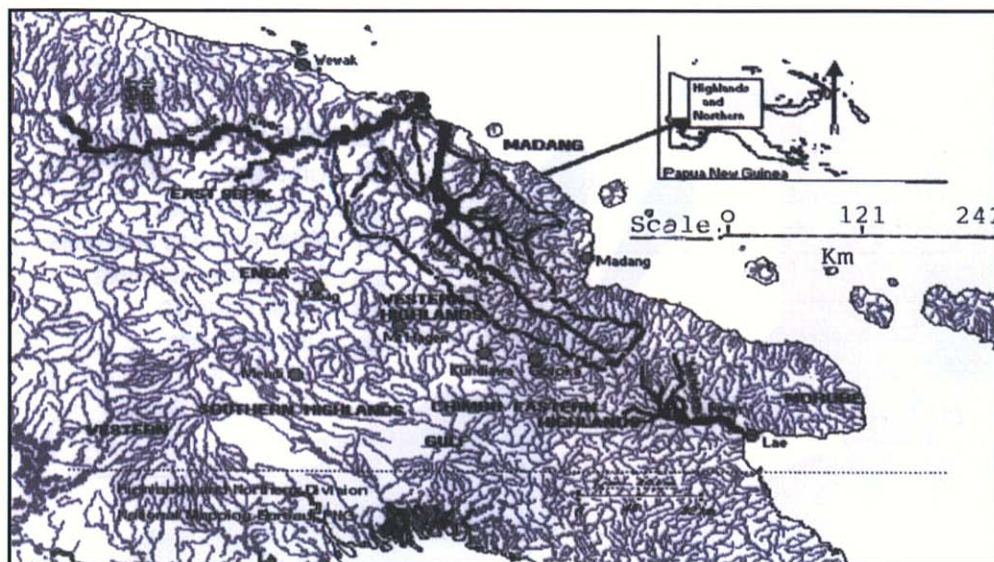


# Ramu Wara

## Map of River

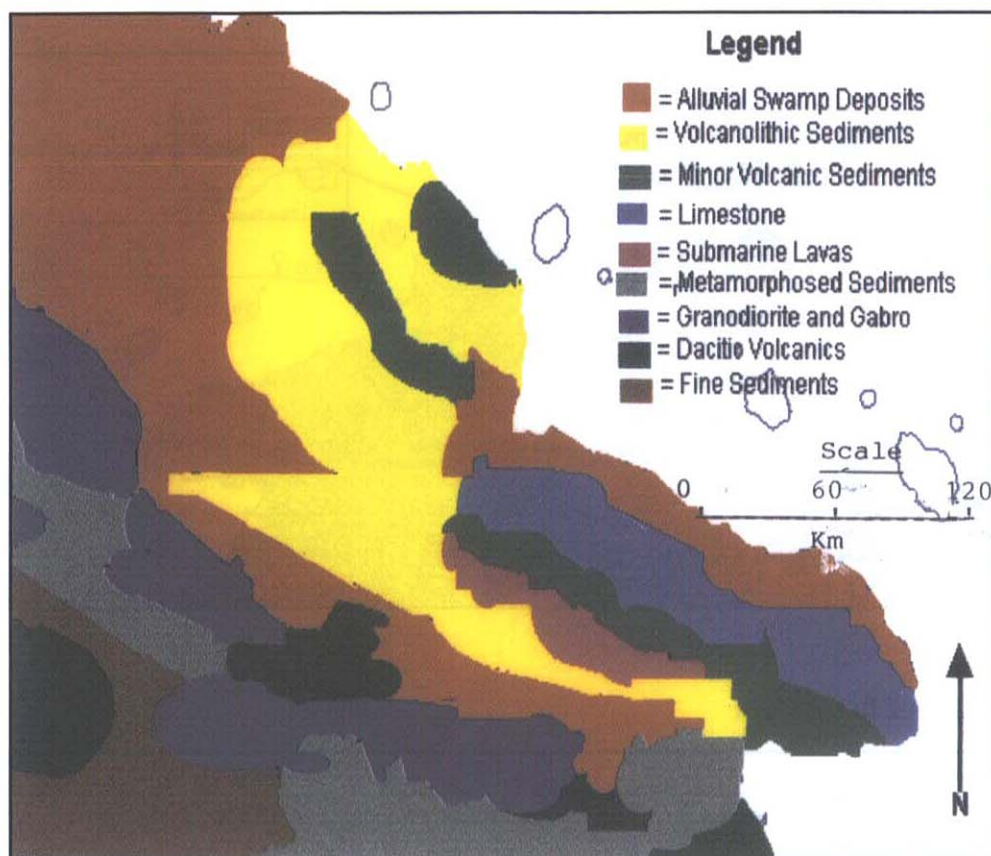


## Table of Basic Data

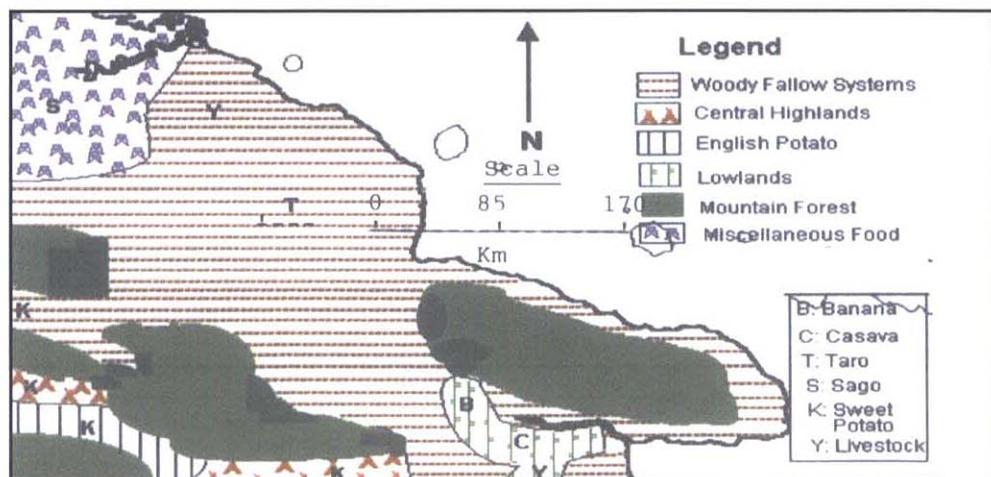
Name: Ramu Wara		Serial No.: PNG-1
Location: EHP and Madang Province, Papua New Guinea	N 03°59'24"~ 06°16'48"	E 144°39'36"~146°06'00"
Area: 17,114 km <sup>2</sup>	Length of main stream: 325 km	
Origin: Kratke Range 3,000 m	Highest point: Mount Otto 3,546 m	
Outlet: Bismark Sea, Pacific Ocean	Lowest point: MSL 0 m	
Main geological features: Limestone, Calcareous, Grandiorite and Gabro		
Main tributaries: Akwitana, 153 km <sup>2</sup> ; Imbrum, 274 km <sup>2</sup> ; Marum, 263 km <sup>2</sup>		
Main lakes: None		
Main reservoirs: Yonki Dam (332x10 <sup>6</sup> m <sup>3</sup> , 1991)		
Mean annual precipitation: 1,070 mm (1986~1990)		
Mean annual runoff: 40 m <sup>3</sup> /s at Yonki damsite (854 km <sup>2</sup> )		
Population: 8,000 (1990)	Main cities: Yonki and Kainantu Townships	
Land use:		

