THE REPUBLIC OF KENYA

LAKE BASIN DEVELOPMENT AUTHORITY

FEASIBILITY STUDY ON KANO PLAIN IRRIGATION PROJECT

VOLUME II - 1

ANNEXES

JANUARY 1992

Japan International Cooperation Agency

THE REPUBLIC OF KENYA FEASIBILITY STUDY ON KANO PLAIN IRRIGATION PROJECT VOLUME II - 1 ANNEXES JANUARY

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FEASIBILITY STUDY
ON
KANO PLAIN IRRIGATION PROJECT

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Abbreviations

AFC ..... Agricultural Finance Corporation
AIRS ..... Ahero Irrigation Research Station
CBS ..... Central Bureau of Statistics
CLSMB ..... Cotton Lint and Seed Marketing Board
DAO ..... District Agricultural Officer
DC ..... District Commissioner
DDC ..... District Development Committee
DO ..... District Officer
FAO ..... Food and Agriculture Organization of the United Nations
GDP ..... Gross Domestic Production
GNP ..... Gross National Production
GOK ..... Government of Kenya
GRDP ..... Gross Regional Domestic Product
HCDA ..... Horticultural Crops Development Authority
IBRD ..... International Bank for Reconstruction and Development, World Bank
IDA ..... International Development Association
IFAD ..... International Fund for Agricultural Development
ILUS ..... Integrated Land Use Survey
JICA ..... Japan International Cooperation Agency
KGGCU ..... Kenya Grain Growers Cooperative Union
K£ ..... Kenya Pounds (20 Kenya Shillings)
KPLC ..... Kenya Power and Lighting Company Limited
KR ..... Kenya Railway Corporation
KSC ..... Kenya Seed Company
Ks ..... Kenya Shillings
KSS ..... Kenya Soil Survey
LBDA ..... Lake Basin Development Authority
NCPB ..... National Cereals and Produce Board
NGO ..... Non-governmental Organization
NIB ..... National Irrigation Board
OECF ..... Overseas Economic Cooperation Fund
PIU ..... Provincial Irrigation Unit
RWSSP ..... Rural Water Supply and Sanitation Project
SSIU ..... Small-Scale Irrigation Unit, Ministry of Agriculture
T&V ..... Training and Visit
UNDP ..... United Nations Development Programme
UNESCO ..... United Nations Educational, Scientific, and Cultural Organization
UNICEF ..... United Nations International Children's Emergency Fund
VAT ..... Value Added Tax

Abbreviations of Measurement

Length

cm = Centimeter
m = Meter
km = Kilometer
ft = Foot
yd = Yard

Area

cm^2 = sq.cm = Square centimeter
m^2 = sq.m = Square meter
ha = Hectare
km^2 = sq.km = Square kilometer

Volume

cm^3 = cu.cm = Cubic centimeter
l = lit = liter
kl = Kiloliter
m^3 = cu.m = Cubic meter
gal. = Gallon
MCM = Million Cubic Meters

Weight

mg = Milligram
g = Gram
kg = Kilogram
ton = Metric ton
lb = Pound

Time

sec = s = Second
min = Minute
hr = Hour
d = Day
yr = Year

Electrical Measures

V = Volt
A = Ampere
Hz = Hertz (cycle)
W = Watt
kW = Kilowatt
MW = Megawatt
GW = Gigawatt

Other Measures

% = Percent
PS = Horsepower
° = Degree
' = Minute
" = Second
°C = Degree centigrade
10^3 = Thousand
10^6 = Million
10^9 = Billion (milliard)

Derived Measures

m^3/s = m^3/sec = Cubic meter per second
cusec = Cubic feet per second
mgd = Million gallon per day
kWh = Kilowatt hour
MWh = Megawatt hour
GWh = Gigawatt hour
kWh/yr = Kilowatt hour per year
kVA = Kilovolt ampere
BTU = British thermal unit

Money

Ks. = Kenya shilling
K£ = Kenya pounds (20 Kenya shillings)
US$ = US dollar
Yen = Japanese Yen

Conversion Factors

	From Metric System			To Metric System		
Length	1 cm	=	0.394 inch	1 inch	=	2.54 cm
	1 m	=	3.28 ft = 1.094 yd	1 ft	=	30.48 cm
	1 km	=	0.621 mile	1 yd	=	91.44 cm
				1 mile	=	1.609 km
Area	1 cm^2	=	0.155 sq.in	1 sq.ft	=	0.0929 m^2
	1 m^2	=	10.76 sq.ft.	1 sq.yd	=	0.835 m^2
	1 ha	=	2.471 acres	1 acre	=	0.4047 ha
	1 km^2	=	0.386 sq.mile	1 sq.mile	=	2.59 km^2
Volume	1 cm^3	=	0.0610 cu.in	1 cu.ft	=	28.32 lit
	1 lit	=	0.220 gal. (imp.)	1 cu.yd	=	0.765 m^3
	1 kl	=	6.29 barrels	1 gal. (imp.)	=	4.55 lit
	1 m^3	=	35.3 cu.ft	1 gal. (US)	=	3.79 lit
	10^6 m^3	=	811 acre-ft	1 acre-ft	=	1,233.5 m^3
Energy	1 kWh	=	3,413 BTU	1 BTU	=	0.293 Wh
Temperature	°C	=	(°F-32) 5/9	°F	=	1.8°C + 32
Derived Measures						
	1 m^3/s	=	35.3 cusec	1 cusec	=	0.0283 m^3/s
	1 kg/cm^2	=	14.2 psi	1 psi	=	0.703 kg/cm^2
	1 ton/ha	=	891 lb/acre	1 lb/acre	=	1.12 kg/ha
	10^6 m^3	=	810.7 acre-ft	1 acre-ft	=	1,233.5 m^3
	1 m^3/s	=	19.0 mgd	1 mgd	=	0.0526 m^3/s

Annex I

Meteorology and Hydrology

Feasibility Study
on
Kano Plain Irrigation Project

Annex-I
Meteorology and Hydrology

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1. INTRODUCTION

This supporting report (ANNEX-I) mainly deals with meteorology and hydrology in the study area. The main objectives of the study is to grasp the general meteoro-hydrological condition prevailing over the study area and supply basic data for the project formulation.

The field works concerned were commenced in the middle of August, 1990 and lasted for two and half (2,5) months until the end of October, 1990. After the field works were ended,all the data collected through the field works were analyzed in the home office work in Japan,and this report was compiled in December, 1990.

It is noteworthy that,in addition to the general hydrological study,the flood damages and river channel erosion were investigated through interview to the inhabitants thereabout.

2. CLIMATE

2.1 Climate Over the Study Area

General aspects of climatic conditions over the study area are studied using existing climatological statistics of four full meteorological stations located at Ahero, Chemelil, Kibos and West Kano. Climatic conditions of the study area are as follows (refer to Table I-1 and Fig. I-1):

(1) Mean maximum temperature

Mean maximum temperature ranges from about 27°C to about 32°C. The trough of the mean maximum temperature takes place between June and July.

(2) Mean minimum temperature

Mean minimum temperature ranges from about 14°C to about 18°C. The trough of the mean minimum temperature takes place between August and September.

(3) Relative humidity

Relative humidity (0900 East African Standard Time) ranges from 55% to 75%. The peak of the relative humidity are observed during May and July.

(4) Rainfall

Average annual rainfall at Nyakwere (9034067) located in the southern part of the study area is estimated at about 1,100 mm. Taking into account the above, average annual rainfall ranges from about 1,100 mm to about 1,600 mm in the study area. Areal distribution of the annual rainfall seems to have a tendency of decrease from north to south and increase from west to east. During the long rains season (March to May), the maximum monthly rainfall is recorded in April at Ahero, Chemelil and Kibos and in March at West Kano. As for the short rains season (October to December), a characteristic common to all study area is hard to find.

(5) Sunshine

Daily sunshine hours ranges from about seven hours to about nine hours. The maximum sunshine hours is observed in January and the minimum in June and July.

(6) Radiation

Daily radiation ranges from about 480 langlays to about 630 langlays (cal/cm^2). The maximum radiation takes place in February and March and the minimum in June and July. These figures have been obtained from Gunn Bellani radiation integrators.

(7) Evaporation

Average annual evaporation ranges from about 1,900 mm at Chemelil to about 2,200 mm at Ahero. On the other hand, monthly evaporation ranges from about 130 mm (4 mm/day) to about 220 mm

(7 mm/day). The maximum monthly evaporation is recorded in March and the minimum in June and July. Figures have been obtained from the A-Pans.

(8) Daily wind run

Daily wind run ranges from about 60 miles to about 120 miles. The maximum daily wind run is observed during January and March and the minimum during June and July.

2.2 Monthly Meteorological Data

Monthly meteorological data such as temperature, relative humidity, rainfall, sunshine hours, radiation, evaporation and wind velocity are tabulated on the above four stations (refer to Table I-2 to Table I-32).

3. RAINFALL

3.1 Basin Rainfall

In the first place, 31 rain gauges over the relevant river basins are chosen from the viewpoints of their data availability and location (refer to Table I-33 and Fig. I-2). Basin rainfall is, then, studied by the isohyetal method using mean annual rainfall of the above 31 stations (refer to Tables I-34 & I-35 and Fig. I-3).

3.2 Storm Rainfall

Rainfall intensity-duration-frequency curves from Kisumu and Kobujoi (upper reach of the Little Oroba river) are collected as the basic data for flood and drainage calculations with small basins (refer to Fig.'s I-4 & I-5).

4. RIVERS FLOW

4.1 Flow Records

Daily flow records are collected from 11 water gauging stations where data is available (refer to Tables I-36, I-37 & I-38 and Fig. I-2). As for the station 1GD04, which is located at just downstream of the proposed Nyando intake site, the flow records are summarized on a 10-day basis (refer to Table I-39). Flow records of the other stations are summarized on a monthly basis (refer to Table I-40 to Table I-49).

4.2 Consistency of Flow Records

River basin runoff coefficients at 1GB03, 1GB08, 1GD02 and 1GD04 are estimated at 9-13% with the catchment areas of 837-2,520 km^2. On the other hand, the coefficients at 1HA01, 1HA04 and 1HA14 are calculated as 19-27% with the catchment areas of 62-117 km^2 (refer to Table I-51). Considering the differences of catchment area sizes, these figures are acceptable.

Double mass curve of annual discharges between 1GD04 and 1HA04 is also studied in order to verify the consistency of flow records at 1GD04 (refer to Fig. I-6). Linear shape of the curve makes it sure that the flow records at 1GD04 are consistent.

5. WATER ABSTRACTION PERMITS

5.1 Water Law and Permits

The relevant legislation is contained in the Water Act (Chapter 372 of the Laws of Kenya). A permit is required if the abstraction is by mechanical means or by diversion. Removing water by a container for domestic or livestock use does not require a permit. The Water Apportionment Board is authorized to issue, amend, refuse and revoke permits.

5.2 Water Abstraction Permits

Major water abstraction permit of lower Nyando flow is permit No. 10675 whose holder is National Irrigation Board. Use of this permit is domestic and irrigation for Ahero Irrigation Scheme. The quantities of

water authorized to be abstracted are about 46.5 m^3/day when the river is flowing normally and about 134,562 m^3/day (1.56 m^3/sec) when the river is under floods (refer to Table I-52).

6. WATER RESOURCES AT 1GD04

6.1 Drought Discharge

Drought discharges of the Nyando river at 1GD04 are estimated with return periods of 2-year, 5-year and 10-year by the Weibull plotting of annual mean flows (refer to Fig. I-7). Typical drought monthly discharges are, then, estimated based on the observed mean monthly discharge pattern in accord with the above probable discharges (refer to Table I-53).

6.2 Available Water Resources

Available water resources of the Nyando river at 1GD04 can be assessed by subtracting the consumptive use demand on the river from the drought discharges above mentioned. The consumptive use demand on the Nyando river, which shall be considered in this study, consists of aforementioned water abstraction permit No. 10675 (for Ahero Irrigation Scheme) and domestic and public water supply in the future.

7. FLOODS

7.1 Recorded Floods and Frequency Analyses

Annual flood records are collected from 11 gauging stations (refer to Tables I-54 & I-55). Frequency analyses are carried out by the Weibull plotting of the above collected records on the extreme probability paper (refer to Fig. I-8). The results of frequency analyses are as follows:

Table I-56 Flood Frequency

(unit: m^3/sec)

Station	Catchment Area (km^2)	No. of Data	Return Period		
			25-Year	50-Year	100-Year
1GD01	2,598	15	610	-	-
1GD03	2,625	20	440	510	570
1GD04	2,520	31	390	490	610
1GB03	837	14	230	-	-
1HA01	62	56	12	-	-
1HA02	10	38	1.2	-	-
1HA04	117	49	50	-	-
1HA14	104	23	49	-	-

It is important to keep in mind that the some flood records are affected by overflows on the upstream and are observed by staff readings once or twice a day.

7.2 Flood Conditions and Damages

7.2.1 Flood conditions and damages survey

Present flood conditions and damages survey is carried out by the study team in order to verify the flood-prone areas, flood depth distribution, flood periods and the extent of damages, etc. In the survey, hearings from inhabitants using questionnaire are adopted as measures on selected sites in the study area. Hearing surveys are conducted at 30 sites in total (refer to Fig. I-9).

7.2.2 Flood conditions and damages in the study area

Flood-prone areas cover the study area excluding the sugarcane belt and the higher ground portions (refer to Fig. I-9).

Major flood periods are roughly recognized as March to June and August. Flood occurs annually from March to June, while in August it occurs occasionally (refer to Table I-57).

Maximum flood depth ranges from one feet to six feet showing general depth as two feet or three feet. These maximum flood depths occur in April in general (refer to Table I-57).

Almost all kinds of cash and food crops are damaged severely by the floods. On the other hand, livestocks are affected by foot and mouth diseases, foot rot and rinderpest, etc. Residents in the flood-prone areas also suffer from diseases such as malaria, bilharzia, typhoid and scurvy, etc. In addition to the above, a great number of residents and cattles are forced to shift their living places and pastures to higher grounds during the flood periods every year. Private and public properties such as houses, furnitures, schools and churches are also damaged by the floods. In some flood-prone areas, houses are built every year after flood period (refer to Table I-58).

7.3 Basic Approach to Flood Control and Protection Measures

The Kano Plains shall be an area of highly profitable farming and other viable economic activities after the solution of the perennial flooding problems.

The rivers in the study area originate from the Kericho highlands to the east and the Nandi Hills to the north, which lie between 5,000 feet and 8,000 feet above sea level. When it rains heavily in the highlands, the rivers get fast-flowing water through the precipitous descent before its speed is checked suddenly on the flat plains. This is the main cause of flooding. Another cause is that, when it rains on the plains, the clayey black soils can soak up a certain amount of water and the rest stays above ground to become floods.

In these situations, a series of small dams on the tributaries of each river system would be better measures to control the flow of flood into the main river before it reaches the Kano Plains.

8. SEDIMENT LOADS

8.1 Sediment Loads

Existing sediment loads data are collected from 22 stations (refer to Table I-59). Particle size distributions are also collected from two stations (refer to Tables I-60 & I-61). These sediment loads data are summarized in sediment rating curves (refer to Fig. I-10 to Fig. I-12). Mean annual sediment loads are estimated as follows:

Table I-62 Mean Annual Sediment Loads

Station	Catchment Area (km^2)	10^3 ton/year*	10^3 m^3/year	m^3/km^2/year
1GB03**	837	43-170	33-130	40-160
1GD04**	2,520	151-658	116-506	50-200
1HA01	62	6	5	75
1HA04	117	22	17	150
1HA14	104	15	12	110

Note: *. Including 30 percent correction for bedload.
**. Lower figures are computed using rating curve of 1GD03 and higher figures of 1GD01.

8.2 River Channel Erosion

River channel erosion survey is carried out in relation to project intake structures and sediment loads study. The field checks are made by the study team at selected portions of river systems in and around the study area.

Severe erosion is observed within the transition zone from highlands to plains. This might be explicable from the viewpoints of topography and soil properties, etc. The types of soil erosion present in the study area are gullies, rills, sheet erosion and river channel erosion.

Road construction including bridge and culvert works without necessary drainage works are also another cause of erosion in the study area. Gabions are used as the protection for river banks erosion around some bridge abutments.

9. WATER QUALITY

9.1 Results of Water Quality Analyses

Four water samples from the Nyando and Sondu/Miriu rivers are analyzed in order to testify their suitability as irrigation water (refer to Table I-63). Table I-64 summarized some of the important and relevant acceptable level of various physico-chemical parameters in Kenya (Kenya Guidelines for Water Quality). The results of the four water samples when compared with those acceptable levels are found to be good and suitable for irrigation.

9.2 Existing Water Quality Data

Existing data of water quality along the Nyando and Sondu/Miriu rivers are collected in order to form a basic idea of water quality situation in the both rivers (refer to Tables I-65 & I-66). The water quality of the both rivers as per the data shows good values well within the required standards for irrigation.

10. LAKE VICTORIA

10.1 Lake Victoria Levels 1899 - 1985

Fluctuations in the level of Lake Victoria are shown in Fig. I-13 for the period 1899 - 1985. The level of Lake Victoria has risen after extremely heavy rainfall during the early Sixties and has not receded yet.

10.2 Water Quality

Existing water quality data are collected from 25 stations in Winam Gulf, Lake Victoria (refer to Tables I-67 & I-68). Maximum values of pH for nine stations are above the acceptable upper levels (pH 9.0) for irrigation in the guidelines.

Tables

Table I-1 Climatological Data (1 of 2)

Parameter	TEMPERATURE(°C)							
	MEAN MAX.				MEAN MIN.			
Station	Ahero	Chemelil	Kibos	West Kano	Ahero	Chemelil	Kibos	West Kano
Jan.	31.3	31.0	30.6	29.4	14.2	13.8	14.9	15.9
Feb.	31.4	31.5	30.9	29.4	14.6	14.2	14.7	16.3
Mar.	31.3	31.4	30.6	29.6	15.5	14.8	14.6	16.9
Apr.	29.4	29.2	29.4	28.1	15.9	15.5	15.2	17.5
May	29.0	28.1	28.5	27.7	15.9	15.2	14.9	17.0
Jun.	28.7	28.0	27.8	27.3	14.8	14.6	14.4	16.2
Jul.	28.7	27.9	28.0	27.3	14.5	14.1	14.0	15.6
Aug.	29.2	28.5	28.7	28.5	14.3	14.0	13.8	15.6
Sep.	30.4	29.4	29.1	29.6	14.1	13.5	13.8	15.3
Oct.	31.0	30.5	30.3	30.4	14.7	13.8	15.2	16.5
Nov.	30.3	29.9	29.8	28.7	14.8	14.3	15.1	16.5
Dec.	30.3	30.6	29.8	29.1	14.4	14.0	14.8	16.3
Year	30.1	29.7	29.5	28.8	14.8	14.3	14.6	16.3

Parameter	RELATIVE HUMIDITY (%)				RAINFALL (mm)			
Station	Ahero	Chemelil	Kibos	West Kano	Ahero	Chemelil	Kibos	West Kano
Jan.	63	59	63	62	84	87	87	105
Feb.	66	60	65	66	97	104	118	129
Mar.	68	62	66	66	140	125	170	179
Apr.	72	71	72	72	192	219	243	155
May	74	70	74	74	126	174	180	125
Jun.	73	73	75	73	77	120	100	99
Jul.	73	75	75	72	77	113	89	85
Aug.	70	72	72	70	75	96	125	66
Sep.	64	66	68	60	72	109	137	78
Oct.	62	63	63	55	76	95	97	75
Nov.	64	62	65	64	101	123	146	88
Dec.	65	61	68	64	87	117	103	130
Year	68	66	69	67	1,204	1,482	1,595	1,314

Source: Climatological Statistics for Kenya, Kenya Meteorological Department, 1984.
Note: Station codes and names are as follows:

Code	Name
9034086	Ahero Kano Irrigation Scheme
9035274	Chemelil Sugar Company Limited
9034105	Kibos Sugar Research
9034133	West Kano Irrigation Scheme

Table I-1 Climatological Data (2 of 2)

Parameter	DAILY SUNSHINE (hours)				DAILY RADIATION (langleys)			
Station	Ahero	Chemelil	Kibos	West Kano	Ahero	Chemelil	Kibos	WestKano
Jan.	8.4	8.8	-	8.5	620	589	605	-
Feb.	8.1	8.5	-	8.2	620	580	616	-
Mar.	8.1	8.6	-	7.9	625	594	612	-
Apr.	7.2	7.5	-	7.4	588	534	572	-
May	7.1	7.3	-	7.6	582	499	548	-
Jun.	6.7	7.3	-	7.2	552	493	502	-
Jul.	6.8	7.0	-	7.4	533	480	527	-
Aug.	6.8	7.1	-	7.6	544	498	536	-
Sep.	7.1	7.5	-	7.9	582	530	569	-
Oct.	7.4	7.8	-	8.1	599	544	600	-
Nov.	7.1	7.2	-	7.2	581	528	568	-
Dec.	8.2	8.5	-	8.2	607	566	579	-
Year	7.4	7.8	-	7.8	586	536	569	-

Parameter	EVAPORATION (mm)				DAILY WIND RUN (miles)			
Station	Ahero	Chemelil	Kibos	West Kano	Ahero	Chemelil	Kibos	West Kano
Jan.	210	188	201	182	87.2	80.5	97.5	107.9
Feb.	203	179	199	173	91.0	84.0	92.8	113.3
Mar.	221	190	206	185	87.6	80.9	87.9	116.4
Apr.	182	150	170	155	76.4	70.4	75.1	92.7
May	163	136	170	147	65.5	63.2	74.7	82.7
Jun.	154	129	147	143	65.9	62.0	66.5	77.7
Jul.	160	130	164	141	65.3	62.3	64.1	78.8
Aug.	170	134	169	143	73.6	66.4	67.1	87.3
Sep.	181	143	167	157	79.0	68.3	73.1	95.2
Oct.	189	159	191	152	78.8	72.0	76.2	105.2
Nov.	172	150	158	162	76.2	75.5	78.1	92.1
Dec.	189	174	182	162	81.1	76.5	84.2	99.4
Year	2,194	1,862	2,124	1,902	77.3	71.8	78.9	95.5

Source : Climatological Statistics for Kenya, Kenya Meteorological Department, 1984.
Note: Station codes and names are as follows:

Code	Name
9034086	Ahero Kano Irrigation Scheme
9035274	Chemelil Sugar Company Limited
9034105	Kibos Sugar Research
9034133	West Kano Irrigation Scheme

Table I-2 Monthly and Annual Mean Max. Temperature (in °C) at Ahero, 1970 - 88

(Unit:°C)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1970	29.3	30.3	29.8	28.9	28.5	28.7	28.7	28.8	29.8	31.3	31.1	30.6	29.7
1971	30.9	32.7	34.0	29.0	28.0	27.7	27.8	28.4	29.8	30.9	30.9	29.2	29.9
1972	31.5	29.7	32.1	30.7	28.6	28.1	29.1	30.1	30.8	30.1	28.7	29.9	30.0
1973	30.4	31.7	33.3	32.1	29.1	28.4	28.9	28.9	29.5	31.5	29.8	31.7	30.4
1974	32.1	33.8	31.6	28.4	27.9	28.4	27.2	29.2	29.5	31.6	30.9	30.7	30.1
1975	31.9	32.5	30.2	29.3	29.2	28.3	28.4	27.1	28.2	29.5	31.0	30.4	29.7
1976	31.6	31.3	32.6	29.8	28.6	28.4	28.0	29.0	30.2	32.8	30.8	30.5	30.3
1977	29.3	29.9	31.1	28.6	29.1	28.6	28.9	29.8	31.4	31.7	28.0	30.4	29.7
1978	30.8	30.9	29.4	29.1	29.1	29.1	28.9	29.0	30.1	30.4	30.0	29.3	29.7
1979	30.6	28.6	30.1	29.3	28.9	28.1	29.0	30.0	31.0	32.2	30.5	30.7	29.9
1980	31.5	32.7	32.0	30.4	29.2	28.6	28.9	30.1	30.8	31.6	30.2	30.4	30.5
1981	32.2	32.4	30.1	29.0	28.8	29.5	28.1	29.2	29.1	30.9	30.6	31.3	30.1
1982	32.1	31.3	32.3	28.7	28.6	28.7	28.9	28.8	30.4	29.6	28.3	29.3	29.8
1983	31.1	32.4	32.7	30.2	29.5	29.1	29.2	28.5	29.6	29.1	30.2	29.6	30.1
1984	29.9	31.8	32.9	29.9	29.6	28.7	28.8	29.8	30.8	30.3	29.3	29.5	30.1
1985	31.9	29.5	31.5	27.9	28.1	28.7	28.2	29.2	30.0	30.8	30.0	31.0	29.7
1986	30.7	31.2	30.0	28.5	28.6	27.5	28.4	30.0	30.3	30.4	29.8	29.0	29.5
1987	30.2	31.1	30.9	29.7	28.6	28.1	30.2	30.4	31.3	31.1	29.7	32.0	30.3
1988	29.6	31.3	30.2	29.3	28.9	29.6	28.9	28.9	29.4	30.0	30.0	30.9	29.8
Mean	30.9	31.3	31.4	29.4	28.8	28.5	28.7	29.2	30.1	30.8	30.0	30.3	30.0

Note: Meteorological Station; Ahero Irrigation Research Station, NIB.

Table I-3 (a) Monthly and Annual Mean Min. Temperature (in °C) at Ahero, 1970 - 88

(Unit:°C)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1970	12.6	12.0	12.9	13.3	13.1	12.0	11.4	11.5	11.2	11.4	11.8	11.5	12.1
1971	11.1	11.0	11.9	13.4	12.9	11.3	10.6	10.6	10.5	11.6	11.7	11.9	11.5
1972	10.8	11.2	11.9	13.1	12.9	12.2	12.2	11.1	11.4	12.5	13.0	12.3	12.1
1973	12.1	12.5	11.8	13.2	13.5	12.4	11.5	11.2	11.6	11.5	12.6	10.2	12.0
1974	10.3	10.0	12.2	13.6	13.2	11.7	11.8	11.5	11.0	11.0	11.4	11.8	11.6
1975	14.3	14.8	16.1	15.9	15.7	14.9	14.2	15.1	14.4	14.5	13.5	14.3	14.8
1976	13.2	14.0	15.1	16.2	16.6	14.5	14.5	14.1	13.5	14.4	15.2	14.6	14.7
1977	15.3	15.1	15.4	16.7	16.8	15.8	15.0	14.2	14.6	15.9	16.4	15.4	15.6
1978	14.4	15.6	16.8	16.3	15.8	15.3	15.2	15.6	14.3	15.8	15.2	16.0	15.5
1979	15.8	16.3	15.6	16.5	15.5	16.6	14.7	15.2	14.9	15.1	15.6	14.9	15.6
1980	14.7	14.5	15.2	16.3	16.7	15.5	14.5	14.9	14.9	14.7	15.4	14.7	15.2
1981	14.2	14.9	16.5	17.1	16.2	15.3	15.1	14.4	14.7	14.7	15.1	15.0	15.3
1982	15.4	15.9	15.3	17.3	17.1	15.7	15.1	15.0	15.0	15.5	16.5	15.3	15.8
1983	15.6	16.2	17.4	16.9	16.8	15.6	15.1	15.6	14.9	16.3	15.3	14.8	15.9
1984	14.1	13.9	15.3	16.8	16.1	15.6	14.8	15.6	14.7	15.1	15.7	14.6	15.2
1985	15.1	17.2	15.6	17.1	16.8	14.7	14.3	14.5	15.2	15.6	15.7	15.2	15.6
1986	14.6	15.3	15.6	17.1	16.3	15.6	14.8	14.0	14.8	15.6	15.7	16.4	15.5
1987	16.2	16.3	16.9	17.2	16.9	16.0	14.5	15.8	15.6	16.4	17.1	15.2	16.2
1988	16.4	16.4	17.0	17.5	16.8	14.5	15.7	15.4	15.6	15.1	15.4	15.1	15.9
Mean	14.0	14.4	15.0	15.9	15.6	14.5	13.9	14.0	13.8	14.4	14.6	14.2	14.5

Note: Meteorological Station; Ahero Irrigation Research Station, NIB.

Table I-3 (b) Monthly and Annual Mean Temperature (in °C) at Ahero, 1970 - 88

(Unit:°C)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1970	21.0	21.2	21.3	21.4	20.8	20.4	20.1	20.2	20.5	21.4	21.5	21.1	20.9
1971	21.1	21.9	23.0	21.2	20.5	19.5	19.2	19.6	20.2	21.2	21.3	20.6	20.8
1972	21.2	20.5	22.0	21.9	20.8	20.2	20.7	20.6	21.1	21.3	20.8	21.1	21.0
1973	21.3	22.1	22.6	22.7	21.3	20.4	20.2	20.1	20.6	21.5	21.2	21.0	21.3
1974	21.2	21.9	21.9	21.0	20.6	20.0	19.5	20.4	20.2	21.3	21.2	21.3	20.9
1975	23.1	23.7	23.2	22.6	22.5	21.6	21.3	21.1	21.3	22.0	22.3	22.4	22.3
1976	22.4	22.7	23.9	23.0	22.6	21.5	21.3	21.5	21.9	23.6	23.0	22.6	22.5
1977	22.3	22.5	23.3	22.7	23.0	22.2	21.9	22.0	23.1	23.8	22.2	22.9	22.7
1978	22.6	23.3	23.1	22.7	22.5	22.2	22.1	22.4	22.2	23.1	22.6	22.7	22.6
1979	23.2	22.5	22.9	22.9	22.2	22.4	21.9	22.6	23.0	23.7	23.1	22.8	22.8
1980	23.2	23.6	23.6	23.4	22.9	22.1	21.8	22.5	22.9	23.2	22.9	22.6	22.9
1981	23.3	23.7	23.4	23.1	22.5	22.4	21.6	21.8	21.9	22.8	22.9	23.2	22.7
1982	23.8	23.6	23.8	23.2	22.8	22.2	22.0	21.9	22.7	22.6	22.4	22.3	22.8
1983	23.4	24.3	25.0	23.5	23.1	22.4	22.2	22.1	22.3	22.7	22.7	22.2	23.0
1984	22.0	22.9	24.1	23.4	22.9	22.2	21.8	22.7	22.8	22.7	22.5	22.1	22.7
1985	23.5	23.4	23.6	22.5	22.5	21.7	21.3	21.9	22.6	23.2	22.9	23.1	22.7
1986	22.7	23.3	22.8	22.8	22.5	21.6	21.6	22.0	22.6	23.0	22.8	22.7	22.5
1987	23.2	23.7	23.9	23.5	22.8	22.1	22.4	23.1	23.5	23.8	23.4	23.6	23.3
1988	23.0	23.9	23.6	23.4	22.9	22.1	22.3	22.2	22.5	22.6	22.7	23.0	22.9
Mean	22.5	22.8	23.2	22.7	22.2	21.5	21.3	21.6	22.0	22.6	22.3	22.3	22.3

Note: Meteorological Station; Ahero Irrigation Research Station, NIB.

Table I-4 Monthly and Annual Mean Relative Humidity (in %) at Ahero, 1970 - 88

(Unit:%)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1970	77	74	76	78	78	76	76	77	67	62	69	77	74
1971	83	68	71	76	77	79	79	79	67	60	64	69	73
1972	62	71	62	68	64	76	76	70	64	69	73	69	69
1973	70	69	60	67	75	76	74	65	48	48	53	58	64
1974	62	56	72	75	74	74	81	72	71	63	64	59	69
1975	54	61	70	75	72	74	72	79	74	70	59	70	69
1976	60	70	63	72	77	75	79	72	64	63	59	64	68
1977	69	69	67	76	72	76	72	68	59	58	73	63	69
1978	59	65	77	75	71	74	76	73	67	67	64	70	70
1979	67	75	65	75	74	78	72	70	64	64	68	69	70
1980	59	61	63	71	77	74	73	79	71	60	67	63	68
1981	57	54	70	76	75	72	78	75	71	62	65	60	68
1982	63	65	60	74	78	77	77	78	69	68	74	72	71
1983	64	64	64	73	72	72	74	77	71	73	67	68	70
1984	64	56	59	71	70	69	71	68	61	66	70	66	66
1985	63	67	64	78	75	75	76	69	65	61	67	62	69
1986	61	62	68	75	73	82	73	64	64	63	67	72	69
1987	68	64	68	72	77	79	68	69	62	59	72	58	68
1988	74	69	73	78	77	71	75	75	73	69	68	62	72
Mean	65	65	67	74	74	75	75	73	66	63	66	66	69

Note: Meteorological Station; Ahero Irrigation Research Station, NIB.

