Nam Khane

Map of River

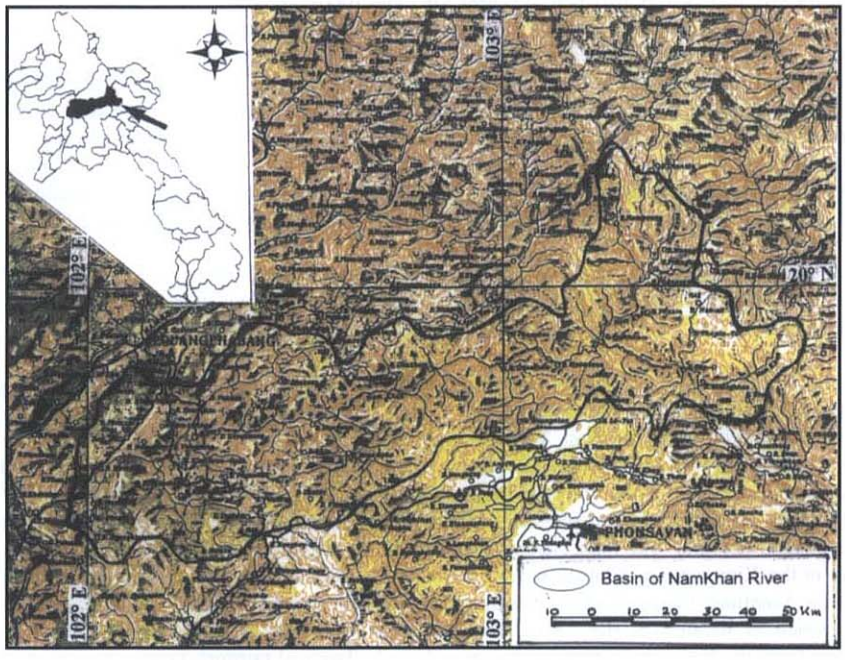
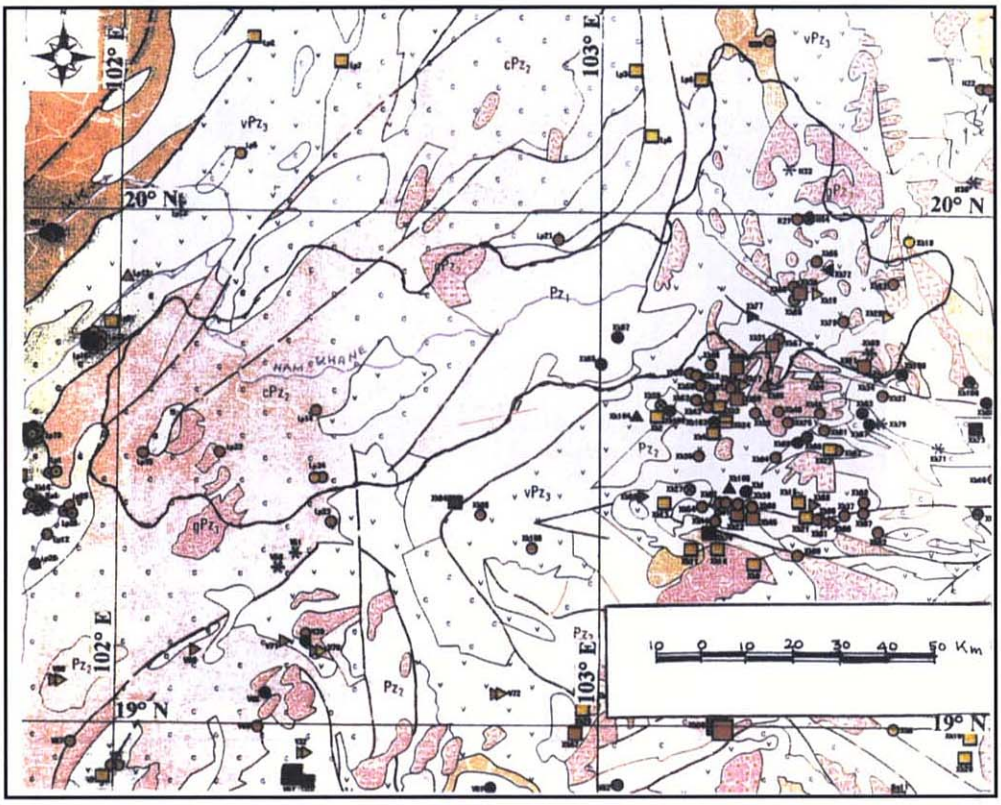