## 2. Geographical Information

### 2.1 Geological Map



### 2.1 Land Use Map



## 1. General Description

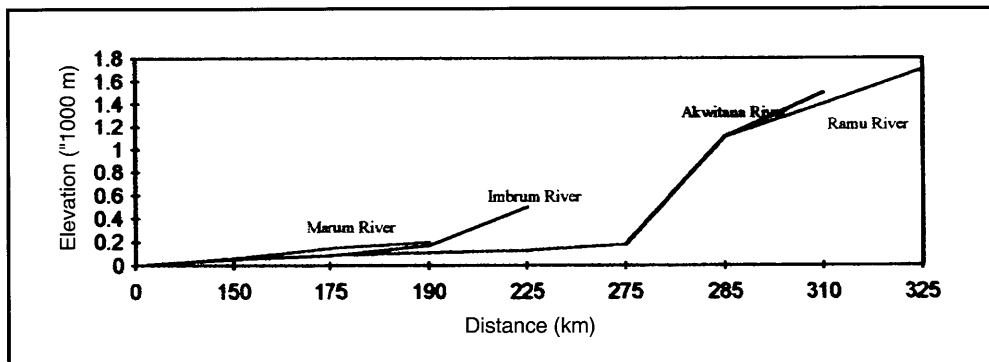
Ramu is the largest river in the Kainantu District of Eastern Highlands Province. It flows through the western end of Madang Province before discharging into sea. The river which originates from Mount Otto (3,200 m) and flows out to the Bismark Sea in the Pacific Ocean has a catchment area of 17,114 km<sup>2</sup>. During the period 1966-1992, the catchment received an average annual rainfall of 1,070 mm and had a mean at the Yonki damsite (854 km<sup>2</sup>) of 40 m<sup>3</sup>/s.

The population in the catchment according to 1990 census was about 8,000. The Yonki dam was commissioned in 1991 to store 332x10<sup>6</sup> m<sup>3</sup> of water. The river segment above Kainantu District is considered as the upper catchment, located in the mountains with small batches of coffee plantations. The river segment below Kainantu District which flows in close proximity to the township is considered as the lower Ramu, commonly known as the Markham plains.

### 2.3 Characteristics of River and Main Tributaries

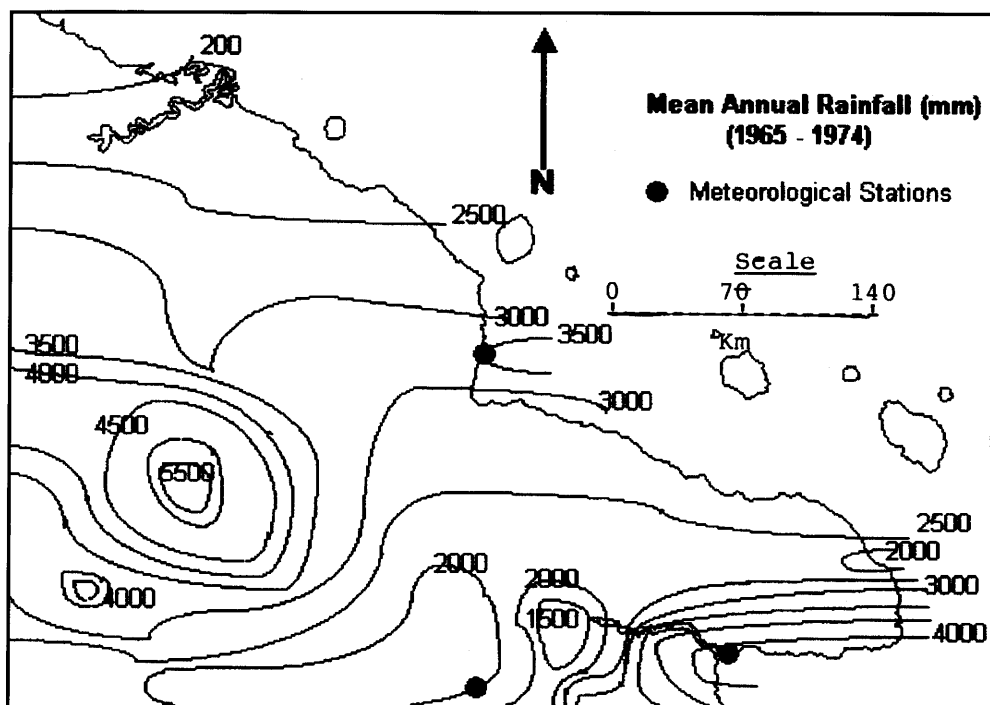
No.	Name of river	Length [km] Catchment area [km <sup>2</sup> ]	Highest peak [m] Lowest point [m]	Cities population (1990)	Land use [%]
1	Ramu (Main river)	325	3,546	8,000	
		17,114			
2	Akwitana (Tributary)	40	3,065	6,434	
		153			
3	Imbrum (Tributary)	55	2,579		
		294			
4	Marum (Tributary)	50	2,830		
		263			

