0.0	0.0	6.9	29.6	10.5	159.0	283.5	269.4	85.7	79.3	20.2	3.2
1987	12.8	0.0	2.1	36.5	210.6	207.5	232.6	195.2	125.1	90.6	17.4	3.7
1988	0.0	32.6	0.0	12.2	62.2	190.5	306.6	304.1	92.1	83.3	7.7	0.7
1989	0.0	1.4	38.7	32.4	59.7	208.4	269.1	279.7	108.1	34.5	7.0	11.9
1990	4.2	0.0	6.5	29.7	13.0	59.4	361.1	235.2	1291.1	1.4	1.2	0.0
1991	0.0	x	x	x	x	x	x	x	x	x	35.9	0.0
1992	0.0	0.0	2.7	51.7	80.7	86.8	249.5	218.2	117.6	79.6	11.9	21.6
1993	0.0	3.5	30.8	78.5	104.2	166.6	305.4	201.9	136.6	86.7	36.8	0.5
1994	0.0	1.0	0.0	7.8	84.5	156.0	289.4	265.9	125.0	38.0	20.0	2.8
1995	0.0	0.0	34.5	23.9	99.3	105.9	283.0	307.1	91.8	11.9	0.9	19.8
1996	0.0	4.4	22.2	83.6	183.8	194.7	249.3	260.0	74.8	67.7	23.2	0.4
1997	0.0	1.8	28.2	42.8	124.2	184.8	239.7	230.4	33.1	200.3	40.2	13.7
1998	0.0	0.0	10.0	3.7	88.5	284.6	383.0	487.9	125.7	126.4	4.8	0.0
1999	35.5	0.0	0.0	42.0	127.1	146.4	444.8	400.6	211.5	337.8	11.3	52.6
2000	0.0	1.4	3.9	73.2	60.7	364.3	451.4	368.6	166.6	268.7	1.9	x

Element: Monthly Rain Fall in mm

Region: Gonder

Station:Humera

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	x	x	x	x	x	66.8	236.0	232.5	87.4	26.5	0.0	0.0
1981	0.0	0.0	0.0	20.0	40.3	103.2	215.3	98.4	96.4	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	35.4	29.2	102.4	176.3	85.2	13.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	27.4	139.5	132.5	198.8	31.1	1.3	0.0	0.0
1984	x	x	x	x	x	x	x	x	x	x	x	x
1985	0.0	0.0	0.0	0.3		78.5	178.2	194.0	72.7	17.9	0.0	0.0
1986	0.0	0.0	8.2	0.0	3.2	139.7	216.8	165.4	85.8	38.1	0.0	0.0
1987	0.0	0.0	0.8	2.7	51.2	107.8	157.1	208.1	23.9	44.9	x	x
1988	0.0	0.0	0.0	0.0	11.1	137.0	205.8	225.3	134.3	9.0	0.0	x
1996	x	x	x	x	x	158.1	104.5	188.3	126.6	2.2	0.0	0.0
1997	0.0					70.8	158.4	384.9	132.3	43.1	2.3	0.0
1998	x	0.0	2.3	0.0	x	73.4	126.3	219.7		10.8	0.0	0.0
1999	2.5	0.0	0.0	15.2	39.2	116.0	202.6	282.5	125.9	10.4	0.0	0.0
2000	0.0	0.0	0.0	25.6	32.6	104.7	228.4	x	115.2	19.4	0.0	0.0

Element: Monthly Rain Fall in mm

Region: Gojam

Station:Kunzela

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	x	x	x	x	x	159.1	347.8	253.8	154.7	68.8	16.3	0.0
1981	0.0	0.0	0.0	20.0	36.5	77.3	317.0	254.3	151.1	43.4	8.5	0.0
1982	0.0	0.0	38.6	17.1	121.8	132.9	206.6	240.2	207.6	112.1	7.6	x
1983	x	x	x	x	x	x	x	187.5	157.4	40.7	10.5	0.0
1984	0.0	0.0	0.0	0.0	137.3	198.3	381.5	249.7	151.3	19.5	0.0	0.0
1985	0.0	x	x	x	x	130.5	365.1	294.1	13.0	43.1	0.0	0.0
1986	0.0	0.0		17.4	17.3	206.0	353.8	289.2	191.9	201.9	x	0.0
1987	0.0	0.0	x	11.8	252.3		273.3	322.2	x	x	4.3	0.0
1988	0.0	30.5		0.0	43.4	113.0	448.6	419.0	263.2	182.2	202.6	0.0
1989	0.0	0.0	21.3	17.4	48.2	166.1	x	x	x	x	x	x
1990	x	0.0	0.0	0.0	43.5	x	x	244.5	x	x	x	x

Element: Monthly Rain Fall in mm

Region: SHOA

Station: Mehal Meda

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	9.0	23.9	54.9	10.9	1.4	67.0	776.6	394.7	143.7	4.9	0.0	0.0
1981	17.0	45.5	374.0	0.0	0.0	0.0	486.2	454.4	63.5	9.6	18.0	23.7
1982	119.8	39.0	98.2	222.0	96.1	0.0	92.2	292.2	203.9	78.9	8.5	0.0
1983	0.0	24.8	126.1	116.2	32.8	13.0	197.0	311.0	34.4	0.0	5.0	0.0
1984	0.0	1.1	55.0	3.2	46.5	72.4	103.3	24.3	46.2	0.0	0.0	0.0
1985	11.2	2.8	0.0	46.5	85.9	0.0	169.5	353.0	5.2	0.0	0.0	1.6
1986	0.0	58.5	70.3	12.0	17.4	175.0	182.0	281.0	95.7	5.6	0.0	0.0
1987	0.0	74.8	106.9	81.4	103.5	0.0	33.8	249.2	31.9	22.2	0.0	2.8
1988	17.1	67.5	12.4	101.3	0.6	26.8	378.9	240.5	90.2	17.3	0.0	0.0
1989	3.5	75.3	110.7	63.6	5.5	19.9	192.7	252.8	46.6	22.3	0.0	26.9
1990	x	76.0	39.0		0.0	x	x	x	x	x	x	x
1991	x	x	x	x	x	x	x	x	x	0.0	0.0	7.2
1992	43.5	6.6	14.0	74.4	16.4	13.6	232.1	264.0	58.1	36.0	7.7	5.7
1993	2.2				75.5	3.3	231.8	170.5	67.6	40.6	0.0	0.0
1994	0.0	0.0	78.6	32.7	9.3	27.6	299.6	3123.3	84.7	3.0	8.7	0.0
1995	0.0	13.9	29.0	75.2	26.5	30.6	348.2	235.3	63.4	8.6	0.0	23.8
1996	53.4	0.0	127.4	4.3	75.6	91.9	294.6	306.4	37.0	2.3	21.3	0.0
1997	41.5	0.0	9.6	38.2	14.2	100.7	26934.0	104.6	30.7	55.9	23.4	0.0
1998	26.9	23.0	48.7	73.4	51.3	12.9	448.2	296.6	54.0	14.5	0.0	0.0
1999	18.5	0.0	21.7	15.3	22.3	30.5	425.3	279.0	49.2	72.0	0.0	1.2
2000	0.0	0.0	11.0	96.0	18.5	32.9	337.6	314.2	83.0	10.8	13.4	9.3

Element: Monthly Rain Fall in mm

Region: Wello

Station: Mekane Selam

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1982	x	x	77.6	92.8	x	x	150.1	x	x	x	x	x
1985	x	x	x	x	54.2	48.6	155.4	266.3	125.5	9.3	30.1	6.5
1986	50.0	74.1	103.1	154.3	0.0	216.2	336.9	198.2	86.3	20.6	18.5	13.9
1987	0.0	47.8	166.4	81.8	116.8	74.9	107.7	205.5	169.1	8.7	0.0	16.0
1988	15.7	99.7	4.4	x	x	x	x	x	x	x	x	x
1989	1.5	39.0	83.0	99.0	151.3	46.8	167.8	170.5	77.1	x	x	x
1992	x	x	x	49.4	25.9	x	x	x	x	x	x	x
1993		4.6	35.1	205.3	53.3	98.3	x	x	146.7	x	10.4	
1994	0.0	21.9	63.8	44.5	41.9	69.4	192.2	97.5	74.2	8.1	19.0	0.0
1995	0.0	26.4	58.0	101.7	98.6	18.7	320.1	226.1	55.4	0.4	0.0	24.5
1996	32.8	1.6	63.8	102.6	83.1	135.0	243.6	194.5	78.2	0.2	23.3	6.5
1997	48.9	2.2	62.5	73.9	49.4	94.7	201.7	137.9	43.0	110.2	100.2	17.0
1998	23.2	3.7	102.8	48.0	70.2	70.9	319.0	264.7	123.7	118.1	19.3	0.0
1999	8.0	0.0	2.4	63.9	24.0	33.1	265.1	220.2	80.7	90.1	0.0	9.8
2000	0.0	0.0	12.5	127.8	43.8	84.1	286.1	185.0	111.3	74.7	36.5	9.0

Element: Monthly Rain Fall in mm

Region: Gojam

Station:Merawi

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	x	x	x	30.0	137.5	241.4	368.4	382.2	212.1	81.2	29.6	0.0
1982	19.9	0.0	36.9	11.3	145.0	239.5	287.5	332.2	158.6	52.1	x	x
1983	x	x	x	x	x	x	x	388.1	158.6	125.8	7.0	0.0
1984	0.0	0.0	11.6	45.2		327.5	341.1	90.6	242.9	0.0	0.0	27.3
1985	0.0	1.0	12.6	28.0	167.5	188.0	424.1	382.3	343.8	11.4	27.7	2.6
1986	0.0	4.5	4.5	19.4	22.0	359.5	522.2	179.5	204.6	64.7	28.4	0.0
1987	0.0	0.0	19.0	15.2	320.9	314.7	332.5	306.5	353.5	64.3	0.8	0.0
1988	11.2	20.3	1.7	0.0	153.3	366.9	503.3	283.4	165.8	182.1	23.3	0.2
1989	0.0	0.0	46.5	49.1		211.5	374.9	375.8	187.8	104.8	12.1	17.1
1990	2.6	0.0	20.4	2.5	49.8	209.1	474.8	573.5	149.2	x	x	x
1991	0.3	0.0	7.7	131.6	79.0	33.8	609.5	425.8	228.6	131.1	16.0	x
1992	0.0	0.0	3.3	107.4	59.3	249.1	463.9	373.1	331.6	x	x	x
1993	x	x	x	x	x	x	x	x	x	x	x	x
1994	x	x	x	x	x	x	229.9	369.1	159.9	86.1	32.0	0.0
1995	0.0	2.0	15.6	37.3	187.1	291.9	299.8	279.0	158.7	48.6	6.4	29.6

Element: Monthly Rain Fall in mm

Region: Gonder

Station: Metema

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	x	x	x	x	x	x	x	x	x	x	x	x
1981	x	x	x	x	x	x	x	x	x	x	x	x
1982	x	x	x	x	x	x	x	x	x	x	x	x
1987	0.0	0.0	0.0	12.0	180.5	181.6	186.7	273.8	165.6	95.5	7.6	x
1988	0.0	0.0	1.0	0.0	88.2	163.1	257.4	296.7	240.3	84.8	0.0	0.0
1989	0.0	0.0	0.0	0.0	58.2	197.0	158.4	240.0	257.4	7.7	0.0	0.0
1994								249.9	121.7	0.0	3.0	0.0
1995	0.0	0.0	0.0	41.5	46.9	242.4	223.2	252.8	155.8	24.0	x	x
1996	x	x	x	x	x	x	x	x	x	x	x	x
1997	0.0	0.0	91.0	22.8	83.0	156.7	194.5	271.2	166.1	32.5		0.0
1998	0.0	0.0	0.0		67.1	138.7	258.4	204.3	208.1	15.6		0.0
1999	0.0	0.0	0.0	0.3	77.0	143.8	265.5	x	x	164.6	0.0	x
2000	0.0	0.0	0.0	25.5	133.3	327.6	202.6	127.0	163.7	86.5	0.0	0.0

Element: Monthly Rain Fall in mm

Region: Gojam

Station:Motta

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	8.4	60.6	66.5	114.2	84.1	171.2	366.0	360.9	149.1	167.2	18.1	0.9
1981	2.7	5.3	20.6	79.6	127.3	130.0	433.6	323.9	150.8	39.8	123.9	10.9
1982	21.8	0.0	58.5	3.5	69.7	37.8	180.0	x	x	x	x	x
1983	x	x	x	x	x	x	x	331.1	116.4	156.2	42.0	0.0
1984	0.0	0.0	47.0	29.0	94.5	165.1	229.2	180.1	163.1	0.0	3.0	3.1
1985	5.9	0.0	7.1	69.7	151.5	31.0	300.0	457.7	142.3	111.4	318.0	15.8
1986	0.0	18.5	9.4	66.6	32.1	229.0	370.7	230.2	86.4	95.8	5.0	0.0
1987	2.9	10.8	31.3	14.6	148.6	98.7	170.6	194.8	78.6	149.1	52.5	0.8
1988	1.4	75.3	2.0	5.8	11.0	81.3	389.2	323.4	147.7	158.9	5.0	0.0
1989	2.1	3.5	55.6	43.2	46.5	62.4	245.6	230.3	79.7	78.8	10.6	28.1
1990	1.3	32.2	14.4	45.1	20.0	113.0	380.5	178.1	258.8	38.1	x	x
1991	0.9	5.1	x	x	x	61.7	318.7	276.7	229.2	44.8	1.2	19.6
1992	0.0	2.3	13.6	67.7	62.3	73.3	184.1	324.4	78.2	122.5	56.4	32.5
1993	3.0	13.1	36.7	124.7	143.4	77.5	333.4	146.0	200.5	118.4	12.0	0.0
1994	0.0	8.9	10.0	32.8	103.3	99.9	312.3	301.1	150.3	36.1	29.7	7.8
1995	0.0	7.0	9.0	22.0	77.8	60.2	355.2	238.0	104.5	70.3	4.1	22.2
1996	0.3	2.1	66.4	61.4	203.7	110.6	310.9	365.7	164.0	58.4	70.5	9.2
1997	0.4	0.0	54.4	58.7	139.9	176.5	272.0	184.4	164.3	188.2	43.0	3.3
1998	5.7	1.0	18.2	34.4	119.5	93.4	363.4	368.5	170.7	198.8	49.2	0.9
1999	18.8	0.0	0.0	22.6	52.9	109.9	300.4	372.6	157.2	202.7	5.5	26.5
2000	0.0	0.0	7.6	111.5	8.0	38.4	243.1	257.8	148.2	209.8	63.0	x

Element: Monthly Rain Fall in mm

Region: Gonder

Station:Nefas Mewcha

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1986	x	x	x	x	x	160.2	272.4	224.5	113.4	19.7	0.0	7.7
1987	8.6	18.3	71.1	26.5	140.8	29.8	85.6	283.9	46.0	13.2	0.5	38.0
1988	4.8	86.8	0.0	34.2	28.6	42.1	451.8	239.0	142.1	68.0	14.5	5.7
1989	10.6	5.6	96.6	60.5	8.5	52.8	265.4	184.8	x	x	x	x
1990	x	x	x	x	x	x	x	x	x	x	x	x
1991	x	x	x	x	x	x	x	x	x	2.8	6.0	56.5
1992	20.6	10.4	49.7	116.4	91.4	69.1	381.7	660.1	169.5	138.7	115.8	76.3
1993	0.0	19.4	132.7	229.8	98.7	21.6	277.5	229.3	118.0	36.1	0.8	0.3
1994	4.1	19.2	49.6	44.8	x	x	x	x	96.5	3.2	1.0	0.8
1995	0.0	12.0	38.9	59.9	82.0	39.1	366.7	263.4	102.5	1.3	8.9	33.4
1996	19.3	4.6	75.9	70.0	137.9	108.2	333.3	272.8	75.5	2.6	54.1	0.0
1997	0.6	0.0	89.3	63.4	59.4	163.6	181.1	232.3	59.3	133.2	93.7	11.2
1998	26.4	20.2	60.5	18.0	84.8	47.6	510.1	322.5	113.8	60.8	3.0	0.0
1999	35.7	0.0	0.0	9.7	2.7	17.7	32.4	35.2	24.1	19.9	3.8	3.7
2000	0.0	1.6	11.0	118.2	21.7	51.5	347.4	393.5	125.5	144.2	29.1	19.7

Element: Monthly Rain Fall in mm

Region: Gojam

Station:Pawe

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1987		0.0	0.0	36.1	185.6	374.1	285.7	246.1	187.1	0.6	0.0	0.0
1988	0.0	15.3	2.7	0.0	104.7	390.2	431.7	466.0	452.1	125.1	0.0	0.0
1989	0.0	0.0	1.9	38.8	18.8	229.6	473.3	347.9	421.2	99.7	1.0	0.0
1990	2.7	0.0	0.2	0.0	22.8	254.5	404.0	386.5	332.7	133.3	x	x
1991	0.0	0.0	2.7	x	x	x	x	x	x	38.0	0.0	0.0
1992	0.0	0.0	1.8	57.2	71.4	175.1	337.8	481.6	238.9	199.8	9.1	1.2
1993	0.0	0.0	8.2	34.5	112.2	321.4	37.5	290.9	168.6	96.5	31.8	0.0
1994	0.0	0.0	0.0	13.7	154.7	207.4	290.7	304.6	304.8	77.9	51.1	0.0
1995	0.0	0.0	35.3	14.8	92.7	412.9	233.3	433.6	248.1	91.6	0.0	1.4
1996	0.2	0.0	42.5	57.1	98.8	206.9	370.5	532.7	272.5	144.5	12.3	0.0
1997	0.0	0.0	2.1	31.2	147.4	180.4	330.8	383.3	175.7	169.5	16.9	1.4
1998	0.0	0.0	9.8	9.6	153.6	511.3	384.8	366.6	243.0	146.7	2.6	0.0
1999	1.6	0.0	0.0	35.5	180.7	280.8	285.7	359.2	223.6	134.6	19.2	4.3
2000	0.0	0.0	2.1	61.2	188.7	264.8	200.9	365.3	176.7	223.9	23.5	2.0

Element: Monthly Rain Fall in mm

Region: Welo

Station:Wegel Tena

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	11.9	62.1	38.6	45.0	5.8	43.6	254.9	243.3	27.5	14.3	3.0	0.0
1981	20.8	8.9				0.0	277.5	246.5	53.8	13.5	9.7	8.0
1982	23.0	36.8	83.4	121.6	64.9	0.0	89.0	286.8	46.7	15.3	x	x
1983	x	x	x	x	x	x	81.6	314.1	25.9	0.4	15.1	0.0
1984	0.0	28.6	10.5	20.1	57.4	33.9	82.2	54.8	47.3	0.0	31.5	2.9
1985	16.8	0.0	17.4	70.8	108.4	9.0	161.5	234.8	72.5	0.0	0.0	0.5
1986	0.0	30.0	40.6	141.9	91.8	188.6	271.1	416.5	236.7	0.0	0.0	6.2
1987	0.0	43.3	112.5	27.2	109.5	1.1	29.8	218.2	47.8	15.3	0.0	9.2
1988	20.8	x	3.1	x	7.3	18.7	370.9	203.9	107.2	8.7	x	x
1989	8.2	40.6	109.4	48.0	x	x	x	x	x	x	x	x
1992	x	x	86.5	36.0	56.1	9.2	144.8	300.8	67.8	11.0	41.8	20.2
1993	6.3	5.7	66.3		67.1	1.6	222.6	199.1	97.2	7.0	0.0	0.0
1994	0.0	34.5	56.1	68.7	26.0	9.8	272.0	302.0	58.9	0.0	7.6	0.0
1995	0.0	30.8	19.4	160.1	15.5		320.2	244.1	52.2	5.7	0.3	36.4
1996	x	x	x	x	x	16.2	237.1	295.6	54.4	0.0	23.0	x
1997	10.5	x	x	x	30.8	94.4	242.1	166.3	x	32.2	60.7	0.0
1998	32.6	27.0	64.7	83.6	32.9	0.0	422.9	293.6	39.9	1.5		0.0
1999	9.0	0.0	0.0	12.0	1.4	259.0	354.0	277.6	62.4	23.7	0.0	5.0
2000	0.0	0.0	6.1	67.5	55.2	10.9	372.9	302.8	85.6	9.0	39.7	30.6

Element: Monthly Rain Fall in mm

Region: Gonder

Station: Adis Zemen

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	0.0	0.0	0.0	65.7	79.6	205.0	591.0	439.6	238.2	31.8	12.5	6.7
1981	0.0	0.0	23.3	71.4	46.1	156.9	435.1	396.1	102.6	13.0	15.3	0.0
1982	0.0	0.0	1.5	12.0	26.7	52.1	240.6	311.6	165.1	75.6	0.0	
1983	x	x	x	x	x	x	x	333.7	81.2	62.3	0.0	0.0
1984	0.0	0.0	0.0	9.2	125.5	206.9	347.1	330.7	170.4	0.0	0.0	16.5
1985	0.0	9.0	0.0	25.6	96.0	137.1	535.8	415.9	83.6	17.2	2.2	0.0
1986	0.0	0.0	5.2	3.2	0.0	211.0	256.5	410.0	194.2	0.0	0.0	0.0
1987	0.0	0.0	0.0	4.3	97.6	162.8	355.4	328.4	75.4	21.3	0.0	0.0
1988	0.0	37.3	0.0	0.0	6.1	185.6	666.2	324.4	158.3	109.8	0.0	0.5
1989	0.0	0.0	2.2	17.4	52.3	189.5	445.9	260.4	134.0	96.1	5.0	9.0
1990	0.0	0.0	0.0	11.5	0.0	60.0	539.0	439.2	342.5	108.3	0.0	0.0
1991	x	0.0	2.4	24.2	16.3	81.5	x	x	x	x	x	x
1992	x	x	x	x	x	x	x	x	x	x	x	x
1993	x	x	x	25.2	66.4	160.2	335.2	376.0	243.0	48.5	6.9	0.0
1994	0.0	0.0	0.0	16.3	46.3	292.1	383.5	357.2	134.7	0.0	4.6	4.1
1995	0.0	3.1	17.2	0.0	91.3	91.4	292.7	312.4	58.6	2.3	0.0	2.3
1996	0.0	0.0	14.8	21.7	82.4	421.1	219.5	262.3	106.4	12.6	23.0	0.0
1997	x	0.0	4.7	26.2	1.7	118.3	337.0	49.4	33.7	56.9	5.0	0.0
1998	0.0	0.0	0.0	11.1	32.4	106.8	325.5	187.0	19.9	1.2	0.0	0.0
1999	x	x	x	x	x	x	x	349.1	156.1	107.0	0.0	0.0
2000	0.0	0.0	0.0	71.5	19.8	166.1	598.7	512.2	150.2	51.6	14.0	0.0

Element: Monthly Rain Fall in mm

Region: Kefa

Station: Agaro

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	x	x	x	x	x	x	x	x	x	x	x	x
1981	x	x	x	x	x	x	x	x	x	x	x	x
1982	x	78.4	78.3	115.0	158.6			211.2	191.8			x
1983	x	63.0		37.7	184.0	342.0	x	x	x	x	x	x
1984	3.8	x	x	50.1	167.1	285.7	218.9	132.0	119.5	13.6	107.2	26.6
1985	0.0	0.0	74.1	118.0	198.1	220.5	305.5	189.9	135.4	83.6	37.0	30.8
1986	18.4	53.0	128.8	66.7	143.4	202.4	237.1	84.6	139.3	31.3	23.2	11.5
1987	8.1	40.2	11.7	81.5	110.1	171.8	257.3	192.6	231.8	160.4	17.2	x
1988	68.1	40.3	39.3	58.8	220.6	390.0	246.3	285.8	218.9	289.5	3.9	10.2
1989	14.4	19.8	101.4	117.2	106.1	167.1	249.5	285.9	85.0	88.8	47.5	149.3
1990	0.0	52.5	264.6	125.7	106.1	282.4	285.2	373.4	200.8	25.5	71.7	6.8
1991	116.9	25.1		62.6	169.6	320.9	252.2	278.8	195.4	57.4	19.9	101.8
1992	36.1	36.3	109.0	135.1	184.0	173.8	256.0	97.8	186.4	101.3	46.9	11.2
1993	44.0	122.6	71.8	191.2	221.0	306.1	141.0	241.1	176.3	239.0	8.3	0.0
1994	95.0	1.5	49.2	85.5	212.6	221.8	x	x	x	x	x	x
1995	x	x	57.3	194.1	159.4	191.7	201.0	293.9	242.3	66.2	24.5	168.4
1996	36.8	58.3	189.3	118.7	262.6	228.3	369.2	106.3	288.1	63.7	118.0	24.8
1997	88.1	21.6	56.4	126.4	264.5	361.5	201.3	230.4	206.7	307.0	205.7	79.4
1998	70.6	21.5	117.5	66.6	106.5	227.4	270.9	365.6	208.8	212.0	75.8	0.0
1999	3.8	6.8	34.1	98.4	212.3		197.5	144.2	191.3	209.6	16.3	17.9
2000	0.0	1.0	119.1	99.7	267.3	297.3	184.3	187.2	273.9	293.1	30.7	32.3

Element: Monthly Rain Fall in mm

Region: SHOA

Station: Alem Ketema

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	12.6	49.6	48.3	81.8	22.6	51.4	485.6	419.4	103.2	29.0	0.4	0.0
1981	0.0	0.7	87.9	51.9	3.2	9.6	414.2	380.4	380.4	7.3	0.0	6.2
1982	9.6	16.8	30.8	90.7	128.6	39.0	88.6	524.3	524.3	1736.0	69.1	0.0
1983	0.0	6.9	92.0	70.0	20.8	31.8	225.4	393.8	393.8	49.6	0.2	0.0
1984	0.0	16.6	32.2	6.3	122.8	127.8	250.1	184.9	184.9	0.0	3.4	4.5
1985	20.3	0.0	13.2	171.2	68.6	17.4	406.7	375.9	375.9	0.0	0.0	0.0
1986	0.0	38.1	47.3	95.5	95.8	138.7	344.4	470.9	470.9	2.7	0.0	0.0
1987	0.0	4.1	125.3	146.4	173.4	6.8	138.9	191.7	191.7	0.0	0.0	24.1
1988	13.3	30.4	0.0	54.0	0.0	57.0	573.5	406.0	406.0	23.4	0.0	0.0
1989	11.4	57.8	82.7	70.9	4.3	43.3	173.2	561.2	561.2	38.2	0.0	51.9
1990	1.0	63.0	21.6									
1991							233.2	342.9	29.5	0.0	0.0	7.9
1992	14.1	48.6	33.2	56.1	15.8	16.8	204.4	326.7	133.9	50.1	112.9	0.0
1993	0.0	23.5	11.7	123.3	111.4	48.3	345.5	256.6	194.6	23.6	0.0	0.0
1994	0.0	0.0	44.0	26.2	8.3	98.6	290.7	320.0	170.5	0.0	2.2	0.0
1995	0.0	3.4	53.9	43.9	50.1	26.0	229.0	342.3	83.3	0.0	0.0	9.8
1996	25.9	6.7	101.6	11.5	79.0	191.1	319.9	338.5	95.0	0.0	16.0	0.0
1997	20.3	0.0	49.3	37.1	40.3	190.0	344.2	252.5	85.0	76.0	46.3	2.1
1998	17.4	17.6	28.3	25.0	73.4	66.8	247.2	355.5	87.1			0.0
1999	7.2	0.0	0.0	1.5	10.0	39.3	297.4	514.6	66.3	151.8	0.0	1.3
2000	0.0	0.0	36.1	103.7	88.1	58.6	449.1	311.5	122.1	7.2	0.0	0.4

Element: Monthly Rain Fall in mm

Region: SHOA

Station: Ambo J.C.A.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1984	0.0	x	11.7	7.6	119.6	187.1	255.0	94.9	x	x	x	x
1985	0.0	x	x	x	x	x	136.2	239.3	109.5	27.5	5.1	9.0
1986	4.4	61.6	49.5	103.7	84.3	196.8	216.7	177.5	115.5	32.8	0.4	0.9
1987	1.5	38.1	144.2	119.8	185.4	129.1	123.1	229.1	62.9	13.8	1.9	49.2
1988	80.0	232.6	8.5	31.5	35.6	116.7	213.5	169.0	141.6	0.6	0.0	
1989	207.0	5.0	37.3	61.5	52.9	164.1	219.5	171.7	134.5	51.8	0.0	42.7
1990	20.0	109.9	78.2	19.5	59.2	185.1	315.9	197.1	94.8	3.3	0.0	x
1991	1.6	58.7	52.4	x	x	x	x	x	x	x	x	x
1992	x	x	x	x	x	x	x	x	x	x	x	x
1993	x	35.6	10.5	181.9	121.2	178.3	268.5	215.5	121.3	25.1	0.0	0.0
1994	x	x	x	x	x	x	x	x	x	x	x	x
1995	x	x	x	x	x	x	x	x	x	x	x	x
1996	x	x	x	x	x	x	x	x	x	x	x	2.2
1997	x	x	x	x	x	x	x	x	x	x	x	0.0
1998	73.7	10.4	40.6	30.7							x	x
1999	8.4	1.0	39.5	20.1	99.2	108.4	195.9	132.9	95.9	119.9	1.3	x
2000	0.0	0.0	9.3	51.5	93.7	121.2	185.5	191.6	131.2	83.7	20.7	14.8

Element: Monthly Rain Fall in mm

Region: Gojam

Station: B/Dar Synoptic

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	0.0	4.4	16.1	51.8	27.9	136.1	349.2	320.5	153.5	55.5	3.2	0.0
1981	0.0	0.0	0.0	68.5	45.3	66.0	636.4	382.7	132.3	57.7	8.0	0.0
1982	4.7	0.1	42.8	9.1	35.4	78.4	266.9	261.5	116.7	73.0	6.0	0.0
1983	0.0	0.3	0.0	0.5	27.5	124.2	335.9	457.6	170.3	126.8	14.1	0.0
1984	0.0	0.0	4.4	0.3	66.3	234.8	381.0	310.4	209.6	0.0	0.1	9.8
1985	3.5	0.0	2.9	66.3	128.8	186.5	446.9	385.3	205.7	64.3	4.4	0.0
1986	0.0	0.3	5.1	16.5	9.4	212.4	410.7	273.2	170.8	115.9	0.0	0.0
1987	0.0	0.1	0.8	8.3	197.7	234.5	208.1	304.2	133.6	97.2	9.3	0.0
1988	1.2	26.9	0.0	0.0	31.6	164.9	467.1	273.8	192.2	116.6	31.0	8.8
1989	0.0	0.0	7.9	9.8	123.0	169.6	417.9	513.0	268.7	66.0	16.4	3.0
1990	4.6	0.6	1.0	9.8	16.9	83.6	559.5	482.2	226.2	38.4	0.0	0.0
1991	0.0	0.1 x	x	x	x	173.1	557.2	358.1	227.6	100.5	0.9	0.0
1992	0.0	0.0	4.3	63.7	49.9	114.4	305.6	446.8	157.1	206.6	65.3	0.0
1993	5.5	0.0	12.2	27.4	106.3	207.8	476.5	342.8	252.0	114.9	18.9	0.0
1994	0.0	0.8	0.0	21.7	112.3	190.3	314.1	272.0	145.6	19.2	3.7	5.6
1995	0.0	4.1	7.2	17.3	42.4	196.1	185.0	67.1	14.4	0.0	0.0	0.9
1996	0.0	0.7	28.0	49.0	99.2	261.6	295.2	359.3	211.9	39.9	26.7	0.0
1997	0.0	0.0	19.4	29.1	237.5	121.7	233.5	217.5	179.7	135.5	23.4	10.1
1998	0.0	0.0	18.8	0.6	107.6	196.5	284.0	433.0	240.6	115.3	1.0 x	
1999	9.0	0.0	0.0	8.1	45.7	129.9	393.6	485.7	196.3	197.3	3.0	0.0
2000	0.0	0.0	0.3	90.3	61.2	153.7	314.2	512.2	225.8	179.3	27.8	0.0

Element: Monthly Rain Fall in mm

Region: Gonder

Station: Chagni

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	0.0	12.8	38.6	87.9	115.6	233.5	289.5	289.5	302.6	166.0	35.4	0.5
1981	7.6	0.0	0.0	5.6	1208.8	171.6	497.1	497.1	269.1	127.4	36.9	0.0
1982	17.7	0.0	86.5	59.3	115.2	288.0	459.9	459.9	279.1	322.1	0.0	0.0
1983	0.0	0.0	0.0	x	x	x	339.9	339.9	336.8	205.8	17.2	0.0
1984	0.0	0.0	0.0	30.5	219.5	293.7	446.0	446.0	340.8	123.7	x	0.0
1985	0.0	0.0	15.7	14.8	328.5	309.0	536.7	536.7	268.6	140.1	16.5	31.9
1986	0.0	0.0	0.0	9.8	23.5	299.9	244.4	244.4	255.2	174.6	21.6	0.0
1987	13.6	0.0	0.3	53.1	200.4	202.1	284.3	284.3	294.4	202.6	26.5	0.3
1988	3.0	42.4	2.1	0.0	149.6	394.9	344.1	344.1	322.5	219.5	22.4	194.5
1989	0.0	0.0	14.3	35.8	218.4	278.4	394.9	394.9	224.0	161.5	5.1	7.2
1990	17.4	0.0	10.7	0.1	65.2	165.3	388.2	483.2	273.8	x	x	x
1991	0.0	x	x	x	x	x	x	x	x	110.6	x	x
1992	x	x	x	x	x	171.2	377.9	x	x	x	x	x
1998	x	x	x	x	142.9	359.9	299.7	246.0	261.2	392.4	44.2	3.2
1999	1.2	0.0	x	24.9	260.9	336.5	234.3	391.7	391.7	228.0	30.7	15.2
2000	0.0	0.0	1.8	122.1	155.9	286.5	334.8	360.1	360.1	316.5	47.7	3.0

Element: Monthly Rain Fall in mm

Region: Gonder

Station:Dabat p Station

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1988	0.0	0.0	0.0	18.0	0.0	x	x	185.3	x	x	x	x
1998	0.0	0.0	16.0	4.9	16.4	119.4	311.6	224.7	191.0	14.4	2.0	0.0
1999	x	x	x	x	x	139.1	263.0	283.7	x	65.2	x	0.0
2000	0.0	9.0	0.0	x	19.5	82.8	218.7	150.4	117.4	76.5	10.4	0.0

Draft

Element: Monthly Rain Fall in mm

Region: Gonder

Station:Debark

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	0.0	11.7	1.7	60.3	67.9	123.8	420.0	310.2	85.7	34.9	8.4	0.0
1981	8.0	0.0	22.4	92.1	74.3	98.2	445.9	547.4	152.1	34.1	0.7	2.7
1982	0.0	0.1	79.9	96.8	51.7	x	360.4	381.6	391.6	29.1	9.2	x
1983												
1984	0.0	0.0	18.5	29.5	146.9	197.5	271.9	66.7	12.5	x	2.2	20.4
1985	0.0	0.0	34.0	40.6		239.2	385.6	294.6	277.6	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	227.0	x	x	x		0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	31.9	220.4	95.0	300.4	49.6	18.4	1.3	x
1988	0.0	43.6	10.0	49.4	167.5	192.9	752.7	575.0	117.7	242.0	x	x
1989	0.0	x	x	x	x	214.3	733.2	318.1	99.2	x	x	x
1992	x	x	x	x	x	17.5	200.4	248.5	97.9	214.7	55.3	1.1
1993	0.7	x	21.3	54.2	83.3	96.6	165.0	162.7	176.4	70.1	0.0	0.0
1994	0.0	0.5	0.5	16.3	67.9	160.7	255.1	313.8	101.1	22.3	15.2	0.0
1995	0.0	1.1	19.4	3.7	131.3	113.4	280.2	308.0	114.4	4.0	5.0	2.1
1996	0.0	0.0	71.6	94.9	125.9	319.1	242.5	224.7	109.8	x	56.5	4.9
1997	0.0	0.0	14.3	33.2	112.8	97.8	225.0	296.5	54.6	85.7	32.0	0.7
1998	0.0	0.0	x	0.0	171.7	162.7	317.9	334.1	192.4	118.8	13.4	0.0
1999	12.7	0.0	0.0	26.3	52.8	91.1	334.6	252.8	141.0	106.6	20.8	18.0
2000	0.0	0.0	0.0	95.9	12.9	156.5	283.8	284.2	189.1	113.5	23.0	0.0