Table of Basic Data

Name: Nam Khane		**Serial No.:** Lao-1
Location: Luang Prabang Province	N 19° 15′	E 101° 45′ ~ 103° 35′
Area: 6,100 km^2	**Length of main stream:** 935 km	
Origin: Phou Nampa (1,828 m)	**Highest point:** North Ban Sakok 10 km (2,257 m)	
Outlet: confluence with the Mekong	**Lowest point:** Xieng Ngeune valley (300 m)	
Main geological features: Palaeozoic Sedimentary, Sandstone conglomerate		
Main tributaries: Nam Bok (448 km^2)		
Main lakes: None		
Main reservoirs: None		
Mean annual precipitation: 1,300 mm (1996)		
Mean annual runoff: 934 m^3/s at Ban Mixay (6,100 km^2) (1960-1990)		
Population: 122,716 (1996)	**Main cities:** Luang Prabang, Xieng Ngeun	
Land use: Forest (30%), Rice field upland (5%), Lowland (1%), **Other** (64%) (1995)		

2. Geographical Information

2.1 Geological Map

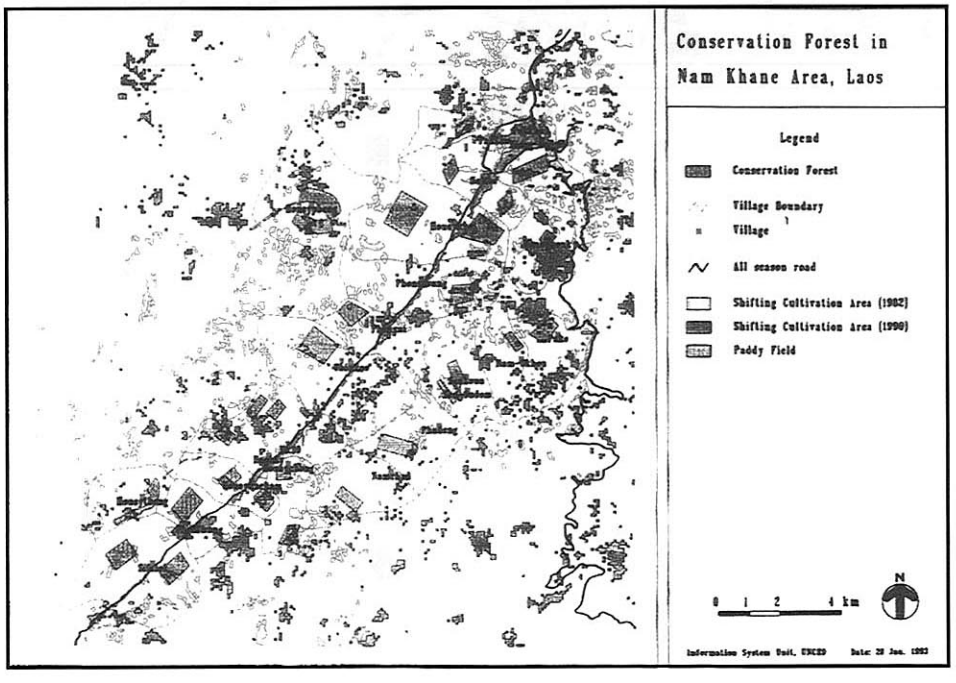


LEGEND

Permian	1	Pz_3	Shallow shelf sea sequence interdigitated with a volcanosedimentary sequence. Mostly sandstone, siltstone and shale in the N and NW. Some silicic, intermediate and mafic extrusive rocks (vl) associated with subvolcanic intrusive centres. Bedded to massive dark grey to light grey marine limestone (c) form extensive karst tracts in N and E, and in the E are intercalated with siltstone, mudstone and some coal seams. Epiclastic rocks predominate over limestones in the W and S.
	2	vPz_3	
	1	cPz_3	
Carboniferous	2		
	1	c	Mostly shallow shelf sea sequence of muddy limestones (c). Some continental Carboniferous in Vientiane basin, Salavan (S) Central and Phongsali Devonian (N).
Devonian	3	cPz_2^c	
	2	c	
	1	Pz_2	Mostly marine volcanosedimentary sequences with mudrocks, wackes, arenites, silicic and intermediate volcanic rocks, lightly metamorphosed.
Silurian	2		
	1		
Ordovician	3	Pz_1	Deep water marine volcanosedimentary sequence, metamorphosed to low or low-medium grades in the E; mudrocks, wackes, semipelitic schists and arenites, amphibolite, black limestone, mafic, intermediate and silicic volcanic rocks.
	2		
	1		
Cambrian	3		
	2		
	1		