### 2.4 Longitudinal Profiles



### 3. Climatological Information

#### 3.1 Annual Isohyetal Map and Observation Stations



#### 3.2 List of Meteorological Observation Stations

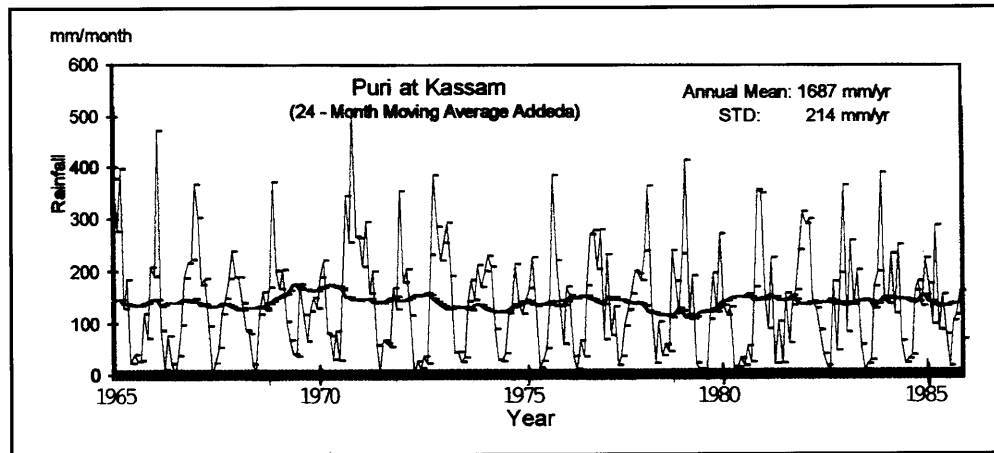
No.	Station	Elevation [m]	Location	Observation period	Mean annual precipitation [mm]	Mean annual evaporation	Observation items <sup>1)</sup>
201800	Sonofi	1.830	S 006°18'36" E 145°42'00"	1963-1984	1,654	-	P(TB)
201600	Aiyura	1.610	S 006°18'34" E 145°43'48"	1963-1984	962	-	P(TB)
202270	Kassam	1.525	S 006°15'00" E 146°01'48"	1963-1984	1,642	-	P(TB)
202350	Damsite	1.270	S 006°05'24" E 145°57'36"	1963-1984	1,051	-	P(TB)

1) P: Precipitation, TB: Tipping bucket with recording chart.