Table I-5 Monthly and Annual Mean Sunshine Hours (in hrs) at Ahero, 1970 - 88

(Unit:hours)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1970	7.1	9.6	7.2	7.6	7.9	8.0	7.4	5.7	6.8	7.5	7.5	9.0	7.6
1971	8.5	9.6	8.5	7.1	6.6	7.2	7.6	7.6	7.6	8.1	8.1	7.6	7.8
1972	9.3	6.5	8.7	8.7	7.8	6.4	6.8	6.9	7.4	7.1	7.2	8.9	7.6
1973	8.5	7.9	7.9	7.6	7.1	7.7	7.0	6.9	6.3	7.1	7.2	9.2	7.5
1974	9.4	9.3	6.1	7.1	7.5	7.9	6.0	7.5	6.4	7.5	6.9	8.5	7.5
1975	9.0	9.4	8.4	7.2	7.2	6.4	6.2	4.9	5.7	6.4	7.5	8.9	7.3
1976	9.7	8.6	8.3	7.1	5.9	6.6	5.4	6.6	7.1	7.4	6.8	7.3	7.2
1977	6.8	7.6	8.0	5.4	6.9	6.9	7.2	6.8	7.3	7.7	5.6	7.1	6.9
1978	7.8	7.5	5.8	6.7	7.5	6.0	6.5	6.6	6.8	7.3	7.6	7.3	7.0
1979	7.3	7.2	8.6	7.4	7.8	6.8	7.4	7.3	7.6	8.3	7.3	9.0	7.7
1980	8.6	9.0	8.3	8.1	6.3	7.1	7.6	7.5	8.2	8.1	6.2	8.6	7.8
1981	9.5	8.9	6.0	7.2	8.2	8.4	6.0	7.2	7.1	8.4	7.7	8.3	7.7
1982	8.3	8.5	9.1	6.1	6.3	7.8	7.3	6.6	7.2	6.3	6.3	7.6	7.3
1983	9.0	8.4	8.1	7.7	8.1	7.3	6.6	6.5	7.0	6.4	7.5	6.7	7.4
1984	8.6	9.6	8.9	8.4	8.3	7.6	7.4	7.3	8.0	7.7	7.0	8.6	8.1
1985	8.8	7.2	7.7	6.3	7.3	7.9	7.3	7.2	8.1	8.0	7.7	8.7	7.7
1986	8.6	9.4	8.4	6.6	7.8	6.6	7.6	8.3	7.1	7.8	6.7	7.8	7.7
1987	7.8	8.7	8.5	8.4	6.6	6.7	8.4	7.4	8.1	8.8	6.3	9.2	7.9
1988	8.1	9.2	7.7	6.0	7.6	8.0	6.4	7.3	6.1	7.6	7.6	7.5	7.4
Mean	8.5	8.5	7.9	7.2	7.3	7.2	7.0	7.0	7.2	7.6	7.1	8.2	7.5

Note: Meteorological Station; Ahero Irrigation Research Station, NIB.

Table I-6 Monthly and Annual Mean Wind Velocity (in km/hr) at Ahero, 1970 - 88

(Unit:km/hr.)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1970	6.88	6.13	5.51	5.11	5.05	5.17	4.96	5.05	5.72	6.00	5.98	6.87	5.70
1971	6.55	7.79	7.56	6.36	4.69	4.60	4.67	5.28	5.43	6.00	5.79	5.74	5.87
1972	6.05	5.99	4.03	6.11	5.03	4.96	4.37	4.96	5.22	5.04	5.19	5.32	5.19
1973	5.78	5.52	6.05	6.12	5.36	4.35	4.55	4.73	4.97	5.08	4.84	5.46	5.23
1974	6.05	6.36	5.28	5.16	4.26	4.69	4.33	4.75	5.02	5.19	5.00	5.10	5.10
1975	6.05	5.83	5.70	4.49	4.19	4.30	3.63	3.79	4.55	4.21	4.23	5.02	4.67
1976	4.87	5.44	5.81	5.01	3.94	3.89	3.73	4.10	4.33	4.78	5.78	5.02	4.73
1977	3.83	4.23	4.69	4.07	4.17	4.07	3.54	4.22	4.62	4.94	3.94	4.19	4.21
1978	4.75	4.79	4.20	3.61	3.35	3.75	4.05	4.24	4.72	4.30	4.11	4.73	4.22
1979	4.73	5.32	5.46	4.58	4.01	3.81	4.31	4.81	5.05	4.60	4.21	5.03	4.66
1980	5.73	5.66	5.57	5.41	2.89	3.27	3.10	4.05	4.66	4.31	4.17	4.53	4.45
1981	4.95	5.95	5.12	4.04	3.75	2.29	1.79	1.92	1.93	2.29	2.41	2.51	3.25
1982	3.07	2.78	2.67	1.27	1.84	3.81	3.74	4.18	4.35	4.04	4.82	4.76	3.44
1983	5.71	5.59	6.04	5.20	4.33	4.29	4.03	4.56	4.52	4.31	4.10	4.55	4.77
1984	5.33	6.16	5.60	5.17	4.51	4.10	4.39	4.59	5.06	4.51	4.37	4.53	4.86
1985	5.09	5.89	5.30	4.46	3.95	3.99	4.30	4.24	5.09	4.87	4.69	5.52	4.78
1986	5.81	6.25	5.77	4.16	3.74	3.27	3.74	3.97	4.26	4.24	3.98	4.69	4.49
1987	5.03	5.16	4.90	4.16	3.45	3.40	3.72	3.87	4.60	4.48	3.99	4.60	4.28
1988	5.49	4.91	5.08	3.74	7.76	3.75	4.06	4.12	4.08	4.15	3.91	4.48	4.63
Mean	5.36	5.57	5.28	4.64	4.22	3.99	3.95	4.29	4.64	4.60	4.50	4.88	4.66

Note: Meteorological Station; Ahero Irrigation Research Station, NIB.

Table I-7 Monthly and Annual Mean Solar Radiation (in langleys) at Ahero, 1970 - 88

(Unit:langleys)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1970	507	612	548	567	548	528	508	473	567	574	564	600	550
1971	570	619	605	546	524	521	526	529	578	611	586	553	564
1972	629	532	628	593	531	483	509	525	564	561	557	626	562
1973	613	602	656	583	567	552	529	577	560	623	639	659	597
1974	673	653	563	677	581	552	540	534	554	613	568	681	599
1975	661	729	648	642	657	578	579	594	583	619	638	674	634
1976	734	689	711	644	586	591	604	591	650	640	603	613	638
1977	598	627	620	587	641	589	560	552	631	630	608	669	609
1978	635	684	627	575	647	574	541	583	567	601	604	547	599
1979	533	604	637	578	533	504	507	521	540	583	534	575	554
1980	575	600	572	556	493	497	515	531	562	568	491	553	543
1981	590	587	509	573	582	522	441	532	544	578	542	569	547
1982	600	611	609	500	518	574	527	565	562	523	508	580	556
1983	597	601	592	520	567	508	491	511	545	575	559	504	548
1984	575	662	692	646	642	636	614	624	679	642	607	672	641
1985	687	602	666	624	608	489	463	471	528	525	447	488	550
1986	456	496	493	474	521	434	460	511	493	524	481	496	487
1987	497	540	549	530	479	444	489	478	521	543	470	529	506
1988	513	559	531	496	508	503	467	498	529	591	571	581	529
Mean	592	611	603	574	565	530	519	537	566	585	557	588	569

Note: Meteorological Station; Ahero Irrigation Research Station, NIB.

*: Figures have been obtained from Pyrano Meter, others with no marks from Gunn Bellani radiation integrators.

Table I-8 Monthly and Annual Mean Pan Evaporation (in mm) at Ahero, 1970 - 88

(Unit:mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1970	7.1	8.1	6.9	6.8	6.0	6.2	5.9	5.5	6.6	7.4	7.3	8.1	6.8
1971	8.2	9.6	9.9	7.4	6.0	5.5	5.8	6.4	6.6	7.5	7.3	6.7	7.2
1972	8.0	7.0	8.8	7.7	5.9	5.6	5.6	6.3	7.1	6.7	6.4	7.2	6.9
1973	7.3	7.6	8.8	8.0	6.7	5.2	5.6	5.8	5.7	6.8	6.5	7.5	6.8
1974	7.9	8.4	7.3	6.4	5.7	5.3	4.4	5.8	5.7	6.7	6.3	6.5	6.4
1975	7.6	8.4	7.2	6.1	5.7	5.1	5.2	5.3	5.0	5.7	6.2	6.6	6.2
1976	7.5	6.8	7.4	6.0	4.6	4.8	4.4	4.7	5.5	6.6	6.3	5.9	5.9
1977	5.6	6.3	6.4	5.0	5.1	4.7	4.7	5.3	6.1	6.8	4.6	5.5	5.5
1978	6.2	6.2	5.2	4.9	4.6	4.6	4.6	4.9	5.4	5.3	5.6	5.5	5.3
1979	6.1	5.5	6.7	5.3	4.7	4.7	4.9	5.3	6.1	6.2	5.6	5.8	5.6
1980	6.5	7.3	7.1	6.5	5.1	4.8	5.0	5.4	6.1	6.5	5.5	6.4	6.0
1981	7.2	7.5	5.7	5.3	5.4	5.3	4.3	5.2	5.0	5.8	5.8	6.0	5.7
1982	6.9	7.0	7.1	5.1	4.9	5.1	4.8	5.1	5.5	4.7	5.0	5.2	5.5
1983	6.3	6.5	7.0	5.7	7.3	4.6	4.5	4.5	5.1	5.1	5.2	5.1	5.6
1984	5.8	7.2	7.3	5.9	5.5	5.2	4.9	5.2	5.9	5.8	5.2	5.6	5.8
1985	6.8	6.3	6.7	5.1	4.8	4.8	4.6	5.1	5.6	6.2	5.3	6.2	5.6
1986	5.9	6.4	6.2	5.3	4.9	4.3	4.7	5.2	5.4	5.8	4.8	5.3	5.4
1987	5.9	6.5	6.1	6.0	4.7	4.6	4.9	5.2	5.8	5.8	5.1	5.8	5.5
1988	6.0	5.9	5.7	4.6	4.8	4.6	4.4	4.9	4.6	5.4	5.2	5.4	5.1
Mean	6.8	7.1	7.0	6.0	5.4	5.0	4.9	5.3	5.7	6.1	5.7	6.1	5.9

Note: Meteorological Station; Ahero Irrigation Research Station, NIB.

Table I-9 Monthly and Annual Rainfall (in mm) at Ahero, 1970 - 88

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1970	224.8	101.3	146.2	198.0	85.4	95.9	72.0	115.7	38.0	31.7	86.0	55.5	1250.5
1971	59.6	6.6	30.6	219.8	170.6	148.5	55.7	71.1	50.1	46.7	134.1	67.5	1060.9
1972	33.7	96.3	67.3	202.9	128.2	62.0	51.7	51.4	139.0	102.2	152.1	72.3	1159.1
1973	153.7	132.9	4.1	76.1	250.5	49.2	71.1	138.4	70.1	56.7	113.0	28.4	1144.2
1974	43.2	18.5	217.6	282.9	126.6	71.9	79.3	84.3	57.6	35.5	109.3	75.7	1202.4
1975	9.7	78.1	178.0	97.6	117.1	59.5	101.9	233.1	64.8	61.1	42.5	78.5	1121.9
1976	112.0	59.5	43.3	144.1	97.7	82.0	121.8	103.9	79.3	22.1	81.7	83.9	1031.3
1977	86.1	123.9	117.3	230.7	120.7	103.9	58.8	68.2	39.9	127.2	157.4	21.9	1256.0
1978	125.6	134.9	202.3	234.1	62.1	52.4	151.3	75.6	89.4	124.9	46.6	137.7	1436.9
1979	78.7	203.3	224.8	100.6	153.9	65.3	53.7	41.8	133.8	56.6	102.7	104.7	1319.9
1980	62.8	30.9	96.6	179.1	102.5	92.0	50.4	45.9	92.0	25.3	67.5	119.0	964.0
1981	7.7	30.4	222.3	167.3	155.0	50.5	127.7	98.3	115.4	27.6	76.0	8.0	1086.2
1982	54.5	174.7	50.8	130.6	198.9	162.4	46.5	166.9	56.7	72.7	177.7	33.8	1326.2
1983	32.0	65.6	68.6	217.1	97.3	57.8	70.3	131.9	38.6	152.7	36.8	60.6	1029.3
1984	60.1	34.3	54.2	170.2	80.2	121.2	73.0	66.0	9.9	108.5	143.7	88.7	1010.0
1985	36.9	45.6	176.9	252.1	165.2	34.2	65.1	138.0	59.8	59.8	83.6	31.0	1148.2
1986	48.3	72.0	151.1	255.8	139.3	74.3	83.9	26.5	98.5	118.4	104.7	136.7	1309.5
1987	57.6	64.2	144.3	203.6	143.6	159.1	33.9	76.1	41.6	68.0	150.7	37.9	1180.6
1988	234.1	18.0	150.7	334.5	135.7	36.1	42.2	106.7	91.2	68.4	81.6	11.4	1310.6
Mean	80.1	78.5	123.5	194.6	133.2	83.1	74.2	96.8	71.9	71.9	102.5	66.0	1176.2

Note: Meteorological Station; Ahero Irrigation Research Station, NIB.

Table I-10 Monthly and Annual Mean Max. Temperature (in °C) at West Kano, 1984 - 88

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1984	29.2	30.3	31.3	28.3	28.5	28.1	27.9	28.6	29.5	29.6	28.7	29.3	29.1
1985	30.6	27.8	30.5	26.9	27.3	27.5	26.8	28.1	28.7	29.7	29.2	29.8	28.6
1986	30.1	29.9	29.0	27.8	27.5	26.5	27.8	29.0	29.8	30.4	29.3	27.9	28.8
1987	28.9		29.4	29.0	27.8	27.3	29.1	29.9	30.7	30.2	28.1	30.4	
1988	28.5	30.3	29.9	28.2	27.9	28.2	27.5	27.7	28.1	28.5	28.7	29.5	28.6
Mean	29.5	29.6	30.0	28.0	27.8	27.5	27.8	28.7	29.4	29.7	28.8	29.4	28.8

Note: Meteorological Station; West Kano Pilot Scheme, NIB.

Table I-11 Monthly and Annual Mean Min. Temperature (in °C) at West Kano, 1984 - 88

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1984	15.6	15.6	16.9	17.6	17.3	16.0	15.6	16.1	15.9	16.0	16.5	15.4	16.2
1985	16.3	16.4	16.6	17.9	16.6	15.9	15.1	15.0	16.1	16.1	16.1	16.7	16.2
1986	16.0	16.7	16.6	17.6	17.2	16.7	15.8	15.2	16.0	17.1	16.7	16.9	16.5
1987	17.0		18.0	18.0	14.9	17.1	15.7	16.5	17.1	17.8	18.1	16.3	
1988	17.3	17.9	17.1	18.3	17.9	15.8	16.7	16.5	16.7	16.6	16.6	16.0	17.0
Mean	16.4	16.7	17.0	17.9	16.8	16.3	15.8	15.9	16.4	16.7	16.8	16.3	16.5

Note: Meteorological Station; West Kano Pilot Scheme, NIB.

Table I-12 Monthly and Annual Mean Relative Humidity (in %) at West Kano, 1984 - 88

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1984	63	58	58	74	69	68	66	72	63	63	66	60	65
1985	56	73	62	79	77	73	74	66	64	57	64	59	67
1986	60	64	69	79	75	80	71	63	58	54	62	72	67
1987	66		70	72	78	79	66	60	58	58	69	58	
1988	75	68	66	80	76	69	72	73	72	61	64	54	69
Mean	64	66	65	77	75	74	70	67	63	59	65	61	67

Note: Meteorological Station; West Kano Pilot Scheme, NIB.

Table I-13 Monthly and Annual Mean Sunshine Hours (in hrs) at West Kano, 1984 - 88

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1984	9.0	9.5	9.1	8.5	8.8	8.1	8.1	8.0	8.1	7.9	7.4	8.6	8.4
1985	9.0	7.1	8.0	6.2	7.6	7.8	7.7	7.8	8.4	7.9	8.0	9.3	7.9
1986	8.9												
1987													
1988													
Mean	9.0	8.3	8.6	7.4	8.2	8.0	7.9	7.9	8.3	7.9	7.7	9.0	8.2

Note: Meteorological Station; West Kano Pilot Scheme, NIB.

Table I-14 Monthly and Annual Mean Wind Velocity (in km/hr) at West Kano, 1984 - 88

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1984	6.55	7.36	6.93	5.74	4.86	4.22	4.68	4.61	4.88	4.65	4.89	5.17	5.38
1985	6.33	5.68	5.96	4.29	3.76	4.05	4.86	4.45	4.66	4.65	4.69	5.50	4.91
1986	6.27	6.69	5.91	4.49	4.31	4.21	4.50	4.82	5.38	5.70	5.21	5.64	5.26
1987	5.69		5.37	4.80	3.85	3.66	4.46	4.89	5.84	5.57	4.10	5.02	
1988	5.26	5.49	6.36	3.94	4.27	4.36	4.76	4.74	4.55	4.61	4.70	5.18	4.85
Mean	6.02	6.31	6.11	4.65	4.21	4.10	4.65	4.70	5.06	5.04	4.72	5.30	5.10

Note: Meteorological Station; West Kano Pilot Scheme, NIB.

Table I-15 Monthly and Annual Mean Solar Radiation (in langleys) at West Kano, 1984 - 88

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1984	726	773	774	749	740	693	688	700	739	724	696	718	727
1985	718	648	740	686	685	677	659	688	747	675	696	755	698
1986	706	767	709	702	698	543	445	497	496	518	488	499	589
1987	505		584	565	519	519	531	527	568	574	508	576	
1988	559	573	699	480	503	521	457	515	483	536	530	561	535
Mean	643	690	701	636	629	591	556	585	607	605	584	622	637

Note: Meteorological Station; West Kano Pilot Scheme, NIB.

Table I-16 Monthly and Annual Mean Pan Evaporation (in mm) at West Kano, 1984 - 88

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1984	6.1	7.4	7.6	5.9	5.7	5.5	5.5	5.9	6.5	6.0	5.7	6.4	6.2
1985	7.1	5.7	7.2	4.9	4.8	5.2	4.9	5.5	6.3	6.3	5.7	6.5	5.8
1986	6.5	7.0	6.4	5.0	5.6	4.4	4.7	5.6	6.0	6.5	5.5	5.3	5.7
1987	6.0		6.2	5.7	4.7	4.6	5.4	6.0	6.5	6.6	5.3	6.5	
1988	5.4	6.6	6.8	5.4	4.9	5.2	4.7	5.2				5.6	
Mean	6.2	6.7	6.8	5.4	5.1	5.0	5.0	5.6	6.3	6.4	5.6	6.1	5.9

Note: Meteorological Station; West Kano Pilot Scheme, NIB.

Table I-17 Monthly and Annual Rainfall (in mm) at West Kano, 1984 - 88

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1984	44.7	46.6	120.7	150.0	76.5	84.6	103.2	92.2	63.5	103.0	73.4	44.4	1002.8
1985	55.7	54.3	240.3	164.7	156.5	68.9	48.6	123.8	60.1	48.6	74.2	57.8	1153.5
1986	69.0	116.1	294.3	229.2	233.1	87.8	101.1	12.3	24.2	34.0	60.8	149.8	1411.7
1987	93.1		113.5	231.6	171.4	151.0	16.7	27.0	16.1	126.5	155.4	35.5	
1988	234.5	50.0	158.0	392.4	136.3	55.8	81.7	106.9	114.2	78.0	75.1	5.6	1488.5
Mean	99.4	66.8	185.4	233.6	154.8	89.6	70.3	72.4	55.6	78.0	87.8	58.6	1264.1

Note: Meteorological Station; West Kano Pilot Scheme, NIB.

Table I-18 Monthly and Annual Mean Max. Temperature (in °C) at Chemelil, 1986 - 88

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1986	31.4	32.5	31.0	28.8	28.6	27.0	28.1	29.6	30.1	31.6	31.4	29.6	30.0
1987	31.5	32.4	31.3	30.2	28.5	28.1	30.6	30.7	31.6	31.7	29.9	32.1	30.7
1988	29.2	30.3	30.1	29.6	29.6	29.9	29.0	29.3	29.4	29.9	29.4	30.0	29.6
Mean	30.7	31.7	30.8	29.5	28.9	28.3	29.2	29.9	30.4	31.1	30.2	30.6	30.1

Note: Meteorological Station; Chemelil Sugar Company Limited.

Table I-19 Monthly and Annual Mean Min. Temperature (in °C) at Chemelil, 1986 - 88

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1986	13.0	13.6	13.6	15.6	14.3	14.2	13.0	11.8	12.3	12.5	12.5	13.6	13.3
1987	13.7	14.4	14.7	15.0	14.5	13.9	12.2	12.8	12.8	13.1	14.3	13.3	13.7
1988	14.6	14.6	15.4	15.6	14.2	12.1	13.5	13.2	13.8	13.5	13.9	13.6	14.0
Mean	13.8	14.2	14.6	15.4	14.3	13.4	12.9	12.6	13.0	13.0	13.6	13.5	13.7

Note: Meteorological Station; Chemelil Sugar Company Limited.

Table I-20 Monthly and Annual Mean Relative Humidity (in %) at Chemelil, 1986 - 88

AT 0900 HRS

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1986	60	61	67	74	75	79	75	69	67	60	59	68	68
1987	63	60	69	73	78	76	68	67	62	61	69	59	67
1988	75	66	73	80	77	71	79	76	74	71	70	63	73
Mean	66	62	70	75	76	75	74	70	67	64	66	63	69

AT 1500 HRS

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1986	32	38	45	59	57	61	55	50	50	47	42	50	49
1987	40	40	48	52	61	57	44	47	48	44	57	38	48
1988	52	39	50	64	57	50	55	59	59	55	54	41	53
Mean	41	39	48	58	58	56	52	52	52	48	51	43	50

Note: Meteorological Station; Chemelil Sugar Company Limited.

Table I-21 Monthly and Annual Mean Sunshine Hours (in hrs) at Chemelil, 1986 - 88

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1986	8.4	9.4	8.5	6.2	7.8	6.5	7.4	7.7	6.9	7.3	6.9	7.0	7.5
1987	7.8	8.5	8.7	7.8	6.9	7.1	8.4	7.1	7.5	8.6	5.6	9.3	7.8
1988	8.9	8.9	7.8	5.5				6.9	5.6	7.5	7.5	7.5	
Mean	8.4	8.9	8.3	6.5	7.4	6.8	7.9	7.2	6.7	7.8	6.7	7.9	7.6

Note: Meteorological Station; Chemelil Sugar Company Limited.

Table I-22 Monthly and Annual Mean Wind Velocity (in km/hr) at Chemelil, 1986 - 88

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1986	4.35	4.83	4.67	4.02	3.86	3.22	3.70	4.02	4.18	4.51	4.99	4.18	4.21
1987	4.67	4.83	4.18	3.86	3.54	3.38	3.86	4.18	4.35	4.67	4.51	5.15	4.27
1988	4.18	4.51	4.18	3.54	3.38	3.70	3.22	3.86	3.86	3.86	4.02	4.99	3.94
Mean	4.40	4.72	4.34	3.81	3.59	3.43	3.59	4.02	4.13	4.35	4.51	4.77	4.14

Note: Meteorological Station; Chemelil Sugar Company Limited.

Table I-23 Monthly and Annual Mean Solar Radiation (in langleys) at Chemelil, 1986 - 88

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1986	546	615	578	492	525	453	476	530	533	544	502	515	526
1987	547	581	587	561	490	487	514	500	530	579	469	592	536
1988	546	614	540	449	536	535	451	481	484	573	546	553	525
Mean	546	603	568	500	517	492	480	504	515	565	506	553	529

Note: Meteorological Station; Chemelil Sugar Company Limited.

Table I-24 Monthly and Annual Mean Pan Evaporation (in mm) at Chemelil, 1986 - 88

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1986	5.0	6.4	5.8	4.6	4.2	4.0	4.5	4.9	6.0	6.2	5.3	4.9	5.2
1987	5.5	6.7	6.1	5.3	4.4	4.4	4.4	4.6	5.9	5.7	5.3	5.9	5.4
1988	5.3	6.5	5.3	4.4	4.6	4.7	3.5	3.9	4.6	5.1	5.2	5.8	4.9
Mean	5.3	6.5	5.7	4.8	4.4	4.4	4.1	4.5	5.5	5.7	5.3	5.5	5.1

Note: Meteorological Station; Chemelil Sugar Company Limited.

Table I-25 Monthly and Annual Rainfall (in mm) at Chemelil, 1986 - 88

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1986	69.5	52.2	149.4	147.9	170.5	126.2	117.5	68.9	67.0	55.4	26.6	97.7	1148.8
1987	47.2	97.9	223.9	150.2	110.2	154.6	40.7	47.2	105.3	46.1	138.1	41.3	1202.7
1988	246.1	40.5	233.6	376.2	126.4	64.2	193.2	112.3	137.5	107.5	109.1	9.5	1756.1
Mean	120.9	63.5	202.3	224.8	135.7	115.0	117.1	76.1	103.3	69.7	91.3	49.5	1369.2

Note: Meteorological Station; Chemelil Sugar Company Limited.

Table I-26 Monthly and Annual Mean Max. Temperature (in °C) at Kibos, 1986 - 90

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1986	30.9	30.8	30.2	28.7	28.5	27.6	28.4	29.7	30.4	31.2	30.1	28.2	29.6
1987	31.2	31.3	30.4	29.5	28.8	28.7	30.4	30.6	31.4	29.8	29.5	32.2	30.3
1988	29.7	31.0	30.0	34.2	28.0	29.4	32.4	28.5	28.0	30.5	30.3	29.9	30.2
1989	27.9	30.2	30.9	28.4	28.0	28.2	28.2	28.9	29.4	29.7	30.5	29.2	29.1
1900	30.8	29.8	28.7	28.9	29.0	29.3	29.3	29.2					
Mean	30.1	30.6	30.0	29.9	28.5	28.6	29.7	29.4	29.8	30.3	30.1	29.9	29.8

Note: Meteorological Station; Kibos Sugar Research.

Table I-27 Monthly and Annual Mean Min. Temperature (in °C) at Kibos, 1986 - 90

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1986	14.9	15.3	15.1	13.2	13.7	13.8	12.9	12.8	13.8	14.9	14.9	15.5	14.2
1987	15.5	15.6	15.8	16.3	15.9	15.4	14.1	14.6	15.4	16.2	16.4	18.8	15.8
1988	16.1	15.3	18.2	16.0	16.1	15.0	16.7	15.7	16.8	10.6	16.3	15.4	15.7
1989	15.3	15.7	15.6	16.3	16.3	15.6	15.6	15.2	14.9	16.2	16.1	16.4	15.8
1900	15.3	16.9	17.2	17.6	16.9	14.4	15.1	15.2					
Mean	15.4	15.8	16.4	15.9	15.8	14.8	14.9	14.7	15.2	14.5	15.9	16.5	15.4

Note: Meteorological Station; Kibos Sugar Research.

Table I-28 Monthly and Annual Mean Sunshine Hours (in hrs) at Kibos, 1986 - 90

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1986	9.4	9.6	9.2	6.8	7.7	5.5	7.5	8.7	7.1	8.0	8.0	8.2	8.0
1987	9.1	9.6	8.7	7.4	7.3	6.0	8.4	7.8	8.4	9.0	9.6	9.5	8.4
1988	8.0	8.2	6.0	5.2	6.5	6.7	6.9	6.7	5.0	7.2	7.4	7.2	6.8
1989	6.6	8.3	6.4	6.5	6.5	6.4	6.8	7.4	6.8	6.7	6.8	6.6	6.8
1900	8.6	5.8	5.9	6.6	7.8	7.6	8.1	7.1					
Mean	8.3	8.3	7.2	6.5	7.2	6.4	7.5	7.5	6.8	7.7	8.0	7.9	7.5

Note: Meteorological Station; Kibos Sugar Research.

Table I-29 Monthly and Annual Mean Wind Velocity (in km/hr) at Kibos, 1986 - 90

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1986	6.50	6.00	5.70	4.40	3.80	3.20	4.10	4.90	5.00	5.50	4.80	4.50	4.87
1987	5.40	5.80	5.10	4.10	3.50	3.20	3.50	4.30	4.60	5.20	4.30	4.90	4.49
1988	6.10	5.30	5.10	4.10	3.40	3.40	2.70	4.60	4.40	4.40	4.60	5.60	4.48
1989	4.70	5.50	6.00	4.60	5.10	4.00	4.00	4.40	4.70	4.30	4.60	5.20	4.76
1900	4.90	4.50	4.80	5.20	5.80	5.80	4.80	4.70					
Mean	5.52	5.42	5.34	4.48	4.32	3.92	3.82	4.58	4.68	4.85	4.58	5.05	4.65

Note: Meteorological Station; Kibos Sugar Research.

Table I-30 Monthly and Annual Mean Solar Radiation (in langleys) at West Kibos, 1986 - 90

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1986	607	598	608	524	558	461	533	594	557	610	564	466	557
1987	599	580	679	589	512	488	581	571	559	652	544	564	576
1988	590	811	616	536	534	643	506	554	555	616	609	593	597
1989	569	582	592	539	541	575	553	597	576	610	556	558	571
1900	666	514	596	557	579	587	589	573					
Mean	606	617	618	549	545	551	553	578	562	622	568	545	575

Note: Meteorological Station; Kibos Sugar Research.

Table I-31 Monthly and Annual Mean Pan Evaporation (in mm) at Kibos, 1986 - 90

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1986	6.3	6.9	6.4	4.9	4.4	3.9	4.7	5.4	5.6	6.2	5.1	5.1	5.4
1987	5.9	6.8	6.1			3.8	4.8	5.2	6.0	5.5	4.8		
1988	4.9	5.8	5.2	5.5	3.8	4.8	3.8	4.2	4.8	4.6	4.1	5.0	4.7
1989	4.6	6.2	6.5	4.8	4.4	4.5	4.2	5.2	4.7	4.7	4.9	5.7	5.0
1900	5.3	6.2	4.9	5.1	4.4	5.1	4.5	4.7					
Mean	5.4	6.4	5.8	5.1	4.3	4.4	4.4	4.9	5.3	5.3	4.7	5.3	5.1

Note: Meteorological Station; Kibos Sugar Research.

Table I-32 Monthly and Annual Rainfall (in mm) at Kibos, 1986 - 90

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1986	127.7	95.2	202.9	200.2	158.1	56.5	123.1	23.4	55.7	87.4	91.6	95.5	1317.3
1987	77.2	108.0	207.0	219.6	200.6	118.6	54.3	90.6	126.4	136.4	98.9	39.9	1477.5
1988	213.4	24.3	208.5	354.9	69.6	122.5	54.5	149.6	112.4	59.7	133.5	63.2	1566.1
1989	50.9	153.6	172.3	134.5	157.5	97.0	117.5	184.2	126.8	94.9	96.5	211.6	1597.3
1900	61.2	288.6	269.0	167.7	112.5	71.2	45.2	87.5					
Mean	106.1	133.9	211.9	215.4	139.7	93.2	78.9	107.1	105.3	94.6	105.1	102.6	1489.6

Note: Meteorological Station; Kibos Sugar Research.

Table I-33 Data Collection Network of Rain Gauges

Station Name	Latitude	Longitude	Altitude (m)	KMD Station Code	Start Year	Data Collection Period	Data Collection Kind
KABUNJOI CATHOLIC MISSION	00.03N	34.59 E	2,073	8934087	61.01.01	1961-1985	Monthly
VIHIGA AGRIC. OFFICE	00.02N	34.43 E	1,585	8934103	61.01.01	1961-1985	Monthly
KABNGENDUI KIBET FARM	00.02N	35.18 E	1,890	8935001	26.01.01	1926-1983	Monthly
NANDI HILLS. SAVANI ESTATE	00.03N	35.06 E	1,829	8935033	61.01.01	1961-1985	Monthly
NANDI. SIRET TEA CO. LTD	00.04N	35.14 E	2,161	8935071	61.01.01	1961-1985	Monthly
LONDIANI FOREST STATION	00.09S	35.36 E	2,316	9035002	26.01.01	1926-1985	Monthly
SONGHOR MBOGO VALE PRI. SCH.	00.04S	35.19 E	1,951	9035009	35.01.01	1935-1985	Monthly
KIPKELION RAILWAY STATION	00.12S	35.28 E	1,931	9035020	26.01.01	1926-1985	Monthly
EQUATOR. BARGANT ESTATE	00.01S	35.24 E	2,012	9035042	61.01.01	1961-1985	Monthly
CHEMELIL PLANTATIONS	00.04S	35.09 E	1,229	9035046	61.01.01	1961-1983	Monthly
KENOIWA. S. KALIA'S FARM	00.16S	35.31 E	2,286	9035102	61.01.01	1961-1984	Monthly
SORGET FOREST STATION	00.02S	35.32 E	2,377	9035128	61.01.01	1961-1985	Monthly
TINGA. LUMBWA	00.05S	35.27 E	2,134	9035188	64.01.01	1964-1985	Monthly
LALIAT FARM AINAMOI	00.16S	35.15 E	1,829	9035200	62.01.01	1962-1985	Monthly
KORU COFFEE BOARD SUB-STATION	00.08S	35.17 E	1,573	9035230	61.01.01	1961-1985	Monthly
KERICHO CHAGAIK ESTATE	00.20S	35.20 E	1,829	9035235	61.01.01	1961-1985	Monthly
KIPKELION WATER SUPPLY	00.12S	35.20 E	1,920	9035258	64.01.01	1964-1985	Monthly
MIWANT THE HILL	00.03S	34.57 E	1,372	9034009	35.01.01	1935-1985	Daily
GENDIA CHIEF'S CAMP	00.23S	34.40 E	1,219	9034018	61.01.01	1961-1985	Monthly
KISUMU METEOROLOGICAL STN.	00.06S	34.45 E	1,149	9034025	61.01.01	1961-1988	Daily
KIBOS COTTON EXP. STATION	00.04S	34.49 E	1,173	9034081	52.01.01	1952-1985	Monthly
KISUMU MUNICIPAL COUNCIL	00.06S	34.45 E	1,180	9034085	62.01.01	1962-1985	Daily
KERICHO KIPSITET	00.13S	35.10 E	1,864	9035269	68.01.01	1968-1985	Monthly
CHEMELIL SUGAR SCHEME	00.04S	35.08 E	1,269	9035274	71.01.01	1971-1985	Monthly
SANGORO PRIMARY SCHOOL	00.21S	34.48 E	1,158	9034067	61.01.01	1961-1985	Daily
MIWANI SUGAR MILL	00.03S	34.59 E	1,207	9034008	31.01.01	1931-1965	Monthly
AHERO IRRIG. RES STATION	00.08S	34.56 E	1,219	9034086	62.01.01	1962-1985	Daily
SUGAR RES. STATION KIIBOS	00.02S	34.49 E	1,203	9034105	69.01.01	1968-1984	Monthly
WEST KANO IRRIGATION SCHEME	00.12S	34.50 E	1,175	9034133	75.01.01	1984-1988	Daily
NYABONDO WATER SUPPLY	00.23S	35.01 E	1,524	9035142	61.01.01	1961-1985	Monthly
HAIL RESEARCH STATION KERICHO	00.22S	35.21 E	2,182	9035279	73.01.01	1973-1983	Monthly

Source: Data Centre, LBDA.