gPz_3	Granitoid plutons (gt), mostly granodiorite and monzogranite, with less abundant gabbro (mt) and silicic subvolcanic intrusive rocks.
gPz_3	Granitoid plutons (gt), mostly granodiorite to monzogranite.
gPz_2	Granitoid plutons (gt), mostly granodiorite to granite, with less abundant diorite phases in the southern part of the Sanakham - Pak Lay belt.
gPz_2	Granitoid plutons (gt) with some associated gabbro intrusions (mt).

2.2 Land Use Map



1. General Description

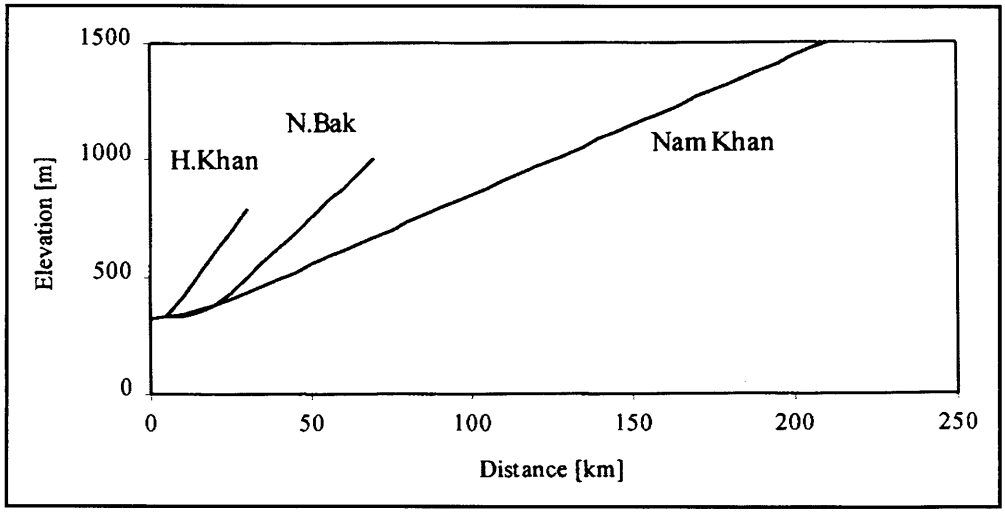
Nam Khane with a total length of 935 km has its origin near Phou Nam Pa at an altitude of 1,828 m. It flows down steep slopes in the east-west direction to meet the Mekong river at Luang Prabang city at an altitude of 300 m. The drainage area of the river at Ban Mixay station is 6,100 km^2. Ban Mixay has been selected as a gauging station in 1996 for avoiding the effect of backwater from river floods in Mekong. Approximately 88% of the upper part of Nam Khane basin is mountainous. The average annual rainfall in the basin is 1,300 mm while the annual runoff is about 600 mm. The hydrogeology of the basin is characterised by 29.4% of sedimentary rock, a total of 17.4% of Gneiss, Schist, Quartzite, Granite and Gable, 13.0% of sandstone and conglomerate, 8.5% of shale and impermeable rock, 7.4% of Limestone, 0.2% of sandy aluminium in the lower valley and 24% of various other rock. The lower reach of Nam Khane in Xieng Ngeun district is more developed than the rest and the rapid development with more than 20,000 inhabitants has brought many changes to the historic city of Luang Prabang. The city is now connected to the national electricity power grid and to the national and international telecommunication network. The annual event of the traditional boat racing in Nam Khane is very popular but there was an exceptionally dry year in 1992 when it could not take place because of very low flow during August to September.