### 3.3 Monthly Climate Data

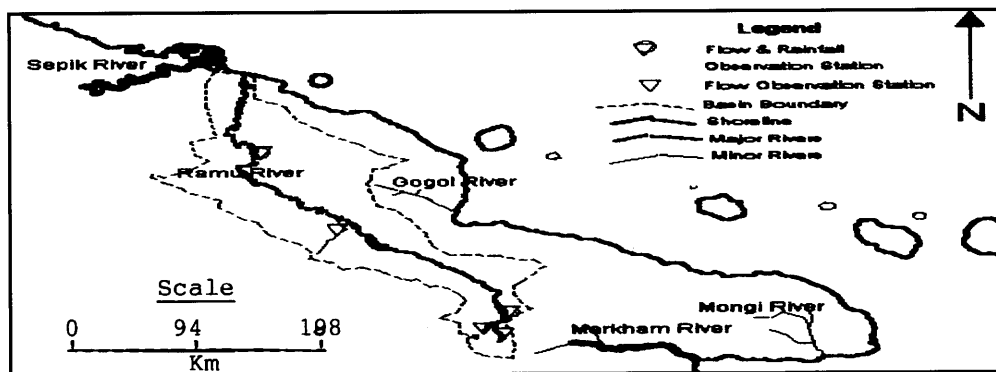
Observation item	Observation station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Period for the mean
Precipitation (mm)	202350	181	194	245	145	116	68	66	64	90	155	164	212	1,654	1963-1984

### 3.4 Long-term Variation of Monthly Precipitation



## 4. Hydrological Information

### 4.1 Map of Streamflow Observation Stations



## 4.2 List of Hydrological Observation Stations

No.*	Station	Location	Elevation [m]	Catchment area (A) [km <sup>2</sup> ]	Observation period	Observation items <sup>1)</sup> (frequency)
201300	Kainantu	S 006°18'00" E 145°48'00"	1,560	212	1962~1994	H2, P, Cont.
202350	Damsite	S 006°05'24" E 145°57'36"	1,200	854	1966~1994	H2, P, Cont.
203450	Bundi	S 006°54'36" E 145°54'06"	540	294	1987~1994	H2, P, Cont.
203650	Kurumbadari	S 005°58'48" E 145°29'24"	200	263	1981~1994	H2, P, Cont.
203800	Aiome	S 005°03'00" E 144°46'48"	80	8,751	1966~1994	H2, P, Cont.

No.*	$\bar{Q}$ <sup>2)</sup> [m <sup>3</sup> /s]	$Q_{\max}$ <sup>3)</sup> [m <sup>3</sup> /s]	$\bar{Q}_{\max}$ <sup>4)</sup> [m <sup>3</sup> /s]	$\bar{Q}_{\min}$ <sup>5)</sup> [m <sup>3</sup> /s]	$\bar{Q} / A$ [m <sup>3</sup> /s/100km <sup>2</sup> ]	$Q_{\max} / A$ [m <sup>3</sup> /s/100km <sup>2</sup> ]	Period of statistics
201300	7.91	281.80	162.74	1.88	3.73	132.92	1961~1994
202350	35.55	1,618.80	440.74	9.35	4.16	189.20	1965~1994
203450	30.85	471.90	277.84	16.23	10.49	94.50	1987~1994
203650	39.90	1,016.70	513.75	10.57	15.17	386.31	1981~1994
203800	781.27	3,259.80	2,440.75	246.75	8.93	37.25	1980~1994

\*:

1) H2: Water level ; P: Precipitation  
Cont. : Continuous

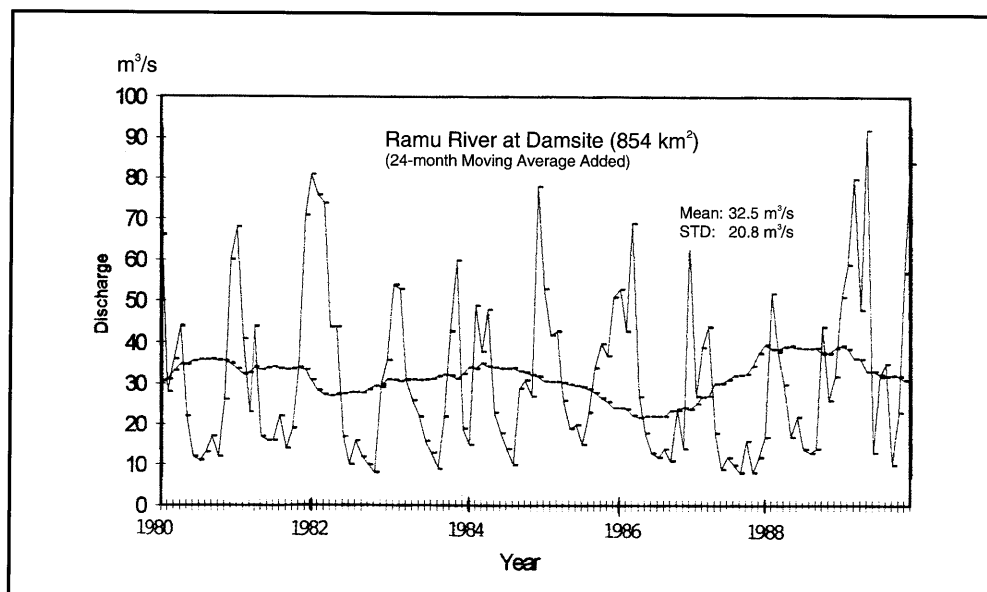
2) Mean annual discharge

3) Maximum discharge

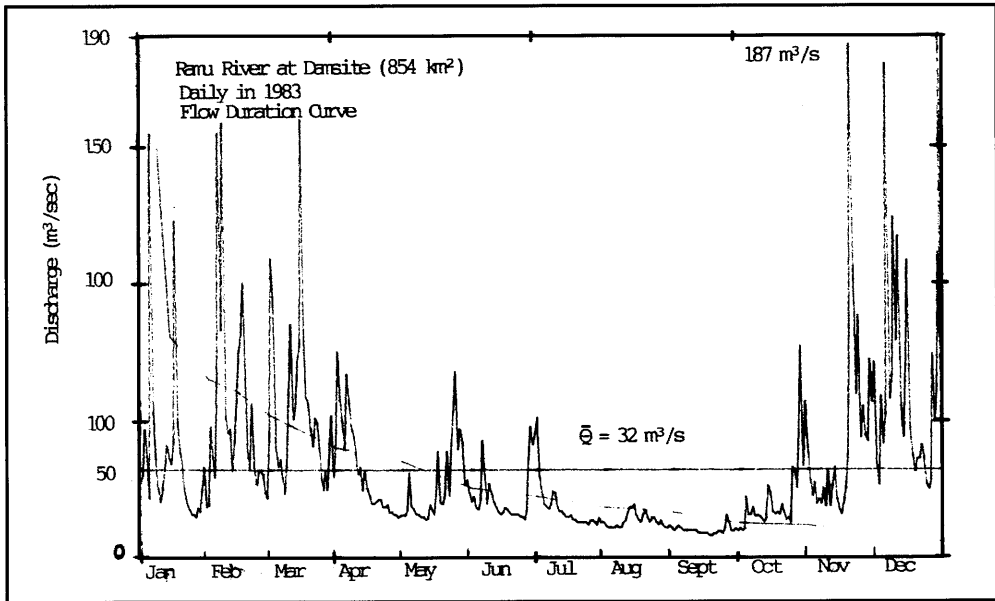
4) Mean maximum discharge

5) Mean minimum discharge

## 4.3 Long-term Variation of Monthly Discharge



### 4.4 Annual Pattern of Discharge



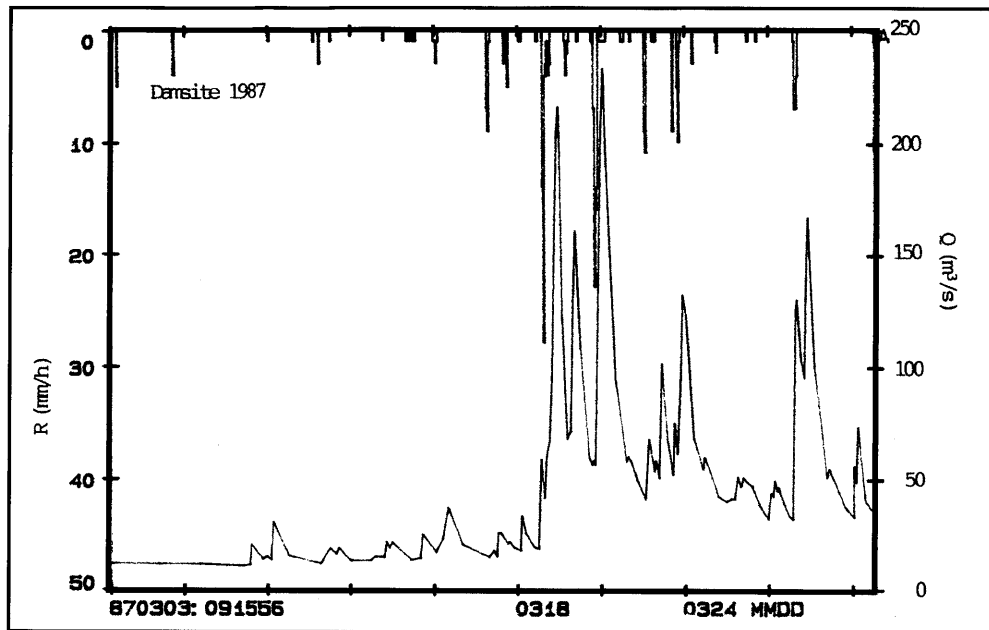
### 4.6 Annual Maximum and Minimum Discharges

At Dam site [854 km<sup>2</sup>]

Year	Maximum <sup>1)</sup>		Minimum <sup>2)</sup>		Year	Maximum <sup>1)</sup>		Minimum <sup>2)</sup>	
	Date	[m <sup>3</sup> /s]	Month	[m <sup>3</sup> /s]		Date	[m <sup>3</sup> /s]	Month	[m <sup>3</sup> /s]
1966	03.10	539	09	6	1980	01.28	469	11	7
1967	02.22	369	09	5	1981	04.15	405	09	10
1968	12.21	308	08	6	1982	05.13	571	07	5
1969	11.24	571	09	8	1983	12.07	310	09	7
1970	12.21	518	09	5	1984	03.24	273	10	8
1971	03.01	336	10	6	1985	02.25	407	09	9
1972	02.08	372	10	5	1986	04.07	454	12	7
1973	03.23	529	09	8	1987	01.19	357	11	3
1974	03.06	200	09	5	1988	10.24	213	01	5
1975	12.19	310	11	6	1989	05.21	1,615	06	5
1976	04.07	382	10	6	1990	04.22	462	09	35
1977	10.30	373	08	8	1991	01.16	258	01	41
1978	11.29	557	09	6	1992	04.21	340	06	22
1979	03.07	410	10	6					

1), 2) Instantaneous observation by recording chart

#### 4.7 Hyetographs and Hydrographs of Major Floods



### 5. Water Resources

#### 5.1 General Description

Ramu catchment occupies about 2% of the land area of the Eastern Highlands and Madang Provinces. A significant quantity of water is used for sugar-cane irrigation and water supply through canal diversion and direct abstraction by pumping. Water usage increases during the dry weather and drought seasons. There are eight perennial streams, flowing as tributaries into the main Ramu River at locations in the mid upper Ramu catchment.