Element: Monthly Rain Fall in mm

Region: SHOA

Station:D/Birhan

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	x	x	x	x	x	x	x	x	x	x	x	x
1981	x	x	x	x	x	x	x	x	x	x	x	x
1982	10.7	29.7	0.0	45.0	67.4	0.7	183.4	270.8	53.8	41.3	x	x
1983	x	x	x	x	x	x	x	x	x	x	x	x
1984	0.0	0.0	26.6	0.0	80.0	90.2	181.2	122.7	106.4	0.0	0.0	0.0
1985	17.4	0.0	27.3	58.6	83.2	15.8	314.6	376.6	88.4	6.5	5.7	0.0
1986	0.0	74.7	99.2	52.5	27.0	141.9	271.3	274.7	115.7	11.3	0.0	0.0
1987	5.0	19.2	108.1	51.7	100.2	0.0	32.3	309.5	47.5	18.7	0.0	6.3
1988	10.6	34.6	16.9	83.1	16.2	16.0	286.2	290.0	152.5	12.1	0.0	0.0
1989	2.3	40.5	97.6	42.7	1.4	41.1	211.3	177.4	67.7	18.6	0.0	30.7
1990	0.0	x	x	59.5	0.9	1.6	321.0	217.2	168.7	0.6	0.0	0.0
1991	4.8	8.3	64.6	21.0	12.0	63.7	215.6	387.5	86.6	6.4	0.0	6.4
1992	30.3	26.7	19.4	80.2	19.3	13.3	307.6	267.6	90.2	41.9	0.5	1.8
1993	4.3	63.2	0.0	116.9	60.5	9.1	506.6	168.4	107.7	43.2	0.0	1.1
1994	0.0	0.0	95.6	0.0	23.2	92.7	391.7	222.9	101.7	x	36.5	0.0
1995	0.0	28.5	19.1	68.4	26.5	23.3	x	233.8	60.4	5.1	0.0	1.7
1996	20.7	2.8	75.4	9.7	129.2	138.0	336.4	252.5	24.3	0.0	3.0	0.0
1997	29.5	4.0	41.2	82.4	25.9	95.1	272.1	200.6	34.8	89.1	x	x
1998	26.7	13.2	14.6	49.3	43.0	13.5	337.3	289.0	70.6	5.2	0.0	0.0
1999	0.0	0.0	26.5	2.8	11.8	48.9	362.4	365.1	52.4	59.6	1.4	0.0
2000	0.0	0.0	25.9	47.3	37.1	16.6	352.4	317.5	105.2	28.5	18.8	6.8

Element: Monthly Rain Fall in mm

Region: Gojam

Station:Debre Markos

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	17.8	26.3	33.9	98.0	169.3	168.4	343.3	342.8	168.6	75.4	9.1	0.0
1981	13.2	1.9	41.4	90.8	77.6	103.3	356.3	315.9	137.1	14.0	0.6	0.0
1982	32.6	13.3	59.8	33.7	88.7	124.2	246.2	328.5	222.2	169.7	41.3	6.3
1983	0.0	14.7	43.8	47.3	114.4	68.2	202.8	360.0	226.6	114.0	47.8	0.0
1984	3.7	0.0	25.4	13.4	103.7	237.6	340.6	162.6	159.4	0.0	13.8	21.4
1985	5.3	0.0	16.8	45.8	129.4	146.5	363.5	441.4	182.9	29.5	27.8	15.3
1986	0.0	31.2	10.3	93.9	28.2	193.8	267.8	267.9	133.2	53.1	0.0	0.0
1987	0.0	26.0	109.2	53.9	188.9	178.8	219.9	258.2	128.1	86.8	6.1	17.1
1988	14.4	60.2	0.7	52.3	31.7	173.8	265.6	335.8	261.1	95.4	1.5	0.0
1989	6.5	22.8	142.5	91.0	25.0	163.1	355.4	330.7	204.4	9.4	7.7	85.9
1990	4.8	18.9	52.1	70.2	32.9	148.5	325.1	353.3	275.8	11.2	20.7	0.0
1991	8.8	3.8	x	x	x	113.9	221.3	311.8	168.0	50.8	32.5	51.0
1992	28.6	31.6	31.0	123.9	83.1	144.9	164.9	307.9	168.7	94.6	72.7	5.5
1993	8.0	27.4	37.8	120.5	197.6	209.6	305.8	262.9	322.1	150.1	5.5	0.0
1994	8.3	5.0	35.2	42.7	139.6	147.6	281.2	301.0	218.1	7.4	13.2	0.5
1995	0.0	1.0	20.3	90.4	146.6	126.4	246.1	344.6	151.2	14.4	12.4	95.5
1996	27.6	4.6	74.1	18.0	228.0	291.7	252.3	360.5	152.1	33.1	35.2	23.2
1997	14.3	0.0	29.6	97.5	118.7	151.0	283.8	338.8	205.8	183.5	85.0	6.7
1998	2.9	2.2	21.0	4.4	152.4	86.0	203.2	252.6	270.7	200.8	6.9	0.0
1999	72.6	0.0	2.8	43.2	46.8	180.7	251.1	340.3	164.3	210.5	2.5	28.3
2000	0.0	0.0	2.9	110.5	29.5	174.9	281.7	211.1	271.0	265.9	32.7	12.3

EVAPORATION

Draft

Monthly Piche Evaporation

Region: Shoa

Station: Debre Birhan

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1985	109.0	105.8	149.3	96.8	114.7	123.7	77.6	68.9	93.9	100.8	104.3	102.0
1986	110.7	76.9	117.4	73.6	117.2	77.2	63.5	26.9	60.0	96.3	72.9	76.7
1987	119.6	101.6	112.1	87.1	107.1	97.1	160.9	92.8	85.3	98.1	99.5	100.0
1988	112.6	102.4	173.1	134.4	187.0	165.8	117.2	90.5	117.8	94.7	106.1	131.8
1989	116.6	131.2	109.5	62.5	149.4	110.1	97.7	86.8	91.7	90.0	102.9	79.5
1990	127.3	x	x	82.9	173.7	146.0	95.6	89.1	85.9	77.4	77.7	x

Monthly Piche Evaporation

Region: Gojam

Station: Chagini

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	139.9	129.9	169.6	166.0	15.6	23.6	12.7	28.0	38.1	59.0	102.6	115.0
1981	130.9	148.9	176.0	176.3	79.3	35.4	14.6	20.0	32.1	78.9	90.0	120.0
1982	144.6	152.0	159.6	199.2	123.7	45.3	23.6	22.4	35.0	51.9	117.2	120.1
1983	159.4	145.1	165.2	159.7	159.4	26.4	56.9	30.3	39.2	46.7	93.2	125.7
1984	146.8	148.9	110.1	137.4	92.1	97.5	94.3	83.7	100.1	96.6	94.3	164.4
1985	187.3	192.0	228.6	212.8	120.0	66.1	63.6	43.8	46.8	74.2	120.9	131.6
1986	117.2	193.6	233.8	229.3	260.6	60.7	56.5	51.9	44.9	73.2	126.8	16.3
1987	165.9	203.8	248.2	164.6	102.5	82.4	60.7	55.1	79.4	81.1	98.3	139.2
1988	171.1	153.5	236.3	269.8	159.9	177.6	45.1	x	x	x	x	x
1988	x	x	x	x	133.4	83.9	44.3	46.4	47.3	45.2	108.9	179.4
1999	211.5	290.7		310.1	103.5	66.4	46.7	50.0	49.2	57.3	111.6	155.7
2000	213.7	254.1	293.9	176.7	95.3	59.6	51.2	40.0	47.8	49.9	97.1	132.3

Monthly Piche Evaporation**Region: Gojam****Station: B/Dar Synoptic**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1997	140.8	159.7	194.7	177.8	117.4	72.0	61.4	64.0	80.0	66.0	101.3	126.6
1998	20.9	135.1	198.8	231.8	162.5	104.9	60.2	54.7	75.3	109.8	143.3	172.3
1999	153.1	220.5	249.6	267.9	175.6	137.4	76.4	69.2	85.4	114.1	236.0	146.6
2000	176.5	212.2	274.7	202.5	198.0	125.5	81.1	72.7	91.5	101.3	114.1	121.1

Draft

Monthly Piche Evaporation

Region: Shoa

Station: Ambo

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1983	x	x	x	x	x	x	x	x	x	79.4	89.6	118.8
1986	282.6	205.7	241.2	167.5	187.8	78.1	52.9	34.7	x	x	185.0	243.7
1987	221.6	134.8	144.6	165.3	127.0	60.0	39.4	37.9	80.8	150.3	175.7	203.2
1988	193.4	155.8	257.4	12.7	161.5	15.5	22.8	30.8	46.7	57.7	x	x
1989	x	x	8.3	x	x	x	x	18.8	48.4	x	76.2	92.4
1990	121.6	62.3	11.5	105.3	108.1	63.2	35.4	35.4	38.5	101.4	120.5	x
1991	75.2	59.3	69.6	x	x	x	x	x	x	x	x	x
1993	79.0	66.0	75.0	55.3	52.6	30.4	29.2	27.8	24.7	41.6	66.5	82.4
1999	x	x	x	x	x	x	x	40.8	x	x	x	x
2000	x	337.5	360.8	183.6	161.2	x	x	x	x	x	x	x

Monthly Piche Evaporation

Region: Shoa

Station: Alem Ketema

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1989	99.7	129.2	133	106.5	188.7	147.9	56.4	39.8	62.5	122	134.7	87.6
1990	136.1	105.6	126.6	x	x	x	x	x	x	x	x	
1991		x	x	x	x	x	x	x	x	92.7	194.1	191.8
1992	170.0	160.3	204.3	211.4	245.1	210.0	68.1	27.4	73.1	131.9	135.9	162.5
1993	233.1	231.9	278.3	x	x	49.2	49.6	59.3	64.6	182.2	217.2	246.8
1994	284.9	235.7	238.3	215.6	298.2	175.0	56.9	44.2	94.8	187.6	192.8	250.1
1995	256.9	215.5	256.0	172.7	240.7	229.6	76.5	43.0	107.3	224.1	211.6	194.2
1996	177.5	211.0	162.8	222.0	189.0	103.3	63.8	53.0	91.6	110.2	176.2	185.7
1997	202.0	273.7	230.5	223.5	274.8	167.3	57.2	56.5	133.3	131.0	152.2	212.8
1998	194.8	202.4	221.2	241.2	227.8	164.1	46.6	27.8	67.3	x	x	x
1999	x	x	x	x	x	168.2	57.9	44.1	90.3	112.7	237.0	237.6
2000	289.0	348.9	373.4	253.8	317.8	238.4	61.4	47.0	91.3	147.8	169.3	221.4

Monthly Piche Evaporation

Region: Gojam

Station: Motta

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990	x	92.8	182.7	240.0	266.1	164.7	58.7	64.0	77.0	147.6	154.8	183.0
1991	180.9	208.6	x	x	x	x	52.7	52.7	74.6	118.4	141.1	169.1
1992	157.0	218.8	272.3	175.6	228.7	157.2	74.7	39.7	80.0	78.9	88.5	113.3
1993	152.0	166.8	203.0	141.9	90.2	68.3	x	x	x	x	x	x
1998	161.0	194.3	251.7	244.1	182.9	117.3	41.3	42.9	65.6	78.1	129.0	187.0
1999	165.0	237.2	275.0	242.3	186.9	129.6	51.0	51.2	69.1	75.1	135.0	156.9
2000	157.2	154.6	181.3	149.6	153.8	120.4	75.8	47.6	76.7	x	x	x

Monthly Piche Evaporation**Region: Shoa****Station: Mehal Meda**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1997	152.8	247.4	191.9	187.2	259.9	177.6	96.4	74.5	164.6	157.4	144.7	227.3
1998	155.0	125.7	149.4	170.3	214.4	264.2	58.0	48.8	110.1	125.6	157.6	217.1
1999	182.4	238.5	152.0	203.9	216.6	196.2	49.6	69.1	96.4	89.2	14.3	159.0
2000	173.1	212.1	230.1	161.7	212.9	209.9	71.3	55.4	94.0	101.5	128.7	166.7

Draft

Monthly Piche Evaporation

Region: Gonder

Station:Gonder Air Port

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	359.5	291.7	414.3	239.4	262.9	151.8	101.8	108.9	153.0	210.3	x	x
1981	237.8	368.4	367.8	326.9	253.0	249.6	x	x	x	259.7	293.5	378.6
1982	383.6	384.6	395.6	483.3	244.5	258.6	160.0	100.5	155.6	216.9	282.9	352.6
1983	363.4	386.3	266.5	441.2	341.3	197.8	126.4	101.3	143.8	187.2	269.8	261.2
1984	380.0	430.4	382.7	402.6	310.4	96.4	125.5	130.6	148.9	284.7	221.8	233.7
1985	323.2	287.7	336.6	273.3	129.5	120.3	176.0	74.8	96.9	181.7	177.1	230.2
1997	291.6	298.7	345.0	310.3	x	107.1	83.2	72.0	134.6	131.5	157.4	171.7
1998	299.3	301.6	337.3	239.9	250.6	160.6	62.7	54.5	111.2	113.5	223.5	239.8
1999	281.1	340.4	356.8	325.7	222.5	157.0	63.9	7.6	108.3	80.6	223.0	215.3
2000	268.0	339.7	313.2	202.3	244.9	159.8	79.0	67.6	97.9	96.6	160.4	x

Monthly Piche Evaporation

Region: Gojam

Station: Finote Selam

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1982	162.5	138.0	150.2	144.3	140.8	161.4	90.2	88.6	92.7	155.5	134.1	153.6
1983	157.4	143.8	188.6	195.8	131.5	116.0	103.5	80.1	118.7	153.9	162.0	177.9
1984	19135.0	210.6	x	145.2	138.7	101.6	115.2	110.1	108.5	146.7	136.7	128.9
1985	172.5	143.2	x	x	x	x	x	x	x	x	x	x
1986	x	x	x	x	231.8	60.9	x	60.0	x	87.9	134.8	146.9
1987	175.1	162.6	173.2	166.8	99.5	89.6	82.7	75.9	101.3	118.8	99.9	99.9
1888	171.7	145.1	239.4	266.9	177.0	56.0	41.7	51.5	72.9	83.5	x	x

Monthly Piche Evaporation**Region: Shoa****Station: Fiche**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1997	124.0	207.6	165.4	136.2	191.5	122.4	42.2	44.7	98.4	91.0	81.7	136.3
1998	119.2	133.5	140.0	165.6	166.1	141.7	36.5	27.2	53.3	79.6	182.2	161.8
1999	158.0	213.3	166.5	208.2	197.5	158.6	34.7	39.9	69.1	77.4	136.0	135.6
2000	183.8	208.9	230.1	142.9	202.9	150.9	45.9	40.6	66.7	99.4	115.7	151.4

Draft

Monthly Piche Evaporation

Region: Gojam

Station: Dabre Markos

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	128.9	110.3	170.6	149.8	114.5	71.1	43.5	50.2	126.3	199.8	X	X
1981	391.8	X	373.7	X	X	239.6	X	31.5	72.3	321.1	339.1	359.9
1982	287.8	279.0	309.5	294.3	228.4	100.8	44.0	43.1	92.9	X	X	X
1985	182.2	195.5	233.9	174.6	99.8	62.9	24.4	27.9	57.1	108.4	131.9	151.2
1986	X	166.1	177.5	149.0	200.1	56.1	37.0	39.1	54.2	94.0	147.5	170.0
1987	174.5	167.4	140.0	150.0	101.5	51.8	40.0	36.0	71.2	81.1	122.8	148.8
1988	287.8	131.7	229.2	209.1	154.7	X	X	25.0	31.2	38.8	X	X
1989												
1990		51.8	193.4	191.0	193.6	71.6	35.8	28.8	39.2	135.7	127.5	189.6
1991	181.5	188.2	X	X	X	19.2	33.6	23.1	59.8	138.5	139.8	160.6
1992	146.6	163.8	197.0	167.3	141.3	65.4	34.2	24.3	53.0	80.6	102.6	126.6
1993	166.0	136.4	196.7	54.4	89.3	51.9	44.9	30.0	41.8	56.8	124.1	198.1
1994	194.6	188.0	166.5	193.0	133.3	59.8	36.9	36.8	83.3	181.1	154.0	237.1
1995	263.2	229.2	225.9	144.7	114.8	X	X	X	X	X	X	X
1996	42.6	194.1	158.3	130.5	99.8	42.5	38.1	42.0	63.6	136.3	139.9	154.5
1997	176.5	258.4	250.4	165.3	148.9	68.0	39.5	42.0	93.6	119.6	84.2	
1998	169.4	197.4	202.0	247.7	147.5	61.2	35.7	30.1	46.1	69.0	139.1	230.1
1999	198.2	283.6	293.6	233.0	154.6	77.8	38.5	38.6	X	21.1	X	X

MONTHLY RUNOFF VOLUME

Draft

SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION NAME: Dabus nr. Assosa BASIN Abbay DRAINAGE AREA 10139 Sq.KM. Stn. No. 115002

YEAR	*	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL		
1963	I							609.765	1141.664	1293.379	1009.300	482.895				
1968	I	173.360	103.42	64.223	37.452		196.231	410.940	1113.328	1289.010	1089.467	467.611	328.451			
1969	I	149.879	83.641	74.000	49.503	57.755	207.927		1193.597	1414.903	1008.933	468.326	245.494			
1970	I	139.722	75.615	58.265	37.367	40.637	150.581	375.597	699.595	1245.773	1148.384	577.882	259.055	4808.473		
1971	I	162.227	81.343	51.480			123.634	384.082	863.599	1193.457	1008.663	526.522	278.620			
1972	I	153.353	81.935	45.901		52.006	181.09	446.64	750.281	1101.731	956.635	430.559	284.089			
1973	I	110.164	51.365						734.272	1216.452	1093.828	525.643	196.373			
1974	I	123.822	61.818	45.159			261.158	477.669	843.136	1239.029	1113.233	500.687	225.648			
1975	I	117.628											216.243			
1976	I				35.385	60.476	158.834									
1977	I							339.236	552.593	893.279	918.882					
1978	I	109.708	51.318	37.979	34.349	67.872										
1979	I		74.46	47.425	31.429	77.922	193.593	467.264								
1980	I															

* I. MONTHLY RUNOFF IN MILLION M³

* I - MONTHLY RUNOFF IN MILLION m³

II - MAXIMUM DISCHARGE IN m³/s

III - MINIMUM DISCHARGE IN m³/s

MP = MOMENTARY PEAK IN m³/Sec

MMD = MAX. MEAN DAILY PEAK IN m³/Sec

SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION:- DABANA nr. ABASINA
 BASIN:- Blue Nile
 DRAINAGE AREA, Km²:- 3281

STATION No.:- 114005
 Co-Ordinate:- 9d02'n 36d03'e

YEAR	*	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1961	I					19.650		350.400	461.480	657.200	495.310	132.940	73.540	
1962	I	37.830	17.800	16.300	8.050	28.570			389.090	451.340	331.540	91.470	44.110	
1963	I	27.840	13.410	11.060	23.850	40.190	68.180	289.900	505.340	518.500	234.610	104.930	69.260	1907.070
1964	I	36.000	18.300	9.310	12.400		77.800	201.400	390.400	515.000	533.500	138.900	74.500	
1965	I	38.240	21.860	15.320	27.430	14.760	84.690	289.700	497.500	566.900	550.500	170.300	89.400	2366.600
1966	I	50.000	34.110		21.240	35.250	185.700	314.200	344.500	399.800	154.370	80.260	45.800	
1967	I	27.880	15.870	19.360	11.560	22.940	96.360	199.420	392.310	609.700	437.700	155.260	100.880	2089.240
1968	I	50.530	38.700	20.450	13.020	19.200	109.050	256.520	469.100	375.300	289.410	85.470	47.660	1774.410
1969	I	35.149	22.525	24.071	20.933	29.604	127.092	312.399	424.150	449.200	191.540	77.080	42.930	1756.673
1970	I	30.570	15.640	17.260			67.250	216.880	444.000	526.300	337.420	105.090	54.380	
1971	I	35.620	15.950	12.290	8.120	22.140	91.070	230.200	337.830	333.230	287.770	130.010	60.020	1564.250
1972	I	37.850	19.070	10.400	15.300	21.200	72.080	314.900	398.900	386.100	157.300	90.450	45.840	1569.390
1973	I	31.860	21.230	7.290	10.410	45.290	141.290	256.200			287.200	108.470	51.980	
1974	I	33.990	16.390	17.860	6.880	82.270	188.190	297.960	456.480	498.920	278.420	116.220	71.730	2065.310
1975	I	31.580	29.410	12.290	9.220	23.260	81.210	206.430		418.900	326.300	138.890	84.490	
1976	I	51.310	27.180	23.570	16.000	41.090	103.780	190.500	164.500	389.100	187.460	123.370	74.540	1392.400
1977	I	45.730	27.360	20.080			130.660	231.500	173.600	585.560	465.200	159.240	100.380	
1978	I	61.820	32.840	33.120	31.760	78.440	146.050			668.870	514.750	131.410	69.830	
1979	I	47.750	23.970	13.670	9.060	28.040	71.900	224.750	387.330	387.100	179.260	70.090	41.890	1484.810
1980	I	20.530	13.190	9.110	18.840	37.180	72.000	247.700		312.300	154.900	62.900	34.700	
1981	I	19.350	8.720				40.660	151.840	363.800			67.300	32.780	
	I	21.920	9.830	12.940	7.014	10.830			385.000	391.100	268.900	82.980	41.930	
1983	I	19.590	12.980	9.660	7.990	13.900	58.530		455.360	441.930	335.230	102.790	51.080	
1984	I	28.140	12.390			95.070	252.240			285.460	103.520	43.120	22.060	

* I. MONTHLY RUNOFF IN MILLION M³

* I - MONTHLY RUNOFF IN MILLION m³/sec
 II - MAXIMUM DISCHARGE IN m³/sec
 III - MINIMUM DISCHARGE IN m³/sec

MP = MOMUNTARY PEAK IN m³/sec
 MMD = MAX. MEAN DAILY PEAK INm³/sec

SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION NAME: Bogena Nr./@ Lumame BASIN Abbay DRAINAGE AREA Sq.KM. Stn. No.

YEAR		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL		
1996	I	0.393	0.088	0.084	0.499	1.150	2.698	9.685	23.076	3.786	0.467	0.209	0.176	42.312		
1997	I	0.000	0.000	0.000	0.000	0.000	1.369	16.217	22.031	7.581	8.972	6.506	4.027	66.702		
1998	I									3.625	4.350	3.405	1.886			
1999	I	1.069	0.025	0.000	0.000					7.709	14.247	1.576	0.000			
2000	I	0.164	0.002	0.000	0.100	0.475	0.809									
2001	I											6.249				
2002	I	3.730	4.350	11.788	8.606	7.171							6.174			
2003	I	4.933	3.051										4.925			

* I. MONTHLY RUNOFF IN MILLION M³

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

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

SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION NAME: Birr Nr./@ Jiga BASIN Abay DRAINAGE AREA Sq.KM. Stn. No.

YEAR		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL		
1985	I	0.925	0.348	0.184	0.178	2.167	4.720	91.798	207.434	119.376	16.823	6.207				
1986	I	0.797	0.350	0.203	0.293	0.105	40.196	139.719	96.045	61.917	19.165	4.103	2.785	365.678		
1987	I	0.521	0.180	0.304	0.161	7.423	16.117					9.329	1.688			
1988	I	1.557	0.679	0.313	0.085	0.485	8.649	217.871	249.442	121.315	53.379	11.096	3.371	668.242		
1989	I	1.659	0.460	0.980	1.824	1.300	7.615	107.299	202.609	120.498	18.777	4.338	3.238	470.597		
1990	I	1.471	0.625	0.238	0.075	1.702	0.365	94.183	174.877	47.946	23.213	3.588	5.211	353.494		
1991	I	0.560	0.245	0.111	0.078	0.090	7.174	156.657	350.450	160.345	19.964	7.398	1.228	704.300		
1992	I	7.877	1.230	0.608	0.769	1.439	13.175	101.102	482.008	81.244	56.926	36.546	10.163	793.087		
1993	I	1.094	1.197	1.072	2.542	6.648	15.414	153.613	145.969	95.996	46.132	15.949	11.098	496.724		
1994	I	2.379	0.141	0.047	0.045	2.641	57.353	172.805	198.759	218.294	14.549	4.460	6.129	677.602		
1995	I	0.803	0.264	0.246	0.240	6.954	16.426	128.812	137.711	69.625	10.733	4.350	4.512	380.676		
1996	I	1.860	0.733	2.388	4.035	22.623	47.055	191.378	258.231	87.032	26.222	7.268	2.733	651.559		
1997	I	2.601	1.378	2.736	2.250	9.298	38.881	130.569	118.513	78.397	44.555	30.644	13.317	473.140		
1998	I	4.609	1.555	0.922	0.452	4.588	18.718	98.168	277.499	107.599	81.164	14.703	6.267	616.243		
1999	I	4.915	1.710	0.793	0.729	4.910	24.369	132.257	237.515	93.515	119.850	13.819	5.225	639.607		
2000	I	2.273	0.582	0.245	1.328	1.608	13.907	86.102	228.963	90.614	90.448	22.289	7.335	545.692		

* I. MONTHLY RUNOFF IN MILLION M³

* I - MONTHLY RUNOFF IN MILLION M³

II - MAXIMUM DISCHARGE IN M³/Sec

III - MINIMUM DISCHARGE IN M³/Sec

MP = MOMENTARY PEAK IN M³/Sec

MMD = MAX. MEAN DAILY PEAK IN M³/Sec

SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION:- Alellu River Nr. Nedjo
 BASIN:- Blue Nile
 DRAINAGE AREA, Km²:-

168

STATION No.:- 115008
 Co-Ordinate:- 9d30'n
 35d00'e
 MEAN ELEVATION, m.a.s.l.:-

YEAR	*	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1980	I		1.157	0.952	1.276	3.017	18.790	34.070	45.960	25.840	13.270	5.000	2.797	
1981	I	1.821	1.283	1.312	1.002	2.700	13.500	13.900	21.080	20.570	19.700	4.960	3.520	105.348
1982	I	1.790	0.999	1.061	0.586	1.450	13.070	34.180	24.590	31.240	15.180	3.450	2.190	129.786
1983	I	1.360	0.920	0.780	0.600	0.950	13.940	17.950	28.650	25.590	12.830	4.230	2.300	110.100
1984	I	1.480	0.954	0.820	0.564	1.440	19.820	40.180	34.610	30.480	5.740	3.090	1.840	141.018
1985	I	1.594	1.187	1.343	1.552	6.287	16.767	27.871	33.915	36.127	17.428	5.985	3.605	153.661
1986	I	2.426	1.669	1.700	1.448	1.302	9.279	37.458	29.429	29.840	13.753	3.089	2.335	133.728
1987	I	1.840	1.360	1.480	1.520	10.640	45.450	41.750	43.750	50.100	13.190	7.300	3.490	221.870
1988	I	2.450	7.380	4.030	1.300	10.310	51.870	40.430	45.690	33.940	30.690	24.520	13.410	266.020
1989	I	0.101	1.890	6.170	4.060	11.040	26.740					7.540	5.190	
1990	I	3.456	2.557	1.977	1.298	2.638	9.506	22.045	60.330	33.050	25.290	4.570	4.950	171.667
1991	I	4.490	2.340	2.560	92.000	1.290	0.840	1.080	6.610	10.480				
1992	I													
1993	I													
1994	I	2.810	1.890	1.640	1.600	7.880	14.370	22.180	25.960	22.440	9.370	7.090	3.070	120.300
1995	I	2.640	2.140	2.510	3.340	17.980	11.530	25.880	28.300	27.640	14.390	7.300	5.580	149.230
1996	I	2.261	1.834	2.201	3.223	14.154	35.517	33.416	14.239	19.408	7.329	3.519		
1997	I	1.992	1.462	1.518	1.404	6.855	29.697	25.503	27.024	26.974	16.469	14.612	2.397	155.907
1998	I	1.929	1.341	1.283	2.853	14.555	18.379	26.147	58.686	48.684	35.609	8.157	2.400	220.023
1999	I	3.866	2.496	2.130	1.534	22.192	22.419	33.711	57.630	51.018	36.128	12.253	4.558	249.935
2000	I	0.296	0.000	1.313	0.112	8.003	39.580	25.445	35.948	31.270	14.780	7.937	8.247	172.931

* I. MONTHLY RUNOFF IN MILLION M³

MP = MOMENTARY PEAK IN M³/sec

SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION:- Abbay near Kessie
 BASIN:- Blue Nile
 DRAINAGE AREA, Km²:- 65784

Station no. :- 112001
 Co-Ordinate:- 10d 04'n 38d 11'e

YEAR	*	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL		
1980	I	230.40	146.10	117.30	118.40	56.60	115.10	1532.10	5403.50	4361.60	1554.30	817.50	506.80	14959.70		
1981	I	310.06	373.30	491.65				3823.60	5168.50	2872.80	1104.60	629.70	400.40			
1982	I	280.70	163.40	166.40	143.30	133.50	105.90	698.80	436.20	1836.00	1272.00	485.70	301.80	6023.70		
1983	I	222.96	114.25	122.74	165.62	237.71	192.55	726.85	5155.83	2198.43	1128.88	556.80	316.59	11139.21		
1984	I	159.58	89.36	56.07	38.56	89.10	285.82	1443.08	1865.73	1028.77	324.41	182.32	135.31	5698.11		
1985	I	91.92	56.01	47.18				1480.03	5421.06	3644.88	1106.20	562.51	359.08			
1986	I	228.39	150.58	143.98	186.19			3129.21	5298.68	2876.68	1139.90	560.12	332.39			
1987	I	201.56	122.36	211.58	181.49	233.96	117.56	180.54	2852.94	1098.90	679.21	479.86	249.56	6609.52		
1988	I	148.22	112.16	71.25	58.19	35.49	71.14	4377.27	11333.32	5107.36	2327.84	1045.11	616.31	25303.66		
1989	I	407.84	230.66	233.81	275.73	135.83	151.95	1616.53	4492.63	2644.36	1154.11	622.31	488.79	12454.55		
1990	I	256.80	169.21	139.65	129.52	80.16	65.39	1411.83	4249.05	2389.88	1051.56	482.54	293.26	10718.85		
1991	I	174.68								3783.35	1464.63	777.03	480.85			
1992	I	285.68	195.88	155.27	98.13	119.90	90.21	1124.41	6504.30	3158.39	1937.80	1045.07	586.24	15301.28		
1993	I	336.22	188.74	134.66	451.22	413.05	395.56	3820.71	4679.88	4848.77	2040.74	997.31	557.11	18863.97		
1994	I	317.31	168.82	141.93	80.83	188.35	308.61	5572.92	12208.31	5593.41	1856.71	1006.58	397.13	27840.91		
1995	I	164.10	106.53	135.41	236.84	196.99	209.44	3127.39	7522.61	2988.14	776.78	476.43	295.10	16235.76		
1996	I	189.95	121.94	224.53	310.40	472.69	1075.91	6016.54	11005.65	3917.92	1730.44	947.40	661.05	26674.42		
1997	I	478.39	290.19	495.24	419.37	512.63	872.62	4068.72	5326.51	1443.63	1675.33	1294.06	630.93	17507.61		
1998	I	481.26	169.90	140.54	104.84	278.48	300.50	5541.04	13582.89	5640.03	3371.32	1392.26	798.13	31801.18		
1999	I	347.74	247.84	148.48	120.92	49.52	150.88	6399.35	11037.92	3658.23	2616.84	1074.34	580.18	26432.23		
2000	I	355.39	228.25	68.88	233.50	110.15	104.31	3475.26	10202.46	3201.34	2218.22	1229.59	550.90	21978.27		

* I. MONTHLY RUNOFF IN MILLION M³

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

MP = MOMENTARY PEAK M³/sec
 MMD = MAXIMUM MEAN DAILY PEAK IN M³/sec

SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION:- Abbay Near Bahir Dar
 BASIN:- Blue Nile
 DRAINAGE AREA, Km²:- 15321

STATION No.:- 112003
 Co-Ordinate:- 11d36'n
 37d24'e

YEAR	*	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1980	I	166.600	104.890	69.430	35.600	13.450	7.990	63.800	372.650	670.900	616.200	377.280	259.850	2758.640
1981	I	173.600	103.800	67.900	37.800	27.000	15.700	50.600	277.000	654.300	675.300	403.800	260.400	2747.200
1982	I	174.600	110.400	87.880	48.170	30.970	18.170	25.700	225.700	496.400			231.900	
1983	I	135.660	84.760	58.560	40.390	19.830	20.940	34.330	188.790	447.040	421.980	269.280	190.420	1911.980
1984	I	121.360	59.660	30.730	18.170	12.190	13.000	26.920	84.340	170.340	195.550	140.970	102.140	975.370
1985	I	14.520	80.810	49.010	41.760	23.140	21.390	41.560	46.480	10.980	20.610	40.130	23.900	414.290
1986	I	174.100	114.600	82.640	48.260	29.240	24.840	76.730	269.700	732.700	775.100	425.500	254.000	3006.410
1987	I	164.300	104.200	81.050	47.780	40.050	46.410	71.090	245.500	488.200	483.100	323.400	202.400	2297.480
1988	I	138.800	88.710	64.760	38.210	26.780	26.480	41.100	883.700	1687.000	1479.000	798.900	417.300	5760.940
1989	I	230.700	128.400	94.060	55.220	41.430	37.880	103.300	509.900	935.100	784.200	459.800	266.000	3645.990
1990	I	159.560	90.980	60.240	36.750	24.900	16.910	37.750	194.880	613.350	630.110	346.680	194.560	2406.710
1991	I	117.340						135.890	794.780	1510.270	1180.220	604.800	338.200	
1992	I	189.300	111.940	75.430	44.480	30.770	21.050	73.760	419.900	848.020	870.050	636.590	385.340	3706.630
1993	I	204.890	109.860	80.330	49.900	35.840	51.900	179.110	495.790	1254.520	1194.990	716.680	395.820	4769.630
1994	I	229.910	119.390	73.080	35.970	27.060	36.710	158.610	1047.250	1926.500	1313.200	632.100	190.520	5790.300
1995	I	59.110	37.860	31.930	25.920	17.280	16.750	89.320	266.950	438.300	407.050	278.450	129.660	1775.250
1996	I	64.410	57.620	57.460	54.790	58.420	67.480	59.950	291.029	1418.770	1157.590	629.940	423.560	4341.019
1997	I	278.840	196.140	293.020	254.420	244.339	243.620	174.920	360.480	507.900	623.380	587.260	403.830	4154.409
1998	I	353.660	85.290	41.030	70.040	109.370	32.940	225.670	689.370	1738.600	1499.040	860.280	490.410	6195.700
1999	I	355.167	294.168	169.114	155.846	55.918	114.998	243.835	483.646	1080.557	1287.496	932.551	534.232	5707.529
2000	I	352.477	221.025	84.564	205.893	46.081	14.848	267.250	635.155	1183.002	1205.309	875.230	493.387	5584.221

* I. MONTHLY RUNOFF IN MILLION M³

SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION NAME: Abay Nr./@ Sudan Border BASIN _____ DRAINAGE AREA _____ Sq.KM. Stn. No. _____

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL		
1979	I														
1980	I	687.997											1115.187		
1981	I														
1982	I				423.259	1101.883	4458.541	10128.214	8206.310	6875.711					
1983	I						3299.536	11354.527	17550.052	9876.861	6423.599				
1984	I														
1985	I														
1986	I														
1987	I														
1988	I														
1989	I														
1990	I														
1991	I														
1992	I														
1993	I														
1994	I														
1995	I														
1996	I														
1997	I														
1998	I														
1999	I	1320.831	804.986	566.292	445.536	1004.573	2461.569	8673.449	16387.553	14625.704	10053.704	4225.851			
2000	I	715.177	334.504	274.889	730.048	816.986	2478.688	7006.207	15018.876	9415.830	9302.833	4315.498	1751.507	52161.043	
2001	I	1065.697	699.727	856.861	965.806	1351.004	3569.353	6959.656	18216.351	14611.097	7577.961	4259.474	2232.707	62365.694	
2002	I	1315.254	1154.967	744.402	807.345	629.282	1911.782	7848.131	14277.680	8957.738	4144.932	1870.281	1079.194	44740.988	
2003	I	754.644	518.168	721.159	730.693	611.792	2203.107	8355.756	14453.838	10710.633	4992.024	1950.083	833.913		

* I. MONTHLY RUNOFF IN MILLION M³

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

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

SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION:- **Mugher near Chancho**
 BASIN:- **Blue Nile**
 DRAINAGE AREA, Km²:- 489

STATION No.:- 112002
 Co-Ordinate:- 9d 18'n 38d 44'e
 MEAN ELEVATION, m.a.s.l.:

YEAR	*	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL		
1980	I	0.490	0.320	0.420	0.360	0.310	0.800	58.410	136.690	52.740	4.090	0.930	0.580	256.140		
1981	I	0.351	0.294	0.690	1.067	0.667	0.370	62.720	132.500	84.470	6.880	0.813	0.589	291.411		
1982	I	0.851	0.531	0.319	0.601	0.921	0.719	16.440	101.270	30.840	6.300	1.620	0.748	161.160		
1983	I	0.638	0.515	0.298	0.497	2.815	2.160	23.590	139.670	65.660	6.730	1.573	0.579	244.725		
1984	I	0.163	3.280	3.530	2.940	4.130	9.400	117.030	111.560	67.990	2.890	1.510	0.920	325.343		
1985	I	0.485	0.337	0.221	0.374	0.894	0.637	53.930	182.520		4.050	1.270	0.694			
1986	I	0.477	0.446	0.640	0.763	0.517	1.420	55.040	96.670	53.070		1.140	0.786			
1987	I	0.567	0.392	1.212	2.700	2.597	9.268	62.040	105.500	41.010	0.650	1.312	0.855	228.103		
1988	I	0.600	0.689	0.560	0.579	0.396	0.679	58.142	154.790	92.270	12.610	1.660	0.944	323.919		
1989	I	0.728	0.719	0.537	1.040	0.521	0.692	61.580	163.160	55.200	6.320	1.380	1.010	292.887		
1990	I	0.669	0.832	0.687	1.272	0.617	0.775	35.140	172.630	86.570	8.020	1.580	1.035	309.827		
1991	I	0.634	1.070	1.320	0.538	0.380	1.290	41.550	156.110	59.670	4.540	1.163	0.900	269.165		
1992	I	0.700	0.637	0.371	0.428	0.541	0.865	25.380	119.540	60.860	6.570	1.360	0.817	218.069		
1994	I	0.676	0.272	0.380	0.504	0.441	2.266	52.385	104.796	53.224	6.133	1.406	0.871	223.354		
1995	I	0.450	0.480	0.420	1.010	0.930	0.970	38.930	96.380	30.250	3.450	1.064	0.785	175.119		
1996	I	0.845	0.434	0.482	0.478	0.550	6.929	86.663	174.324	69.030	6.565	1.029	0.531	347.860		
1997	I	0.292	0.160	0.154	0.292	0.171	0.485	32.839	76.718	24.498	2.076	1.021	0.506	139.212		
1998	I	0.534	0.244	0.213	0.185	0.534	1.833	66.186	149.777	66.528	21.316	2.148	0.766	310.265		
1999	I	0.486	0.133	0.192	0.135	0.153	0.756	33.933	153.158	47.572	10.477	1.461	0.614	249.069		
2000	I	0.348	0.126	0.085	0.178	0.359	0.567	26.207	138.011	38.693	7.486	1.452	0.709	214.221		

* I. MONTHLY RUNOFF IN MILLION M³

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

MP = MOMUNTARY PEAK IN M³/sec
 MMD = MAXIMUM DAILY PEAK IN M³/sec

SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION NAME: **Jema** Nr./@ **Lemi** BASIN **Abbay** DRAINAGE AREA Sq.KM. Stn. No.

