

Song Ky Cung

Map of River

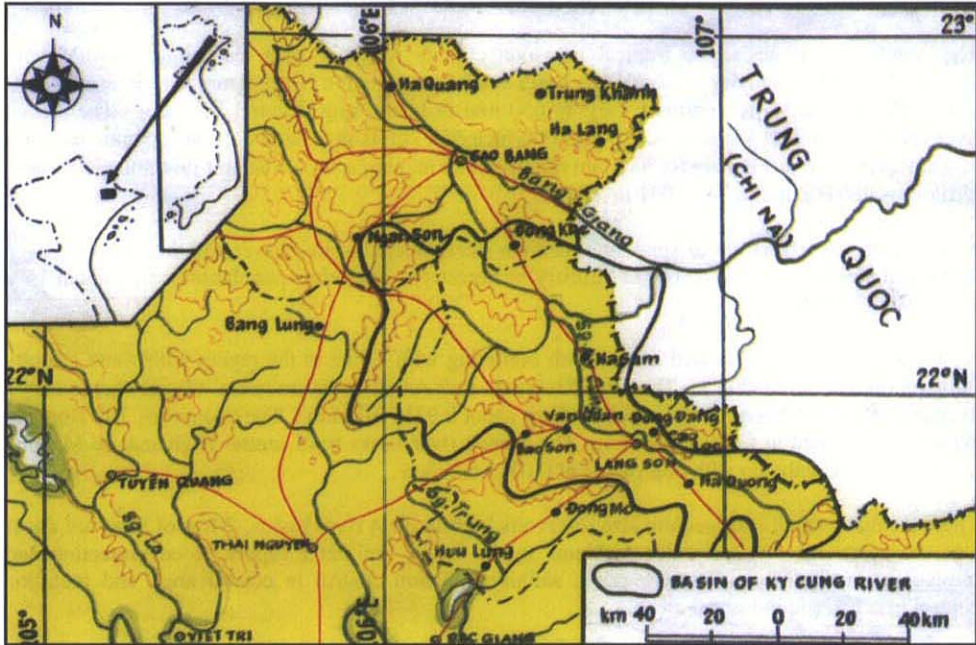
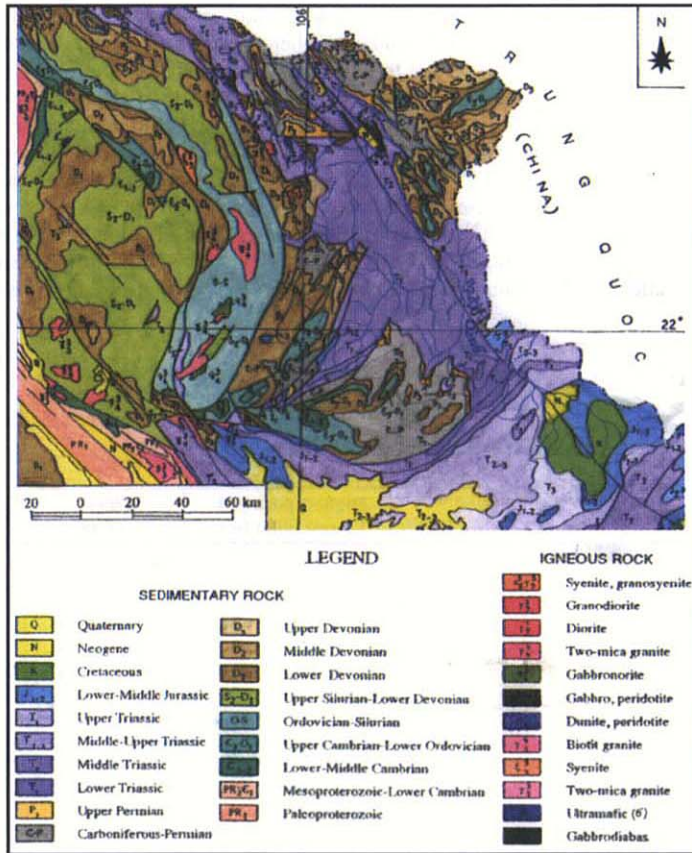