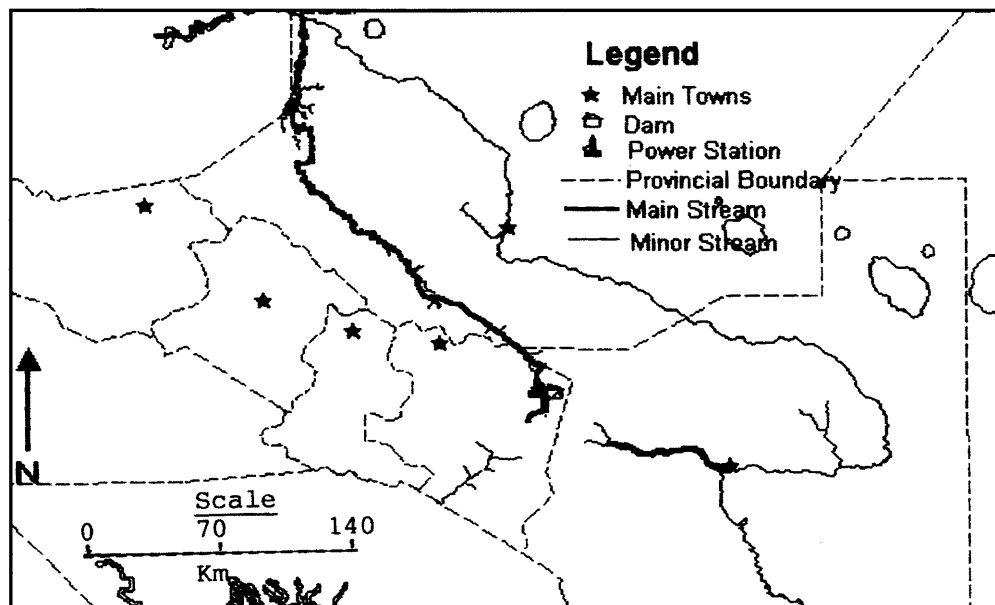
Floods exceeding  $300 \text{ m}^3/\text{s}$  (or  $0.35 \text{ m}^3/\text{s}/\text{km}^2$ ) at the dam site ( $854 \text{ km}^2$ ) monitoring station, occurred 78 times over a 23 year period (1966-1987) which amounts to an estimated average recurrence interval of 3 to 4 times per year. Nine seasonal storms were also registered over the same period occurring more frequently (33%) in March, significantly attributing to the monsoon flooding commonly experienced from December to February. Tropical cyclone induced floods are rare.

Since most of the precipitation in the form of rainfall in the basin occurs during the monsoon seasons, and with high concentration in the higher altitudes (2,000 - 4,000 m), Ramu River rarely experiences any drought conditions.

The Yonki dam was commissioned in 1991, principally to cater for the power demand in the major urban centres of the Highlands region in the Madang and Morobe provinces. Increase in power demand has resulted from increased urbanisation and growth in industrial and commercial activities.



## 5.2 Map of Water Resource Systems



## 6. Socio-cultural Characteristics

Ramu River, just like any natural stream flows continuously defying all political and geographical boundaries. Eastern Highlands and Madang provinces are two main political and geographical regions through which Ramu River flows before discharging into the Bismark Sea. The name Ramu bears neither a distinguished character nor an event to ideally relate it through meaning and origin. Clansmen and tribesmen alike accept the name Ramu and take it for granted. The river not only serves the local inhabitants and the neighbourhood as a source of water for washing, drinking, cooking, fishing and water sports but also brings together all races of mankind to idle around, gather or just to enjoy the nature's scenery.

After the construction of the dam in 1991 the traditional highlands lifestyle has gradually changed from subsistence farming to wage employment. Activities like fishing and water skiing which were traditionally restricted to the coastal or maritime provinces are popular pastimes in the Yonki Dam area. People living in the outskirts of the Yonki township have been attracted to the dam (reservoir) in order to have close accessibility to the water body.

## 7. References, Databooks and Bibliography

- Atlas of Papua New Guinea, Subsistence Crop Systems.
- Bureau of Water Resources: *Hydrological Data Bank*, Department of Environment of Conservation.
- Department of Environment and Conservation (1990): *The PNG Flood Estimation Manual* (3a).
- PNG Hydro-meteorological inventory, Port Moresby 1990.
- PNG Elcom Publication, *The Yonki Hydro-electric Scheme* (2-8).