Table I-34 Average Monthly and Annual Rainfall (in mm) in Subbasin 1G

Rain Gauge Sta. Code	Altitude (m)	Location by Subbasin	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
9035042	2012	1GA	70.8	82.8	79.3	170.6	217.1	143.4	190.2	228.9	151.2	138.4	119.2	68.3	1,660.2
8935001	1890	1GB	56.4	75.1	113.3	234.4	198.4	139.8	157.2	187.3	119.4	90.4	90.5	72.1	1,534.3
8935033	1829	1GB	91.8	117.6	120.5	190.3	191.1	148.3	166.2	177.2	151.8	136.9	155.7	114.1	1,761.5
8935071	2161	1GB	71.7	99.6	125.2	195.1	169.8	139.8	131.8	153.2	132.9	141.6	143.7	105.1	1,609.5
9035009	1951	1GB	73.0	88.2	133.9	295.6	226.6	144.2	145.4	166.5	119.5	114.2	131.6	106.2	1,744.9
9035046	1229	1GB	89.2	99.9	126.6	192.5	164.5	120.5	83.1	107.4	105.8	115.2	155.6	108.1	1,468.4
9035274	1269	1GB	102.1	88.9	95.4	180.8	192.0	132.0	133.4	101.0	107.6	117.5	125.9	101.8	1,478.4
Ave.	-	1GB	80.7	94.9	119.2	214.8	190.4	137.4	136.2	148.8	122.8	119.3	133.8	101.2	1,599.5
9035002	2316	1GC	37.3	45.1	71.0	147.9	150.3	119.9	147.5	170.5	103.6	55.9	57.4	47.3	1,153.7
9035020	1931	1GC	36.4	49.6	83.4	148.1	152.0	114.2	115.9	124.3	93.6	64.5	59.6	42.1	1,083.7
9035102	2286	1GC	36.9	49.6	85.8	180.6	205.4	135.4	157.2	199.9	115.5	101.5	91.3	76.5	1,435.6
9035128	2377	1GC	46.2	59.7	53.4	131.7	151.3	114.2	166.2	203.4	114.9	62.8	106.2	58.8	1,268.8
9035200	1829	1GC	77.6	77.1	146.9	214.5	178.9	175.9	142.2	174.8	90.3	92.8	86.8	60.6	1,518.4
9035235	1829	1GC	83.5	85.4	131.8	238.2	243.6	168.1	157.7	181.6	154.4	131.9	134.1	88.0	1,798.3
Ave.	-	1GC	53.0	61.1	95.4	176.8	180.3	138.0	147.8	175.8	112.1	84.9	89.2	62.2	1,376.4
9035230	1573	1GD	110.2	105.9	183.4	227.2	217.8	148.0	147.5	143.2	109.6	115.5	125.9	124.1	1,758.3
9035269	1864	1GD	107.3	82.1	122.5	172.9	196.6	126.7	135.8	132.7	114.2	105.7	85.1	111.7	1,493.3
Ave.	-	1GD	108.8	94.0	153.0	200.1	207.2	137.4	141.7	138.0	111.9	110.6	105.5	117.9	1,625.8
9035142	1524	1GF	97.3	76.9	138.9	201.9	203.8	150.1	123.2	138.3	133.0	106.8	120.4	110.2	1,600.8
9035188	2134	1GG	64.0	77.9	95.2	136.2	150.6	127.0	152.1	197.7	119.1	97.4	79.7	48.8	1,345.7
9035258	1920	1GG	57.8	68.9	70.4	140.2	166.7	110.0	123.2	117.2	102.3	87.8	61.7	60.4	1,166.6
Ave.	-	1GG	60.9	73.4	82.8	138.2	158.7	118.5	137.7	157.5	110.7	92.6	70.7	54.6	1,256.2
Ave.	-	1G	72.8	79.5	109.8	188.8	187.6	136.5	143.1	161.4	118.8	104.3	107.2	83.6	1,493.4

Note: Above figures are calculated based on monthly data of each year.

Table I-35 Average Monthly and Annual Rainfall (in mm) in Subbasin 1H and 1J

Rain Gauge Sta. Code	Altitude (m)	Location by Subbasin	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
9034008	1207	1HA	59.1	77.8	128.0	203.9	178.4	104.9	81.9	107.2	84.3	85.1	122.8	97.9	1,331.3
9034009	1372	1HA	71.4	80.6	132.0	206.6	169.9	116.1	85.6	110.1	102.2	97.1	129.8	101.0	1,402.4
9034081	1173	1HA	60.5	92.9	132.2	215.0	168.6	84.3	68.6	101.2	91.8	75.7	131.4	99.4	1,321.6
9034085	1180	1HA	60.0	79.8	131.4	223.9	159.3	84.0	62.8	73.7	73.9	84.4	110.6	89.6	1,233.4
9034086	1219	1HA	86.9	81.0	108.2	179.3	145.8	89.2	87.7	87.5	70.3	69.8	116.0	79.2	1,200.9
9034087	2073	1HA	89.4	117.2	163.7	241.1	241.3	144.1	123.3	169.5	182.8	178.8	226.2	140.7	2,018.1
9034105	1203	1HA	93.1	92.8	116.5	201.6	196.1	113.6	111.9	119.3	105.4	110.0	137.5	100.3	1,498.1
9034133	1175	1HA	99.4	66.8	185.4	233.6	154.8	89.6	70.3	72.4	55.6	78.0	87.8	58.6	1,252.3
Ave.	-	1HA	77.5	86.1	137.2	213.1	176.8	103.2	86.5	105.1	95.8	97.4	132.8	95.8	1,407.3
9034103	1585	1HB	85.1	90.4	147.8	245.3	239.5	130.1	115.1	156.4	131.4	151.3	178.8	152.5	1,823.7
9034025	1149	1HB	89.1	86.7	143.4	232.1	170.2	89.5	70.2	85.2	88.7	90.7	141.3	104.7	1,391.8
Ave.	-	1HB	87.1	88.6	145.6	238.7	204.9	109.8	92.7	120.8	110.1	121.0	160.1	128.6	1,607.8
9034018	1219	1HD	69.5	47.2	98.3	157.2	152.5	99.8	71.1	121.5	71.0	101.2	104.6	81.9	1,175.8
9035279	2182	1JC	85.0	87.6	177.6	250.4	315.1	209.3	195.0	236.3	206.2	157.2	155.1	75.6	2,150.4
9034067	1158	1JG	67.4	64.6	114.2	145.6	151.8	66.0	68.9	80.6	65.8	58.9	102.1	99.8	1,085.7

Note: Above figures are calculated based on monthly data of each year.

Table I-36 Network of Water Gauges

MOWD Station Code	Station Name	River Name	Latitude	Longitude	Elevation (m)	Catchment Area (km2)	Observation Type(*)	Data Collection(**) Period
1GB01A	AINAPSIWA	AINAPSIWA	00:05:24S	35:11:15	1,920	5	S	-
1GB01	AINAPSIWA	AINAPSIIWA	00:04:50S	35:11:15	1,880	16	SW	-
1GB02	AINAPSIWA	T. SPRING	00:05:00S	35:11:15	-	-	-	-
1GB03	AINAMOTUA	AINAMOTUA	00:04:20S	35:03:20	1,200	837 (#)	RS	1968-1988
1GB04	AINAPSIWA	AINAPSIWA	00:05:24S	35:11:48	1,940	-	-	-
1GB05	AINAMOTUA	AINAMOTUA	00:01:35S	35:10:30	1,300	606	S	-
1GB06	MBOGO	MBOGO	00:03:30S	35:08:36	1,260	67	S	-
1GB07	KAPCHURE	KAPCHURE	00:00:30S	35:06:00	1,280	129	S	-
1GB08	AINAMOTUA	AINAMOTUA	00:05:35S	35:03:10	1,200	844	S	1955-1961
1GB09	AINAMOTUA	AINAMOTUA	00:03:55S	35:04:35	1,200	743	-	-
1GB10	KAPCHURE	KAPCHURE	00:03:30S	35:04:20	1,200	158	-	-
1GB11	KIGWAN	KIGWAN	00:01:30S	35:10:35	-	1,300	-	-
1GB06A	MBOGO	MBOGO	00:03:28S	35:08:40	1,260	67	-	-
1GC01	MASAITA	MASAITA	00:08:00S	35:36:10	2,332	48	-	-
1GC03	NYANDO	NYANDO	00:12:15S	35:27:30	1,920	523	S	-
1GC04	TUGENON	TUGENON	00:15:10S	35:24:50	1,980	46	S	-
1GC05	MASAITA	MASAITA	00:11:40S	35:32:05	2,057	251	-	-
1GC06	NYANDO	NYANDO	00:12:00S	35:28:00	1,940	1,940	-	-
1GD01	AHERO	NYANDO	00:09:50S	34:55:10	1,160	2,598	-	-
1GD02	NYANDO	NYANDO	00:10:10S	35:09:25	1,240	1,375	S	1955-1961
1GD03	NYANDO	NYANDO	00:08:00S	34:59:25	1,140	2,625	RS	-
1GD04	NYANDO	NYANDO	00:06:05S	35:02:40	1,190	2,520	S	1956-1988
1GD05	NYANDO	NYANDO	00:06:05S	35:02:50	1,190	1,636	SW	-
1GD06	NYANDO	NYANDO	00:09:05S	35:07:50	1,230	1,456	-	-
1GD07	NYANDO	NYANDO	00:09:50S	35:09:50	1,280	1,419	-	-
1GD08	NYANDO	NYANDO	00:08:30S	34:58:25	1,165	2,453	-	-
1GE01	CHERONGIT	CHERONGIT	00:16:55S	35:01:10	1,210	900	S	-
1GE01A	AWACH	AWACH KANO	00:16:15S	35:01:10	1,210	900	-	-
1GD01A	AHERO	NYANDO	00:09:50S	34:55:10	-	-	-	-
1GG01	AWACH	AWACH KANO	00:12:10S	35:20:50	1,540	298	-	-
1GG02	NAMUTING	NAMUTING	00:11:55S	35:15:25	1,360	386	S	-
1HA01	GREAT OROBA	GREAT OROBA	00:01:10S	35:00:00	1,260	62	SW	1932-1988
1HA02	LITTLE OROBA	LITTLE OROBA	00:01:40S	34:58:15	1,280	10	SW	1932-1988
1HA03	NGAITA	NGAITA	00:02:00S	34:53:10	1,220	10	SW	-
1HA04	KIBOS	KIBOS	00:00:10S	34:48:15	1,200	117	SW	1933-1988
1HA05	KIBOS	STREAM	00:00:30S	34:48:05	1,240	-	-	-
1HA06	AWACH	AWACH	00:01:30S	34:47:00	1,200	-	-	-
1HA07	KIBOS	KIBOS	00:05:00S	34:47:30	-	133	S	-
1HA08	KIBOS	KIBOS	00:07:00S	34:47:05	1,140	259	S	-
1HA09	NYAMASARIA	NYAMARIA	00:08:00S	34:47:50	1,140	4	S	-
1HA10	LUANDA	LUANDA	00:08:45S	34:48:30	1,140	234	S	1948-1955
1HA11	GREAT OROBA	GREAT OROBA	00:04:20S	34:59:58	1,190	71	S	-
1HA12	KIBOS	KIBOS	00:04:05S	34:48:50	1,160	238	S	-
1HA13	GWAMBEL	GWAMBEI	00:01:30N	34:43:48	1,490	6	S	-
1HA14	AWACH	AWACH	00:02:50S	34:48:15	1,180	104	S	1961-1988
1HA15	KIBOS	KIBOS	00:04:05S	34:48:50	1,170	-	-	1967-1972
1HA16	KIBOS	KIBOS	00:04:30S	34:48:15	1,160	820	RS	-
1HB04	KISUMU	LAKE VICTORIA	00:05:15S	34:44:25	-	-	-	1964-1985
1JG01	SONDU	SONDU	00:23:35S	35:00:30	1,500	3,287	SR	1946-1989

Source: Data Centre, LBDA.
Notes: (*) S=Staff Gauge, W=Weir. R=Recorder.
(**) Daily data is collected from stations where data is available.
(#) Measured by the Study Team.

Table I-37 List of Rating Curves in Catchment 1G

Code	PERIOD	RATING CURVE DATA; Q=C*((H+A)**B)IN (m3/sec) LOWER BOUNDARY measured (m)	LOWER BOUNDARY extended (m)	UPPER BOUNDARY measured (m)	UPPER BOUNDARY extended (m)	COEFFICIENTS A (m)	COEFFICIENTS B	COEFFICIENTS C	SOURCE
1GB03	09 JAN 1968	0.080	0.000	0.650	-	0.660	4.752	1.118	DACE
	08 JUN 1977	0.650	-	1.480	1.550	0.100	2.893	9.268	DACE
	09 JUN 1977	0.080	0.000	0.520	-	-0.120	0.330	12.801	DACE
	31 DEC 1985	0.520	-	1.480	1.550	0.352	2.514	5.335	DACE
	01 JAN 1986	0.240	-	0.680	-	0.000	2.227	17.540	MOWD
	31 DEC 1988	0.680	-	1.480	-	0.000	1.163	11.636	MOWD
1GB08	01 APR 1955								
	13 JUL 1958	0.390	0.140	2.212	2.900	0.000	1.950	7.057	MOWD
	14 JUL 1958								
	15 NOV 1961	1.701	0.700	1.259	2.900	0.000	1.600	9.509	MOWD
1GD02	02 FEB 1955	0.143	0.000	0.497	-	0.000	1.420	5.844	MOWD
	18 JAN 1962	0.497	-	1.631	1.850	0.000	2.310	10.894	MOWD
1GD04	01 JAN 1956	0.732	0.300	1.442	-	0.000	2.850	10.075	MOWD
	06 JAN 1962	1.442	-	1.710	3.000	0.000	1.820	14.698	MOWD
	07 JAN 1962	0.219	0.219	0.762	-	0.244	2.004	13.742	MOWD
	25 APR 1966	0.762	-	0.756	3.000	0.000	1.747	22.310	MOWD
	26 APR 1966								
	16 MAR 1976	0.003	0.003	0.546	3.000	0.305	1.750	15.079	MOWD
	17 MAR 1976								
	31 DEC 1985	-0.070	-0.070	0.570	3.000	0.151	1.251	20.119	DACE
	01 JAN 1986								
	31 DEC 1988	0.060	-	0.570	-	0.103	1.818	30.612	DACE

Souce: Data Centre(DACE), LBDA.

Table I-38 List of Rating Curves in Catchment 1H

Code	PERIOD	RATING CURVE DATA; Q=C*((H+A)**B)IN (m3/sec) LOWER BOUNDARY measured (m)	LOWER BOUNDARY extended (m)	UPPER BOUNDARY measured (m)	UPPER BOUNDARY extended (m)	COEFFICIENTS A (m)	COEFFICIENTS B	COEFFICIENTS C	SOURCE
1HA01	01 AUG 1931	0.152	0.000	0.235	-	0.000	2.133	7.668	MOWD
	16 APR 1953	0.235	-	0.427	0.550	0.000	2.992	26.636	MOWD
	17 APR 1953								
	31 DEC 1985	0.090	0.550	0.550	0.800	0.198	4.597	15.829	DACE
1HA02	31 DEC 1931	0.052	0.000	0.305	-	0.000	2.222	3.301	MOWD
	31 MAR 1959	0.305	-	1.006	1.250	0.000	2.277	3.524	MOWD
	01 APR 1959								
	31 DEC 1985	0.030	0.001	0.340	0.550	-0.001	1.916	2.052	DACE
1HA04	01 DEC 1932	0.061	0.000	0.232	-	0.000	1.720	9.461	MOWD
	27 JUN 1955	0.232	-	0.427	-	0.000	2.510	30.081	MOWD
		0.427	-	0.488	0.700	0.000	1.736	15.587	MOWD
	28 JUN 1955								
	31 DEC 1985	0.160	0.000	0.600	0.700	0.088	3.206	30.073	DACE
1HA10	01 JUN 1948	0.220	0.154	0.540	-	-0.154	2.981	21.004	DACE
	06 MAY 1955	0.540	-	2.210	2.450	-0.431	1.237	19.116	DACE
1HA14	26 JUN 1961								
	24 APR 1964	0.213	0.000	0.823	1.500	0.000	2.184	7.877	MOWD
	25 APR 1964								
	28 JUL 1969	0.134	0.000	0.610	1.500	0.000	2.152	9.554	MOWD
	29 JUL 1969								
	10 JUN 1971	0.101	0.000	0.579	1.500	0.000	2.168	7.262	MOWD
	11 JUN 1971								
	31 DEC 1988	0.090	0.000	0.330	1.500	0.079	2.644	9.210	DACE
1HA15	24 APR 1967								
	29 APR 1968	0.366	0.100	0.594	1.800	0.000	1.994	14.307	MOWD
	30 APR 1968								
	03 MAY 1969	0.019	0.000	0.335	1.800	0.000	0.624	7.132	MOWD
	04 MAY 1969								
	30 DEC 1969	0.777	0.000	1.494	1.800	0.000	2.691	1.384	MOWD
	31 DEC 1969								
	02 MAY 1972	0.411	0.000	1.006	1.800	0.000	1.661	4.287	MOWD

Souce: Data Centre(DACE), LBDA.

Table I-39 10-Day, Monthly and Annual Mean Nyando Flow (In m3/sec) at 1GD04, 1956 - 88 (1 of 3)

Year: 1956					1958					1960				
Month	First	Middle	Last	Mean	Month	First	Middle	Last	Mean	Month	First	Middle	Last	Mean
1	11.32	8.49	27.05	15.62	1	2.04	0.79	1.75	1.53	1	1.42	1.49	1.80	1.57
2	7.79	8.43	9.35	8.52	2	1.85	9.04	2.19	4.36	2	1.05	1.08	1.03	1.05
3	3.64	2.63	10.05	5.44	3	1.58	5.74	4.08	3.80	3	3.29	3.95	19.82	9.02
4	13.14	9.34	29.49	17.32	4	1.39	1.32	4.06	2.26	4	25.59	25.50	16.31	22.47
5	16.07	31.04	28.64	25.25	5	11.81	27.55	6.24	15.20	5	19.60	15.65	24.84	20.03
6	15.08	7.78	24.98	15.95	6	9.84	6.47	10.13	8.81	6	10.37	7.25	5.62	7.75
7	21.13	11.53	33.07	21.91	7	18.37	35.40	14.99	22.92	7	6.65	5.21	5.07	5.64
8	29.06	40.60	42.83	37.50	8	11.05	22.24	27.53	20.27	8	4.81	8.23	15.26	9.43
9	45.38	20.95	14.63	26.99	9	20.97	17.42	10.04	16.14	9	19.65	16.58	10.76	15.66
10	15.50	14.66	10.23	13.46	10	7.91	11.07	5.18	8.05	10	8.82	5.75	3.69	6.09
11	7.28	5.47	3.86	5.54	11	3.42	2.78	2.31	2.84	11	3.90	10.14	3.59	5.88
12	8.32	3.54	2.67	4.84	12	1.44	3.23	4.79	3.15	12	1.98	1.36	2.16	1.83
Mean	16.14	13.71	19.74	16.53	Mean	7.64	11.92	7.77	9.11	Mean	8.93	8.52	9.16	8.87

1957					1959					1961				
Month	First	Middle	Last	Mean	Month	First	Middle	Last	Mean	Month	First	Middle	Last	Mean
1	2.85	1.66	2.43	2.31	1	2.04	1.43	2.13	1.87	1	0.90	0.45	0.56	0.64
2	2.34	1.75	1.84	1.98	2	1.91	1.52	1.16	1.53	2	1.02	0.62	0.41	0.68
3	1.51	3.38	2.15	2.35	3	2.48	0.85	5.75	3.03	3	0.47	2.17	2.31	1.65
4	5.43	10.20	28.05	14.56	4	2.41	6.40	9.17	5.99	4	7.08	3.39	3.02	4.50
5	25.40	11.56	24.21	20.39	5	7.41	7.99	14.85	10.08	5	7.06	7.84	3.10	6.00
6	53.46	18.45	34.41	35.44	6	5.29	3.10	2.41	3.60	6	2.53	3.37	1.92	2.61
7	17.58	13.26	13.63	14.82	7	3.14	2.07	2.18	2.46	7	2.26	2.24	3.08	2.53
8	21.01	19.46	17.78	19.42	8	4.93	3.42	3.98	4.11	8	11.38	32.13	29.41	24.31
9	18.24	9.18	5.37	10.93	9	10.93	11.49	5.56	9.33	9	29.55	20.98	13.93	21.49
10	4.46	3.25	3.61	3.77	10	7.52	4.18	4.39	5.36	10	15.51	11.77	8.17	11.82
11	3.47	3.12	2.35	2.98	11	15.53	4.49	4.28	8.10	11	19.13	67.86	64.98 *	50.66
12	2.91	1.82	2.63	2.45	12	4.47	3.27	2.11	3.28	12	45.81	70.15 *	57.78 *	57.91
Mean	13.22	8.09	11.54	10.95	Mean	5.67	4.18	4.83	4.90	Mean	11.89	18.58	15.72	15.40

Year: 1962					1964					1966				
Month	First	Middle	Last	Mean	Month	First	Middle	Last	Mean	Month	First	Middle	Last	Mean
1	57.66 *	40.31 *	26.77 *	41.58	1	12.21	9.50	8.38	10.03	1	4.49 *	3.82 *	3.51 *	3.94
2	12.74 *	9.48 *	8.86 *	10.36	2	8.73	6.98	8.55	8.09	2	5.91	5.46	6.39	5.92
3	10.40 *	16.03	21.38	15.94	3	11.57	6.73	12.37 *	10.22	3	4.50	17.00	10.76	10.75
4	25.26	32.41	57.14	38.27	4	8.63	28.48	68.95	35.35	4	3.70	20.78	46.48	23.65
5	74.97	87.07	48.76	70.27	5	22.46	29.85	18.48	23.60	5	17.07	9.22	8.06	11.45
6	32.56	30.76	55.24	39.52	6	17.70	13.93	15.32	15.65	6	7.58	12.20	8.13	9.30
7	27.13	34.08	32.60	31.27	7	31.19	27.20	26.70	28.36	7	7.31	11.20	11.71	10.07
8	37.31	42.68	34.11	38.03	8	48.50	37.74	27.44	37.89	8	8.71	9.50	17.36	11.86
9	36.50	43.22	33.22	37.65	9	35.40	34.17	30.44	33.34	9	24.99	19.47	10.71	18.39
10	21.16	22.20	27.57	23.64	10	31.98	29.11	16.35	25.81	10	6.99	6.73	5.98	6.57
11	15.81	11.45	12.59	13.28	11	11.29	9.81	8.69	9.93	11	7.60	6.61	5.17	6.46
12	14.78	9.71	13.79	12.76	12	7.54	7.34	8.65	7.84	12	3.93	4.56	3.26	3.92
Mean	30.52	31.62	31.00	31.05	Mean	20.60	20.07	20.86	20.51	Mean	8.57	10.55	11.46	10.19

1963					1965					1967				
Month	First	Middle	Last	Mean	Month	First	Middle	Last	Mean	Month	First	Middle	Last	Mean
1	11.32	11.45	12.98	11.92	1	8.28	6.47	5.00	6.58	1	2.89	2.46	2.61	2.65
2	10.18	15.00	8.65	11.28	2	5.37	4.57	3.85	4.60	2	3.87	2.71	2.26	2.95
3	9.66	14.57	12.45	12.23	3	4.77	3.39	5.02	4.39	3	2.87	2.69	2.53	2.70
4	7.87	19.97	64.42	30.75	4	4.13	5.30	11.04	6.82	4	7.79	11.08	9.36	9.41
5	94.34	86.86	47.13	76.11	5	7.96	6.30	5.88	6.71	5	17.86	30.87	30.42	26.38
6	78.00	25.01	18.39	40.47	6	4.26	3.32	3.80	3.79	6	12.90	10.98	16.38	13.42
7	18.76	16.21	15.39	16.79	7	3.58	4.02	3.78	3.79	7	26.51	29.22	36.19	30.64
8	16.44	34.98	37.29	29.57	8	4.25	4.55	4.90	4.57	8	20.63	16.79	25.16	20.86
9	29.00	14.22	11.22	18.15	9	3.78	3.25	3.93	3.65	9	17.40	11.85	11.39	13.55
10	9.52	9.00	8.20	8.91	10	2.99	3.57 *	6.63	4.40	10	7.92	6.77	9.36	8.02
11	7.29	7.88	27.89	14.35	11	6.71	7.45	4.40	6.19	11	5.98	9.95	31.39	15.77
12	60.76	26.86	19.15	35.59	12	4.28	5.95	4.33	4.85	12	32.81	18.78	12.42	21.34
Mean	29.43	23.50	23.60	25.51	Mean	5.03	4.85	5.21	5.03	Mean	13.29	12.85	15.79	13.97

Table I-39 10-Day, Monthly and Annual Mean Nyando Flow (in m3/sec) at 1GD04, 1956 - 88 (2 of 3)

Year: 1968					1970					1972				
Month	First	Middle	Last	Mean	Month	First	Middle	Last	Mean	Month	First	Middle	Last	Mean
1	6.56	5.12	5.30	5.66	1	2.54	9.53	10.80	7.62	1	5.16	5.29	3.53	4.66
2	4.88	9.15	25.92	13.32	2	8.96	5.68	4.53	6.39	2	7.38	7.03	4.57	6.33
3	13.09	16.16	15.65	14.97	3	8.06	11.39	9.98	9.81	3	3.46	3.48	3.20	3.38
4	23.22	18.05	67.38	36.22	4	13.53	12.05	26.74	17.44	4	2.50	3.51	3.48	3.16
5	34.94	27.86	25.86	29.55	5	20.93	25.59	12.66	19.73	5	16.06	10.08	11.57	12.57
6	20.59	24.22	20.31	21.71	6	15.68	12.97	15.18	14.61	6	11.11	7.94	12.25	10.43
7	15.97	15.11	23.19	18.09	7	15.39	13.52	10.35	13.09	7	15.15	12.91	11.62	13.23
8	25.75	30.57	30.49	28.94	8	13.94	27.69	33.84	25.16	8	10.08	11.24	14.53	11.95
9	15.31	12.13	9.14	12.19	9	22.35	21.40	17.25	20.33	9	8.83	6.91	7.67	7.80
10	8.10	6.98	8.77	7.95	10	12.56	12.97	8.61	11.38	10	5.22	7.25	17.55	10.01
11	8.01	5.63	8.19	7.28	11	7.52	5.81	5.19	6.17	11	26.11	31.27	14.99	24.12
12	19.14	6.94	4.98	10.35	12	4.27	4.95	4.04	4.42	12	10.64	12.05	7.35	10.01
Mean	16.30	14.83	20.43	17.19	Mean	12.14	13.63	13.26	13.01	Mean	10.14	9.91	9.36	9.80

1969					1971					1973				
Month	First	Middle	Last	Mean	Month	First	Middle	Last	Mean	Month	First	Middle	Last	Mean
1	4.19	3.74	9.49	5.81	1	3.29	3.73	3.67	3.56	1	6.13	12.37	7.33	8.61
2	9.10	10.43	15.12	11.55	2	2.63	2.09	2.09	2.27	2	4.83	9.40	13.00	9.08
3	6.16	5.58	15.66	9.13	3	2.17	2.67	2.37	2.40	3	6.72	4.52	3.67	4.97
4	4.31	4.70	3.73	4.25	4	5.03	8.87	16.36	10.09	4	3.04	5.86	4.58	4.49
5	7.08	10.05	7.73	8.29	5	15.13	21.21	15.02	17.12	5	9.72	9.50	11.97	10.40
6	4.55	5.78	5.71	5.35	6	13.99	11.70	18.18	14.62	6	14.22	10.32	9.45	11.33
7	4.54	5.17	5.33	5.01	7	17.35	17.69	24.74	19.93	7	8.04	6.38	7.05	7.16
8	6.58	8.93	7.59	7.70	8	16.71	25.61	30.72	24.35	8	12.19	19.39	18.35	16.64
9	7.90	10.63	6.13	8.22	9	32.01	19.19	15.94	22.38	9	17.43	14.40	20.78	17.54
10	4.22	5.16	4.24	4.54	10	17.96	12.19	10.23	13.46	10	12.46	9.04	6.95	9.48
11	4.21	3.71	3.41	3.78	11	7.78	6.96	5.85	6.86	11	7.83	7.01	6.48	7.11
12	3.50	2.31	2.09	2.63	12	4.74	4.57	7.99	5.77	12	4.52	3.26	3.70	3.83
Mean	5.53	6.35	7.19	6.35	Mean	11.57	11.37	12.76	11.90	Mean	8.93	9.29	9.44	9.22

Year: 1974					1976					1978				
Month	First	Middle	Last	Mean	Month	First	Middle	Last	Mean	Month	First	Middle	Last	Mean
1	4.05	3.34	2.40	3.26	1	4.32	3.59	2.86	3.59	1	9.58	12.20	14.16	11.98
2	2.11	2.24	2.03	2.13	2	2.86	3.40	2.85	3.04	2	8.59	8.39	13.72	10.23
3	3.49	2.19	4.50	3.39	3	2.58	2.17	2.88	2.54	3	13.25	20.23	23.39	18.96
4	18.10	17.60	12.69	16.13	4	3.42	5.03	4.24	4.23	4	20.70	29.71	17.93	22.78
5	9.39	9.08	10.28	9.58	5	4.47	6.20	12.04	7.57	5	27.32	28.89	15.32	23.84
6	15.03	7.23	9.13	10.46	6	10.06	6.97	9.19	8.74	6	11.17	11.79	12.53	11.83
7	21.45	28.12	23.59	24.39	7	8.60	16.41	11.75	12.25	7	18.51	17.30	15.51	17.11
8	14.05	11.30	11.53	12.29	8	11.22	13.88	11.78	12.29	8	19.11	16.85	20.23	18.73
9	14.48	11.03	11.97	12.49	9	17.04	12.30	7.74	12.36	9	23.53	17.99	17.20	19.57
10	9.71	7.72	7.20	8.21	10	6.19	4.69	3.97	4.95	10	19.87	14.67	12.94	15.83
11	5.82	4.94	4.38	5.05	11	3.50	3.48	5.60	4.19	11	11.49	9.66	8.32	9.82
12	3.55	3.82	3.12	3.50	12	4.93	2.35	3.04	3.44	12	6.67	10.81	12.94	10.14
Mean	10.10	9.05	8.57	9.24	Mean	6.60	6.71	6.50	6.60	Mean	15.82	16.54	15.35	15.90