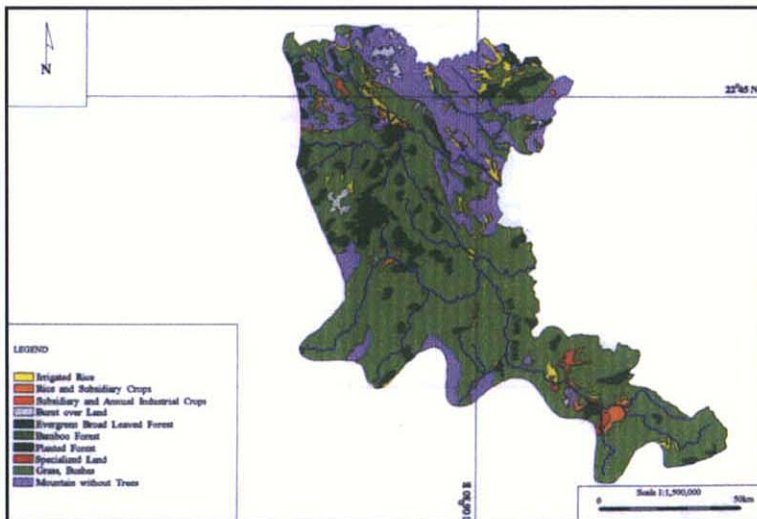
Table of Basic Data

Name: Ky Cung River		Serial No.: Vietnam-1
Location: Lang Son Province, Vietnam	N 21° 38' ~ 22° 26'	E 105° 57' ~ 107° 21'
Area: 6 660 km ² (at the border, 6 532 km ²)	Length of main stream: 243 km	
Origin: Mt. Ba xa (1 166 m)	Highest point: Phia Po (1 541m)	
Outlet: Zuojiang River (China)	Lowest point: River mouth in China	
Main geological features: Triassic and Palaeozoic accumulations, Carboniferous-Permian		
Main tributaries: Ba Thin River (320 km ²), Bac Giang River (2 670 km ²), Bac Khe River (801 km ²)		
Main lakes: De Tam, Tam Thanh		
Main reservoirs: Ta Keo Reservoir (14.10 x 10 ⁶ m ³), Ban Chanh Reservoir (5.10 x 10 ⁶ m ³)		
Mean annual precipitation: 1 348 mm		
Mean annual runoff: 29.3 m ³ /s at Lang Son (1 560 km ²) (1958~1990)		
Population: about 300 000	Main cities: Lang Son	
Land use: Forest (8.0%), Rice paddy (4.8%), Other agriculture (0.9%), Mountain (19.5%), Grass (65.3%)		

2. Geographical Information
2.1 Geological Map



2.2 Land Use Map



1. General Description

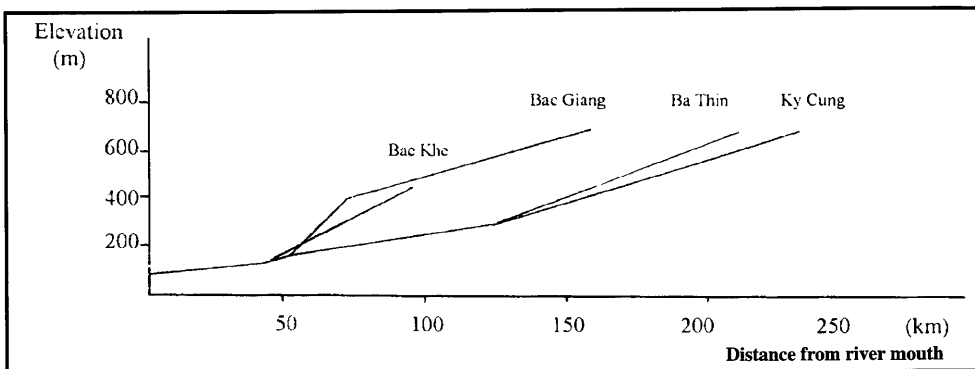
The Ky Cung River is the largest in the north-eastern part of Vietnam. Originating from Mt. Ba Xa (1 166 m) the river is 243 km long, drains an area of 6 660 km², and flows from south-east to north-west and then shifts direction to Northwest-Southeast when approaching the border with China. The river valley is long, has a mild slope, and due to limestone topography has scattered lakes and ponds. Due to complex magma distribution, it is also highly meandering. The tributaries are evenly distributed along its left bank. The annual rainfall varies from 1 500 mm in the south-eastern mountains to 1 300 mm in the lower parts of the basin. The rainy season lasts for 4 months but brings about 80-90% of the annual rainfall. The rainfall, and therefore the runoff, are evenly distributed within the basin. The annual runoff also does not vary very much with time - a wet year runoff being approximately twice a dry year runoff. The coefficient of variation of annual runoff is in the range 0.22 - 0.34. The water resources in the basin are used for irrigation, domestic water supply, and for hydropower generation. The main water resources problems arise from these uses and flood protection needs.