YEAR		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC			
1996	I			281.109	274.589	353.520	426.316	1585.544	1949.794	487.553	192.245	153.615	139.685			
1997	I	123.177	90.207	107.705	108.710	95.437	120.097	475.606	1096.419	135.063	70.932	94.989	41.612			
1998	I															
1999	I															

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MMD = MAX. MEAN DAILY PEAK IN M³/Sec

SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION:- **DIDDESSA NEAR ARJO**
 BASIN:- **Blue Nile**
 DRAINAGE AREA, Km²:- 9981

STATION No.:-114001
 Co-Ordinate:- 8d 41'n 34d 25'e

YEAR	*	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1981	I	48.230	23.500	23.020	18.080	29.810	29.700						
1982	I	34.050	15.020	13.870	8.440	25.150	184.330	598.690	328.500	584.900	653.820	123.100	59.040
1983	I	23.040	16.040	17.350	10.650	30.350	105.060	466.640	1019.680	997.580	1131.730	195.900	78.860
1984	I	37.850	16.400	11.850	9.560	28.200	196.330	817.160	767.610	593.070	135.720		
1985	I	11.940	5.720	3.070	11.800	62.320	179.120	489.680	1099.600	994.810	281.380	79.900	44.360
1986	I	17.280	9.540	15.880	13.700	12.700	123.920	507.100	553.050	856.790	237.970		
1987	I	12.910	6.180	12.350	17.050	36.580				781.040	429.390	168.140	67.620
1988	I	39.720	26.890	21.150	7.870	36.890	303.630	632.660				200.320	
1989	I		22.850	19.992	32.990	26.650	126.370	293.790	565.280	1311.290		109.540	126.523
1990	I	53.020	29.440	32.420	60.070	41.530	164.490	379.210					
1991	I							606.690					13.380
1992	I	23.930	23.220	13.790	20.420	56.050	167.620	406.350	968.820	647.580			
1993	I	42.540	27.865	24.396	54.716	105.219	312.141	599.597	1158.731	630.704	406.975	176.943	73.385
1994	I	39.055	19.571	15.488	15.678	59.712	220.177	534.187	1220.982	858.038	156.358	68.060	63.347
1995	I	20.362	12.244	14.800	19.447	38.256	83.004	224.982	568.944	485.888	156.201	59.932	36.942
1996	I				30.375	141.832	373.141	723.261	854.441	597.656			
1997	I	41.418	19.038										87.151
1998	I												
1999	I												
2000	I											242.015	
2001	I	85.090	59.528	66.056	57.196	128.279	400.842	740.319	1045.295	1005.363	674.058	214.618	135.667
2002	I	98.983	57.199	55.261	63.415	46.248	174.703	457.192	590.993	577.670	210.694	115.209	111.707
2003	I	56.383	36.246	56.160	74.340	47.967	120.211		652.152				83.855
2004	I	52.256	40.177	30.269	28.673	65.179	201.909	526.343	638.817	642.515	538.109	140.226	
	I												

* I. MONTHLY RUNOFF IN MILLION M³

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 MMD = MAX. MEAN DAILY PEAK INm³/sec

SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION :- Debis nr Guder
 BASIN:- Blue Nile
 AGE AREA, Km²:- ! 799

Station no. :- 113037
 Co-Ordinate :-
 Mean Elevation a.m.s.l. :-

Year	*	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1997	I	1.476	0.863	1.132	6.335	1.661	4.929	36.736	56.391	17.729	14.160	5.326	2.988	149.727
1998	I	3.451	2.391	4.233	2.583	4.282	8.812	54.382	90.087	44.415	24.126	4.659	2.197	245.617
1999	I	1.735	1.037	1.470	1.157	3.239	6.105	34.830	64.591	27.203	37.834	5.808	2.064	187.072
2000	I	1.377	0.938	0.843	1.578	3.891	7.416	21.303	66.024	28.031	13.823	3.783	2.093	151.101

* I. MONTHLY RUNOFF IN MILLION M³

Draft

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SEDIMENTATION

Draft

Ministry of Water Resources

Daily Observation

Station number	111020
River basin	Abbay
Station name	Merawi
River	Bered
Catchment area (km2)	81.3

Year	Month	Day	G.H.		Flow		Daily discharge		Sediment concentration		Sediment concentration		Daily sediment load	
			h (m)		Q (m ³ /s)		m ³ /d		g/t mg/kg ppm		g/m ³ mg/l		t/d	
1988	5	20	0.47		0.059		5,098		301.00		285.95		1.55	
1988	6	21	0.54		0.323		27,907		79.82		75.83		2.23	
1988	9	9	0.85		1.785		154,224		157.06		149.21		30.33	
1988	11	16	0.51		0.203		17,539		37.35		35.48		0.66	
1990	8	3	0.57		0.369		31,882		143.85		136.66		4.58	
1994	9	26	0.52		0.374		32,314		202.76		192.62		6.55	
1995	7	30	0.72		1.000		86,400		334.47		317.74		31.20	
1995	8	23	0.69		0.870		75,168		239.67		227.68		18.01	
1996	2	19	0.48		0.077		6,653		169.98		161.48		1.13	
1996	7	28	0.62		0.231		19,958		154.57		146.84		3.09	
1996	10	28	0.61		0.278		24,019		175.13		166.38		4.21	

Ministry of Water Resources

Daily Observation

Station number	112036
River basin	Abbay
River	Mendel
Station name	Tis-Abbay
Catchment area (km ²)	72

Year	Month	Day	G.H. (h) m	Flow (Q) m ³ /s	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l
1987	11	13	0.4	0.106	9,158	125.38	119.111
1988	5	19	0.35	0.052	4,493	477.3	453.435
1988	7	19	0.76	1.000	86,400	2353.86	2236.167
1988	9	7	0.64	0.610	52,704	106.86	101.517
1988	10	14	0.46	0.231	19,958	84.02	79.819
1989	1	3	0.33	0.069	5,962	341.28	324.216
1990	9	7	0.73	1.183	1,670	528.1067	501.701365
1990	9	10	0.68	0.947		338.85	
1993	7	20	0.45	0.110	9,504	541.52	514.444
1994	9	22	0.79	1.150	99,360	548.23	520.8185
1995	7	28	0.27	3.060	264,384	6824.833	6483.59135
1996	2	21	0.4	0.103	8,899	173.823	165.13185

Ministry of Water Resources

Daily Observation

Station number	112011
River basin	Abbay
Station name	Mehal Meda
River	Shay
Catchment area (km2)	67.5

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1989	8	16	1.85	25.771	2,226,614	1247.68	1185.296	2,778.10
1989	8	17	1.46	8.282	715,565	174.41	165.6895	122.65
1996	4	20	0.88	0.157	13,565	59.333	56.36635	0.80
1996	8	9	1.36	4.808	415,411	523.733	497.54635	217.56
1996	8	18	1.24	2.880	248,832	95.333	90.56635	23.72
1997	9	5	0.98	0.488	42,163	66.433	63.11135	2.78
1997	9	7	0.96	0.426	36,806	63.745	60.55775	2.30
1998	8	12	1.42	7.802	674,093	753.333	715.66635	482.43
1998	8	14	1.85	14.480	1,251,072	2562.367	2434.24865	3,045.42

Ministry of Water Resources

Daily Observation

Station number	112009
River basin	Awash
Station name	Mehal Meda
River	Wizer
Catchment area (km2)	

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/ l	Daily sediment load t/d
1998	8.00	12	0.75	1.70	146448.00	91.37	86.80	12.71
1998	8.00	14	0.26	2.53	218851.20	231.20	219.64	48.07

Ministry of Water Resources

Daily Observation

Station number	113020
River basin	Abbay
Station name	Mankusa
River	Debohila
Catchment area (km2)	

Year	Month	Day	G.H.	Flow	Daily discharge	Sediment concentration	Sediment concentration	Daily sediment load
			h (m)	Q (m ³ /s)	m ³ /d	g/t mg/kg ppm	g/m ³ mg/l	t/d
1968	7	30	1.52	37.298	3,222,555	3508.74	3333.30	549.00
1968	8	16	1.7	51.951	4,488,602	6884.68	6540.45	29357.46
1968	8	20	1.83	64.390	5,563,317	1014.68	963.95	5362.74
1968	9	10	1.8	61.377	5,302,984	1314.99	1249.24	6624.70
1968	9	30	1.54	38.784	3,350,930	1165.88	1107.59	3711.44
1994	9	5	1.46	2.630	227,232		0.00	0.00

Ministry of Water Resources

Daily Observation

Station number	113039
River basin	Abbay
Station name	Lumame
River	BOgena
Catchment area (km2)	166

Year	Month	Day	G.H.		Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration		
			h (m)				g/t	mg/kg	ppm
1993	10	5	0.69		3.670	317,088	362.86		344.72
1995	8	2	0.98		12.590	1,087,776	1942.06		1844.96
1995	10	5	0.21		0.330	28,512	234.11		222.40
1995	10	6	0.19		0.220	19,008	256.02		243.22
1995	8	3	0.84		7.610	657,504	1102.73		1047.59

Ministry of Water Resources

Daily Observation

Station number	113035
River basin	Abbay
Station name	Kosober
River	Ayo
Catchment area (km2)	41.4

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1986	3	24	0.29	0.050	4,320	416.25	395.44	1.80
1986	4	24	0.32	0.080	6,912	845.83	803.54	58.47
1986	5	29	0.47	0.680	58,752	9137.52	8680.64	536.85
1987	2	13	0.27	0.050	4,320	320.00	304.00	1.38
1987	4	9	0.26	0.040	3,456	48.00	45.60	0.16
1987	5	12	0.38	0.490	42,336	123.21	117.05	5.22
1987	12	30	0.36	0.270	23,328	9.99	9.49	2.33
1988	1	26	0.32	0.120	10,368	153.18	145.52	1.59
1988	2	26	0.35	0.140	12,096	49.95	47.45	0.60
1988	5	6	0.41	0.649	56,074	123.21	117.05	6.91
1989	1	28	0.34	0.120	10,368	305.00	289.75	0.31
1989	2	17	0.32	0.130	11,232	53.24	50.57	0.60
1989	5	19	0.62	3.550	306,720	2971.88	2823.29	911.54
1993	2	15	0.32	0.120	10,368	1524.26	1448.04	15.80

Ministry of Water Resources

Daily Observation

Station number	112021
River basin	Abbay
Station name	Kabie
River	Selgie
Catchment area (km2)	93.1

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/ l	Daily sediment load t/d
1985	8	20	0.67	0.859	74,218	131.03	124.4785	9.72
1988	7	27	1.37	5.712	493,517	3172.15	3013.5425	1,565.51
1988	8	10	0.85	1.503	129,859	109.38	103.911	14.20
1988	8	19	0.9	2.184	188,698	147.92	140.524	27.91
1988	8	24	0.45	1.958	169,171	84.61	80.3795	11.68
1989	4	12	0.65	0.078	6,739	176.82	167.979	1.19
1989	7	19	0.68	0.198	17,107	527.78	501.391	9.03
1989	8	17	0.79	0.580	50,112	287.7	273.315	14.12

Ministry of Water Resources

Daily Observation

Station number	112022
River basin	Abbay
Station name	Kabe
River	Mechela
Catchment area (km2)	176.9

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1985	8	20	0.6	0.391	33,782	311.52	295.944	10.48
1986	4	23	0.57	0.270	23,328	47.26	44.897	1.69
1989	4	12	0.5	0.208	17,971	97.75	92.8625	1.76
1989	6	19	0.52	0.317	27,389	470.74	447.203	14.19
1989	8	17	0.66	0.548	47,347	84.5	80.275	3.78

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1989	1	24	0.4	0.135	11,664	66.96	63.61	
1989	1	27	0.12	0.134	11,578	57.16	54.30	112.31
1989	2	25	0.11	0.900	77,760	44.90	42.66	41.75
1989	3	30	0.14	0.071	6,134	22.55	21.42	1.08
1989	4	24	0.13	0.233	20,131	55.49	52.72	3.92
1989	5	21	0.13	0.222	19,181	88.33	83.91	0.47
1989	6	14	0.19	0.661	57,110	144.74	137.50	2.26
1989	9	27	0.25	2.436	210,470	489.06	464.61	0.78
1989	12	19	0.17	0.492	42,509	102.81	97.67	0.66
1990	1	22	0.13	0.166	14,342	235.11	223.35	3.49
1990	2	23	0.1	0.07	6,048	184.79	175.55	
1990	3	26	0.1	0.146	12,614	39.17	37.21	0.53
1990	4	26	0.11	0.166	14,342	131.77	125.18	1.12
1990	6	22	0.19	0.518	44,755	183.55	174.37	
1990	7	31	0.39	2.213	191,203	266.57	253.24	1.69
1990	10	17	0.24	1.108	95,731	141.68	134.60	8.24
1991	9	5	0.45	5.364	463,450	236.38	224.56	
1992	8	18	0.42	8.459	730,858	490.66	466.13	99.13
1992	9	3	0.28	2.046	176,774	214.66	203.93	
1992	9	25	0.23	1.819	157,162	167.08	158.73	
1995	1	31	0.14	0.099	8,554	90.71	86.18	3.37
1995	8	8	0.45	3.044	263,002	260.40	247.38	
1996	6	1	0.18	0.293	25,315	152.15	144.55	4.39
1996	8	4	0.49	1.150	99,360	286.87	272.52	1.11
1996	9	9	0.34	0.640	55,296	433.97	412.27	0.49

Ministry of Water Resources

Daily Observation

Station number	112019
River basin	Abbay
Station name	Gundeweian
River	Tigdor
Catchment area (km2)	

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/ l	Daily sediment load t/d
1983	8	29	0.88	4.440	383,616	1374.70	1305.97	527.56
1983	8	30	0.83	3.120	269,568	6374.36	6055.64	1718.32
1984	9	18	0.62	1.170	101,088	414.00	393.30	41.85
1984	9	19	0.68	2.840	245,376	830.66	789.13	203.82
1984	9	20	0.64	1.650	142,560	344.00	326.80	45.04
1985	8	29	0.94	4.540	392,256	267.28	253.92	104.54
1985	8	31	1.42	13.280	1,147,392	723.93	687.73	830.63
1985	10	2	0.4	0.370	31,968	719.00	683.05	23.00
1985	10	5	0.62	1.130	97,632	251.64	239.06	1.67
1985	11	13	0.31	0.150	12,960	129.21	122.75	1.20
1986	1	26	0.3	0.050	4,320	291.37	276.80	2.21
1986	2	21	0.35	0.080	6,912	319.68	303.70	5.37
1986	3	30	0.4	0.120	10,368	515.48	489.71	1.27
1986	4	29	0.4	0.070	6,048	209.79	199.30	15.02
1986	5	24	0.38	0.700	60,480	869.46	825.99	958.12
1986	7	9	0.77	2.610	225,504	4426.16	4204.85	34.93
1986	9	16	0.63	1.690	146,016	235.21	223.45	1504.03
1986	9	17	1	13.500	1,166,400	1632.40	1550.78	108.36
1986	9	17	0.71	2.290	197,856	547.69	520.31	1.48
1986	10	30	0.29	0.070	6,048	244.00	231.80	0.46
1987	2	28	0.25	0.060	5,184	88.00	83.60	0.43
1987	6	28	0.42	0.220	19,008	1011.21	960.65	18.12

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1987	8	2	0.7	1.510	130,464	705.96	670.66	92.10
1987	8	6	0.86	10.500	907,200	3639.69	3457.71	19.10
1987	8	8	0.68	1.240	107,136	551.67	524.09	3301.93
1987	9	25	0.45	0.350	30,240	357.42	339.55	10.81
1988	1	2	0.68	1.7	146880	836.46	794.64	0.68
1988	1	15	1.76	27.43	2369952	7078.12	6724.21	
1988	1	20	0.46	0.019	1,642	365.63	347.35	0.78
1988	1	20	1.08	2.8	241920	4607.25	4376.89	0.61
1988	1	25	0.86	2.600	224,640	1673.96	1590.26	61.56
1988	1	26	0.52	0.160	13,824	4482.18	4258.07	376.04
1988	1	26	1.44	15.86	1370304	8277.08	7863.23	16656.31
1988	1	26	1.29	12.08	1043712	7066.77	6713.43	3104.94
1988	1	26	1.54	20.61	1780704	5482.29	5208.18	11342.12
1988	1	27	1.1	7.38	637632	1220.83	1159.79	737.68
1988	1	28	1.18	10.61	916704	5720.83	5434.79	9762.34
1988	1	28	1.2	10.61	916704	264.58	251.35	778.44
1988	1	29	0.89	3.84	331776	722.91	686.76	5244.31
1988	1	29	0.96	4.48	387072	4100.00	3895.00	242.54
1988	1	30	0.26	0.050	4,320	176.49	167.67	239.84
1988	1	30	0.7	1.51	130464	339.58	322.60	1586.99
1988	1	30	0.49	2.49	215136	88.84	84.40	56.04
1988	1	31	0.66	1.53	132192	227.08	215.73	30.00
1989	1	6	0.21	0.011	950.4	146.25	138.94	172.86
1989	1	11	0.23	0.07	6048	32.91	31.27	3.75
1989	1	25	0.26	0.04	3456	103.82	98.63	0.20
1989	1	26	0.93	3.06	264384	2080.63	1976.60	0.36
1992	8	21	0.65	0.84	72576	3116.30	2960.49	0.14
1992	11	12	0.34	0.15	12960	195.31	185.54	550.08
1992	12	27	0.25	0.070	6,048	113.22	107.56	226.17
1993	10	6	0.71	0.86	74304	246.80	234.46	2.53
1994	10	10	0.42	0.28	24192	185.67	176.39	18.34
1995	8	1	0.83	2.02	174528	879.25	835.29	4.49
1995	8	6	0.94	9.54	824256	368.55	350.12	303.75
1995	8	8	6.43	2.106	181958.4	478.33	454.41	86.31
1995	8	9	0.75	1.63	140832	612.86	582.22	153.50
1995	10	7	0.46	0.28	24192	239.21	227.25	5.78

Ministry of Water Resources

Daily Observation

Station number	113005
River basin	Abbay
Station name	Guder
River	Guder
Catchment area (km2)	524

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/ l	Daily sediment load t/d
1968	6	20	0.61	1.310	113,184	81.03	76.98	1168.44
1968	7	19	1.43	17.007	1,469,405	101.01	95.96	1201.68
1968	8	8	2.13	67.200	5,806,080	43.66	41.48	253.49
1968	8	19	1.88	52.650	4,548,960	256.86	244.02	9.17
1968	9	19	2.1	67.210	5,806,944	206.94	196.59	148.42
1968	10	21	1.27	13.741	1,187,222	75.01	71.26	89.05
1968	11	23	0.595	1.009	87,178	25.62	24.34	2.23
1988	12	21	0.51	0.623	53,827	34.06	32.36	1.82
1989	1	24	0.51	0.571	49,334	31.47	29.90	1.55
1989	2	20	0.47	0.495	42,768	38.72	36.78	1.66
1989	3	26	0.48	0.462	39,917	23.33	22.16	0.93
1989	4	19	0.66	1.929	166,666	524.51	498.28	87.42
1989	5	16	0.61	1.428	123,379	66.37	63.05	8.18
1989	10	30	0.74	0.818	70,675	43.34	41.17	10.55
1989	12	14	0.57	1.153	99,619	40.24	38.23	4.00
1990	1	18	0.51	0.703	60,739	235.42	223.65	14.30
1990	2	17	0.64	1.874	161,914	152.08	144.48	24.62
1990	3	23	0.59	1.287	111,197	49.38	46.91	5.49

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/ l	Daily sediment load t/d
1990	4	11	0.52	1.062	91,757	115.73	109.94	10.62
1990	9	8	1.83	39.529	3,415,306	90.11	85.60	307.74
1990	10	10	1.17	10.988	949,363	77.74	73.85	73.81
1991	8	25	1.9	37.823	3,267,907	95.73	90.94	312.84
1991	10	28	0.62	1.627	140,573	103.64	98.46	14.56
1992	8	31	1.93	39.090	3,377,376	112.66	107.03	380.50
1992	9	23	1.9	28.138	2,431,123	137.29	130.43	926.69
1992	9	31	2.32	67.594	5,840,122	158.66	150.73	333.77
1995	1	23	0.49	8.500	734,400	156.73	148.89	926.69
1996	12	28	0.56	0.609	52,618	103.00	97.85	333.77

Ministry of Water Resources

Daily Observation

Station number	113001
River basin	Abbay
Station name	Guder
River	Bello
Catchment area (km2)	290

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge cu.m/d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1977	7	15	2.7	22.190	1,917,216	13.00	12.35	24.92
1977	7	21	2.56	19.570	1,690,848	45.00	42.75	76.08
1977	7	29	2.37	17.710	1,530,144	10.00	9.50	15.30
1977	8	6	2.3	13.950	1,205,280	13.00	12.35	15.67
1977	8	11	3.14	32.520	2,809,728	23.00	21.85	61.64
1977	8	16	2.95	29.220	2,524,608	30.00	28.50	75.74
1977	8	25	2.62	19.970	1,725,408	17.00	16.15	29.33
1977	8	31	2.53	19.330	1,670,112	10.00	9.50	16.70
1977	9	8	2.72	22.160	1,914,624	15.00	14.25	28.72
1977	9	14	2.91	26.220	2,265,408	47.00	44.65	106.42
1977	9	22	2.28	13.700	1,183,680	10.00	9.50	11.84
1977	9	29	1.85	6.770	584,928	23.00	21.85	13.45
1977	10	5	2.1	9.260	800,064	13.00	12.35	10.40
1977	10	13	1.69	4.680	404,352	10.00	9.50	4.09
1977	10	21	1.951	7.240	625,536	10.00	9.50	6.26

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge cu.m/d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1977	10	27	2.555	17.350	1,499,040	17.00	16.15	26.48
1988	3	29	0.55	0.214	18,490	22.20	21.09	0.05
1988	6	18	0.49	0.595	51,408	88.80	84.36	4.56
1988	11	19	0.795	0.601	51,926	37.43	35.56	1.94
1988	12	20	0.65	0.294	25,402	39.93	37.93	1.01
1989	1	24	0.61	0.286	24,710	27.61	26.23	0.68
1989	2	21	0.55	0.207	17,885	25.82	24.53	0.46
1989	3	26	0.55	0.252	21,773	21.66	20.58	1.37
1989	4	18	1.01	1.252	108,173	62.74	59.60	6.78
1989	5	17	1.01	1.307	112,925	74.70	70.97	8.50
1990	1	19	0.64	0.404	34,906	191.46	181.89	6.68
1990	2	27	1	0.871	75,254	135.21	128.45	10.18
1990	4	28	0.8	0.758	65,491	43.85	41.66	2.87
1990	10	29	0.7	0.426	36,806	85.11	80.85	3.13
1991	8	30	0.76	0.804	69,466	96.04	91.24	6.67
1994	7	31	2.64	22.585	1,951,344	130.86	124.32	235.35
1995	1	22	0.62	0.188	16,243	73.17	69.51	1.13
1995	8	2	2.4	30.240	2,612,736	201.50	191.43	500.14
1996	8	29	2.82	0.97	83808	456.30	433.49	36.33
1996	12	28	0.76	0.409	35337.6	497.30	472.44	16.69

Ministry of Water Resources

Daily Observation

Station number	115010
River basin	Abbay
Station name	Gori
River	Komise
Catchment area (km2)	112

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1988	3	21	0.69	0.520	44,928	67.71	64.3245	3.04
1988	10	3	1.02	4.160	359,424	307.3	291.935	110.45
1989	6	24	0.84	1.730	149,472	83.53	79.3535	12.48
1990	3	20	0.68	0.600	51,840	38.023	36.12185	1.94
1993	5	22	0.98	9.343	807,232	158.4	150.48	121.47
1993	10	20	0.67	1.280	110,592	197.846	187.9537	10.82
1994	10	2	1.03	2.820	243,648	148.74	141.303	36.24
1995	4	9	0.75	0.820	70,848	68.13	64.7235	1.82
1995	11	1	1	2.050	177,120	68.8	65.36	12.19

Ministry of Water Resources

Daily Observation

Station number	113036
River basin	Abbay
Station name	Galebr Mariam
River	Lower Fottom
Catchment area (km2)	757

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/ l	Daily sediment load t/d
1986	4	24	0.34	0.450	38,880	229.71	218.22	8.93
1986	4	31	0.36	0.440	38,016	289.71	275.22	11.02
1986	5	28	0.3	0.480	41,472	135.42	128.65	5.62
1987	2	11	0.37	0.780	67,392	104.00	98.80	7.01
1987	4	10	0.3	0.550	47,520	234.16	222.45	11.55
1987	12	29	0.52	2.210	190,944	62.16	59.05	11.87
1988	1	27	0.41	0.830	71,712	159.84	151.85	11.46
1988	2	27	0.39	0.860	74,304	169.83	161.34	12.62
1988	6	2	0.85	8.862	765,677	1371.21	1302.65	1049.90
1989	1	27	0.46	1.400	120,960	105.88	100.59	12.81
1989	2	18	0.41	0.810	69,984	55.00	52.25	5.85

Ministry of Water Resources

Daily Observation

Station number	111017
River basin	Abbay
Station name	Arb Gebeya
River	Fogeda
Catchment area (km2)	29

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/ l	Daily sediment load t/d
1985	11	24	0.46	0.094	8,122	39.5	37.525	0.32
1986	2	19	0.35	0.008	691	53.3	50.635	0.04
1987	4	28	0.29	0.034	2,938	345.58	328.301	1.02
1994	10	10	0.51	0.266	22,982	113.04	107.388	2.60
1995	8	2	0.69	1.460	126,144	412.749	392.11155	52.06
1995	2	23	0.42	0.044	3,802	110.3567	104.838865	0.13
1996	8	23	0.77	2.929	253,066	140.545	133.51775	36.15
1996	7	30	0.82	2.742	236,909	133.33	126.6635	31.38
1996	10	31	0.46	0.095	8,208	44.7	42.465	0.37

Ministry of Water Resources

Daily Observation

Station number	113026
River basin	Abbay
Station name	Fincha
River	Neshi
Catchment area (km2)	322

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/ l	Daily sediment load t/d
1968	7	1	1.28	3.030	261,792	1668.50	1585.08	436.80
1968	7	11	1.67	7.320	632,448	925.07	878.82	589.05
1968	7	22	1.76	9.460	817,344	153.23	145.57	125.24
1968	7	29	1.74	8.950	773,280	110.93	105.38	85.78
1968	8	5	2.02	15.800	1,365,120	1300.87	1235.83	1775.84
1968	8	12	2.05	15.110	1,305,504	580.83	551.79	758.28
1968	8	19	2.12	18.270	1,578,528	933.36	886.69	1473.33
1968	8	26	2.07	17.000	1,468,800	324.34	308.12	476.35
1968	9	2	1.85	11.820	1,021,248	503.05	477.90	514.20
1968	9	9	1.95	13.100	1,131,840	808.60	768.17	915.90
1968	9	16	1.69	8.750	756,000	901.77	856.68	681.74
1968	9	23	1.89	12.110	1,046,304	587.40	558.03	614.60
1968	10	2	1.87	9.410	813,024	874.97	831.22	690.96
1968	10	21	1.38	4.040	349,056	755.95	718.15	263.87

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1968	10	31	1.14	2.250	194,400	888.35	843.93	172.70
1988	3	31	1.115	0.112	9,677	263.07		
1988	6	6	1.2	1.960	169,344	14.43	13.71	2.54
1988	10	22	1.77	12.332	1,065,485	57.90	55.01	2.47
1988	11	25	0.905	1.250	108,000	45.00	42.75	61.69
1988	12	24	0.76	0.769	66,442	34.86	33.12	4.86
1989	1	26	0.69	0.445	38,448	33.63	31.95	2.32
1989	2	22	0.66	0.390	33,696	80.02		
1989	3	27	0.66	0.467	40,349	25.02		
1989	4	20	0.67	0.419	36,202	27.16	25.80	1.29
1989	5	19	0.8	1.155	99,792	37.45	35.58	2.70
1989	6	12	0.72	0.711	61,430	66.86	63.52	1.01
1989	12	16	0.88	1.855	160,272	26.25	24.94	1.05
1990	1	20	0.7	0.620	53,568	193.65	183.96	4.11
1990	2	21	0.67	0.436	37,670	50.59	48.06	3.53
1990	3	24	0.63	0.281	24,278	12.09		
1990	4	24	0.63	0.305	26,352	73.85	70.16	4.21
1990	10	12	1.375	8.811	761,270.4	69.38	65.91	10.37
1991	8	28	2.21	28.052	242,369.2	3448.00	3275.60	0.30
1991	10	30	0.82	1.903	164,419.2	41.04	38.99	1.75
1995	1	25	0.65			51.20	48.64	2.80
1995	8	4	1.5	12.21	105,494	438.07	416.16	38.51
1996	5	30	0.76	1.08	93,312	65.74	62.45	10.41
							0.00	99.48

Ministry of Water Resources

Daily Observation

Station number	112040
River basin	Abbay
Station name	Estey 2
River	Wanka
Catchment area (km2)	110

Year	Month	Day	G.H.	Flow	Daily discharge	Sediment concentration			Daily sediment load	
			h (m)	Q (m ³ /s)	m ³ /d	g/t	mg/kg	ppm	g/m ³	mg/l
1987	5	19	0.39	0.121	10,454	2388.1			2268.695	24.97
1987	8	11	0.7	2.750	237,600	1692.75			1608.1125	402.20
1988	1	4	0.38	0.158	13,651	5849.7			5557.215	79.86
1988	9	24	0.61	1.400	120,960	147.1			139.745	18.43
1988	11	24	0.39	0.143	12,355	40.1			38.095	0.50
1988	12	28	0.34	0.057	4,925	29.91			28.4145	0.14
1995	8	6	0.81	4.050	349,920	233.433			221.76135	81.68
1996	8	15	0.66	1.934	167,098	170.043			161.54	28.41
1996	10	21	0.35	0.144	12,442	147.633			140.25135	1.84

Ministry of Water Resources

Daily Observation

Station number	112039
River basin	Abbay
Station name	Estey Chena
River	Chena
Catchment area (km2)	32.5

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1985	9	17	0.67	2.100	181,440	54.56	51.832	9.900
1985	9	18	0.48	1.420	122,688	73.16	69.502	8.980
1986	2	22	0.18	0.004	346	60	57	0.021
1986	9	9	0.62	2.640	228,096	194.25	184.5375	41.330
1987	5	18	0.3	0.195	16,848	2162.16	2054.052	36.430
1987	9	11	0.68	3.770	325,728	1112.22	1056.609	362.280
1988	1	4	0.32	0.297	25,661	144.3	137.085	3.700
1988	11	24	0.28	0.099	8,554	47.94	45.543	0.410
1988	12	27	10.25	0.040	3,456	53.06	50.407	0.180
1996	2	26	0.2	0.030	2,592	89.1067	84.651365	0.231
1996	10	31	0.29	0.136	11,750	129.367	122.89865	1.521
1996	8	15	0.52	1.520	131,328	167.377	159.00815	19.025

Ministry of Water Resources

Daily Observation

Station number	1130141
River basin	Abbay
Station name	Dembecha
River	Temecha
Catchment area (km2)	100

GUIDE:

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1968	7	15	1.31	37.090	3,204,576	1191.68	1132.10	4226.00
1968	7	22	1.24	25.860	2,234,304	1098.03	1043.13	3818.83
1968	8	12	1.32	32.010	2,765,664	705.16	669.90	2453.33
1968	8	27	1.36	37.190	3,213,216	533.75	507.06	1950.24
1968	9	6	0.96	13.180	1,138,752	302.66	287.53	1715.05
1968	9	20	1.17	25.110	2,169,504	451.14	428.58	344.65
1969	9	8	1.2	23.500	2,030,400	350.00	332.50	978.75
1985	8	20	1.52	52.290	4,517,856	154.59	146.86	698.42
1985	8	22	1.45	38.240	3,303,936	292.90	278.26	967.72
1985	9	3	1.53	28.810	2,489,184	151.15	143.59	376.24
1985	9	26	1.24	13.070	1,129,248	131.18	124.62	148.13
1985	10	8	1.21	11.040	953,856	1560.91	1482.86	1488.88
1985	11	2	0.84	3.430	296,352	12.31	11.69	3.65
1986	1	9	0.37	0.790	68,256	276.39	262.57	18.86
1986	2	23	0.31	0.530	45,792	283.05	268.90	12.69
1986	3	18	0.24	0.110	9,504	229.77	218.28	2.18
1986	4	26	0.4	0.340	29,376	469.53	446.05	13.79
1986	5	23	0.26	0.128	11,059	472.60	448.97	5.23
1986	7	22	1.66	32.720	2,827,008	1714.53	1628.80	4846.99
1986	7	22	1.58	35.450	3,062,880	1273.06	1209.41	3899.23

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1986	7	23	1.74	53.940	4,660,416	1283.60	1219.42	5982.11
1986	9	6	1.3	14.940	1,290,816	165.29	157.03	213.36
1986	10	26	0.84	4.240	366,336	41.33	39.26	15.14
1987	1	5	0.43	0.450	38,880	374.66	355.93	14.56
1987	4	12	0.34	0.179	15,466	33.33	31.66	0.52
1987	5	1	0.38	0.310	26,784	832.50	790.88	22.30
1987	8	11	1.41	34.790	3,005,856	688.20	653.79	2068.63
1987	8	14	1.58	43.630	3,769,632	3154.62		
1987	8	15	1.37	33.960	2,934,144	1430.08	1358.58	11891.76
1987	9	11	1.57	48.490	4,189,536	574.98	546.23	4196.06
1987	10	5	1.29	27.030	2,335,392	6142.30	5835.19	2408.90
1987	12	27	0.41	0.89	76896	49.95	47.45	14328.76
1988	1	28	0.311	0.56	48384	86.58	82.25	3.84
1988	2	27	0.34	0.530	45,792	243.09	230.94	4.19
1988	4	15	0.2	0.061	5,270	218.45	207.53	11.13
1988	5	10	0.24	0.290	25,056	146.52	139.19	1.15
1988	6	24	0.77	4.280	369,792	16683.30	15849.14	3.67
1988	7	28	1.6	19.400	1,676,160	625.00	593.75	6169.35
1988	9	9	1.31	16.430	1,419,552	415.30	394.54	1026.50
1988	10	23	1.08	8.770	757,728	215.67	204.89	589.54

Ministry of Water Resources

Daily Observation

Station number	113012
River basin	Abbay
Station name	Dembecha
River	Gudla
Catchment area (km2)	242

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/ l	Daily sediment load t/d
1960	9	13	1	27.590	2,383,776		0.00	493.00
1964	9	7	1.05	35.600	3,075,840		0.00	4855.00
1968	6	25	1.65	41.390	3,576,096	832.90	791.26	2978.53
1968	7	15	1.2	38.400	3,317,760	993.24	943.58	3296.33
1968	7	22	1.34	43.960	3,798,144	1613.05	1532.40	6126.60
1968	7	30	1.99	67.340	5,818,176	647.58	615.20	3767.73
1968	8	7	1.99	67.340	5,818,176	356.96	339.11	2076.86
1968	8	12	1.31	41.860	3,616,704	1160.89	1102.85	4198.60
1968	8	14	1.32	24.870	2,148,768	874.34	830.62	1978.66
1968	8	23	1.41	26.900	2,324,160	832.34	790.72	1934.49
1968	9	6	1	16.220	1,401,408	232.59	220.96	327.35
1968	9	20	0.96	15.930	1,376,352	338.44	321.52	465.81