1975					1977					1979				
Month	First	Middle	Last	Mean	Month	First	Middle	Last	Mean	Month	First	Middle	Last	Mean
1	2.73	2.46	2.13	2.44	1	4.52	2.78	3.83	3.71	1	6.96	5.84	10.53	7.78
2	2.11	3.72	2.61	2.81	2	7.62	3.66	5.82	5.70	2	22.13	36.85	23.78	27.59
3	2.34 *	4.63	4.79	3.92	3	4.32	2.91	3.57	3.60	3	12.30	17.88	11.46	13.88
4	3.08	16.02	9.03	9.38	4	16.04	14.69	8.63	13.12	4	17.08	18.05	11.85	15.66
5	3.85	5.59	11.05	6.83	5	32.83	28.84	29.06	30.24	5	14.03	16.81	12.08	14.31
6	13.62	12.32	11.34	12.43	6	23.80	21.77	19.98	21.85	6	12.14	20.48	19.39	17.34
7	6.24	12.62	24.01	14.29	7	23.87	21.09	18.54	21.17	7	18.88	14.12	12.64	15.21
8	22.37	30.99	31.76	28.37	8	24.52	20.88	18.93	21.44	8	21.13	25.83	18.08	21.68
9	55.07	31.25	20.75	35.69	9	15.63	16.06	17.34	16.34	9	13.11	11.20	12.14	12.15
10	26.43	18.80	16.73	20.65	10	10.18	8.85	12.23	10.42	10	9.61	7.33	6.61	7.85
11	10.40	8.12	6.86	8.46	11	17.19	25.05	48.51	30.25	11	8.81	6.34	6.04	7.06
12	10.50	5.65	4.34	6.83	12	21.84	14.84	13.05	16.58	12	5.49	4.83	4.89	5.07
Mean	13.23	12.68	12.12	12.68	Mean	16.86	15.12	16.62	16.20	Mean	13.47	15.46	12.46	13.80

Table I-39 10-Day, Monthly and Annual Mean Nyando Flow (in m3/sec) at 1GD04, 1956 - 88 (3 of 3)

Year: 1980					1982					1984				
Month	First	Middle	Last	Mean	Month	First	Middle	Last	Mean	Month	First	Middle	Last	Mean
1	4.44	3.50	4.30	4.08	1	3.29	2.82	2.28	2.80	1	5.37	4.98	3.93	4.76
2	4.39	2.95	2.56	3.30	2	2.34	5.17	2.29	3.27	2	3.77	2.65	2.71	3.04
3	3.88	3.70	2.70	3.43	3	2.24	2.33	2.60	2.39	3	2.61	2.44	2.25	2.43
4	3.99	10.82	9.21	8.01	4	2.73	5.10	13.90	7.24	4	4.92	5.75	8.02	6.23
5	9.63	24.04	13.97	15.88	5	12.25	18.44	15.51	15.40	5	4.04	3.57	3.18	3.60
6	9.71	10.02	15.50	11.74	6	14.70	9.87	10.97	11.85	6	3.94	4.05	3.67	3.89
7	14.62	13.61	8.42	12.22	7	8.94	6.87	6.47	7.43	7	3.07	3.25	7.26	4.53
8	9.11	7.33	9.74	8.73	8	10.44	15.27	20.95	15.55	8	7.20	8.73	6.49	7.47
9	9.28	7.35	6.32	7.65	9	11.38	8.13	7.90	9.14	9	8.30	5.40	4.00	5.90
10	4.70	5.11	3.88	4.56	10	6.10	7.81	9.33	7.75	10	4.65	4.35	2.60	3.87
11	3.39	4.72	4.82	4.31	11	13.11	13.67	23.35	16.71	11	2.47	3.26	5.37	3.70
12	3.48	3.02	2.66	3.05	12	39.42	16.33	11.68	22.48	12	4.73	5.30	2.50	4.18
Mean	6.72	8.01	7.01	7.25	Mean	10.58	9.32	10.60	10.17	Mean	4.59	4.48	4.33	4.47

1981					1983					1985				
Month	First	Middle	Last	Mean	Month	First	Middle	Last	Mean	Month	First	Middle	Last	Mean
1	2.74	2.21	2.89	2.61	1	9.17	6.87	6.40	7.48	1	2.21	2.57	3.50	2.76
2	6.46 *	2.94	2.05	3.82	2	5.63	4.90	5.25	5.26	2	4.15	2.40	2.18	2.91
3	2.30	6.63	8.18	5.70	3	3.14	4.64	2.84	3.54	3	2.37	2.84	6.15 **	3.79
4	14.77	30.92	25.09	23.59	4	3.40	5.30	10.42	6.37	4	27.21 **	64.40 **	41.29 **	44.30
5	14.83	24.22	11.69	16.91	5	7.03	7.59	8.40	7.67	5	34.67 **	38.96 **	37.93 **	37.19
6	7.93	6.28	6.96	7.06	6	7.85	10.91	10.71	9.82	6	25.54 **	15.28 **	10.53 **	17.12
7	6.29	11.30	17.45	11.68	7	8.32	7.61	10.21	8.71	7	7.27 **	6.99 **	7.27 **	7.18
8	20.12	22.23	18.19	20.18	8	11.24	18.16	24.95	18.12	8	7.46 **	14.23	15.49	12.39
9	16.80	14.95	19.83	17.19	9	24.07	20.55	18.51	21.04	9	15.08	12.86	9.75	12.56
10	17.00	12.46	9.15	12.87	10	17.18	22.69	15.45	18.44	10	7.64	7.23	5.79	6.89
11	7.64	7.07	5.42	6.71	11	12.85	10.42	8.24	10.50	11	5.68 **	4.38 **	2.61 **	4.22
12	4.12	5.20	4.42	4.58	12	6.49	3.22	5.04	4.92	12	4.88	4.27	4.40	4.52
Mean	10.08	12.20	10.94	11.08	Mean	9.70	10.24	10.54	10.16	Mean	12.01	14.70	12.24	12.99

Year: 1986					1988				
Month	First	Middle	Last	Mean	Month	First	Middle	Last	Mean
1	2.12	1.98	1.69	1.93	1	1.54	2.68	3.38	2.53
2	2.33	1.59	1.16	1.69	2	2.11	1.82	1.34	1.76
3	1.61	1.91	1.84	1.79	3	0.92	0.88	5.15	2.32
4	2.29	3.00	7.15	4.15	4	2.71	13.80	26.04	14.18
5	11.46	9.42	10.75	10.54	5	21.28	24.43	10.33	18.68
6	10.49	11.18	7.17	9.61	6	6.46	5.45	3.91	5.27
7	6.38	31.69	5.60 *	14.56	7	8.31 *	7.57 *	10.03 *	8.64
8	6.37	6.68	6.25	6.43	8	27.22	30.68	25.59	27.83
9	4.50	6.22	7.56	6.09	9	28.51	19.44	16.31	21.42
10	5.48	2.97	2.36	3.60	10	24.77	18.45	10.84	18.02
11	2.71	2.88	1.48	2.36	11	8.80	8.61	6.89	8.10
12	1.93	1.75	1.14	1.61	12	3.91	3.52	3.27	3.57
Mean	4.81	6.77	4.51	5.36	Mean	11.38	11.44	10.26	11.03

1987					(Mean 1956-88)	
Month	First	Middle	Last	Mean	Month	Mean
1	0.87	1.16	1.25	1.09	1	6.03
2	0.96	0.74	1.24	0.98	2	5.69
3	2.78	7.41	3.15	4.45	3	6.13
4	2.37	3.62	3.56	3.18	4	14.71
5	4.43	8.76	9.71	7.63	5	19.24
6	16.13	23.34	7.37	15.61	6	13.61
7	7.82	4.35	2.76	4.98	7	13.70
8	1.87	3.64	2.97	2.83	8	18.39
9	2.40	2.50	1.93	2.28	9	15.93
10	1.91	2.35	1.76	2.01	10	9.96
11	8.92 *	13.72 *	7.88 *	10.17	11	9.97
12	2.95	2.17	1.56	2.23	12	8.89
Mean	4.45	6.15	3.76	4.79	Mean	11.85

Note: * These figures are estimated based on the measured of 1HA04 using catchment area propotion and and mean annual discharge ratio of 3.5 (refer to Table A-50).

** Based on the measured discharges of 1HA14 using catchment area propotion and annual discharge ratio of 2.6 (refer to Table A-50).

Other figures come from the measured discharges of 1GD04. The calculation of mean flow in this Table does not imply flow records are complete within any 10-day period.

Table I-40 Monthly and Annual Mean Ainamotua Flow (in m3/sec) at 1GB03, 1968 - 88

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1968	2.47	5.56	7.74	13.64	16.03	14.03	6.01 *	16.16	8.67	5.46	4.84	8.07	9.06
1969	4.04	8.28	6.06	3.70	4.90	4.19	3.87	5.78	6.23	4.04	3.46	2.51	4.76
1970	4.24	2.99	5.15	10.58	11.69	8.68	6.70	12.65	12.87	6.70	4.44	3.78	7.54
1971	1.18 *	0.75 *	1.74	5.91	6.39	6.09	10.04	15.67	14.50	7.57	4.36	3.77	6.50
1972	2.94	3.55	2.33	2.16	6.80	6.66	7.30	7.43	4.71	6.66	14.10	7.11	5.98
1973	5.17	5.43	2.54	2.11	4.35	6.50	3.80	8.43	10.60	5.55	4.23	2.20	5.08
1974	1.76	1.23	1.85	9.34	3.46	3.25	14.28	6.50	7.33	4.71	2.79	1.99	4.87
1975	1.38	1.29	1.55	3.38	3.47	5.89	8.62	15.84	21.81	13.74	5.17	4.39	7.21
1976	2.17	1.79	1.53	2.50	4.66	4.09	5.40	5.36	5.50	2.21	2.15	1.62	3.25
1977	1.99	2.19	1.63	5.21	13.17	8.56	12.53	10.91	9.84	7.12	10.05 *	12.07	7.94
1978	8.14	7.60	11.74	11.45	13.63	8.97	9.83	10.81	13.17	10.21	7.40	6.93	9.99
1979	5.42	9.16 *	10.12	8.95	11.32	11.53	8.94	13.71	8.19	5.38	4.66	3.73	8.43
1980	2.65	1.90	1.94	4.18	7.06	5.54	6.04	4.53	5.92	2.72	2.54	1.09	3.84
1981	0.52	0.44	1.94	7.03	6.25	3.01	5.32	9.05	6.92	5.38	2.75	1.26	4.16
1982	0.87	1.35	0.79 *	2.40 *	5.41	3.24	2.47	5.35	3.04 *	2.87	5.89	7.47 *	3.43
1983	2.48 *	1.75 *	1.18 *	2.12 *	2.55 *	3.26 *	2.89 *	6.02 *	3.70	6.12 *	3.49 *	1.63 *	3.10
1984	1.58 *	1.01 *	0.81 *	2.07 *	1.20 *	1.29 *	1.50 *	2.48 *	1.96 *	1.29 *	1.23 *	1.39 *	1.48
1985	0.92 *	0.97 *	1.26 *	14.71 *	12.35 *	5.69 *	7.04	7.85	6.76	3.62	1.40 *	2.08	5.39
1986	1.52	1.41	1.20	1.73	3.50 *	2.62	5.32	3.26	2.93	1.62	1.59	1.13	2.32
1987	0.81	0.72	2.94	0.96	5.27	7.94	2.35	1.43	1.33	1.12	3.38 *	1.17	2.45
1988	1.51	0.89	2.33	8.61	11.42	3.12	2.87 *	12.05	9.18	5.99 *	2.69 *	1.19 *	5.15
Mean (1968-88)	2.56	2.87	3.26	5.84	7.38	5.91	6.34	8.63	7.86	5.24	4.41	3.65	5.33

Note: * These figures are estimated based on the monthly mean flow table of 1GD04 using catchment area proportion.
The calculation of mean flow in this Table does not imply flow records are complete within any month.

Table I-41 Monthly and Annual Mean Ainamotua Flow (in m3/sec) at 1GB08, 1955 - 61

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1955				2.34	4.32	1.85	2.83	9.51	15.13	10.09	2.83	3.59	
1956	5.05	2.15	1.36	5.82	5.44	4.60	3.94	9.82	6.89	4.99	2.03	1.49	4.47
1957	1.01	1.21	1.10	2.01	5.74	12.07	1.02	5.90	3.67	1.53	1.14	0.97	3.11
1958	1.64	1.75	1.25	0.82	3.67	3.46	12.00	7.11	7.60	2.70 *	0.95 *	1.06 *	3.67
1959													
1960				13.05	11.17				10.79				
1961									11.28				
Mean (1956-58)	2.57	1.70	1.24	2.88	4.95	6.71	5.65	7.61	6.05	3.07	1.37	1.17	3.75

Note: * These figures are estimated based on the monthly mean flow table of 1GD04 using catchment area proportion.
The calculation of mean flow in this Table does not imply flow records are complete within any month.

Table I-42 Monthly and Annual Mean Nyando Flow (in m3/sec) at 1GD02, 1955 - 61

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1955				1.93	4.69	1.26	1.97	13.99	23.81	11.27	2.26	1.58	
1956	6.04	3.61	2.01	5.80	13.14	10.76	17.47	29.17	20.37	8.28	2.88	2.18	10.14
1957	0.94	0.94	1.11	9.93	13.16	21.32	8.98	12.40	6.74	1.51	1.27	0.98	6.61
1958	0.73	1.80	1.75	0.88	5.97	5.54	12.59	15.18	12.28	4.95	1.44	1.48	5.38
1959	1.04	0.85	1.97	3.70	7.00	2.57	1.86	2.61	6.61	2.25	3.77	1.72	3.00
1960	1.14	0.98	6.08	13.88	13.71	5.65	3.13	7.69	11.86	2.97	2.46	1.35	5.91
1961	0.53	0.53	0.56	1.45	3.24	1.76	1.60	20.64	16.73	9.64	27.64 *	31.60 *	9.66
Mean (1956-61)	1.74	1.45	2.25	5.94	9.37	7.93	7.61	14.62	12.43	4.93	6.58	6.55	6.78

Note: * These figures are estimated based on the monthly mean flow table of 1GD04 using catchment area proportion.
The calculation of mean flow in this Table does not imply flow records are complete within any month.

Table I-43 Monthly and Annual Mean Great Oroba Flow (in m3/sec) at 1HA01, 1932 - 88

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1932	0.16	0.12	0.34	0.27				1.39				0.46	
1933	0.22	0.49	0.12	0.12	0.37	0.21	0.48						
1934													
1935													
1936											0.21		
1937													
1938	0.15	0.13	0.28	0.47								0.20	
1939	0.13	0.08	0.06		0.14			0.14	0.17	0.08	0.07	0.01	
1940	0.04	0.03		0.56						0.22	0.62		
1941	0.17	0.09	0.13							0.25			
1942		0.42						1.94		0.29		0.16	
1943	0.03	0.21	0.10	0.13						0.19	0.09	0.18	
1944	0.14	0.07	0.17			0.29	0.11	0.14	0.23	0.15	0.63		
1945	0.12	0.15	0.16	0.14	0.23								
1946													
1947													
1948													
1949													
1950													
1951													
1952													
1953													
1954													
1955								1.10	1.34	1.25			
1956	0.84 *	0.58 *	0.10	0.42	0.97	1.07	1.14	1.37	2.11	2.17	1.25	0.92	1.08
1957	0.89	1.00	0.76	1.26	1.77	2.05	1.93	2.01	1.07	0.45	0.24	0.19	1.14
1958	0.19	0.40	0.43 *	0.31 *	0.46 *	0.52 *	1.08 *	0.88	0.53	0.48	0.20	0.33	0.48
1959	0.10	0.13	0.12	0.12	0.53	0.18	0.11	0.28	0.54	0.81	1.05	0.49	0.37
1960	0.26	0.11	0.54	0.99	0.81	0.72	0.58	0.63	0.82	0.80	0.77	0.31	0.61
1961	0.13	0.12	0.19	0.21	0.23	0.13	0.11	0.15	0.40	0.45	1.95	2.17	0.52
1962	1.88	0.79	0.66	0.89	2.63	2.07	1.33	1.03	0.87	0.91	0.72	0.64	1.20
1963	0.54	0.57	0.44	0.83	2.24	1.51	0.92	0.70	0.61	0.44	0.59	1.37	0.90
1964	0.58	0.50	0.57	1.35	1.22	0.99	0.81	1.07	0.84	0.96	0.63	0.54	0.84
1965	0.43	0.26	0.25	0.40	0.72	0.34	0.34	0.32	0.30	0.29	0.66	0.49	0.40
1966	0.23	0.34	0.60	0.90	0.68	0.65	0.54	0.50	0.53	0.45	0.40	0.25	0.51
1967	0.09	0.07	0.07	0.33	0.68	0.49	0.50	0.43	0.44	0.39	0.71	0.26	0.37
1968	0.51	0.71	0.59	0.96	1.11	1.02	0.87	0.92	0.88	0.88	0.88	0.91	0.85
1969	0.59	1.00	0.66	0.52	0.78	0.59	0.53	0.70	0.66	0.50	0.44	0.25	0.60
1970	0.53	0.34	0.54	0.91	0.99	1.13	0.71	0.75	0.62	0.53	0.53	1.11	0.72
1971	0.27	0.12	0.08	0.45	0.84	0.59	0.55	0.78	0.99	0.72	0.51	0.34	0.52
1972	0.27	0.30	0.18	0.22	0.46	0.51	0.51	0.68	0.54	0.60	1.23	0.80	0.53
1973	0.73	0.53	0.32	0.26	0.59	0.68	0.49	0.45	0.90	0.65	0.98	0.31	0.57
1974	0.23	0.10	0.13	0.56	0.33	0.39	0.74	0.58	1.25	0.98	0.46	0.32	0.51
1975	0.15	0.12	0.17	0.46	0.41	0.28	0.75	0.83	1.12	0.97	0.46	0.38	0.51
1976	0.23	0.15	0.10	0.32	0.56	0.50	0.42	0.45	0.51	0.29	0.32 *	0.23	0.34
1977	0.21	0.29	0.23	0.99	0.86	1.37	1.30	0.95	1.23	0.73 *	2.96 *	1.48	1.05
1978	1.06	0.61	1.00	1.05	1.54	0.77	0.65	0.52	0.53	0.68	0.62	0.55	0.80
1979	0.54	0.81	1.01	1.25	0.90	1.08	0.58	0.80	1.25	0.63	0.59	0.46	0.83
1980	0.32	0.16	0.18	0.61	0.42	0.25	0.80	0.50	0.40	0.42	0.50	0.27	0.40
1981	0.20	0.14	0.21	0.48	0.31	0.43	0.79	0.75	0.77	1.00	0.62	0.57	0.52
1982	0.42	0.28	0.10	0.08	0.87	0.79	0.59	0.45	0.61	0.72	0.99	0.86	0.56
1983	0.37	0.38	0.21	0.49	0.78	0.50	0.58	0.86	0.98	1.27	0.46 *	0.45	0.61
1984	0.43	0.27	0.18	0.76	0.99	0.49	0.65	0.60	0.47	0.58	0.65 *	0.52	0.55
1985	0.12	0.23	0.08	0.59	0.69	0.48	0.73	0.72	0.73	0.50	0.27 *	0.43	0.46
1986	0.33	0.15 *	0.36	0.77	0.66	0.66	0.71	0.53	0.49	0.51	0.51	0.35	0.50
1987	0.27	0.19	0.31	0.26	0.48	0.44	0.37	0.38	0.28	0.34	0.74	0.38	0.37
1988	0.74 *	0.59 *	0.63 *	3.08 *	13.90	1.36	0.80	0.78	1.25	1.17	0.72	0.65	2.14
	0.44	0.37	0.36	0.70	1.25	0.76	0.71	0.71	0.77	0.71	0.75	0.59	0.68

Note: *. These figures are estimated based on the monthly mean flow table of 1HA04 using catchment area proportion.
The calculation of mean flow in this Table does not imply flow records are complete within any month.

Table I-44 Monthly and Annual Mean Little Oroba Flow (in m3/sec) at 1HA02, 1931 - 88

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1931													
1932						0.02				0.01	0.00	0.00	
1933	0.00					0.00							
1934													
1935													
1936								0.02	0.02	0.01	0.00	0.01	
1937	0.00	0.00	0.01	0.06	0.06	0.04	0.02	0.02	0.01	0.01	0.03	0.02	0.02
1938	0.00	0.00	0.01	0.02	0.04	0.04	0.05	0.03	0.05	0.04	0.03	0.01	0.03
1939	0.01	0.00	0.00	0.03	0.02			0.01	0.01	0.00	0.00	0.00	
1940	0.00	0.01	0.04	0.02	0.04	0.03	0.03	0.02	0.02	0.01	0.03	0.02	0.02
1941	0.01	0.00	0.01	0.02	0.05	0.04	0.03	0.02	0.02	0.01	0.04	0.17	0.04
1942	0.02	0.01	0.02	0.06	0.22	0.04	0.02	0.06	0.05	0.01	0.02	0.01	0.05
1943	0.00	0.01	0.01	0.01	0.04	0.02	0.02	0.02	0.02	0.02	0.00	0.01	0.02
1944	0.01	0.00	0.01	0.02	0.02	0.02	0.00	0.01	0.01	0.01	0.03	0.05	0.02
1945	0.01	0.01	0.01	0.01	0.02								
1946													
1947													
1948													
1949													
1950													
1951													
1952													
1953													
1954													
1955								0.01	0.01	0.01			
1956	0.13 *	0.09 *	0.01	0.03	0.03	0.01	0.01	0.02	0.05	0.04	0.02	0.01	0.04
1957	0.03	0.04	0.06	0.15	0.18	0.18	0.19	0.17	0.09	0.02	0.02	0.02	0.10
1958	0.02	0.01	0.01	0.01	0.05	0.03	0.06	0.04	0.02	0.01	0.01	0.01	0.02
1959	0.00	0.00	0.00	0.01	0.03	0.01	0.00	0.02	0.02	0.03	0.09	0.04	0.02
1960	0.02	0.01	0.05	0.16	0.16	0.08	0.05	0.03	0.02	0.02	0.02	0.01	0.05
1961	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.04	0.20	0.25	0.05
1962	0.21	0.07	0.06	0.10	0.30	0.23	0.12	0.09	0.09	0.11	0.06	0.09	0.13
1963	0.05	0.05	0.03	0.13	0.31	0.18	0.09	0.06	0.04	0.02	0.07	0.15	0.10
1964	0.06	0.04	0.08	0.22	0.22	0.11	0.08	0.12	0.10	0.13	0.05	0.04	0.10
1965	0.03	0.02	0.02	0.03	0.07	0.02	0.02	0.02	0.02	0.02	0.06	0.05	0.03
1966	0.02	0.02	0.03	0.12	0.07	0.07	0.05	0.03	0.06	0.03	0.03	0.02	0.05
1967	0.01	0.01	0.01	0.03	0.07	0.05	0.04	0.02	0.02	0.02	0.05	0.29	0.05
1968	0.03	0.06	0.05	0.07	0.07	0.06	0.05	0.06	0.08	0.06	0.05	0.07	0.06
1969	0.03	0.09	0.04	0.03	0.05	0.03	0.02	0.02	0.03	0.02	0.02	0.01	0.03
1970	0.02	0.01	0.03	0.09	0.07	0.06	0.03	0.02	0.02	0.02	0.04	0.03	0.04
1971	0.02	0.01	0.00	0.05	0.11	0.04	0.06	0.09	0.06	0.04	0.02	0.02	0.04
1972	0.01	0.01	0.01	0.02	0.04	0.03	0.03	0.04	0.04	0.07	0.17	0.08	0.05
1973	0.09	0.04	0.02	0.02	0.04	0.04	0.02	0.02	0.04	0.02	0.13	0.02	0.04
1974	0.01	0.00	0.01	0.09	0.03	0.03	0.08	0.03	0.07	0.07	0.03	0.02	0.04
1975	0.01	0.01	0.03	0.05	0.02	0.04	0.07	0.07	0.12	0.08	0.03	0.02	0.05
1976	0.01	0.01	0.00	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.05 *	0.01	0.01
1977	0.01	0.01	0.01	0.03	0.09	0.07	0.09	0.04	0.04	0.12 *	0.48 *	0.11	0.09
1978	0.05	0.03	0.10	0.11	0.13	0.05	0.04	0.03	0.03	0.03	0.03	0.03	0.06
1979	0.02	0.04	0.05	0.06	0.06	0.06	0.04	0.07	0.05	0.03	0.03	0.02	0.04
1980	0.02	0.01	0.01	0.04	0.02	0.02	0.03	0.03	0.03	0.03	0.06	0.03	0.03
1981	0.02	0.01	0.03	0.04	0.03	0.03	0.04	0.03	0.03	0.03	0.03	0.03	0.03
1982	0.03	0.03	0.00	0.02	0.04	0.03	0.03	0.03	0.04	0.06	0.05	0.04	0.03
1983	0.03	0.03	0.02	0.04	0.04	0.03	0.04	0.05	0.16 *	0.20 *	0.07 *	0.03	0.06
1984	0.03	0.02	0.02	0.05	0.04	0.03	0.06	0.05	0.04	0.04	0.10 *	0.04	0.04
1985	0.01	0.02	0.01	0.07	0.09	0.04	0.04	0.04	0.04	0.02	0.04 *	0.01	0.04
1986	0.00	0.02 *	0.06 *	0.12 *	0.11 *	0.11 *	0.11 *	0.09 *	0.08 *	0.08 *	0.08 *	0.06 *	0.08
1987	0.01	0.00	0.02	0.01	0.04	0.03	0.02	0.01	0.01	0.01	0.04	0.01	0.02
1988	0.03	0.01	0.02	0.14	0.21	0.04	0.03	0.03	0.05	0.11	0.04	0.03	0.06
Mean (1956-88)	0.03	0.03	0.03	0.07	0.09	0.06	0.05	0.05	0.05	0.05	0.07	0.05	0.05

Note: *. These figures are roughly estimated based on the monthly mean flow table of 1HA01 using catchment area proportion.
The calculation of mean flow in this Table does not imply flow records are complete within any month.

Table I-45 Monthly and Annual Mean Kibos Flow (in m3/sec) at 1HA04, 1933 - 88

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1933	0.46	0.76	0.24	0.29	1.04	0.89	0.75	0.98	1.63	0.55	0.29	0.43	0.69
1934	0.50	0.02	0.35	0.64	2.06	0.56	0.61	0.67	0.52	0.39	0.38	0.18	0.57
1935	0.07	0.43	0.59	1.09	2.30	3.23	1.23	0.85	0.93	0.75	0.32	0.36	1.01
1936	0.32	1.42	1.88	3.01	1.98	2.83	2.98	1.92	1.21	0.84	0.79	0.67	1.65
1937	0.39	0.45	0.83	4.76									
1938													
1939													
1940	0.18	0.37	1.12	0.86		1.47	1.76	1.03	0.67	0.43	0.98	1.26	0.92
1941	0.37	0.22	0.37	0.84	2.15	1.91	1.02	1.15	1.05	0.75	1.78	4.15	1.31
1942	1.26	0.82	1.11	2.12	4.97	2.49	1.30	2.74	2.37	0.78	0.52	0.37	1.74
1943	0.10	0.39	0.20	0.40	1.57	1.02	0.72	0.90	0.84	0.49	0.21	0.42	0.61
1944	0.39	0.29	0.37	0.62	0.98	0.59	0.24	0.33	0.55	0.32	1.43	1.69	0.65
1945	0.27	0.34	0.40	0.36	0.72	0.91	1.07	1.42	0.78	0.58	0.55	0.66	0.67
1946	0.38		0.11	0.12	0.66	1.20	0.65	2.26	2.91	0.80	1.15	2.24	
1947	0.83	0.57	1.01	2.51	6.31	3.72	2.34	2.60	2.80	1.46	0.69	0.76	2.13
1948	0.28	0.44	0.53	0.58	0.29	0.96	0.58	0.47	0.62	0.47	0.40	0.48	0.51
1949	0.34	0.27		0.73	0.76	1.43	0.89	1.16	0.75	0.62	0.51	0.39	
1950	0.58	0.40	0.74	1.18	0.79	0.97	1.64	1.03	1.54	0.70	0.64	0.54	0.90
1951													
1952	2.57	1.17	0.89	2.28	6.03	3.03	2.21	3.44	3.14	1.95	1.46	0.76	2.41
1953	0.28	0.40	0.59	1.55	0.97	1.20	0.59	0.53	0.77	0.48	0.70	0.64	0.73
1954	0.41	0.49	0.50	0.80	2.10	2.03	1.11	1.29	0.92	0.64	0.50	0.51	0.94
1955	0.60	0.80	0.59	1.18	3.15	1.03	1.90	1.64	3.24	3.09	1.14	1.83	1.68
1956	1.58	1.10	0.61	1.58	2.65	1.95	1.40	1.40	2.09	2.68	1.04	0.59	1.56
1957	0.52	0.59	0.69	1.16	3.82	2.44	1.64	2.03	1.31	0.84	0.79	0.75	1.38
1958	0.62	0.70	0.81	0.59	0.86	0.99	2.03	1.59	0.80	0.82	0.48	1.46	0.98
1959	0.79	0.80	1.23	1.13	2.19	0.71	0.43	0.75	0.83	1.69	2.69	0.98	1.19
1960	0.51	0.81	1.77	3.69	2.97	1.87	1.34	0.90	1.39	1.13	1.30	0.51	1.52
1961	0.65	0.75	0.80	0.90	1.40	0.77	0.50	0.43	1.30	4.56	9.24	10.56	2.66
1962	6.27	1.70	2.22	4.54	4.96 *	6.20	3.45	3.28	2.57	2.80	2.30	1.73	3.50
1963	1.70	1.53	1.14	4.10	7.70	3.90	1.95	1.36	1.11	0.82	2.00	4.29	2.63
1964	1.05	1.10	1.67	4.80	4.25	2.88	2.03	3.70	2.08	4.22	1.58	1.32	2.56
1965	0.98	0.57	0.95	1.37	1.90	0.74	0.67	0.73	0.92	1.07	2.99	1.41	1.19
1966	0.63	0.77	1.80	4.57	3.19	1.53	1.37	1.35	1.42	0.86	1.74	0.57	1.65
1967	0.79	0.68	0.83	1.11	1.98	1.36	1.12	0.89	1.47	1.09	2.14	3.26	1.39
1968	0.92	4.17	3.02	3.43	4.30	5.33	1.89	1.82	2.06	1.58 *	1.36 *	3.81 *	2.81
1969	1.13 *	1.91 *	1.38 *	0.99	3.15	2.00	1.29	1.53	1.61	0.86 *	0.84	0.45	1.43
1970	1.47	1.14	1.91	2.44	3.19	1.98	1.12	0.99	1.13	0.83 *	1.58	1.32	1.59
1971	0.63	0.70	0.67	1.69	3.01	1.35	1.24	2.22	2.44	1.41	0.87	0.85	1.42
1972	0.48	0.54	0.52	0.47	2.71	2.14 *	1.81	2.85	2.04	2.81 *	3.07 *	1.61 *	1.75
1973	2.26	1.54	0.70	1.03	1.84	1.49	1.03	1.31	2.37	1.52	2.02	0.83	1.50
1974	0.49	0.11 *	1.03	4.20	1.93	2.54	4.18	1.50	4.81	3.41	1.24	0.79	2.19
1975	0.39	0.37	0.62	1.50	1.53	1.66	2.51	2.98	3.22	2.79	1.07	0.74	1.62
1976	0.52	0.38	0.41	1.45	1.01	1.34	0.66 *	1.46	1.69	0.67	0.60	0.47	0.89
1977	0.67	1.56	0.99	3.81	4.18	4.02	3.26	1.95	2.64	1.37	5.58	2.63	2.72
1978	3.09	1.79	4.41	5.48	6.62	2.43	1.70	1.61	2.15	2.62	2.15	2.57	3.05
1979	1.34	3.73	2.97	3.74	3.41	3.27	1.90	3.33	2.64	1.13	1.15	1.03	2.47
1980	0.78	0.80	0.64	1.15	3.75	3.41	3.75	1.93	3.01	2.55	1.83	1.26	2.07
1981	0.59	0.99	2.57	6.14	4.44	2.53	4.27	2.18	2.81	2.18	1.28	0.87	2.57
1982	1.52	1.06	1.44	2.69	3.64	3.92	1.80	2.79	2.98	2.53	5.18	4.86	2.87
1983	1.36	0.86	0.69	3.00	3.14	0.92	2.43	8.66	4.00	1.88 *	0.86 *	0.57 *	2.36
1984	0.30 *	0.20 *	0.11 *	0.62 *	0.56 *	0.88 *	1.65 *	1.86 *	0.89 *	0.57 *	1.23 *	0.98 *	0.82
1985	0.23 *	0.44 *	0.44 *	5.34 *	4.49 *	2.07 *	0.87 *	1.17 *	1.77 *	0.95 *	0.51 *	0.36 *	1.55
1986	0.34 *	0.28 *	0.50 *	1.10 *	1.45 *	1.42	1.23	1.17	1.07	0.80	1.04	1.12	0.96
1987	0.99	1.14	1.16	0.81	3.19	3.80	1.08	0.68 *	0.75	0.98	1.65	0.67	1.41
1988	1.40	1.12	1.19	5.82	5.27	1.90	1.14	3.41	2.76	2.27	1.19	0.62	2.34
Mean (1952-88)	1.10	1.05	1.20	2.49	3.16	2.24	1.74	1.97	2.01	1.74	1.85	1.61	1.85

Note: *. These figures are estimated based on the monthly mean flow table of 1HA14 using catchment area proportion.
The calculation of mean flow in this Table does not imply flow records are complete within any month.