2.3 Characteristics of River and Main Tributaries

No.	Name of river	Length [km] Catchment area [km^2]	Highest peak [m] Lowest point [m]	Cities population (1995)	Land use [%] (1994)	Representative vegetation and wildlife
1	**Nam Khane** (Main river)	935 6,100	1,828 307	Luang Prabang 20,000	F (30%)	Clear forest
2	**Nam Bak** (Tributary)	32 448	1,556 314	Pak Bak 5,000	F (30%)	Clear forest

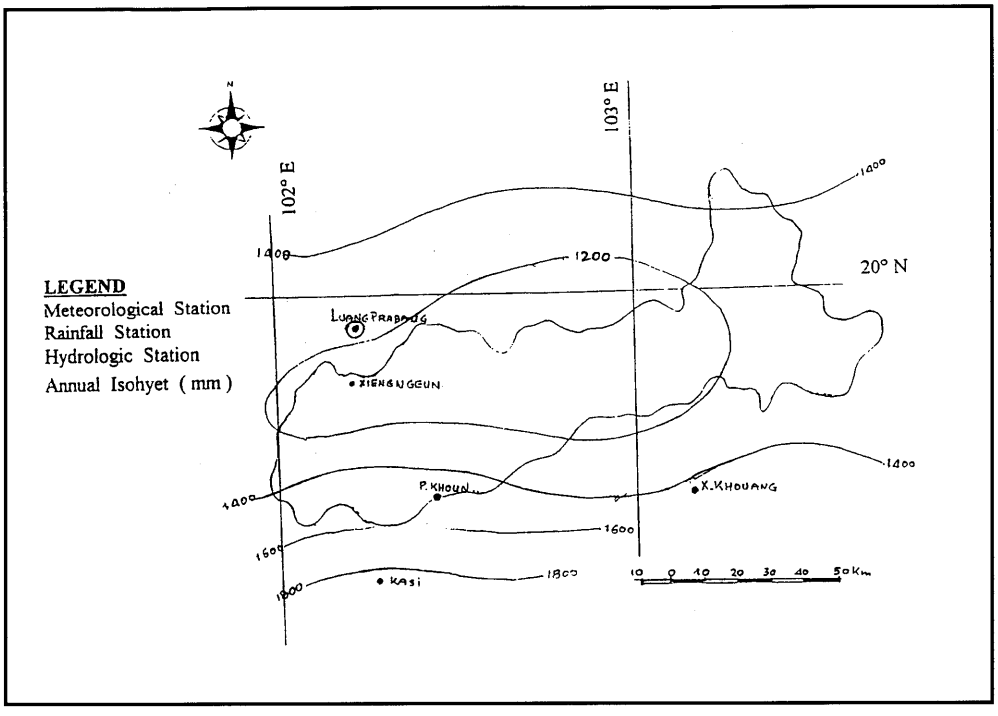
F : Clear forest

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 [mm]	Observation items [1)]
48930*	**Luang Prabang**	305	N 19° 53′ E 102° 08′	1961~1990	1,442.9	114.3	P, E, SR, T,WV
48930*	**Luang Prabang**	305	N 19° 53′ E 102° 08′	1910~1965	1,604.6	-	P
	Xieng Ngeun	290	N 19° 51′ E 102° 08′	1970~1972 1989~1996	1,000.4 1,063.1	-	P
	Phoukhoun	1,340	N 19° 26′ E 102° 26′	1993~1996	1,584.0	-	P
	Senkhalok	390	N 19° 42′ E 101° 53′	1988~1990	1,219.2	-	P
	Viengkham	440	N 20° 27′ E 109° 53′	1993~1996	1,469.8	-	P
	Phonexay	450	N 19° 57′ E 102° 33′	1993~1996	1,156.7	-	P

* : Serial number used by WMO Station index
E: Evaporation; P: Precipitation; DS: Duration of sunshine; SR: Solar radiation; T: Temperature;
TB: Tipping bucket with recording chart; WV: Wind velocity