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	Land use [%]
1	Ky Cung (Main river)	243 6532	625 -----	Lang Son -----	A (0.9) F (8)
2	Ba Thin (Tributary)	52 320	675 -----		G (65.3) M (19.5)
3	Bac Giang (Tributary)	114 2 670	700 -----		P (4.8)
4	Bac Khe (Tributary)	53.5 801	425 -----		

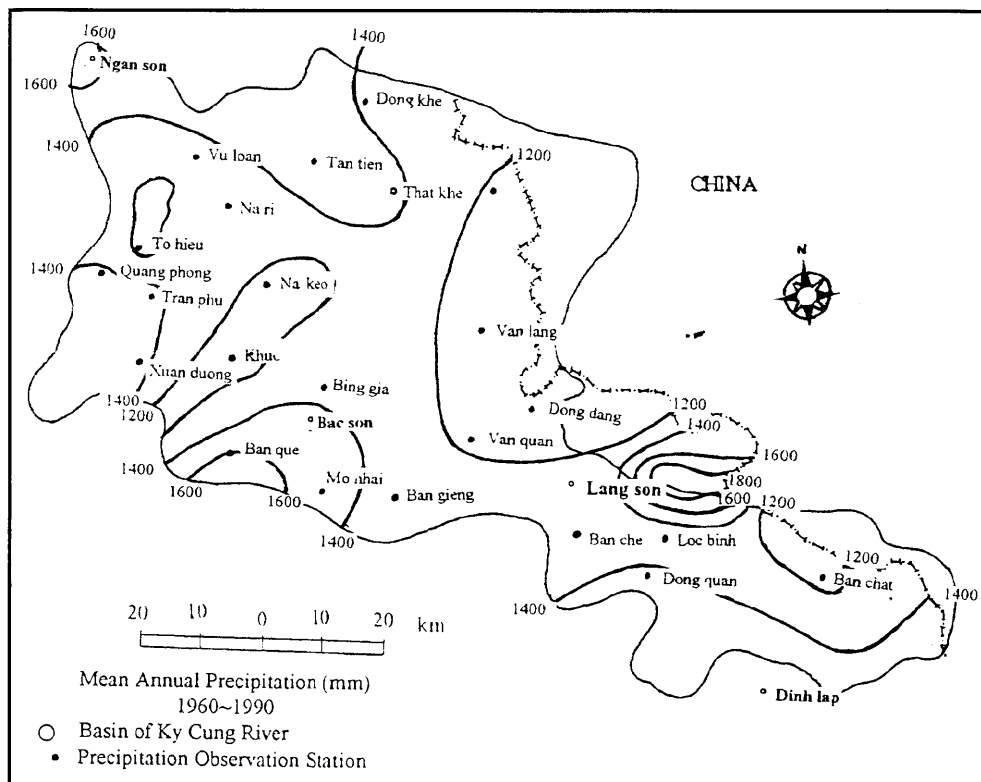
A: Other agricultural field F: Forest G: Grass M: Mountain P: Paddy field

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⁾
111	That Khe	275	N 22° 15' E 106° 28'	(P) 1930 ~ (E) 1960 ~	1 486	713.8	DS, E, P
112	Bac Son	400	N 21° 54' E 106° 19'	(P) 1958 ~ (E) 1963 ~	1 530	814.1	P, E, DS
113	Dinh Lap	174	N 21° 32' E 107° 06'	(P) 1932 ~ (E) 1963 ~	1 445	1 003	P, E, DS
114	Ngan Son	566	N 22° 26' E 105° 59'	(P) 1918 ~ (E) 1961 ~	1 686	823.4	P, E, DS
115	Lang Son	258	N 21° 50' E 106° 46'	(P) 1899 ~ (E) 1959 ~	1 388	1 080	P, E, DS