Table I-46 Monthly and Annual Mean Awach Flow (in m3/sec) at 1HA14, 1961 - 88

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1961	0.58 *	0.67 *	0.71 *	0.80 *	1.24 *	0.68 *	0.62	0.68	0.96	4.05 *	8.21 *	1.53	1.73
1962	5.57 *	1.51 *	1.97 *	4.04 *	4.41 **	5.51 *	3.07 *	2.92 *	2.28 *	2.49 *	1.31	1.00	3.01
1963	1.05	0.99	1.04	3.23	5.14	2.25	0.97	0.76	0.49	0.32	1.38	2.11	1.64
1964	0.62	0.46	1.22	5.52	3.15	1.98	1.44	1.90	0.76	0.96	1.02	0.55	1.63
1965	0.39	0.23	0.22	1.19	2.66	0.66 *	0.71	0.52	0.49	0.47	0.86	1.62	0.84
1966	0.64	1.12	1.63	7.91	2.72	1.63	1.18	0.76	1.14	0.60	1.49	0.62	1.79
1967	0.36	0.21	0.42	1.94	3.05	1.21	1.06	0.79	0.77	0.61	1.21	3.14	1.23
1968	0.70	0.90	2.76	3.55	4.66	3.94	1.80	1.64	2.03	1.40	1.21	3.39	2.33
1969	1.00	1.70	1.23	1.28	2.23	1.76	1.24	1.75	1.14	0.76	0.74	0.40	1.27
1970	0.42	0.38	0.57	1.29	1.47	1.37	0.63	0.94	0.82	0.74	0.52	0.49	0.80
1971	0.21	0.12	0.08	2.17	2.64	1.50	1.15	1.14	1.91	0.81	0.52	0.64	1.07
1972	0.37	0.39	0.78	0.43	3.18	1.90	1.19	1.59	0.96	2.50	2.73	1.43	1.45
1973	1.61	0.95	0.58	1.00	4.16	1.91	0.78	1.38	2.02	1.15	0.95	0.35	1.40
1974	0.28	0.10	0.36	2.26	1.41	1.58	3.97	1.16	2.15	1.67	0.84	0.44	1.35
1975	0.26	0.36	0.51	2.27	1.39	1.51	1.02	2.57	2.35	1.31	0.58	0.46	1.22
1976	0.29	0.21	0.14	1.21	0.95	0.98	0.59	0.65	0.90	0.35	0.31	0.39	0.58
1977	0.65	0.67	1.05	4.21	3.36	3.42	2.30	1.11	1.30	0.65	1.74	0.93	1.78
1978	0.92	1.07	3.78	3.65	5.92	1.43	0.90	0.81	0.75	0.58	0.59	0.61	1.75
1979	0.49	2.32	1.60	1.65	1.25	1.45	1.13	0.79	0.61	0.31	0.58	0.57	1.06
1980	0.22	0.15	0.35	1.31	2.52	2.59	2.04	0.76	0.98	0.79	0.56	0.33	1.05
1981	0.15	0.24	1.03	3.02	1.71	0.93	1.20	1.07	1.36	0.80	0.47	0.24	1.02
1982	0.20	0.16	0.19	0.53	0.98	1.44	0.73	1.08	2.65 *	0.72	3.32	3.30	1.28
1983	0.68	0.40	0.61 *	1.88	2.51	0.92	0.63	1.12	0.99	1.67	0.76	0.51	1.06
1984	0.27	0.18	0.10	0.55	0.50	0.78	1.47	1.65	0.79 **	0.51	1.09	0.87 **	0.73
1985	0.20 **	0.39 **	0.39	4.75	3.99	1.84	0.77	1.04	1.57	0.84 **	0.45	0.32	1.38
1986	0.30	0.25	0.44	0.98	1.29	0.60	0.37	0.54	0.84	0.71 *	0.92 *	1.00 *	0.69
1987	0.24	0.25	1.01	1.57	1.74	2.68	0.69	0.60	0.47	1.05	1.73	0.51	1.05
1988	0.44	0.76	1.04	4.63	3.51	0.93	0.52	1.45	0.79	0.60	0.43	0.23	1.28
Mean (1961-88)													
	0.68	0.61	0.92	2.46	2.63	1.76	1.22	1.18	1.22	1.05	1.30	1.00	1.34

Note: *. These figures are estimated based on the monthly mean flow table of 1HA04 using catchment area proportion.
**. Based on 1HA01 using catchment area proportion.
The calculation of mean flow in this Table does not imply flow records are complete within any month.

Table I-47 Monthly and Annual Mean Luanda Flow (in m3/sec) at 1HA10, 1948 - 55

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1948													
1949													
1950					0.75	1.31	2.52	1.36	2.12	1.44	0.29	0.25	
1951	0.04	0.19	1.11	18.59	11.82	5.42	1.79	3.84	1.44	2.03			
1952													
1953													
1954		0.08	0.21		3.68	2.98	1.72						
1955	0.21	0.66	0.41										

Note: *. The calculation of mean flow in this Table does not imply flow records are complete within any month.

Table I-48 Monthly and Annual Mean Kibos Flow (in m3/sec) at 1HA15, 1967 - 72

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1967	1.67 *	1.44 *	1.76 *	2.35 *	4.83	2.71	2.35	1.93	2.50	1.77	3.85	5.24	2.70
1968	1.07	1.59	4.89	5.28	4.89	4.84	3.59	3.21	3.27	2.47	2.20	3.71	3.42
1969	1.94	2.87	2.96	4.96	6.68 *	3.81	3.07	3.14	1.56	1.11	1.23	0.93	2.86
1970	3.39	3.34	3.64	4.39	3.84	3.08	2.05	1.88	2.09	2.32	1.94	1.81	2.81
1971	1.28	1.03	0.60	3.27	3.76	2.51	2.33	2.34	2.78	1.77	1.26	1.80 *	2.06
1972	0.65	0.73	0.90	0.64	5.74 *	4.54 *	3.84 *	6.04 *	4.32 *	5.96 *	6.51 *	3.41 *	3.61
Mean (1967-72)													
	1.67	1.83	2.46	3.48	4.96	3.58	2.87	3.09	2.75	2.57	2.83	2.82	2.91

Note: *. These figures are estimated based on the monthly mean flow table of 1HA04 using catchment area proportion.
The calculation of mean flow in this Table does not imply flow records are complete within any month.

Table I-49 Monthly and Annual Mean Sondu Flow (in m3/sec) at 1JG01, 1946 - 89

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
1946					14.12	48.26	37.46	83.08	82.50	33.22	16.95	10.04	
1947	13.16	11.83	15.58	99.60	264.97	79.78	52.07	56.27	59.93	53.99	13.44	8.50	60.76
1948	5.30	3.46	2.79	5.17	9.61	25.33	26.59	57.29	64.40	19.03	10.30	2.78	19.34
1949	3.49	2.78	1.74	4.15	5.53	13.46	15.77	36.09	57.62	23.48	10.85	9.31	15.36
1950	6.58	3.89	5.72	14.07	20.89	22.62	35.44	44.78	57.90	24.23	10.47	6.96	21.13
1951	4.50	4.67	4.23	110.48	920.02	87.55	35.21	45.12	28.54	31.42	45.78	123.48	120.08
1952	60.32	14.73	8.72	44.83	201.45	66.52	29.04	52.92	46.56	25.71	15.73	10.62	48.10
1953	5.49	3.17	2.31	6.16	9.86	10.75	9.85	11.96	9.73	7.05	6.65	6.45	7.45
1954	3.32	1.72	1.58	5.89	45.75	75.33	39.00	34.10	56.07	25.91	13.32	11.00	26.08
1955	5.92	5.55	3.10	6.81	16.26	10.25	16.51	45.16	86.04	63.39	25.04	19.21	25.27
1956	41.62	31.56	14.51	36.77	104.10	75.25	48.16	54.04	86.63	40.64	27.72	16.73	48.14
1957	8.58	6.95	6.57	47.67	113.96	149.81	63.26	53.37	45.54	15.27	10.62	9.40	44.25
1958	6.47	9.71	9.70	9.76	66.99	33.78	34.66	32.82	45.29	27.77	13.87	11.52	25.20
1959	8.64	6.64	11.68	37.04	69.75	35.22	16.09	18.21	28.56	22.84	23.27	14.49	24.37
1960	9.74	6.20	17.90	70.06	62.60	55.34	36.56	40.10	78.78	43.50	23.21	13.08	38.09
1961	6.76	4.54	4.32	9.72	24.06	15.55	12.92	33.03	46.28	56.62	258.81	227.19	58.32
1962	85.56	26.66	12.65	32.71	182.56	111.75	88.55	45.75	86.22	73.18	31.11	18.04	66.23
1963	31.95	24.98	21.17	74.05	264.96	118.43	34.96	51.32	37.63	10.98	12.69	88.08	64.27
1964	33.83	13.38	25.37	183.64	108.52	49.04	69.10	71.89	60.73	75.29	22.12	11.40	60.36
1965	10.03	6.37	4.01	32.45	72.74	23.59	15.38	16.38	17.01	11.81	31.57	22.14	21.96
1966	11.02	11.29	32.36	89.45	80.88	33.29	26.36	24.60	71.05	24.10	22.88	11.86	36.60
1967	6.55	4.35	3.64	19.93	99.09	64.22	75.48	40.09	30.81	17.02	21.22	57.12	36.63
1968	15.32	17.18	51.35	122.92	160.99	92.59	57.35	93.56	46.83	17.75	29.27	93.28	66.53
1969	22.83	48.94	39.46	29.85	37.46	23.70	14.16	16.94	34.87	14.15	9.58	6.89	24.90
1970	14.33	22.60	66.73	126.23	115.65	82.58	42.54	79.93	79.54	59.12	27.14	11.90	60.69
1971	10.54	6.86	4.61	11.21	41.77	66.50	64.14	100.38	93.93	46.17	16.84	10.38	39.44
1972	10.25	9.19	7.44	7.66	32.37	41.38	45.88	44.40	26.74	19.83	74.63	47.23	30.58
1973	43.61	32.63	20.06	12.45	33.23	80.71	31.40	48.67	62.91	36.59	30.01	13.36	37.14
1974	7.11	4.50	5.71	72.24	51.20	56.58	130.91	67.00	55.03	42.84	24.24	11.02	44.03
1975	6.21	4.42	5.50	28.79	33.33	50.50	42.40	94.43	136.64	81.90	36.79	14.41	44.61
1976	8.89	6.17	5.39	8.42	22.84	41.59	58.00	50.89	73.24	21.65	11.29	9.07	26.45
1977	11.65	24.01	13.92	89.55	163.96	81.02	109.92	78.33	55.35	26.12	109.91	78.31	70.17
1978	31.26	28.15	168.06	198.19	153.49	46.46	58.52	55.92	70.46	73.79	40.71	28.57	79.47
1979	21.22	69.63	48.07	69.45	92.72	75.23	56.32	63.41	35.35	15.33	10.08	7.65	47.04
1980	5.87	5.22	7.70	14.76	39.42	55.90	64.56	33.42	32.28	14.00	13.23	10.36	24.73
1981	5.69	6.26	12.53	142.07	93.51	33.41	40.33	79.29	62.33	56.68	22.00	13.11	47.27
1982	7.57	4.48	2.66	4.82	44.02	72.24	36.89	65.10	50.18	35.82	122.30	163.90	50.83
1983	26.80	11.74	7.50	16.96	48.94	50.50	42.83	55.15	107.71	80.22	51.82	24.52	43.72
1984	15.84	8.71	6.25	11.75	14.19	10.18	10.71	29.10	32.29	19.59	15.44	30.52	17.05
1985	9.20	9.40	10.13	104.33	107.73	77.88	46.80	77.65	62.56	22.04	22.96	15.44	47.18
1986	8.43	7.31	7.25	14.20	38.42	36.48	26.02	33.54	32.50	19.22	12.83	15.87	21.01
1987	9.88	7.20	20.87	26.46	68.37	131.46	49.19	24.48	21.01	16.70	35.66	25.65	36.41
1988	15.10	14.39	17.26	82.32	170.86	60.68	52.66	99.32	90.85	82.86	83.78	21.10	65.93
1989	12.20	13.61	14.18	66.66	119.36	54.81	32.07	49.70	80.46				
Mean (1947-88)	16.11	13.18	17.57	50.83	102.60	57.72	44.35	51.34	56.28	35.61	34.55	32.19	42.69

Note: Above figures are summarized after interpolation conducted by the D/D Team of the Sondu/Miriu Hydropower Project.

Table I-50 Comparison of Mean Annual Discharges

(Unit: m3/sec)

Sta.Code (Catchment Area)	1GD04 (2,520 km2)		1HA04 (117 km2)	1HA14 (104 km2)
1956	16.53		1.56	-
1957	10.95		1.38	-
1958	9.11		0.98	-
1959	4.90		1.19	-
1960	8.87		1.52	-
1961	-		-	-
1962	-		-	-
1963	25.51		2.63	1.64
1964	-		-	-
1965	-		-	-
1966	-		-	-
1967	13.97		1.39	1.23
1968	17.19		2.81	2.33
1969	6.35		1.43	1.27
1970	13.01		1.59	0.80
1971	11.90		1.42	1.07
1972	9.80		1.75	1.45
1973	9.22		1.50	1.40
1974	9.24		2.19	1.35
1975	-		-	-
1976	6.60		0.89	0.58
1977	16.20		2.72	1.78
1978	15.90		3.05	1.75
1979	13.80		2.47	1.06
1980	7.25		2.07	1.05
1981	-		-	-
1982	10.17		2.87	1.28
1983	10.16		2.36	1.06
1984	4.47		0.82	0.73
	(1956-84)	(1963-84)	(1956-84)	(1963-84)
Total	251.10	200.74	40.59	21.83
n	22	17	22	17
Ave.	11.41	11.81	1.84	1.28
Ratio *)	$1	$1	$4	$3

Note: *) These parameters indicate the ratios of mean annual discharges of 1HA04 and 1HA14 to those of 1GD04 under the condition of equivalent catchment areas. Above ratios are calculated as follows:

$$3.5 = 1.85 \times (2{,}520 / 117) \times (1 / 11.41)$$
$$2.6 = 1.28 \times (2{,}520 / 104) \times (1 / 11.81)$$

Table I-51 River Basin Runoff Coefficient

Station	Catchment Area (km2)	Annual* Mean Runoff (mm)	Basin** Rainfall (mm)	Runoff Coefficient (%)
1GB03	837	201	1,600	13
1GB08	844	140	1,600	9
1GD02	1,375	156	1,360	11
1GD04	2,520	148	1,460	10
1HA01	62	346	1,830	19
1HA02	10	158	1,750	9
1HA04	117	499	1,860	27
1HA14	104	406	1,800	23

Note: *. Using annual mean flow from Table A-39 to Table A-46.
**. Area weighted basin rainfall using Figure A-3.

Table I-52 Water Abstraction Permits in Kisumu District (1 of 2)

Permit No.	Permit Holder	Use	Norgroabs* (m3/day)	Flodgros* (m3/day)	Isuedate*	Expdate*	River
10223	KENYA TEA DEVELOPMENT AUTHORITY		1,222.06450	3,668.64008	07/25/67	07/31/92	LESSER AINABKHOI
10222	MIWANI SUGAR MNILLS	DOM/GEN IRR	1,222.06450	3,668.64008	06/24/70	03/11/94	LITTLE OROBA
10675	NATIONAL IRRIGATION BOARD (AHERO)	DOMGEM IRR	46.48494	134,561.65694	07/29/70	10/04/93	NYANDO
10681	E. A. SUGAR INDUSTRIES LTD	DOM/IND	7,486.52128	0.00000	07/09/69	07/31/94	NYANDO
10939	CHEMELIL SUGAR CO.,TD	INDUSTRIAL/G. IR	6,116.43895	18,349.31686	07/08/70	09/03/94	AINAMOTUA
11523	JOHN MADETE	DOM/MR, IRR	0.91000	18.20000	03/25/68		GAVULILI
11756	LEONARD ERIO SALE	DOMESTIC	1.37008	0.00000	04/15/70	12/04/93	SOBA
11831	SETTLEMENT FUND TRUSTEES	DOM/MINOR IRR	588.40143	0.00000	08/23/72	07/29/93	KIPTURIU
11927	KISUMU COUNTY COUNCIL	DOMESTIC	222,320.32303	0.00000	02/21/79	12/30/05	AWACH
12585	DIRECTOR OF AGRICULTURE	GEN. IRR	0.00000	768.22473	04/03/75	11/30/79	KIBOS
12870	MUNICIPAL COUNCIL OF KISUMU	PUBLIC	1,370.08233	0.00000	02/18/70	09/05/94	KIBOS
12871	MUNICIPAL COUNCIL OF KISUMU	PUBLIC	137.00823	0.00000	09/20/70	06/05/95	KIBOS
12969	DIRECTOR OF WATER DEV. (NYABONDO WAT. SUP	PUBLIC	905.23296	0.00000	10/26/77	11/11/95	MIRIU (SONDU)
P13470	TOWORO INDUSTRIES	INDUSTRIAL	0.00000	2.73000	07/14/76		WIBWA
13623	KENYA RAILWAYS CORPORATION	OTHER/STEAM RAI	818.20000	0.00000	11/15/83	04/21/96	L.VICTORIA
14312	HOMALIME COMPANY	CONSERVATION	0.00000	0.00000	08/30/72	01/19/97	KORU
15657	KORU WATER PROJECT	DOMESTIC	90.98815	0.00000	08/08/77	05/28/99	KORU
16863	JOAB HENRY ONYANGO OMINO	DOM/GEN. IRR	2.27500	4,031.30000	06/23/76		NYANDO
16820	BACHITAR SINGH SANDO	DOM/GENERAL IRR	5.00000	1,454.50000	01/10/79	06/30/88	LAJA STREAM OF KIBOS
16974	HOMA LIME CO. LTD	DOMESTIC	45.44000	0.00000	05/11/83	05/12/03	KAMBORAGOI
17056	DIRECTOR OF WATER DEP. (MUHORONI WATER)	PUBLIC	272.40000	0.00000	04/27/83	12/25/04	NYANDO
17080	DIR. OF WATER DEPART. NYAHERA WATER	DOMESTIC	272.61000	0.00000	11/28/73	12/31/02	ORINDE
17231	KISUMU COUNTY COUNCIL (RAE)	PUBLIC	182.00000	0.00000	10/05/77		AWACH
17714	OTONGLO RICE $ VEG. GROWERS	DOM/MINOR IRR	0.00000	908.70000	12/13/69	12/31/84	ORINDE
18392	DUNGA QUARRY (1977) LTD	INDUSTRIAL	9.08700	0.00000	04/30/80	05/03/97	BUGURUK
184	AMARJIT SINGH BRAH TEJPAL SINGH	DOM/GEN IRR/MIR	17.12603	470.72114	07/19/72	12/31/83	GREAT OROBA
1947	CHEMELIL SUGAR COMPANY LTD.		0.00000	0.00000			AINAMOTUA
19525	KISUMU COUNTY COUNCIL (MIRANGA WATER PR)		9.08700	0.00000	06/16/83		MBOGO
2039	E. A. POWER AND LIGHTING CO. LTD	INDUSTRIAL	1,223.28779	0.00000	02/25/60	12/31/85	L. VICTORIA
216	MIWANI SUGAR MILLS LTD	INDUSTRIAL	1,086.27956	0.00000	07/22/70	02/28/99	LITTLE OROBA
217	MIWANI SUGAR MILLS LTD	DOMESTIC	11.49891	0.00000	06/24/70	12/31/85	MIWANI SPRINGS
2190	DIRECTOR OF AGRICULTURE	MINOR IRR	28.96745	0.00000			KIBOS
2193	CHEMELIL SISAL ESTATES LTD	DOM/MINOR IRR	650.66678	0.00000	09/02/54	09/01/10	NYANGORO
P22953	DUNGA DUARRY LIMITED	DOMESTIC	4.54500	0.01818	10/02/86		L. VICTORIA
2591	HOMA LIME CO. LTD	DOM/IND	48.80918	0.00000	12/11/53	02/01/24	MURWAMOR TRIB. NYANDO
3045	MUNISCIPAL BOARD OF KISUMU	PUBLIC	12,232.87790	0.00000	08/16/72	01/02/95	L. VICTORIA
4306	MRS ANNA MERCDITA VERLAQUE	DOM/MR IRR	42.32576	7.09507	08/06/59		MEMWA
4307	NARENDRAH GOSAR AND CO.	DOM/INDUS/G. IRR	74.22910	954.16448	08/23/72	02/28/86	NGOTA
4604	SETTLEMENT FUND TRUSTEE	DOM/GEN. IRR	9.05233	113.27645	05/13/68	05/31/84	NAMUTING
7327	KISUMU C. COUNCIL	CONSERVATION	0.00000	0.00000	02/06/74	01/19/95	NYANDIWA SPRINS
7853	SETTLEMENT FUND TRUSTEE	DOMESTIC	26.66767	0.00000	12/23/70		SOBA
7932	BAKHTAWAR SINGH	DOMESTIC/IND	4.96655	1,223.28779	02/15/63	02/28/88	NGAITA
8457	COMMISSIONER OF PRISONS	GEN. IRR	0.00000	1,834.96169	09/26/63	09/30/88	KAMETE

Table I-52 Water Abstractio perrmits in Kisumu District (2 of 2)

Permit No.	Permit Holder	Use	Norgroabs* (m3/day)	Flodgros* (m3/day)	Isuedate*	Expdate*	River
9520	DIRECTOR OF WATER DEV. KIBOSWA WATER	PUBLIC	226.55290	0.00000	10/22/69		SOSIANT TRIB. KISIAN
P15389	JAGAT SINGH AND VASANT SINGH	DOMESTIC	2.27500	0.00000	04/24/74		DRUBA TRIB. OF NYAND
P16243	REHMAT KHAN KARDIN	GEN. IRR	0.00000	4,732.00000	11/29/78		AINAMOTUA
P16357	MINISTRY OF HEALTH CHULAIMBO	DOMESTIC	18.20000	0.00000	04/30/75		AWACH
P16385	NYANJOM FARM	GENERAL/MINOR I	1.36900	18.17400	04/16/75	12/31/81	KIBOS
P16969	COMMISSIDNER OF PRISONS	GENERAL IRR	0.00000	0.91000	06/23/76		KIBOS
P17019	NATIONAL IRRIGATION BOARD (WEST KANO)	DOM/GENERAL IRR	186.90000	146.00000	07/24/83	07/27/84	L. VICTORIA
P17072	KORU NURSING HOMA LTD		0.00000	0.00000	09/01/76		MURWAMOR
P17352	SOUTH NYAKACH FARMERS CO-OP SOCIETY	INDUSTRIAL	22.75000	0.00000	10/05/77		KAMUNWA SPRING
P17359	KOGOLO VEGETABLE GROWERS CO, CP SOC. LTD	GEN. IRR	364.00000	0.00000	10/19/77		NYANDO
P17373	ESAU WANGONYE OYUGI	GENERAL IRR	0.00000	81.47097	03/28/79		NYANDO SWAMP
P18237	AHERO MIKAMU GROUP	GEN. IRR	0.00000	0.18200	11/19/82		NYANDO
P20003	REHMAT KHAN KHARDIN	DOM/GEN. IRR	4.55000	728.00000	09/18/84		KIBOS
P20010	FOAM MATTRESS LTD	OTHER/BLOCK MAI	0.00000	2.00000	10/08/85		SAKA
P21235	DIR. OF WATER KOMBEWA MASEND WATER SUPPI	DOMESTIC	118.30000	0.00000	03/30/83		DARAJA NBILI
P21353	PETER WANGUKU	DOM/GEN. IRR	1.13000	54.00000	11/02/83		KAMIRIRO SRT. TRIB. NYANDO
P218	MIWANT SUGAR MILLS	INDUSTRIAL	2,057.00000	0.00000	01/19/77		GREAT OROBA
P22812	CHANNAH AGRICULTURAL CONSTRUCTORS	DOM/MINOR. IRR	13.83600	18.18200	05/06/85		KIBOS
P23120	HILIKIA OBURA OLUOCH	GEN. IRR	0.00000	36.36300	03/18/87		MAKINDU
P23634	GERSON J. OKOTH	DOM/GENERAL IRR	5.36900	118.30000	11/13/85		NYANDO
P4243	PETER OKOLA OCHIENG	DOM/MINOR. IRR	6.18800	20.02000	11/15/72		LONGINI
P20435	WATER STEVEN OKOWKIAKA	GENERAL. IRR	0.00000	63.70000	01/02/81		L. VICTORIA
P12613	GOIBEI GIRLS SECONDARY SCHOOL	DOMESTIC	9.08700	0.00000	08/29/80		MSAOSI SPRINS
15393	WERA AMBITHO	DOMESTIC	4.54500	54.54500	07/23/85		KAPNDIMO
885	KENYA RAILWAY CORPORATION	DOMESTIC	144,347.95927	0.00000	04/27/83	10/05/98	MJGADA
P19633	KENYA CHEMICALS & FOOD CO-OPERATION LTD	INDUSTRIAL	136.36300	0.00000	02/09/84		L. VICTORIA
P22811	BHAGAT SINGH	DOM/MR IRR	11.37500	9.10000	11/14/85		GREAT ORIOBA
2652	W. B JOSEPH WALLES	G. IRR	0.00000	18.10466	11/11/57	12/31/83	KIPTURU
P10958	NYANDO SUGAR COMPANY LTD	GEN IRR.	0.00000	16,147.39883	06/19/67		NYANDO
P17358	FULL GOSPEL CHURCH OF KENYA	DOMESTIC	455.00000	0.00000	12/20/78		NAMUTING
16634	KISUMU C. COUNCIL (CATHOLIC MISSION AHERO)	MINOR IRR	0.00000	9.05233	03/07/69		NYANDO
218	MIWANI SUGAR MILLS LIMITED	INDUSTRIAL	2,057.00000	0.00000	07/15/86	12/31/20	GREAT OROBA
619	THE ESTATE OF COUNT VON TIELE WINOKLER	DOM/INDUSTRIAL	26.71661	0.00000	10/12/53	01/10/18	TUGENON TRIB. NYANDO
3983	BURET TEA COMPANY LTD	DOM/MR IRR.	50.15480	4.52616	03/07/87	12/31/57	NAMUTING
4168	HOMA LIME COMPANY LIMITED	POWER/INDUSTRIA	27.15699	244.65756	08/14/66	12/31/57	MURWAMOR
P21524	JEPKOYAI DIP WATER PROJECT	DOMESTIC	181.74000	0.00000	02/26/83		WAKHAGULI TRIB. GWAMBE

Source : MOWD and Data Centre, LBDA.

Note (Description) : Norgroabs; Amount abstracted when the river is flowing normally,
Flodgros; Amount abstracted when the river is under floods,
Isuedate; Date when the permit was issued,
Expdate; Date when the permit will expire.

Table I-53 Typical Drought Monthly Discharge at 1GD04

(Unit: m3/sec)

Month	Return Period		
	2-Year	5-Year	10-Year
Jan	5.60	3.46	2.75
Feb	5.28	3.27	2.59
Mar	5.69	3.52	2.79
Apr	13.65	8.44	6.70
May	17.86	11.04	8.77
Jun	12.63	7.81	6.20
Jul	12.72	7.86	6.24
Aug	17.07	10.55	8.38
Sep	14.79	9.14	7.26
Oct	9.25	5.72	4.54
Nov	9.25	5.72	4.54
Dec	8.25	5.10	4.05
Annual Mean	11.00	6.80	5.40

Note: Above figures are calculated based on the following procedures:
First; Estimating probable annual mean discharges from plotting position paper (refer to Fig. A-7),
Second; Estimating monthly discharges based on the observed mean monthly discharge pattern during 1956-88 in accord with the probable annual mean discharges (refer to Table A-39).

Table I-54 Annual Flood Series from Subbasin 1G (1 of 2)

Year	NYANDO 1GD1			NYANDO 1GD4			NYANDO 1GD3		
	Date	Gauge Height (ft/m)	Flow (m3/sec)	Date	Gauge Height (ft/m)	Flow (m3/sec)	Date	Gauge Height (ft/m)	Flow (m3/sec)
1948	14/6	6.00	74.0						
1949	18/5	5.00	49.0						
1950	20/7	6.20	80.0						
1951	10/4	10.00	259.0						
1952	26/4	10.42	286.0						
1953	6/5	4.00	30.0						
1954	10/5	10.10	265.0						
1955	30/9	5.65	65.0	2/10	10.65	127.0			
1956	16/8	6.60	92.0	31/3	10.00	113.0			
1957	1/6	6.70	95.0	1/6	8.43	83.0			
1958	15/5	7.70	136.0	15/5	9.53	103.0			
1959	18/4	6.10	77.0	3/11	4.69	28.0			
1960	24/4	9.60	234.0	2/4	6.82	56.0			
1961	13/12	13.60	214.0 *	27/11	15.00	236.0			
1962	11/5	10.60	142.0	11/5 **	11.00 **	134.0 **			
1963				6/6	9.28	108.0			
1964				24/4	15.00	251.0 ***			
1965				22/4	3.98	33.0			
1966				25/4	7.02	77.0			
1967				24/5	9.35	129.0			
1968				26/4	8.92	176.0			
1969				26/2	5.00	75.0	26/2	3.07	80.0
1970				24/4	6.72	116.0	24/4	5.25	277.0
1971				3/9	5.10	77.0	29/6	3.50	109.0
1972				10/11	6.35	107.0	13/11	4.20	166.0
1973				17/2	6.05	100.0	17/2	3.67	122.0
1974				9/4	12.15	277.0	9/4	5.22	273.0
1975				1/9	8.20	156.0	1/9	4.26	171.0
1976				8/9	2.85	33.0	11/7	2.64	57.0
1977				24/11	9.00	178.0	24/11	6.14	397.0
1978				11/4	9.20	184.0	11/4	4.10	171.0
1979				12/2	12.50	347.0	12/2	5.85	378.0
1980				17/5	4.76	83.0	18/4	4.20	180.0
1981				16/5	7.97	178.0	15/5	3.80	155.0
1982				2/12	8.37	192.0	2/12	4.55	225.0
1983				30/8	4.43	75.0	7/10	3.40	123.0
1984				6/9	1.57	11.0	15/11	2.00	39.0
1985							15/4	5.38	317.0
1986				14/7	2.85	29.0	2/5	3.32	95.0
1987							8/6	3.30	94.0
1988							23/4	6.10	339.0

Source: 1948-1983; Lake Basin River Catchment Development River Profile Studies, Valume II/B, Annex I, October, 1985.
1984-1988; The Study Team.

Note: All levels in Table are from observer observations or chart recoreds.
The documenting of a maximum level in this Table does not imply stage records are complete within any year.

* Grundy estimate 566 m3/s ±30%.

** Grundy reported level at 16.29 ft giving 274 m3/s from rating adopted in 1984.
Grundy estimate 396 m3/s ±30%.

*** Hydromet estimate 385 m3/s but probably for a greater level.

Table I-54 Annual Flood Series from Subbasin 1G (2 of 2)

Year	AINAMOTUA 1GB3			AINAMOTUA 1GB8			NYANDO 1GD2		
	Date	Gauge Height (ft/m)	Flow (m3/sec)	Date	Gauge Height (ft/m)	Flow (m3/sec)	Date	Gauge Height (ft/m)	Flow (m3/sec)
1955									
1956				28/6	3.20	68.0	28/1	2.44	86.0
1957				11/6	2.95	58.0	24/6	2.59	98.0
1958				15/5	4.18	115.0	14/5	2.59	98.0
1959				3/11	1.83	25.0	19/4	2.99	137.0
1960				2/4	2.29	36.0	15/4	1.89	47.0
1961				27/11	4.57	108.0	23/11	2.99	137.0
1962				11/5	3.66	76.0			
1963									
1964									
1965									
1966									
1967									
1968	3/5	2.20	130.0						
1969	26/2	2.15	97.0						
1970	28/3	2.27	113.0						
1971									
1972	5/6	1.82	61.0						
1973	29/5	1.65	47.0						
1974	24/7	1.91	70.0						
1975	4/10	2.40	131.0						
1976	22/5	1.06	14.0						
1977	24/11	2.81	96.0						
1978	11/4	1.94	43.0						
1979	12/2	4.03	219.0						
1980	18/4	2.50	74.0						
1981	18/4	1.60	29.0						
1982									
1983									
1984									
1985									
1986	14/7	0.95	11.0						
1987									
1988									

Source: The Study Team.

Note: All levels in Table are from observer observations or chart recoreds.
The documenting of a maximum level in this Table does not imply stage records are complete within any year.