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1982	7	29	1.28	23.210	2,005,344	546.34	519.02	1095.60
1982	8	25	1	11.620	1,003,968	151.04	143.49	151.64
1985	8	17	1.21	30.920	2,671,488	335.71	318.92	836.84
1985	8	18	1.28	34.270	2,960,928	1139.88	1082.89	3375.10
1985	8	19	1.57	17.770	1,535,328	851.07	808.52	1306.67
1985	9	25	0.92	19.220	1,660,608	103.25	98.09	171.46
1986	1	2	0.26	0.290	25,056	273.06	259.41	6.84
1986	2	23	0.31	0.710	61,344	279.72	265.73	17.16
1986	3	18	0.22	0.150	12,960	392.94	373.29	5.09
1986	4	25	0.25	0.210	18,144	180.25	171.24	3.27
1986	5	23	0.2	0.080	6,912	273.06	259.41	1.88
1986	7	17	0.82	16.130	1,393,632	689.92	655.42	966.49
1986	7	19	1.05	25.010	2,160,864	551.32	523.75	1191.33
1986	7	23	1.12	33.830	2,922,912	1378.81	1309.87	4034.14
1986	9	5	1.26	41.680	3,601,152	5150.79	4893.25	18548.78
1986	9	6	0.88	18.600	1,607,040	404.51		
1986	10	26	0.47	2.610	225,504	217.33	206.46	650.06
1987	1	6	0.26	0.310	26,784	322.66	306.53	49.95
1987	2	13	0.2	0.180	15,552	28.00	26.60	8.64
1987	4	12	0.21	0.12	10368	76.00	72.20	0.44
1987	5	1	0.24	0.22	19008	36.63	34.80	0.78
1987	6	24	0.92	20.290	1,753,056	402.93	382.78	0.70
1987	6	27	1.1	33.960	2,934,144	1680.54	1596.51	706.36
1987	8	15	1.06	8.860	765,504	569.43	540.96	4930.95
1987	9	12	0.93	21.030	1,816,992	664.89	631.65	435.90
1987	10	6	0.74	0.890	76,896	536.13	509.32	1208.10
1987	12	27	0.31	0.700	60,480	103.23	98.07	31.96
1988	1	28	0.29	0.310	26,784	113.22	107.56	6.24

Ministry of Water Resources

Daily Observation

Station number	113030
River basin	Abbay
Station name	Debre Zeite
River	Uper Chemoga
Catchment area (km ²)	162

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1988	1	28	1.6	0.100	8,640	459.54	436.563	4
1988	2	29	1.6	0.130	11,232	389.61	370.1295	4
1988	4	13	1.52	0.175	15,120	1122.21	1066.0995	17
1988	5	13	1.49	0.030	2,592	539.48	512.506	1
1988	6	25	1.56	0.130	11,232	12067.92	11464.524	136
1988	9	9	2.39	2.530	218,592	455.21	432.4495	100
1989	3	19	1.98	0.580	50,112	404.412	384.1914	3
1989	6	24	1.84	0.100	8,640	358.255	340.34225	20
1989	8	3	2.42	2.040	176,256	1005.52	955.244	177
1989	8	28	2.36	1.420	122,688	752.61	714.9795	92
1989	9	1	2.48	2.080	179,712	765.73	727.4435	138
1989	9	3	2.46	1.810	156,384	1337.61	1270.7295	209
1989	9	5	2.33	1.180	101,952	533.13	506.4735	54
1989	9	5	2.36	1.420	122,688	781.88	742.786	96
1989	9	10	2.25	1.980	171,072	1424.08	1352.876	244
1989	9	10	2.48	1.830	158,112	1012.5	961.875	160
1989	9	24	2.28	1.410	121,824	524.16	497.952	64
1989	9	28	2.62	3.330	287,712	5539.9	5262.905	1,593
1989	11	10	2.07	0.230	19,872	218.13	207.2235	4
1992	2	1	0.27	0.120	10,368	363.928	345.7316	4
1992	7	11	2.5	0.600	51,840	4229.5	4018.025	219
1993	10	11	0.57	1.910	165,024	563.92	535.724	93

Ministry of Water Resources

Daily Observation

Station number	113041
River basin	Abbay
Station name	Debre Markos
River	Abahim
Catchment area (km2)	31.3

Year	Month	Day	G.H.	Flow	Daily discharge	Sediment concentration			Daily sediment load	
			h (m)	Q (m ³ /s)	m ³ /d	g/t	mg/kg	ppm	g/m ³ mg/l	t/d
1989	4	30	0.22	0.017	1,469	247.64			235.26	0.36
1989	5	9	0.52	0.003	259	172.19			163.58	0.04
1989	6	20	0.36	0.007	605	752.15			714.54	0.45
1989	7	28	0.86	0.640	55,296	11261.25			10698.19	184.09
1989	8	26	0.84	0.620	53,568	388.13			368.72	207.58
1989	8	29	1.77	3.730	322,272	571.25			542.69	13.61
1989	8	29	1.9	3.160	273,024	760.52			722.50	63.13
1989	8	30	0.73	0.620	53,568	257.07			244.21	10433.97
1989	8	31	0.7	0.320	27,648	679.25			645.29	303.03
1989	9	3	0.57	0.470	40,608	666.80			633.46	622.70
1989	9	6	1	1.340	115,776	545.31			518.05	20.78
1989	9	6	0.93	0.900	77,760	895.06			850.31	18.76
1989	9	8	3.1	33.060	2,856,384	3652.92			3470.27	27.08
1989	9	10	2.61	31.230	2,698,272	257.81			244.92	69.91
1989	9	29	2.16	5.370	463,968	653.12			620.47	2044.28
1992	7	10	0.41	0.050	4,320	372.50			353.88	1.61
1995	10	4	1	0.220	19,008	235.03			223.28	3.08
1995	10	5	0.97	0.192	16,589	185.38			176.11	4.47

Ministry of Water Resources

Hydro-Sedimentological Data Base of H-Project "Monitoring and Assessment of Erosion and Sedimentation in Ethiopia"

Daily Observation

Station number	112007
River basin	Abbay
Station name	Debre Birhane
River	Beressa
Catchment area (km2)	211
Transformation equation	$g=20.52(h-0.25)^{2.5}$

GUIDE:

1. Save the file under the new name (name of site) into the folder with the name of the river
2. Clear the old data with: mark, Edit, Clear, Contents Del
2. Fill the data of the HSD (Ato Wondimu) in the fields with the following color:
3. Add an empty row between measurements of non following days

4. Copy the automatically computed values for Water discharge and sediment load in the co

(File name: input1)

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1968	7	22	2.135	98.280	8,491,392	2.611	2.48045	22,171.02
1968	8	4	1.525	35.710	3,085,344	1063.26	1010.097	3,280.57
1989	8	15	1.21	7.184	620,698	191.34	181.773	120.63
1990	2	8	0.68	0.164	14,170	143.34	136.173	2.03
1992	10	12	0.78	1.187	102,557	183.77	174.5815	18.84
1992	11	11	0.63	0.206	17,798	172.48	163.856	3.07
1994	8	19	1.14	6.046	522,374	398.263	378.34985	197.64
1995	5	22	0.92	2.003	173,059	352.9667	335.318365	58.03
1995	2	4	0.7	0.291	25,142	132.99	126.3405	3.18
1995	8	1	0.65	0.127	10,973	111.77	106.1815	1.17
1995	8	14	1.5	18.392	1,589,069	442.8567	420.713865	668.54
1995	8	16	1.18	7.420	641,088	273.013	259.36235	166.27
1995	8	30	1.97	21.597	1,865,981	314.883	299.13885	558.19
1995	8	28	1.12	0.420	36,288	130.923	124.37685	4.51
1995	8	3	1.41	10.691	923,702	1113.3667	1057.698365	977

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1995	7	1	1.37	12.467	1,077,149	548.5667	521.138365	561
1995	7	25	0.96	2.900	250,560	861.28	818.216	205
1995	7	23	1.06	4.052	350,093	1755.733	1667.94635	584
1996	4	18	0.8	0.367	31,709	91.667	87.08365	3
1996	6	20	0.8	0.971	83,894	372.9	354.255	31
1996	8	4	1.02	5.574	481,594	1527.9667	1451.568365	736
1996	8	17	1.46	16.326	1,410,566	473.4	449.73	658
1996	8	21	2.7	68.136	5,886,950	508.133	482.72635	2,985
1997	9	2	0.81	1.125	97,200	93.133	88.47635	9
1997	9	4	0.92	1.324	114,394	111.8	106.21	13
1998	8	10	1.69	23.377	2,019,773	18282.1	17367.995	
1998	8	11	2.44	56.989	4,923,850	703.667	668.48365	
2002	10	1	0.41	0.634	54,778	170.48	161.956	

Ministry of Water Resources

Daily Observation

Station number	112031
River basin	Abbay
Station name	Bichena
River	Suha
Catchment area (km2)	359

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1985	8	29	0.94	3.950	341,280	384.07	364.87	131.08
1985	9	1	2.36	22.950	1,982,880	954.62	906.89	1892.90
1985	10	2	0.49	0.585	50,544	87.58	83.20	4.43
1985	10	5	0.68	2.850	246,240	222.81	211.67	54.86
1985	11	13	0.45	0.207	17,885	50.38	47.86	0.90
1986	4	30	0.38	0.041	3,542	169.83	161.34	0.60
1986	5	25	0.36	0.004	380	186.18	176.87	0.71
1986	6	29	0.76	3.520	304,128	602.85	572.71	183.34
1986	9	13	1.3	9.320	805,248	1988.14	1888.73	1601.26
1986	9	13	1.17	8.580	741,312	1085.18	1030.92	804.46
1986	9	14	1.97	16.510	1,426,464	3847.94	3655.54	5502.25
1986	9	17	0.89	5.610	484,704	368.57	350.14	178.65
1986	9	18	0.8	3.666	316,742	422.98	401.83	133.76
1986	10	30	0.53	0.620	53,568	157.33	149.46	0.43
1986	12	29	0.4	0.110	9,504	220.00	209.00	2.09

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1987	2	28	0.37	0.080	6,912	96.00	91.20	0.66
1987	4	17	0.42	0.220	19,008	280.00	266.00	5.32
1987	6	28	0.46	0.450	38,880	254.61	241.88	9.90
1987	8	6	1.24	7.820	675,648	3165.68	3007.40	2138.88
1987	8	7	0.8	3.850	332,640	779.96	740.96	259.49
1987	9	22	0.49	0.510	44,064	124.36	118.14	5.48
1987	9	26	0.57	1.380	119,232	275.36	261.59	32.86
1987	10	30	0.44	0.240	20,736	128.90	122.46	2.67
1988	5	27	0.37	0.312	26,957	619.38	588.41	16.70
1988	6	26	0.41	0.230	19,872	1415.21	1344.45	28.92
1988	7	25	2.14	18.440	1,593,216	2554.17	2426.46	4069.00
1988	8	2	1.4	11.970	1,034,208	1519.79	1443.80	1571.76
1988	8	9	2.18	19.240	1,662,336	943.75		
1988	8	9	1.29	9.070	783,648	947.92	900.52	2568.83
1988	8	9	2.25	22.690	1,960,416	1236.58	1174.75	742.84
1988	8	10	1.9	18.030	1,557,792	1403.13	1332.97	2424.21
1988	8	10	2.54	32.47	2805408	14639.58	13907.60	2185.78
1988	8	11	2.4	20.3	1753920	4386.46	4167.14	41095.30
1988	8	11	2.3	22.440	1,938,816	4388.79	4169.35	7693.50
1988	8	11	2.57	28.180	2,434,752	12447.92	11825.52	8509.06
1988	8	12	2	16.710	1,443,744	2519.79	2393.80	30307.60
1988	9	4	2.48	27.670	2,390,688	5296.88	5032.04	3637.93
1988	10	30	0.54	0.900	77,760	84.38	80.16	12663.18
1989	1	10	0.39	0.080	6,912	1702.94	1617.79	6.56
1989	3	27	0.42	0.100	8,640	205.29	195.03	11.77
1989	5	6	0.41	0.520	44,928	155.00	147.25	17.74
1992	6	26	0.35	0.160	13,824	1581.34	1502.27	6.96
1992	7	13	0.41	1.220	105,408	10204.90	9694.66	21.86
1994	10	11	0.5	0.690	59,616	254.83	242.09	1075.70
1995	8	3	2.44	13.700	1,183,680	2324.84	2208.60	15.19

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1995	8	5	1.82	7.370	636,768	687.85	653.46	438.00
1995	8	6	0.48	0.751	64,886	272.36	258.74	180.11
1995	8	11	0.89	3.050	263,520	683.48	649.31	17.67
							0.00	2751.87

Draft

Ministry of Water Resources

Daily Observation

Station number	112017
River basin	Abbay
Station name	Bichena
River	DEJEN
Catchment area (km2)	375

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1983	7	28	1.5	23.190	2,003,616	2948.23	2800.82	5907.12
1983	8	2	1.32	18.030	1,557,792	938.80	891.86	1462.46
1983	9	20	0.95	7.300	630,720	249.25	236.79	157.21
1983	9	24	1.59	28.460	2,458,944	2707.51	2572.13	6657.62
1984	9	17	0.85	5.440	470,016	184.42	175.20	86.68
1984	9	18	0.79	4.170	360,288	153.35	145.68	55.25
1984	9	21	1.05	8.590	742,176	290.68	276.15	215.74
1985	8	28	1.06	10.040	867,456	356.07	338.27	308.88
1985	9	1	1.7	39.760	3,435,264	691.47	656.90	2375.38
1985	10	2	0.48	0.860	74,304	320.99	304.94	23.85
1985	10	5	0.78	4.920	425,088	88.31	83.89	37.54
1985	11	13	0.36	0.490	42,336	81.68	77.60	3.46
1986	1	27	0.26	0.150	12,960	1305.80	1240.51	16.92
1986	2	22	0.32	0.260	22,464	267.66	254.28	6.01
1986	3	30	0.26	0.080	6,912	78.08	74.18	5.39
1986	4	29	0.28	0.185	15,984	342.99	325.84	5.48
1986	5	25	0.19	0.040	3,456	366.30	347.99	1.26

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1986	6	30	0.85	5.970	515,808	603.48	573.31	154.86
1986	7	10	1.06	10.510	908,064	1407.56	1337.18	1278.15
1986	9	10	1.4	17.970	1,552,608	739.20	702.24	1147.68
1986	9	13	1.04	9.560	825,984	646.80	614.46	534.25
1986	10	30	0.44	0.960	82,944	99.00	94.05	7.88
1986	12	29	0.27	0.200	17,280	144.00	136.80	2.49
1987	3	27	0.25	0.140	12,096	16.00	15.20	0.15
1987	6	5	0.5	1.150	99,360	215.34	204.57	21.40
1987	7	30	1.62	27.280	2,356,992	3523.40	3347.23	8304.01
1987	8	6	1.64	29.920	2,585,088	3432.12	3260.51	8872.33
1987	8	7	1.06	9.640	832,896	1385.25	1315.99	1153.77
1987	9	22	0.51	1.490	128,736	146.52		
1987	9	26	0.78	4.000	345,600	759.24	721.28	18.86
1987	10	30	0.35	0.480	41,472	323.01	306.86	262.39
1987	12	24	0.31	0.35	30240	43.25	41.09	13.40
1988	1	30	0.25	0.1	8640	169.83	161.34	1.31
1988	5	13	0.24	0.800	69,120	186.48	177.16	1.61
1988	6	28	0.36	0.430	37,152	163.17	155.01	12.88
1988	7	25	1.7	33.810	2,921,184	2131.25	2024.69	6.06
1988	9	5	1.38	22.500	1,944,000	1019.79	968.80	6225.72
1988	10	29	0.57	1.560	134,784	157.29	149.43	1982.47
1989	1	10	0.3	0.190	16,416	104.21	99.00	21.20
1989	3	27	0.29	0.020	1,728	130.00	123.50	1.71
1989	5	5	0.37	0.526	45,446	688.13	653.72	0.22
1989	7	25	1.12	10.020	865,728	2419.90	2298.91	31.27
1989	9	20	0.98	7.820	675,648	238.86	226.92	2095.00
1989	11	12	0.28	0.180	15,552	385.31	366.04	161.38
1993	10	8	0.77	2.340	202,176	775.66	736.88	5.99
1994	10	9	0.57	1.700	146,880	205.02	194.77	75.95
1995	8	3	1.38	18.450	1,594,080	2852.10	2709.50	30.11
1995	8	5	1.08	11.150	963,360	1162.23	1104.12	23.67
1995	8	11	0.82	4.920	425,088	867.03	823.68	368.56
1995	10	6	0.51	1.480	127,872	137.12	130.26	1119.64
1995	10	7	0.49	1.370	118,368	200.05	190.05	4546.48

Year	Month	Day	G.H. h (m)	Flow Q (m3/s)	Daily discharge m3/d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m3 mg/l	Daily sediment load t/d
1983	8	11	1.58	47.750	4,125,600	166.38	158.06	68.66
1983	8	24	1.85	109.230	9,437,472	61.36	58.29	484.70
1985	8	22	1.75	87.460	7,556,544	199.42	189.45	1506.93
1986	4	7	1.45	19.890	1,718,496	315.23	299.47	541.89
1986	6	19	1.3	27.950	2,414,880	64.00	60.80	154.55
1986	8	14	1.84	110.050	9,508,320	595.00	565.25	5699.28
1986	10	18	2.35	83.120	7,181,568	129.10	122.65	930.73
1987	4	25	1.39	14.880	1,285,632	51.48	48.91	66.18
1987	10	19	2.15	181.630	15,692,832	407.87	387.48	6400.64
1988	6	15	1.26	6.590	569,376	4908.00	4662.60	279.28
1988	7	1	1.44	20.980	1,812,672	388.10	368.70	703.52
1988	10	3	2.89	558.920	48,290,688	140.20	133.19	6770.35
1988	11	11	2.47	311.940	26,951,616	41.96	39.86	1130.80
1990	11	1	1.51	31.090	2,686,176	242.84	230.70	652.71
1990	8	3	2.05	153.870	13,294,368	247.80	235.41	3294.34
1993	4	28	1.41	18.071	1,561,334	50.38	47.86	78.66
1995	8	1	1.72	61.410	5,305,824	119.67	113.68	634.93
1996	2	20	1.45	19.935	1,722,384	75.35	71.58	129.77

Ministry of Water Resources

Daily Observation

Station number	115005
River basin	Abbay
Station name	Assosa
River	Hoffa
Catchment area (km2)	194

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1989	11	19	0.89	3.650	315,360	94.733	89.99635	29.98
1990	3	27	0.521	0.338	29,203	49.22	46.759	1.44
1990	6	22	0.56	0.520	44,928	180.8567	171.813865	8.04
1993	12	25	0.64	0.780	67,392	105.54	100.263	7.20
1995	4	10	0.41	0.440	38,016	91.45	86.8775	3.48
1996	3	5	0.47	0.260	22,464	44.23	42.0185	0.94
1996	5	20	0.73	1.050	90,720	181.883	172.78885	15.68

Ministry of Water Resources

Daily Observation

Station number	111014
River basin	Abbay
Station name	Ambessema
River	Gelda
Catchment area (km2)	32

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1983	9	28	0.62	0.699	60,394	2586	2456.7	156.18
1984	9	5	0.6	0.810	69,984	86.73	82.3935	6.07
1985	2	21	0.39	0.045	3,888	56.2	53.39	0.22
1986	2	18	0.35	0.057	4,925	80	76	0.39
1986	6	20	0.36	0.690	59,616	631	599.45	37.62
1987	4	27	0.34	0.034	2,938	49.57	47.0915	0.14
1988	5	25	0.12	0.099	8,554	2164.5	2056.275	18.51
1988	8	13	0.67	2.070	178,848	197.65	187.7675	29.98
1988	8	30	0.68	2.240	193,536	140.19	133.1805	27.13
1988	8	30	0.68	2.270	196,128	157.84	149.948	30.96
1988	9	19	0.61	1.590	137,376	68.63	65.1985	9.43
1988	12	29	0.4	0.134	11,578	23.14	21.983	0.27
1990	2	8	0.35	0.054	4,666	154.5	146.775	0.72
1994	8	25	0.6	1.372	118,541	126.79	120.4505	15.03
1995	8	2	0.58	0.854	73,786	148.3667	140.948365	10.95
1996	2	23	0.34	0.050	4,308	68.5367	65.109865	0.28
1996	10	31	0.43	0.339	29,290	134.933	128.18635	3.75
1996	8	23	0.7	2.991	258,422	182.15	173.0425	42.07
1996	7	29	0.69	3.390	292,896	383.885	364.69075	112.54

Ministry of Water Resources

Daily Observation

Station number	112038
River basin	Abbay
Station name	Ambera
River	Yeda
Catchment area (km²)	125

Year	Month	Day	G.H.	Flow	Daily discharge	Sediment concentration			Daily sediment load	
			h (m)	Q (m ³ /s)	m ³ /d	g/t	mg/kg	ppm	g/m ³	mg/l
1988	4	19	0.41	0.022	1,901	1781.55			1692.47	3.39
1988	5	8	0.41	0.022	1,901	592.94			563.29	1.13
1988	6	25	0.99	0.060	5,184	4082.58			3878.45	21.16
1988	10	28	0.74	0.260	22,464	236.46			224.64	16.54
1989	1	9	0.51	0.120	10,368	550.59			523.06	5.71
1989	3	27	0.39	0.040	3,456	822.35			781.24	2.84
1989	5	2	0.29	0.068	5,875	956.25			908.44	5.62
1989	6	20	0.35	0.017	1,469	2016.56			1915.73	2.96
1989	7	28	1.27	0.540	46,656	3293.23			3128.57	153.65
1989	8	30	1.59	1.250	108,000	1795.73			1705.95	193.94
1989	8	30	1.54	1.240	107,136	1549.06			1471.61	165.96
1989	8	30	1.28	1.170	101,088	1321.36			1255.29	133.57
1989	8	30	1.64	1.450	125,280	1733.96			1647.26	217.23
1989	8	30	1.38	0.670	57,888	1680.52			1596.50	97.28
1989	9	1	0.99	0.460	39,744	1614.48			1533.76	64.16

Year	Month	Day	G.H. h (m)	Flow Q (m3/s)	Daily discharge m3/d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m3 mg/l	Daily sediment load t/d
1989	9	1	0.93	0.360	31,104	881.56	837.48	27.42
1989	9	1	0.88	0.320	27,648	615.42	584.65	17.01
1989	9	2	1.01	0.440	38,016	1486.36	1412.04	56.50
1989	9	2	0.91	0.360	31,104	1213.19	1152.53	37.73
1989	9	2	1.05	0.480	41,472	1308.44	1243.01	54.26
1989	9	3	0.83	0.280	24,192	618.96	588.01	14.97
1989	9	5	0.8	0.270	23,328	1381.88	1312.78	32.24
1989	9	6	1.04	0.440	38,016	1339.17	1272.21	50.91
1989	11	11	0.35	0.180	15,552	370.31	351.79	5.76
1992	2	2	0.51	0.100	8,640	338.00	321.10	2.92
1993	10	9	1.32	1.750	151,200	961.50	913.43	145.38
1994	10	8	0.88	1.050	90,720	1538.84	1461.90	139.60
1995	8	17	1.16	2.126	183,686	4631.26	4399.70	850.69
1995	10	5	0.75	0.420	36,288	543.37	516.20	19.71

Ministry of Water Resources

Daily Observation

Station number	113043
River basin	Abbay
Station name	Amanual
River	Gaziginit
Catchment area (km2)	

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1989	5	11	0.28	0.003	259	387.18	367.82	0.17
1989	6	19	0.78	0.006	518	441.25	419.19	0.23
1989	8	25	2.71		0	568.44	540.02	172.58
1989	9	4	0.58	0.140	12,096	678.75	644.81	7.80
1989	9	8	1.64	2.490	215,136	807.19	766.83	164.97
1989	9	10			0	833.75	792.06	8.21
1994	10	6	0.88	0.087	7,517	314.58	298.85	2.36

Ministry of Water Resources

Daily Observation

Station number	1
River basin	Abbay
Station name	Addis Zemen
River	Bure
Catchment area (km2)	100

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1960	6	16	0.68	0.251	21,686			0.00
1964	7	28	6.3	171.170	14,789,088			0.00
1968	7	7	2.9	32.500	2,808,000	7713.24	7327.578	20575.84
1968	7	23	3.56	44.500	3,844,800	2877	2733.15	10508.42

Ministry of Water Resources

Daily Observation

Station number	111005
River basin	Abbay
Station name	Addis Zemen
River	Ribb
Catchment area (km2)	1592

Year	Month	Day	G.H. h (m)	Flow Q (m3/s)	Daily discharge m3/d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m3 mg/ l	Daily sediment load t/d
1960	6	16	0.68	0.251	21,686			44.20
1964	7	28	6.3	171.170				63.17
1968	7	3	2.9	32.500	2,808,000	7713.240	7327.578	21658.78
1968	7	23	3.56	44.700	3,862,080	2877.770	2733.882	11114.18
1968	8	7	5.03	96.700	8,354,880	3543.780	3366.591	29607.86
1998	8	20	5.44	123.000	10,627,200	3712.610	3526.980	3945.65
1968	9	3	3.32	320.000	27,648,000	3515.400	3339.630	11238.03
1980	8	7	4.56	34.560	2,985,984	2229.610	2118.130	6657.58
1980	9	24	2.6	6.840	590,976	178.180	169.271	105.30
1983	8	15	6.42	134.950	11,659,680	86.820	82.479	10048.54
1985	9	3	2.58	27.310	2,359,584	3178.530	3019.604	7502.37
1986	2	11	2.46	0.094	8,122	2.030	1.929	1.65
1986	8	7	6.07	77.730	6,715,872	4729.710	220.030	31764.13
1986	9	5	3.65	24.580	2,123,712	577.210	548.350	1225.82
1987	4	29	2.36	0.710	61,344	231.610	220.030	14.21
1987	10	29	2.5	16.000	1,382,400	389.610	370.130	53.86

Year	Month	Day	G.H. h (m)	Flow Q (m3/s)	Daily discharge m3/d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m3 mg/l	Daily sediment load t/d
1988	5	25	2.12	0.099	8,554	2164.500	2056.275	18.51
1988	7	22	5.89	60.250	5,205,600	3527.190	3350.831	18361.14
1988	9	2	5.9	56.030	4,840,992	4076.420	3872.599	19283.92
1988	11	18	3.13	2.610	225,504	173.140	164.483	39.04
1988	12	22	2.82	1.084	93,658	95.090	90.336	8.90
1989	2	11	2.7	0.579	50,026	103.920	98.724	5.20
1990	2	12	2.75	0.387	33,437	281.570	267.492	8.30
1990	7	6	5.57	46.104	3,983,386	10530.650	10004.118	41947.60
1992	5	23	3.35	0.493	42,595	987.420	938.049	42.06
1992	7	20	5.32	36.300	3,136,320	19995.750	18995.963	62713.07
1992	8	25	6.4	62.170	5,371,488	3126.020	2969.719	17274.81
1993	5	12	3.05	0.261	22,550	372.650	354.018	8.40
1993	7	20	6.81	90.640	7,831,296	14556.980	13829.131	114000.00
1994	8	26	7.28	113.850	9,836,640	8777.030	8338.179	863365.00
1995	8	3	7.39	138.170	11,937,888	3269.100	3105.645	39026.15
1996	8	24	7.26	212.690	18,376,416	8102.367	7697.249	78754.68
1996	8	12	6.62	57.595	4,976,208	769.745	731.258	4825.65
1996	10	2	4.48	2.074	179,194	25.696	24.411	22.93

Ministry of Water Resources

Daily Observation

Station number

River basin

Station name

River

Catchment area (km2)

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1995	10	22	0.1	0.460	39,744	160.52	152.49	6.38

Ministry of Water Resources

Daily Observation

Station number	112024
River basin	Abbay
Station name	Wereilu
River	Tumelle
Catchment area (km2)	

Year	Month	Day	G.H.	Flow	Daily discharge	Sediment concentration			Daily sediment load	
			h (m)	Q (m ³ /s)	m ³ /d	g/t	mg/kg	ppm	g/m ³ mg/l	t/d
1985	7	11	0.29	0.020	1,728		187.5		178.125	204.66
1985	7	18	0.54	0.325	28,080		827.08		785.726	34.16
1985	7	28	0.52	0.265	22,896		1491.19		1416.6305	0.32
1985	8	21	0.52	1.035	89,424		2288.61		2174.1795	23.22

Ministry of Water Resources

Daily Observation

Station number	115009
River basin	Abbay
Station name	Nedjo
River	Dilla
Catchment area (km2)	69

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/ l	Daily sediment load t/d
1985	9	24	0.88	4.120	355,968	1109.85	1054.3575	395.07
1986	8	4	2.68	10.880	940,032	824.82	783.579	775.36
1986	8	4	0.63	1.210	104,544	401.45	381.3775	41.97
1988	1	22	0.27	3.870	334,368	168.72	160.284	56.41
1988	3	20	0.05	0.400	34,560	46.62	44.289	1.61
1988	1	6	2.35	131.137	11,330,246	2009	1908.55	21,624.34
1989	6	21	0.16	1.280	110,592	64.41	61.1895	7.12
1989	10	30	0.3	3.200	276,480	725.8	689.51	200.40
1990	6	18	0.2	1.280	110,592	404.3	384.085	44.71
1990	3		0.115	0.460	40	40	38	1.58
1994	10	6	0.42	1.780	153,792	134.03	127.3285	20.61
1995	10	6	0.22	0.350	30,240	85.03	80.7785	2.57
1995	6	17	0.28	0.630	54,432	65.04	61.788	3.54
1995	4	28	0.46	2.130	184,032	140.37	133.3515	28.13

Ministry of Water Resources

Daily Observation

Station number	112027
River basin	Abbay
Station name	Mukature
River	Aleltu
Catchment area (km2)	447

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/ l	Daily sediment load t/d
1985	6	2	0.54	0.701	60,566	33.63	31.95	1.94
1988	1	9	0.39	0.063	5,443	44.40	42.18	0.23
1988	7	22	1.6	12.084	1,044,058	212.35	201.73	210.62
1988	8	21	2.16	29.140	2,517,696	174.83	166.09	418.16
1988	8	22	2.78	31.900	2,756,160	178.08	169.18	466.28
1988	8	25	1.8	17.276	1,492,646	157.08	149.23	222.74
1988	8	27	1.73	17.740	1,532,736	167.16	158.80	243.40
1988	8	29	1.74	16.890	1,459,296	214.00	203.30	296.67
1989	1	24	0.34	0.048	4,147	33.33	31.66	0.13
1989	5	3	0.49	0.353	30,499	80.77	76.73	2.34
1989	6	21	0.32	0.052	4,493	102.81	97.67	0.44
1989	12	24	0.38	0.131	11,318	137.74	130.85	1.48

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/ l	Daily sediment load t/d
1990	3	2	0.48	0.420	36,288	116.63	110.80	4.02
1990	5	5	0.38	0.122	10540.8	54.68	51.95	0.55
1992	7	18	1.19	5.446	470534.4	948.73	901.29	424.09
1992	7	24	1.51	10.495	906,768	197.51	187.63	170.14
1992	7	28	2	24.076	2,080,166	1584.38	1505.16	3130.99
1992	8	4	2.13	26.255	2,268,432	379.49	360.52	817.80
1992	8	14	1.62	14.600	1,261,440	136.59	129.76	2.04
1992	8	20	1.46	10.719	926,122	234.00	222.30	0.24
1992	8	31	1	25.471	2,200,694	315.16	299.40	221.71
1992	9	5	2.05	26.997	2,332,541	109.60	104.12	450.24
1992	9	10	1.74	18.500	1,598,400	339.51	322.53	490.82
1992	9	19	1.27	6.999	604,714	203.64	193.46	234.46
1992	9	25	1.02	3.952	341,453	162.13	154.02	256.21
1992	9	25	1.02	3.558	307,411	199.55	189.57	312.28
1992	11	7	0.46	0.080	6,912	168.73	160.29	0.14
1992	11	7	0.49	0.285	24,624	179.17	170.21	2.46
1994	8	16	2.48	50.033	4,322,851	229.65	218.17	0.46
1995	1	28	0.27	0.021	1,814	175.17	166.41	1.55
1995	4	29	0.76	1.410	121,824	457.10	434.25	4.23
1995	7	17	1.39	8.213	709,603	6401.20	6081.14	0.57
1995	7	19	1.461	9.889	854,410	1351.73	1284.15	446.41
1995	7	29	1.38	7.796	673,574	399.80	379.81	179.10
1995	8	10	3.08	95.702	8,268,653	1219.63	1158.65	3295.84
1995	8	11	2.59	49.509	4,277,578	350.1	332.595	861
1995	8	21	1.85	19.413	1,677,283	800.19	760.1805	173
1995	8	24	1.96	23.556	2,035,238	210.273	199.75935	217
1995	8	26	2.36	36.277	3,134,333	131.67	125.0865	694
1995	8	30	1.22	5.058	437,011	264.6	251.37	256
1995	9	20	0.94	3.076	265,766	288.7	274.265	543
1995	9	22	0.77	2.370	204,768	191.233	181.67135	123

Ministry of Water Resources

Daily Observation

Station number	112028
River basin	Abbay
Station name	MUKATURE
River	Robi-Jida
Catchment area (km2)	762

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1985	6	1	0.39	0.061	5,270	35.55	33.77	0.18
1985	7	22	1.14	11.077	957,053	51.66	49.08	46.97
1988	8	25	1.17	12.712	1,098,317	54.08	51.38	56.43
1988	8	29	1.15	11.650	1,006,560	90.16	85.65	86.21
1989	1	24	0.37	0.096	8,294	23.00	21.85	0.18
1989	2	2	0.43	0.243	20,995	89.51	85.03	1.79
1989	5	5	0.33	0.019	1,642	52.71	50.07	0.08
1989	6	21	0.29	0.007	605	76.25		
1989	8	9	1.39	8.547	738,461	92.84	88.20	65.13
1989	9	23	0.8	3.600	311,040	67.86	64.47	20.05
1989	10	19	0.5	0.641	55,382	123.57	117.39	6.50
1989	12	24	0.41	0.196	16,934	57.45	54.58	0.92

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1990	7	19	1.3	10.883	940,291	307.70	292.32	274.86
1992	7	25	1.27	12.99	1122336	179.48	170.51	191.37
1992	7	29	2.18	71.78	6201792	1210.26	1149.75	7130.49
1992	8	13	1.42	20.760	1,793,664	526.94	500.59	897.90
1992	8	16	1.5	26.820	2,317,248	179.90	170.91	396.03
1992	8	21	1.82	51.930	4,486,752	205.16	194.90	874.48
1992	8	31	1.34	16.280	1,406,592	117.67	111.79	157.24
1992	9	4	1.48	21.190	1,830,816	273.98		
1992	9	10	1.38	18.150	1,568,160	198.80	188.86	0.18
1992	9	18	1.18	8.180	706,752	134.30	127.59	49.44
1992	9	24	0.86	3.520	304,128	158.70		
1992	9	25	0.81	2.933	253,411	226.92	215.57	59.39
1994	8	16	1.67	32.599	2,816,554	356.62	338.79	40.75
1995	1	28	0.48	0.037	3,197	102.26		
1995	4	29	0.59	0.439	37,930	43.33	41.16	0.19
1995	7	17	1.46	19.025	1,643,760	286.57	272.24	1.88
1995	7	19	1.26	13.348	1,153,267	179.40	170.43	0.08
1995	7	20	1.48	21.161	1,828,310	570.47	541.94	0.05
1995	7	30	1.69	7.161	618,710	697.30	662.44	68.56
1995	8	10	1.57	53.366	4,610,822	343.93	326.74	21.11
1995	8	21	1.59	27.343	2,362,435	292.98	278.33	0.97
1995	8	24	1.43	18.022	1,557,101	117.59	111.71	6.83
1995	9	9	1.58	25.677	2,218,493	217.33		
1995	9	20	0.86	2.424	209,434	116.80	110.96	289.33
1995	9	22	0.82	2.041	176,342	105.07	99.81	201.44
1995	10	1	0.67	0.836	72,230	66.47	63.14	7505.76
1995	10	2	0.64	0.706	60,998	80.33	76.32	463.89
1996	3	4	0.33	0.017	43	1999.00	1899.05	945.06
1996	6	14	0.55	0.499	68	2009.00	1908.55	920.48
1996	8	17	1.58	1.510	196	3222.00	3060.90	165.53

Ministry of Water Resources

Daily Observation

Station number	112030
River basin	Abbay
Station name	Motta
River	Teme
Catchment area (km2)	156.3

Year	Month	Day	G.H.	Flow	Daily discharge	Sediment concentration			Sediment concentration		Daily sediment load
			h (m)	Q (m ³ /s)	m ³ /d	g/t	mg/kg	ppm	g/m ³	mg/l	t/d
1985	8	29	1.55	12.840	1,109,376	292.56			277.93		324.56
1985	8	30	1.62	14.530	1,255,392	440.87			418.83		553.46
1985	10	3	0.65	0.550	47,520	84.69			80.46		4.02
1985	10	4	0.86	2.350	203,040	456.16			433.35		92.62
1985	11	14	0.59	0.240	20,736	166.15			157.84		3.94
1986	1	26	0.5	0.085	7,344	745.68			708.40		5.48
1986	2	22	0.5	0.120	10,368	542.79			515.65		5.63
1986	3	30	0.47	0.017	1,469	506.16			480.85		0.74
1986	4	29	0.48	0.069	5,962	469.53			446.05		2.80
1986	5	24	0.44	0.022	1,901	745.68			708.40		1.42
1986	7	9	0.95	3.190	275,616	145.45			138.18		40.09
1986	9	14	1.15	4.950	427,680	785.09			745.84		335.77
1986	9	14	1.02	4.120	355,968	1188.52			1129.09		423.08
1986	9	15	1.32	9.110	787,104	1422.96			1351.81		1120.02
1986	9	16	1.24	6.140	530,496	1563.78			1485.59		829.31
1986	10	3	0.58	0.440	38,016	93.00			88.35		3.54
1986	12	31	0.48	0.080	6,912	185.00			175.75		12.40
1987	2	28	0.47	0.020	1,728	84.00			79.80		0.15
1987	4	16	0.53	0.160	13,824	312.00			296.40		4.31
1987	6	27	0.78	1.570	135,648	9329.55			8863.07		1265.33