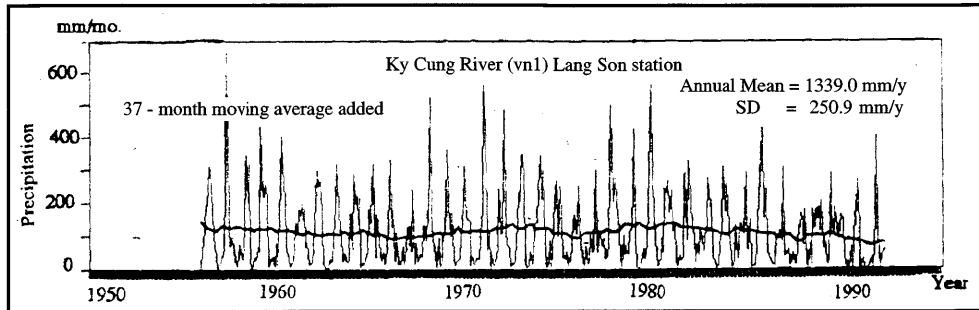
DS: Duration of sunshine observed by Helioscope
E: Evaporation observed by Piche tube

P: Precipitation observed by Pluviometer

3.3 Monthly Climate Data

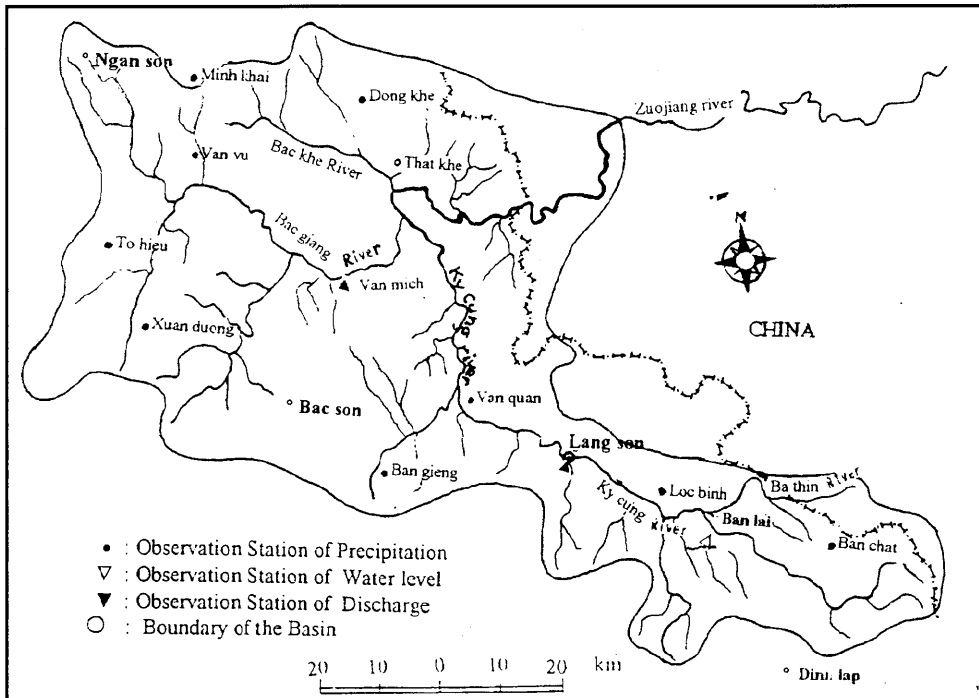
Observation item	Observation station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Period for the mean
Temperature [°C]	Lang Son	13.4	14.3	18.2	22.1	25.5	26.9	27.0	26.7	25.2	22.2	18.3	14.8	21.2	1898~1990
Precipitation [mm]	Lang Son	24.3	43.1	54.3	96.4	165.5	198.6	253.3	251.0	161.2	80.2	34.2	25.5	1387.6	1899~1990
Evaporation [mm]	Lang Son	86.3	72.2	82.8	89.7	112.5	94.3	90.7	78.0	83.3	97.4	97.1	95.2	1079.5	1959~1990
Duration of sunshine [hr]	Lang Son	80.8	56.6	65.4	96.1	184.6	165.5	191.6	172.3	184.2	155.0	136.8	125.4	1614.3	1961~1990