Table I-55 Annual Flood Series from Subbasin 1H (1 of 2)

Year	GREAT OROBA 1HA1			KIBOS 1HA4			AWACH 1HA14		
	Date	Gauge Height (ft/m)	Flow (m3/sec)	Date	Gauge Height (ft/m)	Flow (m3/sec)	Date	Gauge Height (ft/m)	Flow (m3/sec)
1932	23/4	1.38 ft	2.0						
1933	24/7	1.83	4.6	1/9	1.83	7.0			
1934	11/5	1.38	2.0	8/5	1.99	8.6			
1935	20/5	1.33	1.8	20/5	3.17	27.8			
1936	10/8	1.32	1.7	21/6	3.23	29.1			
1937	13/4	1.44	2.3	2/4	4.27	58.7			
1938	3/5	1.55	2.8						
1939	17/4	1.58	3.0						
1940	1/5	2.42	10.7	29/2	3.25	29.7			
1941	11/6	2.08	6.8	8/12	2.58	16.6			
1942	21/5	2.48	11.5	21/5	2.58	16.6			
1943	25/2	1.60	3.1	14/5	1.85	7.2			
1944	1/12	2.17	7.7	1/12	2.33	12.9			
1945	10/9	1.20	1.3	11/6	3.42	33.8			
1946	11/12	1.76	4.1	10/12	2.58	16.6			
1947	30/4	2.09	6.9	28/5	3.25	29.7			
1948	18/6	1.38	2.0	24/9	2.29	12.3			
1949	24/4	1.45	2.3	10/8	1.80	6.7			
1950	27/3	1.35	1.9	16/4	3.00	24.3			
1951	7/4	1.49	2.5	19/4	6.67	181.0			
1952	3/5	2.93	19.0	25&28/4	3.00	24.3			
1953	14/4	1.58	3.0	14/4	2.10	9.9			
1954	23/8	1.15	1.2	2/5	2.67	18.1			
1955	22/8	1.55	2.8	12/5	2.70	18.6			
1956	6/9	1.63	3.3	30/8	3.00	24.3			
1957	12/6	1.52	2.7	2/5	3.00	24.3			
1958	27/7	1.65	3.4	15/7	2.50	15.3			
1959	3/11	1.82	4.6	3/11	3.00	24.3			
1960	17/11	1.56	2.9	26/4	2.24	11.6			
1961	27/11	2.17	7.7	10/11	3.08	25.9			
1962	19/5	2.28	9.0	20/5	3.10	26.4			
1963	9/5	1.85	4.8	28/4	3.20	28.6	28/4	3.90 ft	11.6
1964	24/4	2.13	7.3	24/4	3.40	33.3	24/4	9.00	71.4
1965	3/5	1.78	4.3	29/4	2.00	8.7	22/10	2.20	4.1
1966	25/4	1.78	4.3	25/4	3.20	28.6	25/4	5.40	28.1
1967	27/11	1.65	3.4	27-28/11	3.00	24.3	2/12	3.40	10.4
1968	29/4	1.82	4.6	6/3	3.20	28.6	29/4	4.50	18.9
1969	10/2	1.42	2.2	17/6	1.80	6.7	25/2	2.15	3.8
1970	24/4	2.18	7.8	6/11	2.36	13.3	31/3	2.30	3.4
1971	18/5	1.60	3.1	17/11	2.50	15.3	3/4	5.35	21.1
1972	20/11	1.44	2.3				21/10	1.55 m	19.2
1973	16/1	1.44	2.3	29/5	1.95	8.2	4/5	1.40	15.7
1974	2/9	1.51	2.6	7&18/9	2.50	15.3	3/7	1.00	8.1
1975	23/10	1.44	2.3	27/7	3.00	24.3	18/8	0.88	6.3
1976	22/5	1.38	2.0	26/4	1.80	6.7	24/4	0.81	5.3
1977	6/5	2.20	8.0	24/11	3.50	35.8	7/4	1.40	15.7
1978	8/5	1.54	2.8	12/5	3.50	30.9	12/5	1.30	13.6
1979	12/4	1.51	2.6	9/5	3.10	26.4	12/2	0.92	6.9
1980	22/11	1.21	1.2	25/5	2.90	22.3	26/5;23/6	0.80	5.2
1981	12/10	1.44	2.3	11/6	3.00	24.3	6/4	0.98	7.8
1982	9/11	0.38 m	1.3	19/4	3.40	33.3	30/11	1.00	7.7
1983	11/10	0.43	1.9				27/4	1.12	9.3
1984	26/4	0.37	1.2				23/7	0.78	5.0
1985	16/4	0.37	1.2						
1986	26/4	0.61	6.0						
1987	29/5	0.38	1.3	16/6	2.49	17.9			
1988				25/4	2.59	20.0	24/4	1.25	19.5

Source: 1932-1981; Lake Basin River Catchment Development River Profile Studies, Valume III, Annex A, October, 1985.
1982-1988; The Study Team.

Note: All levels in Table are from observer observations or chart recoreds.
The documenting of a maximum level in this Table does not imply stage records are complete within any year.

Table I-55 Annual Flood Series from Subbasin 1H (2 of 2)

Year	LITTLE OROBA 1HA2			KIBOS 1HA15		
	Date	Gauge Height (ft/m)	Flow (m3/sec)	Date	Gauge Height (ft/m)	Flow (m3/sec)
1932						
1933						
1934						
1935						
1936						
1937						
1938	23/6	0.26	0.2			
1939	17/4	0.22	0.1			
1940	29/2	0.26	0.2			
1941	9/12	0.41	0.5			
1942	13/5	0.46	0.6			
1943	6/5	0.21	0.1			
1944	1/12	0.33	0.3			
1945						
1946						
1947						
1948						
1949						
1950						
1951						
1952						
1953						
1954						
1955						
1956	9/2	0.25	0.2			
1957	21/4	0.30	0.2			
1958	18/7	0.23	0.1			
1959	3/11	0.37	0.3			
1960	26/4	0.43	0.4			
1961	27/11	0.48	0.5			
1962	16/5	0.45	0.4			
1963	27/4	0.45	0.4			
1964	24/4	0.60	0.8			
1965	3/5	0.38	0.3			
1966	25/4	0.38	0.3			
1967	6/12	0.45	0.4			
1968	27/2	0.43	0.4	29/4	1.36	26.4
1969	12/2	0.37	0.3	16/5	1.72	6.0
1970	24/4	0.37	0.3	17/3	1.29	6.5
1971	17/5	0.42	0.4	18/5	1.22	6.0
1972	23/10	0.35	0.3	2/5	1.62	9.6
1973	20/1	0.55	0.7	20/1	0.73	2.5
1974	16/4	0.28	0.2			
1975	25/7	0.76	1.2			
1976	6/9	0.15	0.1	26/8	0.44	1.1
1977	24/11	0.50	0.5	16/6	1.16	5.5
1978	13/5	0.34	0.3			
1979	28/5	0.26	0.2			
1980	24/11	0.22	0.1			
1981	30/7	0.32	0.2			
1982	13/10	0.26	0.2			
1983						
1984	29/3	0.24	0.1			
1985	17/4	0.24	0.1			
1986						
1987	30/5	0.37	0.3			
1988	5/5	0.83	1.4			

Source: The Study Team.

Note: All levels in Table are from observer observations or chart recoreds.
The documenting of a maximum level in this Table does not imply stage records are complete within any year.

Table I-57 Results of Present Flood Conditions Survey (1 of 3)

Site No.	Place	Max. Depth and Its Month Occurrence		Max. Flood Area (%)
		Depth (ft.)	Month	
1.	Asunda Scheme	5	Apr.	100
2.	Alungo Scheme	4	Apr.	100
3.	Kango Sub Location	1	Apr.	75
4.	Sidho Ogwodo	3	Apr.	50
5.	Mlenye School	2	Apr. & May	75
6.	Sidho Kore Scheme	1.5	Apr.	100
7.	Ahero Irrigation Scheme	3	Apr. & Aug.	95
8.	Katho Sub Location	2	Apr.	90
9.	Ayweyo Location	3	Apr. (& Aug.)	85
10.	Wangaya "1" Sub Location	3	Apr.	30

Site No.	Place	Flood Period		Causes of Flood
		First	Second	
1.	Asunda Scheme	Mar.- Jun.	(Aug. - Sep.)	Oroba River siltation and overflow
2.	Alungo Scheme	Apr. - May	Aug.	Oroba River siltation and overflow , Driftwood
3.	Kango Sub Location	Mar. - May	-	Rainfall
4.	Sidho Ogwodo	Feb. - Jun.	Sep. - Oct.	Rainfall
5.	Mlenye School	Mar. - Jun.	(Aug.)	Rainfall
6.	Sidho Kore Scheme	Apr.- Jun.	Jul. - Aug.	Nyando River overflow
7.	Ahero Irr. Scheme	Mar. - May	Jul. - Aug.	Nyando River overflow
8.	Katho Sub Location	Mar. - Jun.	(Aug.)	Nyando River overflow, Ditches siltation
9.	Ayweyo Location	Mar. - Jun.	(Jul. - Sep.)	Nyaidho and Awach Kano Rivers siltation and overflow
10.	Wangaya "1" Sub-Loc.	Mar. - May	-	Nyando River siltation and overflow, Ditches siltation

Source: Field hearing by the study team.
Note : Phenomena in parentheses mean occational.

Table I-57 Results of Present Flood Conditions Survey (2 of 3)

Site No.	Place	Max. Depth and Its Month Occurrence		Max. Flood Area (%)
		Depth (ft.)	Month	
11.	Gem Rae	2	Apr.	95
12.	Border	2	Apr.	85
13.	Kimira Location	3	Apr.	100
14.	Kobala Sub Location	4	Apr. & May	75
15.	Kusa	2	Mar. - May	along swamp only
16.	Wasare Irrigation Scheme	3	Apr.	95
17.	Kasule & Nyalunya Location	2	Apr.	80
18.	Kochieng Sub Location	5	Feb.	40
19.	Rweya Primary School	1.5	Apr.	65
20.	Chiga Sub Location	4	Apr.	80

Site No.	Place	Flood Period		Causes of Flood
		First	Second	
11.	Gem Rae	Dec. - Jun.	-	Awach Kano River overflow
12.	Border	Mar. - Jun.	-	Nyaidho River overflow
13.	Kimira Location	Feb. - Jun.	Nov. - Jan.	Yogo River siltation and overflow
14.	Kobala Sub Location	Mar. - Jun.	(Aug. or Nov.)	Sondu River overflow
15.	Kusa	Mar. - May	(Dec.)	Bugo stream mouth deposit
16.	Wasare Irr. Scheme	Mar. - May	-	Siltation and overflow of Asawo, Ochuoga and Omondo Rivers
17.	Kasule & Nyalunya Loc.	Apr. - Jun.	Aug. - Oct.	Nyamasaria River siltation and overflow
18.	Kochieng Sub Location	Jan. - May	Aug. - Oct.	Ombeyi River siltation and overflow
19.	Rweya Primary School	Mar. - May	Aug. - Oct.	Siltation and overflow of Mayenya, Akech and Obuso Rivers
20.	Chiga Sub Location	Mar. - Jun.	-	Rainfall

Source: Field hearing by the study team.
Note: Phenomena in parentheses mean occational.

Table I-57 Results of Present Flood Conditions Survey (3 of 3)

Site No.	Place	Max. Depth and Its Month Occurrence		Max. Flood Area (%)
		Depth (ft.)	Month	
21.	Upper Bwanda Sub Loc.	1	Apr.	90
22.	West Kano, Outside Irr. Scheme*)	2	Apr.	75
23.	Kasule Sub Loc.	3	Apr.	70
24.	North West Kano*), Irri. Scheme Sub Location	6	Apr.	30
25.	Ugwe School	2	Apr.	80
26.	Obange Irri. Scheme	Protected from floods by surrounding dyke		
27.	Kabonyo	4	Apr.	90
28.	Lower Bwanda Sub Location	2	Apr. (& Aug.)	90
29.	Kochogo Location	4	Apr.	80
30.	Tura Sub Location	3	Apr. & Aug.	70

Site No.	Place	Flood Period		Causes of Flood
		First	Second	
21.	Upper Bwanda Sub Loc.	Feb. - May	(Jul. - Aug.)	Rainfall, Miriu River siltation
22.	West Kano, Outside Irr. Scheme*)	Mar. - May	(Aug.)	Ombeyi River overflow
23.	Kasule Sub Location	Apr. - May	-	Rainfall
24.	North West Kano*) Irr. Scheme Sub Location	Mar. - Jun.	(Oct. - Dec.)	Rainfall, New Ombeyi River siltation and overflow
25.	Ugwe School	Apr. - Jun.	-	Siltation and overflow of Miriu, Abuogo and Aguko Rivers
26.	Obange Irr. Scheme	Protected from floods by surrounding dyke		
27.	Kabonyo	Apr. - May	-	Rainfall, Miriu River siltation and overflow
28.	Lower Bwanda Sub Loc.	Apr. - May	(Aug.)	Rainfall
29.	Kochogo Location	Apr.- Jul.	(Aug. - Sep.)	Rainfall, Nyando River overflow
30.	Tura Sub Location	Apr. - Jun.	Jul. - Aug.	Nyando River siltation and overflow

Source: Field hearing by the study team
Note: Phenomena in parentheses mean occational.
*) South West Kano Irrigation Sheme is protected from floods by surrounding dyke. On the other hand, North West Kano Irrigation Scheme is damaged by floods partly.

Table I-58 Results of Present Flood Damages Survey (1 of 3)

Site No.	Place	Crops	Livestocks	Human/Health	Private Properties	Public Properties
1.	Asunda Scheme	rice, maize, vegetables, sugarcane	shifting cattles	malaria, bilharzia, cough	stored crops, seeds	school, churches
2.	Alungo Scheme	rice, cotton, maize, sorghum, groundnuts, potatoes, cassava	water borne diseases	malaria bilharzia	shifted location already	shifted location already
3.	Kango Sub-Location	maize, sorghum, cassava, potatoes	shifting cattles	typhoid, malaria, bilharzia	houses	no damages
4.	Sidho Ogwodo	sorghum, maize, beans, cotton	shifting cattles	malaria, shifting residents	houses	school
5.	Mlenye School	sugarcane, cotton, maize, sorghum, vegetables	shifting cattles	malaria, typhoid	houses, furnitures	school
6.	Sidho Kore Scheme	rice, maize, potatoes, sorghum	shifting cattles	malaria, swellings, shifting residents	houses	schools
7.	Ahero Irrigation Scheme	maize, sorghum	shifting cattles	malaria, swellings	houses	schools, church
8.	Katho Sub-Location	rice, cotton, maize, sorghum, beans, vegetables	water borne diseases	malaria, bilharzia, swellings	houses, furnitures	school, cattle dip, road
9.	Ayweyo Location	maize, beans, sorghum, millet	shifting cattles	malaria, bilharzia, swellings	houses, furnitures	schools
10.	Wangaya "1" Sub-Location	sugarcane, cotton, maize, millet, beans	shifting cattles, foot rot	malaria, cholera, swellings, shifting residents	houses	school, churches
11.	Gem Rae	maize, millet, cotton, vegetables, tomatoes	shifting cattles, water borne diseases, killing livestocks	malaria, swellings, flu, shifting residents	houses (building every year), furnitures	schools, main road

Source: Field hearing by the study team.

Table I-58 Results of Present Flood Damages Survey (2 of 3)

Site No.	Place	Crops	Livestocks	Human/Health	Private Properties	Public Properties
12.	Border	maize, millet, cassave, beans, potatoes	shifting cattles, foot rot	bilharzia, swellings	houses	no damages
13.	Kimira Location	tomatoes, cotton, millet, maize, sorghum	shifting cattles, foot rot	malaria, bilharzia, swellings, shifting residents	houses, furnitures	no damages
14.	Kobala Sub-Location	millet, maize, cassava, potatoes, onions, tomatoes, cabbage	shifting cattles, foot rot, killing livestocks, rinderpest	malaria, swellings, measles, shifting residents to school compound	houses, furnitures	school
15.	Kusa	crops damaged	no damages	malaria	houses	no damages
16.	Wasare Irrigation Scheme	rice, cotton, ground nuts, beans, vegetables	shifting cattles, foot rot, killing livestocks	malaria, shifting residents	houses (building every year), furnitures	school, church
17.	Kasule & Nyalunya Location	maize, millet, cotton, beans, potatoes, vegetables	shifting cattles, foot rot, killing livestocks	malaria, swellings, shifting residents	houses	school
18.	Kochieng Sub-Location	maize, sorghum, millet, beans	foot rot	diarrhea, swellings, cough	no damages	no damages
19.	Rweya Primary School	rice, cotton, sugarcane, maize, millet, beans, vegetables, potatoes	shifting cattles, rinderpest,liverfluke, foot & mouth diseases	malaria, bilharzia, river blindness, scurvy, shifting residents	houses, furnitures	schools, churches
20.	Chiga Sub-Location	millet, maize, beans, vegetables	foot rot, killing livestocks	shifting residents	houses, furnitures	schools
21.	Upper Bwanda Sub-Location	rice, cotton, sugarcane, maize, millet, beans	shifting cattles, rinderpest, foot rot	diarrhea, smallpox, scurvy, malaria, shifting residents	houses	schools, church

Source: Field hearing by the study team.

Table I-58 Results of Present Flood Damages Survey (3 of 3)

Site No.	Place	Crops	Livestocks	Human/Health	Private Properties	Public Properties
22.	West Kano, Outside Irrigation Scheme	cotton, rice, maize, millet, beans, vegetables	shifting cattles, rinderpest, foot rot, foot & mouth disease	bilharzia, malaria, typhoid, shifting residents	houses (building every year), furnitures	schools, churches
23.	Kasule Sub-Location	millet, maize	little damages	malaria	no damages (building on high ground)	no damages, (building on high ground)
24.	North West Kano Irr. Scheme Sub-Location	rice, maize, millet, peas, vegetables	rinderpest, foot rot, foot & mouth diseases	malaria, bilharzia, scurvy	houses (building every year)	church
25.	Ugwe School	maize, millet, rice, sugarcane, cotton, potatoes	shifting cattles, rinderpest, foot rot	malaria, bilharzia, diarrhea, shifting residents	houses (building every year), furnitures	school
26.	Obange Irrigation Scheme	no damages	no damages	no damages	no damages	no damages
27.	Kabonyo	cotton, potatoes, maize, millet	shifting cattles, rinderpest, foot rot, foot & mouth disease	malaria, bilharzia, scurvy	houses (building every year)	school
28.	Lower Bwanda Sub-Location	rice, sugarcane, maize, millet, vegetables, potatoes	shifting cattles, rinderpest, foot rot, foot & mouth diseases	malaria scurvy, shifting residents	houses (building every year)	school, church
29.	Kochogo Location	sugarcane, rice, millet, maize, potatoes vegetables, cassava.	shifting cattles, rinderpest, foot rot	malaria, scurvy, shifting residents	houses (building every year)	school, church
30.	Tura Sub-Location	maize, millet	shifting cattles, rinderpest, foot rot, foot & mouth diseases	malaria, scurvy, bilharzia, shifting residents	houses (building every year)	schools

Source: Field hearing by the study team.

Table I-59 Sediment Concentration and Sediment Load (1 of 5)

	Date	Discharge (cms)	Load (Tons/day)	Concentration (ppm)
Station Code 1GB01				
1	57.01.12	0.030	0.173	47.200
2	57.05.14	0.039	0.224	46.000
3	57.05.22	0.055	0.681	100.400
4	57.05.27	0.102	1.808	145.100
5	57.05.28	0.066	0.843	104.900
6	57.06.01	0.049	0.345	57.900
7	57.06.14	0.045	0.315	57.500
8	57.06.28	0.036	0.284	64.800
9	57.07.01	0.039	0.203	43.800
10	57.07.17	0.059	0.914	126.000
11	57.07.28	0.039	0.478	100.300
12	57.08.08	0.063	1.250	163.100
13	57.08.14	0.036	0.224	51.800
14	57.08.29	0.045	0.345	62.000
15	57.09.01	0.036	0.244	54.600
16	57.09.07	0.033	0.203	49.100
17	57.09.16	0.049	0.427	72.200
18	57.10.01	0.036	0.254	56.900
19	57.10.18	0.033	0.193	48.600
20	57.10.23	0.033	0.254	63.300
21	57.11.01	0.030	0.193	51.100
Station Code 1GB05				
1	54.04.17	0.610	9.002	120.500
2	54.05.04	2.080	60.452	236.400
3	54.04.20	0.460	5.222	92.700
4	54.04.09	0.610	6.045	80.900
5	54.05.18	2.940	204.988	569.500
6	54.05.19	2.740	72.126	215.000
7	54.06.15	2.440	47.224	158.100
8	54.08.27	3.800	98.207	211.100
9	57.03.29	1.154	34.249	242.400
10	57.11.12	1.107	17.353	128.100
11	57.11.15	0.905	2.723	24.600
12	57.11.18	0.800	2.570	26.200
13	57.11.27	0.719	1.981	22.500
14	57.12.07	0.800	2.642	27.000
15	57.12.16	0.460	1.107	19.700
16	57.12.11	0.700	2.672	31.200
Station Code 1GB06				
1	55.05.12	1.192	97.170	666.000
2	56.07.26	3.800	342.036	735.200
Station Code 1GB07				
1	54.04.17	0.324	1.910	48.100
2	54.04.20	0.215	1.869	71.000
3	54.04.05	0.324	4.928	124.300
4	54.05.18	0.610	5.944	79.600
5	54.05.19	0.508	26.203	420.900
6	54.08.27	0.690	4.206	49.800
7	54.12.28	0.284	1.118	32.000
8	54.10.22	0.470	3.150	54.700
9	55.01.18	0.215	0.681	25.700
10	55.02.08	0.610	4.440	59.500
11	55.02.04	1.309	78.781	491.600
12	55.03.22	0.186	0.549	24.200
13	55.06.06	0.368	4.369	96.900
14	55.05.09	0.960	14.387	122.400
15	55.05.18	0.415	2.814	55.300
16	55.06.20	0.396	2.550	52.600
17	56.07.26	1.283	19.629	125.000
18	57.03.26	1.065	4.542	34.800
19	57.03.07	0.690	4.003	47.400
20	57.05.23	1.936	12.944	54.600
21	57.07.19	1.065	10.038	77.000
22	57.09.12	0.921	2.896	25.700
23	57.10.04	1.065	8.606	66.000
24	57.10.23	1.309	12.192	75.800
25	57.11.04	1.134	13.025	93.800
26	57.12.05	1.065	6.208	47.600
27	57.12.23	0.775	2.906	30.600
Station Code 1GB08				
1	55.05.13	7.280	0.660	741.300
2	55.05.12	11.400	15.230	1091.300
3	55.02.16	0.772	0.081	83.500
4	55.02.25	0.818	0.102	98.900
5	55.03.22	1.820	0.010	3.800
6	55.03.21	0.430	0.041	73.600
7	55.05.12	17.780	21.946	1008.400
8	55.05.10	6.160	21.336	2826.400
9	55.04.14	1.950	12.263	513.700
10	55.04.26	1.448	0.376	209.500
11	55.11.21	1.872	0.163	72.800
Station Code 1GC04				
1	80.05.17	1.225	11.910	112.520
2	80.06.12	0.151	1.060	81.450
3	80.07.23	0.076	0.970	148.390
4	80.10.08	0.061	1.010	192.070
5	82.01.26	0.008	0.010	19.250
6	82.05.21	0.668	11.770	203.990
Station Code 1GD01				
1	48.01.09	1.112	11.613	85.300
2	48.02.13	1.364	11.440	68.500
3	48.02.27	1.268	14.194	91.400
4	49.01.25	1.236	23.998	158.600
5	49.02.22	0.962	11.511	97.700
6	49.04.19	3.062	181.915	485.300
7	49.04.20	8.580	3272.831	3115.700
8	49.04.21	3.662	616.875	1375.900
9	49.04.28	5.070	580.878	935.800
10	49.04.29	10.220	7238.817	5785.400
11	49.05.02	2.260	100.594	363.600
12	57.03.02	0.680	8.951	107.500
13	49.05.11	2.562	115.153	367.300
14	49.05.16	14.546	7017.868	3940.800
15	49.05.25	12.760	3869.111	2476.700
16	49.06.03	10.892	1095.461	825.100
17	49.06.16	7.780	217.871	228.700
18	49.06.24	3.350	78.760	192.000
19	49.06.30	3.928	161.290	335.400
20	49.07.06	3.998	169.357	346.000
21	49.07.13	4.348	104.689	196.700
22	49.08.24	16.464	1178.692	584.800
23	49.08.31	18.760	1676.776	730.100
24	49.09.30	11.228	913.526	664.600
25	49.10.08	6.200	176.906	233.100
26	49.10.20	3.998	44.856	91.600
27	49.11.03	2.904	40.498	113.900

Source: MOWD and Data Centre, LBDA

Table I-59 Sediment Concentration and Sediment Load (2 of 5)

	Date	Discharge (cms)	Load (Tons/day)	Concentration (ppm)
Station Code 1GD01				
28	49.11.14	2.428	37.247	125.300
29	49.11.22	1.666	20.442	100.200
30	49.12.12	2.802	106.324	309.900
31	50.02.22	0.932	12.822	112.400
32	50.04.20	9.564	1876.450	1602.600
33	50.04.22	17.484	5169.022	2414.800
34	50.05.16	1.952	57.831	242.000
35	50.05.27	5.070	441.371	711.100
36	50.05.04	1.988	45.659	187.600
37	50.06.15	2.140	34.991	133.600
38	50.06.28	4.922	267.889	444.600
39	50.07.31	14.730	1146.698	635.900
40	50.11.16	2.102	24.313	94.500
41	50.11.18	1.952	38.415	160.700
42	50.11.29	1.268	13.523	87.100
43	50.12.06	3.062	152.126	405.800
44	51.02.06	1.952	245.740	1028.300
45	51.04.13	74.000	26500.745	2925.100
46	51.04.13	54.200	20838.211	3140.400
47	51.04.13	36.000	15296.134	3470.600
48	51.04.13	149.600	65512.960	3577.000
49	51.04.11	19.422	6466.413	2719.500
50	51.04.10	153.800	40468.205	2149.200
51	51.08.27	16.968	2108.241	1014.900
52	51.08.30	0.160	2.377	121.400
53	51.06.30	9.810	452.780	377.000
54	51.09.08	11.480	1359.418	967.200
55	51.07.20	5.820	194.381	272.800
56	51.10.13	6.048	255.412	345.000
57	51.10.15	4.208	228.173	442.900
58	51.10.12	3.062	56.744	151.400
59	51.12.04	16.866	2875.818	1392.700
60	51.12.13	22.574	2418.781	875.200
61	51.12.14	39.700	5971.804	1228.700
62	52.02.19	46.400	11251.875	1980.700
63	52.02.18	77.000	19419.062	2060.000
64	52.03.25	1.736	11.521	54.200
65	52.04.22	19.646	2723.032	1132.100
66	52.04.25	16.166	3650.254	1844.300
67	52.05.08	150.000	26938.437	1466.900
68	52.07.22	10.220	614.030	490.700
69	52.07.29	10.304	521.340	413.300
70	52.09.04	30.400	3576.787	961.000
71	52.09.16	36.000	7346.564	1666.900
72	52.08.19	12.158	575.351	386.500
73	53.03.17	0.812	14.529	146.100
74	53.04.21	2.656	452.638	1392.000
75	54.01.20	1.268	15.433	99.400
76	54.02.23	0.668	28.174	344.500
77	53.11.05	1.772	48.331	222.800
78	53.10.15	2.260	893.481	3229.200
79	53.06.23	4.278	174.508	333.200
80	54.02.06	0.520	3.556	55.800
81	54.04.10	2.140	327.762	1251.000
82	54.05.03	42.900	25908.386	4932.900
83	54.05.10	96.000	35079.442	2984.700
84	54.05.10	96.000	27636.216	2351.400
85	54.05.10	83.400	23291.160	2281.100
86	54.05.10	62.400	32051.549	4195.500
87	54.05.10	51.700	19662.678	3106.500
88	54.05.17	12.330	1308.618	866.900
89	54.06.19	35.000	25052.132	5846.500
90	54.07.02	29.400	21176.254	5883.300
91	54.07.02	1.598	1145.256	5853.900
92	55.01.15	1.142	3.414	24.400
93	55.01.31	1.666	211.816	1038.500
94	55.03.23	0.992	9.876	81.300
95	55.05.04	7.780	2479.518	2603.200
96	55.04.13	5.070	936.650	1509.000
97	55.05.06	21.844	2580.447	964.900
98	55.05.06	9.400	1171.539	1018.000
99	55.05.05	28.100	14286.575	4152.800
100	55.05.11	28.100	1767.241	513.700
101	55.05.12	37.250	7719.009	1692.600
102	55.06.02	2.562	81.148	258.700
103	55.06.07	1.952	34.676	145.100
104	55.07.22	2.956	233.497	645.200
105	55.07.28	4.704	212.913	369.700
106	56.06.26	42.050	9376.745	1821.400
107	61.04.10	6.668	1042.721	1277.300
Station Code 1GD02				
1	58.02.09	1.240	11.176	73.800
2	58.02.11	2.300	86.766	308.300
3	58.02.13	3.900	237.744	497.100
4	58.03.02	0.400	2.692	54.900
5	57.04.09	1.408	60.757	362.500
6	57.04.15	16.000	686.816	350.500
7	57.05.04	16.000	76.911	390.800
8	57.05.21	12.800	2595.880	1656.500
9	57.05.29	51.800	10652.760	1679.800
10	57.06.01	75.600	10620.248	1147.400
11	57.06.06	26.200	1199.896	374.000
12	57.06.08	29.800	730.504	200.200
13	57.06.24	75.600	5648.960	610.300
14	57.06.26	21.000	1055.624	410.500
15	57.06.27	23.800	1458.976	500.800
16	57.08.01	8.160	212.344	212.100
17	57.08.07	10.700	419.608	350.200
18	57.08.15	12.800	308.864	197.100
19	57.08.28	10.280	561.848	446.300
20	57.08.30	20.800	2149.856	844.400
21	57.11.25	1.632	20.523	102.900
22	57.11.17	0.480	2.012	34.200
23	57.11.17	0.680	8.707	104.600
24	57.12.03	0.788	3.383	35.100
25	58.01.01	1.004	13.106	106.600
26	58.01.16	0.292	1.676	46.900
27	58.01.25	0.740	25.908	285.700
Station Code 1GD03				
1	71.04.13	5.410	115.000	247.000
2	71.05.10	16.800	365.000	254.000
3	71.06.21	10.700	133.000	143.000
4	71.07.08	14.700	218.000	172.000
5	71.07.26	33.900	644.000	220.000
6	71.08.31	59.000	1941.000	381.000
7	71.09.06	63.200	2212.000	453.000
8	71.10.25	13.600	200.000	170.000
9	71.11.10	9.870	92.400	108.000

Source: MOWD and Data Centre, LBDA

Table I-59 Sediment Concentration and Sediment Load (3 of 5)

	Date	Discharge (cms)	Load (Tons/day)	Concentration (ppm)
Station Code 1GD03				
10	71.12.20	4.720	39.200	96.000
11	72.01.10	4.500	70.800	184.000
12	72.01.17	4.270	53.500	145.000
13	72.01.25	3.700	35.200	110.000
14	72.02.02	6.190	148.000	277.000
15	72.02.09	7.750	278.000	415.000
16	72.02.18	4.520	80.400	206.000
17	72.02.23	4.050	46.600	133.000
18	72.02.29	3.910	48.300	143.000
19	72.03.07	3.320	38.000	132.000
20	72.05.23	2.560	107.000	492.000
21	72.07.20	16.900	374.000	255.000
22	79.08.10	35.077	1181.380	389.810
23	80.05.12	34.996	13169.920	4355.630
24	80.06.19	9.282	89.020	111.000
25	80.07.19	14.287	292.700	237.120
26	80.09.03	10.367	237.470	265.120
27	80.10.14	5.843	156.220	309.440
28	84.05.15	4.427	72.820	190.390
29	84.06.19	5.636	86.770	178.190
30	84.09.13	5.934	100.080	195.200
31	84.09.22	4.965	48.820	113.800
32	84.09.29	3.659	30.710	97.140
33	84.10.06	7.403	787.790	1231.660
34	84.11.14	2.654	22.020	96.050
35	84.11.26	3.854	45.850	137.690
36	85.02.22	1.508	8.780	67.370
37	85.03.05	1.786	10.940	70.920
38	85.03.22	2.870	112.750	454.690
39	85.05.05	27.124	2461.250	1050.240
40	85.05.14	88.227	22199.840	2912.290
Station Code 1GD04				
1	57.01.14	1.174	11.085	77.100
2	55.03.21	0.496	6.624	109.000
3	55.02.25	0.222	9.439	347.300
4	55.03.25	0.766	10.343	110.300
5	55.03.21	0.496	6.878	109.900
6	55.05.12	26.600	4078.224	1252.300
7	55.05.13	13.300	1516.106	931.100
8	55.05.11	42.220	148.347	2800.700
9	55.04.14	3.420	179.791	429.400
10	55.03.30	15.000	13989.477	7617.800
Station Code 1GD05				
1	55.03.16	1.211	62.748	423.100
2	55.05.13	9.000	1452.575	1318.300
3	55.05.12	9.000	1303.254	1182.800
4	55.04.25	1.224	50.922	339.900
5	56.07.19	4.700	134.071	233.000
6	57.01.14	0.626	3.322	43.300
1	84.08.24	0.851	20.450	278.170
2	84.11.14	0.386	13.560	406.630
3	85.01.26	0.166	0.880	61.040
4	85.02.23	0.060	0.260	50.620
5	85.03.02	0.228	1.320	67.130
6	85.03.23	0.259	3.240	144.730
7	85.04.28	1.159	24.770	247.340
8	54.04.12	0.257	3.586	113.900