3.3 Monthly Climate Data

Station: Luang Prabang

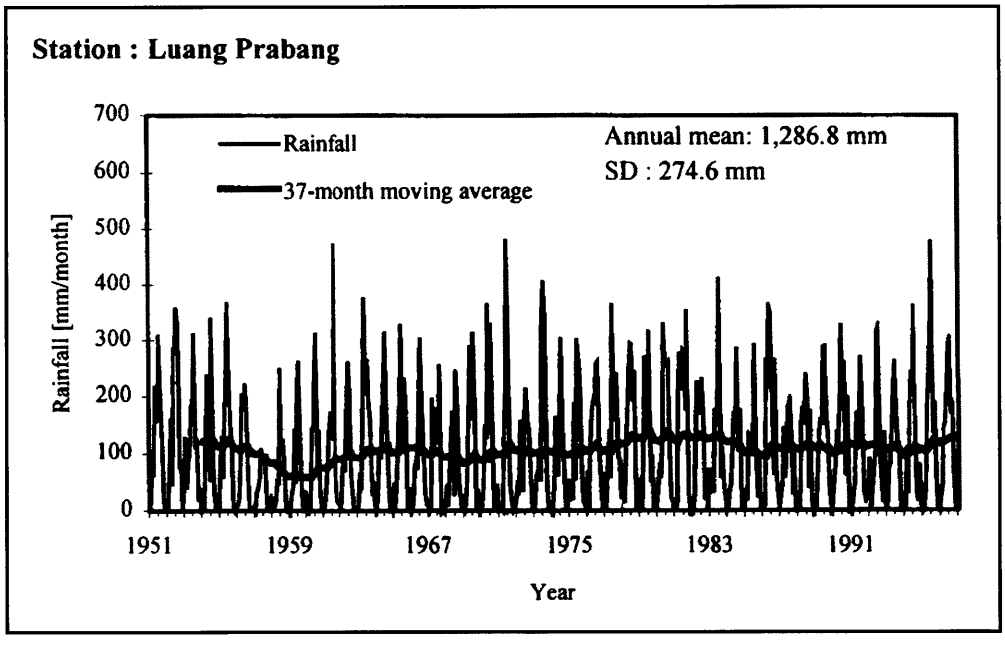
Observation item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Period for the mean
Temperature [°C]	18.4	21.3	24.5	26.7	27.2	27.3	26.6	26.3	26.1	24.7	22.0	18.8	24.2	1906~1942
Precipitation [mm]	14.0	17.7	34.9	1,028	1,557	1,622	2,321	2,811	75.5	76.6	26.5	11.1	124.4	1910~1965
Evaporation + [mm]	100.1	113.9	144.3	159.7	169.4	149.4	146.5	130.0	140.6	144.4	113.6	92.7	1,604.6	1967~1992
Solar radiation [MJ/m²/d]	44.2	49.7	56.2	58.9	59.9	50.9	49.8	50.8	52.0	44.9	43.0	40.3	50.5	1951~1980
Duration of sunshine [hr]	190.7	210.3	209.6	220.0	200.6	136.8	130.2	130.2	133.8	185.4	197.7	170.2	2,115.5	1961~1977

Station: Luang Prabang

Observation item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Period for the mean
Temperature [°C]	19.1	21.6	24.4	26.9	27.7	27.6	27.0	26.7	26.4	24.8	21.9	18.5	24.4	1961~1990
Precipitation [mm]	15.2	18.6	29.8	107.9	147.2	258.2	228.4	288.6	172.6	126.2	40.1	10.1	442.9	1961~1990
Evaporation * [mm]	11.7	18.4	34.1	137.1	165.0	184.5	234.0	256.8	126.9	135.5	60.5	5.2	114.3	1961~1990
Duration of sunshine [hr]	193.6	198.7	166.8	170.8	189.9	101.6	108.3	130.8	161.8	157.1	151.6	161.6	1,892.5	1981~1990