3.4 Long-term Variation of Monthly Precipitation



4. Hydrological Information

4.1 Map of Streamflow Observation Stations



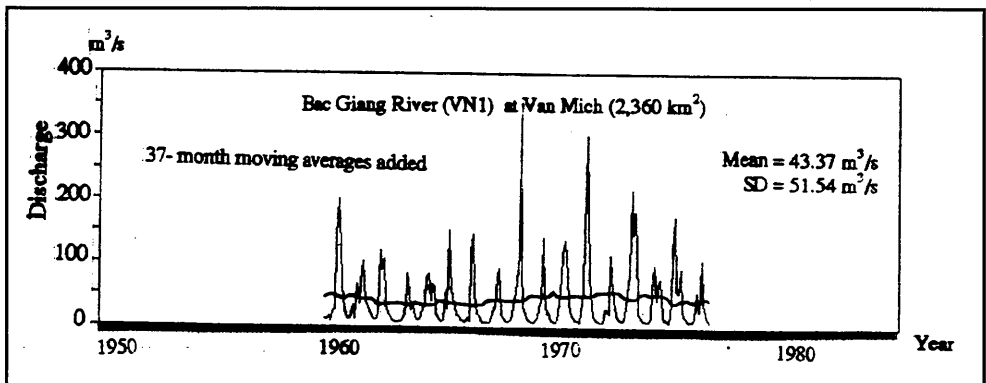
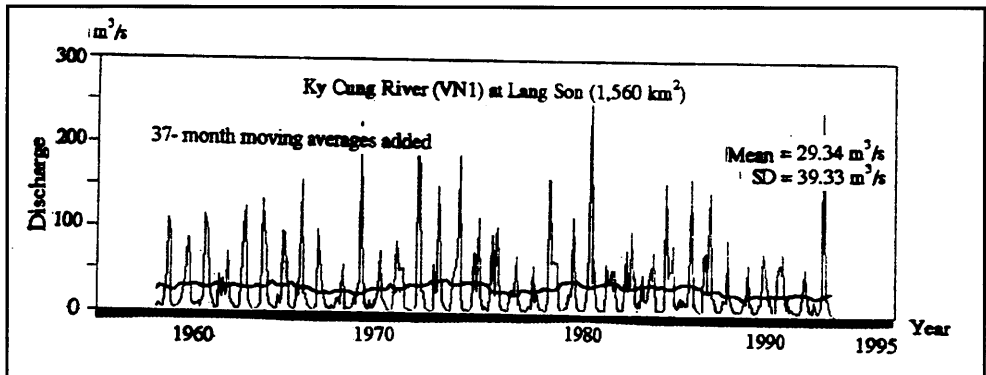
4.2 List of Hydrological Observation Stations

No.	Station	Location	Catchment area (A) [km ²]	Observation period	Observation items ¹⁾ (frequency)
215	Lang Son	N 21° 50' E 106° 45'	1 560	1958~	H, Q, P, S
212	Van Mich	N 22° 06' E 106° 22'	2 360	1960~1976	H, Q, P, S

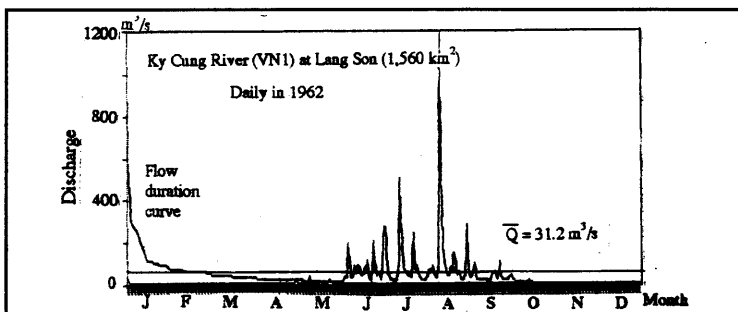
No.	\bar{Q} ²⁾ [m ³ /s]	Q max ³⁾ [m ³ /s]	\bar{Q} max ⁴⁾ [m ³ /s]	\bar{Q} min ⁵⁾ [m ³ /s]	\bar{Q} / A [m ³ /s/100km ²]	Q max / A [m ³ /s/100km ²]	Period of statistics
215	29.3	4 520	1 437	2.76	1.88	290	1958~1990
212	43.4	2 460	1 100	6.84	1.84	104	1960~1976

- 1) H: Water level (twice daily, in flood season more frequent) 2) Mean annual discharge
 P: Precipitation (daily) 3) Maximum discharge
 Q: Discharge (30 - 40 measurements/year) 4) Mean maximum discharge
 S: Sediment concentration (daily index sample; 20 measurements/year) 5) Mean minimum discharge