	Date	Discharge (cms)	Load (Tons/day)	Concentration (ppm)
Station Code 1HA01				
9	54.04.08	0.215	2.428	92.400
10	54.06.18	0.150	0.762	41.400
11	54.08.23	0.532	6.523	100.200
12	55.02.14	0.391	1.869	39.100
13	55.05.06	0.184	5.791	257.400
14	55.04.25	0.193	6.340	268.900
15	55.05.10	0.318	2.438	62.800
Station Code 1HA02				
1	54.04.12	0.024	0.351	117.400
2	54.04.08	0.017	0.205	96.400
3	54.05.18	0.029	0.284	80.200
4	54.11.15	0.004	0.002	3.900
5	55.01.26	0.004	0.002	3.700
6	55.05.06	0.060	3.587	485.200
7	55.06.02	0.017	0.160	75.900
Station Code 1HA03				
1	54.12.22	0.068	0.061	7.500
2	54.04.08	0.031	0.417	109.900
3	54.04.12	0.046	1.026	184.100
4	54.05.18	0.029	0.325	91.500
5	54.09.09	0.016	0.071	39.600
6	55.01.26	0.004	0.010	11.700
7	55.06.21	0.193	3.759	159.500
Station Code 1HA04				
1	84.05.16	0.771	1.700	25.460
2	84.08.29	4.046	62.580	179.010
3	84.09.13	2.145	22.910	123.640
4	84.10.10	1.501	6.720	51.850
5	84.11.17	2.021	17.240	98.720
6	85.01.26	0.609	1.660	31.580
7	85.02.23	0.286	1.400	56.790
8	57.01.02	0.386	3.048	64.400
9	57.01.06	1.450	101.183	570.000
10	57.01.15	0.236	1.280	44.200
11	57.01.26	0.250	1.077	35.200
12	57.02.01	0.494	5.293	87.600
13	57.03.14	0.206	0.925	36.500
14	57.02.19	0.494	1.036	17.200
15	57.02.24	1.668	5.334	26.100
16	57.03.01	0.690	3.332	39.400
17	57.03.16	0.166	0.467	22.900
18	57.03.29	1.088	22.322	167.600
19	57.04.20	3.522	451.419	1046.900
20	57.04.22	3.678	74.341	165.100
21	57.05.02	6.414	810.768	320.400
22	57.05.03	6.414	219.090	279.000
23	57.05.04	4.786	140.980	240.600
24	57.05.06	2.960	49.063	135.400
25	57.05.15	3.164	44.348	114.500
26	57.05.16	5.200	56.337	885.000
27	57.05.17	1.850	43.485	192.000
28	57.05.23	4.448	528.604	970.700
29	57.05.24	2.674	100.828	308.000
30	57.06.11	3.660	38.537	86.000
31	57.08.08	2.960	139.192	384.100
32	57.08.28	1.668	40.762	199.600
33	57.07.03	1.190	10.709	73.500
34	57.08.07	4.872	1895.104	3177.200

Source: MOWD and Data Centre, LBDA

Table I-59 Sediment Concentration and Sediment Load (4 of 5)

	Date	Discharge (cms)	Load (Tons/day)	Concentration (ppm)
Station Code 1HA04				
35	57.08.10	1.450	24.587	138.500
36	57.09.24	0.690	6.777	80.200
37	57.10.23	1.238	58.461	385.700
Station Code 1HA04				
38	57.10.23	2.604	424.962	1333.000
39	57.11.04	0.467	30.246	52.900
40	57.11.06	1.394	73.213	429.000
41	57.11.09	0.434	3.048	57.300
42	57.11.12	1.506	54.945	298.000
43	57.11.16	0.532	4.206	64.600
44	57.12.03	2.604	209.774	658.000
45	57.12.04	0.952	19.152	164.300
46	58.01.01	1.910	214.894	919.000
47	58.01.02	0.650	15.352	192.900
48	57.03.29	3.520	451.419	1046.900
Station Code 1HA07				
1	49.04.25	3.400	4673.600	11200.000
2	49.04.25	6.600	9042.400	11200.000
3	49.04.25	9.400	12801.600	11140.000
4	49.04.26	12.000	19812.000	13520.000
Station Code 1HA08				
1	50.04.20	5.040	115.316	186.900
2	50.05.10	1.238	19.914	131.300
3	50.05.06	0.964	9.642	81.700
4	50.05.16	1.512	15.951	86.300
5	50.05.27	2.060	12.802	50.900
6	50.06.21	1.976	15.545	64.300
7	50.06.15	1.516	16.154	86.800
8	50.07.15	1.650	19.710	97.500
9	50.11.18	1.692	28.854	139.400
10	50.12.08	1.216	18.593	124.600
Station Code 1HA10				
1	49.04.06	0.257	13.340	423.300
2	49.04.12	1.880	597.936	2598.400
3	49.04.20	6.660	590.875	724.700
4	49.04.21	4.760	331.663	569.000
5	49.04.23	4.190	415.178	809.500
6	49.04.25	6.280	621.436	808.300
7	49.04.28	10.200	505.795	405.000
8	49.04.29	5.520	204.927	303.000
9	49.05.02	2.675	66.812	204.000
10	49.05.04	1.529	36.850	197.000
11	49.05.11	0.569	11.237	161.600
12	49.05.13	1.499	91.572	499.000
13	49.04.25	1.649	54.803	270.000
14	49.05.31	0.768	13.767	146.000
15	49.06.16	1.219	16.002	107.300
16	49.06.24	0.985	23.988	199.000
17	49.06.30	1.960	83.566	348.300
18	49.07.13	0.616	6.492	86.100
19	49.08.24	0.786	17.973	186.900
20	49.08.31	0.464	3.190	56.100
21	49.09.30	0.346	1.168	27.700
22	49.10.08	0.257	1.788	57.000
23	49.10.20	0.346	1.666	39.300
24	49.11.03	0.298	2.042	56.100
25	49.11.14	0.272	1.463	44.000

	Date	Discharge (cms)	Load (Tons/day)	Concentration (ppm)
Station Code 1HA10				
26	49.12.12	4.760	1125.047	1930.600
27	50.04.20	4.570	378.297	676.100
28	50.05.04	0.648	9.093	114.500
29	50.05.10	0.327	12.832	320.800
30	50.05.16	0.245	10.963	365.000
31	50.05.27	0.508	9.967	160.300
32	50.06.15	0.733	12.517	139.600
33	50.06.28	0.822	14.508	144.100
34	50.07.31	0.860	4.714	44.800
35	50.11.16	0.068	2.042	244.200
36	50.12.08	0.257	9.327	296.000
37	50.12.29	0.464	31.892	561.000
38	50.11.18	0.228	2.601	93.400
39	51.03.08	0.084	5.232	511.700
40	51.02.09	0.168	31.689	1540.700
41	51.04.12	26.720	1667.480	509.700
42	51.04.12	20.620	1259.535	498.900
43	51.04.11	29.620	3540.130	976.000
44	51.06.30	2.132	70.724	271.000
45	51.07.20	0.786	13.574	141.100
46	51.10.13	0.222	4.958	182.500
47	51.10.12	0.216	4.501	170.200
48	51.12.04	3.278	129.103	321.700
49	52.01.03	7.800	293.583	307.400
50	52.02.14	1.649	92.537	458.300
51	52.03.25	0.985	32.756	271.700
52	52.04.22	6.280	542.178	702.300
53	52.05.01	29.280	663.641	185.100
54	52.05.09	14.000	269.951	157.500
55	52.07.29	2.311	71.262	251.800
56	52.09.09	3.240	243.210	613.100
57	52.08.19	2.935	246.614	686.200
58	52.10.17	0.308	7.884	209.400
59	53.11.20	2.132	223.205	855.200
60	53.06.30	0.126	5.618	363.800
61	53.03.17	0.189	5.690	246.400
62	53.04.21	11.000	2128.378	1580.400
63	54.05.21	4.190	224.942	438.500
64	54.05.17	7.800	186.182	262.200
65	54.04.20	1.052	54.986	427.000
66	54.06.28	1.098	20.279	150.800
67	53.06.23	2.748	254.376	756.000
68	54.01.22	0.437	15.890	296.800
69	54.05.05	5.900	386.588	535.200
70	54.06.26	1.098	22.179	165.000
71	55.04.27	1.098	39.228	291.800
72	55.05.10	2.311	85.060	300.600
73	55.05.06	3.240	265.013	668.100
74	49.07.06	1.098	23.124	348.300
1	54.05.03	4.800	550.692	937.100
2	54.04.30	0.976	32.949	275.900
3	54.05.17	3.260	148.234	571.400
4	54.06.19	2.500	121.453	396.800
5	54.06.28	1.819	65.054	292.200
6	54.08.23	3.080	260.675	891.300
7	54.09.15	1.647	140.452	696.400
8	55.01.17	0.179	1.331	60.700
9	56.07.26	0.026	0.538	172.400
10	56.11.21	0.293	1.900	53.000

Source: MOWD and Data Centre, LBDA

Table I-59 Sediment Concentration and Sediment Load (5 of 5)

	Date	Discharge (cms)	Load (Tons/day)	Concentration (ppm)
Station Code 1HA12				
11	71.06.04	5.680	145.000	296.000
12	71.07.10	1.680	36.600	252.000
13	71.08.28	3.790	77.800	238.000
14	71.12.16	0.820	12.600	176.000
15	72.01.15	0.730	9.300	146.000
16	72.02.11	0.630	5.900	108.000
17	72.03.09	0.510	3.700	83.000
18	72.06.10	3.880	108.000	322.000
19	72.07.11	2.770	37.900	158.000
Station Code 1HA14				
1	80.08.05	0.783	5.220	77.160
2	80.10.08	0.632	14.120	258.550
3	81.02.18	0.474	7.550	184.440
4	84.05.17	0.319	4.600	166.930
Station Code 1HA14				
5	84.06.20	1.214	50.770	484.010
6	84.08.29	1.726	76.590	513.610
7	84.09.13	0.800	5.820	84.160
8	84.10.10	0.740	9.440	147.690
9	84.11.17	0.954	19.280	233.900
10	85.01.26	0.624	14.060	260.820
11	85.02.23	0.327	2.340	82.870
12	85.03.02	0.447	11.080	287.200
13	85.03.23	0.692	47.300	791.050
14	85.04.28	4.624	104.680	262.020
Station Code 1HA16				
1	80.07.29	2.792	31.180	129.270
2	80.08.06	1.595	17.080	123.920
3	80.10.28	2.537	15.740	71.820

Source: MOWD and Data Centre, LBDA

Table I-60 Suspended Sediment Grain Size Distribution of River Nyando, 1GD03

Date	Flow	Percentage of particles smaller than size (diameters in mm)								
	m^3/s	.002	.005	.02	.05	.063	.125	.250	.50	1.00
8.6.71	24.2	60.1	78.1	96.1	98.9	99.4	99.6	100.0	-	-
21.6.71	10.7	65.8	65.8	65.8	98.7	100.0	-	-	-	-
8.7.71	14.7	80.5	-	97.0	98.8	100.0	-	-	-	-
19.7.71	28.2	53.9	67.4	99.0	-	-	99.5	-	100.0	-
26.7.71	33.9	56.9	78.0	91.6	97.9	100.0	-	-	-	-
31.8.71	59.0	43.2	56.8	82.0	94.2	99.2	-	99.8	100.0	-
6.9.71	63.2	41.2	58.0	84.4	91.6	94.7	98.5	99.6	99.9	-
15.9.71	31.2	49.2	73.4	97.6	-	100.0	-	-	-	-
22.9.71	19.5	42.4	63.6	72.3	95.5	97.3	98.8	99.3	100.0	-
29.12.71	11.8	53.3	65.2	97.2	98.8	99.3	99.6	99.8	100.0	-
10.1.72	4.50	6.6	20.6	66.7	88.9	92.2	96.0	99.3	99.9	-
17.1.72	4.27	37.0	51.4	68.1	98.0	98.7	99.5	99.7	100.0	-
2.2.72	6.19	25.4	43.2	69.9	97.9	98.8	99.4	99.9	100.0	-
9.2.72	7.75	51.2	61.7	82.0	95.2	97.0	99.3	99.8	100.0	-
18.2.72	4.52	32.7	57.3	83.8	97.0	97.2	96.6	99.2	99.9	100.0
23.2.72	4.05	22.5	56.1	80.8	93.2	96.4	99.3	100.0	-	-
29.2.72	3.91	22.4	57.1	81.6	97.9	98.6	99.1	99.3	99.5	99.8
7.3.72	3.32	32.0	58.7	75.8	98.2	98.4	99.1	99.6	100.0	-
25.4.72	5.56	33.4	65.9	89.9	89.9	91.6	92.6	94.8	97.9	99.9
23.5.72	2.56	36.9	56.0	77.8	77.8	78.9	82.1	87.5	93.2	100.0
20.7.72	16.9	30.4	41.6	74.4	90.9	92.0	97.5	99.7	100.0	-

Source: Lake Basin River Catchment Development River Profile Studies, Volume II/B, Annex I, 1985.

Table I-61 Suspended Sediment Grain Size Distribution of River Kibos, 1HA12

Date	Flow	Percentage of particles smaller than size (diameters in mm)								
	m^3/s	.002	.005	.02	.05	.063	.125	.250	.50	1.00
4.6.71	5.68	42.3	53.4	-	95.8	99.6	100	-	-	-
11.2.72	.63	8.9	32.7	63.5	92.3	93.6	97.7	99.0	99.6	100
8.5.72	5.92	38.5	51.9	66.9	73.3	77.0	84.6	92.7	98.8	100
10.6.72	3.88	29.5	37.1	73.4	85.6	90.2	96.3	99.0	100	-
11.7.72	2.77	10.4	18.7	25.4	35.8	36.8	49.3	73.2	93.9	100

Source: Hydrometeorological Survey of the Catchments of Lakes Victoria, Kyoga and Albert, Vol I, Part II, 1974.

Table I-63 Results of Water Quality Analyses for River Nyando and Sondu/Miriu

	Sample Station Test Parameter	Nyando River, 1GD1	Nyando River, 1GD4	Sondu/Miriu River, 1JG3	Sondu/Miriu River, 1JG1
1.	pH	6.8	6.8	7.5	7.2
2.	Conductivity (μS/CM)	380	380	60	50
3.	Dissolved solids (mg/1)	260	240	80	70
4.	Alkalinity ($CaCO_3$ mg/1)	100	100	50	60
5.	Suspended Solids (mg/1)	430	450	100	100
6.	Sodium (Na^+ mg/1)	20	22	14	10
7.	Potassium (K^+ mg/1)	2.8	1.4	0.4	0.3
8.	Magnesium (Mg^{2+} mg/1)	<0.01	<0.01	<0.01	<0.01
9.	Calcium (Ca^{2+} mg/1)	50	48	29	28
10.	Chlorine (Cl^- mg/1)	30	32	21	25
11.	Nitrates ($N.No_3^-$ mg/1)	8.5	6.2	2.2	2.0
12.	Nitrite ($N.No_2^-$ mg/1)	0	0	0	0
13.	Ammonia (NH_4^+ mg/1)	0.4	0.5	0.0	0.0
14.	Phosphate ($P.Po_4^{3-}$ mg/1)	0.06	0.08	0.02	0.02
15.	Sulphates (SO_4^{2-} mg/1)	200	250	190	190
16.	B.O.D$_5$ (O_2 mg/1)	8.0	8.0	4.2	3.0
17.	SAR	0.8	0.9	0.7	0.5

Source : Prepared by JICA Study Team

Table I-64 Acceptable Levels of Various Physico-Chemical Values in Water Used for Domestic Consumption (A), Wildlife Watering (B) and Irrigation (C) in KENYA

	Parameter		(A)	(B)	(C)
1.	pH	GE/LE	6.5/8.5	6.5/9.0	4.5/9.0
2.	Conductivity (μS/CM)	LE	150	-	-
3.	Dissolved solids (mg/1)	LE	500	2,500	500
4.	Alkalinity ($CaCO_3$ mg/1)	GE/LE	30/500	20/1000	-
5.	Suspended Solids (mg/1)	LE	1.0	-	-
6.	Sodium (Na^+ mg/1)	LE	270	1,000	1,500
7.	Potassium (K^+ mg/1)	LE	-	-	-
8.	Magnesium (Mg^{2+} mg/1)	LE	0.05	-	-
9.	Calcium (Ca^{2+} mg/1)	LE	200	1,000	1,500
10.	Chlorine (Cl^- mg/1)	LE	250	-	150
11.	Nitrates ($N.No_3^-$ mg/1)	LE	8.0	20	-
12.	Nitrite ($N.No_2^-$ mg/1)	LE	4.0	10	-
13.	Ammonia (NH_4^+ mg/1)	LE	0.01	0.4	-
14.	Phosphate ($P.Po_4^{3-}$ mg/1)	LE	0.01	0.2	-
15.	Sulphates (SO_4^{2-} mg/1)	LE	500	1,000	-
16.	B.O.D$_5$ (O_2 mg/1)	LE	4	10	10

Note: GE = Greater than or Equal to, LE = Less than or Equal to.

Source : Prepared by JICA Study Team

Table I-65 Physical and Chemical Characteristics of Water Quality of Nyando River (1 of 2)

	pH	Colour (Hazen)	Turbidity (ATU)	P-V (mg/l)	Conductivity (µS/cm)	Fe (mg/l)	Mn (mg/l)	Ca (mg/l)	Mg (mg/l)	K (mg/l)	Al (mg/l)	Total-Hardness (mg/l)	Total-Alkalinity (mg/l)
Station Code NY.1 (Nyando River at 1GD7)													
Samples	10	8	6	4	10	7	5	4	3	-	-	9	10
Min.	7.1	5	10.0	7.20	100.0	0.02	0.02	12.00	3.90	-	-	8.00	10.00
Max.	8.2	750	200.0	59.00	315.0	6.50	0.50	25.70	7.30	-	-	102.00	156.00
Station Code NY.2 (Nyando River at 1GD1)													
Samples	10	7	7	6	10	7	7	5	4	-	-	10	10
Min.	7.1	50	30.0	9.40	48.0	0.03	0.07	0.90	4.40	-	-	20.00	7.60
Max.	8.0	660	165.0	98.60	320.0	16.00	0.70	29.00	8.30	-	-	111.00	164.00
Station Code NY.3 (Ainamotua River at 1GB5)													
Samples	10	6	7	6	10	7	6	5	3	1	2	10	10
Min.	7.1	5	11.0	2.50	160.0	0.03	0.01	14.50	4.00	96.00	120.00	18.00	0.52
Max.	8.4	250	172.0	48.70	310.0	8.90	0.30	35.00	11.20	96.00	134.00	152.00	157.00
Station Code NY.4 (Ainamotua River at 1GB9)													
Samples	8	6	5	4	4	6	7	4	3	-	-	8	8
Min.	7.0	5	5.0	4.50	170.0	0.06	0.01	30.00	6.30	-	-	44.00	42.00
Max.	8.5	400	85.0	34.80	355.0	8.80	0.50	264.00	12.60	-	-	166.00	190.00
Station Code NY.5 (Kapchure River at 1GD10)													
Samples	9	7	5	5	9	7	4	5	4	-	-	9	9
Min.	6.9	5	8.0	14.00	100.0	0.02	0.02	3.10	3.40	-	-	32.00	4.80
Max.	7.7	700	63.0	47.00	145.0	2.50	0.25	18.00	4.50	-	-	60.00	80.00
Station Code NY.6 (Nyando River at 1GD4)													
Samples	6	4	5	4	6	4	5	4	3	-	-	6	6
Min.	6.9	15	12.0	3.40	120.0	0.10	0.02	13.00	6.50	-	-	74.00	82.00
Max.	8.1	700	234.0	63.00	310.0	16.00	0.40	28.00	11.00	-	-	114.00	142.00
Station Code NY.7 (Nyando River at 1GD8)													
Samples	9	5	5	5	9	5	6	4	4	-	-	8	9
Min.	6.9	5	22.0	14.00	120.0	0.02	0.01	6.80	5.60	-	-	38.00	26.00
Max.	8.0	2,500	900.0	126.00	300.0	210.00	11.00	32.00	18.00	-	-	250.00	164.00
All Stations													
Samples	62	43	40	34	58	43	40	31	24	1	2	60	62
Min.	6.9	5	5.0	2.50	48.0	0.02	0.01	0.90	3.40	96.00	120.00	8.00	0.52
Max.	8.5	2,500	900.0	126.00	355.0	210.00	11.00	264.00	18.00	96.00	134.00	250.00	190.00

Table I-65 Physical and Chemical Characteristics of Water Quality of Nyando River (2 of 2)

	Cl (mg/l)	Fluoride (mg/l)	NO_3-N (mg/l)	NO_2-N (mg/l)	NH_4 (mg/l)	SO_4 (mg/l)	P (mg/l)	TDS (mg/l)	Ortho (mg/l)	TSS (mg/l)	COD (mg/l)
Station Code NY.1 (Nyando River at 1GD7)											
Samples	9	6	6	5	1	3	-	2	7	-	1
Min.	4.00	0.15	0.04	0.02	0.90	0.30	-	138.0	0.09	-	5.30
Max.	8.00	20.60	2.50	0.03	0.90	2.90	-	189.0	0.42	-	5.30
Station Code NY.2 (Nyando River at 1GD1)											
Samples	10	7	6	5	1	4	-	4	8	1	1
Min.	3.00	0.30	0.05	0.01	0.85	1.50	-	90.0	0.05	0.04	27.00
Max.	11.00	1.50	3.00	0.10	0.85	3.10	-	193.0	6.60	0.04	27.00
Station Code NY.3 (Ainamotua River at 1GB5)											
Samples	9	7	5	3	1	8	-	3	6	-	-
Min.	0.40	0.04	0.01	0.01	0.25	0.10	-	120.0	0.04	-	-
Max.	8.00	1.80	2.50	0.04	0.25	5.00	-	174.0	0.40	-	-
Station Code NY.4 (Ainamotua River at 1GB9)											
Samples	7	5	5	5	1	3	-	4	8	-	-
Min.	2.00	0.19	0.01	0.02	0.25	0.30	-	113.0	0.13	-	-
Max.	7.00	0.85	2.80	0.04	0.25	3.30	-	216.0	3.20	-	-
Station Code NY.5 (Kapchure River at 1GD10)											
Samples	9	6	6	5	1	5	-	4	7	-	-
Min.	1.00	0.19	0.01	0.03	0.03	0.10	-	60.0	0.05	-	-
Max.	8.00	0.50	2.00	0.80	0.30	3.00	-	87.0	0.45	-	-
Station Code NY.6 (Nyando River at 1GD4)											
Samples	6	5	4	3	1	4	-	3	4	-	-
Min.	2.00	0.29	0.01	0.01	0.60	0.30	-	108.0	0.12	-	-
Max.	8.00	4.00	2.70	0.03	0.60	8.60	-	186.0	0.35	-	-
Station Code NY.7 (Nyando River at 1GD8)											
Samples	9	5	4	4	1	4	-	2	5	-	-
Min.	3.00	0.10	0.06	0.02	1.40	0.03	-	147.0	0.16	-	-
Max.	15.00	1.30	4.00	0.28	1.40	5.30	-	180.0	0.50	-	-
All Stations											
Samples	59	41	36	30	7	31	-	22	45	1	2
Min.	0.40	0.04	0.01	0.01	0.03	0.03	-	60.0	0.04	0.04	5.30
Max.	15.00	20.60	4.00	0.80	1.40	8.60	-	216.0	6.60	0.04	27.00

Source:MOWD and Data Centre, LBDA.
Note:Sampling was dated from 13 April 1982 to 22 September 1987.

Table I-66 Physical and Chemical Characteristics of Water Quality of Sondu/Miriu River (1 of 2)

	pH	Colour (Hazen)	Turbidity (ATU)	P-V (mg/l)	Conductivity (µS/cm)	Fe (mg/l)	Mn (mg/l)	Ca (mg/l)	Mg (mg/l)	K (mg/l)	Al (mg/l)	Total-Hardness (mg/l)	Total-Alkalinity (mg/l)
Station Code MI.1 (Miriu River at 1JB3)													
Samples	10	8	6	4	10	6	5	2	2	-	-	10	10
Min.	6.7	5	1.0	4.00	23.0	0.02	0.01	2.40	2.40	-	-	2.00	10.00
Max.	7.4	85	40.0	19.00	260.0	3.50	0.20	3.10	3.40	-	-	24.00	34.00
Station Code MI.2 (Kimungu River at Londian Road, Kericho)													
Samples	7	5	4	3	7	5	5	3	3	-	-	7	7
Min.	6.6	5	2.0	3.16	40.0	0.02	0.01	4.00	0.50	-	-	12.00	12.00
Max.	7.9	250	16.0	8.85	80.0	3.40	0.20	4.80	1.40	-	-	38.00	32.00
Station Code MI.3 (Kimungu River at Bridge, Kericho/Sotik Road)													
Samples	10	7	6	5	10	7	6	3	3	-	-	9	10
Min.	6.5	5	2.0	4.10	26.0	0.02	0.01	2.40	1.00	-	-	2.00	6.00
Max.	8.4	30	15.0	22.25	250.0	0.80	0.20	4.00	3.40	-	-	40.00	34.00
Station Code MI.4 (Kipsonoi River at Bridge, Sotik/Kericho Road)													
Samples	9	5	7	5	9	6	5	4	4	-	-	9	9
Min.	6.5	50	1.0	3.16	27.0	0.04	0.20	2.40	1.00	-	-	4.00	12.00
Max.	7.3	250	85.0	38.00	480.0	9.50	0.60	7.20	2.90	-	-	45.00	42.00
Station Code MI.5 (Sondu River at 1JG1)													
Samples	10	7	8	6	10	7	8	4	3	-	-	10	10
Min.	6.5	5	9.0	2.50	40.0	0.03	0.01	2.40	1.00	-	-	10.00	10.00
Max.	8.6	75	220.0	31.60	200.0	2.30	0.50	7.90	3.50	-	-	104.00	120.00
Station Code MI.6 (Sondu River at 1JG2)													
Samples	7	7	4	2	7	5	7	1	-	-	-	7	7
Min.	7.0	15	5.0	4.00	25.0	0.05	0.01	4.00	-	-	-	12.00	3.00
Max.	8.9	100	85.0	14.00	75.0	1.20	12.00	4.00	-	-	-	40.00	34.00
All Stations													
Samples	53	39	35	25	53	36	36	17	15	-	-	52	53
Min.	6.5	5	1.0	2.50	23.00	0.02	0.01	2.40	0.50	-	-	2.00	3.00
Max.	8.9	250	220.0	38.00	480.00	9.50	12.00	7.90	3.50	-	-	104.00	120.00

Table I-66 Physical and Chemical Characteristics of Water Quality of Sondu/Miriu River (2 of 2)

	Cl (mg/l)	Fluoride (mg/l)	NO_3-N (mg/l)	NO_2-N (mg/l)	NH_4 (mg/l)	SO_4 (mg/l)	P (mg/l)	TDS (mg/l)	Ortho (mg/l)	TSS (mg/l)	COD (mg/l)
Station Code MI.1 (Miriu River at 1JB3)											
Samples	10	6	4	4	-	3	3	3	4	-	-
Min.	1.00	0.05	0.90	0.10	-	0.80	0.04	0.1	0.30	-	-
Max.	15.00	0.80	11.30	0.18	-	10.00	0.37	28.0	15.00	-	-
Station Code MI.2 (Kimungu River at Londian Road, Kericho)											
Samples	7	4	3	3	-	5	2	-	2	-	-
Min.	2.00	0.09	0.80	0.02	-	0.90	0.03	-	0.30	-	-
Max.	6.00	0.30	1.90	0.03	-	2.50	0.37	-	0.42	-	-
Station Code MI.3 (Kimungu River at Bridge, Kericho/Sotik Road)											
Samples	10	4	4	5	-	6	4	-	3	-	-
Min.	0.01	0.05	1.00	0.01	-	0.50	0.03	-	0.25	-	-
Max.	7.00	0.20	1.80	1.00	-	5.00	0.32	-	0.59	-	-
Station Code MI.4 (Kipsonoi River at Bridge, Sotik/Kericho Road)											
Samples	8	6	3	3	-	4	3	-	2	-	-
Min.	4.00	0.07	1.20	0.02	-	0.60	0.01	-	0.26	-	-
Max.	10.00	0.70	1.90	0.04	-	7.00	0.37	-	0.30	-	-
Station Code MI.5 (Sondu River at 1JG1)											
Samples	9	6	4	4	1	3	2	2	2	-	-
Min.	2.00	0.05	1.20	0.02	0.32	0.90	0.02	24.6	0.28	-	-
Max.	6.00	0.60	1.50	0.03	0.32	1.00	0.15	38.0	0.36	-	-
Station Code MI.6 (Sondu River at 1JG2)											
Samples	4	3	3	3	-	2	3	1	2	-	-
Min.	2.00	0.15	1.50	0.01	-	8.00	0.02	45.0	0.29	-	-
Max.	4.00	0.65	8.00	0.93	-	9.00	0.40	45.0	0.40	-	-
All Stations											
Samples	48	29	21	22	1	23	17	6	15	-	-
Min.	0.01	0.05	0.80	0.01	0.32	0.50	0.01	0.1	0.25	-	-
Max.	15.00	0.80	11.30	1.00	0.32	10.00	0.40	45.0	15.00	-	-

Source:MOWD and Data Centre, LBDA.
Note:Sampling was dated from 13 April 1982 to 24 September 1987.