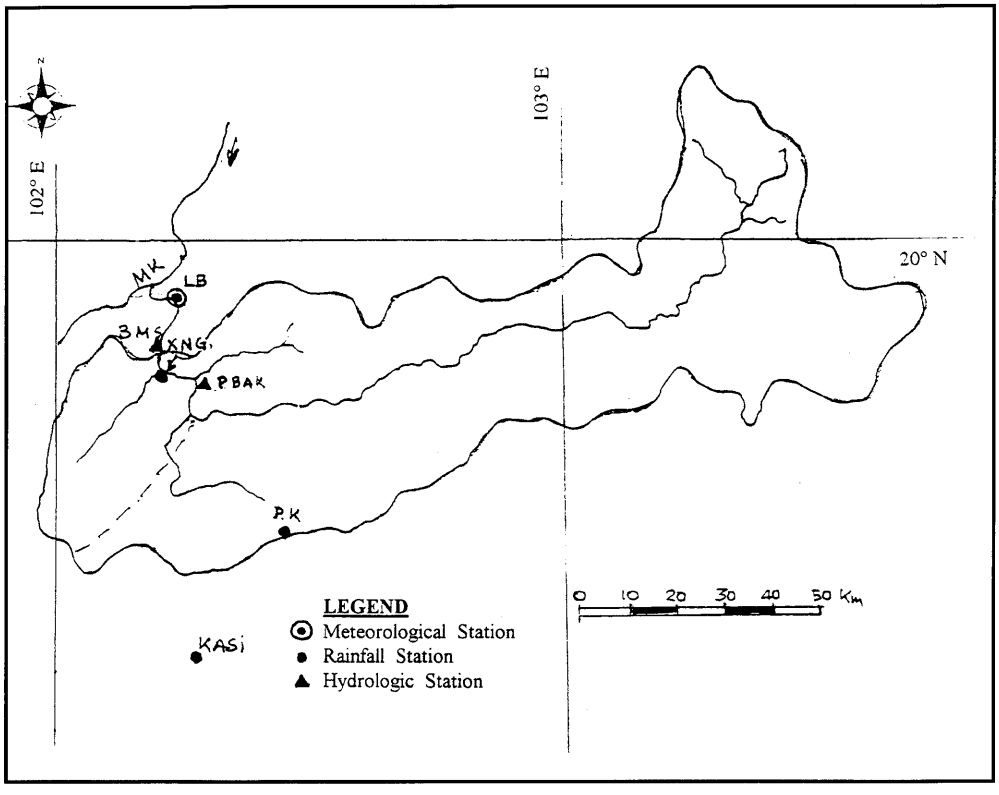
+: Piche

3.4 Long-term Variation of Monthly Precipitation



4. Hydrological Information

4.1 Map of Streamflow Observation Stations



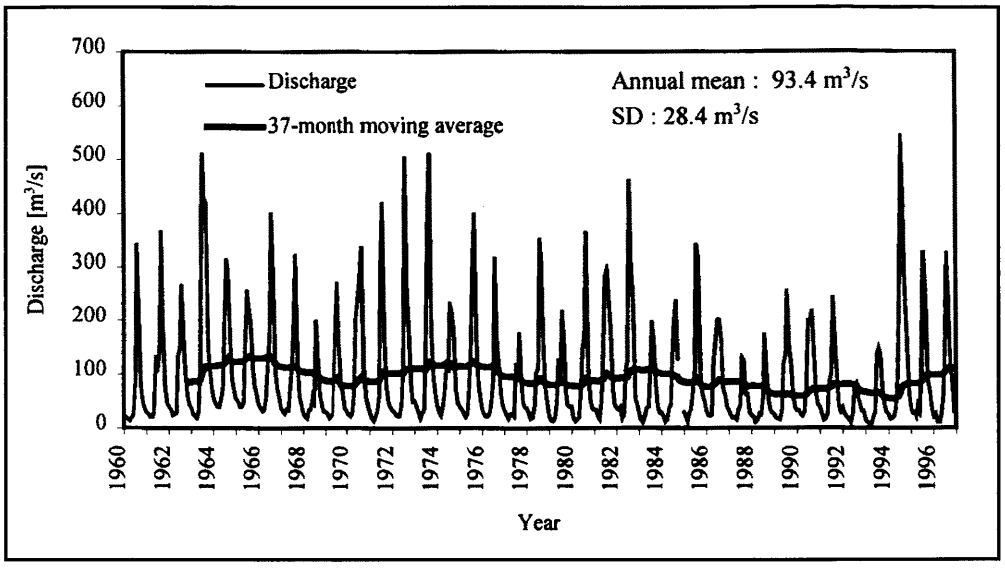
4.2 List of Hydrological Observation Stations

No.	Station	Location	Elevation [m]	Catchment area (A) [km^2]	Observation period	Observation items[1] (frequency)
1	Pakbark	N 19° 44.6′ E 102° 16.8′	307	5,800	1987~1996	H, Q
2	Ban Mixay	N 19° 47.2′ E 102° 10.6′	299	6,100	1960~1996	H, Q