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1987	8	2	1.07	4.310	372,384	828.06	786.66	308.36
1987	8	3	1.35	7.860	679,104	3575.31	3396.54	2428.01
1987	8	5	1.11	4.670	403,488	733.71	697.02	296.04
1987	10	31	0.66	0.610	52,704	277.50	263.63	14.62
1987	12	23	0.54	0.180	15,552	129.57	123.09	2.02
1988	1	30	0.52	0.100	8,640	96.59	91.76	0.83
1988	5	21	0.59	0.152	13,133	55529.10	52752.65	729.25
1988	6	27	0.05	0.600	51,840	3629.72	3448.23	187.13
1988	7	26	2.2	25.280	2,184,192	2543.75		
1988	8	13	1.62	16.040	1,385,856	2151.04	2043.49	5556.04
1988	8	13	1.46	11.230	970,272	1066.66	1013.33	2981.03
1988	8	14	1.3	7.23	624672	674.96	641.21	1013.38
1988	8	16	1.34	8.32	718848	795.83	756.04	421.63
1988	8	17	1.24	7.240	625,536	668.75	635.31	572.08
1988	8	18	1.71	16.730	1,445,472	1385.42	1316.15	418.33
1988	8	18	1.96	19.840	1,714,176	2523.96	2397.76	20002.58
1988	8	21	2.14	24.430	2,110,752	2244.79	2132.55	4326.51
1988	8	21	1.44	11.370	982,368	709.16	673.70	4338.19
1988	8	23	1.16	6.510	562,464	557.76	529.87	691.74
1988	8	23	2.04	24.350	2,103,840	1872.92	1779.27	313.72
1988	8	25	2.36	29.560	2,553,984	1893.75	1799.06	3940.32
1988	8	28	1.25	6.150	531,360	1418.75	1347.81	4836.61
1988	8	31	1.01	3.440	297,216	252.08	239.48	753.87
1988	9	1	1.1	3.990	344,736	448.96	426.51	74.92
1988	10	20	0.7	0.930	80,352	99.90	94.91	154.77
1989	1	12	0.5	0.920	79,488	69.71	66.22	8.03
1989	3	25	0.52	0.180	15,552	165.88	157.59	0.72
1989	5	7	0.48	0.110	9,504	11.25	10.69	2.58
1989	6	26	1.1	4.810	415,584	848.33	805.91	1.06
1989	11	13	0.56	0.270	23,328	127.50	121.13	352.58
1993	10	6	0.85	2.220	191,808	312.35	296.73	2.97
1994	10	10	0.6	0.762	65,837	263.99	250.79	59.91
1995	8	6	1.26	6.830	590,112	723.30	687.14	17.38
1995	8	7	1.24	21.710	1,875,744	1690.93	1606.38	426.83
1995	8	8	1.96	4.209	363,658	541.37	514.30	89.21
1995	8	12	1.04	4.070	351,648	728.16	691.75	256.06

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/ l	Daily sediment load t/d
1995	8	13	0.91	2.792	241,229	376.58	357.75	52.32
1995	9	8	1	3.730	322,272	162.35	154.23	3171.76
							0.00	199.44

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Ministry of Water Resources

Daily Observation

Station number	112037
River basin	Abbay
Station name	Motta
River	Sede
Catchment area (km2)	209

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1987	6	27	0.79	0.460	39,744	1414.44	1343.72	56.22
1987	8	3	3.82	14.850	1,283,040	4572.20	4343.59	5866.33
1987	8	5	2.04	4.160	359,424	1501.14	1426.08	539.54
1987	9	23	1.19	1.380	119,232	798.90	758.96	95.25
1987	9	24	1.09	1.020	88,128	534.44	507.72	47.00
1987	10	31	1.19	1.990	171,936	433.16	411.50	74.48
1987	12	23	0.64	0.220	19,008	153.18	145.52	2.90
1988	1	30	0.47	0.140	12,096	316.68	300.85	3.83
1988	5	21	0.58	0.257	22,205	5488.17	5213.76	188.48
1988	6	27	0.62	0.340	29,376	3969.42	3770.95	114.82
1988	7	26	3.92	15.080	1,302,912	2564.58	2436.35	3430.05
1988	8	15	3.5	12.120	1,047,168	390.63	371.10	409.06
1988	8	16	3.38	11.270	973,728	555.21	527.45	540.62
1988	8	16	3.79	15.460	1,335,744	4590.62	4361.09	6004.10

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1988	8	17	3.15	7.730	667,872	954.17	906.46	802.14
1988	8	19	4.34	22.440	1,938,816	1134.38	1077.66	2199.40
1988	8	20	4.16	19.220	1,660,608	1116.67	1060.84	1854.35
1988	8	21	4.04	16.590	1,433,376	2620.83	2489.79	3756.63
1988	8	22	3.48	12.160	1,050,624	647.92	615.52	650.72
1988	8	22	3.35	9.690	837,216	767.71	729.32	642.74
1988	8	24	0.86	7.080	611,712	1476.00	1402.20	1902.89
1988	8	24	2.64	6.940	599,616	641.67	609.59	384.76
1988	8	25	2.49	6.050	522,720	416.67	395.84	217.50
1988	8	27	3.96	16.460	1,422,144	2775.00	2636.25	3946.55
1988	8	28	3.25	10.800	933,120	1007.29	956.93	939.92
1988	8	29	3.04	8.640	746,496	1033.34	981.67	771.38
1988	8	29	3.18	10.630	918,432	1181.25	1122.19	1084.90
1988	9	2	1.99	3.780	326,592	477.08		
1988	10	30	1.14	1.370	118,368	181.25	172.19	155.81
1989	1	12	0.7	0.300	25,920	216.47	205.65	21.45
1989	3	25	0.47	0.080	6,912	178.82	169.88	5.61
1989	5	7	0.49	0.045	3,888	162.19	154.08	1.24
1989	7	27	2.35	5.7	492,480	908.44	863.02	447.30
1989	11	18	0.93	0.48	41,472	250.94	238.39	10.41
1992	7	22	0.94	2.880	248,832	717.50	681.63	0.63
1992	7	23	2.03	7.490	647,136	3919.95	3723.95	178.54
1994	10	11	1.15	0.910	78,624	154.77	147.03	2536.74
1995	8	12	2.92	9.880	853,632	2256.83	2143.99	12.18
1995	8	13	2.39	5.923	511,747	1211.99	1151.39	620.23
1995	10	8	1.37	1.070	92,448	313.78	298.09	29.01

Ministry of Water Resources

Daily Observation

Station number	112018
River basin	Abbay
Station name	Motta
River	Azuari
Catchment area (km2)	209

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1985	8	29	1	14.500	1,252,800	366.68	348.35	459.38
1985	8	30	1.29	22.800	1,969,920	468.75	445.31	923.40
1985	9	24	1.86	44.910	3,880,224	749.96	712.46	2910.01
1985	10	3	0.52	0.330	28,512	145.52	138.24	4.15
1985	10	4	0.63	2.510	216,864	135.10	128.35	29.30
1985	11	14	0.44	0.450	38,880	69.82	66.33	2.71
1986	1	26	0.39	0.100	8,640	2900.00	2755.00	2.51
1986	2	22	0.4	0.320	27,648	249.75	237.26	6.91
1986	3	30	0.36	0.123	10,627	109.89	104.40	1.17
1986	4	29	0.37	0.180	15,552	159.84	151.85	2.47
1986	7	9	0.72	3.920	338,688	227.35	215.98	27.00
1986	9	14	0.92	7.220	623,808	905.11	859.85	564.61
1986	9	15	1.06	11.440	988,416	2422.96	2301.81	2394.89
1986	9	16	0.8	5.270	455,328	610.86	580.32	278.14
1986	10	30	0.47	0.600	51,840	148.00	140.60	7.67
1986	12	31	0.4	0.280	24,192	180.00	171.00	4.35
1987	2	28	0.38	0.240	20,736	400.00	380.00	8.29
1987	4	17	0.41	0.360	31,104	388.00	368.60	12.07

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1987	6	27	0.56	1.940	167,616	5284.31	5020.09	952.78
1987	8	2	0.75	5.060	437,184	1277.61	1213.73	558.55
1987	8	3	1	10.550	911,520	3135.08	2978.33	2861.33
1987	8	4	0.81	5.870	507,168	930.18	883.67	471.76
1987	8	6	0.91	8.200	708,480	2862.69	2719.56	2028.16
1987	9	25	0.56	1.110	95,904	132.09	125.49	12.66
1987	9	27	0.51	0.710	61,344	172.05	163.45	10.57
1987	10	31	0.5	0.890	76,896	99.90	94.91	7.68
1987	11	23	0.43	0.390	33,696	59.94	56.94	2.02
1988	1	30	0.42	0.300	25,920	59.94		
1988	5	21	0.38	0.184	15,898	173.16	164.50	1.55
1988	6	27	0.48	0.770	66,528	1121.21	1065.15	2.75
1988	7	26	0.92	9.180	793,152	1902.04	1806.94	74.59
1988	8	14	1.54	28.52	2464128	464.58	441.35	1508.61
1988	8	16	1.1	15.01	1296864	1746.87	1659.53	1144.78
1988	8	18	1.41	26.880	2,322,432	2242.71	2130.57	2265.45
1988	8	19	1.66	37.690	3,256,416	1656.25	1573.44	5905.27
1988	8	21	0.76	4.520	390,528	2322.92	2206.77	5393.44
1988	8	28	0.86	7.230	624,672	428.13	406.72	903.16
1988	8	29	0.97	9.790	845,856	3939.58	3742.60	267.44
1988	8	30	0.7	2.020	174,528	432.29	410.68	3332.32
1988	9	3	0.7	2.020	174,528	405.21	384.95	75.45
1988	10	30	0.56	1.470	127,008	176.04	167.24	70.72
1989	3	25	0.42	0.270	23,328	8.50	8.08	22.36
1989	5	7	0.4	0.230	19,872	154.69	146.96	1.98
1989	7	26	0.84	6.240	539,136	2276.04	2162.24	3.07
1989	9	22	0.9	6.580	568,512	958.70	910.77	1227.10
1989	10	13	0.46	0.640	55,296	185.31	176.04	545.03
1992	7	23	0.85	1.700	146,880	29.43	27.96	10.25
1993	10	6	0.69	3.090	266,976	304.08	288.88	432.27
1994	10	10	0.49	0.753	65,059	227.44	216.07	81.18
1995	8	6	0.95	9.050	781,920	499.93	474.93	14.80
1995	8	8	0.83	6.470	559,008	867.82	824.43	548.45
1995	8	13	0.71	3.100	267,840	2047.71	1945.32	482.12

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1995	10	8	0.54	1.350	116,640	288.62	274.19	390.91
							0.00	34.41

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Ministry of Water Resources

Daily Observation

Station number	113029
River basin	Abbay
Station name	Metekele
River	Ardie
Catchment area (km2)	219

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1977	7	12	1.38	15.610	1,348,704	25.00	23.75	33.72
1977	7	16	1.64	22.800	1,969,920	25.00	23.75	49.25
1977	7	30	1.44	16.370	1,414,368	15.00	14.25	21.22
1977	8	4	1.3	12.720	1,099,008	10.00	9.50	10.99
1977	8	13	1.72	24.810	2,143,584	23.00	21.85	49.30
1977	8	18	1.47	18.840	1,627,776	10.00	9.50	16.28
1977	9	3	1.82	27.480	2,374,272	30.00	28.50	71.23
1984	8	27	1.07	19.380	1,674,432	406.20	385.89	680.15
1984	8	28	1.72	21.890	1,891,296	400.32	380.30	757.12
1984	10	14	1.14	7.940	686,016	47.58	45.20	32.64
1985	7	25	2.36	44.230	3,821,472	1120.93	1064.88	4283.60
1985	8	7	1.96	28.490	2,461,536	530.41	503.89	1305.62
1985	9	9	2.94	67.470	5,829,408	1166.43	1108.11	6799.60
1985	9	18	1.91	27.900	2,410,560	1434.83	1363.09	3458.74
1985	9	19	3.02	59.910	5,176,224	2200.08	2090.08	11388.11
1985	9	20	1.58	21.250	1,836,000	288.43	274.01	529.56
1985	10	29	0.98	4.360	376,704	51.00	48.45	19.21
1985	11	29	0.69	1.830	158,112	41.55	39.47	6.57
1986	1	29	0.52	0.430	37,152	416.25	395.44	15.46

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1986	2	25	0.45	0.300	25,920	439.56	417.58	11.39
1986	3	28	0.43	0.790	68,256	382.95	363.80	26.14
1986	4	23	0.4	0.170	14,688	396.27	376.46	5.82
1986	5	29	0.42	0.135	11,664	149.85	142.36	1.75
1986	6	19	0.72	2.630	227,232	606.76	576.42	137.86
1986	8	26	1.98	32.010	2,765,664	2824.02	2682.82	7810.29
1986	8	27	1.5	19.320	1,669,248	364.46	346.24	608.37
1986	8	31	1.7	22.600	1,952,640	503.59	478.41	983.37
1986	9	25	1.7	26.510	2,290,464	906.54	861.21	2083.24
1986	10	22	1.16	10.840	936,576	483.00	458.85	452.36
1987	4	3	0.39	0.170	14,688	456.00		
1987	10	31	0.59	1.040	89,856	36.63	34.80	6.70
1988	1	25	0.58	0.58	50112	89.91	85.41	3.29
1988	2	25	0.48	0.39	33696	193.11	183.45	4.50
1988	4	25	0.38	0.138	11,923	86.56	82.23	6.51
1988	5	31	0.46	0.367	31,709	532.80	506.16	1.03
1988	6	22	1.22	9.660	834,624	2727.27	2590.91	16.89
1988	7	31	2.12	34.080	2,944,512	677.08	643.23	2276.20
1988	9	16	1.43	17.630	1,523,232	187.50	178.13	1993.67
1988	10	21	1.3	14.340	1,238,976	167.75	159.36	285.61
1989	1	29	0.51	0.700	60,480	27.06	25.71	207.84
1989	2	14	0.5	0.510	44,064	34.12	32.41	1.64
1989	5	22	0.75	2.430	209,952	898.75	853.81	1.50
1993	10	15	1.22	10.770	930,528	293.12	278.46	188.69
1994	9	30	1.24	10.870	939,168	137.62	130.74	272.76
1995	8	9	1.73	23.280	2,011,392	305.33	290.06	129.25
1995	8	12	2.2	40.561	3,504,470	918.83	872.89	1.37
1995	8	29	1.61	20.610	1,780,704	446.50	424.18	117.55
1995	9	1	2.18	38.410	3,318,624	1856.23	1763.42	795.08
1995	9	13	3.08	70.820	6,118,848	2883.53	2739.35	151.78
1995	9	20	3.3	81.205	7,016,112	2163.06	2054.91	211.57
1995	9	26	1.26	131.150	11,331,360	322.33	306.21	15176.31
1995	9	30	1.2	10.887	940,637	161.36	153.29	17643.88
1995	10	2	1.15	9.956	860,198	245.96	233.66	6160.14
1995	10	7	1.11	0.074	6,394	215.16	204.40	614.14

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1995	10	13	1	6.860	592,704	198.33	188.41	3243.84
							0.00	3652.47

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Ministry of Water Resources

Daily Observation

Station number	116004
River basin	Abbay
Station name	Metekel(Mandura)
River	Gillgel Belles
Catchment area (km2)	675

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1995	8	10	2.08	82.573	7,134,307	3101.86	2946.77	21808.50
1995	8	21	1.75	55.169	4,766,602	1964.03	1865.83	403.68
1995	8	25	2.26	104.280	9,009,792	2420.53	2299.50	12632.52
1995	8	28	1.91	20.081	1,734,998	2152.20	2044.59	22129.67
1995	9	2	1.58	37.278	3,220,819	686.13	651.82	3734.06
1995	9	9	1.96	72.092	6,228,749	2028.10	1926.70	9361.76
1995	9	19	3.31	21.700	1,874,880	236.73	224.89	2209.91
1995	10	4	1.47	31.884	2,754,778	830.83	789.29	443.84
1995	10	16	1.12	14.144	1,222,042	330.33	313.81	2288.76

Ministry of Water Resources

Daily Observation

Station number	111002
River basin	Abbay
River	Gilgel Abbay
Station name	Merowi
Catchment area (km2)	1664
Transformation equation	

Year	Month	Day	G.H. (h) m	Flow (Q) m3/s	Daily discharge m3/d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m3 mg/l	Daily sediment load t/d
1968	6	28	1.69	70.840	6,120,576	1868.16	1774.75	108625.04
1968	7	22	2.47	150.681	13,018,877	1462.10	1389.00	180831.56
1968	8	12	2.39	171.700	14,834,880	1089.61	1035.13	153560.22
1968	8	26	2.44	195.940	16,929,216	1367.22	1298.86	219886.65
1983	8	18	2.28	117.900	10,186,560	820.69	779.66	79420.08
1985	8	30	2.58	75.960	1,670	2009.00	1908.55	31.87
1986	2	10	0.53	3.450	298,080	145.33	138.06	411.54
1986	4	11	0.44	1.940	167,616	77.33	73.46	123.14
1987	4	25	0.46	2.180	188,352	31.46	29.89	56.29

Year	Month	Day	G.H. (h) m	Flow (Q) m3/s	Daily discharge m3/d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m3 mg/l	Daily sediment load t/d
1987	10	23	1.38	48.800	4,216,320	531.69	505.11	21296.86
1988	5	20	0.75	10.944	945,562	220.00	209.00	1976.22
1988	7	20	2.5	213.450	18,442,080	2163.64	2055.46	379069.21
1988	9	8	2.08	123.640	10,682,496	883.34	839.17	89644.62
1990	8	2	2.45	195.940	16,929,216	3298.85	3133.91	530546.51
1993	5	7	0.5	3.586	309,830	177.45	168.58	54.98
1995	8	23	2.31	173.500	14,990,400	1637.60	1555.72	24548.28
1996	2	17	0.42	2.546	219,974	121.14	115.08	26.65

DAMS and RESERVOIRS

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Abbay dam site location,		Degree,minute,Second	Degree,minute,second
Projects	Location	North latitude	East longitude
Lake tana project	Megech	12°31'40'	37°28'00'
	Gumara(Gm-6/WAPCOS-I)	11°45'30'	37°48'30'
	Gumara(Gm-6/WAPCOS-II)	11°44'30'	37°48'40'
GUDER,NESHE,DIDESSA	Lower Guder	09°25'20'	37°39'20'
	Neshe-A	09°24'10'	37°15'20'
	Neshe-B	09°45'40'	37°15'25'
	Upper Didessa	08°12'20'	36°48'20'
	Dabana	08°12'20'	36°00'47'
	Anger	09°41'30'	36°44'40'
	Nekemet	09°25'50'	36°30'00'
	Negeso	08°51'50'	36°32'40'
	Lower Didessa	09°29'00'	35°58'30'
BELLES DIDIR GALEGU	Upper Beles		
RAHAD	Lower beles	11°06'30'	35°50'30'
	Upper Dindir	12°00'15'	36°12'00'
	Lower Dindir	12°01'00'	35°52'40'
	Galegu	12°10'30'	35°59'45'
	Rahad	12°32'30'	36°19'30'
BULE NILE HPWP	Karadobi	09°51'20'	37°41'30'
	Mabi	10°19'02'	36°40'10'
	Mendaia or Mendeya	10°04'00'	36°33'50'
	Border	11°12'50'	35°05'40'

IRRIGATION DAM PROJECT

PROJECT	Max Irrg.ha	Mean flow Mm ³	Res ELEV.	Live storage	project cost	Cost per Storage
				ate diff. Level Vu.Mm ³	Cost M\$	COST/m ³
GUMARA-A	13976	235	1940	134	73	0.54
				223	97	0.43
				333	128	0.38
GUMARA-B	13976	248	1960	136	68	0.5
				218	87	0.4
				317	110	0.35
MEGECH	7311	203	1920	51	59	1.16
				124	85	0.69
				260	118	0.45
RIBB	19625	454	1905	49.5	49	0.99
				99.5	62.5	0.63
				173	80	0.46
GILGEL ABBAY-B	11508	2200	1880	80	120	1.5
				216	155	0.72
				419	198	0.47
JEMA	7786	175	2110	54	62	1.15
				99	80	0.81
				163	103	0.63
NEGESO	22815	188	1970	56	92	1.64
				107	114	1.07
				177	139	0.79
ANGERE	14450	541	1385	555	108	0.19
				1653	194	0.12
				3583	318	0.09
GALEGU(1)	9860	196	770	69	82	1.19
				187	127	0.68
				374	186	0.5
RAHAD(1)	45135	1410	855	436	164	0.38
				943	204	0.22
				1693	249	0.15

IRRIGATION PROJECT POSSIBLE HYDROPOWER DEVELOPEMENET

PROJECT	Res.elv	I _{min} MW	DC _{min} M\$	IC _{max} MW	Dc _{max} M\$	Aver. Cost \$/kw
GUMARA-A	1940	0.9	2.4	3.6	6.5	1978
	1950	1.1	2.8	4.4	7.5	1864
	1960	1.3	3.1	5.2	8.4	1769
GUMARA-B	1960	1	2.6	3	5.7	2075
	1970	1.2	3	4.8	7.9	1808
	1980	1.4	3.3	5.6	8.8	1729
MEGECH	1920	1	2.6	4	7	1910
	1935	1.3	3.1	5.2	8.4	1769
	1950	1.6	3.6	6.4	9.7	1663
RIBB	1905	3	5.7	9	12.4	1508
	1915	3.8	6.7	11.4	14.6	1401
	1925	4.6	7.7	13.8	16.8	1332
GILGEL ABBAY-B	1880	1.6	3.6	3.2	5.9	1979
	1890	2	4.25	4	7	1875
	1900	2.4	4.8	4.8	7.9	1764
JEMA	2110	1.1	0.8	4.4	7.45	1864
	2120	1.3	3.1	5.2	8.4	1769
	2130	1.5	3.5	6	9.3	1707
NEGESO	1970	2.6	5.7	13	17.6	1490
	1975	2.8	5.9	14	18.6	1458
	1980	3	6.2	15	19.6	1431
ANGERE	1385	1.8	4	5.4	8.6	1744
	1410	2.8	5.4	8.4	11.8	1536
	1420	3.2	5.9	9.6	13	1473

HYDRPOWER SCHEME EXCEPT ABBAY RIVER

PROJECT	Mean flow Mm ³	Res.Elev.	Vu Mm ³	IC MW	E GMH	Total cost
BELES DANGUR	2918	830	2530	104	455	233
		835	2960	113	495	260
		840	3470	123	539	288
		845	3930	133	583	319
		850	4470	143	626	352
FETTA	765	1955	125	94	410	126
		1960	312	126	553	160
		1965	595	134	588	184
		1970	972	139	608	213
LOWER DIDDESSA	7604	970	3220	190	832	196
		980	4290	235	1029	243
		990	5510	295	1292	304
		1000	6910	355	1555	371
LOWER GUDER	2290	1010	8490	400	1752	441
		1360	709	30	131	50
		1380	1606	52	228	81
		1400	3006	72	315	125
LOWER DABUS (incl.D/S power development)	48970	1410	3926	82	359	161
		1335	385	164	709	248
		1340	608	172	753	271
		1345	888	187	819	299
UPPER DABUS(incl.D/s power developm)	4870	1350	1223	212	928	333
		1365	423	152	666	219
		1370	983	163	714	239
		1375	1963	174	762	259
		1380	3483	193	845	283

ABBAY RIVER HYDRPOWER DEVELOPMENT

PROJECT	Mean flow Mm ³	Res.Elev.	Vu Mm ³	IC MW	E GMH	Total cost
KARADOBI	1670	1075	6000	660	2890	958
		1100	11600	850	3720	1301
		1125	18900	1050	4600	1733
		1150	28100	1300	5695	2313
		1175	38900	1580	6962	3035
MABIL	22620	860	1600-4000	510	2230	656
		880	4700-7050	800	3500	880
		900	8700-11100	1120	4900	1132
		920	13800-16200	1400	6130	1399
MENDAIA	35310	720	4800-7100	980	4290	885
		730	7300-9700	1210	5300	1036
		740	10300-12700	1450	6350	1194
		750	13800-16200	1700	6750	1362
BORDER	48493	570	1810-5110	750	3285	786
		580	6800-10100	1050	4600	973
		590	13200-16500	1430	6260	1190
		600	21000-24300	1780	7800	1412

PROJECTS CONSIDERED AS IRRIGATION DAMS

PROJECT	Max Irrg,ha	Mean flow Mm ³	Res ELEV.	Vu.Mm ³	Cost M\$	COST/m ³
UPPER GUDER	4896	183	2425	27	5.8	0.21
			2430	100	8.2	0.08
			2435	244	11.4	0.05
NEKEMET	11220	1937	1300	276	140	0.51
			1310	771	189	0.25
			1320	1710	251	0.15
DABANA	16388	1609	1330	3340	334	0.1
			1340	921	303	0.33
			1350	1193	358	0.3
			1360	1523	419	0.28
UPPER DIDESSA	14280	1712	1370	1923	485	0.25
			1400	1140	73	0.06
			1410	2160	111	0.05
NESHE-A	7217	103	1420	2490	163	0.05
			2215	114	28	0.25
			2220	205	34	0.17
NESHE-B	7217	103	2225	323	42	0.13
			2230	464	50	0.11
			2210	76	24	0.32
			2215	151	29.5	0.2
LOWER DINDIR	49555	2009	2220	258	36	0.14
			2225	398	43	0.11
			750	439	71	0.16
			755	657	83	0.13
UPPER DINDIR		1125	760	942	97	0.1
			765	1332	115	0.09
			950	318	238	0.75
			960	656	320	0.49
GALEGU	9860	196	970	1123	413	0.37
			980	1743	517	0.3
			770	69	82	1.19
			785	187	127	0.68
RAHAD	45135	1410	800	374	186	0.5
			855	436	164	0.38
			865	943	204	0.22
			875	1693	249	0.15

Multipurpose projects considering hydropower

PROJECT	Mean flow Mm ³	Res.Elv.	VU.Mm ³	P MW	Cost M\$	Totale Cost/kw\$
UPPER GUDER	183	2435	244	10.4	20	3020
NEKEMET	1937	1320	1710	16	18.6	>5000
DABANA	1609	1360	1523	41.6	36.7	>5000
UPPER DIDESSA	1712	1410	2160	30	32	4800
NESHE-A	103	2215	114	19.2	20	2900
NESHE-B	103	765	151	19.2	20	2900
LOWER DINDIR	2009	970	1332	26	26.3	>5000
UPPER DINDIR	1125	785	1123	31	30	>5000
GALEGU	196	785	187	2	4.2	>5000
RAHAD	1410	875	1693	20.8	22.4	>5000

Power Developemenet downstream Irrigation Reservoirs

PROJECT	IC MW	Total cost	Cost/KM \$
DABANA	24	70	2900
NEKA	56	102	18200
NEBA	32	56	1750

Summary of Hydropower Project Transmission Costs

PROJECT NAME	DISTANCE (km)	Nearest substation	Installed capaci	Voltage(KV_)	NB of Circuits	TransmissionCost(10 ⁶ US\$)
Aleltu east	94	Addis	204	230	1	19.7
Aleltu west	100	Addis	214	230	1	19.7
Chemoga yeda	60	Deber markos	250	230	1+1	8.6
1st stage ulitimate	60	Deber markos	630	230	1	15.5
Fettam	150	Deber markos	94-139	230	1	16.3
Lower Dabus	270	Ghedo	120-360	400	1	60
Upper dabus	270	Ghedo	100-350	400	1	60
Border	400	Deber markos	750-1780	400	2	96
Mabil	200	Deber markos	510-1400	400	2	53
Mendaia	400	Deber markos	980-1700	400	2	96
Karadobi	70	Deber markos	660-1580	400	2	25
Lower Guder	90	Guder	30-82	132	1	9
Dabana	80	Nekemet	30-100	132	1	8.2
Lower Dideessa(BOP)	240	Ghedo	190-400	400	1	54
Lower Dindir	250	Bahir Dar	010-50	132	1	23
Upper Dindir	250	Bahir Dar	15-37	132	1	23
Nekemet	180	Ghedo	150-200	230	2	41
Neshe-A	50	Fincha-A	20-60	230	1	9.7
Neshe-b	50	Fincha-A	20-60	230	1	(total)

HYDROPOWER

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Power plants in the Abay, Baro-Acobo and Tekeze river basins are given in the following table.

No.	Name of the Power Plant	River Basin	Region	Year of Com.	Installed Capacity (MW)	Turbine types
1	Fincha'a	Abay	Oromia	1973	134	Pelton
2	Tis Abbay II	Abay	Amhara	2001	73	Francis
3	Tis Abbay I	Abay	Amhara	1964	11.4	Francis
4	Sor	Baro Akobo	Oromia	1992	5	Francis
Hydropower Plants under construction						
Item No.	Name of the Power Plant	River Basin	Region	Year of Com.	Installed Capacity (MW)	
1	Beles multipurpose Project	Abay	Amhara	2009	470	
2	Tekeze	Tekeze	Tigray	2008	300	

Identified potential hydropower sites with their locations in the specified river basins are given in the following tables.

1. ABAY RIVER BASIN

MATER PLAN STUDIES	NAME OF THE HYDROPOWER PROJECTS	PROJECT COST USD	LOCATION	GENERATION CAPACITY
ABBAY MASTER PLAN				
Hydropower Scheme except Abbay River	BELES DANGUR	233,000,000		455 GWh/yr
	FETTAM	126,000,000		410 GWh/yr
	LOWER DIDESSA	196,000,000	North latitude = 09 29'00" East longitude = 35 58' 30"	832 GWh/yr
	LOWER GUDER	50,000,000	North latitude = 09 25'20" East longitude = 37 39' 20"	131 GWh/yr
	LOWER DABUS	248,000,000		709 GWh/yr
	UPPER DABUS	219,000,000		666 GWh/yr
Abbay River Hydropower Development	-	-		

	KARADOBI	958,000,000	North latitude = 09 51'20"East longitude =37 41' 30"	2890 GWh/yr
	MABIL	656,000,000	North latitude = 10 19'02"East longitude =36 40' 10"	2230 GWh/hr
	MENDAIA	885,000,000	North latitude = 10 04'00"East longitude =36 33' 50"	
	BORDER	786,000,000	North latitude = 11 12'50"East longitude =35 05' 40"	3285 GWh/yr
MULTI - PURPOSE PROJECTS	-	-		
Hydropower Projects	UPPER GUDER	20,000,000		10.4 MW
	NEKEMTE	18,600,000	North Latitude = 09 25 50"East longitude = 36 30' 00"	16 MW
	DABANA	36,700,000	North Latitude = 08 55' 05"East longitude = 36 00' 47"	41.6 MW
	UPPER DIDESSA	32,000,000	North Latitude = 08 12' 20"East longitude = 36 48' 20"	30 MW
	NESHE A	20,000,000	North Latitude = 37 15' 20"East longitude = 09 45' 10"	19.2 MW
	NESHE B	20,000,000	North Latitude = 37 15' 25"East longitude = 09 45' 40"	19.2 MW
	LOWER DINDIR	26,300,000	North latitude = 12 01'00"East longitude =35 52' 40"	26 MW
	UPPER DINDER		North latitude = 8 12'20"East longitude =36 48' 20"	31 MW
	GALEGU	4,200,000	North latitude = 12 10'30"East longitude =35 59' 45"	2 MW
	RAHAD	22,400,000	North latitude = 12 32' 30"East longitude =36 19' 30"	20.8 MW
TOTAL		4,557,200,000		216.2MW

2. BARO-AKOBO RIVER BASIN

MATER PLAN STUDIES	NAME OF THE HYDROPOWER PROJECTS	PROJECT COST USD	LOCATION	GENERATION CAPACITY GWh/yr
BARO-AKOBO MASTER PLAN	1. BARO DAM	209,442,000	UPPER PART OF THE BASIN	1049
	2. GEBA-A DAM	180,627,000	60 KM EAST OF GORE	865.6
	3. BIRBIR-A DAM	130,417,000	70 KM ENE FROM DEMBIDOLO	492.3
	4. KASHU DAM	80,790,000	22 KM SSE OF MIZAN TEFERI	298.5
	5. GUMERO DAM	84,946,000	28 KM NORTHWEST OF GORE	255
	6. BIRBIR-R DAM	930,900,000	11 KM UPSTREAM OF THE CONFLUENCE OF THE GEBA RIVER	2503
	7. SOR DAM	127,566,000	10 KM NORTHWEST OF METU	542
	8. GILO-1 DAM	212,377,000	95 KM WNW FROM MIZAN TEFERI	425.7
	9. TAMS DAM	2,809,519,000	IS ON THE BARO RIVER 47 KM EAST OF GAMBELLA	5485
	10. GEBA-R DAM	1,011,422,000	75 KM FROM GAMBELLA	1574
TOTAL		5,778,006,000		13,490.10

3. TEKEZE RIVER BASIN

MATER PLAN STUDIES	NAME OF THE HYDROPOWER PROJECTS	PROJECT COST USD	LOCATION	GENERATION CAPACITY MW
TEKEZE MASTER PLAN	1. TK03 DAM	193,080,646	NORTHING 1391027 EASTING 441042	69
	2. TK04 DAM	2,037,923,195	NORTHING 1424777 EASTING 483504	220.5
	3. TK07 DAM	1,036,591,000	NORTHING 1533176 EASTING 381974	671
	4. TK12 DAM	539,304,000	NORTHING1411239 EASTING 509256	91
	5. TK16 DAM	110,257,836	NORTHING1419512 EASTING 271468	3
	6. TK21 DAM	98,470,305	NORTHING 1463224 EASTING 274601	14.2
	7. TK22 DAM	89,768,562	NORTHING 1390525 EASTING 236113	3.7
	8. TK23 DAM	35,464,440	NORTHING 1492271 EASTING 558952	0.06
	9. TK25 DAM	78,883,375	NORTHING 1508248 EASTING 544946	6.4
TOTAL		4,219,743,359		1,078.86

**CROP WATER REQUIREMENT &
CROPPING PATTERN**

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APPENDIX B, section 3, TABLE 1: CROPPING PATTERN 1 (LAKE TANA BASIN)