4.3 Long-term Variation of Monthly Discharge

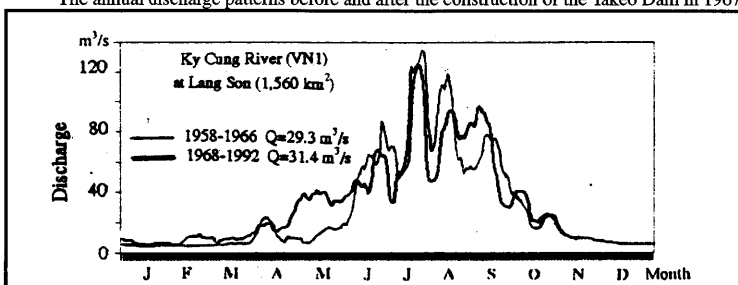


4.4 Annual Pattern of Discharge



4.5 Unique Hydrological Features

The annual discharge patterns before and after the construction of the Takeo Dam in 1967



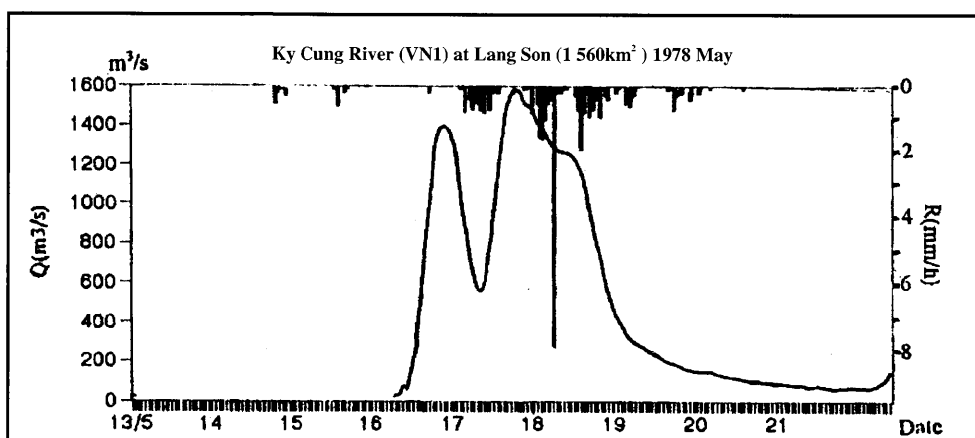
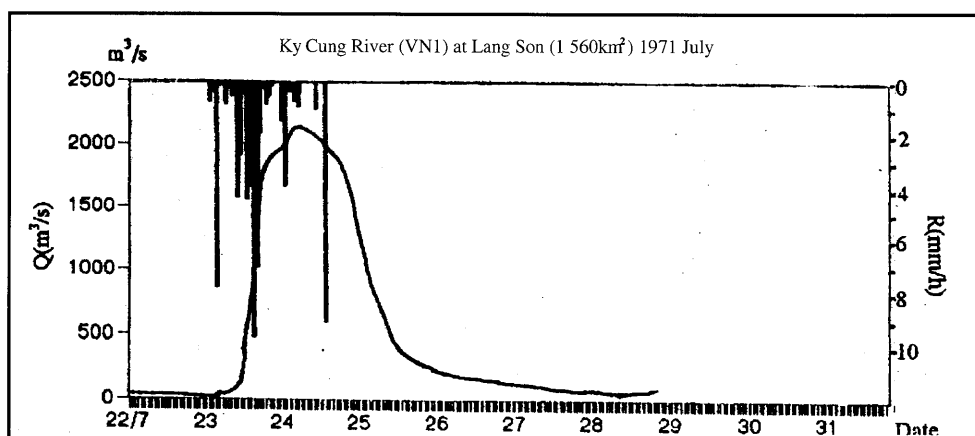
4.6 Annual Maximum and Minimum Discharges

At Lang Son [1 560 km²]