Table I-67 Locations of Water Quality Gauging Stations in Winam Gulf, Lake Victoria

Station Code	Bearings	Location
1	34° 49 'E 0° 18 'S	1 km into lake from Nyando mouth in Nyakach Bay off Sondu Miriu mouth
2	34° 45 'E 0° 18 'S	Off Sondu Miriu mouth
3	34° 36 'E 0° 20 'S	Kendu Bay off Awach river
4	34° 27 'E 0° 20 'S	Open water off Homa point and Gingra rock
5	34° 30 'E 0° 27 'S	Off Oluch river near Homa Bay town
6	34° 17 'E 0° 24 'S	Off lighthouse near Uyoma point
7	34° 12 'E 0° 25 'S	Mbita causeway west 100 m from causeway
8	34° 12 'E 0° 25 'S	Mbita causeway east 50 m from causeway
9	34° 28 'E 0° 31 'S	100 m off Homa Bay sewage lagoons
10	34° 44 'E 0° 06 'S	70 m off Kisumu water supply intake
17	34° 46 'E 0° 11 'S	Off Kibos river mouth 100 m into lake
22	34° 41 'E 0° 06 'S	50 m off Kisian river mouth
24	34° 33 'E 0° 06 'S	Off Nyakagaral island northshore of gulf between rock and island 200 m SW of rock
25	34° 27 'E 0° 11 'S	500 m off shore of Asembo northshore of gulf
26	34° 18 'E 0° 13 'S	Centre of Asembo Bay
30	34° 42 'E 0° 14 'S	Between Karonga island and Sondu Miriu mouth
31	34° 35 'E 0° 15 'S	On line between Rambuga island and Wire hill (flat topped)
32	34° 06 'E 0° 22 'S	West of Pusinga Due south of Bridge island
33	34° 05 'E 0° 16 'S	Due west of Saga island approx. 7 1/2-8 miles
34	34° 14 'E 0° 12 'S	In mouth of Pusinga channel between Ulugi pt and island
36	34° 23 'E 0° 23 'S	At intersection of Homa Bay and channels from main lake and gulf
37	34° 27 'E 0° 16 'S	Homa Bay north of Homa Bay town north of Siriki point
38	34° 28 'E 0° 16 'S	On line between Gingra rock and island south of Asumbo
39	34° 31 'E 0° 09 'S	On line between Ndere island and Homa mountain
40	34° 42 'E 0° 09 'S	On line Hippo point to Homa mouth

Source : Prepared by JICA Study Team

Table I-68 Physical and Chemical Characteristics of Water Quality in Winam Gulf, Lake Victoria (1 of 4)

	Temperature (°C)	Conductivity (µS/cm)	Turbidity (ATU)	DO (mg/l)	pH	Alkalinity (mg/l)	Chloride (mg/l)	Phosphate (mg/l)	Nitrate (mg/l)	Nitrite (mg/l)	Ammonia (mg/l)	Silica (mg/l)	Sulphate (mg/l)
Station Code 1.													
Samples	165	165	98	168	161	64	-	1	3	-	3	3	1
Min.	24.0	130.0	2.0	1.40	7.0	52.00	-	0.01	0.10	-	0.50	1.20	2.30
Max.	29.6	221.0	69.0	10.80	9.7	155.00	-	0.01	0.10	-	0.70	2.00	2.30
Station Code 2.													
Samples	26	24	19	23	18	17	-	-	-	-	-	-	1
Min.	20.3	43.3	6.5	3.80	6.0	14.00	-	-	-	-	-	-	1.80
Max.	27.4	148.0	180.0	8.80	9.2	89.00	-	-	-	-	-	-	1.80
Station Code 3.													
Samples	15	19	11	19	14	13	-	-	1	-	1	1	-
Min.	24.0	100.9	17.0	3.80	7.2	50.00	-	-	0.35	-	0.80	1.40	-
Max.	28.4	150.0	81.0	8.80	9.0	72.00	-	-	0.35	-	0.80	1.40	-
Station Code 4.													
Samples	17	17	7	17	8	7	-	-	-	-	-	-	-
Min.	25.0	112.0	5.0	5.00	6.9	48.00	-	-	-	-	-	-	-
Max.	26.5	140.0	8.8	9.20	7.4	70.00	-	-	-	-	-	-	-
Station Code 5.													
Samples	14	9	6	12	8	2	-	-	-	-	-	-	-
Min.	26.0	130.0	5.1	4.03	7.8	53.00	-	-	-	-	-	-	-
Max.	26.5	160.0	12.0	8.05	8.4	55.00	-	-	-	-	-	-	-
Station Code 6.													
Samples	85	81	49	76	50	43	10	1	3	-	3	3	-
Min.	23.0	110.0	2.5	2.07	6.3	46.00	7.30	0.04	0.10	-	0.20	0.60	-
Max.	26.8	142.3	8.5	9.04	8.8	80.00	23.50	0.04	0.10	-	0.35	0.60	-
Station Code 7.													
Samples	18	18	16	17	17	13	-	1	1	-	-	1	-
Min.	24.9	88.0	2.2	2.70	7.4	39.00	-	0.01	0.10	-	-	0.01	-
Max.	28.5	110.6	21.0	9.45	9.5	66.00	-	0.01	0.10	-	-	0.01	-
Station Code 8.													
Samples	28	24	22	31	22	22	-	3	3	1	3	1	-
Min.	24.2	92.0	2.9	4.96	6.5	48.00	-	0.04	0.10	0.80	0.40	0.50	-
Max.	26.5	132.0	6.9	10.60	8.8	68.00	-	0.04	0.10	0.80	0.60	0.50	-

Table I-68 Physical and Chemical Characteristics of Water Quality in Winam Gulf, Lake Victoria (2 of 4)

	Temperature (°C)	Conductivity (µS/cm)	Turbidity (ATU)	DO (mg/l)	pH	Alkalinity (mg/l)	Chloride (mg/l)	Phosphate (mg/l)	Nitrate (mg/l)	Nitrite (mg/l)	Ammonia (mg/l)	Silica (mg/l)	Sulphate (mg/l)
Station Code 9.													
Samples	8	8	6	8	6	2	-	-	-	-	-	-	-
Min.	25.0	120.0	10.0	5.50	7.4	55.00	-	-	-	-	-	-	-
Max.	26.0	140.0	56.0	7.40	8.9	55.00	-	-	-	-	-	-	-
Station Code 10.													
Samples	59	58	37	61	27	39	-	-	-	-	-	-	-
Min.	24.7	120.0	6.2	3.10	7.3	51.00	-	-	-	-	-	-	-
Max.	29.0	220.0	23.0	10.30	9.5	87.00	-	-	-	-	-	-	-
Station Code 17.													
Samples	12	10	6	12	6	5	-	-	-	-	-	-	-
Min.	22.5	110.0	7.0	3.00	7.8	59.00	-	-	-	-	-	-	-
Max.	28.0	140.0	52.0	9.66	8.7	63.00	-	-	-	-	-	-	-
Station Code 22.													
Samples	9	9	9	10	6	6	-	-	-	-	-	-	-
Min.	26.0	125.0	11.0	6.81	8.2	60.90	-	-	-	-	-	-	-
Max.	27.1	140.0	21.0	7.80	9.8	71.00	-	-	-	-	-	-	-
Station Code 24.													
Samples	3	3	3	3	3	3	-	-	-	-	-	-	-
Min.	25.0	120.0	4.7	7.50	8.7	57.00	-	-	-	-	-	-	-
Max.	26.0	135.0	5.0	8.20	8.9	63.00	-	-	-	-	-	-	-
Station Code 25.													
Samples	3	3	3	3	3	3	-	-	-	-	-	-	-
Min.	24.5	130.0	6.1	7.10	8.9	51.00	-	-	-	-	-	-	-
Max.	26.5	135.0	7.2	9.10	9.2	63.00	-	-	-	-	-	-	-
Station Code 26.													
Samples	3	3	3	3	3	3	-	-	-	-	-	-	-
Min.	24.6	128.0	6.5	7.00	8.7	56.00	-	-	-	-	-	-	-
Max.	26.0	139.0	7.3	8.80	9.1	60.00	-	-	-	-	-	-	-
Station Code 30.													
Samples	16	15	13	14	15	14	-	-	-	-	-	-	-
Min.	23.5	126.0	6.6	4.00	7.7	63.00	-	-	-	-	-	-	-
Max.	27.0	145.0	10.2	8.20	8.2	79.00	-	-	-	-	-	-	-

Table I-68 Physical and Chemical Characteristics of Water Quality in Winam Gulf, Lake Victoria (3 of 4)

	Tempera-ture (°C)	Conducti-vity (µS/cm)	Turbi-dity (ATU)	DO (mg/l)	pH	Alkali-nity (mg/l)	Chloride (mg/l)	Phosphate (mg/l)	Nitrate (mg/l)	Nitrite (mg/l)	Ammonia (mg/l)	Silica (mg/l)	Sulphate (mg/l)
Station Code 31.													
Samples	27	24	21	26	24	24	6	-	3	-	2	3	-
Min.	24.0	125.0	3.1	4.04	7.4	54.00	10.40	-	0.01	-	0.35	0.60	-
Max.	26.5	150.0	13.0	8.50	8.7	81.00	21.40	-	0.10	-	0.40	0.70	-
Station Code 32.													
Samples	35	25	31	34	31	31	11	1	2	-	2	1	-
Min.	24.0	86.0	1.4	1.90	7.3	33.00	1.80	0.01	0.10	-	0.35	0.40	-
Max.	26.2	102.5	6.5	9.20	9.5	55.00	17.50	0.01	0.20	-	0.70	0.40	-
Station Code 33.													
Samples	17	16	15	16	15	6	-	-	-	-	-	-	-
Min.	24.0	85.0	1.4	0.70	7.1	39.00	-	-	-	-	-	-	-
Max.	27.0	90.0	4.1	10.60	8.5	41.00	-	-	-	-	-	-	-
Station Code 34.													
Samples	135	114	81	119	81	52	8	1	2	-	2	2	-
Min.	23.3	88.0	2.2	1.30	7.0	41.00	5.70	0.01	0.10	-	0.20	0.30	-
Max.	28.5	122.5	10.0	9.80	9.2	63.00	20.60	0.01	0.15	-	0.35	0.30	-
Station Code 36.													
Samples	68	61	22	65	22	16	8	-	2	-	-	2	-
Min.	23.5	120.0	3.2	0.20	7.6	48.00	14.90	-	0.10	-	-	0.60	-
Max.	27.5	144.3	6.6	8.15	9.0	75.00	30.50	-	0.10	-	-	0.70	-
Station Code 37.													
Samples	15	13	12	15	11	8	4	-	3	-	3	3	-
Min.	24.2	120.0	9.2	4.31	7.8	66.00	12.00	-	0.10	-	0.10	0.50	-
Max.	26.5	154.8	13.0	8.10	8.9	75.10	18.50	-	0.10	-	0.40	0.50	-
Station Code 38.													
Samples	3	3	3	3	3	3	-	-	-	-	-	-	-
Min.	23.5	130.0	3.6	6.20	8.0	54.00	-	-	-	-	-	-	-
Max.	24.0	130.0	4.1	7.20	8.2	55.00	-	-	-	-	-	-	-
Station Code 39.													
Samples	8	2	6	8	6	6	-	-	-	-	-	-	-
Min.	23.5	125.0	3.3	2.30	7.4	55.00	-	-	-	-	-	-	-
Max.	26.9	125.0	6.4	8.72	8.3	85.00	-	-	-	-	-	-	-

Table I-68 Physical and Chemical Characteristics of Water Quality in Winam Gulf, Lake Victoria (4 of 4)

	Tempera-ture (°C)	Conducti-vity (µS/cm)	Turbi-dity (ATU)	DO (mg/l)	pH	Alkali-nity (mg/l)	Chloride (mg/l)	Phosphate (mg/l)	Nitrate (mg/l)	Nitrite (mg/l)	Ammonia (mg/l)	Silica (mg/l)	Sulphate (mg/l)
Station Code 40.													
Samples	1	4	3	-	3	3	-	-	-	-	-	-	-
Min.	27.5	140.0	8.5	-	7.6	63.00	-	-	-	-	-	-	-
Max.	27.5	140.0	11.0	-	7.9	74.00	-	-	-	-	-	-	-
All Stations													
Samples	790	728	502	763	563	405	47	8	23	1	19	20	2
Min.	20.3	43.3	1.4	0.20	6.0	14.00	1.80	0.01	0.01	0.80	0.10	0.01	1.80
Max.	29.6	221.0	180.0	10.80	9.8	155.00	30.50	0.04	0.35	0.80	0.80	2.00	2.30

Source:MOWD and Data Centre, LBDA.

Note:1) Sampling was dated from 8 June 1984 to 13 February 1986.

2) Sampling depth ranged from ø to 45 m.

Figures

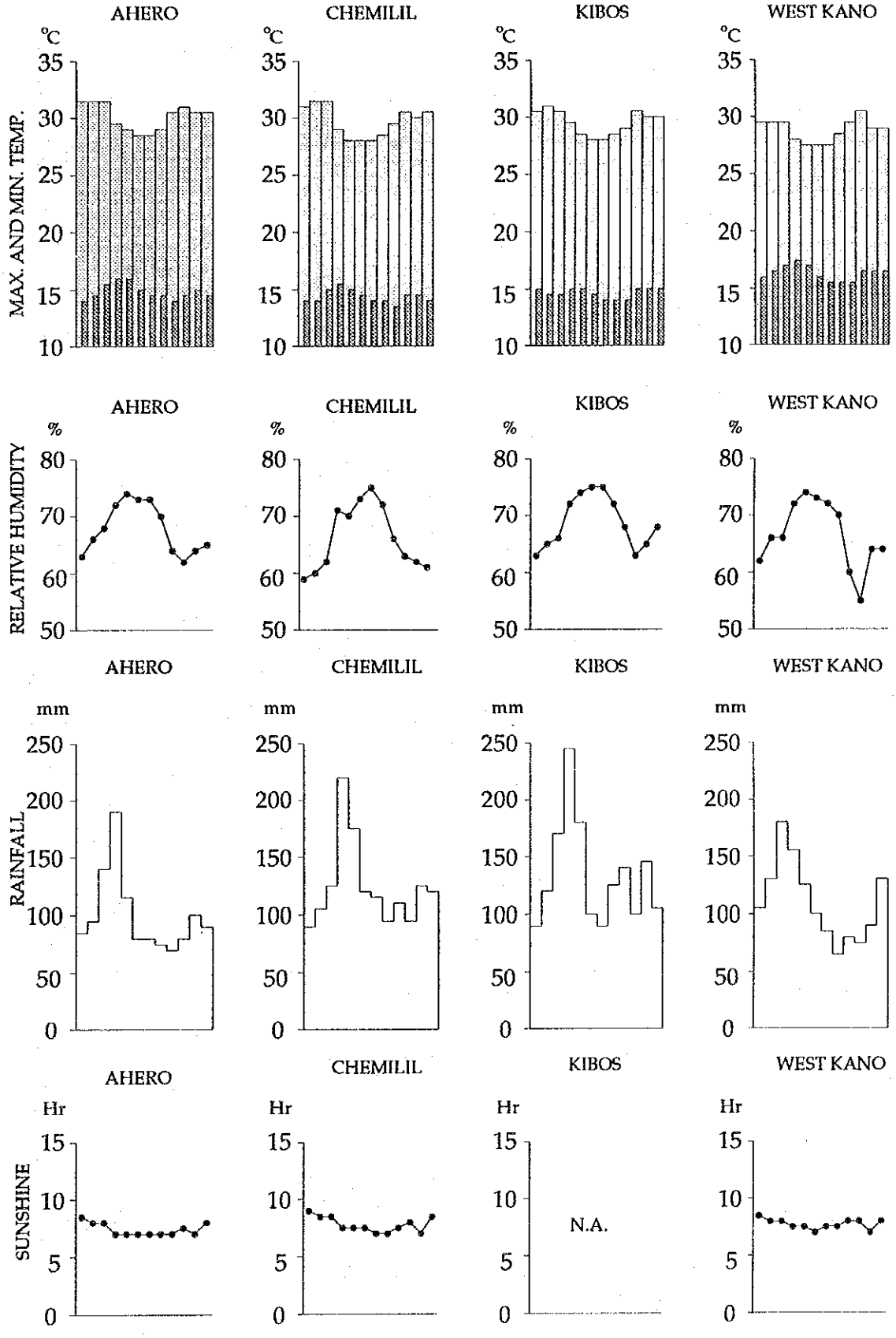

Fig. I-1 Monthly Climatological Variations (1 of 2)

REPUYBLIC OF KENYA
KANO PLAIN IRRIGATION PROJECT
JAPAN INTERNATIONAL COOPERATION AGENCY

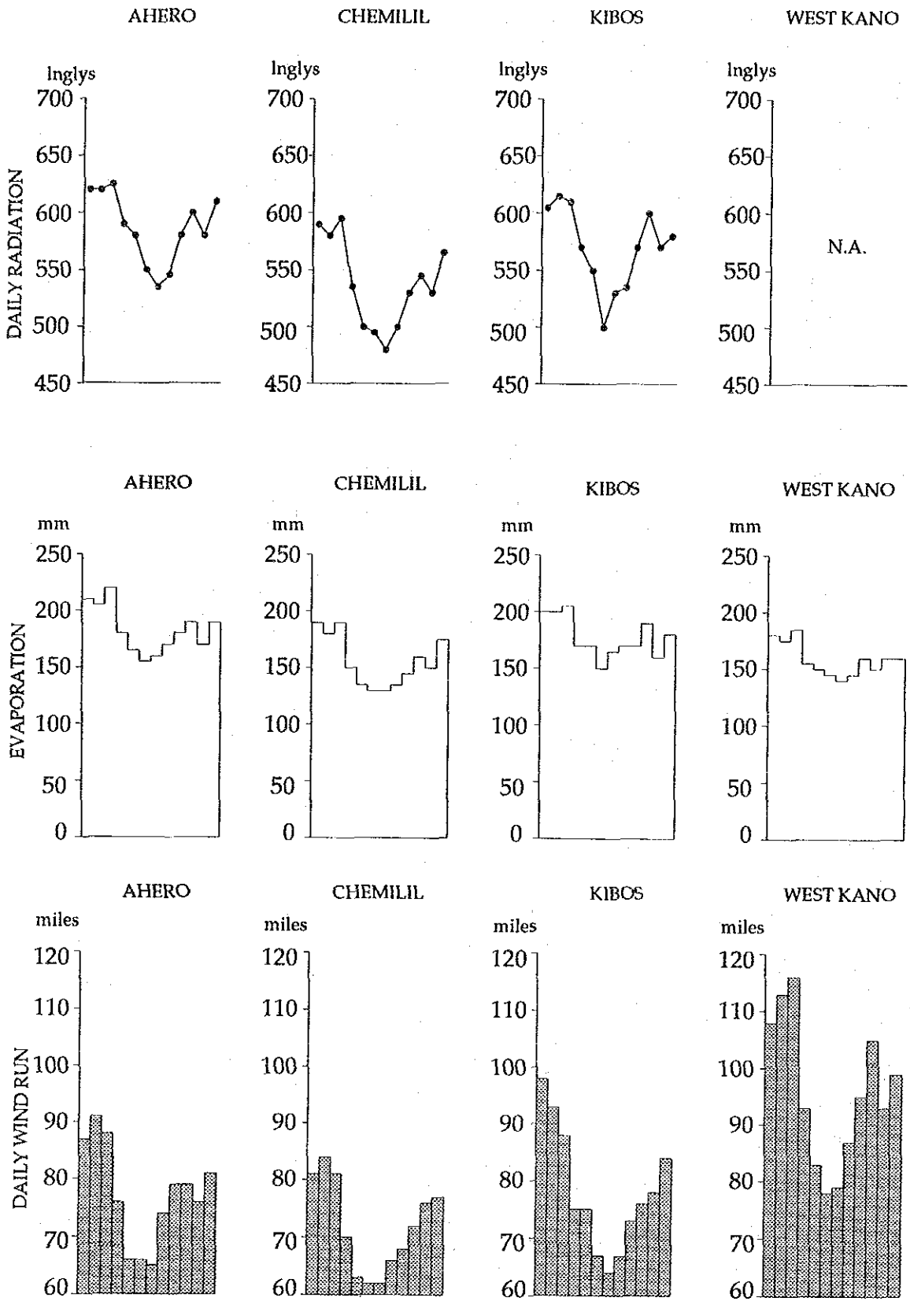

Fig. I-1 Monthly Climatological Variations (2 of 2)

REPUYBLIC OF KENYA
KANO PLAIN IRRIGATION PROJECT
JAPAN INTERNATIONAL COOPERATION AGENCY

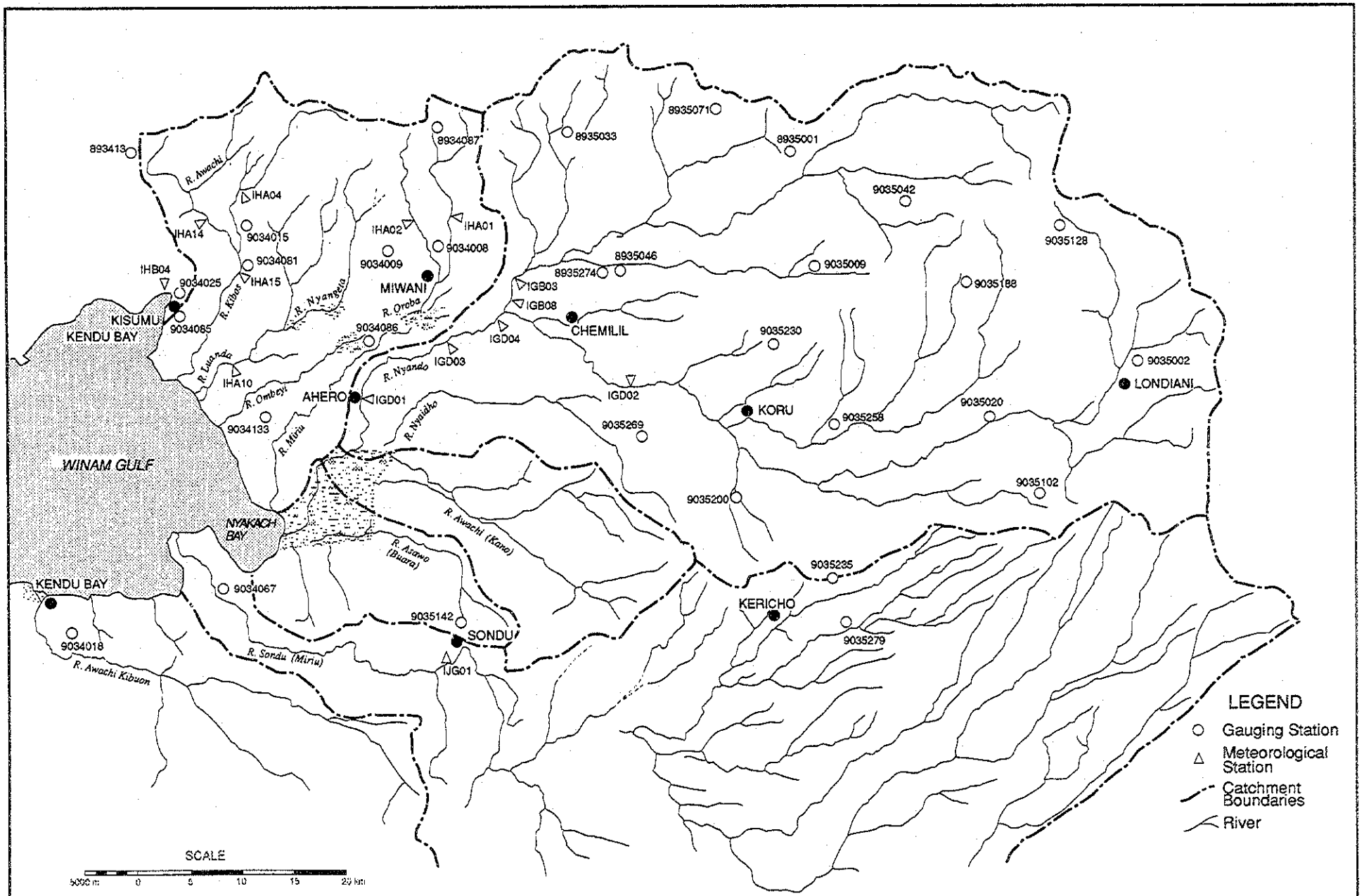

Fig. I-2 Location of Gauging and Meteorological Stations

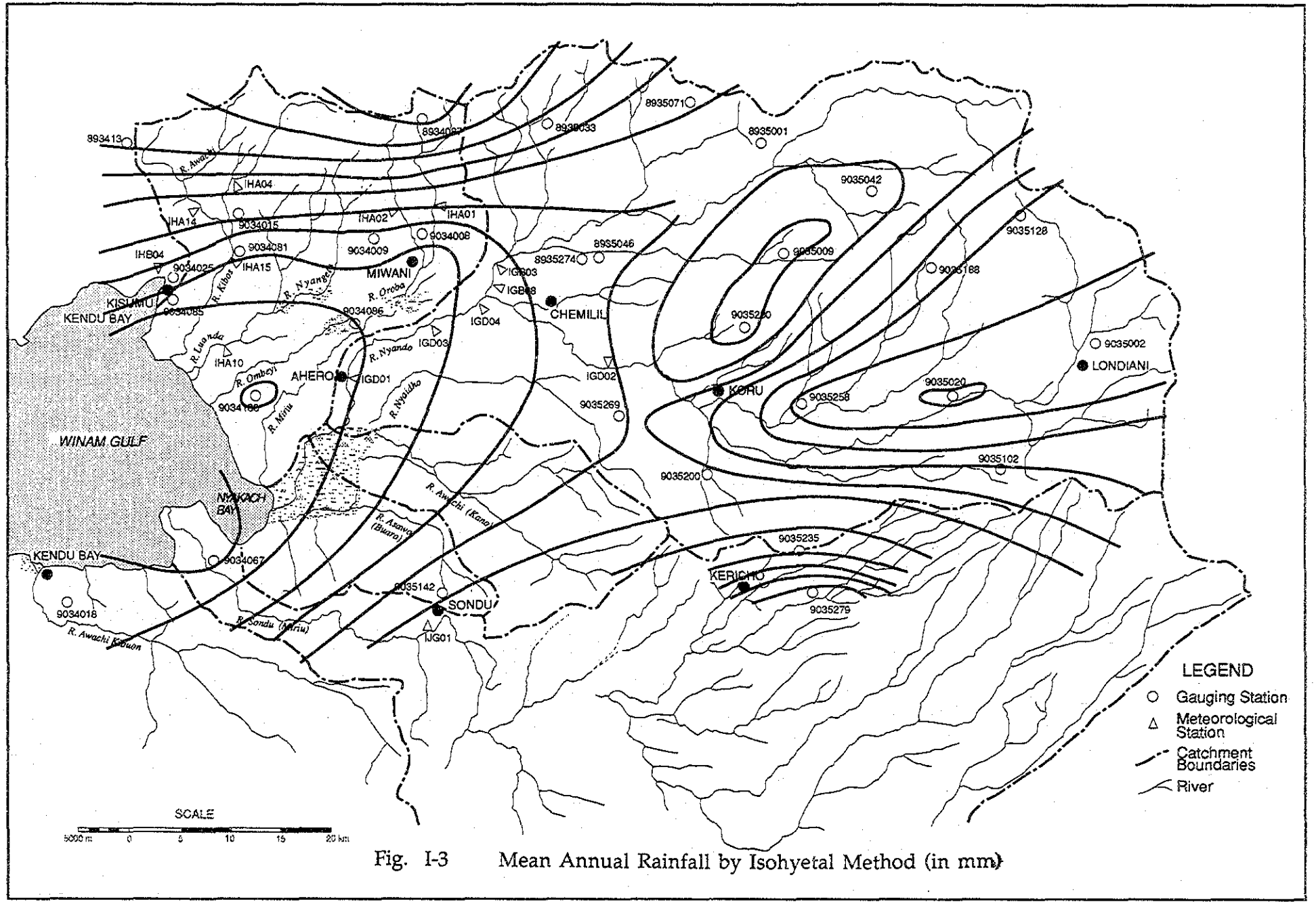

Fig. I-3 Mean Annual Rainfall by Isohyetal Method (in mm)

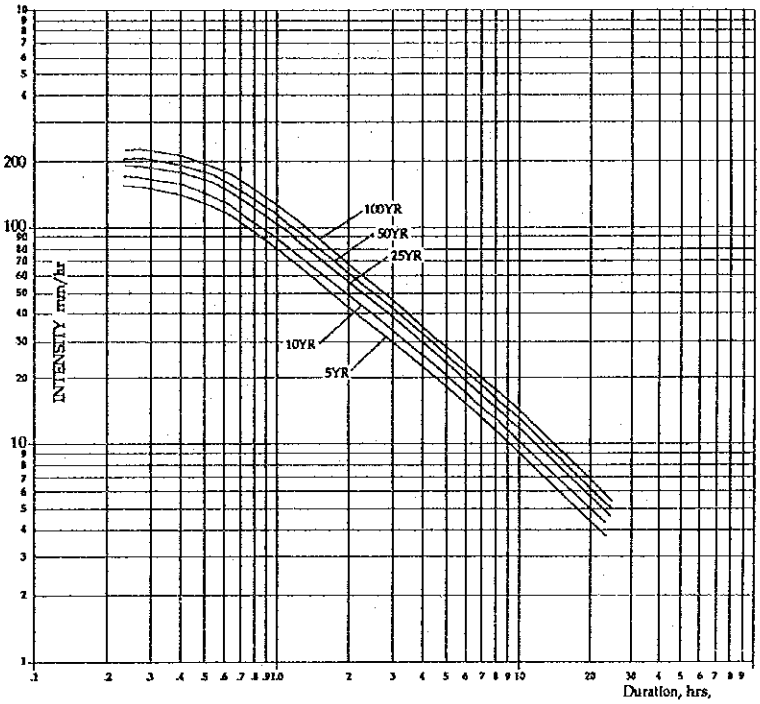

Fig. I-4 Rainfall Intensity-Duration-Frequency Relationships for Kisumu

Source : Lake Basin River Catchment Development River Profile Studies, Volume II/B, Annex I, October 1985.

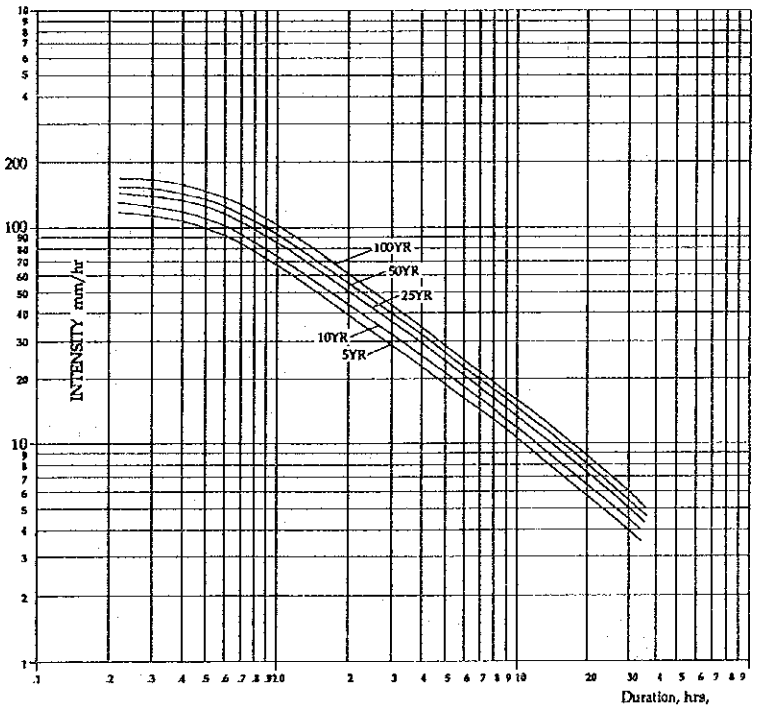

Fig. I-5 Rainfall Intensity-Duration-Frequency Relationships for Kobujoi

Source : Lake Basin River Catchment Development River Profile Studies, Volume II/B, Annex I, October 1985.

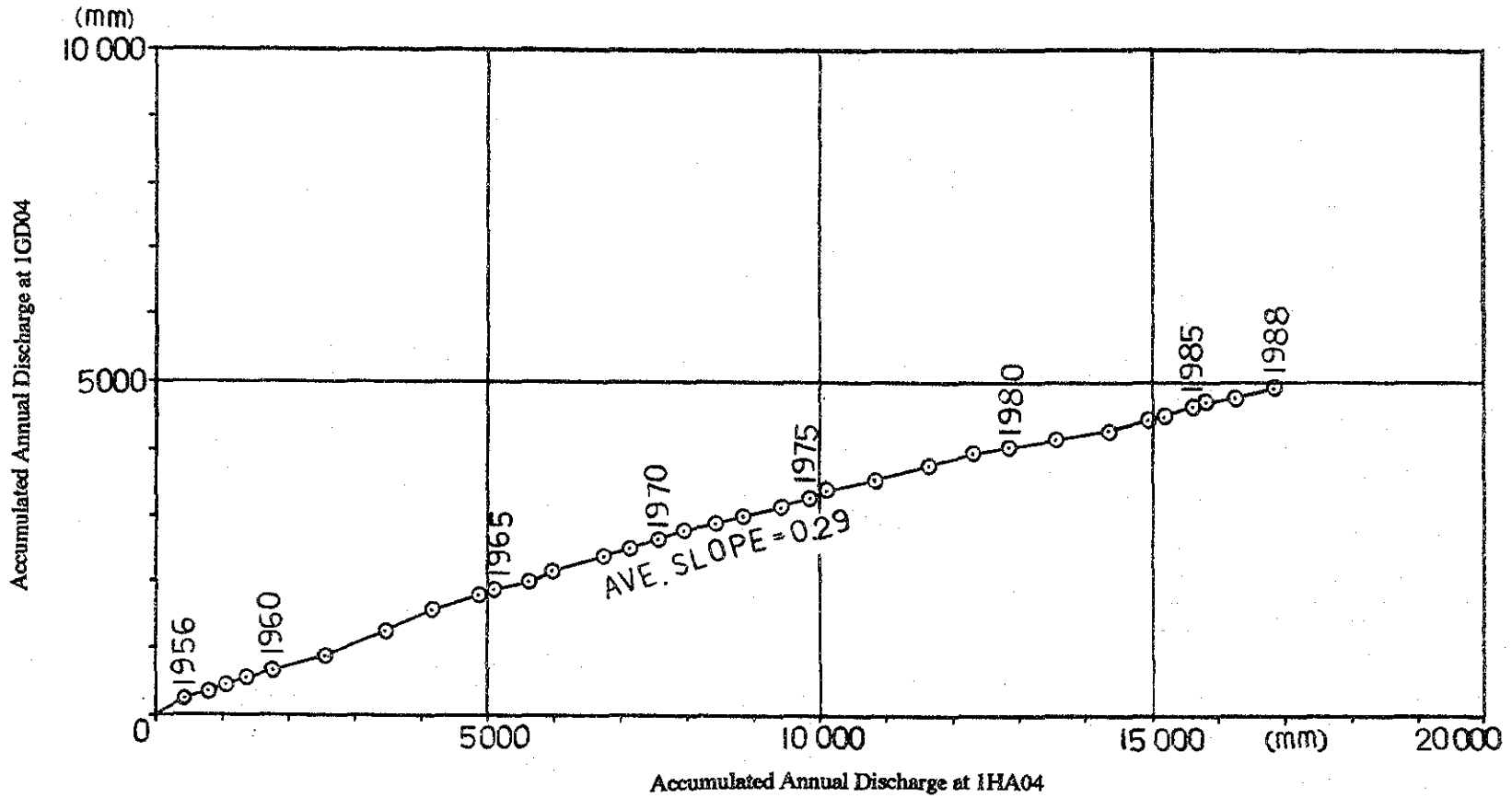

Fig. I-6 Double Mass Curve of Annual Discharge of 1GD04 and 1HA04

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