CROP	cropped area (%)		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
	wet	dry													
COTTON, wet			kc				0.45	0.45	0.75	1.15	1.15	0.85	0.75		
	0		%												
MAIZE, wet			kc				0.40	0.65	0.85	1.10	0.80	0.30			
	20		%				8.00	13.00	17.00	22.00	16.00	6.00			
MAIZE, dry			kc	0.85	1.10	0.80	0.30						0.40	0.65	
		20	%	17.00	22.00	16.00	6.00						8.00	13.00	
SORGHUM, TEFF, wet			kc					0.30	0.70	1.10	0.70				
	20		%					6.00	14.00	22.00	14.00				
WHEAT, wet or dry			kc	1.10	1.10	1.05	0.25	0.80	1.10	1.10	1.05	0.25		0.80	
	0	10	%	11.00	11.00	10.50	2.50							8.00	
BARLEY, wet or dry			kc	1.10	1.10	0.45	0.25	0.82	1.10	1.10	0.45	0.25		0.82	
	20	10	%	11.00	11.00	4.50	2.50	8.20	11.00	11.00	4.50	2.50		8.20	
GROUNDNUT, wet or dry			kc	0.75	0.90	1.05	0.60	0.45	0.75	0.90	1.05	0.60		0.45	
	0	0	%												
SESAME (as for sunflower), wet			kc					0.25	0.80	1.00	1.20	0.70			
	0		%												
NOUG (as for sunflower), wet			kc					0.25	0.80	1.00	1.20	0.70			
	20		%					5.00	16.00	20.00	24.00	14.00			
SUNFLOWER, dry			kc	0.80	1.00	1.20	0.70	0.25	0.80	1.00	1.20	0.70		0.25	
		10	%	8.00	10.00	12.00	7.00							2.50	
FIELDPEAS, dry			kc	1.15	1.10	0.30								0.95	
	0		%												
SOYBEAN, dry			kc	0.80	1.10	1.10	0.70	0.40							
	0		%												
CASTORBEANS, dry			kc	1.17	1.12	0.90	0.30						0.75	1.03	
	0		%												
POTATOES, dry			kc	1.02	1.05	1.00	0.70							0.75	
	5		%	5.10	5.25	5.00	3.50							3.75	
LENTILS, dry			kc	1.15	1.10	0.30								0.95	
	0		%												
SUGARCANE, per.			kc	0.80	0.80	0.80	0.80	0.80	0.90	0.90	0.90	0.90	0.90	0.80	
	10	10	%	8.00	8.00	8.00	8.00	8.00	9.00	9.00	9.00	9.00	9.00	8.00	
FRUITS, per.			kc	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	
	5	5	%	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	
GRAPES, per			kc	0.65	0.64	0.60	0.45	0.45	0.52	0.52	0.64	0.70	0.75	0.70	
	0	0	%												
RED PEPPER, wet and dry			kc	0.60				0.40	0.60	1.00	1.00	0.90	0.80	0.70	
	5	5	%	3.00				2.00	3.00	5.00	5.00	4.50	4.00	3.50	
GINGER, wet and dry			kc	0.32		0.20	0.50	0.70	0.80	0.75	0.75	0.75	0.80	0.80	
	0	0	%												
COFFEE, per			kc	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
	0	0	%												
TOBACCO, dry			kc	0.70	1.10	1.00	0.30							0.10	
	0		%												
ONION, dry			kc	0.80	1.10	1.00	0.90							0.40	
		5	%	4.00	5.50	5.00	4.50							2.00	
RICE, wet			kc												
	0		%												
SUDAN GRASS, wet or dry			kc	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
	0	0	%												
CROPPING INTENSITY	WET	DRY	wkc	0.71	0.77	0.65	0.38	0.27	0.59	0.80	0.97	0.66	0.26	0.25	0.52
	100	80	%												

filename: EVAPOTRA.XLS

range: CROPPAT1

APPENDIX B, section 3, TABLE 2:		CROPPING PATTERN 2 (NORTH WEST BASINS, LOWER BELES)												
crop	cropped area (%)		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
	wet	dry												
COTTON, wet			kc				0.45	0.45	0.75	1.15	1.15	0.85	0.75	
	40		%				18.00	18.00	30.00	46.00	46.00	34.00	30.00	
MAIZE, wet			kc				0.40	0.65	0.85	1.10	0.80	0.30		
	20		%				8.00	13.00	17.00	22.00	16.00	6.00		
MAIZE, dry			kc	0.85	1.10	0.80	0.30						0.40	0.65
		20	%	17.00	22.00	16.00	6.00						8.00	13.00
SORGHUM, TEFF, wet			kc					0.30	0.70	1.10	0.70			
	20		%					6.00	14.00	22.00	14.00			
WHEAT, wet or dry			kc	1.10	1.10	1.05	0.25	0.80	1.10	1.10	1.05	0.25		0.80
	0	0	%											
BARLEY, wet or dry			kc	1.10	1.10	0.45	0.25		0.82	1.10	1.10	0.45	0.25	0.82
	0	0	%											
GROUNDNUT, wet or dry			kc	0.75	0.90	1.05	0.60	0.45	0.75	0.90	1.05	0.60		0.45
	0	0	%											
SESAME (as for sunflower), wet			kc					0.25	0.80	1.00	1.20	0.70		
	0		%											
NOUG (as for sunflower), wet			kc					0.25	0.80	1.00	1.20	0.70		
	5		%					1.25	4.00	5.00	6.00	3.50		
SUNFLOWER, dry			kc	0.80	1.00	1.20	0.70	0.25	0.80	1.00	1.20	0.70		0.25
		20	%	16.00	20.00	24.00	14.00							5.00
FIELDPEAS, dry			kc	1.15	1.10	0.30								0.95
		0	%											
SOYBEAN, dry			kc	0.80	1.10	1.10	0.70	0.40						
		10	%	8.00	11.00	11.00	7.00							
CASTORBEANS, dry			kc	1.17	1.12	0.90	0.30						0.75	1.03
	5		%	5.85	5.59	4.50	1.50						3.75	5.15
POTATOES, dry			kc	1.02	1.05	1.00	0.70							0.75
	5		%	5.10	5.25	5.00	3.50							3.75
LENTILS, dry			kc	1.15	1.10	0.30								0.95
		0	%											
SUGARCANE, per.			kc	0.80	0.80	0.80	0.80	0.80	0.90	0.90	0.90	0.90	0.90	0.80
	10	10	%	8.00	8.00	8.00	8.00	8.00	9.00	9.00	9.00	9.00	9.00	8.00
FRUITS, per.			kc	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
	0	0	%											
GRAPES, per			kc	0.65	0.64	0.60	0.45	0.45	0.52	0.52	0.64	0.70	0.75	0.70
	0	0	%											
RED PEPPER, wet and dry			kc	0.60				0.40	0.60	1.00	1.00	0.90	0.80	0.60
	5	5	%	3.00				2.00	3.00	5.00	5.00	4.50	4.00	3.00
GINGER, wet and dry			kc	0.32		0.20	0.50	0.70	0.80	0.75	0.75	0.75	0.80	0.40
	0	0	%											
COFFEE, per			kc	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
	0	0	%											
TOBACCO, dry			kc	0.70	1.10	1.00	0.30							0.10
	5		%	3.50	5.50	5.00	1.50							0.50
ONION, dry			kc	0.80	1.10	1.00	0.90							0.40
		0	%											
RICE, wet			kc											
	0		%											
SUDAN GRASS, wet or dry			kc	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	0	0	%											
CROPPING INTENSITY	WET	DRY	wkc	0.66	0.77	0.74	0.42	0.37	0.53	0.80	1.10	0.93	0.54	0.98
	100	80	%											

APPENDIX B, section 3, TABLE 4:

CROPPING PATTERN 4 (DIDESSA, ANGAR, DABUS BASINS)

crop	cropped area (%)		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
	wet	dry													
COTTON, wet			kc				0.45	0.45	0.75	1.15	1.15	0.85	0.75		
		0	%												
MAIZE, wet			kc				0.40	0.65	0.85	1.10	0.80	0.30			
		20	%				8.00	13.00	17.00	22.00	16.00	6.00			
MAIZE, dry			kc	0.85	1.10	0.80	0.30						0.40	0.65	
		20	%	17.00	22.00	16.00	6.00						8.00	13.00	
SORGHUM, TEFF, wet			kc					0.30	0.70	1.10	0.70				
		30	%					9.00	21.00	33.00	21.00				
WHEAT, wet or dry			kc	1.10	1.10	1.05	0.25	0.80	1.10	1.10	1.05	0.25		0.80	
		10	%	11.00	11.00	10.50	2.50	8.00	11.00	11.00	10.50	2.50		8.00	
BARLEY, wet or dry			kc	1.10	1.10	0.45	0.25	0.82	1.10	1.10	0.45	0.25		0.82	
		0	%												
GROUNDNUT, wet or dry			kc	0.75	0.90	1.05	0.60	0.45	0.75	0.90	1.05	0.60		0.45	
		10	%	7.50	9.00	10.50	6.00	4.50	7.50	9.00	10.50	6.00		4.50	
SESAME (as for sunflower), wet			kc					0.25	0.80	1.00	1.20	0.70			
		0	%												
NOUG (as for sunflower), wet			kc					0.25	0.80	1.00	1.20	0.70			
		10	%					2.50	8.00	10.00	12.00	7.00			
SUNFLOWER, dry			kc	0.80	1.00	1.20	0.70		0.25	0.80	1.00	1.20	0.70	0.25	
		0	%												
FIELDPEAS, dry			kc	1.15	1.10	0.30								0.95	
		0	%												
SOYBEAN, dry			kc	0.80	1.10	1.10	0.70	0.40							
		10	%	8.00	11.00	11.00	7.00								
CASTORBEANS, dry			kc	1.17	1.12	0.90	0.30						0.75	1.03	
		0	%												
POTATOES, dry			kc	1.02	1.05	1.00	0.70							0.75	
		0	%												
LENTILS, dry			kc	1.15	1.10	0.30								0.95	
		0	%												
SUGARCANE, per.			kc	0.80	0.80	0.80	0.80	0.80	0.90	0.90	0.90	0.90	0.90	0.80	
		0	%												
FRUITS, per.			kc	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	
		10	%	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	
GRAPES, per			kc	0.65	0.64	0.60	0.45	0.45	0.52	0.52	0.64	0.70	0.75	0.70	
		10	%	6.50	6.40	6.00	4.50	4.50	5.20	5.20	6.40	7.00	7.50	7.00	
RED PEPPER, wet and dry			kc	0.60				0.40	0.60	1.00	1.00	0.90	0.80	0.70	
		0	%	3.00										3.00	
GINGER, wet and dry			kc	0.32	0.20	0.50	0.70	0.80	0.75	0.75	0.75	0.80	0.80	0.40	
		0	%												
COFFEE, per			kc	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
		0	%												
TOBACCO, dry			kc	0.70	1.10	1.00	0.30							0.10	
		0	%												
ONION, dry			kc	0.80	1.10	1.00	0.90							0.40	
		5	%	4.00	5.50	5.00	4.50							2.00	
RICE, wet			kc												
		0	%												
SUDAN GRASS, wet or dry			kc	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
		0	%												
CROPPING INTENSITY	WET	DRY	wkc	0.65	0.73	0.67	0.39	0.23	0.56	0.80	1.01	0.80	0.30	0.24	0.46
	100	80	%												

filename: EVAPOTRA.XLS

range CROPPAT4

APPENDIX B, section 3, TABLE 3:		CROPPING PATTERN 3 (SUGARCANE PROJECTS, UPPER BELES, FINCHAA,												
crop	cropped area (%)		CROPPING PATTERN 3 (SUGARCANE PROJ E AMARTI-NESHE)											
	wet	dry	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
COTTON, wet			kc					0.45	0.45	0.75	1.15	1.15	0.85	0.75
		0	%											
MAIZE, wet			kc					0.40	0.65	0.85	1.10	0.80	0.30	
		10	%					4.00	6.50	8.50	11.00	8.00	3.00	
MAIZE, dry			kc	0.85	1.10	0.80	0.30							0.40
		10	%	8.50	11.00	8.00	3.00							4.00
SORGHUM, TEFF, wet			kc						0.30	0.70	1.10	0.70		
		0	%											
WHEAT, wet or dry			kc	1.10	1.10	1.05	0.25		0.80	1.10	1.10	1.05	0.25	0.80
		0	%											
BARLEY, wet or dry			kc	1.10	1.10	0.45	0.25		0.82	1.10	1.10	0.45	0.25	0.82
		0	%											
GROUNDNUT, wet or dry			kc	0.75	0.90	1.05	0.60		0.45	0.75	0.90	1.05	0.60	0.45
		10	%						4.50	7.50	9.00	10.50	6.00	
SESAME(as for sunflower),wet			kc					0.25	0.80	1.00	1.20	0.70		
		0	%											
NOUG (as for sunflower), wet			kc					0.25	0.80	1.00	1.20	0.70		
		10	%					2.50	8.00	10.00	12.00	7.00		
SUNFLOWER, dry			kc	0.80	1.00	1.20	0.70		0.25	0.80	1.00	1.20	0.70	0.25
		0	%											
FIELDPEAS, dry			kc	1.15	1.10	0.30								0.95
		0	%											
SOYBEAN, dry			kc	0.80	1.10	1.10	0.70	0.40						
		0	%											
CASTORBEANS, dry			kc	1.17	1.12	0.90	0.30							0.75
		0	%											1.03
POTATOES, dry			kc	1.02	1.05	1.00	0.70							0.75
		0	%											
LENTILS, dry			kc	1.15	1.10	0.30								0.95
		0	%											
SUGARCANE, per.			kc	0.80	0.80	0.80	0.80	0.80	0.90	0.90	0.90	0.90	0.90	0.80
		60	%	48.00	48.00	48.00	48.00	48.00	54.00	54.00	54.00	54.00	54.00	48.00
FRUITS, per.			kc	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
		0	%											
GRAPES, per			kc	0.65	0.64	0.60	0.45	0.45	0.52	0.52	0.64	0.70	0.75	0.70
		0	%											
RED PEPPER, wet and dry			kc	0.60				0.40	0.60	1.00	1.00	0.90	0.80	0.60
		5	%	3.00				2.00	3.00	5.00	5.00	4.50	4.00	3.00
GINGER, wet and dry			kc	0.32		0.20	0.50	0.70	0.80	0.75	0.75	0.75	0.80	0.40
		0	%											
COFFEE, per			kc	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
		0	%											
TOBACCO, dry			kc	0.70	1.10	1.00	0.30							0.10
		0	%											
ONION, dry			kc	0.80	1.10	1.00	0.90							0.40
		0	%											
RICE, wet			kc											
		0	%											
SUDAN GRASS, wet or dry			kc	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
		5	%	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
CROPPING INTENSITY	WET	DRY	wkc	0.65	0.64	0.61	0.56	0.62	0.81	0.90	0.96	0.89	0.72	0.67
	100	80	%											
filename:	EVAPOTRA.XLS		range CROPPAT3											

APPENDIX B, section 3, TABLE 5

CROPPING PATTERN 5 (GUDER)

crop	cropped area (%)		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
	wet	dry													
COTTON, wet			kc				0.45	0.45	0.75	1.15	1.15	0.85	0.75		
		0	%												
MAIZE, wet			kc				0.40	0.65	0.85	1.10	0.80	0.30			
		20	%				8.00	13.00	17.00	22.00	16.00	6.00			
MAIZE, dry			kc	0.85	1.10	0.80	0.30						0.40	0.65	
		20	%	17.00	22.00	16.00	6.00						8.00	13.00	
SORGHUM, TEFF, wet			kc					0.30	0.70	1.10	0.70				
		30	%					9.00	21.00	33.00	21.00				
WHEAT, wet or dry			kc	1.10	1.10	1.05	0.25	0.80	1.10	1.10	1.05	0.25	0.80		
		10	%	11.00	11.00	10.50	2.50	8.00	11.00	11.00	10.50	2.50	8.00		
BARLEY, wet or dry			kc	1.10	1.10	0.45	0.25	0.82	1.10	1.10	0.45	0.25	0.82		
		0	%												
GROUNDNUT, wet or dry			kc	0.75	0.90	1.05	0.60	0.45	0.75	0.90	1.05	0.60	0.45		
		10	%	7.50	9.00	10.50	6.00	4.50	7.50	9.00	10.50	6.00	4.50		
SESAME (as for sunflower), wet			kc				0.25	0.80	1.00	1.20	0.70				
		0	%												
NOUG (as for sunflower), wet			kc				0.25	0.80	1.00	1.20	0.70				
		10	%				2.50	8.00	10.00	12.00	7.00				
SUNFLOWER, dry			kc	0.80	1.00	1.20	0.70	0.25	0.80	1.00	1.20	0.70	0.25		
		0	%												
FIELDPEAS, dry			kc	1.15	1.10	0.30								0.95	
		0	%												
SOYBEAN, dry			kc	0.80	1.10	1.10	0.70	0.40							
		10	%	8.00	11.00	11.00	7.00								
CASTORBEANS, dry			kc	1.17	1.12	0.90	0.30						0.75	1.03	
		0	%												
POTATOES, dry			kc	1.02	1.05	1.00	0.70							0.75	
		0	%												
LENTILS, dry			kc	1.15	1.10	0.30								0.95	
		0	%												
SUGARCANE, per.			kc	0.60	0.80	0.80	0.80	0.80	0.90	0.90	0.90	0.90	0.90	0.80	
		0	%												
FRUITS, per.			kc	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	
		10	%	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	
GRAPES, per			kc	0.65	0.64	0.60	0.45	0.45	0.52	0.52	0.64	0.70	0.75	0.70	
		10	%	6.50	6.40	6.00	4.50	4.50	5.20	5.20	6.40	7.00	7.50	7.00	
RED PEPPER, wet and dry			kc	0.60				0.40	0.60	1.00	1.00	0.90	0.80	0.60	
		0	%	3.00										3.00	
GINGER, wet and dry			kc	0.32		0.20	0.50	0.70	0.80	0.75	0.75	0.75	0.80	0.40	
		0	%												
COFFEE, per			kc	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
		0	%												
TOBACCO, dry			kc	0.70	1.10	1.00	0.30							0.10	
		0	%												
ONION, dry			kc	0.80	1.10	1.00	0.90							0.40	
		5	%	4.00	5.50	5.00	4.50							2.00	
RICE, wet			kc												
		0	%												
SUDAN GRASS, wet or dry			kc	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
		0	%												
CROPPING INTENSITY	WET	DRY	wkc	0.65	0.73	0.67	0.39	0.23	0.56	0.80	1.01	0.80	0.30	0.24	0.46
	100	80	%												

filename:

EVAPOTRAXLS

range CROPPAT5

APPENDIX B, section 3, TABLE 6

CROPPING PATTERN 6 (LAKE TANA, RICE)

crop	cropped area (%)		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
	wet	dry												
COTTON, wet			kc				0.45	0.45	0.75	1.15	1.15	0.85	0.75	
	0		%											
MAIZE, wet			kc				0.40	0.65	0.85	1.10	0.80	0.30		
	0		%											
MAIZE, dry			kc	0.85	1.10	0.80	0.30						0.40	0.65
	0		%											
SORGHUM, EFF, wet			kc					0.30	0.70	1.10	0.70			
	0		%											
WHEAT, wet or dry			kc	1.10	1.10	1.05	0.25	0.80	1.10	1.10	1.05	0.25		0.80
	5	0	%					4.00	5.50	5.50	5.25	1.25		
BARLEY, wet or dry			kc	1.10	1.10	0.45	0.25	0.82	1.10	1.10	0.45	0.25		0.82
	0	0	%											
GROUNDNUT, wet or dry			kc	0.75	0.90	1.05	0.60	0.45	0.75	0.90	1.05	0.60		0.45
	5	0	%					2.25	3.75	4.50	5.25	3.00		
SESAME (as for sunflower), wet			kc				0.25	0.80	1.00	1.20	0.70			
	0		%											
NOUG (as for sunflower), wet			kc				0.25	0.80	1.00	1.20	0.70			
	5		%				1.25	4.00	5.00	6.00	3.50			
SUNFLOWER, dry			kc	0.80	1.00	1.20	0.70	0.25	0.80	1.00	1.20	0.70		0.25
	0		%											
FIELDPEAS, dry			kc	1.15	1.10	0.30								0.95
	0		%											
SOYBEAN, dry			kc	0.80	1.10	1.10	0.70	0.40						
	0		%											
CASTORBEANS, dry			kc	1.17	1.12	0.90	0.30						0.75	1.03
	0		%											
POTATOES, dry			kc	1.02	1.05	1.00	0.70							0.75
	0		%											
LENTILS, dry			kc	1.15	1.10	0.30								0.95
	0		%											
SUGARCANE, per.			kc	0.80	0.80	0.80	0.80	0.80	0.90	0.90	0.90	0.90	0.90	0.80
	5	5	%	4.00	4.00	4.00	4.00	4.00	4.50	4.50	4.50	4.50	4.50	4.00
FRUITS, per.			kc	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
	0	10	%	8.00	8.00	8.00	8.00							8.00
GRAPES, per			kc	0.65	0.64	0.60	0.45	0.45	0.52	0.52	0.64	0.70	0.75	0.75
	0	0	%											
RED PEPPER, wet and dry			kc	0.60				0.40	0.60	1.00	1.00	0.90	0.80	0.70
	0	5	%	3.00										3.00
GINGER, wet and dry			kc	0.32		0.20	0.50	0.70	0.80	0.75	0.75	0.75	0.80	0.80
	0	0	%											0.40
COFFEE, per			kc	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
	0	0	%											
TOBACCO, dry			kc	0.70	1.10	1.00	0.30							0.10
	0		%											
ONION, dry			kc	0.80	1.10	1.00	0.90							0.40
	0		%											
RICE, wet and dry			kc	0.12	1.00	1.00	1.05	0.80		0.12	1.00	1.00	1.05	0.80
	80	60	%	7.20	60.00	60.00	84.00	64.00		7.20	60.00	60.00	63.00	48.00
SUDAN GRASS, wet or dry			kc	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	0	0	%											
CROPPING INTENSITY	WET	DRY	wkc	0.22	0.72	0.72	0.96	0.69	0.15	0.26	0.81	0.79	0.72	0.53
	100	80	%											

filename:

EVAPOTRAXLS

range CROPPAT6

APPENDIX B, section 3, TABLE 7

CROPPING PATTERN 7 (DEBRE MARKOS BASINS)

Crop	cropped area (%)		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
	wet	dry												
COTTON, wet			kc				0.45	0.45	0.75	1.15	1.15	0.85	0.75	
	0		%											
MAIZE, wet			kc				0.40	0.65	0.85	1.10	0.80	0.30		
	20		%				8.00	13.00	17.00	22.00	16.00	6.00		
MAIZE, dry			kc	0.85	1.10	0.80	0.30						0.40	0.65
		10	%	8.50	11.00	8.00	3.00						4.00	6.50
SORGHUM, TEFF, wet			kc					0.30	0.70	1.10	0.70			
	10		%					3.00	7.00	11.00	7.00			
WHEAT, wet or dry			kc	1.10	1.10	1.05	0.25	0.80	1.10	1.10	1.05	0.25		0.80
	20	20	%	22.00	22.00	21.00	5.00	16.00	22.00	22.00	21.00	5.00		16.00
BARLEY, wet or dry			kc	1.10	1.10	0.45	0.25	0.82	1.10	1.10	0.45	0.25		0.82
	0	0	%											
GROUNDNUT, wet or dry			kc	0.75	0.90	1.05	0.60	0.45	0.75	0.90	1.05	0.60		0.45
	10	10	%	7.50	9.00	10.50	6.00	4.50	7.50	9.00	10.50	6.00		4.50
SESAME (as for sunflower), wet			kc				0.25	0.80	1.00	1.20	0.70			
	0		%											
NOUG (as for sunflower), wet			kc				0.25	0.80	1.00	1.20	0.70			
	10		%				2.50	8.00	10.00	12.00	7.00			
SUNFLOWER, dry			kc	0.80	1.00	1.20	0.70	0.25	0.80	1.00	1.20	0.70		0.25
	0		%											
FIELDPEAS, dry			kc	1.15	1.10	0.30								0.95
	0		%											
SOYBEAN, dry			kc	0.80	1.10	1.10	0.70	0.40						
	0		%											
CASTORBEANS, dry			kc	1.17	1.12	0.90	0.30						0.75	1.03
	0		%											
POTATOES, dry			kc	1.02	1.05	1.00	0.70							0.75
	10		%	10.20	10.50	10.00	7.00							7.50
LENTILS, dry			kc	1.15	1.10	0.30								0.95
	0		%											
SUGARCANE, per.			kc	0.80	0.80	0.80	0.80	0.80	0.90	0.90	0.90	0.90	0.90	0.80
	0	0	%											
FRUITS, per.			kc	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
	20	20	%	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00
GRAPES, per			kc	0.65	0.64	0.60	0.45	0.45	0.52	0.52	0.64	0.70	0.75	0.70
	0	0	%											
RED PEPPER, wet and dry			kc	0.60				0.40	0.60	1.00	1.00	0.90	0.80	0.70
	10	5	%	3.00				4.00	6.00	10.00	10.00	9.00	8.00	7.00
GINGER, wet and dry			kc	0.32		0.20	0.50	0.70	0.80	0.75	0.75	0.75	0.80	0.80
	0	0	%											
COFFEE, per			kc	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
	0	0	%											
TOBACCO, dry			kc	0.70	1.10	1.00	0.30							0.10
	0		%											
ONION, dry			kc	0.80	1.10	1.00	0.90							0.40
		5	%	4.00	5.50	5.00	4.50							2.00
RICE, wet			kc											
	0		%											
SUDAN GRASS, wet or dry			kc	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	0	0	%											
CROPPING INTENSITY	WET	DRY	wkc	0.71	0.74	0.71	0.42	0.31	0.67	0.90	1.02	0.87	0.41	0.27
	100	80	%											

filename:

range CROPPAT7

Monthly Gross Irrigation Requirements (mm)

PROJECT	EFF%	CROP PAT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
TANA SUB BASIN															
GILGEL VALLEY PROJECT	60	6	285	146	136	177	0	0	121	0	0	18	73	15	972
NW LAKE TANA PUMPING	50	1	144	166	171	68	0	0	0	0	0	0	91	158	799
WEST MEGECH PUMP PROJECT	50	1	144	166	171	68	0	0	0	0	0	0	91	158	799
MEGECH GRAVITY	50	1	143	164	170	66	0	0	0	0	0	0	91	157	791
EAST MEGECH PUMPING PROJECT	50	1	145	166	172	68	0	0	0	0	0	0	92	158	800
NE TANA PUMP PROJECT	50	1	165	197	176	68	0	0	0	0	0	0	85	147	839
RIBB GRAVITY PROJECT	60	6	290	138	155	197	60	0	0	0	0	53	78	17	989
GUMERA 1870 PROJECT	50	1	156	175	165	71	0	0	0	0	0	0	92	150	810
GUMERA 1850 PROJECT	50	1	156	175	166	72	0	0	0	0	0	0	93	150	813
GUMERA 1810 PROJECT	60	6	290	138	155	197	59	0	0	0	0	53	78	17	986
JEMA GRAVITY PROJECT	50	1	142	180	138	37	0	0	0	0	0	0	84	147	727
GILGEL ABBAY I	50	1	148	187	144	41	0	0	0	0	0	0	86	151	757
KOKA PROJECT (ACRES)	50	1	144	182	140	39	0	0	0	0	0	0	85	148	738
SW LAKE TANA PUMPING	50	1	152	189	175	86	0	0	0	0	0	0	60	162	824
BELES SUB BASIN															
UPPER BELES	50	3	157	164	141	136	43	0	0	0	0	0	152	194	986
LOWER BELES	50	2	174	218	204	108	6	0	0	0	0	0	143	148	1001
DEBER MARKOS SUB BASIN															
MIDDLE BIRR	50	1	148	177	121	54	0	0	0	0	0	0	60	157	717
LOWRE BIRR	50	1	161	192	142	71	0	0	0	0	0	0	65	166	797
DEBOHILE	50	7	143	166	127	56	0	0	0	0	0	0	60	160	711
FETTAL	50	7	123	146	96	6	0	0	0	0	0	0	60	125	556
AZENA	50	7	164	179	166	81	0	0	0	0	0	0	81	161	832
DINDIRA SUB BASIN															
UPPER DINDIR	50	2	169	215	210	93	0	0	0	0	0	0	154	141	981
LOWER DINDIR	50	2	179	228	230	108	15	0	0	32	17	0	166	146	1121
GALEGU	50	2	178	227	227	105	11	0	0	23	10	0	164	146	1090
RAHAD	50	2	179	228	228	107	13	0	0	27	14	0	165	146	1106
DABUS SUB BASIN															
DABUS (H)	60	4	146	184	155	25	0	0	0	0	0	0	66	142	718
DIDESSA SUB BASIN															
ARJO-DIDESSA	50	4	138	157	93	13	0	0	0	0	0	0	85	112	598
NEGESO	50	4	120	138	76	0	0	0	0	0	0	0	71	125	530
DABANA	50	4	139	159	97	16	0	0	0	0	0	0	86	114	610
DIMTU	50	4	139	159	96	15	0	0	0	0	0	0	85	113	608
ANGER SUB BASIN															
ANGER	50	4	142	169	97	21	0	0	0	0	0	0	88	120	637
FINCHAA SUB BASIN															
AMERTI -NESHE	50	3	137	137	100	77	10	0	0	0	27	105	169	170	933
FINCHAA	60	3	113	112	81	61	4	0	0	0	18	85	139	141	753
GUDER SUB BASIN															
GUDER	50	5	91	93	91	0	0	0	0	0	13	15	109	140	551
ANONU	50	4	141	166	125	23	0	0	0	0	12	0	63	134	665
KALE	50	4	142	168	127	25	0	0	0	0	15	0	64	135	675
JEMMA SUB BASIN															
DEBER GURACHA	50	1	93	108	32	0	0	17	0	0	0	0	60	130	439
TANA SUB BASIN															
TIS ABBAY PROJECT	50	1	155	194	179	81	0	0	0	0	0	0	70	149	829
DURETE PROJECT	50	1	110	142	73	11	0	0	0	0	0	0	60	138	534
DEBER MARKOS SUB BASIN															
GUGCHIS/TIMBER PROJECTS	50	7	118	146	101	32	0	0	0	0	0	0	60	149	607
CHAGNI	50	7	153	165	167	58	0	0	0	0	0	0	62	166	771
LAH	50	7	58	42	21	0	0	0	0	0	0	0	74	146	341
GULA DEMBECHA	50	7	88	74	39	0	0	0	0	0	0	0	84	163	449
YETMEN/YETNORA PROJECTES	50	7	137	105	66	0	0	0	0	0	0	0	84	139	531
JEDEBE/LUMAME PROJECTS	50	7	134	148	106	0	0	0	0	0	0	0	72	148	608
CHEMOGA KOLA	50	7	190	216	211	108	0	0	0	0	0	25	121	199	1070
DABUS SUB BASIN															
LOWER DEBUS PROJECT	50	4	175	216	230	90	0	0	0	16	0	0	103	165	995
DILA PROJECT	50	4	135	166	115	5	0	0	0	0	0	0	60	137	618
DIDESSA SUB BASIN															
LUGOJEMA AGANTI PROJECT	50	4	151	182	157	4	0	0	0	0	0	0	60	159	714
CHIGSHA/DEMBA GUSU PROJECT	50	4	142	180	134	38	0	0	0	0	0	0	100	162	756
GUMI/BIYO PROJECT	50	4	143	172	165	51	0	0	0	0	0	0	94	160	785
DALE/LEKU UKE PROJECT	50	4	135	161	153	36	0	0	0	0	0	0	89	155	728
DIDESSA PUMPING	50	4	136	164	118	0	0	0	0	0	0	0	71	134	623
UPPER DABANA	50	4	109	117	56	0	0	0	0	0	0	0	60	109	452
URGESA WAMA PROJECT	50	4	157	159	92	0	0	0	0	0	0	0	78	140	625

Monthly Gross Irrigation Requirements (mm)

PROJECT	EFF%	CROP PAT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
GUDER AND FINCHAA SUB BASIN															
NEDI	50	3	160	154	113	85	0	0	0	0	0	11	129	159	812
HULUKE DEBIS PROJECT	50	5	114	115	60	0	0	0	0	0	0	2	83	132	507
BELES SUB BASIN															
BAR	50	4	156	195	188	107	0	0	0	0	0	0	99	158	902
MUGER SUB BASIN															
ROBI/HOMECHO PROJECT	50	4	105	72	0	0	0	0	0	0	0	0	73	125	374
WELATA SUB BASIN															
SELGI	50	4	128	106	83	16	0	62	0	0	41	19	92	128	675
GIAMMA SUB BASIN															
AELTU SHOA	50	7	160	108	90	28	9	99	4	12	74	72	107	159	921
CHACHA	50	7	119	100	57	9	0	0	0	0	0	52	91	154	583
WESERBI	50	7	68	29	0	0	0	0	0	0	0	25	83	100	306
AELTU N/SHOA	50	7	118	82	0	0	0	0	0	0	0	32	98	140	470
WEBERI	50	7	120	85	4	0	0	0	0	0	0	34	99	142	484
ROBI	50	7	117	80	0	0	0	0	0	0	0	31	98	139	464

Draft

TEKEZE SUB-BASIN

Draft

RAINFALL

Draft

Element: Monthly Rain Fall in mm

Region: Tigray

Station:Abiaddi

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	0.0	0.0	0.0	x	x	x	x	x	x	x	x	x
1995	0.0	0.0	71.0	66.0	x	47.2	33.5	422.0	43.0	x	x	x
1996	0.0	0.0	0.0	73.0	x	340.3	x	x	x	x	x	x
1997	x	x	x	x	47.0	54.9	228.1	127.0	2.0	154.0	6.5	0.0
1998	0.0	0.0	2.5	5.4	304.8	155.9	701.1	975.1	292.4	30.1	0.0	0.0
1999	15.2	0.0	0.7	x	39.5	x	301.0	475.5	108.8	0.0	0.0	x
2000	0.0	0.0	0.7	60.7	63.8	53.0	1432.1	240.7	56.4	78.8	28.0	0.0
2001	0.0	3.3	23.9	4.8	8.0	106.8	475.2	378.1	58.6	0.0	3.7	0.0
2002	0.0	0.0	21.0	37.0	0.0	75.3	169.1	150.8	67.2	0.0	0.0	0.1
2003	0.0	32.7	17.1	11.1	5.0	146.3	235.3	414.2	124.3	0.0	0.0	0.0

Element: Monthly Rain Fall in mm

Region: Tigray

Station:Shire Endeselassie

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1992	x	x	0.0	34.2	8.4	107.3	218.0	281.4	207.7	33.2	13.0	17.1
1993	0.0	0.0	2.0	29.4	68.1	146.5	233.4	247.4	132.3	97.3	0.0	0.0
1994	0.0	13.8	0.0	7.7	36.2	131.4	282.2	358.3	231.9	15.8	11.1	2.9
1995	0.0	0.0	21.1	17.2	x	46.9	439.2	192.0	188.1	2.0	0.0	0.0
1996	0.0	0.0	28.5	34.5	12.2	112.8	190.7	218.4	111.3	11.0	23.2	1.9
1997	0.0	0.0	11.4	15.3	177.4	128.7	349.9	233.1	144.7	144.2	79.8	6.0
1998	0.0	0.0	12.2	3.0	100.9	108.0	379.8	278.2	128.9	55.5	0.0	0.0
1999	2.5	0.0	0.0	22.4	16.8	133.3	215.1	420.3	181.3	277.0	0.0	0.0
2000	0.0	0.0	3.5	51.3	25.0	142.8	274.6	232.1	238.4	144.9	2.3	0.0

Element: Monthly Rain Fall in mm

Region: Tigray

Station: Mekele

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	0.0	83.1	0.0	114.3	43.5	42.1		407.9	17.7	0.0	0.0	0.0
1981	0.0	0.0	24.0	5.6	11.3	0.0	349.0	205.3	22.9	0.0	0.0	0.0
1982	0.0	24.4	45.2	70.8	9.3	8.0	192.6	207.1	31.2	0.0	0.0	0.0
1983	0.0	11.0	0.0	27.5	106.3	1.8	244.3	255.1	35.0	1.6	17.4	0.0
1984	0.0	0.0	14.2	0.0	0.0	9.7	117.6	78.9	44.7	0.0	25.9	0.0
1985	0.0	x	24.7	126.8	37.4	14.6	124.4	180.8	20.6	0.0	0.0	0.0
1986	0.0	x	x	x	x	x	x	x	x	x	x	x
1987	0.0	2.0	79.0	37.2	126.7	56.6	177.2	220.2	36.3	1.9	0.0	0.0
1988	1.8	29.3	0.0	10.1	37.6	6.7	380.3	394.9	59.0	0.0	0.0	0.0
1989	x	x	x	x	x	x	x	x	x	x	x	x
1990	x	x	x	x	x	x	x	x	x	x	x	x
1991	x	x	x	x	x	x	197.5	216.3	28.2	53.1	0.0	0.0
1992	8.7	2.1	38.5	1.0	30.7	6.2	140.7	233.1	1.3	2.1	54.2	8.3
1993	11.7	7.7	63.9	125.0	74.7	69.0	217.2	106.5	15.2	20.0	0.0	0.0
1994	0.0	5.3	0.4	43.8	0.1	67.6	147.9	317.8	70.1	0.0	1.8	2.0
1995	0.0	5.9	31.2	29.2	27.1	6.8	268.2	237.7	51.4	3.0	0.0	21.7
1996	1.4	0.0	59.5	12.5	92.2	47.9	109.2	224.0	7.1	0.0	31.4	1.1
1997	0.0	0.0	19.8	32.6	29.8	32.4	236.1	100.5	16.3	82.9	15.7	0.0
1998	10.0	1.2	0.0	10.6	22.0	48.0	289.0	315.8	31.7	22.0	0.0	0.0
1999	22	0.3	10.9	0.0	0	7.4	293.6	359.2	22.8	0.9	0	0.0
2000	0	0.0	0	10.4	24.6	5.4	201.4	182.0	15.8	2.2	10.3	3.5

Element: Monthly Rain Fall in mm

Region: Wello

Station:Lalibela

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	0.0	0.0	71.5	7.0	8.0	3.0	222.0	286.5	28.5	2.5	26.5	0.5
1982	21.0	14.0	15.5	6.0	24.5	3.0	74.5	312.3	0.0	0.0	0.0	0.0
1983	7.0	69.5	143.0	0.0	86.5	28.0	152.0	294.6	48.5	1.3	5.0	x
1985	x	18.7	57.1	47.3	56.3	36.8	166.9	187.1	42.5	15.8	0.0	5.5
1986	0.0	9.8	15.3	125.4	52.5	177.3	287.1	266.8	52.1	3.9	0.0	3.6
1987	0.0	2.8	86.5	2505.0	86.4	18.3	24.3	206.3	22.7	9.0	0.0	10.4
1988	12.3	43.2	0.0	47.0	5.9	22.5	463.9	209.3	118.0	8.6	0.2	0.0
1989	0.2	4.2	60.0	94.9	30.1	13.6	139.7	x	x	x	x	x
1992	x	x	x	35.4	70.2	41.8	139.4	302.6	x	58.1	52.9	40.2
1993	5.0	4.7	73.9	194.9	38.4	3.1	219.1	103.2	111.1	22.9	4.8	0.0
1994	0.0	3.1	8.4	46.5	3.4	41.6	446.0	311.0	65.0	3.7	1.8	0.9
1995	0.0	28.6	10.2	83.2	68.0	4.3	307.4	227.3	46.9	0.7	0.0	20.7
1996	30.6	1.8	118.7	47.0	56.2	161.6	306.5	288.4	20.5	0.7	35.0	0.8
1997	15.7	8.4	95.5	58.7	24.3	104.5	3004.2	162.0	24.9	100.3	100.9	2.6
1998	5.9	7.7	26.6	19.2	44.0	15.8	340.8	258.6	58.1	21.5	0.0	0.0
1999	0.0	0.0	0.0	22.3	0.7	20.2	333.7	319.6	50.4	22.4	3.3	1.8
2000	0.0	0.0	25.9	79.9	13.5	16.2	213.1	206.3	71.1	80.7	36.6	9.3

EVAPORATION

Draft

Monthly Piche Evaporation**Region: Wollo****Station: Lalibela**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1999	x	x	x	x	x	x	x	x	x	x	x	x
2000	264.2	254.5	229.1	154.3	254.3	217.3	365.9	34.1	97.8	24.0	77.4	81.0