No.	$\overline{Q}$[2] [m^3/s]	Q max[3] [m^3/s]	$\overline{Q}$ max[4] [m^3/s]	$\overline{Q}$ min[5] [m^3/s]	$\overline{Q}$ /A [m^3/s/100 km^2]	Q max / A [m^3/s/100 km^2]	Period of statistics
1		900	586	15.4	1.42	15.5	1990~1996
2		5,280	1,001	11.9	1.53	86.6	1960~1996

1) H1: Water level by recording chart; H2: Water level by manual Q: Discharge
2) Mean annual discharge
3) Maximum discharge
4) Mean annual maximum discharge
5) Mean annual minimum discharge

4.3 Long-term Variation of Monthly Discharge



4.6 Annual Maximum and Minimum Discharges

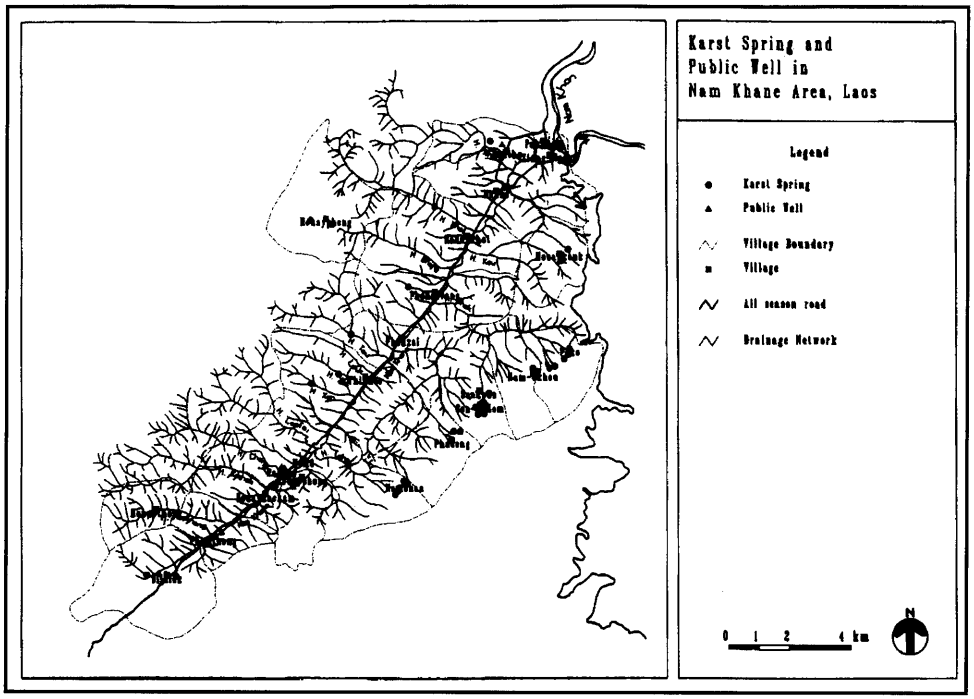
At Ban Mixay [6,100 km²]