Year	Maximum ¹⁾		Minimum ²⁾		Year	Maximum ¹⁾		Minimum ²⁾	
	Date	[m ³ /s]	Month	[m ³ /s]		Date	[m ³ /s]	Month	[m ³ /s]
1958	8.11	1 750	5	2.00	1975	8.31	1 640	12	2.86
1959	8.02	455	5	2.80	1976	7.28	684	3	2.28
1960	8.14	964	5	1.96	1977	7.22	939	1	2.44
1961	10.22	753	3	2.00	1978	5.17	1 590	2	3.14
1962	8.12	1 430	3	2.80	1979	7.07	579		
1963	7.25	1 600	5	1.20	1980	7.24	2 800	4	3.20
1964	7.04	1 810	6	1.70	1981	6.08	551	3	4.26
1965	7.25	2 170	2	1.90	1982	5.07	1 780	3	4.47
1966	7.27	945	5	1.60	1983	3.01	857	7	5.37
1967	9.12	348	7	2.02	1984	6.26	2 460	5	2.37
1968	8.14	2 300	1	2.50	1985	9.11	2 020	5	5.73
1969	8.13	583	4	1.41	1986	7.23	4 520	3	3.56
1970	5.02	1 360	3	2.40	1987	8.23	717	3	5.40
1971	7.24	2 160	5	1.58	1988	6.28	318	7	2.59
1972	8.29	1 630	5	1.40	1989	6.12	854	1	3.06
1973	9.03	1 760	4	2.27	1990	10.21	1 510	1	4.30
1974	6.14	1 480	6	2.25					

1), 2) Discharge rated according to manual observation of water level

4.7 Hyetographs and Hydrographs of Major Floods



5. Water Resources

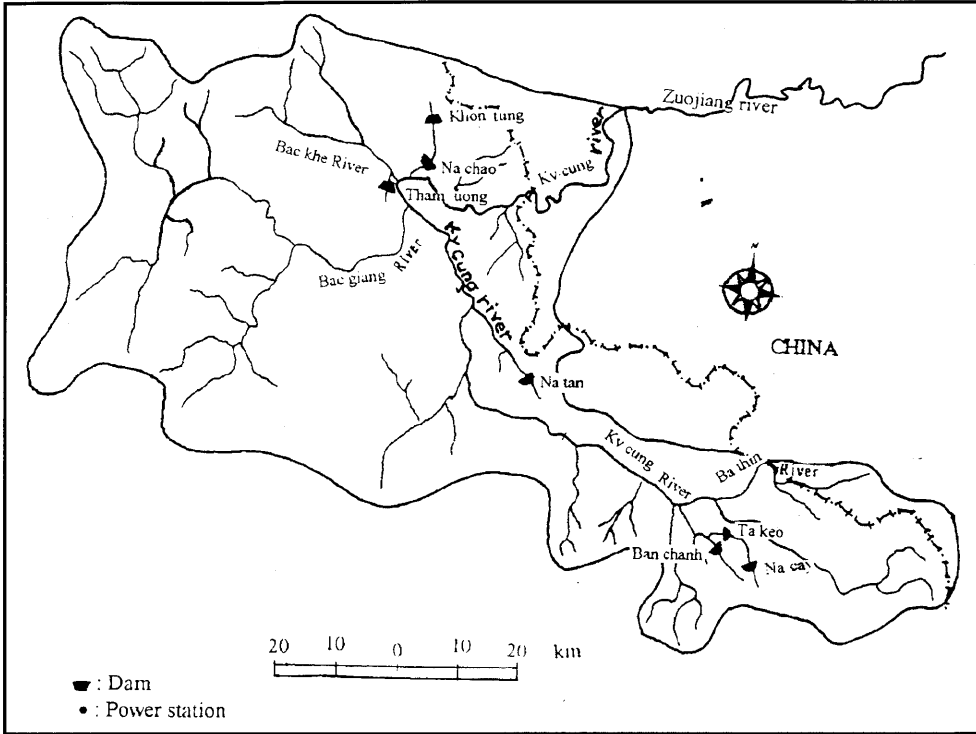
5.1 General Description

The Ky Cung river system generates a runoff of 8.92 km³, of which 7.22 km³ is within Vietnam and 1.70 km³ is from China. The Ky Cung River alone generates a runoff of 3.60 km³ at the border. The mean annual discharge of Ky Cung River alone is 114 m³/s (0.017 m³/s/km²) while it is 133 m³/s (0.020 m³/s/km²) for the whole basin.

The Ky Cung River runoff is smaller than the average runoff of river basins in Bac Bo (Northern Vietnam) and unevenly distributed over the year. Approximately 70 - 75% of annual total is concentrated in 4 months of flood season from June to September. The dry season lasts for 8 months from October to May and contributes about 25 - 30% of the annual total runoff.