Draft

MONTHLY RUNOFF VOLUME

Draft

SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION NAME: TEKEZE Nr./@ YECHI BASIN TEKEZZE DRAINAGE AREA _____ Sq.KM. Stn. No. _____

YEAR		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL		
1994	I															
1995	I															
1996	I	40.202	27.386	38.460	98.982	156.139	73.310	1377.677	1383.019	906.715	85.325	69.339				
1997	I					49.922		2477.064		131.142	205.973	220.659				
1998	I				37.300	103.498	74.099	3554.386	9312.687	3253.078	243.616	56.197	28.994			
1999	I	28.369	10.105						5833.314	3451.451	407.282	97.527	50.161			
2000	I	26.514	12.668		19.026	18.275	20.378	1288.679	4436.649	739.592	186.293	75.122	35.054			
2001	I	18.092	8.170	19.860	11.103	15.764			8104.086	869.609	104.896	49.821	36.706			
2002	I	27.461	14.454	14.556	25.999	8.248	31.419	683.931	2111.483	399.928	76.113	45.179	39.886	3478.655		
2003	I	29.380	27.831	87.400	37.712						149.392	61.566	42.390			

* I. MONTHLY RUNOFF IN MILLION M³

* I - MONTHLY RUNOFF IN MILLION M³

II - MAXIMUM DISCHARGE IN M³/Sec

III - MINIMUM DISCHARGE IN M³/Sec

MP = MOMENTARY PEAK IN M³/Sec

MMD = MAX. MEAN DAILY PEAK IN M³/Sec

SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION:- Tekeze river near EMBAMADRIE
 BASIN:- TEKEZE
 DRAINAGE AREA, KM²:- 45694

STATION No.:- 121006
 co-ordinate:- 13D44'N 38D12'E
 MEAN ELEVATION,m.as.l.:

YEAR	*	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEP	OCT	NOV	DEC	TOTAL
1967	I	20.00	10.00	12.00	20.00	60.00	400.00	3509.30	4626.80	1257.20	322.40	57.22	50.80	10345.72
1968	I	31.02	16.20	12.96	18.99	15.33	302.10	1381.30	1668.39	531.40	99.97	23.65	18.34	4119.65
1969	I	15.23	10.34	82.22	49.53	181.62	113.30	804.98	1866.14	612.88	230.19	72.93	19.18	4058.54
1970	I	9.89	6.84	7.13	17.51	1.63	241.15	2376.67	1490.35			47.00	24.58	
1971	I	17.63	9.28	10.78	13.62	71.69	126.97	766.53	1109.16	476.87	75.39	24.24	13.82	2715.98
1972	I	9.65	4.97	5.19	37.40	22.53	154.07	892.26	1002.58	244.75	28.48	22.40	8.26	2432.54
1973	I	4.31	1.64	0.70	10.48	41.62	6.29	1388.80	3179.07	730.83	207.10	43.70	20.36	5634.90
1974	I	13.91	8.51	11.98	11.07	55.96	153.60	1162.18	2531.30	655.60	115.40	56.50	42.30	4818.31
1975	I	18.67	16.64	11.35	19.59	2.72	103.78	1062.87	3446.18	2168.08	340.39	144.43	99.49	7434.19
1976	I	70.41	47.34	58.77	48.45	86.51	176.52	881.26	2128.84	711.86	168.39	110.02	62.64	4551.01
1994	I		7.14	5.69	10.72	52.89	118.23			1226.00	75.30	14.44	5.04	
1995	I	0.99	1.68	142.71	345.80	93.30	113.94	1517.70	2837.10	1021.20	229.55	79.15	69.98	6453.10
1996	I	54.45	52.43	251.93	205.60	185.49	523.62	1365.80	2796.40	962.90	329.90	179.20	148.50	7056.22
1997	I	72.53	38.44	145.60	80.53	173.60	387.10	1328.70	1545.40	423.40	528.00	296.50	117.20	5137.00
1998	I	42.202	15.330	20.417	70.870	217.255	226.317				780.960	416.634	217.155	
1999	I	214.257	120.200	134.301	122.565		257.974	1777.422	3642.015	2117.175	857.713	406.738	235.244	
2000	I	91.208	154.698	150.870	196.215	197.453	245.070	1344.396	3292.709	1282.925	676.279	364.935	270.462	8267.218

* I. MONTHLY RUNOFF IN MILLION M³

SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION:- TEKEZE river at HUMERA
 BASIN:- TAKEZE
 DRAINAGE AREA, KM²:- 17962.5

STATION No.:- 122002
 co-ordinate:- 14d17'n 36d37'e
 MEAN ELEVATION,m.as.l.:

YEAR	*	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEP	OCT	NOV	DEC	TOTAL
1981	I				22.410	25.040	52.250	1673.100	4213.200	1013.420	246.240	49.160	17.230	
1982	I	2.080	203.750	32.880	27.500	36.040	446.180	1894.200	934.500	359.720	95.890	36.210	8.510	
1983	I	1.500	0.100	51.830	27.060	144.400	552.590	3073.200	121.570	263.840	56.590	11.160	1.890	
1984	I	0.139	9.780	1.614	47.500	110.090	931.730	843.500		497.400	35.170	0.879	5.480	

* I. MONTHLY RUNOFF IN MILLION M³



SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION:- ZARIMA RIVER AT ZAREMA
 BASIN:- TAKEZE
 DRAINAGE AREA, KM²:- 3259

STATION No.:- 122001
 co-ordinate:- 12d25'n 38d02'e
 MEAN ELEVATION,m.as.l.:

YEAR	*	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEP	OCT	NOV	DEC
1973	I						1.82	20.08	284.52	131.32	29.85	8.66	5.67
1974	I	4.10	2.61	2.21	1.75	2.78	9.25	120.07	459.62	199.55	10.22	2.61	1.40
1975	I	0.92	0.69	0.66	0.62	0.68	1.42	142.79	198.01	119.51	26.30	11.83	9.66
1976	I	1.75	0.96	0.55	0.23	0.36	2.42	16.63	122.92	58.28	2.47	2.22	3.60
	I												

- * I. MONTHLY RUNOFF IN MILLION M³
- II. MAXIMUM DISCHARGE IN M³/sec
- III. MINIMUM DISCHARGE IN M³/sec

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

Draft

SEDIMENTATION

Draft

Ministry of Water Resources

Daily Observation

Station number	121010
River basin	Tekeze
Station name	Wokro
River	Genfel
Catchment area (km2)	481

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1994	6	20	0.28	2.602	224,813	2057.28	1954.42	462.50
1994	6	21	1.19	39.540	3,416,256	11208.44	10648.02	38290.90
1994	6	21	0.46	5.050	436,320	1540.62	1463.59	672.20
1994	6	23	1.04	34.840	3,010,176	15227.73	14466.34	45838.10
1995	8	28	0.35	0.236	20,390	142.17	135.06	2.90
1995	9	1	0.44	1.099	94,954	340.83	323.79	32.36
1996	8	24	0.62	4.606	397,958	1112.48	1056.86	442.72
1996	8	25	0.42	2.352	203,213	429.00	407.55	87.18
1996	8	26	0.29	0.970	83,808	184.19	174.98	15.44

Ministry of Water Resources

Daily Observation

Station number	121007
River basin	Tekeze
Station name	Hawzien
River	Suluh
Catchment area (km2)	399

Year	Month	Day	G.H.	Flow	Daily discharge	Sediment concentration	Sediment concentration	Daily sediment load
			h (m)	Q (m ³ /s)	m ³ /d	g/t mg/kg ppm	g/m ³ mg/l	t/d
1994	8	9	0.46	0.78	67392.00	647.67	615.29	43.60
1994	8	12	0.49	0.99	85536.00	1627.31	1545.94	139.20
1994	8	17	0.48	0.95	82166.40	1865.17	1771.91	153.20
1995	8	12	0.69	2.41	207878.40	2630.13	2498.62	546.70
1995	8	16	1.27	11.76	1016064.00	22283.90	21169.71	22641.90
1995	8	16	1.40	18.82	1626048.00	10028.27	9526.86	16306.50
1995	8	17	1.18	9.14	789696.00	38502.33	36577.21	30405.10
1995	8	17	0.61	1.61	139276.80	1699.23	1614.27	236.70

Ministry of Water Resources

Daily Observation

Station number	121006
River basin	Tekeze
Station name	Ambamadre
River	Tekeze
Catchment area (km2)	45694

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1995	8	15	5	945.500	81,691,200	13041.17	12389.11	1065348.80
1995	8	15	3.35	520.220	44,947,008	14737.63	14000.75	662412.40
1995	8	16	4.66	797.460	68,900,544	24130.60	22924.07	1662611.50
1995	8	17	4.75	1009.600	87,229,440	22371.13	21252.57	1951421.40
1995	8	18	5.18	992.140	85,720,896	9978.93	9479.98	855402.80
1995	8	20	5.38	1156.720	99,940,608	16388.13	15568.72	1637839.70

Ministry of Water Resources

Daily Observation

Station number	
River basin	Tekeze
Station name	Debark
River	Asera
Catchment area (km²)	

Year	Month	Day	G.H m	Flow m ³ /s	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1995	8	9	0.53	0.810	69,984	257	244.15	17.99
1996	11	2	0.32	0.320	27,648	104.8567	99.613865	2.90
1996	11	10	0.38	0.161	13,910	145.5	138.225	2.02

Ministry of Water Resources

Daily Observation

Station number	
River basin	Tekeze
Station name	Dansha
River	Raza
Catchment area (km2)	

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/ l	Daily sediment load t/d
1996	8	2	0.97	19.460	1,681,344	2095.85		
1996	8	3	0.9	18.520	1,600,128	359.02	341.07	3523.80
1996	8	10	1.7	81.640	7,053,696	1118.69	1062.76	57447.80
1996	8	11	2.19	101.590	8,777,376	2677.13	2543.27	7841.50
1996	8	12	2	98.780	8,534,592	2156.36	2048.54	23498.20
1996	8	13	1.74	78.190	6,755,616	545.35	518.08	18403.60
1996	8	14	1.5	56.030	4,840,992	391.86	372.27	36845.10
1996	8	15	1.41	53.710	4,640,544	6321.33	6005.26	1896.99
1996	8	16	2.24	138.090	11,930,976	262.30	249.19	29334.40
1996	8	17	1.67	70.096	6,056,294	1927.89	1831.50	36221.00
1996	8	18	1.42	47.840	4,133,376	350.72	333.18	11675.90
1996	8	19	1.34	43.120	3,725,568	811.88	771.29	14449.70
1996	8	20	1.32	4187.000	361,756,800	492.98	468.33	3024.70
1996	8	22	1.82	89.680	7,748,352	1273.18	1209.52	1783.40

Ministry of Water Resources

Daily Observation

Station number	121012
River basin	Tekeze
Station name	Aynalem
River	Metera
Catchment area (km2)	69

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1992	8	23	0.53	0.08	6998.40	976.43	927.61	6.80
1992	8	25	0.45	0.01	777.60	454.10	431.40	0.35

Ministry of Water Resources

Daily Observation

Station number	121013
River basin	Tekeze
Station name	Aquale
River	Aquale
Catchment area (km2)	

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	1994	
							g/m ³ mg/l	t/d
1994	7	17	0.45	1.61	139104.00	1077.79	1023.90	149.90
1994	7	18	1.21	18.83	1626912.00	28928.68	27482.25	47064.40
1994	7	18	0.38	0.77	66614.40	20934.42	19887.70	1394.50
1994	7	19	0.51	0.21	18144.00	4197.17	3987.31	76.15
1994	7	19	0.96	20.63	1782432.00	18721.15	17785.09	3246.10
1994	7	20	0.36	0.43	37238.40	688.44	654.02	25.60
1994	7	20	1.12	19.51	1685664.00	22721.86	21585.77	38301.40
1995	8	28	0.32	0.20	16848.00	248.00	235.60	4.20

Ministry of Water Resources

Daily Observation

Station number	121016
River basin	Tekeze
Station name	Aito Wedeko
River	Mariam Shewito
Catchment area (km2)	

(File name: input1)

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1992	8	5	0.47	0.11	9158.40	2282.82	2168.68	20.91
1992	8	6	0.50	0.15	12787.20	1192.48	1132.85	15.25
1992	8	7	0.58	0.35	30326.40	2629.09	2497.64	79.73
1992	8	8	0.49	0.13	11491.20	364.39	346.17	4.19
1992	8	9	0.48	0.11	9590.40	237.48	225.60	2.27
1992	8	10	0.47	0.10	8899.20	223.15	211.99	1.99
1992	8	12	0.56	0.33	28857.60	1658.67	1575.74	47.87
1992	8	12	1.51	33.35	2881440.00	10742.35	10205.23	30953.44
1992	8	16	0.64	0.95	81648.00	4922.25	4676.14	401.89
1992	8	24	0.58	0.39	33436.80	1297.41	1232.54	43.38
1992	8	29	0.54	0.27	23241.60	2004.35	1904.13	46.58
1992	8	31	0.99	7.48	646272.00	9294.27	8829.56	6006.63
1992	9	7	0.52	0.23	20217.60	268.58	255.15	5.43
1992	9	8	1.31	22.49	1943136.00	8529.18	8102.72	16573.36
1992	9	8	1.18	14.79	1277856.00	8628.33	8196.91	11025.76
1993	8	17	0.43	0.10	8208.00	740.14	703.13	5.77
1993	8	20	0.43	0.08	7257.60	2206.37	2096.05	15.21
1994	8	13	0.43	0.11	9158.40	273.96	260.26	2.38

Ministry of Water Resources

Daily Observation

Station number	121014
River basin	Tekeze
Station name	Aito Wedeko
River	Mai Dunger
Catchment area (km2)	88

Year	Month	Day	G.H.		Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration			Daily sediment load t/d
			h (m)				g/t	mg/kg	ppm	
1992	8	3	0.75	0.11	9158.40	4782.14	4543.03		43.80	
1992	8	4	0.82	0.84	72576.00	1976.09	1877.29		143.42	
1992	8	5	0.73	0.10	8985.60	2445.65	2323.37		21.97	
1992	8	6	0.71	0.17	15033.60	1115.05	1059.29		16.76	
1992	8	7	0.58	0.25	21859.20	1596.66	1516.82		34.90	
1992	8	9	0.53	0.13	11145.60	327.93	311.53		3.65	
1992	8	10	0.51	0.11	9676.80	274.96	261.21		2.66	
1992	8	13	0.60	0.58	50371.20	715.94	680.14		36.06	
1992	8	20	0.81	1.29	111283.20	1867.11	1773.76		207.78	
1992	9	10	1.57	11.29	975456.00	7254.18	6891.47		7076.13	
1993	8	21	0.88	0.18	15552.00	700.86	665.81		10.90	

Ministry of Water Resources

Daily Observation

Station number	121015
River basin	Tekeze
Station name	Adwa
River	Mai Midimar
Catchment area (km2)	216

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/ l	Daily sediment load t/d
1992	8	6	0.42	0.903	78,019	1685.32	1601.05	131.49
1992	8	8	0.39	0.369	31,882	890.63	846.10	28.44
1992	8	9	0.34	0.251	21,686	498.76	473.82	10.82
1992	8	11	0.33	0.247	21,341	229.96	218.46	4.91
1992	8	12	0.69	2.620	226,368	2095.06	1990.30	474.25
1992	8	14	0.41	0.800	69,120	351.71	334.12	24.32
1992	8	17	0.4	0.403	34,819	1083.07	1028.92	37.71
1992	8	19	0.39	0.407	35,165	638.31	606.39	22.37
1992	8	24	0.58	1.187	102,557	2245.74	2133.45	230.31
1992	8	29	0.57	0.787	67,997	1440.94	1368.89	97.98
1992	9	4	0.62	1.070	92,448	1089.47	1034.99	1000.72
1992	9	9	1.48	30.512	2,636,237	8657.94	8225.04	22824.20
1993	8	21	0.53	0.551	47,606	1156.85	1099.01	52.32
1994	8	18	0.41	0.171	14,774	78.45	74.53	1.10

Ministry of Water Resources

Daily Observation

Station number	121008
River basin	Tekeze
Station name	Adikumsi
River	Ghiba
Catchment area (km2)	4342

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1995	6	19	1.22	45.440	3,926,016	21680.41	20596.39	85117.60
1995	6	21	1.3	33.890	2,928,096	17727.40	16841.03	51907.50
1995	6	21	0.84	12.860	1,111,104	39831.30	37839.74	76136.80
1995	6	22	1.48	45.460	3,927,744	19384.37	18415.15	93477.90
1995	6	23	1.6	20.700	1,788,480	22644.00	21511.80	19687.20
1995	6	24	1.5	65.150	5,628,960	15505.50	14730.23	700362.40
1995	6	28	0.85	17.940	1,550,016	12706.30	12070.99	187782.20
1995	6	30	2.5	284.300	24,563,520	28512.30	27086.69	175047.10
1995	6	31	1.53	77.250	6,674,400	28134.70	26727.97	8881.70
1995	8	1	1.48	64.130	5,540,832	31592.20	30012.59	44256.70
1995	8	2	0.75	13.450	1,162,080	7542.97	7165.82	40498.30

Ministry of Water Resources

Daily Observation

Station number	
River basin	Tekeze
Station name	Rama
River	Endesa
Catchment area (km2)	

Year	Month	Day	G.H.	Flow	Daily discharge	Sediment concentration	Sediment concentration	Daily sediment load
			h (m)	Q (m ³ /s)	m ³ /d	g/t mg/kg ppm	g/m ³ mg/l	t/d
1992	8	16	0.37	1.19	102902.40	261.82	248.73	26.94
1994	8	21				215.50	204.73	
1994	8	19	0.49	1.07	92448.00	663.01	629.86	61.29
1994	8	18	0.44	0.57	48988.80	678.20	644.29	33.22
1994	8	20	1.74	29.42	2541888.00	5344.92	5077.67	13586.20
1994	8	21	0.23			219.31	208.34	

Ministry of Water Resources

Daily Observation

Station number	121009
River basin	Tekeze
Station name	Quiha
River	Dollo
Catchment area (km2)	134

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1992	8	23	0.37	0.15	12787.20	2262.53	2149.40	28.93
1992	8	26	0.35	0.68	58752.00	900.43	855.41	52.90
1994	7	19	0.44	0.38	32832.00	6669.64	6336.16	218.98
1994	7	25	0.39	0.33	28425.60	1481.68	1407.60	42.12

Ministry of Water Resources

Daily Observation

Station number	121011
River basin	Tekeze
Station name	Mekelle
River	illala
Catchment area (km2)	190

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1992	8	23	1.06	0.30	26092.80	1026.93	975.58	26.80
1992	8	25	1.02	0.15	12528.00	472.48	448.86	5.92
1992	8	27	1.04	0.65	55814.40	578.52	549.59	32.29

Ministry of Water Resources

Daily Observation

Station number	121004
River basin	Tekeze
Station name	Mekelle
River	Ghiba
Catchment area (km2)	2449

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d
1994	8	3	1.27	5.02	433382.40	4107.06	3901.71	1779.90
1994	8	5	1.42	6.29	543283.20	5452.14	5179.53	2962.00
1994	8	6	1.94	28.19	2435443.20	9623.36	9142.19	23437.10
1994	8	7			0.00	9032.70	8581.07	
1994	8	22	1.48	8.69	750816.00	7304.06	6938.86	5484.00
1994	8	22	1.48	8.69	750816.00	7304.06	6938.86	5484.00
1994	8	24	1.60	14.41	1245024.00	13355.85	12688.06	16628.40
1995	7	29	1.62	12.95	1118880.00	20390.47	19370.95	22814.50
1995	7	31	1.98	12.95	1118880.00	10413.57	9892.89	11651.50
1995	8	1	1.83	12.80	1105920.00	18392.70	17473.07	20340.80
1995	8	2	1.50	4.11	355104.00	4692.97	4458.32	1666.50
1995	8	4	1.46	3.67	317260.80	10146.83	9639.49	3219.20
1995	8	5	1.74	9.26	800064.00	6414.60	6093.87	5132.10
1996	8	14	0.61	2.43	209865.60	610.16	579.65	128.00
1996	8	15	0.73	4.98	430583.04	1694.98	1610.23	729.70
1996	8	16	0.73	3.74	323395.20	528.77	502.33	171.00
1996	8	17	0.75	6.42	555033.60	3948.44	3751.02	2191.50
1996	8	18	0.62	2.49	215222.40	2281.96	2167.86	491.50
1996	8	19	0.68	3.31	285811.20	2203.52	2093.34	629.80
1996	8	22	1.04	19.21	1659830.40	6425.20	6103.94	10664.70
1996	8	23	1.20	20.25	1749600.00	4401.41	4181.34	7700.70
1996	9	4	0.74	3.34	288662.40	2464.83	2341.59	711.50
1996	9	5	0.74	5.74	496022.40	11343.92	10776.72	5626.80

DAMS and RESERVOIRS

Draft

Area storage curve for TK-03 TK-04 TK07 TK12 TK16 TK21 TK22 TK23 TK25

TK-03

Elevation (masl)	Heigh over Thalweg(M)	Area 10 [^] 6m2	Delta-volume 10 [^] 6m3	Volume 10 [^] 6m3
1250	0	0	0	0
1300	50	24.17	604.25	604.25
1400	150	118.85	7151	7755.25
1500	250	378.23	24854	32609.25

TK-04

Elevation (masl)	Heigh over Thalweg(M)	Area 10 [^] 6m2	Delta-volume 10 [^] 6m3	Volume 10 [^] 6m3
1160	0	0.34	0	0
1200	40	18.54	377.6	377.6
1240	80	39.66	1164	1541.6
1280	120	73.38	2260.8	3802.4

TK-25

Elevation (masl)	Heigh over Thalweg(M)	Area 10 [^] 6m2	Delta-volume 10 [^] 6m3
1880	0	0.26	0
1920	40	1.63	37.88
1960	80	14.96	331.86
2000	120	45.93	1217.82
2040	160	104.06	299.9

TK-07

Elevation (masl)	Heigh over Thalweg(M)	Area 10 [^] 6m2	Delta-volume 10 [^] 6m3	Volume 10 [^] 6m3
840	0	6.49	0	0
880	40	41.73	964.4	964.4
920	80	60.03	2035.2	2999.6
960	120	91.33	3027.2	6026.8
1000	160	135.47	4536	10562.8

TK-21

Elevation (masl)	Heigh over Thalweg(M)	Area 10 [^] 6m2	Delta-volume 10 [^] 6m3
740	0	0.77	0
760	20	11.63	123.96
780	40	24.48	361.07
800	60	42.04	665.2
820	80	65.49	1075.34

TK12

Elevation (masl)	Heigh over Thalweg(M)	Area 10 [^] 6m2	Delta-volume 10 [^] 6m3	Volume 10 [^] 6m3
1330	0	0	0	0
1360	30	0.85	12.75	12.75
1400	70	2.87	74.4	87.15
1440	110	6.49	187.2	274.35
1480	150	11.95	368.8	643.15
1520	190	19.73	633.6	1276.75
1560	230	30.15	997.6	2274.35
1600	270	45.71	1517.2	3791.55

TK-23

Elevation (masl)	Heigh over Thalweg(M)	Area 10 [^] 6m2	Delta-volume 10 [^] 6m3
2120	0	0	0
2130	10	0.056	0.28
2140	20	0.222	1.39
2150	30	0.636	4.29
2158	38	1.15	7.144

TK-16

Elevation (masl)	Heigh over Thalweg(M)	Area 10 [^] 6m2	Delta-volume 10 [^] 6m3	Volume 10 [^] 6m3
920	0	0.17	0	0
940	20	0.87	10.4	10.4
960	40	2.11	29.8	40.2
980	60	4.13	62.4	102.6
1000	80	7.37	115	217.6

TK-22

Elevation (masl)	Heigh over Thalweg(M)	Area 10 [^] 6m2	Delta-volume 10 [^] 6m3
820	0	0.05	0
840	20	3.3	33.5
860	40	10.9	142
880	60	25.38	365.8
900	80	47.65	730.3

TABLE WR4.2;GENERAL DAM DATA OF SELECTED SITE

SITE	N		E	UTM COORDINATES		DAM TYPE	THALWEG	Tailwater	NSL	GR.STORAGE VOL (Mm*3)		DSL	
				E	N		(MAS)*	(mas)*	(masl)*	available	desired	(masl)	
TK03	12	35.011	38	27.426	441042	1391027	RCCGD	1250	1250	1328	2598	2598	1294
TK04	12	53.35	38	39.812	463504	1424777	RCCGD	1160	1100	1275	3802	4884	1222
TK07	13	52.033	37	54.467	381974	1533176	CFRD	820	800	990	9380	9661	881
TK12	12	46.023	39	5.115	509256	1411239	RCCGD	1330	1330	1500	964	964	1412
TK16	12	49.998	36	53.661	271468	1419512	CFRD	920	920	1000	218	468	969
TK21	13	13.717	36	55.2	274601	1463224	RFD	740	740	800	1118	1118	763
TK22	12	34.117	36	34.283	236113	1390525	RFD	820	820	871	388	388	843
TK23	13	29.952	39	32.683	558952	1492271	RCCGD	2120	1212	2157	12	30	2153
TK25	13	38.626	39	24.941	544946	1508248	CFRD	1860	840	1955	344	334	1908

TABLE WR4.3; SPECIFIC DAM DATA OF SELECTED SITES

SITE	THALWEG	DAMCREST	DAM HT	NST	GR.STOR	LIVE STOR	DAM VOLUMES 10^3M *3			W;H	DEAD STOR
	(masl)*	(masl)*	M	(masl)*	Mm^3	Mm^3	RCCED	RFD	CFRD	rato	Mm^3
TA03A	1250	1335	85	1328	2598	2121	1168	5187	3914	7.6	477
TK03B	1250	1305	55	1300	604	286	448	1931	1434	9.4	318
TK04A	1160	1280	120	1275	3802	2942	965	4314	3273	3	860
TK04B	1160	1260	100	1255	2390	1530	625	2779	2100	3.2	860
TK04C	1160	1240	80	1235	1400	692	395	1734	1301	3.7	708
TK07A	840	998	158	990	9380	7529	4578	20566	15708	6.5	1851
TK07B	840	968	128	960	6027	4176	2724	12197	9285	6.7	1851
TK07C	840	938	98	930	3720	2280	1435	6386	4834	7.1	1440
TK07D	840	910	70	900	2000	766	660	2893	2168	7.5	1234
TK12A	1330	1505	175	1500	964	830	3362	15098	11531	4.4	134
TK12B	1330	1475	145	1470	547	413	2053	9188	6996	4.4	134
TK12C	1330	1445	115	1440	274	184	1212	5401	4100	4.4	90
TK16A	920	1008	88	1000	218	162	556	2449	1841	4.5	56
TK16B	920	980	60	972	85	45	160	676	498	4.3	40
TK21A	740	809	69	800	1118	950	200	820	602	6.3	168
TK21B	740	788	48	779	460	320	65	258	186	4	140
TK22	820	878	58	871	388	345	697	2901	2127	22.4	43
TK23	2120	2160	40	2157	12	5	76	263	185	9.6	7
TK25	1880	1962	82	1955	334	240	494	21770	1638	4.3	94

Dams and large weirs in the Tekeze project proposed by different Consultants

Tek nr	Source	River	Coordinate		Coordinate		Near by town	Disch.by others(m3/s)
			lat	lon	easing	northing		
			d-m-s	d-m-s				
1	2	3	4	5	6	7	8	9
Hydropower Projects Selected by WAPCOS								
1	TK -1	Tekeze	12-07-30	38-29-40	444.989	1340.308		44
2	TK -2	Tekeze	12-36-00	38-29-15	444.279	1364.267		67.3
3	TK -3	Tekeze	12-36-00	38-28-40	443.278	1392.834		89
4	TK -4	Tekeze	12-56-12	38-36-20	457.214	1430.038	Islamage	96.8
5	TK -5	Tekeze	13-19-20	38-44-30	472.022	1472.654	Abi Adi	101.3
6	TK -6	Tekeze	13-30-28	38-37-25	459.267	1493.189	Abi Adi	114.8
7	TK -7	Tekeze	13-50-00	38-56-00	384.719	1529.415	Embama	130.8
8	TK -8	Tekeze	14-12-15	37-29-00	336.339	1570.699		154.3
9	TK -9	Tekeze	14-16-00	37-02-20	288.424	1577.972	Humera	167
10	TK -10	Tekeze	14-18-40	36-43-30	254.593	1583.199	Humera	175
11	TK -11	Hamu	12-59-25	39-04-20	507.832	1435.934	Finerawa	9.3
12	TK -12	Tserare	12-48-40	39-09-30	517.183	1416.127	Sekota	16.3
13	TK -13	Tserare	12-37-30	39-16-30	529.866	1395.558	Korem	5.9
14	TK -14	Tserare	12-38-30	39-26-30	547.964	1397.426	Korem	4.2
15	TK -15	Goang	12-52-30	37-03-00	288.393	1423.989		4.9
16	TK -16	Goang	12-50-20	36-55-00	273.886	142.107		4.5
17	TK -17	Goang	12-49-45	36-44-30	254.874	1419.191		5.8
18	TK -18	Goang	12-48-00	36-34-00	235.839	1416.136		7
19	TK -19	Goang	12-48-00	36-27-30	224.071	1416.25	Metema	4.3
Hydropower Projects Studied by WRDA								
5A	TK -5A	Tekeze	13-20-08	38-44-07	471.332	1474.129	Abi Adi	92.5
6A	TK -6A	Tekeze	13-37-10	38-37-22	459.196	1505.538	Abi Adi	114
7A	TK -7A	Tekeze	13-46-00	38-00-00	391.894	1522.011	Embama	146.7
Multipurpose Projects Selected by WAPCOS								
20	WAP	Tekeze	14-16-00	37-02-07	288.732	1577.97	Humera	
21	WAP	Angereb	13-14-00	36-55-00	274.244	1463.75		
22	WAP	Gondula	12-37-00	36-32-00	232.026	1395.882		
Multipurpose Projects Selected by others								
23	Hun	Measannu	13-30-00	39-33-00	559.532	1492.365	Quiha	
24	Hun	Measannu	13-30-00	39-32-00	557.719	1492.361	Quiha	
25	ELC	Genfel	13-38-00	39-32-00	545.068	1507.081		
26	ELC	Tekeze	13-20-08	39-25-00	471.332	1474.129	Abi Adi	
27	ELC	Tekeze	13-37-10	38-37-22	459.196	459.196	Abi Adi	

HYDROPOWER

Draft

**ENERGY PRODUCTION CAPACITY OF THE PROJECT SITES BASED ON AVAILABLE
LIVE STORAGE OF THE RESERVOIRS**

Project site	dam ht(m)	HRL/TWL	Head(m)	Mean Ann. Flow	Live storage	Res(%)	Qreg(%)	Qreg(Mm)	Energy equiv	Firm power Gwh/yr	Surples power Gwh/yr
	1	2	3	4	5	6=(5)/(4)	7=.75*(6)	8=(4)(7)	9	10=(8)(9)	11=(4-8)(9)
TK03A	85	1328/1250	63	1448	2121	146	100	1448	0.1545	224	0
B	55	1300/1250	40	1447	286	20	15	207	0.0981	20	115
TK04A	120	1275/1160	152	2707	2942	108	81	2193	0.3732	818	141
B	100	1255/1160	141	2707	1530	56	42	1137	0.3462	394	544
C	80	1235/1160	121	2707	692	26	19	519	0.297	154	651
TK07A	158	993/800	153	5298	7529	142	100	5298	0.3755	1989	0
B	158	963/800	131	5298	7176	135	100	5298	0.322	1706	0
C	198	963/800	111	5298	2280	43	32	1695	0.2725	462	982
TK12A	175	1500/1330	139	574	830	145	100	574	0.3409	196	0
B	145	1470/1330	119	574	413	72	54	310	0.2918	106	90
C	115	1440/1330	89	574	184	32	24	138	0.2183	30	95
TK16A	88	100/920	68	282	162	57	43	122	0.1668	20	27
B	60	970/920	48	282	45	16	12	34	0.1177	4	29
TK21A	69	800/740	44	654	50	145	100	654	0.108	71	0
B	48	779/740	28	654	320	49	37	242	0.0687	17	28
TK22	58	871/820	40	239	345	144	100	239	0.0982	23	0
TK23	40	2157/2120	33	15	5	33	25	3.75	0.081	0.3	0.9
TK25	82	1955/1840	100	161	240	149	100	161	0.2455	40	0

Installed capacity

Projecs Site	Installed Capacity(MW)	Project Cost in Mill US \$)	Cost Per KW (US \$)
TK 3A	36	133	3694
3B	3.3	60.5	18333
TK 4A	133	184.7	1389
4B	63.5	124.8	1965
4C	24	81.4	3392
TK 7A	321	419.8	1308
7B	275	381.6	1388
7C	75	235.2	3136
TK 12A	31	248.1	8003
12B	15	172.9	11527
12C	4.5	118.3	26289
TK 16A	3.4	66.3	19500
16B	0.6	44	73333
TK 21A	11.4	57.2	5018
21B	2.8	41.3	14750
TK 22	3.7	89.8	24270
TK 23	0.06	35.5	591667
TK 25	6.4	78.9	12328

**CROP WATER REQUIREMENT &
CROPPING PATTERN**

Draft

AVERAG YIELDS OF MAJOR CROPS GROWN BY THE PEASANT SECTOR UNDER RAINFED CONDITION (qt/ha)

Crop	TIGRAY		NORTH GONDER		SOUTH GONDER		NORTH WELLO		WAG HEMRA		NATIONAL AVG
	1994	1995	1994	1995	1994	1995	1994	1995	1994	1995	
Teff	5.1	6.92	4.16	6.86	6.34	6.86	5.58	7.06	5.59	7.06	7.69
Barley	4.09	9.35	8.61	6.01	9.48	6.01	13.26	7	10.72	7	1011
Wheat	4	10.01	9.31	6.91	13.66	6.91	16.77	6.95	11.73	9.95	12.75
Maize	4	15.09	9.75	11.36	13.26	11.36	17.47	6.64	15.89	6.64	17.45
Sorghum	6.14	17.99	12.43	9.86	8.86	9.86	14.85	12.72	22.09	12.72	13.21
Mille	10.97	6.87	5.48	8.84	3.73	8.84					7.83
Oats			11.23		9.72		9.2		14.83		12.46
Horse Bean	7.02	14.4	7.33	7.58	11.64	7.58	4.56	9.02	6.03	9.02	10.8
Filed pea	2.56	7.65	6.56	3.47	3	3.47		6.39	8.19	6.39	8.49
Haricot bean	2.5		5.05		9.11		8.25		8.44		6.52
Chick Pea	0.45	7.96	4.13	7.49	6.14	7.49	4.21	5.74	4.43	5.74	7.75
Lent	3.07	4.83	1.49	7.38	5.54	7.38	7.18	6.1		6.1	5.72
Vetch	3.54	2.84	2.9	4.55	0.44	4.55					9.2
Nug	5.49		5.44		4		2.13		1.25		3.05
Linseed	2.69	3.01	2.62		4.57		7.02	2.6		2.6	4.93

AREAS CULTIVATED UNDER MAJOR GROUPS ,PER ZONE(*1000ha)

Region/Zone	Cereals	Pulses&Oil Crops	Total
Tigray Region			
Wester Zone	292.2	15.4	307.6
Central Zone	277.4	69.4	346.8
Eastern Zone	128.6	18.6	147.2
Souther Zone	304.1	60.1	364.2
Sum	1002.3(86%)	163.5(14%)	1165.8(100%)
Amhara Region			
NorthGonder	462.2	168.5	630.7
Souther Gonder	354	152	506
North Wello	298.3	78.4	376.7
Sum	1114.5(74%)	398.9(26%)	1513.4(100%)

MAJOR CROPS GROWN IN THE BASIN			
Zone	Altitude(m)	Major Crop grown	Cropping pattern
Bercha	<500	sesame,Cotton,Banana,Citrus	Seame - Cotton
Kolla	500-1600	sorghum Millet maize,teff,Nigerseed soybean banana,citrus	Sorghum,teff,Maize,Pulses
Woyna Dega	1500-2400	Teff,Soybeans,Lentil,Filedpea,Vetch,Chickpea,Wheat,Barlay,	Wheat,Teef,barley.
Dega	2300-3200	Oats,Fenugreek,Sorghum,Maize,Nigerseed,Banana,Potato	Barley,Wheat,Pulses.
Wurch	>3200	Barley,Horse bean,Wheat,Teff,Oats,Maize,Sorghum,Filed pea, Peach,Potato.	Barly,Bean