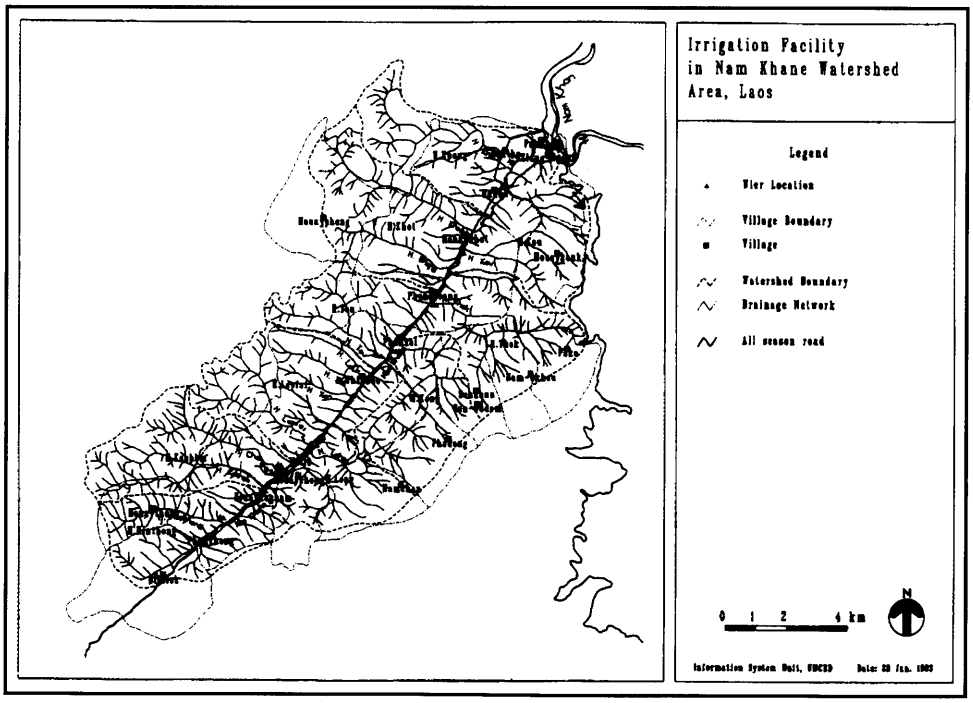
Year	Maximum [1]		Minimum [2]		Year	Maximum [1]		Minimum [2]	
	Date	[m³/s]	Month	[m³/s]		Date	[m³/s]	Month	[m³/s]
1960	8.14	1,660	4-5	10.9	**1979**	8.09	474	3	10.6
1961		657	3-4	14.4	**1980**	9.04	817	3	9.2
1962	6.19	1,130	5	15.4	**1981**	9.08	734	4	7.1
1963	7.25	5,280	4	15.4	**1982**	8.10	1,070	6	3.5
1964	8.26	1,210	4	31.8	**1983**	8.26	644	3	7.1
1965	7.26	1,340	4	30.7	**1984**	7.14	404	3	5.0
1966	9.01	968	3	27.0	**1985**	9.01-09	664	3	5.0
1967	7.27	717	3	21.8	**1986**	7.25	426	4	13.6
1968	9.08	1,410	3	15.1	**1987**	9.01	419	5	6.0
1969	6.26	659	3	13.8	**1988**	8.11	510	4	5.52
1970	9.19	916	4	15.6	**1989**	6.23	868	4	3.61
1971	7.19	828	3	11.3	**1990**	7.30	668	4	15.8
1972	8.24	1,360	5	9.9	**1991**	8.27	583	5	10.3
1973	8.27	2,760	4	12.9	**1992**	7.24	229	5	2.81
1974	8.28	901	3	18.3	**1993**	8.24	566	3-4	3.35
1975	9.02	1,500	5	14.7	**1994**	8.30	1,265	3	4.21
1976	8.15	634	4	15.6	**1995**	8.05	684	4	4.21
1977	6.30	464	3	13.8	**1996**	8.17	879	3-4	1.06
1978	9.29	726	4	12.3					

1. Observation interval: daily, twice a day and hourly during flood
2. Observation interval: daily, twice a day.
Nature of minimum flows: absolute minimum flows within two or three days.

5. Water Resources

5.2 Map of Water Resources Systems





6. Socio-cultural Characteristics

The city of Luang Prabang, with its long history and its relative isolation, is a unique place characterised by beautiful temples and French provincial architecture. It is located between beautiful mountains and rivers in Nam Khane. There were 66 historic temples built before the 20th century, but now only 32 of them are remaining, many of them well preserved and of great cultural interest.

The unique sacred and secular architecture has received international recognition and Luang Prabang has been designated as a world cultural heritage site by UNESCO in 1996. As a result, the scenic and the historical beauty of the city attracts a growing number of tourists and to cater for their needs, several hotels, guest houses, handicraft centres, shops and restaurants have been established. Another scenic spot in Xieng Ngeun district where Nam Khang Noy meets Nam Khang Ngnai, has been established recently by CPAWM as a place of village forestry development.

7. References, Databooks and Bibliography

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UNCRD and Nihon Fukushi University: *Thematic Maps of Nam Khane watershed, Xiang Ngeun District, Luangprabang province*, Symposium on Environmentally Sound Development and Quality of life in shifting cultivation areas, 23-24 February 1994.