During the period 1958~1990, the average flood flow at Lang Son station (1 560 km²) has been 1 440 m³/s or 0.92 m³/s/km². The maximum discharge occurred in 1986 with a flow of 4 520 m³/s or 2.9 m³/s/km². Flood discharges greater than 2 000 m³/s (1.29 m³/s/km²) have occurred 6 or 7 times in 30 years. Floods have clear cut mountainous character with the average rate of water level increase is around 41 - 68 cm/hour.

5.2 Map of Water Resource Systems



5.3 List of Major Water Resources Facilities

Name of river	Name of dam	Catchment area [km ²]	Gross capacity [10 ⁶ m ³]	Effective capacity [10 ⁶ m ³]	Purpose	Year of completion
Ky Cung	Na Tan	9.2	4.10	3.76	A	1973
	Khon Tung	2.8	1.85	1.70	A	1968
	Na Chao	10.5	4.90	4.50	A	1969
	Tham Uong	6.3	2.35	2.10	A	1980
	Ta Keo	24.2	14.1	13.5	A, W	1967
	Na Cay	5.1	3.10	2.8	A	1965
	Ban Chanh	10.3	5.10	4.75	A	1965

A: Agricultural use, W: Municipal water supply

Note: The dams/reservoirs in Bac Giang and Bac Khe rivers were constructed during the period of 1965-1975. The Ta Keo (1967), Na Cay and Ban Chanh reservoirs on Ky Cung river provide water for irrigation of more than 2 200 ha. For local requirements, there are some mini-hydropower stations in the north western part of the basin.

5.4 Major Floods and Drought

Major Flood at Lang Son [1 560 km²]

Date	Peak discharge [m ³ /s]	Rainfall [mm] Duration	Meteorological cause	Dead and missing	Major damages (Districts affected)
1965 7.22~7.28	2 170	166.3 7.22~7.25	Typhoon		Lang Son Town
1968 8.07~8.18	2 300	374.8 8.06~8.15	Typhoon		Lang Son Town
1971 7.23~8.04	2 160	334.6 7.23~7.29	Typhoon		Lang Son Town
1980 7.19~8.05	2 800	303.1 7.18~7.26	Typhoon		Lang Son Town
1984 6.20~7.09	2 460	429.8 6.20~6.22, 6.26~6.27	Typhoon		Lang Son Town
1985 9.06~9.18	2 020	163.3 9.06~9.13	Typhoon		Lang Son Town
1986 7.19~8.02	4 520	319.8 7.13~7.16, 7.19~7.23	Typhoon		Lang Son Town, Van Mich Towns

5.5. Groundwater and Water Quality

Groundwater is available in carboniferous-Permian, karstic, alluvial formations with quality suitable for domestic use. The values of water quality components at Lang Son station (1964~1982) are:

	pH	ION [mg/l]							
		Ca ⁺⁺	Mg ⁺⁺	Na ⁺ +K ⁺	HCO ₃ ⁻	SO ₄ ⁻	Cl ⁻	SiO ₂	F ⁺⁺⁺
Mean annual	6.76	12.0	3.36	10.5	58.8	9.39	6.26	9.23	0.49
Maximum	7.60	33.7	15.8	38.6	189	56.0	36.9	24.0	3.90
Minimum	4.40	2.40	0.50	0	14.8	0.50	0.70	0.50	0.02

6. Socio-cultural Characteristics

The Ky Cung river basin is located mainly in the mountainous areas of north-east Vietnam. The main economic activities are paddy cultivation, industrial plants farming, and animal husbandry. Most of the population in the basin come from ethnic minority groups. The basin also has several beautiful landscapes such as karstic/limestone caves and mountains (Nhi Thanh, Tam Thanh caves, Vong Phu or "Woman looking for husband" mountain).

7. References, Data Books and Bibliography (In Vietnamese)

- Institute of Meteorology and Hydrology (1985): *Main morphometric features of Vietnam rivers*, Hanoi.
- Meteorological and Hydrological Yearbooks.
- State Programme N42 A Report, *Assessment of hydrometeorological natural conditions and resources in service of production and national defence with focus on agriculture*. Vol I: Meteorological data, Vol II: Hydrological data.
- Tran Tuat, Tran Thanh Xuan and Nguyen Duc Nhat (1987): *Hydrogeography of Vietnam rivers*, Science and Technique Publishing House.
- Vietnam National Committee for the IHP (1992): *Assessment of Water Resources and Water Use in the Socialist Republic of Vietnam*.