MEAN MONTHLY PET VALUES (based on Tekeze project data) mml/day

STATION		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
G5	Avikel	4.5	4.9	5.4	5.5	4.8	3.7	2.9	3.1	3.6	3.6	3.8	4.1
G9	Debark	4.3	4.6	5.7	5.1	5.1	4.4	3.2	3.2	4	3.5	3.5	2.9
G10	Debre Tabor	4.2	4.5	5	5.1	5	4.2	3.3	3.6	3.9	3.8	3.8	3.1
G12	Gonder	4.1	4.7	5.3	5.1	4.9	3.7	3.1	3.3	3.8	3.9	3.9	4
G13	Gorgor	3.8	4.3	4.8	5	4.9	4.5	3.7	3.6	4	4	3.7	3.5
G15	Humera	3.2	4.2	4.8	5.3	5.1	4.9	4.1	3.8	3.6	3.7	3.6	5
G19	Mietema	3.7	4.6	5.1	5.4	5.1	4.5	3.7	3.3	3.3	3.7	3.7	5.3
G20	Nefase mewech	3.8	4.2	4.5	4.8	4.9	4.5	3.7	3.4	3.9	4.5	4	3.4
G22	Yifag	4	4.5	5	5.2	4.8	4.2	3.5	3.5	3.9	4	3.8	3.6
W6	Kobo	3.6	4.2	4.7	4.9	4.7	4.7	4.1	4	3.7	3.9	3.8	4.2
W7	Kombolch	3.6	4	4.4	4.5	5	5.1	4.3	4.2	3.8	3.9	3.6	3.3
W12	Lailbela	4.2	4.7	5	5	5.4	4.7	3.1	2.7	3.8	3.9	3.8	3.7
W18	Sirinka	3.3	3.7	4.1	4.5	4.8	5.2	4.7	4.2	4.5	4	3.9	3
W22	Wegel Tena	4	4.4	4.3	4.8	4.8	5.2	3.4	3.6	4	4.1	3.6	3.5
T12	Endesilasie	4	4.3	5.3	5.4	4.9	4.5	3.4	3.1	3.8	4	3.8	4.1
T16	Llala	3.5	4	4.4	4.9	5	5	4.2	3.8	4.2	4.1	3.6	3.5
T18	Mehoni	3.6	3.8	4.3	4.7	4.8	5	4.3	4.2	4.1	3.9	3.7	3.7
T19	Mekele	3.4	3.9	4.4	4.6	4.8	5.3	4.4	4.2	4.5	4	3.5	3.2
T25	Shiket	3.2	3.4	4.2	4.7	4.8	5.2	5	4.6	4.4	3.9	3.4	3.5

SURFACE WATER RESOURCE OF THE TEKEZE ANGEREB GOANG BASIN

Cachment	Area(km ²)	Percipaitaion(mm)	MAR(10 ⁹ m ³)
Tekeze	63376	616	5.875
Angereb	13327	730	1.454
Goang/Gendua	6694	930	0.862
Total	83397	830	8.191

LOWLAND IRRIGATION POTENTIAL

River	Dam site	Mean annual flow	Qreg Mm ³	use by small scale irrig.	left for large scale irrig.	water avilabel for plantes	Large scale irrigation potenetial(ha)
Tekeze	TK-7	5298	5298	844	4544	2672	152700
Angereb	TK-21	654	654	191	463	278	23200
Goang	TK-16	282	122	90	271	163	13600
Gendua	TK-22	239					
		6473	6313	1125	5188	3113	189500

IRRIGATION WATER REQUIREMENTS(CWR)FOR

HUMERA													
Month	JAN	FAB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Avg
PET mm/day	4.9	6.4	7.4	8.2	7.9	7.6	6.3	5.8	5.6	5.7	5.5	5	6.39
Abderafi													
Month	JAN	FAB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Avg
PET mm/day	5.3	6.5	7.3	7.6	7.2	6.4	5.2	4.7	4.7	5.2	5.3	5.3	5.9

EXISTING SMALL-SCALE IRRIGATION IN TIGRAY RIGION(1995)

ZONE	WEREDA	IRRGATED AREA	IRRIGABLE AREA BY (HA)
Eastern	Bezete	14	23
	Tsede Amba	12	12
	Atsbe	40	170
	Tserea	87	101
	Felte Belassa	43	45
wester	Lahlay Kuraro	33	44
	Medabay Tabor	7	13
Centeral	Zana	16	20
	Laelay machew	9	10
	Aderbaete	15	18
	Hahaete	96	140
	Maykenatal	35	140
	Tenka Melash		7
Souther	Agewe	30	25
	Dedeba Ergajen	22	105
	Enderta	18	27
	Adegudom	47	51
	Bora	28	30
	Alemata	48	100
	Total	601	1068

EXISTING SMALL-SCALE IRRIGATION IN AMHARA REGION

ZONE	WEREDA	IRRGATED AREA	IRRIGABLE AREA BY (HA)
North Gonder		1040	
South Gonder	Ebinat	26	
	Farta	306	
	Lay Gavint	29	
	Tach Gavint	13	
North wello	Mekel	230	383
	Gedan	436	
	Bugen	50	
	TOTAL	2129	

BARO SUB-BASIN

Draft

RAINFALL

Draft

Element: Monthly Rain Fall in mm

Region: illubabur

Station:Bedelle

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1980	x				207.8	284.9	173.7	236.1	304.1	363.0	86.4	49.8 x	
1981	18.0		7.0	115.0		261.0 x	x	x	x	x	x	x	
1982	x	x	x	x	x	x	x	x	x	x	x	x	
1983	x		8.3	47.8	61.7	237.3	368.5	498.9	467.9	305.9	197.4	99.1	0.0
1984	x		0.0	44.6	65.6	291.2	275.2	469.0	210.9	241.8	8.9	24.6	5.0
1985	4.9	0.0	17.5	138.1	289.7	399.3	248.8	290.4	359.6	50.4	28.6	33.4	
1986	0.0	63.7	43.0	54.1	69.1	908.7	263.9	272.0	193.7	92.2	31.5	0.4	
1987	2.0	27.6	104.1	71.9	169.9	307.6	491.7	335.8	194.1	228.2	31.2	27.7	
1988	18.1	94.7	66.3	14.1	337.0	327.6	257.7	349.9	365.9	225.0	13.3	6.7	
1989	0.0	0.1	100.2	4.0	46.5	124.8	99.1	130.4	68.3	56.0	6.8	0.0	
1990	0.3	34.3	77.2	90.0	97.0	419.7	231.1	363.9	279.9	62.9	29.0	13.4	
1991	25.4	17.9	63.0	88.9	130.0	118.3	371.1	346.0	248.4	85.5	31.7	11.5	
1992	35.6	38.9	104.3	136.8	203.1	259.2	306.0	280.4	255.7	213.9	64.5	28.0	
1993	1.8	34.1	80.3	141.4	242.5	221.8	217.7	356.8	199.9	182.5	1.4	0.0	
1994	16.8	2.0	32.6	106.1	225.1		249.5	257.5	275.9	20.7	17.2	0.0	
1995	0.0	16.6	101.5	129.6	257.4	291.7	256.5	318.2	325.7	77.4	10.3	24.3	
1996	48.3	33.5	208.3	82.7	317.4	232.4	289.9	202.7	228.3	69.8	44.6	12.5	
1997	52.7	1.8	49.8 x		x	x	x	x	x	x	x	x	
1998	13.1	14.6	87.0	56.9	202.6	332.1	313.9	326.5	290.8	244.6	58.5 x		
1999	28.0	2.9	11.0	148.0	403.9	440.6	318.8	241.6	324.1	328.1	8.1	38.9	
2000	0.0	0.0	3.9	123.1	255.7	419.7	185.9	273.2	285.6	242.4	29.3	7.8	

Element: Monthly Rain Fall in mm

Region: illubabor

Station:Alge

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1980		0.0	81.6	80.6	138.9	267.1	167.9 x	127.6	127.6 x		77.4	4.2	
1981		6.0	0.0		50.0	244.5	207.9	381.7	375.4	375.4	145.0	44.6	4.6
1982		30.8	36.4	106.2	40.9	159.0	347.6	353.3	235.9	235.9	61.9	28.7	0.0
1983		1.4 x		x	38.5	205.9	354.0	384.5	300.5	300.5	177.1	47.5	0.0
1984 x			0.0	40.5	81.9	259.1	187.2	419.7	325.6	325.6	12.4	14.0	30.1
1985		31.4	0.0	52.5	114.1	377.7	297.7	280.6	348.3	348.3	102.2	54.5	9.8
1986		0.0	12.2	41.0	24.2	82.6	418.4	336.0	299.2	299.2	96.0	16.5	0.0
1987 x		x		52.8	133.8	203.0	343.4	546.1	270.4	270.4	253.0	66.4	16.8
1988		21.7	41.8	47.1	2.7	315.9	395.4	264.3	359.5	359.5	318.3	19.0	2.8
1989		12.5	67.9	149.5	56.6	169.2	228.4	284.8	405.9	405.9	210.7	38.4 x	
1990		12.1	31.8	35.1	60.1	148.7	341.9	361.8	465.9	337.2	133.5	22.8	17.6
1991		14.6	14.0	85.4	91.3	183.9	306.0	296.4	278.8	509.2	93.0	37.8	17.7
1992		26.1	6.4	61.9	120.9	176.6	217.0	265.3	202.6	394.3	192.5	54.5	2.9
1993		16.6 x		x	95.2	293.3	335.6	231.3	393.4	301.4	133.0	60.1	2.4
1994		10.9	0.0	5.2	94.9	290.7	183.1	192.7	345.2	254.4	42.6	32.0	27.9
1995		1.9	18.9	61.7	51.6	186.9	178.0	135.2	263.5	304.7	104.7	29.5	35.0
1996		80.4	10.3	48.5	101.7	281.7	319.7	254.9	343.6	264.2	100.7	27.9	19.9
1997		29.7	5.2	59.3	160.5	198.8	291.2	344.1	252.4	201.8 x		x	x
1998		2.7	3.2	80.5	24.8	187.7	376.9	312.3	295.1 x		x		x
1999		18.9	17.7	0.0	96.4	319.1	246.8	203.3	270.1	281.7	207.4	3.1	14.6
2000		0.0	1	11.2	177.8	231.6	243.6	221.7	358.6	313.3	256.3	65.3	9.0

Element: Monthly Rain Fall in mm

Region: illibabor

Station:Teppi

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1980	x	x	x	x	x	x	x	x	x	x	x	x	
1981	x		0.0 x	x	x		156.8	166.9	173.8	167.6	128.7	74.5	28.1
1982	89.5		12.0	61.7	207.3	215.9	224.3	82.0 x	x	x	x	x	
1983	x	x	x	x	x		96.1	273.5	234.9	281.0	136.6	26.2 x	
1984	x		6.4	117.5	278.5	205.7	411.9	274.1	274.0	121.6	19.5	97.9	79.6
1985	1.4	3.3	129.9	51.4	413.9	171.2	405.3	179.7	167.2	47.3	126.1	27.5	
1986	12.3	38.7	79.5	207.9	104.3	200.3	124.0	151.9	97.7	140.2	38.5	27.4	
1987	22.8	11.7	117.2	137.4	139.7	107.5	241.4	232.9	161.7	105.5	83.3	26.3	
1988	71.3	51.0	36.8	71.2	357.1	150.0	221.6	257.1	275.5	170.3 x		7.4	
1989	10.3	28.4	89.2	122.5	154.5	135.7	1175.1	255.6	185.7	154.3	94.4	137.6	
1990	57.7	25.3	172.2	119.6	302.8	172.2	183.0	402.1	163.2	194.8	74.2	41.4	
1991	51.2	63.2	107.1	188.2	123.6	140.6	217.1	149.0	260.5	70.8	69.8	44.7	
1992	x		17.4	63.0	135.2	154.2	185.0	172.9	193.7	255.4	156.5	108.0	62.2
1993	95.3	65.2	82.1	134.8	159.8	135.1 x		210.4	119.8 x		69.7	65.5	
1994	3.2	21.8	37.3	201.9	278.5	175.4	169.1	192.5	143.1	99.1	143.7	100.9	
1995	111.7	61.2 x		x	193.5	151.5	144.8	198.1	252.7	106.9	98.9	78.3	
1996	59.6	61.2	128.2	165.6	134.4	263.3	180.8	172.7	224.3	177.5	81.5	57.6	
1997	98.9	4.9	110.8	259.2	250.1	149.2	98.2	153.4	101.3	239.2	142.4	149.2	
1998	126.2	69.2	142.0	184.5	129.9	216.8	219.1	335.4	207.9	157.5	55.0 x		
1999	16.3	7.7	87.1	184.9	238.2	156.4	173.2	158.7	146.2	179.2	62.1	35.9	
2000	22.3	7.7	71.4	204.1	208.8	142.1	138.4	149.0	153.9	214.2	105.4	60.6	

Element: Monthly Rain Fall in mm

Region: illubabur

Station:Metu

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1998												
1999	28.3	10.3	1.3		336.9	217.9	332.7	295.8	406.4	275.3	6.2	72.4
2000	17.9	11.2	3.7	110.8	267.6	192.5	261.7	186.2	150.9	178.7	19.5	6.8

Draft

Element: Monthly Rain Fall in mm

Region: illubabor

Station:Masha

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	29.8	94.5	240.5	206.4	458.1	368.1	354.3	248.2	299.6	196.9	298.2	54.0
1981	30.5	10.3	137.3	196.2	329.2	244.5	208.1	237.7	366.3	116.9	226.1	36.2
1982	94.5	109.2	268.2	195.2	250.3	270.6	474.5	728.2	412.2	208.9	95.7	19.4
1983	x	x	x	91.8	250.1	322.2	305.2	332.7	326.2	157.8	155.3	38.9
1984	35.9		122.9	133.6	246.3	279.8	333.7	293.6	251.3	x	64.3	156.1
1985	x	x	171.8	240.9	204.4	247.7	305.9	408.7	224.7	105.0	117.3	60.2
1986	10.2	98.2	89.6	98.7	180.9	332.2	328.9	384.4	238.1	114.0	109.6	88.7
1987	33.5	14.7	183.4	136.4	196.0	327.6	333.1	310.8	265.5	337.4	90.1	96.9
1988	147.6	160.2	96.3	31.8	641.6	710.4	289.5	318.3	194.7	251.5	83.0	x
1989		69.8	221.1	101.9	217.6	204.9	231.6	298.5	251.6	205.9	100.7	127.5
1990	x	x	x	x	x	x	x	x	x	x	x	x
1991	40.3	68.2	146.5	232.3	171.5	106.1	193.3	278.2	136.3	168.2	134.7	39.0
1992	75.6	21.5	100.2	99.5	139.5	195.4	137.2	302.3	159.6	139.5	125.3	109.7
1993	38.9	135.2	113.4	142.9	206.4	250.7	317.9	272.5	325.9	199.4	62.3	45.8
1994	59.2	11.5	37.4	115.9	352.4	350.9	263.0	164.0	215.4	118.0	56.7	110.9
1995	4.5	58.9	80.8	54.6	125.2	276.2	214.2	371.0	264.2	128.2	168.5	126.1
1996	130.5	50.3	159.5	215.9	246.3	184.5	x	x	x	x	x	x
1997	x	x	x	x	x	253.4	290.9	274.5	256.2	356.4	120.3	53.0
1998	46.6	6.4	226.4	129.0	163.0	314.0	337.3	286.0	335.2	377.5	x	46.8
1999	54.8	12.7	3.9	300.6	426.3	304.2	328.3	250.0	271.5	244.6	98.1	101.0
2000	79.0	23.9	59.4	x	324.2	302.7	392.3	384.4	209.7	290.6	168.3	97.2

Element: Monthly Rain Fall in mm

Region: illubabor

Station: Abobo

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1980		0.0	3.5	25.9	104.8	136.7	112.8	93.5	144.6	126.8	62.7	38.9	5.7
1981	x	x		60.5	47.7	223.3	76.2	253.6	222.1	x	x	x	
1982		29.5	x	40.4	93.2	185.7	165.6	68.0	165.1	x	x	x	
1983	x	x	x		71.8	x	x	x			147.6	58.6	1.5
1984		0.0	0.0	15.6	116.7	305.4	62.6	195.7	x	x		79.0	16.0
1985	x	x	x		113.8	153.4	132.2	310.6	196.4	118.8	63.1	35.3	8.5
1986		0.0	0.5	36.5	21.7	104.5	104.5	238.4	59.4	180.5	60.4	35.5	0.0
1987		10.2	4.2	27.2	40.8	128.3	205.7	150.4	246.1	124.2	87.5	47.3	0.0
1988		1.9	54.7	46.8	34.0	212.5	90.0	145.0	268.7	271.1	222.1	19.0	6.0
1989	x		0.0	60.8	106.1	136.6	112.5	180.3	87.9	142.0	165.3	24.2	0.0
1990	x	x	x	x		97.4	51.7	218.8	161.8	73.3	107.9	21.1	15.3
1991		0.0	0.0		150.2	126.4	125.1	x	x	x	x	x	
1992		0.0	0.0	0.0	71.6	46.3	38.0	x	x	x	x		38.3
1993		2.1	26.1	43.6	121.6	192.7	160.0	91.1	31.9	97.3	91.3	11.0	0.8
1994		0.0	0.0	0.0	41.2	68.2	406.2	121.3	223.9	9.0	5.0	56.4	11.2
1995		0.0	9.0	44.3	35.9	136.9	168.5	179.7	105.3	75.4	78.5	6.9	13.9
1996		36.2	0.0	57.9	32.9	39.5	x	x	x	x	x	x	
1997	x	x	x	x	x	x	x	x	x	x	x	x	
1998	x	x	x	x	x	x	x	x	x	x	x	x	
1999	x	x	x	x	x	x	x	x	x	x	x	x	
2000	x		11.5	4.2	38.8	x	153.6	151	313.1	68.5	x	24.7	x

EVAPORATION

Draft

Monthly Piche Evaporation

Region: illubabor

Station: Masha

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1996	x	x	x	x	x	x	x	x	x	x	x	x	
1997	x	x	x	x	x		19.3	19.1	42.8	53.8	55.6	45.5	63.8
1998	70.1	116.3	82.3	103.9	64.4	46.4	41.3	33.3	31.3	34.1	73.9	104.1	
1999	94.7	137.5	171.1	81.8	41.4	42.7	32.5	28.6	33.9	36.1	77.5	63.6	
2000	56.9	106.6	90.2	77.2	60.5	32.2	32.1	56.0	40.6	41.4	59.9	55.2	

Draft

Monthly Piche Evaporation

Region: illubabor

Station: Bedelle

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1986	x	x	x	x	x	x	x	x	x	x	x	x	
1987	x	x		116.6	179.1	132.3	91.9	101.8	80.9	118.7	136.1	123.6	166.8
1988	177.4	144.4	192.7	236.1	126.3	107.8	48.9	47.2	75.6	147.4	189.8	195.1	
1997	x	x	x	x	x	x	x	x	x	x	x	x	
1998	128.2	140.9	143.0	x	x	x	24.0	20.6	30.3	38.7	x	x	
1999	143.8	198.4	201.3	157.0	59.8	54.9	32.5	33.5	42.4	53.0	144.2	130.3	
2000	34.7	x	x	x	x	x	41.7	34.2	43.8	55.9	96.5	125.8	

Draft

MONTHLY RUNOFF VOLUME

Draft

SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION:- SORE R. NR. METTU
 BASIN:- BARO-AKOBO
 DRAINAGE AREA, Km²:- 1622

STATION No.:- 101001
 Co-Ordinate:- 8d19'n 35d36'e

MEAN ELEVATION, m.a.s.l.:

YEAR	*	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1980	I	10.218	7.215	6.753	17.382	71.820	159.430	370.790	437.450	390.000	177.390	53.370	25.800	1727.62
1981	I	12.640	4.740	10.350	4.830	25.200	86.460	166.070	409.710	558.490	277.490	50.540	18.500	1625.020
1982	I	23.750	14.880	15.720	8.580	27.690	114.500	189.600	286.000	272.200	249.000	53.480	21.190	1276.590
1983	I	8.780	8.420	10.860	9.340	15.060	46.470	202.200	267.400	366.800	270.100	80.580	30.240	1316.250
1984	I	5.470	2.220	3.860	5.190	16.360	84.660	312.700	245.100	247.600	77.120	31.260	24.000	1055.540
1985	I	9.790	4.340	4.140	8.760	11.810	107.600	227.400	303.900	364.680	174.520	52.660	31.480	1301.080
1986	I	15.210	6.800	8.170	6.230	8.120	55.180	166.440	260.510	342.650	134.100	48.000	38.920	1090.330
1987	I	37.810	12.460	8.510	8.960	17.620	97.730	222.160	377.970	314.150	296.580	73.280	39.320	1506.550
1988	I	26.740	21.970	17.220	4.350	22.270	147.910	341.720	439.420	458.680	399.330	81.600	24.750	1985.960
1989	I	8.930	14.190	9.730	14.960	22.270	78.240	232.760	390.320	313.130	164.740	44.180	61.170	1354.620
1990	I	23.100	17.560	10.650	12.000	20.470	172.470	288.380	399.870	429.860	226.650	50.700	23.340	1675.050
1991	I	18.210	6.690	8.500	14.980	18.290	65.820	189.160	362.230	322.030	154.980	26.420	29.170	1216.480
1992	I	17.390	13.420	9.640	29.400	61.840	107.190	204.830	394.450	182.580	103.130			
1993	I					57.580	243.350	416.710	504.840	394.970	236.820	85.340		
1994	I	19.380	11.230	10.330	10.510	36.920	101.610	293.270	480.360	480.360	201.080	35.150	18.700	1698.900
1995	I	7.390	5.920	10.320	15.760	24.210	84.420	20.350	342.360	427.260			47.240	
1996	I	28.990	24.960	13.220	9.487	63.380	191.480	313.430	444.600	424.400	240.970	42.000	22.060	1818.977
1997	I	13.230	7.530	5.670	16.600	41.850	153.100	226.100	422.040	303.850	228.560	208.200	49.770	1676.500
1998	I	13.830	5.490	10.060	5.800	25.700	122.530	279.200	446.450	416.300	343.670	93.290	18.550	1780.870
1999	I	9.820	3.230	0.920	2.530	105.320	197.320	258.570	311.970	248.600	391.150	62.080	18.460	1609.970
2000	I	9.856	2.754	1.231	5.630	38.898	153.174	329.221	365.737	389.912	317.380	119.462	29.664	1762.919

* I. MONTHLY RUNOFF IN MILLION M³

SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION:- GEBA R. NR. SUPI
 BASIN:-BARO-AKOBO
 DRAINAGE AREA, Km²:-3894

STATION No.:-BA1003
 Co-Ordinate:-8d29'n 35d39'e

MEAN ELEVATION, m.a.s.l.:

YEAR	*	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1976	I			22.330	59.850	204.380		506.300	381.110	89.760	71.650		30.030	
1977	I	22.730		20.830										
1978	I													
1979	I		84.200	25.310	670.790	38.840	89.540	249.060	349.630	340.510	165.540	44.370	26.550	
1980	I			14.620	34.380	70.410	153.960	352.450	472.500					
1981	I				10.940	26.750	70.200	149.400	365.950	388.640	260.330	19.040	26.090	
1982	I	27.270												
1983	I			15.560	11.980	18.940	42.850							
1984	I													
1985	I													
1986	I	19.150	12.960	15.870	20.080	20.100	72.890	214.530	257.210	424.600	201.610	39.660	23.290	1321.950
1987	I	14.830	10.810	16.230	21.340	39.810	107.280	348.440	452.210	458.160				
1988	I	31.330	24.630			2.680								
1989	I	25.950	18.770	18.890	26.230	28.680	74.900	193.240	481.950	529.910		62.830	49.900	
1990	I	17.890	14.490	23.020	22.500	27.270	102.060	213.690	506.340	680.140	476.090	72.560	28.980	2185.030
1991	I	21.830	12.990	16.170	18.210	45.660								
1992	I													
1993	I					62.710						80.880	33.550	
1994	I	23.400	12.700	10.790	12.640									
1995	I	13.560	8.200	7.840	8.350	22.340	76.920	164.330	430.340	696.470				
1996	I				29.470	54.510	130.110	257.530	575.090	384.290	150.600	46.910	33.260	
1997	I		13.940	17.840	29.380	55.670	200.400	319.090	499.400	386.670	239.960	348.100	123.250	
1998	I	35.400	16.630	26.200	19.040	45.350		420.970	483.710	436.670	418.010	99.780	41.850	
1999	I	39.740	23.736	20.051	20.666	125.862	175.064	264.503	463.458	404.813	669.676	99.310	67.390	2374.271
2000	I	22.245	11.549	9.407	15.861	44.297	89.596	242.096	330.459	530.244	338.990	61.378	37.082	1733.206
2001	I	20.155	14.160	-	-	65.070	-	-	-	-	-	148.288	-	
2002	I	10.763	7.557	8.949	15.539	11.434	59.208	238.737	420.154	504.734	137.290	35.655	22.503	
2003	I	12.746	7.557	14.143	13.333	-	44.575	239.904	-	-	164.214	29.739	17.976	
2004	I	11.194	10.315	7.653	7.496	13.235	-	-	-	-	-	-	-	

* I. MONTHLY RUNOFF IN MILLION M³

SUMMARY OF HYDROMETRIC DISCHARGE DATA

STATION NAME: Baro Gambella BASIN Baro DRAINAGE AREA 23461 Sq.KM. Stn. No. 102001

YEAR		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL		
1976	I	229.219	148.948	196.816	145.236	466.974	1167.034	1618.815	2270.915	2312.153	1295.516	949.156				
1977	I	217.134	125.985	119.892	91.010	166.928	791.756	1537.501	2145.069	3133.466	2240.150	1012.445	405.505	11986.841		
1978	I	302.131	135.504	107.785	191.205	688.754	1159.790	2030.892	2527.940	2515.442	2526.565	872.170	570.548	13628.726		
1979	I	417.228	227.344	143.867	142.873	377.125	854.024	1822.822	2088.839	2135.015	1469.959	573.583	519.793	10772.472		
1980	I	186.539	130.825	115.819	214.134	686.999	1181.217	2119.103	2711.042	2234.556	1556.087	578.543	311.370	12026.234		
1981	I	197.179	110.367	135.994	82.143	345.443	776.102	1415.178	2213.138	2808.953	1705.394	530.064	326.342	10646.297		
1982	I	214.409	125.484	143.064	104.600	210.625	814.734	1525.409	2177.764	2238.132	1994.490	656.368	245.845	10450.924		
1983	I	149.208	103.821	106.052	103.785	269.890	608.405	1650.202	2136.352	2793.951	2210.409	885.314	307.159	11324.548		
1984	I	182.906	104.399	103.355	92.235	280.250	965.749	2191.681	2333.344	2542.373	1009.701	430.522	374.794	10611.309		
1985	I												293.991			
1986	I															
1987	I															
1988	I															
1989	I															
1990	I	300.649	216.114		128.064	248.658	1101.145	1739.588	3204.937	3381.282	2236.921	788.379				
1991	I	213.149	110.348	136.053	265.224	561.846			2747.076				350.063			
1992	I	179.092	142.602	118.891	195.525	509.096	941.088	1821.682	2464.954	3134.787	2900.256	1164.547				
1993	I	303.351	239.706				1737.18						547.21			
1994	I	279.615	153.779	115.744	150.602	540.572	1127.437	2029.011	2519.636	2742.779	1132.01	574.886	426.476	11792.547		
1995	I	186.328	109.599	120.293	140.989	320.146	720.613	1278.298	2113.144	2760.786	1721.934	621.989	364.963	10459.082		
1996	I	298.598	165.35	206.825	197.098	765.804	1589.786	2459.219		2740.547	1990.884	703.849	415.4			
1997	I	283.689	153.162	175.735	327.647	648.491	1427.028	1835.071	2747.843	2291.25	1922.722	1784.551	421.44	14018.629		
1998	I	342.294	155.632	208.616	144.907	447.006	1273.088	2183.817		2847.303	2955.279	1210.106	618.539			
1999	I	299.283	155.841	106.014	138.105	945.471	1727.634	2013.655	2718.856	2397.519		1041.624	452.33			
2000	I	285.99	152.432	105.18	183.847	590.972	1350.334	2157.441	2356.592	2488.471	2634.909	1201.129	456.746	13964.043		

* I. MONTHLY RUNOFF IN MILLION M³

* I - MONTHLY RUNOFF IN MILLION m³

II - MAXIMUM DISCHARGE IN m³/s

III - MINIMUM DISCHARGE IN m³/s

MP = MOMENTARY PEAK IN m³/Sec

MMD = MAX. MEAN DAILY PEAK IN m³/Sec

SEDIMENTATION

Draft

Ministry of Water Resources

Hydro-Sedimentological Data Base of Project "Monitoring and Assessment of Erosion and Sedimentation in Ethiopia"

Daily Observation

Station number	0-101007
River basin	Baro-Akobo
Station name	Gore
River	Gumero
Catchment area (km ²)	100
Transformation equation	$g=20.52(h-0.25)^{2.5}$

GUIDE:

1. Save the file under the new name (name of site) into the folder with the name of the river basin
2. Clear the old data with:mark, Edit, Clear, Contents Del
2. Fill the data of the HSD (Ato Wondimu) in the fields with the following color:
3. Add an empty row between measurements of non following days

4. Copy the automatically computed values for Water discharge and sediment load in the columns O and P

(File name: input1)

Year	Month	Day	G.H. h (m)	Flow Q (m ³ /s)	Daily discharge m ³ /d	Sediment concentration g/t mg/kg ppm	Sediment concentration g/m ³ mg/l	Daily sediment load t/d	Sediment loss kg/km ² day
1988	3	17	0.37	0.123	10,627	105.45	100.1775	1.12	11.20
1988	9	22	0.77	5.440	470,016	46.81	44.4695	22.03	220.30
1988	9	23	0.86	14.810	1,279,584	43.76	41.572	55.99	559.90
1988	9	24	0.85	12.630	1,091,232	34.35	32.6325	39.52	395.20
1988	9	25	0.9	18.940	1,636,416	51.05	48.4975	83.54	835.40
1988	10	2	0.8	8.030	693,792	10.42	9.899	7.23	72.30
1988	10	3	0.78	8.600	743,040	33.34	31.673	24.77	247.70
1989	3	16	0.49	0.700	60,480	162.35	154.2325	9.82	98.20
1989	3	23	0.29	0.380	32,832	51.08	48.526	1.68	16.80
1989	6	6	0.79	1.480	127,872	53.63	50.9485	6.86	68.60
1989	6	26	0.68	5.310	458,784	78.68	74.746	36.10	361.00
1989	11	17	0.47	0.710	61,344	144.9967	137.746865	7.87	78.70
1989	11	20	0.46	0.860	74,304	100.6367	95.604865	7.47	74.72
1990	7	1	0.69	3.630	313,632	66.043	62.74085	20.71	207.10
1996	8	27	0.69	4.840	418,176	95.333	90.56635	37.87	378.73

DAMS and RESERVOIRS

Draft

Dams for irrigation purpose

DAM NAME	ITANG LARE	DUMBONG	CHIRU	GAMBELLA	GILO-2	GILO-1
Catchment Area	24420km ²	1100KM ²	733KM ²	22740KM ²	9640KM ²	7570KM ²
Mean Annual Flow	390m ³ /s	7.8M ³ /S	5.5M ³ /S	372M ³ /S	92.3M ³ /S	74.1M ³ /S
Dam type	Earth fill	Rollcrete	Earthfill	Rockfill	Earth fill	Rockfill
Dam Height	11m	48m	37m	50m	36m	107m
Crest Level	El.436	El.518	El.517	El.490	El.478	El.612
Normal Max Operating Level	El.431.6	El.513.5	El.512	El.485	El.472	El.606.6
Normal Min. Operatinh Level	El.428.5	El.506	El.504	El.482	El.460	El.578.6
Active Storage;	157.9mcm	93.3mcm	132.5mcm	214mcm	1427.6mcm	2341mcm
Dead Storage;	88.6mcm	66.2mcm	115.1mcm	1239mcm	564.1mcm	874mcm
Reservoir Surface Area;	71km ²	13.9km ²	21.8km ²	74.5km ²	150.7km ²	116.8km ²
Spillway Design Flood;	1397m ³ /s	600m ³ /s	100m ³ /s	1740m ³ /s	665m ³ /s	1065m ³ /s
Gates	Ungated	Ungated	Ungate	Ungated	Ungated	3-7m*6high
Max.Flood Level;	El.434	El.515.5	El.514	El.487	El.475	EL.609
Irrigation Outlet Capacity;	100m ³ /smax each bank	20m ³ /S	18m ³ /s	200m ³ /s	90m ³ /s(2045m ³ /s intake)	200m ³ /s
Gates	8 5m*5m high	2-5M*2.5Mhigh	2-5*m2.5mhigh	8-5m*5m high	8-5m*2.5m high	2-1M*3.5high
Access Road to Dam	30km long improvement	20km long road improved			New 11km long road	

Dams for Hydropower purpose

DAM NAME	BARO	Geba-A	Birbir-A	Gumero	Birbir-R	Sor	GILO-1	Tams	Gaba-R
Catchment Area	1620 km ²	1086km ²	3579km ²	443km ²	6840KM ²	1770km ²	7570KM ²	20970km ²	6220km ²
Mean Annual Flow	49.9m ³ /s	35.9m ³ /s	57.9m ³ /s	8.7m ³ /s	105.9m ³ /s	53.7m ³ /s	74.1M ³ /S	329m ³ /s	143.1m ³ /s
Dam type	Earthfill	Earthfill	Earthfill	Rockfill	Rockfill	Earthfill	Rockfill	Rockfill	Rockfill
Dam Height	45m	45m	56m	33M	190m	66m	107m	270m	240m
Crest Level	El.1725	El.2175	El.1436	El.1613	El.1163	El.1544	El.612	El.765	El.1120
Normal Max Operating Level	El.1720	El.2170	El.1430	El.1608.5	El.1158	El.1539	El.606.6	EL.760	El.1115
Normal Min. Operatinh Level	El.1710	El.2160	El.1410	El.1600	El.1056	El.1513	El.578.6	El.705	El.1083
Active Storage;	483mcm	550mcm	827mcm	160mcm	2490mcm	184mcm	2341mcm	4807mcm	1365mcm
Dead Storage;	117mcm	315mcm	273mcm	140mcm	180mcm	59mcm	874mcm	5543mcm	2535mcm
Reservoir Surface Area;	78.5km ²	65.8km ²	65.7km ²	30.9km ²	57.5km ²	13.6km ²	116.8km ²	105km ²	53.1km ²
Spillway Design Flood;	460M ³ /s	270m ³ /s	340m ² /s	60m ³ /s	726m ³ /s	672m ³ /s	1065m ³ /s	1365m ³ /s	920m ³ /s
Gates	Ungated	Ungated	Ungate	Ungate	3-6m*4mhigh	3-6m*5.5mhigh	3-7m*6high	3-6.75m*8high	3-8*6m high
Max.Flood Level;	El.1722	El.2172	El.1433	El.1610	El.1160	El.1541	EL.609	El.762	El.1117
Irrigation Outlet Capacity;	55.2m ³ /s	48.3m ³ /s	89m ³ /s	12.8m ³ /s	360m ³ /s	200m ³ /s	200m ³ /s	1200m ³ /S	400m ³ /s
Gates	1-2m*2m	1-2m*2m	1-2m*2	1-.8m*.8m	2-1.83m*3.66m high	2-1.8m*2.8high	2-1M*3.5high	4-1.83m*3.66high	2-1.5m*3.5mhigh

HYDROPOWER

Draft

Project Name	Installed Capacity	Constraction Cost (US\$/KM)
Baro-Akobo Basin Projects		
Baro-A 1&2	210	1295
Gebe-A 1&2	171	1351
Birbrr A&R	455	1810
Birbrr -R(1121)	360	2112
TAMS	1060	2831
Other basin in Ethiopia		
Gilgel Grbe	180	1534
Aleltu East 1	186	2053
Aleltu west	165	2856
Halele-Warebesa	332	2400
Chemoge-yeda I&II	580	1810
	With Diesel Plant	
Kashu	60	0.4
Gumero	50	0.049
Baro-1	40	0.05
Desel Plant	50	0.065

**CROP WATER REQUIREMENT &
CROPPING PATTERN**

Draft

Typical cropping pattern	jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Annul
Rain (1)-mm/month	0	0	8	25	100	118	145	166	110	55	15	0	932
Field Water Requirements-mm													
WET SEASON													
Cottn 25%					25	42.5	87.5	45	12.5				212.5
Maize 40%					40	100	128	40	12				320
Sorghum 19%					17.1	49.4	19	13.3					98.8
Soy Bean 10%					5	15	20	15	8	2			65
Vegetables 1%					0.4	0.6	1.5	0.8					3.3
Green Manure 5%					5	8.5	11	7					31.5
Sup Total 100%	0	0	0	0	92.5	216	267	121	32.5	2	0	0	731.1
DRY SEASON													
Cottn 15%	29.7	8.3								16.5	28	57.8	140.3
Maize 15%	46.2	19.8	8.3								16.5	41.3	132.1
Sorghum 10%	7.7									9.9	22	17.6	57.2
Groundnuts 15%	24.8	18.2	13.2								6.6	23.1	85.9
Vegetables 1%	0.7	0.6								0.4	0.7	1.2	3.6
Soy Bean 10%	16.5	8.8	2.2							5.5	16.5	22	71.5
Sup Total 66%	125.6	55.7	23.7	0	0	0	0	0	0	32.3	90.3	163	490.6
Total													
Crop Intensity 166%													
Field Water Requirements-mm	125.6	55.7	23.7	0	92.5	216	267	121	32.5	34.3	90.3	163	1221.7
Net Irrgation Requirements(2)-mm	125.6	55.7	15.7	0	0	98	122	0	0	0	75.3	163	655.3
Net Irrgation Requirementsm ³ /ha	1256.0	557	157	0	0	980	1220	0	0	0	753	1630	6553
Gross Irrgation Requirementsm ³ /s	2512.0	1114	314	0	0	1960	2440	0	0	0	1506	3260	13106
Gross Irrgation Requirements-l/s/ha	0.94	0.46	0.12	0	0	0.76	0.91	0	0	0	0.58	1.22	